High-Tech Entrepreneurship in Asia
This book is dedicated to Marina Zhang’s parents who went through the hardship of the Cultural Revolution in China, yet never forgot to educate their daughter to treasure the values of honesty, good judgment, hard work, courage, knowledge and an understanding heart.
High-Tech Entrepreneurship in Asia

Innovation, Industry and Institutional Dynamics in Mobile Payments

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Preface

This book examines the relationships between high-tech entrepreneurship and innovation in an important new technology – mobile payments – in Korea and China, the world leaders of this technology in development and diffusion.

Mobile payment technologies result from the convergence of the mobile communications and financial payment industries. Their development is a complex and lengthy process, which on the one hand relies on familiar and well-defined infrastructure (mobile communications and payment networks); and on the other is driven by emerging but sophisticated applications that require consumers to change their behaviour in the way they pay for goods and services. This process requires continuous modification or re-innovation involving high order technological capabilities and business skills. The book shows how the development and diffusion of mobile payments is a social process requiring extensive collaborative efforts conducted within specific national institutional structures and cultures.

The role of high-tech entrepreneurial start-ups in the development of an emerging technology is commonly considered to be that of a technological 'challenger' or an 'agent' for technology transfer rather than a direct engine of economic growth. While systematized innovative activities carried out by large corporations are widely recognized and well studied, the role of start-ups, often as the initiator of a new technological innovation (especially if the technology is successful but the start-up fails), has not been given sufficient consideration in the literature dealing with technological development and diffusion, leaving an important research gap.

Using a process-oriented case inquiry, this book aims to fill this gap by examining in detail the critical role played by high-tech entrepreneurial start-ups in the development of mobile payment applications. It examines high-tech entrepreneurship in an Asian context. Asian nations are increasingly contributing to the development of world-leading technology and encouraging the creation of high-tech start-up firms, but there is little detailed research into the role of these firms in developing technology in Asia, another research gap. The book investigates the processes of
technological development and diffusion of mobile payments in China and Korea: the former a country with the world's largest mobile communications market, and the latter a country that has the most advanced mobile networks in the world. We show how a multiplicity of factors explain how entrepreneurial start-ups can be instrumental in introducing new technological innovations and how their efforts can potentially lead to the creation of a pool of distinctive competencies by integrating new technological innovations and existing business capabilities. However, many factors (such as a lack of resources and legitimacy in society) often constrain effective innovation strategies in start-up firms. We show the importance of cultural factors and the institutional structures and public regulatory frameworks in Korea and China for shaping these strategies and in the development of emerging technologies. It is essential for the study of high-tech entrepreneurship to be located firmly within the specific technological and national environment in which it emerges.

Chapter 1 offers an introduction to the main issues and themes in the book. It discusses the background to the research behind the book, and the research questions addressed in the study. It offers an intellectual map and analytical framework for the issues considered and definitions and methods used.

Chapter 2 introduces the mobile payment industry, addressing the history of technical developments, the importance of international technological standard-setting activities, the formation and development of the industry's value chain, and its current market status in different countries.

Chapter 3 reviews and evaluates the extensive literature on innovation management and technology diffusion relevant for the study of high-tech entrepreneurship. It develops a set of specific research issues which are used as a set of analytical lenses by which to examine the case studies. The technical characteristics of various types of innovations, the standards and standard-setting activities around different technological systems, different diffusion curves, and different corporate strategies in managing the development of an emerging technology are all discussed.

Chapter 4 reviews and evaluates the literature on entrepreneurship, especially high-tech entrepreneurship. This chapter also develops a set of specific research issues which guide the case studies by addressing the strategic choices as well as their consequences confronting high-tech entrepreneurial start-ups. These choices include founder-CEO replacement in a firm's strategic reorientation, the use and structure of venture capital
investment, plans for early international expansion, and the ways in which social networks and alliance partners are managed.

Chapter 5 outlines the research methodology and data collection methods. Conducting research in high-tech entrepreneurship, especially in 'high context' countries such as Korea and China, requires significant attention to research methods. This section details the specific research strategy and research protocols which were followed in the course of the research. Both the justifications for, and limitations of, the methodology are also discussed. The approach adopted is argued to provide a model for future research in this area.

Chapter 6 presents a detailed case analysis of the emergence and development of the mobile payment industry in Korea. A high-tech entrepreneurial start-up, Avaro InfoTech, is examined at several levels of analysis, including: the individual level (entrepreneurs, venture capitalists, professional managers); the organizational level (decision-making, social networks, a cross-border R&D team, strategic choices); the industry level (industry standards, competition, cross-industry alliances); and the institutional level (government policies, social and cultural influences, national business system).

Chapter 7 analyses the emergence and development of the mobile payment industry in China in the broader context of the phenomenally rapid development of the Chinese telecommunications industry. This case shows how the Chinese government plays a central role in shaping the development and diffusion of an emerging technology, such as mobile payments. Several sub-case studies are undertaken in this chapter, which provide insights into how high-tech entrepreneurial start-ups are encouraged to find niche markets in their interactions with industry incumbents and government-sponsored new firms.

Chapter 8 examines how technology, firm and international circumstances create the context for the analysis of high-tech entrepreneurship. Based on the analytical lenses developed in Chapters 3 and 4, and the case analysis of the technology, nations and firms in Chapters 2, 6 and 7, the convergence of the theoretical frameworks and the constructs from the empirical case studies provides the basis for the generation of a number of propositions about the role and potential of high-tech entrepreneurship and innovation. It argues that the study of high-tech entrepreneurship is by necessity a highly complex issue involving complicated interactions between individuals, innovation opportunities, institutional structures and national cultures. This chapter discusses the implications of these propositions for entrepreneurs (managers) and public policy makers, as well as suggestions for future research.
The authors have worked together since 1994, and collaborated in studies on the Chinese telecommunications industry in the late 1990s funded by the International Finance Corporation. The research base for this book is derived from Marina Zhang's PhD thesis, awarded by the Australian National University. Mark Dodgson was the outside supervisor of this thesis. The book emerged as a result of continuing research collaboration between the authors supported by the Australian Research Council (grant number: DP0210830), whose financial assistance is gratefully acknowledged. Numerous people need to be thanked for their comments and advice over elements of the production of the book, including Steve Dowrick, Bruce Stening, Judy Matthews, Paul Atkins, Magnus Holmen, Don Scott-Kemmis, Xiao-ying Shi, Deane Terrell, Chong Choi, Tim Kastelle, Paul Brewer, Sunil Venaik and Gary Knight. The field work for the study benefited hugely from the time and consideration of many very busy managers and heartfelt thanks are offered to Bill Wang for his generous time and valuable ideas.

NOTES

1. Avaro InfoTech is a fictitious name used for the purpose of confidentiality.
## Glossary

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<td>2.5G</td>
<td>Second-and-a-half Generation mobile communications system</td>
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<tr>
<td>3G</td>
<td>Third Generation mobile communications system</td>
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<td>3GPP</td>
<td>The Third Generation Partnership Project</td>
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<tr>
<td>ADSL</td>
<td>Asymmetric Digital Subscriber Line</td>
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<tr>
<td>AMPS</td>
<td>Advanced Mobile Phone System (one of the first generation mobile networks)</td>
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<tr>
<td>ARPU</td>
<td>Average Revenue Per User</td>
</tr>
<tr>
<td>ATM</td>
<td>Automated Teller Machine</td>
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<tr>
<td>B2B</td>
<td>Business to Business</td>
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<tr>
<td>Bluetooth</td>
<td>A standard for short-range wireless communication between computing devices and associated peripherals, including laptop computers, PDAs, mobile phones.</td>
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<tr>
<td>BOSS</td>
<td>Business Operation Support System</td>
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<tr>
<td>Broadband</td>
<td>A technology that enables high-speed Internet access and content delivery.</td>
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<tr>
<td>CAT</td>
<td>Credit Authorization Terminals</td>
</tr>
<tr>
<td>CDMA</td>
<td>Code Division Multiple Access</td>
</tr>
<tr>
<td>cdmaOne (IS-95)</td>
<td>One of the second generation mobile networks, pioneered by US firm Qualcomm and further developed in South Korea.</td>
</tr>
<tr>
<td>CDMA2000</td>
<td>One of the three 3G standards approved by IMT-2000.</td>
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<tr>
<td>cHTML</td>
<td>Compact Hypertext Mark-up Language, a subset of HTML 3.0, is used for programming for mobile Internet content.</td>
</tr>
<tr>
<td>CNAPS</td>
<td>China National Advanced Payment System</td>
</tr>
<tr>
<td>Contactless Card</td>
<td>A card consisting of a memory or microprocessor chip connected to an antenna. The antenna and micro-module are embedded into the plastic card body.</td>
</tr>
<tr>
<td>Encryption</td>
<td>The process of concealing the contents of a message from all except those who know the key.</td>
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<tr>
<td>DCS</td>
<td>Digital Cellular System</td>
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<td>DDN</td>
<td>Digital Data Network</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>DSMP</td>
<td>Data Service Management Platform</td>
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<tr>
<td>Dual Slot</td>
<td>A telephone handset or other mobile device that has two slots for chips. One is for the Subscriber Identification Module (SIM) of the network operator that resides in the phone and the other is the chip embedding bankcard information.</td>
</tr>
<tr>
<td>EDGE</td>
<td>Enhanced Data Rates for GSM Evolution (considered a future 3G technology)</td>
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<tr>
<td>Electronic Cash</td>
<td>The generic term for cash value stored in electronic form on the chip of a smart card. In an electronic cash transaction, the value is directly transferred from the consumer’s chip to the retailer’s chip.</td>
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<tr>
<td>EMV Chip</td>
<td>Europay, MasterCard and Visa developed specifications that define a set of requirements to ensure interoperability between smart cards and terminals on a global basis, regardless of the manufacturers, the financial institutions, or where the card is used.</td>
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<tr>
<td>FSTC</td>
<td>Financial Services Technology Consortium</td>
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<tr>
<td>GPRS</td>
<td>General Packet Radio Service (a 2.5G mobile network)</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>GSM</td>
<td>Global Standard for Mobile Communications</td>
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<td>HTML</td>
<td>Hypertext Mark-up Language. The open coding standard (middleware), in which pages are written for the world-wide-web.</td>
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<tr>
<td>HTTP</td>
<td>Hypertext Transfer Protocol. The standard used by Internet browser programs for network communications across the world wide web.</td>
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<tr>
<td>ICP</td>
<td>Internet Content Provider</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
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<tr>
<td>IMT-2000</td>
<td>The term used by the International Telecommunications Union (ITU) for the specification for 3G wireless services.</td>
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<td>IP</td>
<td>Internet Protocol</td>
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<td>IPO</td>
<td>Initial Public Offering</td>
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<td>IrDA</td>
<td>Infrared Data Association</td>
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<tr>
<td>IrFM</td>
<td>Infrared Financial Messaging</td>
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<tr>
<td>ISDN</td>
<td>Integrated Services Digital Network</td>
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<tr>
<td>ISP</td>
<td>Internet service providers</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>ITU</td>
<td>International Telecommunication Union</td>
</tr>
<tr>
<td>IVR</td>
<td>Interactive Voice Response</td>
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<tr>
<td><strong>TERM</strong></td>
<td><strong>DEFINITION</strong></td>
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<tr>
<td>JAVA/BREW</td>
<td>JAVA/BREW is a software platform that has been specifically designed to enable the development of applications optimized for use on mobile and portable consumer devices.</td>
</tr>
<tr>
<td>K-Java</td>
<td>K-Java is a derivation of Java. It defines a subset of limited Java commands used in low-memory environments such as modern mobile phones and smart phones. It is also referred to as J2ME – Java 2 platform Micro Edition.</td>
</tr>
<tr>
<td>Kbs</td>
<td>Kilobits per second. The standard measure for the speed (or bandwidth) of a network access device such as a modem. Most landline modems now operate at a speed of 56Kbs, or 56,000 bits of information transmitted per second.</td>
</tr>
<tr>
<td>LAN</td>
<td>Local Area Network</td>
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<tr>
<td>m-commerce</td>
<td>Mobile commerce. Referring to all forms of electronic commerce that take place when a consumer makes an online purchase using a mobile device such as a mobile phone or a wireless PDA.</td>
</tr>
<tr>
<td>m-payment</td>
<td>Mobile payments. Referring to multiple, overlapping payment methods in mobile commerce, m-payments are defined as wireless transactions of a monetary value from one party to another using a mobile device.</td>
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<tr>
<td>MMS</td>
<td>Multimedia Messaging Service</td>
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<tr>
<td>MISC</td>
<td>Mobile Information Service Centre</td>
</tr>
<tr>
<td>MNE</td>
<td>Multinational Enterprise</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
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<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer</td>
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<tr>
<td>OTA</td>
<td>Over the Air</td>
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<tr>
<td>PCS</td>
<td>Personal Communications Services</td>
</tr>
<tr>
<td>PDA</td>
<td>Personal Digital Assistant</td>
</tr>
<tr>
<td>PDC</td>
<td>Personal Digital Cellular. The 2G digital wireless standard used in Japan based on TDMA air interface</td>
</tr>
<tr>
<td>PHS</td>
<td>Personal Handy-Phone System, known as Xiaolingtong (little smart phone) in China.</td>
</tr>
<tr>
<td>PIN</td>
<td>Personal Identification Number</td>
</tr>
<tr>
<td>PKI</td>
<td>Public Key Infrastructure. A cryptographic key and certificate delivery system which makes possible secure financial electronic transactions and exchanges of sensitive information between relative strangers. A PKI will provide privacy, access</td>
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control, integrity, authentication, and non-repudiation support to information technology applications and electronic transactions.

**Portal**
A web site aiming to be a first ‘port of call’ for Internet users. Most portals are search engines (such as Yahoo!, Excite, Lycos or the second-generation search engine, Google) offering news and other content facilities.

**POS**
Point of Sale

**PSTN**
Public Switched Telephone Network

**PTA**
Post and Telecommunications Administrator

**SDK**
Service Development Kit

**SIM**
Subscriber Identity Module

**Smart Card**
A card with a small computer chip embedded in it. The chip enables applications such as security, electronic purse, coupon, loyalty, identification and so on.

**SME**
Small and Medium-sized Enterprises

**SMS**
Short Messaging Service

**STK**
SIM (Subscriber Identification Module) Tool Kit

**TACS**
Total Access Communications System (one of the first generation mobile networks)

**TCP/IP**
Transmission (Transfer) Control Protocol/Internet Protocol

**TDD**
Time Division Duplex

**TDMA**
Time Division Multiple Access

**TD-SCDMA**
Time Division Synchronous Code Division Multiple Access (one of the 3G mobile network standards)

**TMN**
Telecommunication Management Network

**U-Commerce**
Ubiquitous Commerce

**UMPS**
Universal Mobile Payment Service

**UMTS**
Universal Mobile Telecommunications System (original name for 3G mobile standard, especially referring to WCDMA)

**URL**
Uniform Resource Locator

**USSD**
Unstructured Supplementary Service Data

**VoIP**
Voice over Internet Protocol

**WAN**
Wide Area Network

**WAP**
Wireless Application Protocol

**WCDMA**
Wideband CDMA

**WML**
Wireless Mark-up Language

**XML**
eXtensible Mark-up Language
1. Introduction

BACKGROUND

In recent years, industries based on information and communications technologies (ICT) have been the fastest-growing sectors in the economy (OECD, 2000), and one of the most important contributors to business and industrial innovation (for example Cairncross, 1997; Greenspan, 1998; de la Torre and Moxon, 2001; Schilling, 2005). ICT is pervasive, with impacts on many elements of industry as well as on many aspects of our daily life (Freeman and Soete, 1997). Since the 1990s, mobile communications and the Internet (data communications) have provided two of the most rapidly diffusing ICTs around the world. At the turn of the century, the potential technological convergence and integration of these two phenomena led many to believe that there would be a revolution through the advent of the so-called ‘mobile Internet’ (or wireless data communications). This expectation led to massive investments in firms associated with the mobile Internet, mobile commerce, mobile multimedia, mobile payments, third generation mobile communications networks (3G) and so on, and also impacted significantly on national regulations and policies concerning ICT industries in general, and 3G in particular. Until 2001, there was a strong belief that applications based on the mobile Internet would constitute a major breakthrough for radio technology, which is the base for modern mobile communications, and that they would ‘take off’ at an unprecedented scale internationally.

The reality has turned out to be something of a disappointment. Despite recent progress in mobile data communications – such as Cingular’s Blackberry mobile data service (a service providing e-mails on mobile phone sets based on Mobitex data communications technology) in the United States, NTT DoCoMo’s i-mode services (mobile multimedia) in Japan, and the booming GSM-based short messaging service (SMS) in Europe and Asia – the general market development of mobile data communications and 3G networks, at least from the consumer’s perspective, is still fragmented and uncertain.
The development of the technology and industry from the perspectives of standardization institutes (and/or industry consortia), government regulatory bodies and mobile operators, on the other hand, is seen to be much more promising. Since the late 1990s, all these stakeholders in mobile data communications and 3G mobile networks have undertaken great efforts to develop, standardize, negotiate, license and plan the launch of 3G mobile communications networks and, based on these, mobile data communications. For example, by 2001, telecom operators worldwide had committed an estimated US$1,000 billion\(^1\) investment (including licensing fees, infrastructure build-up, and marketing costs) in 3G systems (Forrester Research, 2001). This investment can be described as the largest 'technology push' ever witnessed in history. Microsoft, Intel, Cisco, IBM and Sun Microsystems, among other leading IT firms, have invested heavily in research and development (R&D) in mobile-related devices and applications. At the same time, the venture capital community has sponsored numerous new ventures based on mobile Internet technologies and applications (ARC, 2003). These developments reinforced a strong belief that a prosperous future lay in the convergence of mobile telephony and data communications in the mobile Internet. There was expectation of a so-called 'killer application' that would trigger the take-off of the mobile Internet. In this environment, mobile commerce (m-commerce) which, utilizing mobile data communications networks, promises to deliver electronic commerce capabilities such as monetary transactions from one party to another directly into consumers’ hands – anytime and anywhere – was considered to have such potential. Mobile payments, as a vital tool in m-commerce, therefore attracted considerable attention. Mobile payments, a term referring to multiple, overlapping payment methods in mobile commerce, are defined as wireless transactions of a monetary value from one party to another using a mobile device (Mobile Payment Forum, 2002).

Mobile payment technologies are the result of convergence between the mobile communications and financial payment networks. The emergence and development of mobile payments, therefore, is inevitably a complex process: relying on familiar and well-defined industries, mobile payment technologies function as the interface for an emerging but sophisticated application that requires consumers to change their behaviour in payment activities. The application of mobile payments involves the use of credit cards and direct debit cards – which are almost ubiquitous, widely understood, well trusted by a wide range of consumers, and incorporate a transaction that is not conceptually radical – in a wireless environment. Security is guaranteed by another familiar device, the personal identification number (PIN), which is widely utilized by consumers who use ATMs (automatic teller machines), telephone and/or e-banking
services, and a range of other services where personal authentication is required.

Based on infrared technology, a Korean high-tech entrepreneurial start-up, Avaro InfoTech, Inc., introduced to the world its first infrared-based mobile payment ‘showcase’ – MAYZ Universal Mobile Payment Services (UMPS) – in April 2002. As pointed out in a BusinessWeek article on April 2, 2002, Korea brought the concept of ubiquitous m-commerce a step closer to reality. In this article, Avaro was recognized as the independent inventor of this promising technology. In a more recent article in the Economist (July 23, 2005), ‘Pay with a wave of your phone: Japan’s leading mobile operator believes it has found the next big thing’, Avaro was not even mentioned. NTT DoCoMo was put forward as the ‘inventor’ of infrared-based mobile payment technology. However, in April 2003, NTT Data, the consulting arm of NTT Group, signed an agreement with Avaro to use Avaro’s MAYZ mobile payment technologies in trials by NTT DoCoMo (NTT Data, 2003).

The Avaro case suggests that the contribution of independent high-tech entrepreneurial start-ups to industrial innovation is often undervalued and commonly misunderstood. It has long been recognized that technological evolution plays a critical role in industrial development and industry life cycles (Tushman and Andersen, 1986; Dosi et al., 1988; Anderson and Tushman, 1990; Utterback and Suarez, 1993; Utterback, 1994; Freeman and Soete, 1997). The diffusion of any innovation involves a process of technological improvement and development, and a continuous stream of technological changes (Rosenberg, 1976; Christensen and Rosenbloom, 1995). It may be that industry incumbents contribute more than start-ups to this continuous process of technological improvement and development; as Baumol (2002: p. ix) argues, highly efficient sets of innovative activities are carried out within ‘innovative oligopolistic corporations’. However, it is often high-tech entrepreneurial start-ups that initiate breakthroughs in the technological development process. In some ways, this ‘transition’ from entrepreneurial-led innovations to corporation-driven ones indicates the evolutionary cycle of an industry, within which two different patterns of innovative activities, described as Schumpeter Mark I and Mark II models, take turns in leading (Nelson and Winter, 1982). According to the industry life cycle view (Anderson and Tushman, 1990), at the early stage of an industry’s development, technology changes rapidly, uncertainty is high, barriers to entry are low and entrepreneurial firms are often the major innovators, bringing in ‘technological discontinuities’. At this stage, entrepreneurial firms are considered to be key elements in industry dynamics; Nelson and Winter (1982) describe this as the Schumpeter Mark
I pattern of innovation. When the industry develops and matures around a 'dominant design' (Utterback and Abernathy, 1975; Anderson and Tushman, 1990; Utterback and Suarez, 1993), technological changes follow well-defined trajectories, and economics of scale, broad technological capabilities, absorptive capacity and financial resources become important in innovative activities. At this stage, incumbent firms show more competitive advantage in industrial innovations; Nelson and Winter (1982) describe this as the Schumpeter Mark II pattern of innovation.

Technological merits alone cannot guarantee the success of the firm that owns them. A technology can be altered according to the choices made by influential actors in a society to serve certain objectives, '...because technology is political ... under current political auspices and for the foreseeable future, the new technology will invariably constitute extensions of power and control' (Noble, 1986: p. 351). As Tuomi (2002) demonstrates in the Linux 'open source' development model, fundamentally innovation is a social development in which not only the merits of the technology, but also its meaningful use grounded in social contexts, are very important. This point will be illustrated in both the case of Avaro and the Chinese case presented in Chapter 7, where a joint venture between the world's largest mobile operator – China Mobile Communications Corporation (CMCC) – and the People's Bank of China (the country's central bank), which was endorsed by the central government, has started to introduce and diffuse mobile payment solutions in the country, based on a mobile payment technology invented and trialed by a Chinese high-tech entrepreneurial start-up firm.

In both the Avaro (Korean) and Chinese cases, the real issues relating to the diffusion of the new technology by high-tech start-ups were those of dealing with the challenges of technological uncertainty, complexity and the discontinuous nature of technological development in the context of a highly specific institutional environment including government regulatory policies, (cross-national) industrial standards consortia, and cooperation and competition involving industry incumbents from stakeholders in two established industrial sectors (mobile communications and financial payments). These cases raise the fundamental question: how do entrepreneurial high-tech start-ups contribute to the development of an emerging technology such as mobile payments, and under what conditions?
RESEARCH QUESTIONS

In a high-tech environment, entrepreneurial activity often arises out of technological advances, rather than from the recognition of new commercial opportunities (Kelly and Rice, 2001). Technological advances and diffusion have produced increasing numbers of products that have new functions and, therefore, substitute for existing product offerings, sometimes across industries. This, as a result, has blurred the boundaries of industries or created new industries (Bettis and Hitt, 1995). High-tech entrepreneurial ventures are recognized as one of the key forces in the creation of technological advances (Fontes and Coombs, 2001). However, the economic value of any innovation remains latent until it is adopted and commercialized, and it often generates different economic value depending on the business model upon which the innovation is commercialized (Chesbrough, 2003). Mainstream technology diffusion studies try to understand adopters' behaviour and its consequent impact on the diffusion curve (Bass, 1969; Rosenberg, 1972; 1976; Singhal, 1994; DeBresson, 1995; Moore, 1995b; Rogers, 1995; Geroski, 2000; Baptista, 2001). These studies assume that the 'agents' that manage technology diffusion are large organizations. This is, to some extent, true, because as Rogers (1995: p. 34) claims '…diffusion is fundamentally a social process’, and to successfully manage it requires the solution of multiple issues – marketing, distribution, pricing, regulations, finance and politics – that large firms are better resourced to deal with.

An innovation often requires considerable modification before it can function successfully in a new environment. The process of modification, or re-innovation (Rothwell and Gardiner, 1988), often involves a high order of skill and ability, which may be beyond the capabilities of the entrepreneurial start-ups that invented it and, perhaps, first introduced it to the market. As Rosenberg argues (1976: p. 186, italics added): ‘The selection of a technology as appropriate in a particular context, and its adaptation and modification in order to enable it to function efficiently in an environment different from the one in which it originated, are activities which typically require a very high degree of technological sophistication.’ Thus, it can be argued that the diffusion of an innovation is inextricably interwoven with its development, which often involves the participation of incumbent organizations and complementary assets (Teece, 1986; Teece, et al., 1997). In other words, in order for an innovation to become technologically mature and commercially viable, the innovation process needs complementary contributions from different players, especially incumbents in the industry in question. However, in practice, alliances and
technology licensing contracts between high-tech start-ups and large
incumbents often involve heavy transaction costs, which, as a result, may
squeeze start-up firms out of competition (Christensen, et al., 2005). This
suggests that the significant contribution made by entrepreneurial start-ups
in the process of technological development and diffusion may be
neglected because while small firms are able to set the innovative agenda in
the early stages, incumbents tend to take an increasingly dominant role in
organizing and maturing the technology (Miller and Garnsey, 2000).

Traditionally, a high-tech entrepreneurial start-up’s role is considered to
be that of a technological ‘challenger’ (Schilling, 1998; Chesbrough, 2003)
or an ‘agent’ for technology transfer (Fontes and Coombs, 2001) rather
than a direct engine of economic growth (Miller and Garnsey, 2000).
Entrepreneurial start-ups, constrained by a lack of internal resources –
known variously as liability of newness (Singh, et al., 1986) or liability of
adolescence (Fichman and Levinthal, 1991), liability of smallness (Baum,
1996), and liability of foreignness in the international market (Zahra, et al.,
2005) – confront severe challenges in their early stages of development. On
the other hand, traditional variables measuring the contribution of a firm in
economic activity (such as sales revenues, profits, taxes, employment,
export outputs, investment in R&D and so forth) do not provide accurate
measurement of the contribution made by high-tech entrepreneurial start-
ups, especially before they can generate sustainable growth.

Baumol (2002) believes that most of the utility in technological products
comes from more routine innovation that takes place after the product has
entered the marketplace. In other words, most improvements in economic
welfare are due not to major breakthroughs, but rather to routine
i), emphasizing the importance of ‘systematized, bureaucratized, and
highly efficient sets of parallel activities’ carried out within ‘innovative
oligopolistic corporations’ in the development of technological innovation,
fails, however, to recognize the contribution of independent innovators
(often entrepreneurs) who may provide the breakthroughs that initiate the
 technological development process. By introducing a new technology into
the marketplace, entrepreneurs can potentially stimulate the development
of an entire new industry. Due to path dependency – the way that relatively
small historical events may have a great impact on the final outcome
(Artur, 1989; 1994) – entrepreneurial start-ups’ initial efforts to introduce
their innovations to the marketplace often have a profound impact on the
trajectory of the diffusion, especially if those innovations are ‘selected’ by
the market.

In this context, this book aims to answer several questions: What roles
do entrepreneurial start-ups play in the emergence and development of a
new technology in the networked economy? What are the main strategic choices that enable entrepreneurial start-ups to contribute to the emergence and diffusion of a new technology? What major factors constrain the innovation strategies of entrepreneurial start-ups?

INTELLECTUAL MAP AND ANALYTICAL FRAMEWORKS

A technological system such as mobile payments can be examined at different levels of analysis, such as at national, sectoral, network or component levels. The development of a technological system involves not only its construction, but also its use. In a complicated technological system which consists of various components and subsystems, both the attributes of and relationship between the components or subsystems influence the development of the system. The development of a technological system, therefore, is influenced by numerous interrelated social, legal, institutional, economic, organizational and technical factors, and often involves changes in industrial structure, technical standards and regulations or the creation of new industries (Rosenberg, 1976; Anderson and Tushman, 1990; Rogers, 1995; Baptista, 2001; Schilling, 2005). In other words, the development of a technological system often causes the creation of a new ‘value network’ – the context within which a firm competes and solves its customers’ problems (Christensen and Rosenbloom, 1995). According to Carlsson and Stankiewicz (1991), for an emerging technology to evolve into self-sustaining and self-reinforcing applications with economic value, there must be three underlying elements: (1) innovative ideas, or an embryo; (2) mechanisms for getting the diffusion process started (often entrepreneurs); and (3) a favourable institutional environment for the applications, embedding the technological ideas to be adopted and diffused by users. These three elements suggest that in order to investigate the questions outlined in the previous section, a set of research issues must be developed from the literature on innovation management, high-tech entrepreneurship and their institutional context.

In recent decades, the primary source of wealth in many industrialized countries has been knowledge itself (Cairncross, 1997; Teece et al., 1997; Schilling, 2005). As Dunning (2000) points out, in high-tech industries, innovations occur so frequently that the market is never in equilibrium. The acquisition of technological capabilities is believed to be a complex learning process at all levels in a society (Dodgson, 1993a; Kim, 1997; Schilling, 2005). We propose therefore, when examining a technological
development, analysis should begin with its technical system (components and relations between them), then move to its technological system (interfaces and standards based on which different components or subsystems interact to serve a specific function), then to its actor system (the stakeholders along the value chain of the system in question), and finally to its institutional system (in which all these elements at different layers operate).

Hence, two sets of analytical lenses in their institutional context are needed to examine the central research questions. They are depicted in Figure 1.1. The first, developed from the literature on innovation management and diffusion, addresses issues related to the technical and technological systems, as well as the institutional system of a technological development. The second, developed mainly from the entrepreneurship literature, addresses the issues of the actor system, again within an institutional context.

Figure 1.1: Intellectual map

The Global Network Economy

Innovation is a complex and lengthy process that involves not only the innovative firm but also a system of interactions and interdependencies.
between the firm and other organizations and institutions around it (Dodgson, et al., 2005). Traditional studies of the diffusion of innovation mainly focus on adopters’ behaviour and their consequent impact on the diffusion curve (Moore, 1995a; Rogers, 1995). However, due to the importance of network effects (or network externalities), whereby products and services rely on being compatible within networks of users and which helps explain the long lead times for many innovations, followed by explosive growth in the diffusion of interactive technologies (Farrell and Saloner, 1985; Katz and Shapiro, 1985; Arthur, 1996), an inferior technology or network, instead of superior alternatives, may be adopted by the market as a standard (David, 1985; Rosenbloom and Cusumano, 1988). This phenomenon has drawn attention from a wide range of researchers (Katz and Shapiro, 1985; 1986; Robertson and Gatignon, 1986; Arthur, 1990; Katz and Shapiro, 1994; Saloner and Shepard, 1995; Liebowitz and Margolis, 1998). Given that network effects are a typical characteristic of the modern network economy (Castells, 1996; Shapiro and Varian, 1998), it can be argued that the market alone may not be adequate in picking up the optimal technology or network for society; therefore, other factors in a broader context may play an important role in the development of emerging technologies. To understand this dilemma, it is useful to consider the nature of the global network economy, its boundaries and characteristics.

Towards the end of the last century and into the twenty-first century, major western economies, at least partly, have undergone a transformation from ‘...processing of resources to processing of information, from application of raw energy to application of ideas’ (Arthur, 1996: p. 100). This transformation implies that a new mechanism of economic returns has started to kick in to determine underlying economic behaviours and business competition in part of the modern economy.

Indeed, the world economy is experiencing a number of broad trends including the rise of an economic environment characterized by increasing globalization and inter-connectedness, in which knowledge has grown in importance as an input to a range of products and service and a revolution in ICTs (Cairncross, 1997; Greenspan, 1998; Shapiro and Varian, 1998; Bartlett and Ghoshal, 2000; Doz, et al., 2001). In Death of Distance, Cairncross (1997) describes how distance no longer determines the cost of electronic communications and how this has driven fundamental structural changes in modern society. The business and financial press has adopted the term ‘new economy’ to describe these societal changes (Greenspan, 1998), while academics tend to use the terms ‘network economy’ (Shapiro and Varian, 1998), ‘information economy’ (Castells, 1996) or ‘knowledge
economy' (Doz et al., 2001) to define the changes related to globalization, the ubiquity of ICT facilitating connectivity and the increasing knowledge content of business. All terms have their merits in highlighting different aspects of these changes in society; however, the concept of ‘new economy’ is, to some extent, misleading – in fact, the world economy, led by the advanced capitalist economies, is continually in a process of ‘creative destruction’ as Schumpeter (1934) described it many decades ago. Shapiro and Varian (1998) reinforce this point in their book Information Rules, arguing that durable economic principles do not change while technologies do in today’s frenetic business environment.

Indeed, not all parts of the modern economy are ‘new’. There are two types of economies existing alongside with each other. As Arthur (1996: pp. 100-101) points out, the modern economy has split into two interrelated parts of business corresponding to the two types of economic returns: diminishing returns, based squarely upon the assumption that ‘…products or companies that get ahead in a market eventually run into limitations, so that a predictable equilibrium of prices and market shares is reached’; and increasing returns, mechanisms of positive feedback that can cause possible customer ‘lock-in’ within markets, businesses and industries, which reinforce ‘…the tendency for that which is ahead to get further ahead, for that which is losing advantage to lose further advantage’. Hence, increasing returns reign in the newer part of the modern economy – the high-tech driven ‘network economy’ – while diminishing returns operate in the more traditional part of the economy – the processing industries (Arthur, 1996; Shapiro and Varian, 1998).

The central difference between these social and business structures, according to Shapiro and Varian (1998), is that the ‘new’ part is driven by economies of networks, while the ‘old’ part is driven by economies of scale. The result is that new firms such as Yahoo! and eBay, amongst others, have emerged as leaders in shaping their respective new industries. On the other hand, not every new firm can win in the ‘newer’ part of economy: many high-tech entrepreneurial start-ups and their innovative ideas never take-off because further development of their innovations relies fundamentally on existing infrastructure and assets, and such firms do not have the ability to leverage resources in well-established industries. Numerous new firms that were created to take advantage of the opportunities of e-commerce or m-commerce, for example, failed simply because they did not have the resources to deal with the rules that still control traditional commerce (this being especially true in the business-to-consumer (B2C) sector) (Kalakota and Robinson, 2001).

The network economy – the ‘newer’ part of the modern economy – is characterized by two distinctive features: (1) network effect or network
externalities - the advantage of being connected to a larger network, real or virtual; and (2) temporary monopolies - today's leading market positions are more likely to be replaced by emerging start-ups with superior technologies, and in shorter intervals (Arthur, 1996; Shapiro and Varian, 1998; Casson, 2000). In the network economy, the standardization and standards-setting process of any emerging technology is strongly influenced by social conventions and public policies that are customary and self-reinforcing. In this process, the institutional setting (including government regulatory bodies, cultures, and business systems) plays a critical role. Indeed, to commercially exploit any technological innovation, technological capabilities must be coupled with the right business capabilities (such as regulatory frameworks, business systems, culture and business strategies) in a society (Kim, 1997; Dodgson, 2000b). It becomes essential to differentiate between technological and business capabilities at different layers of network. Figure 1.2 depicts a three-layered network model (infrastructure, architecture and application) to show the general structure of a 'network' or an interactive technological system, where the distinction between the system and sub-systems (components) is clear and the interdependency between them is important. Many modern high-tech industries are operating based on such a structure in the network economy. At each layer, there are distinct characteristics, which require different strategies (business and technology) in managing the development of emerging technologies.

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**Figure 1.2: Network structure**

The largest network in the world, the Internet (world wide web), is composed of three distinctive layers: public telecommunications networks.
and international ‘gateways’ which provide backbone telecom infrastructure and link the telecommunications (Internet) networks across different continents by telecom carriers in each country; access networks which provide Internet access to users (they are often leased from telecom carriers by a limited number of Internet services providers (ISPs)); and application services providers (ASPs) and Internet content providers (ICPs) which provide end-users applications.

In the case of mobile payment technologies, because the distinction between systems and components is clear and interdependency between them is important, the technological system can be analysed using this network structure model: mobile communications and payment infrastructures are at the infrastructure layer; mobile payment platforms are at the architecture layers; and different payment solutions are at the application layer.

Analytical Lens I: Development of Emerging Technologies

Successfully managing the development and diffusion of emerging technologies is a complex, dynamic and multi-faceted task in the network economy (for example, Rosenberg, 1972; Rogers, 1995; Geroski, 2000). Where the increasing returns mechanisms and network effects drive the development of the industry, technological prowess alone is not enough to guarantee an emerging technology’s success (for example, Anderson and Tushman, 1990; Utterback, 1994; Funk, 2003; Schilling, 2005). The diffusion of an emerging technology is a function of multiple factors, including the marginal utility offered by the new innovation; the state of enabling technical systems and their complementary or competing systems; the status of customer expectations; the threat of competitive forces (new entrants or incumbents); the issue of whether the industry faces increasing returns; and, fundamentally, a firm’s internal and external resources. The collective result of these factors is that a particular technology may have a better chance to be selected as a technological standard or a ‘dominant design’ if it is institutionalized and selected by certain social conventions (Anderson and Tushman, 1990; Besen and Farrell, 1994; Utterback, 1994; Schilling, 2005). As a result of network externalities, the status derived from being recognized as a technical standard often leads to positive feedback and increasing returns working in favour of the firm which possesses this standard technology. At a social level, customers may subscribe to the ‘network’ embedding this technology, not just because of their individual assessment of the quality and usefulness of the network, but because of ‘herding’ pressures caused by the number of customers that have already adopted this ‘network’ (Schelling, 1978; Bikhchandani, et al.,
1992; Shiller, 1995; Choi, et al., 2000). Standardization and standard setting, from both a technological and social perspective, have changed the very nature of competition in the network economy, especially in emerging industries.

**Analytical Lens II: High-Tech Entrepreneurship**

High-tech entrepreneurial start-ups are recognized as one of the driving forces behind innovative technological changes in the modern economy (Schilling, 2005). On the other hand, limited by liabilities of newness, smallness and foreignness, high-tech ventures often face enormous challenges to develop viability and long-term growth (for example, Dodgson and Rothwell, 1989; Garnsey, 1998; Schilling, 2005). However, history has shown that many successful high-tech entrepreneurial ventures, such as eBay, Yahoo!, Microsoft and Dell, among others, have become vital players in their respective industries and have, in fact, created new industries or changed the structure of existing ones. One thing these successful high-tech ventures have in common is that they undertake a strategic re-orientation at a certain point in the course of their developmental cycle (Gersick, 1994), changing their resource base from *entrepreneurial* capabilities – the ability to identify new opportunities and develop the resources necessary to match the opportunities in the start-up phase (Arthurs and Busenitz, 2006) – to *dynamic* capabilities – the ability to adapt quickly to the changing environment (Teece et al., 1997; Dodgson et al., 2005). In the course of their development, such firms often need to make several critical strategic choices. For example the entrepreneurial firm needs to:

- identify and analyse the business model necessary to bring their business vision and technological innovation to the marketplace;
- think ahead about whether or not the venture takes an early internationalization approach and, if so, where to obtain the required resources;
- consider whether to collaborate with established companies, which itself can be a matter of life or death for the start-up;
- consider whether to share control under a new governance structure in return for necessary financial capital;
- acknowledge the need for the venture to undergo a strategic re-orientation, in which the founding CEO may need to be replaced by professional managers.
DEFINITIONS

This book aims to gain an understanding of how high-tech entrepreneurial start-ups contribute to the vitality of an emerging technology and what factors and conditions are critical in enabling them to do so. In order to provide clarity, it is necessary to give clear definitions of the key concepts in the central research questions, and also to establish the authors’ position in relation to these concepts.

There is no clear-cut definition of a high-tech entrepreneurial start-up. This type of firm is sometimes referred to as a new technology-based firm (Bollinger, et al., 1983; Autio, 1994; 1997; Fontes and Coombs, 2001; Colombo and Grilli, 2005). Nonetheless, it is widely agreed that this type of firm has several common characteristics. According to Bollinger et al. (1983), these attributes include: (1) a clearly identifiable nucleus of people, ranging from one to four or five, as the founders of the venture; (2) independence, that is to say the venture is not a subsidiary of a large organization; and (3) innovation: the primary motivation for founding such a venture is to exploit a technically innovative idea.

An emerging technology, arising from a technological innovation, has the potential to change existing customers’ needs, or create new customer demand and, as a result, to generate new consumption behaviours or new processes of production (Barney, 2002). This type of technology may take the form of a ‘discontinuous’ innovation (Robertson, 1971; Anderson and Tushman, 1990), making previous knowledge bases redundant. High-tech products, according to Arthur (1996: p. 103), are complicated to design and to deliver to the marketplace; ‘...they are heavy on know-how and light on resources...’. This rather simple and direct description implies three embedded attributes of high-tech products and/or services: (1) high up-front costs – these types of products or services often have R&D costs that are large relative to their unit production costs; (2) network effects (or network externalities) – many of these types of products or services rely on being compatible with a network of users; and (3) customer lock-in – these types of products or services are typically difficult to use and require user training (Arthur, 1996; Shapiro and Varian, 1998; Schilling, 2005). These attributes determine that in high-tech markets, increasing returns mechanisms work to provide high-tech products or services that have gained initial market advantage with further advantage, making these markets unstable and subject to a lock-in effect (Schelling, 1978; Arthur, 1994; Dickson, 1995).

Mobile payment systems are the focal technological system examined here. Mobile payments are defined as wireless transactions of a monetary
value from one party to another using a mobile device (Mobile Payment Forum, 2002). Mobile payment technology has some unique features that make it an interesting focal technology through which to understand the phenomenon of technological convergence and its evolutionary path. First, given the rapid technological development and market growth of mobile payment systems, it provides a relatively short time frame within which to study the emergence and evolution of the dynamics of the industry. Second, mobile payment systems, relying on large infrastructure networks (mobile communications networks and payment networks), provide an excellent opportunity to appreciate the importance of large network characteristics such as network effects, standardization, scale economies and strong and complex system interdependencies. It has been noted that large infrastructure networks such as those in the telecommunications industry can present paradigmatic cases of standard setting in complex technological systems (David and Steinmueller, 1994). An industry such as mobile payments which relies on large networks is often one in which government has a strong interest in setting the standards (Funk and Methe, 2001).

An industry relying on large infrastructure networks has two inherent characteristics in its diffusion pattern: network externalities (Allen, 1988; Schilling, 1998; Shapiro and Varian, 1998; Mahler and Rogers, 1999; Mansell and Steinmueller, 2000), defined as a quality of certain goods and services such that they become more valuable to a user as the number of users increases (Mahler and Rogers, 1999); and critical mass (Allen, 1988; Moore, 1995a; Mahler and Rogers, 1999), defined as the minimum number of subscribers for an interactive product or service to achieve self-sustainable growth (Rogers, 1995), or the point at which an interactive innovation is perceived as valuable by potential adopters (Mahler and Rogers, 1999). The combination of these two aspects of a particular innovation can, in a favourable institutional environment, potentially speed up the diffusion process.

METHODOLOGY

Since the circumstances of high-tech entrepreneurship are characterized by technological complexity and environmental dependency in the global network economy, this book takes an eclectic multidisciplinary approach. It uses a process-oriented case inquiry to investigate the processes of technological development and diffusion of mobile payments initiated by high-tech entrepreneurial start-ups in Korea and China: nations that
respectively lead the world development and use of mobile payment technology and provide the world's largest mobile telephony market. The benefit of this approach is that it has the capacity to address processural matters and to deal with a multiple stakeholder environment (Stake, 2003). In order to examine the unique processes of each case in its original context — technological, national and so on — the research design of this study is targeted at obtaining data in a real-life environment, focusing on understanding the interactions of and relationships among many influential players.

High-tech entrepreneurship research engages with a holistic and dynamic process, involving numerous antecedent variables, and whose outcomes are extremely sensitive to 'events' — decisions, actions, activities and their interactions in a time series (Gersick, 1994). The interactions between the levels of analysis (such as entrepreneurial individuals, entrepreneurial firms, industrial settings and the societal/institutional infrastructure) in entrepreneurship study are vital for understanding the sequences of events within each case. Therefore, in this study, the process of events in each case study is treated as a holistic unit of analysis, which allows an examination of changes in the levels of analysis over time (Van de Ven and Huber, 1990; Van de Ven and Poole, 1990; Dansereau, et al., 1999; Langley, 1999).

The study uses a two-pronged strategy, which is described as a 'double loop' approach (see Chapter 5). This means that the case studies are built upon conceptual structures that are anchored in analytical frameworks developed in Chapters 3 and 4; at the same time, in the process of constructing the case studies, the findings provide another channel by which to identify complex, situated, problematic relationships related to the research questions. The conceptual convergence between the findings developed from the analytical frameworks and the constructs from the empirical case studies leads to a set of abstracted propositions in the analysis process.

Both case studies are constructed in an eclectic way with a focus on events in a time process, drawing in phenomena such as the changing relationships and interactions between, as well as cognitions and feelings of, the stakeholders involved. The objective of these case analyses is to examine the dynamic processes of each case in the presence of multilayered and changing contexts, multidirectional causalities and feedback loops that often disturb a steady progression toward equilibrium (Langley, 1999). The two case studies were not chosen with the objective of direct comparison as, for example, would have been provided by two very similar firms in different places. Instead, each case is examined in such a way as to concentrate on understanding its own complexities and
Introduction

This approach can be described, according to Stake (2003), as a 'collective case study'. In addition, the two cases are embedded in their own unique national contexts – Korea and China – which differ considerably in terms of factors such as industrial policies, innovation systems, business systems, cultures and ideologies. All these factors, individually or collectively, have an impact on the emergence and development of high-tech activities.

The research design and protocols are detailed in Chapter 5.

REFLECTIONS ON THE BOOK’S CONTRIBUTION

Given the importance of technological innovation as one of the driving forces for modern economic growth, the role of high-tech entrepreneurial start-ups, often as the initiator of a new technological innovation, has not been given sufficient consideration in the literature dealing with technological development and innovation diffusion (Autio, 1997; Miller and Garnsey, 2000). This lack of recognition of high-tech entrepreneurial start-ups in the technological development process is even more relevant if the innovation from such a firm survives, but the firm fails to achieve viability and long-term growth. It is particularly interesting to examine high-tech entrepreneurship in the emerging technological powerhouses of Asia, and in countries like Korea and China where traditionally it is large, established firms that are presumed to be the technological leaders.

The major contribution of this book is to enrich our understanding of high-tech entrepreneurship by undertaking process-oriented case studies within their specific national and technological contexts. Many high-tech start-ups are competing in some emerging industries with radically new technologies that are awaiting government evaluation and sanction, for example, the adoption of 3G standards at a national level (Arthurs and Busenitz, 2006). The case studies in this book, by piecing together the 'events' that occurred in a time sequence (process) in their special conditions and environments, identify the factors (technological, industrial, institutional, cultural and social) that influenced the subject firms to make certain strategic choices, and specify the conditions and contexts in which the firms made those choices. The implications of this are relevant not only to the entrepreneurs who manage a technological development, but also to public policy makers. If they have an understanding of the critical factors that influence the success or failure of a high-tech firm in managing the development of a new technology, managers (entrepreneurs) can formulate their strategic choices in anticipation of these factors. Public policy makers
can also better consider policies which encourage the contribution of such firms to economic growth.

NOTES

1. According to Forrester Research’s report (2001), total 3G implementation costs exceeded US$13 billion (around €10 billion) per operator in a large European country. For example, France Telecom was expected to spend US$14.5 billion on its 3G roll-outs— with US$6.43 billion for licenses, US$6.5 billion for network build and US$1.65 billion for marketing.

2. ‘South Korea: A Nation of Digital Guinea Pigs.’

3. With 310 million mobile subscribers (as of the end of 2004), China Mobile Communications Corporation was the largest mobile operator in the world.

4. Williamson (1975) recognized the concept of ‘lock-in’ — an important concept in the network economy — which is explained in detail in Chapter 3.

5. In this book, ‘network economy’ is used to refer to the ‘newer’ part of the modern economy, which represents some fundamental structural changes in society.

6. Network externalities were first defined and discussed in Rohlfs (1974). The idea was dormant for several years until Katz and Shapiro (1985) recognized its importance for strategy and Farrell and Saloner (1986) explored the dynamics of installed base competition. Arthur (1989; 1994) has emphasized the role of positive feedback in the economy. This concept is discussed in detail in Chapter 3.

7. Independence, however, is hard to judge because, for example, one entrepreneur (or an entrepreneurial team) may found more than one venture at the same time, to which he or she may have cross-ownerships, and in some cases a bigger one may own a smaller one.

8. Schilling (2005) claims that path dependency (learning effects) and network externalities are two primary sources of increasing returns.
2. Mobile Payment Technologies

INTRODUCTION

Mobile commerce (m-commerce) promises to deliver electronic commerce capabilities directly into consumers’ hands – anytime and anywhere – utilizing wireless technology. Mobile payments, referring to multiple, overlapping payment methods in mobile commerce, are important tools in m-commerce. According to the Mobile Payment Forum – a global, cross-industry alliance of the leading organizations from the wireless and financial industries dedicated to advancing standardized technology and functionality for secure mobile payments – mobile payments are defined as wireless transactions of a monetary value from one party to another using a mobile device (Mobile Payment Forum, 2002). A mobile device can be a mobile phone or any wireless-enabled portable device, such as a PDA (personal digital assistant), a key ring, a contactless card or a handheld computer. Various dimensions, such as payment size, location of purchase, channel of payment and time of payment can be used to characterize a mobile payment system.

The concept of mobile payments emerged in the late 1990s when European mobile operators (and banks) paid a huge premium for the 3G (third-generation) mobile network spectrum licenses and were hungrily looking for ‘killer applications’ (Forrester Research, 2001). In order for mobile operators to validate their investments, mobile commerce and mobile payments were expected to revolutionize the mobile communications industry and generate substantial new income streams.

At that time, the question confronting mobile operators regarding mobile payment technologies was not ‘if’, but ‘when’ and ‘how’, to launch a global mobile payment network to earn estimated transaction fees in the range of 1.5 per cent to 4 per cent (Frost & Sullivan, 2002). The opportunity of mobile payments was extremely attractive for various stakeholders. Led by mobile equipment makers, such as Ericsson, the mobile industry in the early 2000s believed that mobile operators would be able to provide financial services, allowing mobile users to use the smart cards on their mobile phones as a payment device (Ericsson, 2000).
theory, this is plausible: (1) the SIM card in a mobile phone can store a huge amount of information and has a relatively high level of security; (2) mobile operators have a billing infrastructure that is under-utilized; (3) therefore, it is widely believed that mobile operators’ billing infrastructure can compete with the payment networks of financial institutions. Meanwhile, financial institutions became aware of the competition from the telecommunications industry. As stated in the consulting firm, Booz-Allen’s, report, ‘Today, banks are at another competitive crossroad. This time the new contenders in financial services are telephone companies, specifically wireless telecoms’ (Booz Allen Hamilton, 2002: p 3).

Dozens of high-profile mobile payment ventures, for example, Paybox\(^3\) in Europe, have been created but then failed to meet expectations. The initial failure of Paybox in 2001 was believed to signal the death of mobile payments in Europe. One of the reasons for this kind of failure was attributed to the fact that, first of all, these ventures were either driven mostly by financial institutions or mobile operators and, therefore, did not have enough knowledge of the mobile payment business operating as it does at the convergence of mobile communications and payment networks; and secondly, the concept of mobile payments was too broad and general for consumers to adopt. Fundamentally, a lack of cross-industry interoperability and cross-border interconnectivity were the real obstacles to mobile payments achieving wider acceptance in Europe. By 2002, the concept of mobile payments faced widespread scepticism.

As mobile handsets continue to develop and mature into multi-functional devices, so do secure and convenient payment methods for m-commerce. The convergence of mobile telecommunications and payment technologies has resulted in the so-called ‘mobile wallet’ wherein users can store payment information in their mobile handsets and use wireless communications for many payments. Mobile payments have recently made substantial breakthroughs. For example, Paybox revived and has become one of the most prominent mobile payment schemes introduced into the European market. Paybox has transformed into a third-party driven mobile payment system. It processes direct debit accounts through IVR (interactive voice response) or SMS (short message service) to initiate and authenticate ‘mobile wallet’ transactions. The advantage of Paybox is that only the mobile phone number, not the bank account number or card details, are transmitted over the network.

Over recent years some Asian countries have progressed to more advanced stages of mobile payments, allowing different payment methods to be used for purchases over mobile devices, and where payments are made simply by waving a mobile device in front of a cash register, charges then being made to the owner’s credit account stored in the smart card of
the phone (this is classified as 'proximity payments' and will be discussed in detail later in this chapter). For example, in Hong Kong, the Octopus Transit Card, launched by the Mass Transit Railway Corporation (MTR) - an RFID (radio frequency identity) - based mobile payment system - is widely used as a payment instrument not only for mass transportation, but also in retail outlets, such as 7-11 grocery stores, McDonald’s, vending machines and so on. Currently, the Octopus Card can be integrated into mobile phone sets of which 65 per cent of residents in Hong Kong own one or more (ITU, 2004a). The success behind Octopus Card is that it targeted a very specific application, easy payment for public transportation; once it was widely adopted by consumers, it spread its foothold to other areas of business. In South Korea and Japan, consumers can use their mobile phones, with their financial information stored in either the phone chips or IC chips, for a range of banking applications such as credit card payments, as well as to pay for purchases at retail outlets.

Two lessons have been learned from both the success and the failure of mobile payments. First, the success of mobile payment solutions relies on cross-industry cooperation, including banks, credit card companies, services providers, merchants and the mobile telecommunications operators (telcos), and especially between banks and mobile telcos. All relevant parties have to agree on technological standards and security standards, as well as revenue-sharing schemes, such as how much money each party will get from mobile payment transactions. Second, perhaps an even more important lesson is that it takes time for people to change their habits and adopt a new payment method. Therefore, open standards, not specific to any operators or payment schemes, ensuring interoperability across platforms and services, as well as a unified understanding of the benefits of mobile payments, are critical for the widespread diffusion of mobile payment technologies.

MOBILE PAYMENT TECHNOLOGY

Mobile payment technology has some unique features that make it an interesting focal technology through which to understand the phenomenon of technological convergence and its evolutionary path. First, it provides a relatively short time frame within which to study the emergence and evolution of industry dynamics, given the rapid technological development and market growth of mobile payment systems in recent years. Second, it provides a unique opportunity to appreciate the importance of large network characteristics such as network effects, standardization, scale
economies and strong and complex system interdependencies, given that a mobile payment system relies on large infrastructure networks (mobile communications networks and payment networks).

**Mobile Payments: The Convergence of Mobile Communications and Payment Industries**

The rapid development of mobile communications technologies in the late 1990s resulted in the conception of mobile payment services, based on a mobile data transmission speed that allows users to conduct electronic transactions via mobile phones (mobile commerce). This original form of mobile payments was driven mainly by mobile equipment manufacturers: the mobile phone, which began as a wireless voice-oriented communications device, was evolving into a multi-functional device that not only allows messaging but multi-faceted functions such as playing music, capturing and displaying images and initiating and authenticating payments.

At the same time, bank cards (including credit cards and debit cards) became ubiquitous in most western economies. In recent years, IC chip-based smartcards, contactless cards and electronic cash have become widely accepted by consumers. As depicted in Figure 2.1, the evolutionary result of convergence between advances in mobile communications technologies and payment solutions is mobile payment technologies.

There are three different categories of mobile payments:

- **Billing-based payments**: where charges are added to the mobile phone bill itself. The user pays for the purchase of products or services when paying the phone bill. This category of payment can be either pre- or post-paid. In the latter case, mobile operators extend credit to their users. Billing-based payments are mainly used in on-line transactions, that is, mobile portal-related services such as downloading ring tones, logos, games and other digital content and services.
- **Mobile-wallet payments**: where payments are made with bank accounts associated with the mobile phone through SMS (short message service) or IVR (interactive voice response) over the air (OTA) or wide-area network (WAN). This category of payment generally uses a browser-based transport infrastructure or an SMS-based system. They can be used in on-line, phone-to-phone and phone-to-machine transactions, such as for paying bills (phone and utility bills), topping-up pre-paid accounts (mobile phone accounts, IC cards or IP cards), purchasing digital content and services, and paying for goods at vending machines.
• **Proximity payments**: The payments are made with credit/debit cards through proximity communications media such as infrared, RFID or Bluetooth without occupying airtime. This category of payments is primarily a substitution of an existing card-based payment scheme but it has the potential to expand to new services where mobility is important. Proximity payments can be used for phone-to-phone, phone-to-machine or face-to-face (at point-of-sale) transactions such as parking meters, mass transportation and retailers.

![Diagram of Mobile Payment Technologies]

*Figure 2.1: The emergence of mobile payments*

This categorization is based on the mobile payment settlement process: settled to a credit or debit card, versus settled to a mobile wallet account, versus aggregated to a user’s phone bill. In addition, there are other ways of categorizing mobile payments. For example, by size: mobile payments can be categorized as micropayments which are generally under US$10, especially for regular small applications such as parking, mass-transit ticketing and vending machines, versus macropayments which are over US$10 (Mobile Payment Forum, 2002); and by content and transaction type: mobile payments can be categorized as digital content downloaded to a handset, versus mobile Internet purchases of physical goods for delivery, versus point-of-sale purchases.
No matter what type of mobile payment is used, in each mobile transaction card issuers have to validate the identity of their cardholders in real time, using their chosen authentication method such as a personal identity number (PIN) or smart card. Consumers will have the assurance that their payment data sent over open networks is not compromised, and that their payment accounts will be protected from unauthorized use when shopping online over mobile devices. Merchants will have the benefit of guaranteed payment.

Mobile Proximity Payments

Perhaps the most promising mobile payment application of all for revenue potential is the use of mobile technology to facilitate proximity payments, broadly defined as payments made at point-of-sale (POS) terminals, vending machines, ticketing machines and turnstiles, toll gates and the like. This area is of growing interest due to the following reasons:

- The success of contactless card and RF (Radio Frequency) tag schemes in the public transportation sector;
- The development of location-based wireless technology;
- The development of short-range communication solutions including infrared financial messaging (IrFM), Bluetooth and RFID (Radio Frequency Identification);
- The need to provide two-way payment services between merchants and consumers;
- The desire of the traditional payment industry to provide ‘anytime, anywhere, and anyhow’ capability to pay for goods and services.

Proximity payment solutions have wide applications in handling micropayments. Peter Burns, director of the Payment Cards Centre at the Federal Reserve Bank of Philadelphia in the United States, believes that small dollar transactions will pose the biggest challenge for the credit card networks, because it is complicated and expensive for micropayments to go through the credit card networks (Infrared Data Association (IrDA), 2002). Proximity payment solutions have the potential to fill this gap in respect of small-amount credit payments. Credit cards have been in use as one of the most common payment instruments in western societies for almost 50 years in their original format. The technologies and mechanisms behind credit cards are far from being ideal; however, they reflect the ‘best available’ ones at the time the system was introduced. Under the surface of a plastic rectangle, a credit card is really about the financial data stored on the magnetic strip at the back of the card. The data can be stored on any media.
This thought has triggered exploration into the possibilities of payment instruments based on other media, such as smart cards or mobile phone chips.

According to Sue Gordon-Lathrop, Vice President of Emerging Consumer Environments, Visa International, traditional payment cards have had difficulty penetrating certain retail environments, such as drive-through restaurants and mass transit where swiping a magnetic strip through a POS (point-of-sale) terminal and waiting for an authorization is not desirable. ‘Contactless technology solves the problem of speed by enabling the cardholder to initiate and complete the transaction remotely without a clerk having to manually swipe the card through the terminal’ (Visa International, 2004: p. 2). In theory, this application can be expanded to any retail environment where speed, security and convenience are critical and, as discussed earlier, this application has been commercialized in both Korea and Japan. Another example of this application is its use in hotels and airlines, two famously margin-squeezed industries, where proximity payments can eliminate or at least reduce the reliance on staff to handle payments, which often involves repeat customers.

Under the surface, there are many benefits of using mobile proximity payments, such as faster card payment processing, low installation/implementation costs as well as potential fraud reduction. In a broader definition, mobile proximity payments are transactions that are conducted without manually swiping a card through a card-reading device such as a POS (point-of-sale) terminal (Visa International, 2004). Payment information is sent from a consumer’s payment instrument, whether a contactless smart card or a mobile device, using a wireless communications media such as infrared, Bluetooth or proprietary radio frequency (RF) beams, to a reader at a payee’s site. For example, in Hong Kong, a local resident is likely to hold a transit card (Octopus Transit Card) that is embedded with a microchip (which stores the user’s pre-paid money value) allowing the user to quickly get aboard buses and subways by waving the card close to a radio frequency (RF)-based card-reading device.

Mobile proximity payments differ from mobile commerce transactions in that payment details are not sent over the air and the user must be within a certain range (anywhere between two centimetres and 20 metres) of the wireless-reading device. As Ed Kountz, senior analyst with Tower Group, says: ‘Contactless technology for proximity payments could be the most compelling application for smart cards, particularly in environments where cash handling costs are high, and speed and convenience are critical’ (Visa International, 2004: p. 2).
Currently, there are three wireless communications technologies supporting proximity payments: RFID (radio frequency identification), Bluetooth and infrared.

RFID-based contactless/dual interface (a combination of contactless and contact chips) card is the most prevalent proximity payment technology because of its popularity in mass transit programs. There are two types of RFID technologies: low-frequency RF operating at less than 300 KHz and ultra-high-frequency RF operating at between 902 and 928 MHz. Low-frequency RF is used in applications such as petrol station payment systems. For example, the ExxonMobil Speedpass system uses a device such as a key ring embedded with a contactless card to send payment information to an RFID-equipped reader in the pump within a 10-centimetre range. Ultra-high-frequency RF has a range of transmission of up to ten metres and is used largely in road-tolling applications, such as Octopus Transit Card in Hong Kong, London’s Oyster and Melbourne’s CityLink expressway where a transponder located in the windshield of the car sends signals containing the driver’s name and other road-user information to a reader in the tollbooth. Due to the lack of a technological standard and the relatively large communications distance, RFID will probably remain a technology best suited for proprietary applications and not the global payment environment.

Bluetooth is one kind of wireless radio frequency standard that is backed by an impressive list of hardware and software companies, including Ericsson, IBM, Intel, Microsoft, Motorola, Nokia and Toshiba, among others. Bluetooth sends wireless signals between devices equipped with a Bluetooth chip on the 2.45 GHz band. Depending on the strength of the signal, compatible Bluetooth devices can communicate at distances of up to 80 metres, although distances of up to 10 metres are more common. It provides a better connection, since the data radiates in all directions. As an open standard and promoted by heavyweight technology companies, Bluetooth is currently finding its way into many mobile devices. However, Bluetooth has not been used in the payment area mainly because its capacity to transmit financial information over a relatively long distance and in multiple directions has created concerns about possible fraud in a payment environment.

Infrared is one of the most popular wireless communications technologies. Infrared first gained popularity in the home entertainment industry, where TV, VCRs and stereos can be controlled from a remote wireless device that beams information across a room. Infrared is an ideal wireless technology for the transmission of confidential payment information (beaming mobile phones, PDAs and other mobile devices at infrared-enabled card readers, such as POS terminals, ATMs, kiosks, petrol
pumps, turnstiles and tollbooths), due to its low costs, high security, and
one-to-one, short-range, high-speed directional connection. Although the
line-of-sight requirement of infrared communications is a disadvantage for
some applications, in a payment environment, consumers and merchants
may be assured that their payment information cannot be intercepted, as the
transactions must be completed face-to-face.

A common technological standard of infrared data applications is the
specifications of the Infrared Data Association (IrDA\textsuperscript{9}), an industry
consortium. IrDA is an international organization, founded in 1993,
dedicated to creating global, interoperable, low-cost infrared technology
specifications (standards). The IrDA’s specifications support a broad range
of computing and communications devices by configuring information to
be sent over distances of up to 100 centimetres and at a 30-degree cone
angle. Ron Brown, executive director of the IrDA, summarizes the benefits
of infrared technology: ‘First of all, it costs pennies to install, therefore it is
ubiquitous. Second, it doesn’t take up a lot of space on a device, it uses less
power than other wireless technologies, and it doesn’t have frequency and
interference problems’ (Visa International, 2004: p. 5). Currently, infrared
is available in almost all new mobile phone handsets.

Within the IrDA, the Infrared Financial Messaging (IrFM) Special
Working Group has been working on specifications that utilize existing
financial services infrastructures to process wireless payment transactions
(credit cards, debit cards and loyalty programs) at the point of sale. The
IrFM’s effort has been supported by other industry consortia, such as the
Financial Services Technology Consortium (FSTC) which established a
working relationship with the IrFM Special Working Group early in the
development of the IrFM specification (IrDA, 2003). The commercial
implementation of the infrared-based mobile proximity payment services,
led by Avaro InfoTech in Korea, has proven a success for the IrFM. On 24
December 2002, the Ministry of Information and Communications (MIC)
of Korea stated that the country’s mobile payment standardization should
be in compliance with the IrFM specification (v1.0) (MIC, 2002).

Recently, wireless local area networks (W-LAN) technology, commonly
referred to as Wi-Fi, has gained popularity in short-range wireless
communications. Wi-Fi is based on the IEEE 802.11 specification that
allows devices to communicate across distances of up to 100 metres with a
data transmission rate of at least 11 Mbps. Despite its high speed, Wi-Fi
has not been considered seriously as a payment transmission option.

The current magnetic payment cards (credit cards and debit cards) have
been a mainstay technology of the payment industry for over 20 years.
However, despite all the reassurances regarding encryption and security
technologies provided by both IT companies and financial services institutions, in the Internet era the fear of letting credit card information go into cyber space is one of the barriers that has held back the take-off of e-commerce. Mobile proximity payments have the potential to expand the current consumer electronic payments by including new cardholders and conducting new types of payments in new merchant environments.

The Value Chain of the Mobile Payment Industry

As shown in Figure 2.2, the value chain of the mobile payment industry involves a complex array of actors, including mobile network operators, banks, credit card companies, independent payment service (platform) providers, merchant networks and mobile terminal manufacturers.

Figure 2.2: The value chain of the mobile payment industry

Mobile network operators are attracted by the benefits of mobile payments. They possess the necessary billing infrastructure and have strong relationships with mobile users. As the voice market matures, mobile operators are moving into data services in order to increase margins and average revenue per user (ARPU). The advantages of mobile payments for
mobile network operators are not limited to financial returns, and mobile payment services are regarded as a distinguishing factor in competition.

Banks and credit card companies have long-established relationships with merchants and consumers. They also have extensive expertise and experience in payments and risk management. Mobile payments enable financial institutions to capture revenues from transactions in which they would not otherwise be involved, such as among young people who traditionally are not high users of banking and credit services. Initially, many banks were reluctant to move into mobile payments, mainly deterred by unpredictable investment costs and a fear of diversification away from their core business. In recent years, however, financial institutions, especially credit card companies, have been actively pursuing mobile payments opportunities.

Third-party service providers (sometimes including mobile handset manufacturers) operate mobile payment platforms and develop mobile payment applications. In the industry value chain, therefore, many actors are fighting to take a role that would allow them to influence the standardization of mobile payments. The battle is especially severe between the mobile operators and financial institutions. On top of this, there have emerged many industry forums and consortia aimed at facilitating cross-industry cooperation. However, no dominant patterns have emerged yet in global standards for mobile payment technologies and in the business models under which the technologies are implemented and diffused.

Mobile Payment Industry Consortia

The mobile payments industry has illustrated many examples of different players putting their own interests ahead of the development of the entire industry. The mobile operators and financial services institutions can both see new revenue streams for their businesses, and believe they are better equipped than the other party to manage the mobile payment sector.

Like any payment technology, the key to success in mobile payment solutions is that consumers can use their financial cards (credit or debit) with a wide network of merchants, as well as on the ATM networks. This, in turn, requires standardization of mobile payment technologies internationally in order to ensure a minimum level of interoperability and compatibility. For example, the majority of merchants worldwide are equipped with magnetic card readers to accept a wide range of physical cards (credit or debit). Therefore magnetic strip images are the de facto standard for physical cards. The current financial institutions own the
payment infrastructure directly or indirectly; they have unwavering trust from businesses and consumers and powerful governmental alliances worldwide; and they operate in almost every concern that a consumer might want to make a payment.

Security is obviously an important issue that needs to be tackled in standardization, for a range of different purposes, such as transmission, holding information, payments and authentication for remote access to corporate networks. Fragmentation in the standardization process is hindering the development and deployment of mobile payment systems worldwide. Part of the reason for this is the complexity of the industry value chain: each actor in the value chain wants to have its own interests promoted and protected in the process of setting up industry standards. For example, an increasing number of mobile carriers in Europe are interested in developing their own payment systems for micropayments, with the plan to let macropayments go to the financial institutions.

One of the biggest impediments to the mobile payment industry’s growth, therefore, has been a lack of consistency in payment models and an absence of consensus on technology and security standards. Without cross-industry cooperation on these important issues, financial institutions, telecommunications operators, handset manufacturers and services providers continue to develop, in isolation, proprietary solutions to address specific requirements for individual market sectors, which will cause confusion among consumers and delay the diffusion of mobile payment technologies.

There are over 21,000 financial institutions and more than 500 mobile operators worldwide. The objective of setting up international mobile payment standards is to develop agreement between financial institutions and mobile operators to combine their complementary skills and capabilities. There are many industry consortia/forums promoting mobile payment solutions worldwide. Some of these organizations have been created around existing protocols in order to support and promote the development of emerging standards, and to share experiences and influence the emerging standards in the common interest of the participants. These interest groups have a common objective: to drive m-commerce to mass markets by promoting secure transactions while enabling ubiquitous payment interoperability among different devices and networks through developing industry standards for the mobile technology. The standards have the capability to lead the development of a mobile payment technological system that allows consumers to use mobile phones to make purchases at stores, with authorization and payment data flowing securely through the cellular phone networks operated by mobile communications carriers and then to financial institutions. Global standards have the
Mobile Payment Technologies

potential to give mobile operators and financial institutions flexibility in choosing security and authentication services, with a key goal being that they are able to work on existing infrastructures.

However, different groups obviously have different approaches resulting from their different agendas.

**Mobile Payment Forum**

In order to prevent further market fragmentation and encourage growth of an interoperable global mobile payment market, four major international payment card companies, American Express Co., Visa International, MasterCard International and the Japanese card issuer JCB Co., joined forces to lead an effort to recruit members of the mobile industry to work together with the aim of identifying the challenges and opportunities facing the mobile payment market. Established in November 2001, the Mobile Payment Forum has been dedicated to creating a foundation to facilitate the widespread deployment of secure authenticated, interoperable mobile payments, using a choice of appropriate protocols and payment solutions. The group has since grown to more than one hundred members including not only technology and telecommunications companies such as Oracle, NTT DoCoMo, Vodafone, 3 (former Hutchison 3G) and Telecom Italia Mobile, but also such financial services firms as J. P. Morgan Chase & Co. and Citigroup Inc. The objective of this Forum is to provide a *bridge* between the financial services industry and the telecommunications industry.

Based in Wakefield, US, the Mobile Payment Forum works on standards for use by banks, phone manufacturers and mobile carriers. The combined experience and expertise of these key industry players allows the Forum to effectively address the critical issues for mobile payments. The Forum’s main objectives are the standardization of the ‘building blocks’ for enabling secure mobile commerce by transferring the financial service providers’ experience in security mechanisms, or by providing similar security levels for authentication, data integration, privacy and non-repudiation in the mobile environment.

**Mobey Forum**

Mobey Forum was founded in May 2000 by a number of the world’s leading financial institutions and mobile terminal manufacturers in Europe with the mission of encouraging the use of mobile technology in financial services.

The Mobey Forum supports both remote (mobile wallet) and local (proximity) payment methods and a dual-slot¹⁰ device for secure mobile
payments. Mobey Forum members include leading financial institutions such as Visa International, ABN Amro Bank, Bank of Ireland, BBVA, HSBC Holdings, Barclays Bank, Credit Suisse, Nordea, Royal Bank of Scotland, Deutsche Bank and technology vendors such as Accenture, Hewlett Packard, Hitachi, Meridea Financial Software, NCR, Siemens, Ericsson and Nokia, among others. However, unlike the Mobile Payment Forum, Mobey Forum does not have significant participation from mobile operators. As a consequence, this Forum has experienced many difficulties in putting forward any global standards that mobile operators will support. For example, its dual-slot plan has not received support from the operators.

**PayCircle Consortium**
PayCircle Consortium is a non-profit organization initiated by Siemens, HP, Sun Microsystems, Oracle and Lucent as founding members. PayCircle has challenged the mobile operators’ ambition of leading the mobile payment industry. PayCircle argues that mobile carriers’ billing platforms are far from sufficient to support mobile commerce. PayCircle’s key objective is to promote a common mobile payment system as an open platform by which mobile carriers are connected to a large number of merchants. The open platform is to attract new mobile communications services to m-commerce and to encourage consumers to choose from a variety of content and service providers, which is considered one of the key success factors for mobile commerce.

**Mobile electronic Transactions (MeT)**
MeT Limited is a company founded to establish a framework for secure mobile transactions, ensuring a consistent user experience independent of device, service and network. MeT’s sponsors include Ericsson, NEC, Nokia, Panasonic, Siemens and Sony Ericsson. Currently, MeT has about 50 associate members. Unlike Mobile Payment Forum and Mobey Forum which aim at providing high-level standardizations to encourage the use of mobile technology by gaining the trust of intermediation financial services, such as mobile banking and mobile commerce, MeT has a much wider focus covering all aspects of mobile transactions. However, MeT liaises closely with organizations such as Mobey on issues of banking and financial services and it also works with many other industry bodies to cover other aspects of mobile transactions. The key objective of MeT is to ensure that interoperable mobile transaction solutions are developed around the world, enabling consumers to access goods and services seamlessly wherever they may be with consistent user experience.
Mobile Payment Services Association (MPSA)
In February 2003, Orange, Telefonica Moviles, T-Mobile and Vodafone initiated the Mobile Payment Services Association, headquartered in London. As a commercial organization, MPSA aims at developing and delivering an open, commonly branded mobile payment solution. MPSA hopes that their solution will work across country boundaries and will complement existing industry practices. Apart from commercial interests, this mobile operators-driven association aims to push mobile commerce forward for consumers, content providers, merchants and banks by creating an open and interoperable platform, at least Europe wide. Its initial targeted market sector is micro payments: low-priced purchases through a mobile operator-managed billing system. An easier, more secure and more convenient mobile-enabled way to use existing credit and debit cards is MPSA’s second-stage objective.

Infrared Data Association (IrDA)
The Infrared Data Association (IrDA), based in California, is an international organization that creates and promotes interoperable, low-cost infrared data connectivity standards. The infrared-based ‘Point & Pay’ profile specification, developed by the Infrared Financial Messaging (IrFM) Special Working Group within IrDA, is, so far, the most mature and viable wireless proximity payment standard, and has been endorsed by leading card companies such as Visa International (Visa International, 2004), as well as being accepted as the country-based mobile payment standard in both Korea and Japan. IrDA is a truly international organization and its members include CrossCheck, C-SAM, Extended Systems, Avaro InfoTech, Ingenico, In2M, Link Evolution, Novalog, NTT DoCoMo, Palm Computing, Toshiba TEC, Verifone, Visa International, ViVOtech and ZiLOG.

The world’s major cross-industry consortia and alliances have been listed above; however, there have been many more created to promote region-based standards. Whether these industry consortia are organizations seeking commercial interests or whether they are non-profit driven; whether they are led by mobile operators, financial institutions or mobile equipment manufacturers; whether they are located in the United States or in Europe, these industry alliances work on creating open and interoperable mobile payment standards to promote mobile commerce in general, and mobile payments in particular, on a worldwide scale. These organizations have attracted a variety of ‘actors’ along the value chain of the mobile payment industry. In many cases, a single player joins in multiple
consortia; indicating that despite the fact that the path for collaboration is well underway, judging from the number of these cross-industry alliances, there exists a high degree of uncertainty as to the future adoption of a unified mobile payment technological standard. No doubt, there is a need for a convergence between the mobile world and the financial world in order to achieve vigorous development of the mobile payment industry. However, it seems that there is a question yet to be answered of whether the effort to create standardization is pushing the market to accept mobile payment technologies or whether strong individual businesses are determining the standards development for mobile payments.

Mobile Payments in the Context of the Mobile Communications Industry

The mobile payment system is the crucially important component in the mobile commerce architecture and involves cross-industry synergies such as establishing industry-wide standards that both financial services institutions and mobile communications operators need to support. In most cases, mobile payments emerged in the wake of the development of modern mobile communications technologies, and its development has been driven by the development of mobile communications. It is very important, therefore, to examine the development of mobile payment technologies against the background of the evolution of mobile communications industry.

Mobile communications networks have evolved from analogue-based systems to digital-based systems and from circuit-switching to packet-switching technologies. This evolution can be described by different generations of mobile networks: first-generation (1G) such as AMPS (advanced mobile phone system) and TACS (total access communication system); second-generation (2G) such as GSM (global system for mobile communications), cdmaOne (code division multiple access one), TDMA (time division multiple access) and PDC (personal digital cellular); enhanced second-generation (2.5G) such as GPRS (general packet radio system), CDMA2000 1x (code division multiple access 2000 1x), and EDGE (enhanced data rate for GSM evolution); and third-generation (3G) such as W-CDMA (wideband code division multiple access), CDMA2000 2x (code division multiple access 2000 2x), and TD-SCDMA (time division synchronous code division multiple access) networks. More than 90 per cent of mobile communications networks in the world today are based either on the second-generation (2G) or the third-generation (3G) technologies or between (2.5G), all of which offer digital networks (ITU, 2004b).
The evolution path of wireless technologies towards 3G, as defined by the ITU, is shown as below:

![Diagram of the evolution path to 3G - IMT 2000](image)

Source: Adapted from IMT-2000 (ITU, 1999)

Figure 2.3: Evolution path to 3G – IMT 2000

Broadly, m-commerce refers to all forms of electronic commerce that take place when a consumer makes a transaction using a mobile device. Wireless technologies supporting mobile commerce have been experiencing a revolutionary development. SMS (short message service) is a derivative of the old numeric-paging network, with additional functionality for two-way communication, supporting text and attachments on most 2G mobile phones. SMS is widely used in mobile commerce such as downloading ring tones, logos, and games for the mobile phones. It is also widely used in initiating and authenticating mobile transactions. WAP (wireless application protocol) is the display language designed for mobile handsets. It was created and promoted by the WAP Forum sponsored by the handset giants, Motorola, Ericsson, and Nokia, among others. WAP is a derivative of the XML/HTML language family, but operating without a keyboard or mouse. Limited by bandwidth, this technology has never broadly diffused. There are more users of SMS than of WAP today. GPRS (general packet radio service), with higher bandwidth, offering up to 56 kbps (compared to between 2400 bps and 9600 bps of 2G networks) voice and high-volume data transmission, enables many m-commerce
applications to operate smoothly. It offers ‘always-on’ data communications. With the rollout of 3G networks, such mobile commerce features as streaming media, high-speed (upward of 2 mbps, though more likely to deliver up to 384 kbps) data transmission and global roaming will become realities.

In searching for such a so-called ‘killer application’ for mobile data communications, mobile operators devised the original architecture for mobile commerce which consists of three major components: merchant enterprises (content), mobile carriers (infrastructure), and payment platforms (payment media). It offers an evolutionary solution to expand Internet access to more consumers and to make on-line commerce more widely accepted. According to Accenture’s (2002) report ‘The M-Commerce Roadmap’, the success of mobile commerce is a journey in stages. The ability to move from one stage to the next depends on several things: consumer attitudes and behaviour, technology maturity, industry cooperation and regulatory developments.

The most successful case of mobile data communications is Japanese NTT DoCoMo’s i-mode. By all criteria, i-mode is a success story. According to Lindmark (2002), first of all, i-mode has been a profitable service and it has contributed to slowing down the declining ARPU (average revenue per user) characterizing the industry. For example, in April 2004, i-mode mobile data services in Japan generated €14 ARPU (about 26 per cent of DoCoMo’s total revenues), in comparison with €3-4 ARPU (about 16 per cent – with large variation across countries – of revenues) in Europe. Secondly, while the European operators’ revenues in mobile data communications come almost exclusively from SMS (short message service), i-mode offers real mobile data communications, with rich content and online entertainment experiences.

Many studies have tried to explain the success of i-mode in Japan (for example, Kodama, 2002; Ratliff, 2002; Funk, 2003). These studies have identified three key success factors: (1) the low penetration rate of fixed Internet access explaining the quick take-off of the i-mode; (2) unique Japanese cultural characteristics facilitating the diffusion of mobile Internet; and (3) unique technological choices, for example, cHTML as the mark-up language. However, there is inadequate empirical evidence to verify any of these claims. What is clear is that part of DoCoMo’s success can be attributed to its unique business model in which third-party content providers obtain access to DoCoMo’s subscribers, enabled by a micropayment system (Ratliff, 2002). In this model, DoCoMO collects 9 per cent of the charge as a handling fee while maintaining its ability to control and coordinate the cross-industry activities. In fact, DoCoMo plays a controlling role in the entire value chain in the industry: it has dictated
terminal design and launching schedules, attracted official and unofficial content providers, controlled customer relationships, and given large commissions to dealers. As a consequence, mobile entertainment services flourish in Japan (Xu, 2003). From a marketing perspective, DoCoMo’s success lies in engaging the young consumer market segment at an early stage (Ratliff, 2002).

Apart from the success of i-mode, Japan was the first country in the world to offer 3G services. According to the studies of DoCoMo (for example, Kodama, 2002; Ratliff, 2002; Funk, 2003), there are three major reasons why Japan, and DoCoMo in particular, has pushed for the rapid implementation of 3G: (1) a lack of radio frequencies that calls for an early use of the IMT 2000 (3G) spectrum; (2) the industrial and political failure of 2G in Japan that has driven pro-active actions to strengthen the industry in the 3G arena; and (3) a need for international roaming. 3G licenses were awarded to the three incumbent operators in Japan in June 2000. In October 2001, NTT DoCoMo became the first operator to launch WCDMA-based FOMA 3G services in highly-populated areas in Japan. By June 2004, FOMA had attracted 4.5 million subscribers. In the spring of 2002, KDDI, the second mobile operator in Japan, launched its CDMA 2000-based 3G services. KDDI’s services took off much more rapidly with more than 14 million subscribers as of June 2004. J-Phone, or Vodafone Japan, launched its WCDMA service in December 2002 and had attracted 199,500 subscribers by June 2004 (ITU, 2004a).

The Business Opportunities of Mobile Payment Technologies

Opportunities exist at both ends of the value spectrum of mobile payments: mobile operators have the capability to manage micropayments based on their sophisticated billing infrastructure, while financial institutions are perhaps better equipped to deal with macro payments. In both cases, cooperative approaches are essential. At present, micropayments and payments for premium content and services, such as downloading digital ring tones to a mobile phone, are developing faster, while macropayments and proximity-based micropayments are lagging behind due to the lack of common standards which both telcos and financial institutions could agree upon and support.

The current market of mobile payments
A commercial study by Frost and Sullivan (2002), the international marketing consulting company, believes that the foundations of mobile commerce are currently being laid and that the market will take off within
the next few years. The report expects that trade worth $25 billion will be generated through mobile payments in 2006, which equates to around 15 per cent of estimated on-line e-commerce consumer spending. It argues mobile payments offer a genuine and compelling set of benefits to both consumers and merchants, as well as significant market opportunities for the network operators, banks, credit card associations, manufacturers and the host of start-ups that are looking to claim a stake in the payment market.

Similarly, although forecasting a faster adoption of mobile payments in Europe over the following five years, based on consumer spending data from organizations such as the European Central Bank and Eurostat, Forrester Research (2001) projected an estimated €26 billion in mobile payments in 2005. The report predicted that almost half of the gross profit of €3.2 billion in the five key mobile payment sectors in 2005 would be payments for mobile content. However, it was expected that its share would drop from 50 per cent in 2000 to 20 per cent in 2005. According to Forrester Research, three elements would hinder the wide spread of mobile payments over the following five years: (1) consumers were not ready to change their payment behaviour; (2) providers would continue to resist collaborating on full-featured services; and (3) an easy-to-use, cheap, secure and standardized technology would take years to roll out.

According to Richard Jesty of ARC Group (2003), the global mobile payment industry will achieve more than 100 per cent annual growth and its total revenues will reach US$20 billion in 2005. The majority of current mobile payment revenue comes from transactions such as prepaid top-up services, either directly from linked accounts or from ATM networks. However, he argues that the ‘virtual payment’ (a payment instrument used for a wide variety of mobile commerce) and point-of-sale payments (proximity payments which have gained extensive recognition and been commercialized in Korea and Japan) will become key drivers for the growth of mobile payments.

Not enough data exist to verify the forecasts of these consulting firms. The progress of development in mobile payments, furthermore, differs widely from region to region: Asia is leading in mobile payments and Europe follows, while the United States and Latin America are still in their infancy stage. The reason why the Asian market took off early was that consumers there are particularly technology-conscious. Mobile phones have been widely accepted, especially among the young, for more than just voice in advanced Asian countries. According to Arthur D. Little’s (2005) survey, Korea, Singapore and Japan are considered leaders in utilizing mobile payments. When discussing success factors for the development of mobile payments, Arthur. D. Little claims that the majority of mobile
payment markets are currently mobile operator-driven as, in general, mobile operators are moving most aggressively into mobile payment solutions as they consider them to be an extension of their core business. However, they also believe that the most developed mobile payment markets in the world, Korea and Singapore, have been government-driven. This illustrates the importance of the regulatory environment on the coordination of telecommunications and financial industries in the emergence and development of mobile payments.

The following are some examples of mobile payment solutions.

- In the United States, the mobile payments industry is still in its infancy. Cingular Wireless was the first mobile operator to offer a mobile payment service trial; the solution was equipped by payment technology vendor Qpass. In another example, eONE Global Network and Sprint teamed up to offer another mobile payment trial system.

- In Europe, the mobile payment industry has reached a more advanced stage. In Finland, the Finnish mobile phone giant, Nokia, collaborated with microchip vendor Nordea, credit card provider Visa, and IBM Finland in a market trial of ‘mobile wallet’ applications. In this mobile phone manufacturer (Nokia) driven case, GSM handsets equipped with a mobile wallet were provided for users to try mobile payment services. This application supports standardized mobile public key infrastructure (PKI) that offers digital signature capability for mobile wallets. Germany’s Paybox of mobile Internet and m-POS payments is a more sophisticated example: Paybox uses mobile networks to authorize bank account transfers or credit card transactions. After initial failure, Paybox’s second-stage success lay in the cooperation between telcos and financial institutions. Paybox is backed by both Deutsche Bank and several German and Austrian mobile carriers, and is currently operating and offering mobile payments in Spain, Austria, Sweden, Germany and the UK.

- In some Asian countries, mobile payments technology represents the most advanced stage of development so far. For example, in Korea, three mobile operators offer commercial mobile proximity payment solutions. Although the infrared-based proximity payment solution was first launched by a high-tech entrepreneurial start-up, the most famous showcase of a mobile proximity payment system is SK Telecom’s Moneta System. Visa International has played an important role in the deployment of Korea’s mobile payment systems. In Japan, NTT DoCoMo, after testing a credit card payment service based on infrared transmission (IrDA) ports, together with Visa International, JCB,
Nippon Shinpan, OMC Card and AEON Credit, launched its mobile payment services (JCB, 2004).

**Mobile payment opportunities in Korea and China**

Korea is at the cutting edge of mobile information technologies and has attracted attention from all over the world for its highly developed network convergence between mobile communications technologies and the Internet. Korea’s success represents an excellent example of its vast broadband applications and its innovation and achievement in building this converged network from hardly any technological base in mobile telecommunications a decade ago. Korea had almost no advanced mobile telecommunications technologies before CDMA was introduced and commercialized in Korea in 1996. Since then, Korea has accelerated the technological development of CDMA and has led the world in its development of CDMA and 3G networks (International Cooperation Agency for Korea IT (ICA), 2004). Facing the need to shift to higher-value technology-intensive products, Korean industrial policies were directed at encouraging large increases in R&D investments by its major industrial players in recent decades (Kim, 1997). As a consequence, despite the fact that it started relatively late, Korea has spent heavily on R&D to strengthen its technological competitiveness.

Korea is leading the R&D and commercialization of mobile payments in the world. However, whilst mobile proximity payments have offered many potential benefits they have not encouraged the key players to cooperate. As a result, a lack of standardization of infrastructure – different systems offered by different carriers – has caused confusion among consumers as well as fragmentation of the market and, therefore, delayed the diffusion of mobile payments to the mass market in Korea (ICA, 2004).

The key feature of m-commerce, compared to e-commerce, is that while e-commerce bridges distance and enables companies to display and sell goods to consumers and other businesses around the world over the Internet, m-commerce offers proximity and, therefore, security. Another advantage of m-commerce is that mobile phones are cheaper, easier to use and more prevalent than PCs. Deploying mobile payment services is, therefore, a cheaper option, especially in countries where credit and banking services are not available to most of the population: m-commerce and m-payment schemes can fill the void. A phone turned debit card is particularly useful in those countries, such as China, where credit card uptake is comparatively low, but pre-paid mobile phone usage is high.

Compared to the high-profile telecommunications industry, China’s financial sector has been the focus of much criticism (Horizon, 2003). It has lagged behind the country’s general economic development pace. The
payment infrastructures are particularly old-fashioned, based on the ‘cash is king’ motto. Considering the imbalance between the development of electronic payment systems and the development of mobile communications, the proposal to effectively use mobile phones as a new payment instrument in China has attracted intense attention from the government. The regulatory environment and policy frameworks have been recognized as critical factors that have helped shape the landscape of China’s telecommunications industry (there is a more detailed discussion of the government’s role in Chapter 6). This top-down approach allows resources to be mobilized in order to achieve strategic national goals. There is no doubt that a positive regulatory environment is crucial to the development of China’s mobile payment industry.

Challenges Ahead

The market for mobile payments is still at the early stage of development worldwide. This means it is highly unpredictable, with many different technologies available but underdeveloped consumer interest. For the foreseeable future, mobile payments are not expected to replace traditional payment instruments. Rather than replacing the current payment infrastructure, it is possible that mobile payments will evolve in two directions: in the short term, managing small transactions (micropayments) such as small digital purchases; and in the long term, being integrated with the current payment infrastructure so that mobile phone users can trigger larger purchases (macropayments), using their credit cards, from their phone. In this way, mobile payments will overcome the lack of sophisticated electronic payment networks in developing countries, as well as complement (but not replace) the existing payment infrastructure of credit cards in developed countries.

Mobile service delivery channels have been recognized as an important component of the distribution networks and also as a driver for the economic sustainability of 3G and future mobile infrastructures in the next decade. Consequently, the mobile payment industry has been recognized as a strategically critical business sector by both mobile operators and financial institutions. It is a good example of an emerging industry which bridges the traditional economy and the (new) network economy. Indeed, mobile payment is fundamentally a service business where both volume (critical mass) and economy of network (network effects) are important.

Mobile payment is a global issue, which requires certain stability and predictability in the area of systems infrastructure and standards before a mass market can be developed. The challenge ahead for the development of
mobile payment technologies, as a critical enabler of m-commerce and mobile services delivery channels, is to create cooperation between cross-industry players – namely the mobile communications industry and the financial (payment) services industry – to develop consensus for a ‘standard’ in order for the market of mobile payments to accelerate.

This cooperation is about standards, which determine not only how technological components work together, but also how the stakeholders (actors) work together. Consumers and retailers want a unified standard; they do not want to worry about which phone uses which system. For example, Korean mobile operators have been accused of ‘doing their own thing’, instead of developing a cross-industry standard. As a result, the lack of standards and diversified messages sent to consumers has caused them confusion and delayed the adoption of mobile payment services in that country. Mobile payments will really only work if consumers do not need to think about using them when making payments. That is still a long way off, even in Korea.

The success of mobile payments depends on establishing partnerships and defining a clear role (as well as incentives) for all relevant actors along the industry value chain. Mobile operators have already come to terms with the fact that they cannot play the mobile payment game alone. They do not have a recognized brand name in the payment industry, nor a trusted merchant network, let alone experience in financial risk management. For this reason, a partnership with banks and credit card companies is essential in the development of mobile payments.

NOTES

1. Mobile Payment Forum’s board members include: American Express, JCB, MasterCard, Visa, Orange, Sprint, Vodafone, T-Mobile and Nokia, among others.
2. A contactless card consists of a memory or microprocessor chip connected to an antenna. The antenna and micro-module are embedded into the plastic card body. This technology offers several benefits such as faster transactions than with standard ‘contact’ smart card technology and contactless transactions – maintaining a distance between the reader and the card.
3. Paybox.net AG was founded in July 1999. After a pilot phase in December 1999, Paybox was launched in May 2000. Its original shareholders included Deutsche Bank (50 per cent) and Debitel AG (4.8 per cent), with the rest of the capital (45.2 per cent) privately owned. In July 2001, Mobilkom Austria joined Paybox and became a new shareholder. Since 2002, Paybox has developed a variety of strategic partners including Lufthansa Systems, Hewlett Packard,
Experian, and Oracle, among others, and re-positioned itself as a third-party mobile payment provider.

4. Electronic cash is the generic term for cash value stored in electronic form on the chip of a smart card. In an electronic cash transaction, the value is directly transferred from the consumer's chip to the retailer's chip.

5. For example, consumers in countries such as Sweden, Ireland and the United Kingdom can use an SMS message to authorize a payment from a bank account that is linked to their mobile phone subscription.

6. The distinction between micropayments and macropayments is important since the security requirement is different. For example, authentication for any macropayment transaction through a trusted financial entity is extremely important, whereas network authentication, such as a SIM card, is generally sufficient for micropayments.

7. Location-based wireless technology refers to mobile applications that can process specially coded satellite signals, and determine the precise location of the user, such as GPS (global positioning system). A GPS receiver can be embedded in a mobile device.

8. Bluetooth is the registered trademark of a short-range wireless communication standard. The name derives from King Harald Blötn (Bluetooth), a Viking King in the tenth century in Denmark.

9. For additional information, see http://www.irda.org.

10. A dual-slot mobile device is a handset or other mobile device that has two slots for chips. One is for the Subscriber Identification Module (SIM) of the network operator that resides in the phone and the other is the chip embedding bankcard information.

11. PDC is the second-generation digital mobile network mainly used in Japan.

12. EDGE is a higher bandwidth version of GPRS, permitting transmission speeds of up to 384 Kbps. It is compatible with the GSM protocol, but requires higher quality radio signals to reach the enhanced speed. Sometimes, EDGE is considered one of the 3G technologies.


14. TD-SCDMA, China's home-made 3G standard, together with CDMA2000 2X and WCDMA, was accepted as an official standard for third-generation (3G) mobile networks in May 2000 by the ITU. One year later, TD-SCDMA, was also accepted by 3GPP (3rd generation partnership project) and included in 3GPP's 4th Release. This breakthrough indicates that TD-SCDMA has not only been accepted by the ITU, but also by an influential industry alliance of operators and manufacturers as one of the choices for the next generation of mobile networks (Datang Group Newsletter, April 1, 2001).

15. XML – eXtensible Mark-up Language: A business middleware coding standard allowing for the automated exchange of data between integrated applications across the Internet. Negating the use of a proprietary value-added network (VAN), XML can be used across IP systems (most notably extranets) to permit supply chain integration, logistics tracking and e-procurement to save time, reduce costs, and to strengthen business relationships. HTML – Hypertext
Mark-up Language: The open coding standard (middleware) in which pages are written for the world wide web.

16. cHTML, compact HTML, a subset of HTML 3.0, is used for programming mobile Internet content. It practically eliminates the switching cost for Internet content providers to make their services available on i-mode.

17. This low fee has provided a strong incentive for content providers. As a result, a large number of Japanese content providers joined i-mode. In April 2000, for example, 448 application alliance partner companies and 8,023 voluntary i-mode Internet websites, including 20 search engines, had content provision contracts with NTT DoCoMo. The availability of the contents has contributed to attracting more and more subscribers. As more subscribers sign up for i-mode, more content providers are enticed to provide more content. A positive feedback loop is thus established.

18. Japan has been late in liberalizing its telecommunications industry in comparison with other countries, despite the fact that it was first to launch a public cellular network in 1979. Japan delayed its handset liberalization until 1994, after which its mobile growth took off.

19. J-Phone, later became part of Vodafone Group and was renamed Vodafone Japan.

20. According to Tower Group, mobile-based premium content and service was already a $2 billion a year industry by 2003 (Tower Group, 2004).

21. Moneta has created a lot of global interest but has been considered a failure in Korea. Based on infrared technology, the Moneta system uses an infrared beam to send credit card information to an acceptance device (known as ‘dongle’ in Korea). However, while the Moneta system is based on one IC chip to one credit card, the MAYZ system offers one IC chip to multiple credit cards. Therefore, Moneta’s users need to have multiple IC chips for multiple credit cards and insert a different chip into the handset slot when a different credit card is needed, while MAYZ users can select different credit cards from a single chip.

22. Visa and MasterCard control a global network of more than 21 million merchant locations and have more than 450 million cards in circulation. These global payment card companies have to have their say in the development of the mobile payment industry.
3. The Development of Emerging Technologies

This chapter builds an analytical framework of the development and diffusion of emerging technologies as a basis for the subsequent examination of the empirical case studies. By reviewing the relevant literature in the areas of innovation studies, technology diffusion and corporate strategies in managing the development of an emerging technology, this chapter identifies and evaluates theories in those fields and develops specific research issues that lay the groundwork for the case studies. The central issue addressed in this chapter is the need for a firm to manage the development of an emerging technology in the context of global competition by taking into account technological uncertainty and complexity, as well as the discontinuous nature of technological development.

INTRODUCTION

Innovation can be simply defined as the successful application of new ideas to products, processes, and services (Dodgson et al., 2005). An innovation will gain economic significance only if it is diffused and utilized. In other words, innovations must have the capacity to increase the utility for end-users when adopted and diffused (Rogers, 1995). With the potential of altering existing patterns of consumption or production, innovation has had an increasingly significant impact on business and competition, which, in turn, has caused necessary adjustment in competitive strategies among business managers and government policy makers (Robertson and Gatignon, 1986; Utterback and Suarez, 1993; Rogers, 1995; Nelson, 2004). The innovation process provides a means by which managerial decisions, organizational structures, resources (economic, social and environmental) and skills are reconfigured and used to produce innovative outcomes (Dodgson et al., 2005). As Porter (1998: p. 166) says ‘...the significance of a technology for competition comes from the way it potentially impacts a firm’s competitive advantage or industry structure, rather than from its
scientific merits or its prominence embodied in its physical product or
service’. Indeed, innovation is the main factor behind economic growth
(Van de Ven, 1988; Utterback and Suarez, 1993; Freeman and Soete, 1997;
Baumol, 2002; Carlsson and Mudambi, 2003; Dodgson et al., 2005). The
role of innovation in economic life has drawn an increasing number of
scholars to study the way firms have adjusted their competitive strategies in
response to the rapid technological changes that have occurred since the
late twentieth century (Bettis and Hitt, 1995), because, amongst other
reasons, technological change can alter the interrelationships between
industries and, therefore, bring about changes to industry boundaries
(Porter, 1998; Barney, 2002; Tuomi, 2002; Chesbrough, 2003; Schilling,
2005).

Managing technological development and diffusion is a social event
involving decisions around how and why new ideas are developed and
spread. It reflects an aggregate outcome of individual choices to adopt new
applications based on technological advancement, modification and/or
convergence (Mansell and Steinmueller, 2000). Different innovations have
varying impacts on industry structures and they require different strategies
for firms to achieve and maintain sustainable competitive advantage
(Schilling, 2005). The competition of technologies in the ‘newer’ part of
economy (network economy) has shifted to competition between
interactive (or network-based) applications or systems (Katz and Shapiro,
1994). An interactive or network-based innovation is composed of a
number of components and functionalities that, governed by a standard
interface or architecture, are made up of end-user applications (Schilling,
2005). Because of the interdependencies of interactive or network-based
innovations, the development of such innovations is influenced by various
factors such as network standards (Katz and Shapiro, 1985; 1986; Allen,
1988; Liebowitz and Margolis, 1994; Mansell and Steinmueller, 2000),
user’s herding propensities (Schelling, 1978; Banerjee, 1992; Bikhchandani
et al., 1992; Shiller, 1995), and regulatory policies (David and Steinmueller,
1994; Tassey, 2000; Baumol, 2002; Funk, 2003).

This chapter addresses two central issues: What are the factors
(technical, technological, organizational, institutional and social) that
facilitate the emergence and development of an innovation in the network
economy? And how do these factors interact or interplay? The chapter
reviews the innovation literature, identifies different types of innovations
and discusses the implications of managing the development and diffusion
of these innovations. This is followed with a discussion on the importance
of technical compatibility standards and social conventions in the network
economy, which are identified as critical factors influencing the emergence
and development of a new technology; and an evaluation of the diffusion
literature, from which the interplay of these factors is demonstrated. The chapter concludes with a discussion on corporate strategy, which is used as an analytical lens to examine the significance of the factors and their interactions.

WHAT IS INNOVATION?

Innovation, as the application of something new, involves the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order. Innovation, as a pioneering activity, is rooted primarily in a firm's internal competencies. In the past 50 years, with the growing economic power of late industrializing countries (for example, Japan and Korea) in the worldwide market, the distinction between innovation and creative imitation is, however, blurred (Kim, 1997). Schumpeter (1934: p. 13) distinguishes the two by saying that innovation involves 'commercialization of invention', which is the purely physical act of creation and discovery, while imitation refers to the 'diffusion of innovation'. In this chapter we focus on technological innovation, which refers to the creation of new knowledge that is applied to practical problems (Dodgson et al., 2005), rather than imitation.

The Schumpeterian Legacy

The Schumpeterian school of thought recognizes two main patterns of innovation in industries. In his earlier work, Schumpeter focused exclusively on small firms, led by individual entrepreneurs, which he took as 'agents' of innovation-based growth (Schumpeter, 1934). This 'creative destruction' pattern, labelled as the Schumpeter Mark I model, sees entrepreneurs as the ultimate force driving the emergence of new innovations. The entrepreneur is the one who observes market imperfections and undertakes purposeful actions that lead to economic transformation (Kirzner, 1997). According to this Schumpeterian perspective, entrepreneurship is an everlasting process of creative destruction and reconstruction through which the entrepreneur continually destroys or displaces existing products or methods and organization of production and replaces them with new ones. The Schumpeter Mark I pattern suggests that the role of entrepreneurship and innovation replaces price and market as the most central competitive weapons in key parts of economic activity and is essential to the survival of firms in a capitalist economy (Kirzner, 1973; Cheah, 1990; Casson, 2003; Fagerberg, 2003).
In Schumpeter's later works, he observed that innovation may also be carried out through what he called 'collective entrepreneurship', for example, in the R&D departments of large firms (Schumpeter, 1942). This 'creative accumulation' pattern, labelled the Schumpeter Mark II model, argues that the development of industrial R&D practices has made it very difficult for entrepreneurial firms to undertake the type of long-term, complex R&D projects that are necessary for the development of new products. Specifically, Schumpeter (1942: p. 82) argued that capitalism, by nature ‘...a form or method of economic change’, is never stationary and innovation provides the driving force for capitalism to continue functioning. Fagerberg (2003) points out that Schumpeter did not provide a sufficiently detailed analysis of his second model. Many decades later, Baumol (2002) attempts to provide such analysis by explaining how large corporations contribute to economic growth by carrying out systematic R&D activities in the free-market system.

The Schumpeterian Mark I and Mark II models differentiate the ways in which innovative activities are structured and organized. During the evolution of an industry, a Schumpeter Mark I firm may evolve into a Schumpeter Mark II organization. According to Breschi et al. (2000), technology-related factors, rather than country-related ones, play a fundamental role in affecting the 'choice' of either the Schumpeter Mark I or Mark II model in innovative activities in an industry. These authors use four dimensions to measure a technological regime which, they argue, determines the sectoral patterns of innovative activities. These four dimensions are ‘...technological opportunities, appropriability of innovations, cumulativeness of technical advances and the properties of the knowledge base’ (Breschi et al., 2000: pp. 390-391).

Similar to Schumpeterian perspectives, the modern Austrian school of economics deals with the issues of change, uncertainty and disequilibrium in a business environment (Jacobson, 1992; Kirzner, 1997). Complementary to each other, both the Schumpeterian and Austrian schools of economic thought are concerned about competition as a dynamic and continuous process of change, a perspective which differs from neo-classical economics that views the market as the dominant force, without analysis of what goes on inside firms or the role of entrepreneurs in economic activities (Simon, 1990). The neo-classical view argues that because new ideas would be shared in an information-perfect and complete environment, innovation would not occur (Parker and Stacey, 1994). With the Schumpeterians emphasizing technological innovation and the Austrians emphasizing market innovation, the two, together, provide a complementary view that economic evolution is ‘...a process driven by the imaginative innovations of entrepreneurs’ (Casson, 2000: pp. 234-235).
The Schumpeterian and Austrian schools of economics advocate an important link between economic theories and the social environment, placing importance on understanding the nature of firms as well as the role of entrepreneurs in economic development.

**The Innovation Cycle**

Utterback and Abernathy (1975) argue that innovative processes systematically correspond with a firm’s stages of technological development and the strategies it uses to manage such development. Their theory defines the dynamics of innovation in an industry and how the rate of major innovation for both products and processes follows a general pattern over time. This pattern is characterized with three distinctive periods: a period of fluidity of high product innovation; a transitional period in which the rate of major product innovations slows down and the rate of major process innovations speeds up; and a specific period in which the rate of major innovation tapers for both product and process (Utterback and Abernathy, 1975).

Product innovations are embodied in the outputs of an organization – its goods or services – while process innovations are innovations in the way an organization conducts its business, such as techniques of producing or marketing goods or services (Utterback and Abernathy, 1975). Product and process innovations often occur in tandem: new processes may enable the production of new products; while new products may enable the development of new processes (Schilling, 2005).

Utterback and Abernathy’s (1975) dynamic model of product versus process innovations suggests that innovation exhibits a cyclical nature. Technology evolves through long periods of incremental change punctuated by revolutionary breakthroughs that either enhance or destroy the competence of firms in an industry (Tushman and Andersen, 1986). There are two significant events in an innovation cycle: the emergence of a technological discontinuity and a dominant design (see Figure 3.1).

These two events are the key factors driving changes in the competitive landscape of an industry, bringing in new technological leaders or destroying established players (Anderson and Narus, 1990). According to Tushman and Anderson (1986) breakthroughs, or technological discontinuities, significantly increase both environmental uncertainty and munificence. On the other hand, the appearance of a dominant design – a single architecture that establishes dominance in a product class that permits firms to design standardized and interchangeable parts and to optimize organizational processes for volume and efficiency (Abernathy, 1978) – leads the innovation into a period in which the rate of product
innovation slows down and the rate of process innovation speeds up (Utterback, 1994). In effect, a technological discontinuity can initiate substantial technological rivalry between alternative technological regimes and the emergence of a ‘dominant design’ (also labelled as ‘technological trajectory’ (Dosi, 1982) or ‘platform leadership’ (Cusumano and Gawer, 2002)) and can end this period of technological ferment (Tushman and Andersen, 1986).

![Diagram of Developmental Stages of Innovation](image)

**Source:** Utterback and Abernathy (1975)

**Figure 3.1: Developmental stages of innovation**

Technological evolution plays a critical role in industrial development and industry life cycles. As Rosenberg (1972: p. 203) notes, a technological breakthrough is hardly ever a complete innovation. The establishment of a dominant design is not a function of technical merits, rather the result of a selection by technological, market, legal, political and social factors working together (Tushman and Andersen, 1986; Anderson and Tushman, 1990; Utterback and Suarez, 1993; Utterback, 1994; Schilling, 2005). In other words, the development of a dominant design is the process in which technological and market choices interplay with each other, but one which is constrained by the earlier path of a technical base as well as the evolution of customer preferences in the industry. According to Utterback (1994: pp. 27-29), the following factors are important driving forces behind the emergence of a dominant design: (1) collateral assets or co-specialized
The Development of Emerging Technologies

assets, such as market channels, brand images and customer switching costs, which give companies advantages that can enforce their products as a dominant design; (2) industry regulation and government intervention, which often have the power to impose a standard that accordingly can become a dominant design; (3) strategic manoeuvring by firms, for instance, by means of open licensing and establishing alliances; and (4) communications between users and producers, by which a certain set of features or products can be selected by the market. Successful variations of a dominant design are preserved by the incremental evolution of this design until a new technological discontinuity initiates a new cycle of variation, selection and retention. In general, a better set of complementary assets is associated with a higher likelihood of dominance, other things being equal (Suarez, 2004).

![Diagram of Innovation Cycle](image)

Source: Adapted from Anderson and Tushman (1990)

Figure 3.2: Innovation cycle

As shown in Figure 3.2, in an innovation cycle, a technological breakthrough starts an era of technological ferment, characterized by a wide variety of applications with less radical innovations. When the most attractive niches are occupied, production techniques become more standardized, barriers to entry increase and the industry stabilizes. This phase often closes with a choice around a dominant design. In the period of incremental development, innovations occur around elaboration of the dominant design and development of product platforms. Firms with better
capabilities in process innovation and integration will gain a competitive advantage. This cycle begins again with the next technological discontinuity.

Architectural Innovation

The innovation life cycle theory provides a categorization of innovation as either incremental versus radical or process versus product innovations. This categorization, however, is incomplete and potentially misleading (Henderson and Clark, 1990). An innovation is embedded in applications which interact with customers. A key element of innovative activities is, in fact, the identification of promising applications (Levinthal, 1998). An application is a collection of two or more components, governed by an interface or an architecture, together serving a specific customer purpose (Katz and Shapiro, 1994). This is to say that an application embodies a set of components or elements to form a whole whereby certain relationships exist between the components or elements as well as with their surroundings. Therefore, not only the elements or components, but also the links between them, form a coherent application, which has properties distinct from others (Henderson and Clark, 1990).

In order to distinguish between the components of an application and the ways they are integrated into the application (that is, the product architecture), Henderson and Clark (1990) propose another categorization of innovations along two dimensions: the horizontal dimension captures an innovation’s impact on components (physically distinct portions of a system that embody a core design and perform a well-defined function); and the vertical dimension captures its impact on the linkages and interactions between components.

As shown in Figure 3.3, this view proposes four types of innovations – incremental, modular, architectural and radical – depending on whether core components, or linkages between them, or both, are changed (Henderson and Clark, 1990). According to Henderson and Clark, if the linkages are changed, but the core components are left untouched, the innovation is an architectural innovation. The essence of an architectural innovation is the reconfiguration of an established application to link existing components in a new way. An architectural innovation has the potential to destroy the usefulness of a firm’s architectural knowledge but preserve the usefulness of its knowledge about the components. Since the architecture tends to be embedded in the structure and information-processing procedures of established organizations, an architectural innovation has the potential to cause destruction for established firms (Schilling, 2005). Such destruction is often difficult for firms to recognize
and react to in advance. In contrast, if an innovation changes one or more components, but does not require significant alteration of the overall architecture of the system, it can be considered a modular innovation \( (ibid.) \). If individual producers are allowed to focus on the design and development of their specific components (modules) as long as these components (modules) can work together according to certain component interfaces in a system, in theory, this process – ‘modularization’ – can greatly enhance efficiencies in design and development and specialization in the production system \( (Dodgson et al., 2005) \). However, as pointed out by Dodgson \emph{et al.} \( (2005) \), modularity can be problematic in practice, because systems integration requires deep knowledge of different components, the interfaces between the components, and how they fit together.

Core Concepts

<table>
<thead>
<tr>
<th>Linkages between Core Concepts and Components</th>
<th>Reinforced</th>
<th>Overturned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unchanged</td>
<td>Incremental Innovation</td>
<td>Modular Innovation</td>
</tr>
<tr>
<td>Changed</td>
<td>Architectural Innovation</td>
<td>Radical Innovation</td>
</tr>
</tbody>
</table>

Source: Henderson and Clark \( (1990) \)

\emph{Figure 3.3: Architectural innovation}

A Systems View

In the network economy, market competition has been argued to have shifted from competition between isolated products to between systems \( (Katz and Shapiro, 1994; Shapiro and Varian, 1998) \). An innovation can be a system comprised of components which relate to each other in a designed architecture \( (Anderson and Tushman, 1990; Leonard-Barton, 1992; Antonelli, 1994) \). Each component can also be viewed as a sub-system, comprised of sub-components whose relationships to each other are also
defined by a different product architecture (Christensen and Rosenbloom, 1995). In other words, systems are made up of components, relationships, and attributes (Carlsson, et al., 2002). As innovations hardly ever take place in isolation, in most complex technological applications, innovation cycles apply at the subsystem level. Studying the components separately or the relations at the subsystem level is therefore not sufficient for analysing and understanding the behaviour of the whole system.

An innovation is often the result of interactions between the firm and its environment, such as competitive or cooperative organizations, the institutional set-up and government regulatory bodies (Tushman and Andersen, 1986). Thus, it makes more sense to study the components and their relations of a system in a context (Christensen and Rosenbloom, 1995). Christensen and Rosenbloom use the concept of ‘value network’ to define the context within which a firm identifies and responds to customers’ problems. Within a value network, each firm’s competitive strategy, and particularly its cost structure and its choices of markets and customers to serve, determines its perceptions of the economic value of an innovation. Therefore, it is believed that the value network of a system is an important factor shaping the industry structure (Christensen and Rosenbloom, 1995; Christensen, 1997).

**Generic versus Non-Generic Innovations**

Carlsson et al (2002) describe ‘generic’ innovations – such as internet portal and mobile telephony – which can be commercialized as a result of technical inventions and which often generates a ready-to-use application and fulfills a specific customer requirement. This type of innovation often represents an end-user application (product/service), meaning that they can be utilized by end-users for generic purposes (without specific applications). The diffusion process of such generic innovations, therefore, can commence almost immediately, because the homogeneity of customer requirements of a generic innovation creates a self-sustaining diffusion process (Lindmark, 2002).

In the case of non-generic innovations, such as e-commerce and mobile data communications, which provide the basic technological architecture on which specific applications (products or services) are built and where the economic value of this type of innovation relies on the availability of the specific applications, diffusion requires diversified applications to meet the heterogeneity of customer demands. Therefore, application diversification becomes a key element in the diffusion process (Lindmark, 2002). Application diversification often involves the development of complementary systems. If an innovation requires adaptation to a multitude
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of applications, differing substantially from the core innovation in functionality, technical performance and costs, its diffusion opportunities are greatly limited (ibid.). Architecture is very important in non-generic innovations: not only does it reduce and resolve technical interdependencies, but it also creates opportunities for others to contribute their expertise to the system being built (Henderson and Clark, 1990; Utterback, 1994; Schilling, 2002). In this situation, an open innovation approach to achieve economies of scale and scope is often an effective strategy in the diffusion of non-generic innovative systems (Chesbrough, 2003).

Christensen (1997) categorizes innovations into two distinctive groups based on their impact on environments: sustaining and disruptive innovation. According to Christensen (1997), in sustaining circumstances, incumbents almost always prevail, while in disruptive circumstances, entrants are likely to beat incumbents. The implication of this view is that the best way for upstarts to attack established competitors is to disrupt them.

In any event, if an innovation needs to rely on complementary assets - additional goods or services that enable or enhance the value of the focal innovation (Teece, 1986) - the entrant players that promote this innovation are often in a disadvantaged position, because the adoption of this kind of innovation requires the leverage of the resources of incumbent firms. In the market created by this kind of innovation, incumbents often enjoy the built-in advantages of brand names, customer relationships and deep financial capital, while most new entrants lack knowledge and long-standing relationships with the stakeholders involved.

Open Innovation

Technology licensing, OEM (original equipment manufacturer) agreements and strategic alliances are considered effective strategies for a firm to use its technological breakthroughs in order to build a self-reinforcing user base and suppliers of complementary applications (Hill, 1997). Schilling (2005) argues that, sometimes, less vigorous protection of a technology may be to the firm's advantage - it can encourage other producers (and complementary goods providers) to support the technology - and, as a result, may increase its rate of diffusion and its likelihood of rising to the position of a dominant design. Such strategies do not come without costs and risks, however: having opened the core technology to competitors, the firm bears the substantial risk of being undermined by either licensees or strategic partners (Hill, 1997). Legal instruments, especially in developing countries, are rarely as effective as a sponsoring firm might hope for in
limiting imitation of a technology and therefore maintaining its unique ownership of the core technology (Kim, 1997).

Thus, if a firm is unable to produce the technology effectively or market the technology intensively, then protecting the technology so that the firm maintains its position as the sole provider may significantly hinder its adoption. In fact, Chesbrough (2003: p. xx) put forward the notion of a ‘paradigm shift’ – from closed innovation to open innovation – suggesting how companies can commercialize their innovative outcomes quickly. Open innovation assumes that companies cannot and should not rely only on their own technological innovations, but also on information and innovation from a variety of sources, including high-tech start-ups and universities, to create new products and services; as well as using internal and external paths to market their innovations. Historical evidence suggests that the open innovation approach is effective. For example, IBM’s use of an open architecture and its policy of making its hardware architectural information available to the public created an ‘open network’ for component suppliers to develop a wide variety of choices. The fact that IBM’s personal computers were built largely from nonproprietary components opened the door to many imitators who created an ‘IBM compatible’ standard, which helped IBM avoid being marginalized in the personal computer market in the early 1980s (Utterback, 1994). In more recent times, more and more firms have started to benefit from their use of an open innovation strategy (Dodgson, et al., 2006). According to Chesbrough (2003), Cisco, a Silicon-Valley start-up, has kept up with the R&D output of what he argues is perhaps the finest industrial research organization in the world without doing much internal research of its own. Cisco is one of the largest network equipment providers in the world competing directly with incumbent players such as Lucent Technologies, Nortel and Ericsson.

Chesbrough (2003) argues that there are several factors that lead to a shift from a closed to an open innovation approach: (1) the increasing availability and mobility of a highly experienced and skilled workforce; (2) the growing presence of private venture capital; (3) the availability of external ideas; and (4) the increasing capability of external suppliers. A closed innovation approach, based on an internally focused logic, alternatively, believes that “successful innovation requires control” and relies mainly on internal R&D outcomes (Chesbrough, 2003: p. xx).

The open innovation approach suggests that a firm should not only use external innovative ideas as a source of innovation, but also rely on external channels to market innovative ideas, thereby generating economic value for the firm (Chesbrough, 2003). One assumption of the open innovation approach is that ideas that are not readily used can become
obsolete quickly. The implementation of a successful open innovation strategy is not as simple as it sounds. Chesbrough argues that the choice of open/closed innovation is contingent upon the particular business models chosen by firms in a certain industrial and technological context. A business model that defines the architecture of a system within which internal and external ideas converge is a critical weapon for open innovation, because the open innovation paradigm requires an entirely different mind-set toward managing intellectual property (IP). An open innovation approach suggests that instead of managing the IP to one’s exclusive use, it is important to manage it to profit from other’s use of it and get value from others’ IP at the same time.

It can be argued that open innovation is critical in leveraging innovation processes in small high-tech start-ups. As argued by Gans and Stern (2003), high-tech start-ups may either commercialize their technology through establishing a novel value chain on their own (a relatively closed mode of innovation), or integrate their technology into an existing value chain (which involves cooperation with incumbent players). The choice of specific mode by which a high-tech firm manages its innovation process for an emerging technology is the result of multiple factors: not only the particular business model or value proposition that the firm pursues matters (Chesbrough, 2003), but also whether or not the firm in question possesses the necessary complementary assets which can contribute to the value proposition (Teece, 1986). In addition, as argued by Christensen et al. (2005), the choice of innovation strategy reflects a high-tech firm’s position within the innovation system and the nature and stage of maturity of the technological regime.

In his analysis of the tradeoff between the benefits of innovation 'spillovers' and loss of control over the innovation, Chesbrough (2003) addresses the issues confronted by established firms. From an entrepreneurial high-tech start-up’s point of view, to take an open innovation approach is possibly very risky. As Christensen et al. (2005) argue, open innovation sometimes has to be conducted under conditions of high transaction costs. This point is discussed in more detail in Chapter 4.

TECHNOLOGICAL STANDARDIZATION

Dominant designs alter the pattern of innovation and competition in an industry (Utterback and Abernathy, 1975) and they are sometimes associated with standards (Utterback and Suarez, 1993). In one way, dominant designs and standards are closely linked with each other; for
example, Utterback (1994) argues that industry regulation often has the power to impose a standard and thus define a dominant design. This statement implies a sequential relationship between the two. In many cases, they emerge simultaneously, but based on different criteria (Funk, 2003). The literature in this area focuses more on technical merits as a critical factor for a product to be enacted as a dominant design, but emphasizes the effects of installed bases and network externalities as critical factors in the establishment of a standard (Funk and Methe, 2001). Essentially, a dominant design is considered as the product architecture of a technical solution at the product level, while a standard is often used at higher level (that is, a system or, sometimes, an industry) which defines the interface for different components to work together. The standard setting for a system (or an industry) is a social and political event (David and Steinmueller, 1994; Tassey, 2000; Blind and Thumm, 2004), which takes into account not only consumers’ behaviour, but also the behaviour of suppliers of complementary assets, industry consortia and regulatory bodies. In some industries, dominant designs, as well as technological shifts, are specified in the standardization process (Tushman and Andersen, 1986).

**Technical Compatibility Standards**

When market competition shifts from isolated products to competition between technological systems, three issues become central when considering technology adoption and diffusion: (1) rational buyers’ expectations concerning the attractiveness of future system components; (2) the availability of complementary components; and (3) compatibility between subsystems. A principal means of achieving compatibility between subsystems is the utilization of ‘technical compatibility standards’, often referred to as ‘technical standards’. In ICT industries, a technical standard is defined as ‘...a set of technical specifications adhered to by a producer, either tacitly, or as a result of a formal agreement, or in conformity with regulatory authorities’ (David and Steinmueller, 1994: p. 218). In recent decades, globalization, technological changes and the convergences and complexity of technological systems in the network economy, have called for increasing needs for technical compatibility standards. This is because technical standards greatly simplify the process of developing and designing the components of systems and realizing potential complementarities of subsystems.

In a broader context, technical standards provide rules for interconnecting parts of the network infrastructure (David and Greenstein, 1990). Numbers of studies have addressed the importance of setting a
technical standard in an emerging industry (Farrell and Saloner, 1985; Katz and Shapiro, 1994) and the interactions between technology diffusion strategy and marketing strategy (Capon and Glazer, 1987; Anderson and Narus, 1990; Achrol, 1991; Kotabe, et al., 1996). The increasing need for technical standards reflects the growing phenomenon that network-based modular products, constituted by information-based resources and solutions, can reach customers through many independent distribution points in the current network economy (Werbach, 2000; Dodgson et al., 2005). As an alternative to compatibility standards, gateway devices (for example, translators, emulators, adaptors or converters) allow otherwise incompatible subsystems to work together (Farrell and Saloner, 1985).

According to David and Bunn (1988: p. 170), ‘...gateway technologies make it technically feasible to utilize two or more components/subsystems as compatible substitutes or complements in an integrated system of production’.

In the case of competition between standards, or competition between systems or networks that are, to a certain degree, defined by standards, positive feedback loops work more or less in favour of the more widely adopted standard (a larger installed base), and therefore the market can potentially become locked into such a standard or system/network (Schelling, 1978; David and Greenstein, 1990; Greenstein, 1992; Arthur, 1994; Katz and Shapiro, 1994; Arthur, 1996; Schilling, 1998; Shapiro and Varian, 1998). Sponsors of the winning standards are therefore more likely to be successful in the competition in the network economy. The success of the QWERTY keyboard is a classic example of a larger installed base that leads to a certain product design becoming the industry standard (David, 1985). A company can rapidly build the installed base of a technology and encourage or sponsor the availability of complementary products through strategies, such as: (1) open systems; (2) interorganizational linkages and bundling arrangements (for example, leveraging on a large installed base of another product); (3) aggressive marketing and promotion; or (4) investing in consumer education, to improve its chance to enter or establish a new or emerging market with a new technology (Schilling, 1998).

The choice of an open or closed policy plays a major role in the competition between standards because this policy can affect the installed base (Funk and Methe, 2001). Firms that adopt an open policy are more likely to obtain an early installed base for their products. An open policy is also more likely to attract producers of complementary products and customers who may not want to become dependent on a single firm (Farrell and Saloner, 1986; Funk, 2003). The growing complexity of technical systems, combined with the rapid pace of technological development, has increased the need for compatibility standards; more and more components
and subsystems have to be assembled in order to provide fully functional systems and applications.

The establishment of standards is partly driven by political processes – by the regulatory regime. Regulatory authorities encourage standardization and impose the introduction of standards. To be able to pick and promote the winning standards is of increasing importance not only to management but also to policy makers (Schilling, 2005). Governments have on various occasions tried to intervene in order to influence standards in certain directions, such as in public health, environmental protection or national supplier industries, by promoting a certain technical standard which they perceive as beneficial to the national interest (Mansell and Steinmueller, 2000; Kim and Kim, 2004).

Standard Setting

Standards can emerge and develop through different processes. Standards may be established through the creation of dominant market shares for the particular implementation of a technology. The result of this method of standard formation is referred to as a de facto standard (Greenstein, 1992; David and Steinmueller, 1994; Hill, 1997). In this way, standards may arise from uncoordinated independent actions of market participants. When a particular set of specifications gains market share so that it guides the decisions of other market participants, those specifications have become a de facto technical standard (for example, the IBM personal computer architecture has been the technical compatibility standard for the IBM-compatible PC industry). Firms and other organizations often promote (sponsor) de facto standards in the pursuit of commercial benefits.

Standards that are achieved through a process of deliberation (sometimes legally enforced) are referred to as de jure standards (David, 1987; Sirbu, 1989; Schmidt and Werle, 1998). In this way, standards may arise from formal coordination and consensus-building activities of firms, technical experts, customers and other interested parties, such as ITU (International Telecommunication Union) standards for the telecommunications industry. In a broad sense, informational aspects of standards make them similar to those of public goods in such a way that, by endorsing the standards, all participants or potential participants gain equal accessible rights to the informational specifications (David and Steinmueller, 1994). As a result, this can lead to competition between participating agents. It is not uncommon in some countries to witness the benefits of standardization being disproportionately internalized by a small group of firms and, thus, become potentially a strategic instrument for these firms to achieve dominance in an industry (Farrell and Saloner, 1985;
David and Greenstein, 1990; Besen and Farrell, 1994; David and Steinmueller, 1994; Levinthal, 1998). This explains why market rivalries involving sponsored standards have been increasingly common, especially in the computing and telecommunications industries. There are numerous international standards-setting organizations that enact *de jure* standards in the interests, and with the support, of technology producers and users (Mansell and Steinmueller, 2000). For example, Bluetooth, as a standard for short-range wireless communications technologies, has been supported by a large number of prominent companies. The success of Bluetooth, at least in part, is due to the structure and design of the international standardization ‘club’ that promotes it (Keil, 2002). With *de facto* standards, products are commercialized before standardization occurs, while with *de jure* standards the products are commercialized after the standards are determined (Farrell and Saloner, 1985; Besen and Farrell, 1994; Funk and Methe, 2001).

It has become more difficult for the standard-setting process to rely exclusively on formal standard bodies alone. Nowadays, standards are increasingly set by consortia with less strict government requirements (Weiss and Cargill, 1992; Tassey, 2000). However, standardization via an *ex ante* route can reinforce industry structure, since dominant agents have greater possibilities of aligning standards to their own competitive strength, reinforcing barriers to entry and anticipating future technological discontinuities (Tushman and Andersen, 1986; Anderson and Tushman, 1990; Utterback, 1994). Hence, the ability of firms to influence standards often depends not only on their technical capabilities but also their market power. This explains why incumbent firms are more likely to reinforce their incumbency by using their dominant technical and market positions in standards-setting activities (Utterback, 1994). For example, dominant suppliers, though sometimes lacking technical innovativeness, can anticipate technological change, and thus reinforce their incumbent positions, by influencing the standard setting process in their industry (Schilling, 1998; 1999). This is especially true when promoting a certain standard internationally: large firms are increasingly involved in influencing standards setting, either directly or by participating in international cooperative organizations such as 3GPP$^2$ (Third Generation Partnership Project). Because of the shorter life cycle for innovations and lower physical barriers in protecting technological resources than ever before (Schilling, 2005), firms are required to diffuse their innovations more quickly and more broadly. Thus, a global diffusion strategy is imperative for such innovations, because the adoption of national and regional standards on a global scale influences the competitiveness of firms.
INCREASING RETURNS, PATH DEPENDENCY, NETWORK EXTERNALITIES

High-tech products or services, based on various innovations, have three distinctive features: (1) high up-front costs: these types of products or services often have R&D costs that are large relative to their unit production costs; (2) network (or interactive) effects: many of these types of products or services rely on being compatible with a network of users to form an interactive or network-based application/system; and (3) customer lock-in: these types of products or services are typically difficult to use and require user training (Arthur, 1996; Shapiro and Varian, 1998). These attributes determine that in high-tech markets, increasing returns mechanisms work to provide high-tech products or services that have gained initial market advantage (whether gained by accident, smart strategy, or even pure luck) further advantage, making these markets subject to lock-in effect (Williamson, 1975; Schelling, 1978; Arthur, 1994; Dickson, 1995). Schilling (2005) claims that path dependency (learning effects) and network externalities are two primary sources of increasing returns.

Increasing Returns

As discussed in Chapter 1, with the importance of high-tech industries in our modern life, increasing returns reign in the newer part – the high-tech driven ‘network economy’ – while diminishing returns operate in the more traditional part of the economy – the processing industries (Arthur, 1996).

In the high-tech driven network economy, an increasing returns mechanism based on positive feedback loops reigns when the effects of customer switching costs become difficult to overcome. Customer switching costs exist when, for example, a firm’s customers make investments in order to use this firm’s particular products or services, and when these investments are not useful in other firm’s products or services. On the other hand, high customer switching costs can lead to customer lock-in in the network economy because of increasing returns mechanisms. Therefore, increasing returns is a dynamic concept and relies on the importance of positive feedback mechanisms, whereby an advantage or disadvantage becomes self-reinforcing (Arthur, 1994; Katz and Shapiro, 1994; Arthur, 1996; Shapiro and Varian, 1998). According to Arthur (1996), increasing returns generates not equilibrium but instability in the marketplace.
Conventional equilibrium economic theory assumes that the actions of sellers and buyers produce a negative feedback loop that ‘...leads to a predictable equilibrium for prices and market shares’ (Arthur, 1994: p. 1). According to this theory, the feedback processes will bring the market back to an equilibrium in which resources are used most efficiently. However, Dickson’s (1992) ‘competitive rationality’ theory, which draws on the framework of disequilibrium in the marketplace, challenges this traditional economic theory. Competitive rationality is a ‘cognitive construct’; instead of focusing on heterogeneity of buyer demand and heterogeneity of seller supply, it focuses on heterogeneity in changes in demand and supply and the dynamic interactions and exchanges between buyers and sellers (Dickson, 1992).

In the ‘newer’ part of the modern economy, the development of an immediate large client base thus becomes an especially crucial element of marketing strategy in an industry where network effects reign (Kotabe et al., 1996; Lee, et al., 1997). Therefore, to understand variation in the ‘adaptability’ of buyers and sellers over time becomes very important. From the institutional perspective North’s (1990) approach, using institutional economics and transaction costs, explains the persistence of both inefficiency and noneconomic rationalities with a focus on processural issues that characterize changing environments between equilibrium states. North’s approach more or less supports Dickson’s (1992) model.

**Path Dependency**

Path dependency has been claimed to provide an alternative analytical perspective for economics, a revolutionary reformulation of the neoclassical paradigm (Liebowitz and Margolis, 1995). A process is said to be path-dependent if accidental events might have persistent effects on its course. Increasing returns to adoption imply that a technology’s trajectory is characterized by path dependency, meaning that relatively small historical events may have a great impact on the final outcome (Arthur, 1989; 1994). Arthur (1990: p. 99) uses path dependency to differentiate the ‘positive feedback economics’, in which increasing returns reign, from ‘conventional economics’, in which diminishing returns work.

Path dependency comes from the idea of ‘sensitive dependence’ from chaos theory or complexity theory: the non-linear models argue that the determination outcome such as lock-ins is caused by small, insignificant events (Liebowitz and Margolis, 1995). It is easy to understand this causal relationship: for each new technology in the presence of network effects, the greater the number of adopters, the greater the payoffs to those adopters (Arthur, 1990). This, in some way, explains how markets choose a certain
technology/network over others. It is argued that such choices sometimes represent the inefficiency of markets (Arthur, 1989). Similarly, David (1985) claims that the accretion of technological innovations inherited from the past cannot be legitimately presumed to constitute socially-optimal solutions. This kind of market inefficiency or market failure is often illustrated in the success of the QWERTY keyboard (David, 1985; Arthur, 1989) and the VHS video recorder (Arthur, 1990), it being said that their respective superior rivals could not dislodge the ‘lock-ins’ although the dominant technologies did not represent the optimal solutions for society. In computer software markets, legacy systems also indicate path dependence: a customer needs not merely the best products, but rather the best available products that are backward compatible with their previous investments. Such limitations in customers’ choices often lead to vendor lock-in.

The insufficiency of empirical evidence to support theories of path dependency suggests that there must be other factors, such as the importance of marketing communication, technology sponsorships and government policies, that cause increasing returns (Schilling, 2005). These factors are discussed in the following sections.

**Network Externalities**

A special category of increasing returns to adoption from the demand side is labelled as ‘network effects’ (Robertson and Gatignon, 1986; Katz and Shapiro, 1994; Saloner and Shepard, 1995), or ‘network externalities’ (Rohlfs, 1974; Weiss and Cargill, 1992; Schilling, 1998; Mansell and Steinmueller, 2000). Among economists, ‘network effects’ is the preferred term. There are two types of network effects: direct network effects – those generated in a direct physical network of users of a product or service (for example, mobile phones); and indirect network effects – those generated through market-mediated effects such as situations where complementary goods (for example, cartridges) are more readily available or are lower in price as the number of users of a focal good (for example, printers) increases. Network externalities or network effects of an innovation are an important aspect of relative advantage because they create utility for the adopters as other adopters increasingly adopt it (Rogers, 1995). In other words, network effects can be described as the result of consumption complementarities where the utility derived by a consumer is affected by the total number of consumers in the same network (Suarez, 2005). This type of argument is largely based on the assumption that each user contributes equally to the utility derived by users in the network. However, network effects do not necessarily lead to market dominance by one firm;
this happens when there are standards which allow multiple firms to interoperate, thus allowing the network externalities to benefit the entire market (Liebowitz and Margolis, 1998). For example, Wintel (Microsoft’s Windows operating systems plus Intel’s microprocessors) PC architecture co-exists with Apple’s Macintosh, despite Macintosh’s consistently small market share (Chesbrough, 2003). This challenges one of the assumptions of network effects theory: that consumers are identical in their valuations of competing standards (Katz and Shapiro, 1994; Saloner and Shepard, 1995). Once heterogeneous tastes are allowed, it becomes feasible for competing standards to coexist (Liebowitz and Margolis, 1998).

In the presence of network externalities, attackers with disruptive technologies are likely to beat the entrenched market because of the ‘tipping’ phenomenon (Bikhchandani et al., 1992; Shiller, 1995; Bikhchandani, et al., 1996; Gladwell, 2000). For example, if an established company whose market power is largely reliant on network effects starts to lose its market share against a challenger with a disruptive technology or open standard based competition, its market share will be substantially reduced. According to the ‘tipping point’ theory, if, at a certain time, a ‘tipping point’ is reached at which the network effects of the challenger dominate those of the former incumbent, it is very likely that the challenger will take over the incumbent’s market position (Gladwell, 2000).

The term ‘tipping point’ refers to a dramatic moment when something unique becomes common (Gladwell, 2000). This phase was coined by Morton Grodzins (1958) when he studied the integration of neighbourhoods in the United States in the early 1950s. The idea was expanded and built upon by Schelling (1978). Tipping point, as a social term, is used widely to explain social epidemic phenomena. Gladwell (2000) ‘borrows’ this term to explain the technology adoption process (that is, the diffusion process of an innovation); from a social point of view, the rate of the adoption or diffusion, beyond a certain point, tips and increases dramatically.

INFORMATION CASCADES, HERDING BEHAVIOUR, SOCIAL CONVENTIONS

From the above discussion of the tipping point phenomenon, it is clear that social factors, together with technical ones, interactively drive innovation and technological development in the network economy. According to Cooke and Morgan (2000), institutional settings consist of two layers of substance: a ‘hard’ layer, the ensemble of organizations which are directly
linked with economic development, such as government agencies, banks, universities, training institutes, trade associations and so on; and a ‘soft’ layer, the social norms, habits and conventions, which influence the ways people and organizations interact. Given that innovation and technological development occur within a certain institutional context (Freeman, 1987; Lundvall, 1992; Freeman and Soete, 1997), as Mansell and Steinmueller (2000) point out, technology diffusion is a ‘social process’, within which not only individual, but also collective or institutional, objectives and actions influence the adoption behaviour. Hence, it is argued that, beyond technical standardization, social conventions and social networks contribute importantly to the success of the development and diffusion of an emerging technology.

The adoption process of an interactive innovation is a social feedback loop – a process whereby users (firms and consumers) subscribe to a ‘network’, not because of their individual rational assessment of the innovation’s efficiency or economic returns, but because of a bandwagon – herding pressure caused by the sheer number of users that have already adopted the same network (Abrahamson, 1993). This phenomenon can be explained by the ‘aggregation of individual behaviours’, which was discussed by Schelling (1978) in his book *Micromotives and Macrobehavior*. Schelling (1960; 1978) was among the earliest economic sociologists to analyse the role of social factors in the diffusion of innovation, though he offered his ideas in a non-market context. Without using the current terminology, Schelling (1978: pp. 36-38) anticipated some issues that are discussed in the path dependency/increasing returns literature: he used the term ‘interactive behaviours’ that, he believed, determines outcomes of aggregated actions, though they can be inferior in the presence of preferred alternatives.

**Herding Behaviour and Information Cascades**

Herding behaviour occurs when a consumer’s choice depends on the decisions of others; as a result, it helps accelerate the process of social lock-in effects and increasing returns. From an individual perspective, Choi, *et al.* (1997) argue that the difficulty of assessing product quality, especially when there is uncertainty in the environment, is often a factor in herding behaviour. In this situation, the ‘choice’ made by consumers reflects the individuals’ propensity to herding behaviour. According to Schelling (1978), most individuals are expected to know very little about the whole environment and the way it operates. The ‘irrationality’ of an individual’s choice often leads to unintended and unanticipated consequences as the aggregate of individual behaviour leads to an uncanny
result that is difficult to predict from the simple sum of individual motives and objectives (Choi, 1998).

From the viewpoint of institutional economics and transaction costs, North (1990) points out the existence of inefficiency and noneconomic rationalities in consumer’s choices and explains why aggregated decisions may not accurately reflect their intentions, and therefore why the possibility of suboptimal outcomes may increase. He states that long-term economic change occurs as a result of the accretion of innumerable short-term decisions by political and economic entrepreneurs acting in an interactive way, though individual choices represent their subjective modelling of the environment at the time. North’s (1990) conclusion is based on his analysis focusing on processural issues that characterize changing environments between equilibrium states (Hirsch and Lounsbury, 1996).

Nevertheless, reinforcing feedback loops are one of the underlying forces that determine whether one or the other network will acquire momentum and a certain herding pattern occurs. One factor that can lead to the development of this type of self-reinforcing feedback loop is the way information is communicated within a society. Rogers (1995) defines the diffusion-decision process of innovation as the process through which an individual (or other decision making unit) passes: (1) from first knowledge of an innovation; (2) to forming an attitude toward the innovation; (3) to a decision to adopt or reject; (4) to implementation of the new idea; and (5) to confirmation of this decision. Because of the propensity of herding behaviour, the potential users of an innovation get to know about the existence of it and are persuaded to adopt it mainly through communication with those who have already adopted the innovation (Rogers, 1995). This implies that the dynamics of diffusion reflects the dynamics of communication between the adopters and potential adopters.

In the process of herding behaviour, the information acquired by customers depends on their observation of others as customers or potential customers. Therefore, technology (product or service) providers with a large clearly identifiable user base in the marketplace have a clear competitive advantage, because their user base serves as a ‘signal’ (Spence, 1973) of quality in the market. This is, in fact, an ‘information cascade’ phenomenon. Similar to Arthur’s (1994) ‘information contagion theory of path dependency’, the information cascade occurs when a subsequent actor, based on the observation of others, makes the same choice independent of what his/her private information suggests (Bikhchandani et al., 1992; 1996). As a result, at the social level, information cascade accelerates network externalities, such as herding towards certain choices, lock-ins and increasing returns for those ‘selected’ (sometimes suboptimal) choices.
Social Conventions

Social conventions are social interpretations, norms, rules and legitimization processes that constrain action and create typical behavioural patterns in a society (Jones, et al., 1997). Young (1996: p. 105) states, ‘...it would scarcely be an exaggeration to say that almost all economic and social institutions are governed to some extent by conventions’ and a convention is ‘...an equilibrium that everyone expects in interactions that have more than one equilibrium’. In other words, conventions are created out of uncertainty and randomness in a socio-economic system and they have the capacity to govern culture, patterns of behaviour and institutions in a society. Certain social conventions can influence the dynamics of communication in a society (Schelling, 1960; Lewis, 1969; Sugden, 1986).

To understand how conventions are developed is particularly relevant in formulating a competitive strategy for innovation and technological development in the network economy. Conventions can be formed either formally or informally. In respect of formal conventions, they are formally designed and dictated from the top but internalized by the population through different means: (1) sheer enforcement (deterministic) and (2) positive predisposition (semi-emergent). For informal conventions, they arise from the base (are purely emergent) rather than being decreed from the top (Choi and Chen, 2004).

People follow authority not only because it is thought that humans possess an instinct of obedience, but because humans seem to be conditioned to believe ‘experts’ (Shiller, 2000). Hence, in the process of formal conventions being formed, they can be induced via, for example, expert opinions. As long as the authority that decrees a formal convention can convince people of its expertise, the convention survives and works (Choi and Chen, 2004).

Informal conventions develop from an evolutionary ‘bottom-up’ model (Young, 1996). As demonstrated by the success of the open-sourced Linux system, Tuomi (2002) argues that non-organized (trivial) individual effort can lead to the emergence of social translation mechanisms that allow several communities to interface simultaneously with a common technological artefact and, as a result, lead to a high-quality collective outcome. The establishment of informal conventions is rooted in humans’ fundamental ability to observe how others behave in a similar environment. In the network economy, with the pervasive use of the Internet, informality is dominating the development of conventions because of the increasingly
pluralistic nature of the society, especially through the Internet (such as opinion leadership arising from Internet chat rooms).

Since the process of the identification of socio-economic systems is modelled as an emergent process primarily driven by informal conventions, it is difficult to predict outcomes. It can be argued that formal conventions cannot push socio-economic systems towards desired equilibrium. However, through positive predisposition, such as opinion leadership, they can play an ancillary role in reinforcing the establishment of informal conventions.

**Focal Points**

The rate of adoption of a particular actor identification, such as an informal convention, increases when people’s behaviour is herded around certain collective contextual cues: Schelling (1978) called them ‘focal points’, while Lewis (1969) named them ‘salience’. Psychologists Deutsch and Gerard (1955) explained why this happens: fundamentally, through focal points, such identification is able to coordinate behaviour and reduce measurement costs in social exchanges. Based on this assumption, people believe that the judgment of a large group of people cannot be wrong and they unconsciously convince themselves to agree with it. Therefore, herding around focal points increases the adoption rate of identification as an informal convention.

Focal points are context specific and rely on the culture in which the social actors are embedded (Schelling, 1960; Lewis, 1969). The fundamental assumption of the concept of focal points is dependent on a certain level of common knowledge of information. Information in a society, however, is greatly influenced by advertising and other types of communication mechanisms, including word-of-mouth. von Hippel (1986) uses the concept of ‘lead users’ to describe a group of users who are trend-setters for very novel products or products that are characterized by rapid change (such as high-tech products or services). ‘Lead users’ are a valuable tool for managing new product development and diffusion because they can contribute not only to the identification of improvement for an emerging product/service by incorporating their preferences of emerging needs, but also to the diffusion of the emerging product/service by utilizing their perceptions of the product/service as a source of ‘information’. However, according to Dickson (1995), this simple model of the communication mechanism may have simplified the diffusion process because it fails to consider the effects of other marketing tools such as channel goodwill, shelf space, sales-training, sales incentives and switching costs as sources of even greater path dependency.
What constitutes the focal points which facilitate the development of social conventions? According to Elasbach and Sutton (1992), the status of a firm as a ‘signal’ (Spence, 1973) of the underlying quality of the firm’s products is not reliable because such signals are based on perceptions that can be manipulated by impression management tactics. Social conventions are system outcomes that are selected by powerful authorities. Their internalization by actors in the socio-economic system is, however, dependent on conventions being positively identified by expert opinions and third-party intermediaries. The successful diffusion of an interactive innovation is influenced by a firm’s political power, social networks and marketing strategies, which facilitate the creation of certain social conventions.

DIFFUSION OF INTERACTIVE INNOVATIONS

High-tech products rarely stand alone in the network economy. They depend on the existence of other products and other technologies to form a ‘system’ or ‘network’ to provide systematic solutions for users (Katz and Shapiro, 1994; Shapiro and Varian, 1998). Because positive feedback loops work across markets as well as within markets (Arthur, 1996), the diffusion of interactive technologies lies in the ‘linking’ and ‘leveraging’ within the (technological) ecology, transferring a user base built-up from one node of products to others in the ecology (Rogers, 1995). A fundamental characteristic of the diffusion of an interactive or network-based technology is that both its demand and supply sides are affected by network externalities (Allen, 1988; Antonelli, 1989). In other words, when interactions between consumers or potential consumers occur, as a result, preferences for a certain product/service are influenced by such interactions, with the presence of externalities.

Along with the existence of externalities, critical mass is a phenomenon which, theoretically, determines the fate of the diffusion of an interactive innovation. Critical mass occurs as a result of ‘herding behaviour’ and is compounded by the externality characteristic of networks. Critical mass is concerned with the number of adopters, as well as the existence of opinion leaders among those numbers (Mahler and Rogers, 1999). As discussed, lead users of novel products (often in high-tech sectors) can be taken as opinion leaders (von Hippel, 1986). This implies that the information (perceptions) about the innovation, as well as its communication channels and structures, play a vital role in achieving a critical mass.
Mansell and Steinmueller (2000: p. 104) suggest that it is important to ‘identify’ and ‘map’ the broad paths of various alternatives and to seek an understanding of the possible elements that are likely to be influential for a particular path which emerges as the most likely course of technological development. The implication is that managing technology diffusion, not only in respect of technology strategy, but also in relation to the understanding of behaviour-based theories, should take into account the effects of social externalities, matters such as inter-firm relations, social structure and social networks, in addition to technical standardization.

**Diffusion Process**

Innovation diffusion is ‘...the aggregate outcome of individual choices to adopt new technologies’ (Mansell and Steinmueller, 2000: p. 104, italics added). This definition is shared by both sociologists and economists. For both economic and sociological perspectives, technology diffusion examines the adoption behaviour of those who employ emerging technologies (Rogers, 1995). Economists tend to focus their analysis of technology diffusion exclusively on relative profitability in adopting a certain technology, while sociologists regard it as the process of ‘uncertainty reduction’ that is influenced by individual cognitive processes and the availability of information for these processes to operate (Robertson and Gatignon, 1986; David and Greenstein, 1990; Mansell and Steinmueller, 2000; Baptista, 2001).

Rogers (1995: p. 5) describes innovation diffusion as a ‘...process by which an innovation is communicated through certain channels over time among the members of a social system’. This description contains four elements: an innovation to be adopted, communication channels, time factors and a social system. The diffusion of innovation is therefore about the communication of perceived – instead of objective – characteristics of the innovation among the potential adopters in a society. There seems to be agreement among economists, sociologists and marketers that the perceived value or economic advantage that an innovation presents over competing alternatives is influential in its diffusion process. While economists stress the economic advantage of an innovation, social diffusion studies concentrate on the diffusion process, that is how different adopter categories in a social system (for example, categorizing adopters according to their propensity to adopt an innovation) obtain knowledge of, become persuaded about, and decide to adopt and implement (and continue to use) a given innovation (Rogers, 1995). Sometimes, expectations of future improvements of an innovation will also affect the rate of diffusion, since many improvements are made after as well as during the diffusion
process (Rosenberg, 1972). During the diffusion phase, the innovation can be modified or improved as more people adopt and use it. As Rosenberg (1976: p. 186, original italics) points out, ‘The selection of a technology as appropriate in a particular context, and its adaptation and modification in order to enable it to function efficiently in an environment different from the one in which it originated, are activities which typically require a very high degree of technological sophistication.’ Therefore, the process of diffusion may also include a process of ‘re-innovation’ (Rothwell and Gardiner, 1988). Indeed, the diffusion of an innovation is a possible source for innovation itself. As Rosenberg (1972) points out, technological evolution is, indeed, its diffusion process.

According to Rogers (1995), the most common diffusion model is a logistic one, a symmetric S-shaped (sigmoidal) curve, where the growth rate \( r \) is proportional to the product of the fraction of the market penetrated \( p \) and the fraction that remains to be penetrated \( 1 - p \) or \( r = p(1 - p) \). There are three distinct periods in an S-shaped curve: (1) the period of early adoption, (2) the rapid market expansion period and (3) the maturity phase. Traditional diffusion research explains the S-shaped pattern in terms of information and uncertainty reduction, and degrees of ‘innovativeness’ among potential adopters, which make them adopt an innovation in a time sequence (Foster, 1986; Rogers, 1995). In reality, however, many innovations diffuse according to some asymmetric S-curves, taking into consideration outside influences, such as mass marketing (a combination of information sources) (Bass, 1969) or technological changes (quality and cost improvement) (Rosenberg, 1972; Geroski, 2000), or analysing diffusion as occurring at multiple levels (Lindmark, 2002). Hence, symmetric S-curves are rarely observed in practice.

The diffusion process of interactive technologies is heavily dependent on system interdependencies. The interdependence of adopters of an interactive innovation, therefore, can change the shape of the diffusion curve from the regular S-shaped one to a curve that has a flatter slope initially but which quickly becomes steeper than the normal S-shaped curve. Because of network externalities, prospective adopters perceive more value as the adopter pool grows; the utility of an interactive or network-based innovation, therefore, depends on the size of the user community (Allen, 1988). The point at which the slope makes this change and diffusion becomes self-sustaining is the ‘critical mass’ (Rogers, 1995: p. 313). The difficulties in forecasting the diffusion trends of an interactive innovation – for example, in the repeated underestimation of the demand for mobile telephony and repeated overestimation of the demand for mobile data communications (Lindmark, 2002) – can be partly attributed to the
complexities of identifying system interdependencies when introducing an interactive or network-based innovation.

Take-off Phenomenon

In recent years, with the rapid market growth in the applications of the Internet, and mobile communications, there has been a widespread industrial belief in (or at least a hope for) a deviation, or so-called ‘take-off’, for interactive technologies from the S-shaped curves. Such a belief (or hope) is commonly shared by managers and industry analysts in ‘super-hyped’ industries like e-business and mobile data communications (Lindmark, 2002). Despite the phenomenon of take-off attracting increasing interest from academics with a view to exploring its theoretical foundations, it has rarely been observed in empirical research, at least until recently when, for example, many countries experienced take-off in the subscription to mobile telephony services in the mid to late 1990s (Lindmark, 2002).

Take-off can be defined as a ‘sudden very large increase in the number of adopters’ of an innovation coinciding with the advent of critical mass, and after take-off, further diffusion becomes a more or less ‘self-sustaining’ process (Link, 1997: p. 82). Theoretically, take-off can occur because network externalities present where economies of scale on supply side or economies of network reign (Schelling, 1978; Arthur, 1989; Katz and Shapiro, 1994; Schilling, 1998; Mansell and Steinmueller, 2000). From a social standard point of view, if a certain technology takes the lead in market share, it can subsequently project a signal to the market that to adopt this technology may reduce the risk of being locked into a smaller network. Therefore, a take-off can be triggered by the perception of such a sudden reduction in the risks of adoption. It is reasonable to predict that the degree of risk aversion among potential adopters determines whether take-off will be induced, provided that compatibility issues have been sufficiently addressed.

A take-off includes two distinct features: (1) a positive discontinuity in the diffusion rate, accompanied by (2) a switch from a non-self-sustaining process to a self-sustaining one (see Figure 3.4).

Traditional diffusion theory explains relatively rapid market expansion in the diffusion process being caused by the activation of word-of-mouth communication (Link, 1997). The take-off phenomenon involves, however, more complex causal relationships than the single-dimensional word-of-mouth communication mechanism suggests. In fact, causal mechanisms behind take-off are not sufficiently investigated in the literature (Maitland,
This is hardly surprising since, as discussed in previous sections, the rate of diffusion is dependent on a number of interrelated factors.

Critical Mass

Complexity theory (see for example, Foster, 2003) interprets take-off as representing a shift in system dynamics from negative to positive feedback mechanisms, and such a 'tipping point' is referred to as a 'critical mass' (Allen, 1988; Gladwell, 2000; Lim et al., 2003).

Critical mass is a term originally used in nuclear engineering, referring to the critical amount of uranium needed to cause an explosive chain reaction. In social science, critical mass refers to a certain minimum level where, once the measure of an activity passes it, the activity becomes self-sustaining and self-reinforcing (Schelling, 1978). In the diffusion literature, critical mass is defined as 'a point in time at which enough individuals have adopted an interactive innovation that the perceived cost-benefit of adopting the innovation becomes self-sustaining' (Rogers, 1995: p. 313). Rogers explores the critical mass phenomenon as an approach to understanding the adoption of interactive communications technologies. He believes that a critical mass must be achieved before an interactive (network-based) technology – for example, fax machines or mobile
telephony – takes off into rapid growth and, therefore, the diffusion process becomes self-sustaining.

Essentially, taking economic returns to adoption into consideration in the diffusion process, critical mass denotes a point at which positive feedback effects outweigh negative feedback, so that a process becomes self-sustaining in some sense. As the market share, or client base, of an interactive technology develops, reputation and customer loyalty begins to kick in. When the client base of the technology reaches the critical mass point, the firm or partnership of firms which possesses the technology can experience positive feedback mechanisms, which, in turn, leads to an acceleration of competitive advantage (Farrell and Saloner, 1986; Funk and Methe, 2001; Schilling, 2002). On the other hand, if an interactive technology cannot reach such a critical mass point of users within a certain period of time, the technology will rapidly lose the developmental momentum and will suffer the fate of being defeated by competing technologies. Geoffrey Moore’s (1995) Cross the Chasm theory, although it ‘borrowed’ ideas from Rogers (1995), demonstrates a ‘chasm’ (see Figure 3.5) often encountered by high-tech products/services in the course of their diffusion. If the diffusion cannot overcome this chasm, the innovation will either serve the niche market which is represented by the innovator adopters, or simply disappear in the market. For example, one of the reasons that Europe’s high performance ISDN (integrated services digital network) plan did not fully realize its potential was that the ‘convergent markets’ that were expected to develop were not large enough to support the investment costs of upgrading the entire network, and, therefore, to cross the ‘chasm’ (Mansell and Steinmueller, 2000).

![Chasm model](image)

*Source: Moore (1995a)*

*Figure 3.5: ‘Chasm’ model*
Managing a critical mass strategy is a matter not only of a firm’s technology strategy, but also its marketing strategy. Rogers (1995) acknowledges that the awareness and knowledge of an innovation can be made most efficiently through the mass media; however, the focus of critical mass research has been more on technical aspects and there has been a gap in understanding the firm-level strategies used to address this issue (Maitland, 1998). In other words, the important role played by a firm’s marketing communications strategy, for example, how to best utilize the mass media, its social networks and its interactions with other firms within an industry, has received less attention, especially empirically.

Indeed, although many scholars claim that interactive (network-based) technologies should be expected to have a pronounced critical mass in their rate of diffusion, in complex systems which involve a vast number of components and relations, critical mass is difficult to operationalize. It has been recognized that many elements affect the point of critical mass; therefore determining its position and implementing a strategy to manipulate it is a complex and, in many cases, an elusive task (Maitland, 1998; Mahler and Rogers, 1999; Lim et al., 2003). As Rogers (1995) admits, the evidence of critical mass is very sparse in practice. While the term is widely used both by practitioners and in the diffusion literature (Allen, 1988; Carlsson and Stankiewicz, 1991; Hordes, et al., 1995; Lim et al., 2003), in most cases the concept seems to be used more as a metaphor than as an actual phenomenon. To assess whether or not a critical mass has been reached requires careful system delineation, including all relevant relations, their strength and the definition of system boundaries (Lindmark, 2002). The diffusion literature (Allen, 1988; Carlsson and Stankiewicz, 1991; Hordes et al., 1995; Maitland, 1998; Mahler and Rogers, 1999; Lindmark, 2002; Lim et al., 2003) argues that some kind of external influence often induces the occurrence of a critical mass, as endogenous growth is often not sufficient to trigger the diffusion process to reach the critical mass. Therefore, to assess and operationalize a critical mass, not only do all relevant relations in an interactive system need to be analysed, but also external influences, such as public policy-makers at the social level and all managerial decisions at the firm level, should be identified and examined.

Indeed, the installed base has become one of key determinants in users’ technology selection. This argument relies on the assumption that networks are composed of identical users each making the same contribution to the utility of other members of the user base, irrespective of their location in the network (Suarez, 2005). Social network theory has long studied the effect of different types of network structure on organizational outcomes and decisions. Suarez (2005), borrowing theories of social networks, from
the strength-of-ties perspective (for example, Rindfleisch and Moorman, 2001), argues that, if networks are not uniform and can be classified in accordance with their strength of ties, technological choices of users in different parts of a network with different characteristics of ties will have different impacts on the final selection of technology.

INNOVATION IN AN INSTITUTIONAL CONTEXT

The innovation process can be seen as a channel through which technical possibilities match market opportunities, involving multiple interactions and types of learning in an institutional setting (Freeman and Soete, 1997). From an innovation management point of view, Dodgson et al. (2005) describe the innovation process as the one by which managerial decisions, organizational structures, and combinations of resources and skills together produce innovative outcomes. For an innovation to evolve into self-sustaining and self-reinforcing applications, there must be three underlying elements: (1) innovative ideas, (2) entrepreneurs and (3) a favourable institutional environment (Carlsson and Stankiewicz, 1991). Innovation has been discussed in previous sections of this chapter and entrepreneurship will be addressed in the next chapter. This section discusses the institutional context within which innovation is initiated, developed and diffused.

The Role of Institutions

The institutional context is considered as a set of formal or informal rules. Specifically, Edquist and Johnson (1997: p. 46) define institutions as '...sets of common habits, established practices, rules, or laws that regulate the interactions between individuals or groups'. According to this definition, institutions have three basic functions in the development of a new technology: (1) to reduce uncertainty and provide information, (2) to manage conflicts and cooperation and (3) to provide incentives to innovation (though they may also act as obstacles). Put a different way, institutionalization is the process by which a firm adopts structural forms that are perceived to grant legitimacy to the organization in the eyes of important stakeholders whether they be employees, customers, government regulators, or others (Zucker, 1986). The elements of an institutional context (that is, people, ideas, physical resources, capital, infrastructure and regulatory environment) are not only important in the process of new technology development, but also in the technology diffusion process. In
other words, the success of the development of a new technology as well as the diffusion of the technology, require the successful acquisition of legitimacy for the technology by the institutional elements within which the firm with the technology operates (Zimmerman and Zeitz, 2002; Sung and Carlsson, 2003; Morlacchi, 2004). This kind of legitimacy is often a function of both technical standardization and social standardization, which have been discussed respectively earlier in this chapter.

Institutional theory emphasizes that organizations must conform to institutional rules and requirements if they are to receive support and be perceived as legitimate (Baum and Oliver, 1991). At the firm level, questions of how and why a firm ends up with a certain structure has also been a focus of institutional theory, which suggests that firms adopt structures and forms for legitimacy within their domain of operations (Zucker, 1986). Developing ties with important institutions and other organizations operating in the same institutional context can also increase the chance of the organization’s survival (Baum, 1996). At the societal level, technology competition has created ‘webs – loose alliances of companies organized around mini-ecology...’ (Arthur, 1996: p. 106) – which, as a whole, nurture and support the development of innovation (Lundvall, 1992; Cooke and Morgan, 2000).

In recent decades, research on standardization and standards-setting has shifted towards how the socio-economic system selects certain ‘actors’ and identifies their assets, the processes of the institutionalization of standards-setting and the formation of social conventions (Choi and Chen, 2004). The significance of the social aspects of standardization shows the importance of institutions and cultures in the standardization process, especially towards intellectual property. At the global level of standards-setting, this requires the analysis of ‘business systems’ (North, 1990), or the identification of differences in countries and regions. Whitley (1992: p. 13) uses national business systems to describe the nature of ‘wide-ranging’ and ‘long-ranging’ institutions that tend to develop ‘cohesion and resistance to major changes once established in certain cultural contexts’.

A national business system is defined as collective institutionalized patterns of social and organizational structure (Whitley, 1992). According to this definition, different national business systems form distinctive and enduring ways of structuring economic co-ordination and control that inherently shape the logics governing economic decision-making, actions, and the market processes through establishing and enforcing conventions, values, views, norms, practices, and the so-called ‘rules of the game’.

Traditionally, research on innovation diffusion tended to focus at the individual consumer level, on reasonably low technology products and services, and from a behavioural perspective (Robertson and Gatignon,
1986). The success of the development and diffusion of an interactive technology is driven by the creation and maintenance of a critical mass in the user base for the applications, which is facilitated by the establishment of both technical and social standards. These standards can define the rules that guide the interactions between components of the systems as well as actor systems. Since standards facilitate the coordination of economic activities, they are sometimes included as an element of the institutional system (Edquist and Johnsson, 1997). Therefore, a crucial step for the successful development and diffusion of an interactive technology at the firm level is to find ‘fits’ with the firm’s institutional environment, from both technical and social aspects.

Indeed, to find an institutional fit is especially relevant for most high-tech industries, where initial R&D costs are large relative to variable unit production costs, and where exceptional success can be achieved by certain players. At the firm level, a firm’s adaptability and flexibility in managing its internal resources, its social networks and its interactions with institutions in the environment, as well as its technological advancement and implementation of the right strategy, at the right time, with the right speed, are crucial elements for the firm’s success in managing the development and diffusion of innovations in the network economy (Teece et al., 1997; Deeds et al., 2000).

The interactive nature of the innovation process means that firms, regions and nations need to develop institutional structures and mechanisms that can promote continuous interaction and feedback within and between firms and various institutions which constitute the national system of innovation (Cooke and Morgan, 2000).

**National Innovation Systems (NIS)**

The national innovation systems approach believes that innovation and the technology development in a country is the result of a complex set of relationships among actors in the system, including enterprises, universities and government research institutes (Freeman, 1987; Lundvall, 1992; Freeman and Soete, 1997; Lundvall, 2004).

Freeman (1987) defines a national innovation system as the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies. Lundvall (1992) gives a broader definition that covers all parts and aspects of the economic structure and the institutional setting which affect learning as well as searching for and exploring new knowledge. In this definition, a national innovation system is composed of the elements and relationships which interact in the production, diffusion and use of new and
economically useful knowledge. The OECD (Organization for Economic Co-operation and Development), however, defines the national innovation system as the flow of technology and information among people, enterprises and institutions which is the key to innovative process at the national level (OECD, 1997). No matter which definition is used, interactions of actors/elements or flow of technology and information among actors/elements in a system are recognized as important elements in a national innovation system.

Empirical and comparative studies have found that differences between national innovation systems reflect different institutional arrangements, including: systems of university research and training and industrial R&D; financial institutions; management skills; public infrastructure; and national monetary, fiscal and trade policies (Nelson, 1993). More recent work has identified five functions of an innovation system; instead of taking the innovation system as a 'theoretical concept', the national innovation system is believed to facilitate: (1) the creation and diffusion of 'new' knowledge; (2) the direction of the search process among users and suppliers of technology; 3) the supply of resources, including capital, competencies and other resources; (4) positive external economies through the exchange of information, knowledge and vision; and (5) the formation of markets (Lundvall, 2004).

Since many high-tech innovations have the potential of achieving almost immediate global applications and shorter than ever effective life cycles (David and Greenstein, 1990; Hill, 1997; Mansell and Steinmueller, 2000; Baptista, 2001), the effectiveness of using innovation systems at a national level becomes a contentious issue. On the one hand, national policy roles, such as protecting weak industries, promoting 'national champion' firms, and pursuing self-contained industrial policies, have been substantially undermined in the new economic order which is based on free trade within and between large trade blocs (Gillies, 1994). Cooke and Morgan (2000), on the other hand, argue that, for the nation, despite the effect of 'convergence' of economic activities between countries, the 'diversity' of national patterns of economic behaviour has proven persistent; for most firms, their international business, especially in relation to their associational activities, is very much confined within national and, in many cases, regional boundaries (inter- or intra-nationally). The reason for this durability of national specialization is due to the fact that many technological and organizational developments tend to be path-dependent and difficult to adjust (Arthur, 1994). Thus, national innovation systems continue to be of significance for the understanding of innovation and economic development. According to Cooke and Morgan (2000), innovation systems at the regional level are, perhaps, more relevant in
today's economic environment. This is because the ability of a region to cope with challenges presented in the new economic order depends largely on the extent of collaboration between its firms, and the ability of regional governments in supporting such collaboration, using their term, 'associational economies' (Cooke and Morgan, 2000).

EMERGING INDUSTRIES AND FIRST-MOVER ADVANTAGE

Barney (2002) defines emerging industries as newly created, or newly recreated ones formed by technological innovations, changes in demand, and the emergence of new customer needs. Day (2000) argues that scientific innovations have the potential to create a new industry or transform an existing one. However, a new technology usually asserts its advantages over an old one slowly. Rosenberg (1976: p. 174, original italics) claims that ‘...new techniques frequently require considerable modification before they can function successfully in a new environment’. In other words, most improvements in economic welfare are due not to major breakthroughs, but rather to routine improvements around a dominant design of a product class (Anderson and Tushman, 1990; Utterback and Suarez, 1993).

Baumol (2002: p. ix) observes that most of the utility in technological products comes from more routine innovation that takes place in 'systematized, bureaucratized, and highly efficient sets of parallel activities' carried out within 'innovative oligopolistic corporations'. This argument is rather contentious in that it neglects the contribution of independent inventors and innovators who may provide the initial breakthrough that ignites the formation of a new value chain for an emerging industry. As Schumpeterian scholars claim, entrepreneurship contributes by identifying opportunities, initiating innovation processes, and sometimes bringing an innovation to a marketable product – in other words, in the development of a new industry (Kirzner, 1997).

The emergence of a new industry is usually a period of considerable uncertainty and confusion from both supply and demand viewpoints. According to Day (2000), for the supply side, there is little agreement about what the major applications (products/services) should be or how they should interact with one another. For the demand side, this is a period during which consumer usage patterns and behaviour are exploratory and formative.
Tushman and Anderson (1986) remark that technological discontinuities can reward those innovative firms that are first to recognize and exploit technological opportunities. Their argument is based on their belief that early movers can gain a great deal of competitive edge from their early movements and these benefits are difficult for followers to copy. Traditionally, Foster (1986) explains an ‘attacker’s advantage’ in the way in which technology evolves in an S-shaped curve and, therefore, attackers with technological discontinuities may capitalize on the opportunities when an old, existing technology reaches diminishing returns. He argues that a technological change can be identified in relation to the technological trajectory over time in terms of its ‘salient attributes’ (for example, performance) instead of in terms of its architecture; because technological performance, mapped in relation to cumulative engineering effort, follows an S-shaped path as initial exponential improvement encounters diminishing returns. As discussed before, with the existence of network externalities, the ‘first-mover advantage’ may come in such a way that firms with disruptive technologies can take the lead to build the user base and eventually drive the diffusion process to ‘herd’ around their product/service offerings. First-mover advantage fundamentally arises from three primary sources: (1) technological leadership, (2) preemption of strategically valuable assets, and (3) the creation of customer switching costs, taking into consideration technological improvements, not only in terms of their impact on components, but also on architectures (Foster, 1986; Anderson and Tushman, 1990; Christensen and Rosenbloom, 1995; Ratliff, 2002). Therefore, Foster’s (1986) attacker’s advantage may not be so salient if new technological paradigms, such as employing innovative architectures, are considered.

Traditional technology and innovation management literature suggests that two factors, technological capabilities and organizational dynamics, play an important role in shaping the competitive landscape of an emerging industry. Christensen and Rosenbloom (1995) expand this theory to include ‘value networks’ as another critical factor. They argue that the interlocking effect of these three factors (technological capabilities, organizational dynamics and value networks) is even more important in determining the success or failure of new entrant versus incumbent firms in an emerging industry. This is because a value network is the context within which a firm establishes a cost structure and operating processes and works with suppliers and channel partners in order to respond profitably to the common needs of a class of customers (Christensen and Rosenbloom, 1995). A key factor determining the success of an innovation is whether or not it can address the needs of the emerging market which embeds the innovation within the new value network. The new technological paradigm
(new value network) of the emerging industry often requires a different set of technological capabilities and organizational dynamics to which incumbents may find it difficult to adapt.

Similarly, Day (2000) explains first-mover advantage as being associated with an architectural technology change, lying in the attacker’s differential ability to identify and make strategic commitments to attack and develop emerging market applications. The development of an emerging industry requires far more than technological activities; it involves creating markets, and focusing on commercial opportunities which are initially small and poorly defined. The new competences intrinsically required by a new technological paradigm ask incumbents to switch to a new mode of learning and then invest time and resources in learning about the new architecture (Henderson and Clark, 1990). This task requires incumbents to re-orient their knowledge base from one that involves refinement within a stable architecture to one that involves active search for new solutions within a dynamic architectural context. Thus, an entrepreneurial start-up firm, if its innovation addresses user needs and wants in an emerging but initially insignificant niche of the market, has the potential to invade the mainstream parts of the value networks and therefore ‘attack’ incumbent firms and, subsequently, disrupt established trajectories of technological progress in established markets and render certain advantages.

Technological discontinuities have the potential to break the grip of established firms in a product class, but discontinuities are not all alike. According to Tushman and Anderson (1986), competence-enhancing discontinuities, building on existing experience, can advance incumbents’ competitive edge; competence-destroying discontinuities, requiring fundamentally new skills and technological competence, can open opportunities for new entrants. Therefore, when the evolution of technology, consumer demand and production technology cannot be influenced by first-moving firms (for example, in the competence-enhancing industry), first-moving strategy sometimes can become a disadvantage (Tushman and Andersen, 1986; Schilling, 2002). It is quite common for innovators – those firms that are first to commercialize a new technology – to grieve the fact that competitors and imitators profit more from the innovation than the first movers themselves (Teece, 1988). First movers typically undertake the substantial expenses of the R&D for their innovations, and they often have to invest in developing suppliers and distribution channels, as well as consumer education. A latecomer, or an imitator, may capitalize on the fruits of the first-mover’s R&D efforts, fine-tune the product/service offerings to clearer customer demands as the market becomes more certain, and, thus, avoid any mistakes made by the
first movers (Schilling, 2005). It can be argued that there may be cost advantages in being an efficient 'second mover' (Barney, 2002) or ‘first follower’ (Schnaars, 1994) especially in industries where returns to investing early are very uncertain.

Managing the timing of entry into an emerging market is a complex matter. The optimal timing of entry is a function of several factors, including the margin of advantage offered by the new innovation, the state of enabling technologies and complements, the state of customer expectations, the threat of competitive entry, whether the industry faces increasing returns, and a firm’s resources (Schilling, 2005).

COMPETITIVE ADVANTAGE IN THE CONTEXT OF RAPID TECHNOLOGICAL DEVELOPMENT

Technological change has been one of the most dynamic but uncertain factors driving the competitive landscape in recent decades (Bettis and Hitt, 1995; Freeman and Soete, 1997; Baumol, 2002). The breakthrough and development of new technologies does not in itself guarantee commercial success. This is especially challenging for high-tech entrepreneurial start-ups which possess promising technological breakthroughs, but are generally constrained by limited internal resources to externalize these innovations, especially in the global market. Abernathy and Utterback (1978) suggest that strategy formulation and the leadership qualities of key managers are critical success factors in relation to the evolution of innovative small high-tech firms. Similarly, Berry (1996) also points out that the presence of a diversified management team, in which technological expertise is balanced with business skills in other functional areas, is recognized as a determinant of success in start-ups which invent and possess emerging technologies. Indeed, the strategic choices of a start-up, in particular, the way it cooperates with others, has a positive impact on how far ahead the firm is in relation to its rivals. In modern economies, one of the critical challenges firms, large or small, are facing is to develop and implement the most suitable strategies to survive and thrive through the complex dynamics (for example, standards competition) that characterize technological changes.

Industrial economics recognizes the role of the external environment in the technological development process (Schumpeter, 1934; Casson, 2003; Fagerberg, 2003; Holmen, et al., 2004). For example, the presence of network externalities, customer’s herding behaviour in their choices of technological standards, the entry barriers posed by patents, and so forth,
all play a critical role in the technology selection/rejection process. However, this is not the complete explanation for a certain technology being adopted as a standard. Schilling (1998) demonstrates that a firm that has a greater understanding of the forces driving technology adoption, and that effectively manipulates them to its favour, enjoys a competitive advantage in technological development. A firm's strategic management can influence its chances of success in a standards battle.

The Porterian Value Chain

According to Porter (1998), the significance of a technology for competition comes from the way it potentially impacts an industry structure, rather than from its scientific merits or its prominence as embodied in its physical product or service. Recognizing that technological change is 'one of the principal drivers of competition', Porter (1998: p. 165) describes a five-force model – the threat of entry, rivalry, substitutes, suppliers and buyers – to identify threats to an industrial structure. Porter argues that technological change determines the rules of competition in an industry by shaping the industrial structure, as well as in creating new industries. To achieve technological leadership, therefore, is an effective strategy for a firm to attain sustainable competitive advantage.

Technological leadership can be sustained by two factors: (1) competitors cannot duplicate the technology and (2) the firm innovates its technology as fast as or even faster than its competition. A firm's ability to sustain its success on the technological front is most likely the result of constant innovations to adapt to changing circumstances. Using an activity-based theory of the firm, Porter introduced the concept of the value chain. He views strategy as a particular configuration of activities that a firm adopts compared to its competition, which is an important 'resource' differentiating the firm from competitors. Tidd et al. (2005), however, argue that Porter's analysis is static and fails to recognize that technology itself can be a source of change.

The Resource-Based View

The resource-based view treats a firm's internal resources as critical to identifying and acting upon opportunities (Penrose, 1958). The resource-based view can be used as a general model to analyse organizational strengths and weaknesses. It is based on two assumptions: (1) resource heterogeneity – firms have different resources and capabilities, and (2) resource immobility – some of these resources and capabilities are either very costly to copy or inelastic in supply, in other words, can persist over
time. The resource-based view focuses on the idiosyncratic, costly-to-copy resources controlled by a firm which, if exploited by a firm, will give the firm a competitive advantage. Resources provide advantage, according to Barney (2002), when they address four questions: (1) the question of value: Do a firm’s resources and capabilities enable the firm to respond to environmental threats or opportunities? (2) The question of rarity: Is a resource currently controlled by only a small number of competing firms? (3) the question of imitability: Do firms without a resource face a cost disadvantage in obtaining or developing it? (4) the question of organization: Are a firm’s other policies and procedures organized to support the exploitation of its valuable, rare and costly-to-imitate resources?

Apart from tangible resources, a firm’s intangible assets have been recognized as an important resource for sustaining its competitive advantage. For example, global leadership skills and a firm’s reputational capital (Ireland and Hitt, 1999; Petrick, et al., 1999; Zahra, 1999); organizational vision (Selznick, 1957; Collins and Porras, 1995; Zahra, 1999); tacit knowledge and know-how (Nonaka and Takeuchi, 1995; Nahapet and Ghoshal, 1998; Nonaka, 2000; Lubit, 2001); and innovative business models (McGrath and MacMillan, 2000; Hitt, et al., 2001) are all critical resources for a firm to achieve and maintain sustainable competitive advantage in the network economy.

The resource-based view believes that opportunities arise due to various ways of configuring the internal resources of a firm and the unique competence developed in its members over time (Garnsey, 1998). This view perhaps answers only part of the question of opportunities. Recent literature takes into consideration both the internal and external resources of firm, as well as interactions between them, as critical resources for a firm’s competitive advantage (Alvarez and Busenitz, 2001). This is to say that opportunities are formed not only from internal resources controlled by a firm, but also by the total stock of resources that can be mobilized in order to realize them (Teece, 1986). Alvarez and Busenitz (2001) believe the interplay between resources and environmental factors provides a different route to opportunities.

**Dynamic Capabilities**

As sustainable competitive advantage is a moving target, the resource-based view can help managers choose strategies only as long as the rules of the game in an industry remain relatively stable. The dynamic capabilities framework provides a tool for analysing the sources and methods of wealth creation in environments of rapid technological change and building upon a
The Development of Emerging Technologies

firm's resource base (Teece and Pisano, 1994; Teece et al., 1997; Deeds et al., 2000; Luo, 2000). It is argued that a firm's dynamic capabilities rest on its distinctive ways of coordinating and combining resources (processes) and specific asset positions (such as the firms' portfolio of difficult-to-trade knowledge assets and complementary assets), as well as the evolution path(s) it has adopted or inherited (Teece et al., 1997). Teece et al. (1997) also argue that a firm's dynamic capabilities are largely related to finding knowledge external to the firm and integrating it with internal knowledge.

Globalization has created bountiful opportunities but also posed significant challenges for firms operating in conditions of rapid technological change. This is because the changing technological landscape in a global arena challenges traditional rules of competition. Companies around the globe, therefore, are searching for innovative ways that allow them to capitalize on opportunities in the globalization of technological development; in such a dynamic and competitive environment, dynamic capabilities are required by managers to develop sustained global competitiveness (employees and external sources) (Zahra, 1999). Luo (2000) proposes three essential ingredients of dynamic capabilities that are necessary conditions for sustained success in today's world economy, characterized as it is by increasing technological advancement and business globalization. According to Luo, a firm's capability possession (meaning its distinctive resources), capability deployment (meaning its resource allocation) and capability upgrading (meaning dynamic learning) have all become increasingly fundamental to the firm's international expansion and global operations in a context of rapid technological development. Developing dynamic capabilities is critical for a firm to gain sustainable competitive advantages in environments with rapid technological change.

Organizational Learning

A firm's core capabilities are those that differentiate it strategically. It is a firm's knowledge set around its core capabilities that sharpens its competitive edge (Leonard-Barton, 1992). In the context of rapid technological development, it is not just a firm's core capabilities, but the speed with which it can acquire new capabilities (learning) which is more critical for the firm to expand its knowledge set and skill base, as well as to maintain its competitive advantage (Schilling, 1998). In other words, if a firm fails to invest in learning, it is likely to be slower in acquiring the necessary capabilities than its competitors, and thus less able to respond to technological changes and emerging opportunities (Cohen and Levinthal, 1990). Investment in learning can help firms avoid falling into the trap of becoming overly reliant on an aging knowledge base, or failing to
recognize the impending obsolescence of their technologies (Schilling, 2002).

The ability of a firm to recognize the value of new, external information, to assimilate it, and to apply it to commercial uses is the function of the firm's absorptive capacity, which, in turn, is critical to its innovative capabilities (Cohen and Levinthal, 1990). Absorptive capacity refers to the phenomenon whereby individuals, as they learn, increase their future ability to assimilate knowledge. A firm's absorptive capacity is path dependent, meaning that what a firm hopes to do technologically in the future is dependent on what it has been capable of doing in the past (ibid.). A firm's ability to recognize, assimilate and exploit knowledge, internally and externally, is, therefore, largely a function of the level of prior-related knowledge. This concept refers not only to technical skills, but also managerial skills. With accelerating technological change, shorter product life cycles, globalized markets, and more knowledge-based products and services, firms have recognized that knowledge is the most strategic resource, and learning the most important process, in organizational development (Dodgson, 1993a). Organizational learning is much more than the sum of individual learning (Cohen and Levinthal, 1990). Therefore, learning is profoundly a collaborative, socially interactive process in which 'associational economics' best captures the central idea with respect to economic evolution (Cooke and Morgan, 2000).

Collaboration

The logic for collaboration lies in the belief that a firm's competitive advantage comes from its intangible assets (that is, its intellectual capital and knowledge sets) which are exchanged, shared and synthesized via relationships across communities of firms, especially in the context of rapid technological development (Hamel, et al., 1989; Teece, 1998). As a result, this requires firms to search for inter-firm collaborative arrangements to forge vertical and horizontal links with organizations across a diverse range of industries and specializations (Dodgson, 1993b).

Collaborative networks are of proven importance in high-tech sectors. In the high-tech sector of an economy, the most significant source of innovation does not come from individual organizations or people, but from the collaborative networks that leverage resources and capabilities across multiple organizations or individuals (Chesbrough, 2003). Collaboration is often facilitated by geographical proximity, which can lead to regional technology clusters (Saxenian, 1994; Cooke and Morgan, 2000). Cooke and Morgan (2000) have shown that the ability of a region to cope with the increasing challenges of fast technological change depends
on the extent of collaboration between its firms, and the ability of regional
governments to support such collaboration (or ‘association’).

Collaboration can be seen as a form of horizontal integration where
companies operating in similar or related activities establish joint
agreements for technology and information exchange (Lawton Smith, et
al., 1991). An important effect of collaboration is to increase the firm’s
inter-dependency. As discussed before, new entrants often possess
interruptive technologies which have the potential to cause industry
structural changes. In modern high-tech sectors, such technological
breakthroughs often come from small firms (Dodgson, 1993a; Stuart, 2000;
Schilling, 2005). However, high-tech entrepreneurial start-ups are often
constrained by their internal and external conditions to compete with
incumbents, especially globally (Dodgson and Rothwell, 1991; Garnsey,
1998). These constraints – ‘thresholds’ of development (Dodgson, 2000a) –
requires small firms to form inter-firm collaborations for externalizing their
innovation. The essence of the collaboration between large and small firms
in innovation is that a symbiotic relationship exists in which technology is
developed that could not have been created independently because of
resource constraints. The need for such collaboration is especially
imperative as the pace of technological change increases and the product
life cycle is shortened. While large firms prefer to choose such forms of
collaboration as sub-contracting, strategic alliances, trade associations, and
so on, small firms may achieve more effective collaboration through
personal trust and cooperation within professional networks (Lawton Smith
et al., 1991). Given the inherently complex nature of long-term
collaboration between large organizations and small start-ups, and given
their different resource and behavioural advantages, the critical question to
be addressed is whether collaboration with incumbent firms is an effective
method for high-tech entrepreneurial start-ups to achieve viable growth in
the long run.

**Business Model**

The concept of a business model is widely applied in the context of
entrepreneurial start-up firms; it has substantial value in understanding how
companies can convert technological potential into economic value
(Chesbrough, 2003). In the boom days of IPOs (initial public offerings) for
dot.com firms on Wall Street, ‘business model’ became a buzz term for
most venture capitalists. ‘Stories’ that explain how new ventures work are
believed to be the essence of business models (Magretta, 2002).

According to Chesbrough (2003: p. 64), a business model is the
‘architecture of the revenue’ for the firm. Indeed, the business model is a
useful framework to link a firm’s technical decisions to its economic outcomes. In a broader sense, a good business model remains essential to every successful organization, whether it is a new venture or an established player (Magretta, 2002). Magretta argues that a robust business model contains precisely delineated characters, plausible motivations, and a plot that turns on an insight about value. A good business model should be able to answer certain questions: Who is the customer? How do we make money? What underlying economic logic explains how to deliver value to customers at an appropriate cost? This implies that the importance of the business model has extended far beyond the traditional boundaries of technical management to encompass marketing, sales, customer support, finance, collaboration, and even learning.

SUMMARY

A particular technology has better chance to be awarded a technical standard if it is institutionalized and selected by certain social conventions (Anderson and Tushman, 1990; Besen and Farrell, 1994; Utterback, 1994; Schilling, 2005). Because of network externalities, this often leads to positive feedback and increasing returns working in favour of the firm which possesses the standard technology. At a social level, customers subscribe to a ‘network’, not because of their individual assessment of the quality and usefulness of the network, but because of ‘herding’ pressures caused by the number of customers that have already adopted the ‘network’ (Schelling, 1978; Bikhchandani et al., 1992; Shiller, 1995; Choi et al., 2000). Focal points, as socially reinforced reliable signals (Spence, 1973), drive one network to acquire momentum over others, accelerating a certain herding pattern around these focal points. The way information is communicated in a society plays a significant role in the development of such focal points, as information facilitates how social conventions are formed out of uncertainty and randomness in the socio-economic system (Welch, 1992; Singhal, 1994; Bikhchandani et al., 1996; Geroski, 2000). In the network economy, we argue, the standardization and standards-setting process of interactive technologies has been strongly influenced by social conventions that are customary and self-reinforcing. In this process, the institutional setting (including government regulatory bodies, cultures, business systems and so on) plays a critical role.

Most high-technology industries, such as computer hardware and software, telecommunications, and even the entertainment industry, are becoming interactive or network-based systems, characterized by three
distinctive features: (1) high up-front costs, (2) network effects and (3) customer lock-in effects (Katz and Shapiro, 1994; Shapiro and Varian, 1998). These features determine that interactive or network-based industries are part of a network economy, where the economic behaviours and business competition are driven by disequilibrium (competitive rationality) and increasing returns (Dickson, 1992; Arthur, 1996). Therefore, in the context of the network economy, a high level of adaptability to the new rules of economic behaviour and business competition is essential for the diffusion of interactive technologies.

In conclusion, managing the development of an emerging technology is an exceedingly complex matter. The optimal outcome of such endeavour is a function of multiple factors, including the margin of advantage offered by the new innovation, the state of enabling technologies and complements, the state of customer expectations, the threat of competitive forces (new entrants or incumbents), whether the industry faces increasing returns, and a firm’s resources (internal and external). As demonstrated in the foregoing arguments, not only these factors, but also the interplay among them, play an important role in shaping the emergence and development of a new industry which embodies the emerging technology in question.

Our intention is to address the research questions outlined in Chapter 1: What roles do entrepreneurial start-ups play in the emergence and diffusion of a new technology in the networked economy? What are the main strategic choices that enable entrepreneurial start-ups to contribute to the emergence and diffusion of a new technology? What major factors constrain the innovation strategies of entrepreneurial start-ups? The extensive literature on innovation and diffusion studies uncovers the complex relationships between the many factors (technical, technological, organizational, institutional and social) that provide the answers to these questions. In synthesis these factors will be considered at three levels:

At the technology level, the characteristics of an entrepreneurial start-up firm’s innovation (in this book, the focal innovation is mobile payment technologies), the composition of the value chain of the industry which embodies the core innovation, as well as the possible impact of this innovation on the existing industry structure and strategic choices of key stakeholders in the industry, are investigated.

At the firm level, the entrepreneurial start-up’s internal and external resources, its core competencies, business models, as well as its strategic choices such as undertaking a strategic re-orientation and collaboration with industry incumbents, are examined.

At the institutional level, the government regulatory policies, national innovation systems, national business systems, social and cultural influences on entrepreneurial activities are discussed.
NOTES

1. The labels ‘Schumpeter Mark I’ and ‘Schumpeter Mark II’ were originally introduced by Nelson and Winter (1982) in their work *An Evolutionary Theory of Economic Change*.

2. A standard-developing organization set up to expedite the development of open, globally-accepted technical specifications for the third generation of mobile communications, for example, UMTS (universal mobile telecommunications system) as the accepted 3G standard in European countries.

3. Later, Liebowitz and Margolis (1995) interpreted VHS’s success over Betamax video recorders as being due to VHS’s own merits such as longer recording/playing time, which was cited as one of the critical features attracting consumers at that time.

4. Rogers’ first edition of the ‘*Diffusion of Innovation*’ was published in 1962.

5. ISDN (integrated services digital network) can provide end-to-end digital connection and support multiple telecommunication services including voice and non-voice.
4. High-Tech Entrepreneurship

INTRODUCTION

While the global network economy has brought numerous opportunities for high-tech entrepreneurial start-ups, it also poses severe challenges for such firms. Statistics suggest that a large proportion of high-tech start-ups die young, either being taken over by a larger enterprise or simply dissolving in the marketplace (Cooper, et al., 1988; Cosh and Hughes, 1998). Using the entrepreneurship literature, this chapter tries to answer these questions: Why is it that some high-tech entrepreneurial start-ups (such as eBay, Yahoo! and Google, among others) become ‘winners’ in the game of developing technology and setting technology/industry standards and drive the formation and development of emerging industries? And what differentiates these highly successful innovators from those that have only short lives?

High-tech entrepreneurial start-ups are one of the driving forces for the emergence and formation of many new industries, such as Internet based e-business. However, there is no clear-cut definition of a high-tech entrepreneurial start-up, or new technology-based firm (Bollinger et al., 1983; Autio, 1997; Fontes and Coombs, 2001). It is widely agreed that this type of firm has several common characteristics. According to Bollinger, Hope and Utterback (1983), these attributes include: (1) a clearly identifiable core of people, ranging from one to four or five, who are the founders of the organization; (2) independence, that is to say the organization is not a subsidiary of a large firm; and (3) innovation, meaning the primary motivation for founding such an organization is to exploit a technically innovative idea.

It has long been recognized that some entrepreneurial start-ups offer truly innovative products and services that require a new and different configuration of resources (Schumpeter, 1934), while others merely imitate or reproduce existing products or services with limited improvement (Kirzner, 1973). In Chapter 3, the distinction between different types of innovations was elaborated upon in detail. Some new ventures launch products or services that destroy, disrupt, or make obsolete established
competencies, while others refine and enhance them (Christensen, 1997). According to this distinction, new high-tech ventures can be placed along a continuum from imitators to initiators (Cheah, 1990). Based on the level of novelty of the innovation a new venture offers, the venture needs to adopt different market entry strategies. Schilling (2005) suggests if a new venture offers highly novel products and services that have the potential to disrupt the existing industry, an attacker's strategy which can ferment a revolution and lead to a new industry is suitable. Examples of this kind of venture include classic American technology ventures such as Yahoo!, eBay or Netscape. On the other hand, if the venture’s new products or services are merely based on improvement in the existing offerings, a more moderate strategy, which aims to refine the offerings in an effort to deliver cheaper, higher-quality products or services, is recommended. Dell Computer offers a good example in this category (Carr, 2003).

High-tech start-ups, being entrepreneurial, independent and innovative, are considered technological ‘challengers’ to established firms and industries if they offer disruptive innovations (Schilling, 1998; Chesbrough, 2003). Given that most of these sorts of firms do not develop viability and substance in the long term, their direct contribution to economic growth has not been well recognized (Miller and Garnsey, 2000). Traditionally, high-tech entrepreneurial start-ups have been considered more as ‘agents’ of technology transfer than as direct motors of growth (Fontes and Coombs, 2001). Many reasons can be given to explain why the contribution of high-tech start-ups has been undervalued; one of them is that traditional variables (such as return on investment, employment opportunities or tax generated), which are devised to measure the contribution of large firms, are often used to measure the contribution of high-tech entrepreneurial start-ups in the process of technological development and industrial structural change. Entrepreneurial firms, constrained by a lack of internal resources – known variously as liability of newness (Singh et al., 1986) or liability of adolescence (Fichman and Levinthal, 1991), and liability of smallness (Baum, 1996) – obviously cannot deliver what these research variables measure. On the other hand, a high-tech start-up’s long-term viability and sustainability can only be achieved when its innovative ideas are diffused and commercialized. However, the activity of commercialization requires large expenditure prior to the emergence of any revenue (Schumpeter, 1928; Rosenberg, 1972). This is especially relevant in high-tech industries where not only are upfront R&D costs high, but also continuous product development and marketing, especially in the international market, is expensive (Jones, 1999; Gans and Stern, 2003; Hsu, 2004; Crick and Spence, 2005).
The undervaluation of high-tech entrepreneurial start-ups’ contribution to economic growth has a long history. Baumol (2002), for example, believes that most of the utility in technological products comes from more routine innovation that takes place after the product has entered the marketplace. In other words, he believes the largest contribution to economic welfare is due not to major breakthroughs but, rather, to routine improvements in existing products and processes. Baumol’s view (2002) emphasizes the importance of systematized R&D activities carried out within large corporations and fails to recognize the contribution of independent inventors/innovators (often entrepreneurs) to a technological development process.

Baumol (2002) does admit, however, in many cases, that small entrepreneur-led firms are active in innovation in new and promising areas, and therefore play a very important role, and often a dominant one, in the early phase of a technological development. In contrast, an alternate view that operating in the new paradigm of open innovation (Chesbrough, 2003), and provided a high-tech venture can achieve the necessary resources through outside financial capital investment and collaborative networks, and implement strategic re-orientation and appropriate international strategies, such firms have the potential to play a defining role in the diffusion of an innovation by launching it in the marketplace first, making it available for adoption, managing the growth of the firm around it, and even creating a new industry based on this innovation.

This chapter, after reviewing and evaluating the literature on entrepreneurship, especially that relating to high-tech start-ups, identifies key elements that influence their strategic choices, as well as discussing how these elements work together, in order to assess under what conditions high-tech entrepreneurship can contribute to aggregate industrial innovation.

WHAT CONSTITUTES ENTREPRENEURSHIP RESEARCH?

The dotcom boom and bust at the end of the last century served to remind us of one enduring truth about entrepreneurship: it is a risky business. Nevertheless, entrepreneurship is associated with the spirit of pursuing opportunities by trying something new. The popular business media attributes entrepreneurship with three characteristics: the creativity to invent things, the passion for a vision and the grit to make it happen (Financial Times, August 11, 2000). This view, on the one hand, reinforces
a common belief that entrepreneurship is one of the driving forces for rapid technological breakthroughs and the emergence of new industries; on the other hand, it reminds us that the more novel a venture is, the harder it is to predict how things will turn out.

Nevertheless, Schumpeterian entrepreneurship is closely related to the emergence, diffusion and development of technological innovations and emerging industries (Schumpeter, 1934; 1942). Yet the mainstream entrepreneurship literature has long been debating one fundamental question: what constitutes entrepreneurship research? In fact, a lack of consensus on a definition of entrepreneurship and the absence of a strong theoretical unification of entrepreneurship have contributed to the fragmented nature of the research in this field (Low and Macmillan, 1988; Gartner, 1990; Stevenson and Jarillo, 1990; Thompson, 1999; McDougall and Oviatt, 2000; Shane and Venkataraman, 2000; Zahra and Dess, 2001). Traditionally, there are at least two basic understandings of entrepreneurship shared by scholars across different disciplines, namely: (1) the recognition of the individual as an important or even vital element in the creation of new value in an entrepreneurial event (Carland, et al., 1984; Busenitz and Barney, 1997; Baron, 2000; Francis and Sandberg, 2000; Littunen, 2000; Kreiser, et al., 2002; Shook, et al., 2003); and (2) the belief that the resources in the environment play an important role in increasing entrepreneurial activities in a society (Stevenson and Jarillo, 1990; Douglas and Shepherd, 1999; Robinson, 1999; Busenitz, et al., 2000; Chrisman, et al., 2002; Davidsson and Honig, 2003; Brockner, et al., 2004).

Recent research has started to shift the focus towards the interactions between individual entrepreneurs, their entrepreneurial processes and the environment in which they operate. As Bruyat and Julien (2000: p. 165) state, ‘...entrepreneurship, as the dialogue between individual and new value creation, within an ongoing process and within an environment, has specific characteristics’. The process of value-generating entrepreneurial activities is constrained by resources available in a certain environment. This definition avoids the potential difficulties caused by definitions which emphasize entrepreneurs’ attributes of risk taking, pro-activeness, innovativeness (Cauthorn, 1989; Covin, et al., 2000) or their propensity to pursue opportunities without taking account of the resources of the environment (Stevenson and Jarillo, 1990).

In the network economy in which the increasing returns mechanism reigns, scholars emphasize the interactions between traditional entrepreneurship research and other management disciplines, such as international business, innovation and technology management and strategic management. Therefore, new research streams have emerged such
as international entrepreneurship (McDougall, 1989; Hordes et al., 1995; Oviatt and McDougall, 1995; McDougall and Oviatt, 2000; Zahra, et al., 2000; Yeung, 2002a), strategic entrepreneurship (Shan, 1990; Stevenson and Jarillo, 1990; Hitt et al., 2001), and technological (high-tech) entrepreneurship (Roberts, 1991; Christensen and Rosenbloom, 1995; Berry, 1996; Phan, 2004). These emerging research fields reflect the fact not only that other social sciences have started to include entrepreneurial activities in their research agenda, but also that entrepreneurship scholars have started to consider different aspects in their traditional studies (McDougall, et al., 1994; McDougall and Oviatt, 2000).

Strategic management theories and concepts have, for example, substantial relevance within the field of entrepreneurship (Alvarez and Busenitz, 2001). Among many strategic management theories, as analysed in Chapter 3, dynamic capabilities, defined as the ability to reconfigure a firm’s resource base (Teece et al., 1997), is closely related to the successful growth of entrepreneurial firms into consolidation and expansion phases. At the start-up phase of a new venture, entrepreneurial capabilities (which can be seen as the ability to identify a new opportunity and develop the resource base needed to pursue the opportunity) play a more important role (Arthurs and Busenitz, 2006). Different capabilities, or more precisely, different strategies, are required for different phases of an entrepreneurial start-up’s growth. Essentially this is because, at various stages, entrepreneurial start-ups need to have different logics and mind-sets to pursue different business objectives. For instance, at the early start-up stage, due to the very nature of entrepreneurial activities that derive innovative ideas from non-routine decision-making mechanisms (Schumpeter, 1934), a heuristic-based logic is often a more effective source of competitive advantage for entrepreneurial firms which start their businesses in a highly ambiguous and uncertain environment (Alvarez and Busenitz, 2001). For such a firm to successfully transit from a start-up phase to a sustained growth phase, however, requires the firm to adopt more systematic decision-making and to develop dynamic capabilities.

ENTREPRENEURSHIP IN AN INSTITUTIONAL CONTEXT

Entrepreneurial behaviour does not occur in isolation; rather, it takes place in its contextual environment, and environmental factors, in turn, often shape entrepreneurial activities (Bird, 1989; Lee and Peterson, 2000). Among environmental factors, culture (for example, Lee and Peterson,
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2000; Steensma, et al., 2000; Thomas and Mueller, 2000; Lounsbury and Glynn, 2001; Hayton, et al., 2002), institutional infrastructure (for example, Busenitz et al., 2000; Ahlstrom and Bruton, 2002; Yeung, 2002a), and social networks in geographic clusters (for example, Garnsey, 1998; Baptista, 2001; Mezias and Kuperman, 2001) are recognized as playing important roles in facilitating entrepreneurial activities and outcomes.

It has been observed that the propensity toward entrepreneurship is stronger in some societies than in others (Thomas and Mueller, 2000). This observation implies a role for culture in the theory of entrepreneurship. Lee and Peterson’s (2000) ‘cultural model’ suggests that a society’s propensity to generate autonomous, risk-taking, innovative, competitively-aggressive and proactive entrepreneurs and firms – defined as ‘entrepreneurial orientation’ (Lumpkin and Dess, 1996; 2001) – is dependent on its cultural foundations and such foundations are influenced by the economic, political, legal and social profiles in the society.

Culture alone, however, does not adequately describe cross-country differences in entrepreneurial activities. A country’s institutions are one of the important social influences on entrepreneurial behaviour (Casson, 1990; Busenitz et al., 2000; Yeung, 2002a). For example, Casson (1990) suggests a positive relationship between a nation’s ‘institutional infrastructure’ – attributes such as access to research and educational institutes, access to sources of financing, availability of pools of educated labour and so forth – and entrepreneurial behaviour in that country. Specifically, Busenitz et al. (2000) identify three dimensions of a country’s ‘institutional infrastructure’ (Casson, 1990), or ‘institutional profile’ (Bruyat and Julien, 2000): a regulatory dimension (government policies), a cognitive dimension (widely-shared social knowledge), and a normative dimension (the value systems in a society). All three dimensions in a society’s institutions play significant roles in shaping that society’s entrepreneurial orientation and activities. This view supports the argument that there are different levels of entrepreneurship across nations. In a similar fashion, Yeung (2002b), based on his studies of southeast Asian countries, has demonstrated that diverse national ‘institutional structures’, which constitute ownership patterns, business formation and co-ordination, management processes, and work and employment relations, explain different levels of entrepreneurial performance among nations.

As Baptista (2001) argues, the diffusion of emerging technologies is ‘spatially variable’: the diffusion of innovations can be leveraged within a technological ecology. This suggests that successful entrepreneurship is not just the result of solitary individuals (organizations) acting in isolation. Instead, entrepreneurs or entrepreneurial organizations exist as part of a
larger community (Mezias and Kuperman, 2001). From a resource-based view, to obtain strategic resources through inter-firm networks, especially in regional clusters, is an effective means to overcome the liabilities (such as newness and smallness) confronting start-ups (Garnsey, 1998). In other words, in a specific context, various types of entrepreneurial behaviours interact and ultimately promote entrepreneurship throughout the community. There exists a strong relation between the fast growth of high-tech entrepreneurial start-ups and the existence of a pool of high-tech firms that promote innovation and the capacity for industrial regeneration (Moore and Garnsey, 1993). Major examples of such clusters include Silicon Valley in California (Saxenian, 1994), Cambridge in the UK and Grenoble in France (Druilhe and Garnsey, 2000). Although these scholars commonly recognize the important role played by entrepreneurs in such clusters, Saxenian’s (1994) work focuses on the benefits of firms clustering together, whereas Druilhe and Garnsey (2000) examine how such technology districts can be successfully created.

The implications for managers and public policy makers in managing the formation and development of emerging technologies/industries are firstly, institutional arrangements should help legitimate, regulate and standardize emerging technologies/industries; and secondly, both public resource endowments of basic scientific knowledge, financing mechanisms, and proprietary R&D, manufacturing, marketing and distribution functions by private entrepreneurial firms, are necessary to commercialize emerging technologies (Van de Ven, 1993). This is a research area in which there is interplay of social, economic and political factors which, consequently, influence entrepreneurial activities and outcomes. Therefore, the social context of entrepreneurship is not just about demographic statistics; on the contrary, it shapes entrepreneurial acts in a society.

HIGH-TECH ENTREPRENEURSHIP

In a technology-intensive environment, entrepreneurial activity often arises out of technological advances, rather than from the recognition of new opportunities (Kelly and Rice, 2001). Technological advances have produced increasing numbers of products that have new functions and therefore substitute for existing product offerings, sometimes across industries. This, as a result, has blurred the boundaries of industries or created new industries (Bettis and Hitt, 1995). Put differently, in an industry populated by high-tech entrepreneurial firms, the rapid
development of new products is believed to be one of the key success factors for an industry’s creation and development (Schoonhoven, et al., 1990). High-tech entrepreneurial ventures play a vital role in the creation of new industries.

The phenomenon of high-tech entrepreneurial start-ups operating globally has received increasing attention over the past decade across a broad range of disciplines, especially after scholars in the fields of international business and technology/innovation management started to take account of the role of entrepreneurship in their research. According to Phan and Foo (2004: p. 2), high-tech entrepreneurship research is about understanding ‘...the conditions and drivers that lead to the identification and exploitation of opportunities for value creation’. This definition does not suggest any difference from mainstream entrepreneurship. According to Phan and Foo (2004), high-tech entrepreneurship is a complicated subject because it occurs at many levels of analysis: at the individual level, the focus is on entrepreneurs, venture capitalists, and other individuals that initiate and drive technological innovation; at the organizational level, the research emphasis has been on the technological teams, strategies, structures, processes and inter-organizational alliances that impact value creation; and at the societal level, it is about the resources exchanged among different actors in the ecology of value creation, which includes social, economic and political factors such as government technology and competition policy, industry standards and the economics of geographical locations. Research into high-tech entrepreneurship, therefore, is highly interdisciplinary (Roure and Maidique, 1986; Ray and Turpin, 1990; Shan, 1990; Berry, 1996; Hansen and Bird, 1997; Crick and Jones, 1999; Baron and Hannan, 2002).

Some of the characteristics associated with high-tech entrepreneurial start-ups, or new technology-based firms, include: (1) the core technologies/products often have the attributes of network industries which rely on technical compatibility standards and can achieve almost immediate global applications (Day, 2000; Lee, 2000); (2) the social networks of the founding entrepreneurial teams and the strategic alliances the start-up firms choose to form play a vital role in facilitating their social legitimization (Hoang and Antoncic, 2003); and (3) the success of high-tech entrepreneurial start-ups is intimately linked to the availability and quality of outside financial capital (Mayer, 2002). These features determine that high-tech entrepreneurial start-ups will be better off if they pursue a collaborative approach with potential partners, especially in the international market. Hordes et al. (1995) suggest that three conditions are critical for such firms to become global players in comparison with general start-ups: (1) the ability to create an instant network of users and to utilize
it consistently in a short time frame; (2) the ability to generate new knowledge and leverage it to the point of need and apply it in the network of users; and (3) the ability to achieve coordination on a global basis to maintain a sustainable competitive advantage in the long term.

These factors imply that high-tech entrepreneurial start-ups may need to undergo a ‘strategic reorientation’ (Gersick, 1994) during the evolutionary process of their life cycle. As Berry (1996) points out, a high-tech start-up firm needs to transform itself from being ‘inward-looking’—focusing on technological possibilities—to ‘outward-looking’—emphasizing the need to identify market and social opportunities. In other words, a high-tech venture’s long-term success relies on its successful formulation and execution of strategic reorientation, which should reflect not only changes in its internal competences, but also changes in the marketplace. This is because different types of management skills are needed at different developmental stages in the course of high-tech start-ups. As Dodgson and Rothwell (1989) point out, there are several critical ‘thresholds’ in a start-up’s development, which may not represent a strict chronological sequence of the transitional phases of the venture’s development. According to Dodgson and Rothwell (1989), these developmental thresholds include: a start-up phase; a technological and scientific consolidation phase; internationalization of markets; professionalization of management; vertical integration; and product and business diversification. Dodgson and Rothwell (1989) argue that the founders of entrepreneurial high-tech start-ups, although they may possess technical skills as well as entrepreneurial ambitions and spirits, are not always best equipped to handle the more formal aspects of management tasks, such as creating financial control and reporting systems, personnel management and creating effective organizational structures, and may not be good at delegating responsibilities. Obviously, entrepreneurial capabilities (Arthurs and Busenitz, 2006), which are critical in identifying new opportunities and developing the resources necessary to match the opportunities for the start-up phase, are rarely sufficient for the longer-term success of a high-tech venture. A strategy to adjust a new venture’s resource base to accommodate rapid technological and market changes (in other words to develop dynamic capabilities) is essential for the venture’s sustainable growth (Alvarez and Busenitz, 2001; Arthurs and Busenitz, 2006). The managerial transition is often a daunting time not only for founders, but also for the firm. One of the reasons is that the entrepreneurial founders find it difficult to let go their control over their ventures (Mayer, 2002).

Given the importance of technological innovation as one of the driving forces for high-tech entrepreneurial activities, the technological environment has not been given sufficient consideration in the literature
dealing with high-tech entrepreneurship (Autio, 1997). High-tech start-ups are, more and more, competing in some emerging industries with radically new technologies that are awaiting government evaluation and sanction, for example, the adoption of 3G standards at national level (Arthurs and Busenitz, 2006). Theoretically, a successful high-tech entrepreneurial start-up can experience rapid growth if its core technologies/products are endorsed as one of the industry standards and the diffusion of their applications is facilitated by appropriate social conventions.

It is rare for any high-tech companies to operate entirely in domestic markets (Jones, 1999; Burgel and Murray, 2000). The pressure of increasingly rapid international technological developments requires high-tech start-ups to significantly adjust managerial capabilities in order for them to compete in the global market. This is because international expansion is not only an extremely complex exercise, but also one that takes up substantial amounts of time and energy from the management teams of such firms. A start-up firm’s choice of international expansion (which will be discussed in detail in the following section) is influenced by the characteristics of the industry in which the firm operates, such as its stage of development, structure, maturity, competition and so forth. For example, in emerging industries, entrepreneurial capabilities will be more useful, and therefore, entrepreneurial start-ups will have a much better chance to grasp the opportunities of ‘first-mover advantage’, and sometimes ‘winner-take-all’ benefits (Schilling, 2005). The growth of an entrepreneurial firm is highly dependent on the firm’s strategies that mobilize its resources to match the entrepreneurial opportunities (Garnsey, 1998). Thus, high adaptability in strategy formulation and execution is essential for a high-tech entrepreneurial start-up to compete in the global market.

HOW DOES ENTREPRENEURSHIP FACILITATE THE DEVELOPMENT OF EMERGING TECHNOLOGIES?

From a macro-perspective, the emergence and development of new industries is a social process, which involves not only the standardization of embedded technologies, but also the development of social conventions and social norms that facilitate technological and industrial development. Entrepreneurship studies, from a micro-perspective, analyse the interactions between entrepreneurial individuals/organizations and their environment within entrepreneurial processes. Specifically, high-tech entrepreneurship, with a focus on entrepreneurial activities in innovations
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which potentially have the capacity to change existing patterns of either consumption or production, can influence the way emerging technologies and industries are created and developed. In this section, consider the critical strategic choices, as well as their implications, confronting high-tech entrepreneurial start-ups in the circumstances of increasingly rapid technological development and competition in the global market. We will examine the moderating roles of outside financial capital investment, founder-CEO replacement, and international and collaborative strategies.

Outside Financial Investment

Financial capital, especially from the investment community, is one of the resources required for high-tech entrepreneurial firms to achieve long-term viability and sustainability. Sources of finance, maturity of assets and the capital structure of high-tech start-ups have been shown to have an important impact on the operations of the business, the risk of failure, the firm’s performance and the potential for business expansion (Cassar, 2004). In the high-tech entrepreneurial setting, venture capital firms (VCs) are perhaps the most dominant source of funding that shapes the environment within which new ventures evolve. Venture capital is not the only source of financing for high-tech start-ups. In fact, the most important sources of financing at the start-up phase of entrepreneurship are the funds of the entrepreneurs themselves and bank loans. The sources that provide the largest amount of funds at the early developmental stage are private investors (business angels). Venture capital only later plays a role (Mayer, 2002).

Business angels are considered one of the most significant sources of funding for start-up firms, especially in providing seed financing. Business angels are often wealthy individuals who provide financing to start-up firms in their early growth stage (Elitzur and Gavious, 2003). According to Elitzur and Gavious (2003: p. 710), ‘...[business] angels could be relatives of the entrepreneur, or, alternatively, individuals from the industry who were successful earlier with their own companies and are now looking to help young companies’. Business angels provide start-ups not only with financial aid but also advice on the entrepreneurs’ management practices. In return, Elitzur and Gavious argue, business angels often enjoy the fact that their ‘experiences’ are valued.

Venture capital, combined with a liquid stock market, is considered one of the critical factors that contributes to the successful development of high-tech industries in the global network economy (Chesbrough, 2003; Hsu, 2004). There is a positive relationship between a high-tech start-up’s utilization of outside financing such as venture capital and its overall
performance (Hsu, 2001). One explanation, based on ‘signalling’ theory (Spence, 1973), is that such outside financing is regarded as an important ‘signal’ about the quality of the start-up receiving the financing, which, subsequently, increases the probability of the growth of such a firm (Davila, et al., 2003). The status of the venture capital firms and the amounts of funding they provide are considered to have a particularly direct effect upon the intensity of such signals (Hsu, 2001; Gans, et al., 2002). Not only the venture capitalists’ reputations, but also their industry experiences – with important business ties – are important resources.

Private investors and venture capitalists often have complementary roles in high-tech entrepreneurship, with private investors investing mostly at the early-growth stage and venture capitalists financing the later (fast-growth) stage (Manigart and Struyf, 1997). Venture capitalists often act as institutional investors following principal-agent relations with start-up firms and closely monitor their major business decisions; however, business angels can be more actively and directly involved in the start-ups’ management activities, exerting more control (Jeng and Wells, 2000; Mayer, 2002; Davila et al., 2003). Venture capitalists are focused on exit, but business angels are much less so. IPOs (initial public offerings) are the most preferred route of exit for venture capital investors as they potentially can yield the highest returns on investment and are therefore the strongest driver for venture capital financing (Jeng and Wells, 2000). Three factors are recognized to positively influence a high-tech start-up’s timetable to an IPO: (1) the reputations of participating venture capital firms and strategic alliance partners; (2) the money a start-up raises; and (3) the size of a start-up’s network of strategic alliances (Chang, 2004). In addition, a convincing business model which a high-tech start-up presents to its potential investors is considered a catalyst for an IPO (Magretta, 2002; Chesbrough, 2003).

The injection of outside capital often creates concerns for founding entrepreneurial teams because it potentially causes changes in the start-up’s ownership and governance structure. Willingness to invite and accept outside investment may contribute to the overall higher performance of the entrepreneurial firm, but there is no clear indication as to what constitutes the optimal configuration of the governance structure and control system of such firms (Daily and Dalton, 1992; Daily, et al., 2002).

In relation to a high-tech entrepreneurial start-up’s commercialization strategy for its innovations, studies have shown a positive link between the availability of venture capital and a more ‘cooperative’ commercialization approach (Hsu, 2001; Gans et al., 2002). However, these authors argue, there is no clear and direct causal relationship between the two: a start-up may seek venture capital investment because it has a cooperative plan; or sometimes a start-up venture utilizes the extra value provided by the
network resources, information and reputation of the venture capital firms to overcome constraints when forming cooperative ties with other players.

External financing is a two-way selection process. From the viewpoint of venture capitalists, there are two fundamental criteria to consider when making an investment decision: (1) the extent to which the start-up is initially insulated from competition and (2) the degree to which there is demonstrated market acceptance of the technology (Macmillan, et al., 1987). However, these are 'ideal' conditions and hard to measure in practice. Outside financiers are concerned about funding for high-tech start-ups because of the uncertainties not only associated with the commercial prospects of innovative products/services, but also with the managerial competence of such ventures (Moore and Garnsey, 1993). Such concerns, Moore and Garnsey argue, are often caused by: (1) an information gap between the entrepreneurial ventures that are seeking finance and the potential fund providers, such as business angels, venture capitalists and investment bankers; and (2) an asymmetry of interests between the ventures and the potential fund providers. In practice, in financing decisions in relation to high-tech start-ups in the global network economy, venture capitalists and other venture financiers, instead, look for entrepreneurs who have a global vision, international business competence, and an established international network (McDougall et al., 1994).

It is not just venture capitalists which screen promising start-ups as investment recipients. Entrepreneurs select venture capitalists as much as venture capitalists select entrepreneurs. If possible, entrepreneurial start-ups choose venture capital firms with the best knowledge of their industry and the strategies appropriate for their growth (Sandberg and Hofer, 1987). Hsu's (2001) study demonstrates that high-tech entrepreneurial ventures choose to pay a higher price (in other words, to accept lower valuations for their equity) for teaming with venture capital firms which have more prestigious status, wider social networks and deeper industry knowledge. Hsu argues that association with prominent venture capital partners can facilitate a cooperative strategy for high-tech start-ups in diffusing their innovations by lowering transaction costs. This is because, in situations like this, venture capitalists have become more than strictly an institution of financial intermediation; instead, prominent venture capitalists provide more value-added assistance, not limited to their traditional roles of financial capital investors for establishing start-up governance, monitoring through corporate boards, and designing contracts to control agency problems, but also more intangible, perhaps more distinctive ones, such as deal experience in specific industries (industry experience), information network and reputation to the entrepreneurial start-ups they fund (Hsu, 2001; 2004). These studies suggest that high-tech entrepreneurial start-ups
seeking to diffuse and manage emerging technologies on a global basis should look for affiliations with more prominent venture capital partners, especially when their emerging technologies have uncertain aspects, such as being dependent on government policy.

![Stages of high-tech venture development](image)

Source: Adapted from Mayer (2002)

**Figure 4.1: High-tech entrepreneurship and financial capital**

Recently, agency theory has been used in the entrepreneurship literature to examine the relationship between entrepreneurs and venture capitalists (Cable and Shane, 1997; Rogers, 2001; Arthurs and Busenitz, 2003). Fundamentally, agency theory – developed in the 1920s from economic models of risk and decision-sharing arrangements – applied in organizational studies is very useful in dealing with the owner-manager interface, and particularly for issues of stock holders versus professional managers. In entrepreneurial settings, with the receipt of financial capital, entrepreneurial founders need to confront the reality that the governance and ownership structure of their ventures needs to be altered. Venture capitalists often choose to finance start-ups that have a strong technology potential but which sometimes are at risk of failure in the short run because of a lack of funds and management experience (Baum and Silverman, 2004). Therefore, the injection of venture capital often results in a change in such firms' governance and control structure: start-up firms often need to attract professional managers into their management to separate the responsibilities of risk taking (by owners/founders) from those of decision-making (by the professional management team) (Rogers, 2001). However, sometimes a mismatch between a venture capital firm and a start-up firm can occur which will possibly result in unnecessary structural changes and
the demise of the start-up venture. Due-diligence is not only essential for venture capitalists, but also for high-tech entrepreneurs.

As depicted in Figure 4.1, it is clear that a high-tech entrepreneurial start-up’s financing model is closely connected to the ownership and governance structure of the firm.

According to Mayer (2002), the transition from the personal funds of the entrepreneurs to private investors to venture capital financing to the stock market represents a ‘gradual broadening of the investor base’. This evolutionary progress of a high-tech start-up firm often implies a ‘strategic re-orientation’, sometimes involving the replacement of the founding CEO.

The Entrepreneurial Founding Team

The entrepreneur is the individual responsible for the process of creating new value (an innovation and/or a new organization); in other words, the individual without whom the new value would not be created (Bruyat and Julien, 2000). This implies a configuration of personality traits, psychological states, attributes, attitudes and values of an individual motivated to create new value. There are two evident, but contradictory, opinions about the role of individual entrepreneurs in entrepreneurial activities: (1) the entrepreneur’s personal characteristics, abilities, social networks, prior knowledge and experience play an important role in entrepreneurial activities (Carland et al., 1984; Busenitz and Barney, 1997; Baron, 1998; Littunen, 2000; Kisfalvi, 2002; Kreiser et al., 2002; Sternberg, 2004); and (2) the individual entrepreneur’s characteristics do not have significant impact upon entrepreneurial activities and outcomes (Gartner, 1985; Cassar, 2004).

The first view portrays a typical Schumpeterian heroic entrepreneur as an individual equipped with the ability to take risks and be innovative (Brockhaus, 1980; Cauthorn, 1989; Covin et al., 2000); special cognitive qualities such as an ‘optimistic bias’ or inflated illusion of control (Baron, 2004a; 2004b; Ward, 2004); flexibility in response to a changing environment (Hansen and Bird, 1997; Robinson, 1999; Eisenhardt and Companys, 2002); the capability to make speedy decisions under uncertainty (Eisenhardt, 1990; Baron, 2000; Littunen, 2000); the capacity to gather ‘successful intelligence’ – a combination of analytical, creative and practical intelligence (Sternberg, 2004); and the spirit to cooperate (Hoang and Antoncic, 2003; Simsek, et al., 2003). The second (contradictory) view is that individual entrepreneurs are not so different from other managers and, in fact, their individual characteristics are not significant in shaping entrepreneurial activities (Gartner, 1985; Astebro, 1998; Cassar, 2004).
Commonly, what often matters more than the role of the individual is the constitution of the entrepreneurial founding team, which is typically comprised of one to four or five core founding members (Bollinger et al., 1983). The founding team often has the power to decide the strategic directions and actions of the start-up that, in turn, can potentially translate into a competitive advantage for the firm. An entrepreneurial founding team's combined characteristics (profile), therefore, plays a profound role in shaping a start-up's strategic choices and its subsequent fate (Roure and Maidique, 1986; Gatewood, et al., 1995). For example, the personal networks of founders and founding teams become embedded in the systems and competencies of the start-up firm and result in organizational-level advantages (Hoang and Antoncic, 2003). Similarly, as Shane and Stuart (2002) argue, the social capital of founders represents an important endowment for early-stage organizations. While the debate about the entrepreneurial founding team's role is still continuing, it is generally believed that the founders of successful start-up firms have not only more extensive social capital and social networks, but also greater prior experience of working together, higher propensity to form more functional teams, and deeper experience in the functions they perform in the new venture (Roure and Maidique, 1986).

From a life cycle perspective, there are two factors that influence the likelihood of an organization's surviving its start-up years: (1) the environmental resources and competitive conditions at the time of founding and (2) the strategies that the organization uses during its early years to exploit the environmental conditions (Romanelli, 1989). An entrepreneurial founding team's combined profile often influences the pattern as to how the start-up firm identifies and pursues the strategic 'priorities' to best utilize its resources and competitive conditions (Kisfalvi, 2002). However, the strategy in relation to devoting often-scarce resources to the identified strategic priorities is often subjective, and sometimes risky, in nature. On the other hand, Romanelli (1989) believes that successful founders often have the capability of overcoming such 'hazards' by tailoring strategies to opportunities presented by the environment.

The success of a new venture requires a special combination of entrepreneurial, managerial, and technological roles within the firm. As the firm grows and changes, the way these roles are defined and fulfilled needs to be changed accordingly (Dodgson and Rothwell, 1989). At the infancy stage of a start-up firm, the founding team and its leadership plays a critical role in allocating limited capital and resources to pursue what they believe are the right opportunities presented by the environment (de Koning and Maravanyika, 2004). Once the business has reached a certain size, the founding team has to learn how to delegate managerial tasks and
decentralize their control (Casson, 1990). This requires not only a shift of mind-set among the founding members of the start-up, but also a firm-level strategic and structural reorientation (Quinn and Cameron, 1983; Thompson, 1999). Success for any business is dependent upon the ability to find a valuable strategic position, whereby the organization’s resources, competences and capabilities are deployed and managed to strengthen this position in order to sustain growth. Given that such a position is a moving target (Barney, 2002), successful entrepreneurial firms are required to have flexibility in not only creating, but also in sustaining an effective strategic position in a dynamic environment. The successful identification and execution of a strategic reorientation is often vital for an entrepreneurial start-up’s long-term viability and sustainability.

The challenge is for an entrepreneurial founding team to be aware and to acknowledge that, at a certain stage, it is necessary for the start-up firm to undertake such a strategic change (sometimes including the replacement of the founding CEO) in order to sustain its strategic position (Berry, 1996; Kreiser et al., 2002; Shook et al., 2003). Many entrepreneurial founding teams are reluctant to acknowledge the necessity of such changes. Among these changes, the most challenging one is perhaps around the replacement of the founder CEO.

A substantial body of knowledge about CEO succession has been established in recent decades, especially with the increasing importance of venture capital in the global high-tech sector. Except for a limited number of studies dealing with family businesses that lack direct applicability to non-family CEO succession, previous studies of succession have not examined the very first succession event in a start-up firm, the event of founder-CEO replacement (Wasserman, 2003). According to Wasserman, founder-CEO succession should take into consideration the higher level of attachment of the founding team to the firm they create (emotionally, the firm is their ‘baby’); the much larger equity holdings of the founding team (which give them much more control of the firm); the higher likelihood of the founding team remaining in the firm (even though it is being run by their successors); and the fact that nearly all founder-CEO succession involves outsider successors (in contrast to later-stage succession, which can involve insider successors). In the recent history of Internet start-ups there are two central events that have triggered founder-CEO succession: (1) the completion of a critical product development and (2) the raising of each round of financing from outside investors (Uebasaran, et al., 2003; de Koning and Maravanyika, 2004).

The evidence from previous research on managerial succession in general, and founder succession in particular, is inconclusive about whether succession harms or helps organizations (Haveman and Khaire, 2004). In
the light of emerging technologies where venture capital plays an important role in facilitating the diffusion and development of such technologies, a founding team, after leading a start-up firm's technological innovation, may become the firm's liability because their technology-oriented mindset and entrepreneurial management style and practices may become a constraint on the firm adopting a market-oriented philosophy and, as a consequence, may cause the firm to miss many opportunities the changing market presents, especially those in international markets.

**International Strategy**

Although high-tech start-ups often lack the resources required to reach international markets, the phenomenon of international new ventures, global start-ups and born global firms have long been observed empirically and studied theoretically (Rialp, *et al.*, 2005). International business research has started to place an emphasis on the importance of entrepreneurship as a major research topic in its discipline (Casson, 2000). At the same time, entrepreneurship scholars have started to recognize the international aspects of entrepreneurial activities (Oviatt and McDougall, 1994). The emergence of the new research field of international entrepreneurship, argue McDougall and Oviatt (2000), is the result of frequent intersections between the paths of international business and entrepreneurship studies. However, the simple combination of theories in international business and entrepreneurship, not surprisingly, does not predict entrepreneurial outcomes in an international context (Yeung, 2002a). In fact, the emergence of international entrepreneurship comes from recognition by each of the other's significance. For example, McDougall and Oviatt (2000) propose a new research agenda which considers two aspects of the story: in the first place, international entrepreneurship as an emerging research field reflects the trend towards the internationalization of entrepreneurial activities; and, in the second place, the increasing importance of an entrepreneurial mindset and action has been recognized in the global economy.

International entrepreneurship, as an emerging research field, has had its own evolutionary course. The increasingly important role played by start-up firms in the global marketplace triggered the need for academia to find a theoretical basis for this phenomenon (Oviatt and McDougall, 2005). According to Oviatt and McDougall (1994), it was the business press (for example, *Wall Street Journal*, December 5, 1989; *The Economist*, May 9, 1992; July 3, 1993) that first recognized the importance of the emerging phenomenon of international new ventures in the late 1980s and early 1990s. In 1994, Oviatt and McDougall put forward a theory of international
new ventures, which was granted the Decade Award by the *Journal of International Business Studies* (JIBS) in 2005. However, it was not until 2000 that McDougall and Oviatt (2000) started to expand their views into ‘international entrepreneurship’ by highlighting the qualities that make firms entrepreneurial. In the past ten years, the phenomenon of start-up firms undertaking aggressive internationalization strategies, as well as their significant contribution to the global economy, attracted worldwide attention, and, as a result, led to the establishment of international entrepreneurship as an independent research field (Rialp et al., 2005; Zahra, 2005).

According to Autio (2005), Oviatt and McDougall’s (1994) article amply deserved the JIBS Decade Award because of its contribution in challenging the traditional paradigm of international business in the context of entrepreneurship. Their view challenged and revisited some established theories about the internationalization process, especially stage theory which argues firm’s internationalization develops through a process of gradual acquisition, integration and use of knowledge about foreign markets and operations (Johanson and Vahlne, 1977). Based on a totally different logic, Oviatt and McDougall (1994) treat the setting up of cross-border operations as an endowment of organizational resources that an international new venture possesses. According to this logic, the actions involved in a new venture’s internationalization are the ‘engine’ through which the venture’s unique competitive advantage is developed and sustained. In other words, the actions are a major source of competitive advantage for such firms (Zahra, 2005).

An international new venture is defined as ‘...a business organization that, from inception, seeks to derive significant competitive advantage from the use of resources and the sale of outputs in multiple countries’ (Oviatt and McDougall, 1994: p. 49). According to this definition, in contrast to established multinational enterprises (MNEs), international new ventures start their businesses with an aggressive international strategy. As Zahra (2005) points out, this definition is concerned with ‘value added’ activities, not those conducted through the ‘assets owned’ (Casson, 1982). Indeed, Oviatt and McDougall (1994) explicitly claim that new ventures do not need to own their resources in order to expand their international business operations. In their words, ‘...foreign direct investment is not a requirement’ for an early internationalization (p. 49).

Studies suggest a positive relationship between the age at which a firm internationalizes and its subsequent international performance, based on organizational learning theory (Barkema and Vermeulen, 1998; Autio, et al., 2000). This is because, Autio *et al.* (2000) argue, the adoption of new knowledge involves not merely the learning of the new, but the unlearning
of the old. According to this theory, the younger a firm undergoes internationalization and gains international experience and knowledge, the more ‘learning advantage of newness’ (Oviatt and McDougall, 1994) it will enjoy, thus the better it will perform in the international arena. This is because the ventures may become path-dependent on the development of domestic competencies which will eventually become ‘domestic rigidity’ (Oviatt and McDougall, 1994) in a way that will constrain the venture’s international expansion. This point is consistent with the conclusion drawn by Brush (1992) that the younger a firm is when it goes international, the more positive is its attitude towards the international market and, therefore, the better international performance it achieves later on.

In contrast to Oviatt and McDougall’s logic that early internationalization is the source of international competitive advantage, Brush (1992) argues that start-up firms seek international expansion either motivated by survival needs, or pursuing perceived opportunities. Knowledge intensity, defined as ‘...the extent to which a firm depends on the knowledge inherent in its activities and outputs as a source of competitive advantage’ (Autio, 2000:p. 913), is one distinctive attribute which determines a high-tech entrepreneurial firm’s propensity to pursue early internationalization. On the other hand, high-tech start-ups proactively pursuing an early international strategy, either by their own choice or because they are forced to by competitive pressure, do so because the international market is considered a useful means to helping them recover significant R&D costs. Autio et al. (2000) argue that the more knowledge-intensive resources (such as a unique management style, organizational culture and business know-how, or innovative products or strategies) a high-tech venture has, the more likely it will pursue an early international strategy.

Two factors encourage knowledge-intensive new ventures to diffuse their knowledge-intensive products or services on a global scale as fast as possible. First, reproducing and distributing knowledge-intensive products such as computer software comes at nearly marginal cost (Shapiro and Varian, 1998); and, second, the economic life cycle of knowledge-intensive products has become shorter than ever before due to rapid technological innovation which urges such firms to reach as many customers (globally) as possible within the ever-shorter effective life cycle (Baron and Hannan, 2002). Because of these distinctive features, reaching a global ‘critical mass’ of users for the new technology is often crucial for a high-tech entrepreneurial start-up’s success.

In the past ten years, the majority of studies in the emerging field of international entrepreneurship build upon Oviatt and McDougall’s logic, explaining why and how international new ventures benefited from
undertaking early internationalization, sometimes, from their inception (McDougall, 1989; Rennie, 1993; Oviatt and McDougall, 1994; Madsen and Servais, 1997; Jones and Coviello, 2005; Zahra, 2005). How these types of ventures reach international markets in the first place and what the outcomes are of their early internationalization activities are, however, not well documented due to a lack of longitudinal datasets (Autio, 2005). In particular, little has been done to provide such ventures with practical marketing strategies to deal with the challenges they face in diffusing and developing their innovations in the global market (Gabrielsson and Manek Kirpalani, 2004).

Bartlett and Ghoshal (2000) argue that the emerging network economy requires companies to develop multiple strategic assets: global-scale efficiency and competitiveness; national responsiveness and flexibility; and a worldwide innovation and learning capability. These strategies, described as a transnational approach, require firms to build integrated networks of assets and resources, multidimensional management perspectives and capabilities, and flexible coordinative processes. Bartlett and Ghoshal argue that multinational enterprises have advantage in transnational approach. Indeed, as Liesch and Knight (1999) argue, internationalization cannot proceed until a small enterprise has acquired relevant knowledge through a process of information internalization and translation. This argument poses a question that is critical in understanding what Oviatt and McDougall call ‘learning advantage newness’: do the internationalizing small firms possess sufficient capability to ‘internalize and translate’ necessary information, which is considered a unique ‘international competitive advantage’ and which helps such firms to achieve international expansion? Similarly, as Zahra (2005) points out, Oviatt and McDougall’s model fails to take into consideration a firm’s absorptive capacity (Cohen and Levinthal, 1990), which is believed necessary for the firm to understand, appreciate, assimilate and exploit knowledge from its new international environments.

Oviatt and McDougall’s (1994) view implies that there must be a channel for international new ventures through which their unique intangible assets (for example, organizational culture, relationships and innovative capabilities), especially those that enhance their entrepreneurial activities in foreign markets, are developed and enhanced, although no empirical evidence has proven this. This view neglects the subtle and profound impact of some of the institutional settings of host countries, including their national cultures, languages, business systems, social conventions and geographical features, on the survival and long-term success of these new ventures (Zahra, 2005).
In any event, for start-up ventures to pursue international markets is easier than ever before, but, at the same time, also poses severe challenges to those start-ups. This is because sustainable competitive advantage requires any firm to possess not only unique resources, but also dynamic capabilities that enable the firm to adapt quickly to the changing environment (Teece et al., 1997; Barney, 2002; Zahra, 2005). It is not a trivial exercise for a start-up firm to commit its often-scarce resources to the international market, especially if there exists a high level of uncertainty about its emerging technologies. High-tech entrepreneurial start-ups need to confront the dilemma of effectively protecting their intellectual property and, at the same time, pursuing early international activities such as forming strategic alliances or networks around their technology with a variety of partners on a global scale.

Social Networks and Inter-Firm Alliances

Social networks (formal or informal) have been recognized as a critical factor shaping entrepreneurial activities in a society (Jarillo, 1989; Lee and Peterson, 2000; Hoang and Antoncic, 2003; Simsek et al., 2003). Social networks contribute to entrepreneurial activities in two ways: (1) by facilitating the exchange of resources (not only tangible resources, but also intangible ones such as information, emotional support or reputation (Jarillo, 1989) among ‘actors’ (Hoang and Antoncic, 2003) in the networks; and (2) by enabling entrepreneurs to gain ‘legitimacy’ and overcome liabilities of ‘newness’ and ‘smallness’ (Singh et al., 1986; Suchman, 1995; Henderson, 1999) by being associated with, or being endorsed by well-regarded individuals or organizations with an explicit certification (Davidsson and Honig, 2003; Hoang and Antoncic, 2003). Because of the liabilities that start-up ventures often have, start-up firms need to leverage their social relationships to mobilize their limited resources to achieve a sustainable competitive advantage (Lorenzoni and Lippardin, 1999). Social networks are a special governance form for entrepreneurial firms in which the development of trust plays a major role in facilitating resource exchange (Birley, 1985; Dubini and Aldrich, 1991; Jones et al., 1997; Elfring and Hulsink, 2003; Hoang and Antoncic, 2003).

Social networks are referred to as the entrepreneurs’ (or entrepreneurial team members’) strong and active personal relationships that exist before the foundation of the entrepreneurial ventures (Lechner, et al., 2006). According to Hoang and Antoncic (2003), three elements – the content, governance and structure of a network – constitute the social network construct. Social networks are considered especially critical for entrepreneurial firms, particularly at the founding stage (Birley, 1985;
Jarillo, 1989). For example, founders’ personal networks (based on personal trust), though unplanned, provide faster access to the resources needed to establish the venture (Lechner et al., 2006). During the start-up process, entrepreneurs seek not only the resources of equipment and money, but also advice, information and reassurance, as well as help and guidance from both formal networks (banks, accountants and lawyers) and informal ones (family, friends and business contacts) (Birley, 1985).

Social networks play different roles at different phases of a venture’s development (Greve and Salaff, 2003). Similarly, Lechner et al. (2006) argue that different types of social networks are needed at different phases of venture development. This is to say, although entrepreneurial founders’ personal networks are considered one of the most important strategic resources at the start-up stage (Dubini and Aldrich, 1991; Ardichvili, et al., 2003), over-reliance on such social networks could cause problems after the initial start-up phase. Deeds and Hill (1996) argue that, when a new venture enters into a fast growth phase beyond initial start-up, the founders’ personal networks will not be able to provide the number of beneficial relationships that are required for formal organizational and market development. In fact, with the development of new ventures, the social networks need to become more complex in order to function in more areas and be more socially embedded, moving from unplanned to planned, and finally, structured networks (Lorenzoni and Lipparini, 1999). At later stages, social networks may play an important role in helping new ventures obtain social legitimacy, which is considered critical for the firm’s survival and development (Baum and Oliver, 1991).

Gaining social legitimacy, or the process of a new venture’s institutionalization, is the path through which the firm adopts structural forms that grant the firm recognition in the eyes of important stakeholders, whether they be employees, customers, government regulators, or others (Zucker, 1986). Unless they adopt these forms and norms, an entrepreneurial start-up firm would find it difficult to operate efficiently in the society. From a transaction cost perspective, legitimacy makes market transactions cheaper and easier (Williamson, 1985; Jones and Hill, 1988; North, 1990; Hirsch and Lounsbury, 1996).

Obtaining such legitimacy remains elusive for many start-up firms, especially high-tech ones. This is because, at the early stages of high-tech entrepreneurship, it is difficult to acquire external resources, since the knowledge-based assets are intangible and sometimes uncertain (Autio et al., 2000). Rogers (2001) suggests two channels through which a high-tech entrepreneurial start-up may gain legitimacy: (1) a ‘contractual and monitoring-based’ approach, concentrating on building institutional infrastructures that help high-tech start-ups acquire external resources such
as venture capital; and (2) a ‘certification-based’ approach, suggesting that a start-up rely on the quality of its partners and affiliates as a signal for its own quality. The first channel, from a social perspective, has been discussed in Chapter 3. The second channel implies a collaborative approach: start-up firms gain legitimacy through forming alliances with established organizations, clients, government agencies and even competitors.

In research into strategic alliances, a large number of studies have focused on providing insights into how western companies might ‘win’ in strategic alliances with Asian companies, such as with Japanese or Korean firms (Hamel et al., 1989). Based on these studies (Contractor and Lorange, 1988; Hamel et al., 1989), it has been concluded that Japanese companies emerge from an alliance stronger than their western partners because they make a great effort to learn new skills. On the other hand, western companies often enter alliances with an aim to avoid investment rather than to acquiring new skills. In a situation where both partners are equally intent on learning the other’s skills, trust is an effective way to avoid conflict and therefore nurture the survival of the alliance (Dodgson, 1993b; Arino, et al., 2001). Indeed, the controlling position in a partnership cannot guarantee the success of the alliance, or improve the controlling party's competitive advantage.

Inter-firm alliances are believed to be pathways for the exchange of resources and also function as signals that convey social status and recognition for smaller partners (Stuart, 2000). The advantage which a firm derives from a portfolio of strategic coalitions, therefore, depends upon the resource profiles of its alliance partners. One important resource a strategic partner can provide is its social status or market power. This is because alliances can convey one party’s social status to the other and create recognition for the recipient party in the society. This is particularly true if alliances act as an endorsement for the start-up firm in the relationship. This kind of alliance often includes relationships (for the start-up) with prominent firms or individuals such as well-known venture capital firms or industry figures, or highly regarded clients. The endorsement can build public confidence in the value of the younger firm’s products and services and thereby facilitate the firm’s efforts to attract customers and other partners. As Stuart et al. (1999: p. 345, italics added) point out, ‘...the impact of inter-organizational relations is driven more by who a company is associated with than by the volume of its relations’.

While the significance of strategic alliances for entrepreneurial start-ups’ early survival and subsequent development has been widely acknowledged, evidence suggests that, in many circumstances, larger partners appropriate more of the economic value created in alliances with
entrepreneurial start-ups (Alvarez and Barney, 2001; Rothaermel, 2001). This, as a consequence, can put the entrepreneurial partner's performance and long-term survival at risk. A BusinessWeek (March 10, 2003b) article describes this phenomenon: 'Startups may die, but not their bright ideas'; this is to say, industry incumbents may cherry-pick straggling start-ups' technologies by means of undervalued acquisitions or copycatting. Deeds et al. (2000) explain the reason why this kind of 'accident' occurs. Due to the imbalance of learning ability and absorptive capacity between the young and the established partners, the entrepreneurial firm often discovers that the complementary assets provided by the larger partner are a poor match and that the large partner may have opportunistically exploited the entrepreneurial firm's know-how but paid little in return (Deeds et al., 2000). Among different types of alliances, 'co-opetition' networks (that is, cooperation between competitors), especially for start-up ventures at the foundation stage, can be very risky because such relationships might lead to the disclosure of the ventures' competitive information (Baum and Silverman, 2004).

As for a high-tech entrepreneurial start-up's technology strategy, technological leadership is a necessary but not sufficient condition for its commercial success (Dodgson and Rothwell, 1989). Many of today's products rely on diverse technologies (which may be different components of systems) and most companies cannot maintain cutting-edge sophistication in all of them. This is especially true if the product/service comes from architectural innovations (Henderson and Clark, 1990), the success of which requires not only innovative business models, but also the support of existing infrastructures. Constrained by limited resources, a collaborative strategy (relying on alliances and the broader social networks to obtain legitimacy) is perhaps more efficient than pure competition in the arena of technology/product development for a high-tech start-up. This collaborative strategy can best be pursued if a high-tech start-up firm enjoys the strength of intellectual property rights, effective complementary asset ownership, and affiliation with venture capitalists who can reduce the transaction costs associated with locating appropriate cooperative partners in the international market (Hsu, 2001). The assumption of this argument is that an 'ideal market' functions efficiently, and incumbents are willing to contract for innovations from start-ups and so foreclose on a potential form of competition. However, the collaborative strategy is closely linked to the overall business, especially taking into account the cultural environment, and also as part of the overall movement towards 'open innovation' (Chesbrough, 2003).

Apart from the strategic choices of (1) establishing alliances, and (2) configuring them into an efficient network that provides access to diverse
information and capabilities with minimum costs of redundancy, conflict
and complexity, there exists a third way for entrepreneurial start-ups to
enhance their early performance by building social legitimacy: judiciously
allying with potential rivals that provide more opportunity for learning and
less risk of intra-alliance rivalry (Joel, et al., 2000). This third strategy is
more important under conditions of positive feedback and increasing
returns, where standards become critical for the success of any new
technology or industry. A typical form of such an ‘ally’ strategy is the
formation of an industry or technology forum, an often unofficial ‘club’
formed by competing firms (globally) with a unified aim to promote a
specific technical standard (such as Bluetooth as a technical standard for
short-range wireless communications) (Keil, 2002).

The ability to manage alliances effectively is a firm-level dynamic
capability that enables a firm to ‘integrate, build and reconfigure internal
and external competences to address a rapidly changing environment’ in
order to create innovative forms of competitive advantage and market
positions (Teece et al., 1997: p. 516). Rothaermel and Deeds (2006) also
argue that there exists a path-dependent alliance management capability;
when a new venture possesses this capability, it has tangible benefits that
provide the basis for a firm-level competitive advantage. These authors all
support the view that the extent of a high-tech venture’s alliance experience
is positively associated with the effectiveness of its alliance strategies. The
ability to manage inter-organizational alliances is particularly important for
high-tech start-ups, because such firms need to rely on extensive inter-firm
cooperation in discovering, developing and commercializing new products,
given their limited access to necessary resources (Alvarez and Barney,
2001; Rothaermel and Deeds, 2006). Entering into inter-firm relationships
carries costs and risks, especially for entrepreneurial firms that seek
alliances with established firms. Therefore, if a high-tech start-up firm
enters too many alliances, the transaction costs rise substantially, which,
beyond a certain point, will erode the benefits alliances bring to the firm
(Jones and Hill, 1988).

The strategic decision as to whether to tango with industry incumbents
or dance alone is sometimes an issue of life and death for high-tech start-
ups. Rich resources (for example, international marketing capabilities or
the ability to deal with demanding regulations) and extra cash offered by
incumbent firms can indeed buy time for a high-tech start-up to
commercialize its emerging technologies, but can mean that the start-up
firm loses control over its technologies or even its future. This is because
entrepreneurial start-ups are more vulnerable due to a lack of both internal
efficiency and external legitimacy (Shan, 1990; Kelly and Rice, 2001).
Nonetheless, strategic alliances are a widely utilized and actively pursued
approach. Creating an alliance means sharing control, but they are critical instruments in serving customers in a global environment. Finding the right balance between tangoing together and dancing alone is, from an entrepreneurial start-up's perspective, critical for the success of managing emerging technologies.

SUMMARY

Many entrepreneurial 'intangibles', such as access to novel ideas, role models, informal forums, region-specific opportunities, safety nets, access to large markets and executive leadership, are desirable conditions for entrepreneurship, and specifically, for Schumpeterian entrepreneurship, to thrive in a locality (Berry, 1996; Brush, et al., 2001; Venkataraman, 2004). Entrepreneurial activity is not undertaken in isolation. Sound legal systems, capital markets and other structural features are necessary prerequisites for entrepreneurship (Busenitz et al., 2000; Lounsbury and Glynn, 2001; Ahlstrom and Bruton, 2002; Yeung, 2002b). In addition, government policy and regulation has a big impact on institutional structures, which, in turn, facilitate entrepreneurial activities in a society (Miller and Garnsey, 2000; Acs et al., 2001).

There are several critical strategic choices confronting high-tech entrepreneurial firms. First, an entrepreneur from such a firm needs to identify and analyse various underlying assumptions from the market perspective before conducting an expensive technical experiment in bringing her vision and innovations into the marketplace. Secondly, if her domain is the high-tech sector, she needs to think ahead about whether or not the venture takes an early internationalization approach and, if so, where to obtain the required resources. Thirdly, she needs to consider the option of collaborating with established companies, which itself can be a matter of life or death for the start-up. Fourthly, she needs to consider her preferences; whether she is willing to share control under a new governance structure in return for necessary financial capital or remain queen of her own domain. The final but not least important challenge is that the founding team, at a certain point, has to acknowledge the need for the venture to undergo a strategic re-orientation, within which she and her co-founders may need to be replaced by professional managers.

In conclusion, high-tech entrepreneurial start-ups' strategic choices of their technology strategy and diffusion trajectory, moderated by different aspects in their institutional environment, become vital for the creation and development of emerging industries on a global scale. After reviewing the
relevant literature, this chapter offers the following research issues to guide the analysis of the following case studies.

- What influences the firm’s strategic choices in using outside financial capital, such as venture capital, and how does such capital work for or against the firm’s long-term development?
- What attributes do entrepreneurial founding teams have and how do these attributes influence the firm’s strategic direction and actions?
- What factors influence the high-tech start-up firm’s international strategies?
- What factors determine the firm’s decision to form strategic alliances and how do these decisions influence the firm’s survival and long-term viability?
INTRODUCTION

Technological evolution is one of the driving forces in industrial development and industry life cycles (Tushman and Andersen, 1986; Anderson and Tushman, 1990; Utterback and Suarez, 1993; Utterback, 1994; 2003b; Dodgson et al., 2005). The evolutionary process of any emerging industry, however, is a complex, dynamic and lengthy one that involves multi-faceted interactions and interdependencies among multiple stakeholders. Therefore, technological prowess, often possessed by high-tech entrepreneurial start-ups (Dodgson, 1991; Dodgson and Rothwell, 1991; Deeds et al., 2000; Phan and Foo, 2004), is not enough to guarantee an emerging technology’s success in a market where path dependency and network effects drive the development of the industry (Farrell and Saloner, 1986; Katz and Shapiro, 1986; Arthur, 1996; Teece et al., 1997; Augsdorfer, 2005).

Mainstream technology diffusion studies try to understand adopters’ behaviour and its consequent impact on the diffusion curve (Bass, 1969; Rosenberg, 1972; 1976; Singhal, 1994; DeBresson, 1995; Moore, 1995a; Rogers, 1995; Geroski, 2000; Baptista, 2001); however, the role played by high-tech entrepreneurial start-ups in the process of technology diffusion, especially if a technology survives but the start-up that invents and introduces this technology fails, has not been sufficiently studied (Miller and Garnsey, 2000).

From a methodological viewpoint, entrepreneurship is believed to be one of the most difficult areas to study in the social sciences (Bruyat and Julien, 2000). To understand the dynamic process of entrepreneurship is particularly challenging because it involves multiple modes of activity that occur simultaneously and interdependently over time (Low and Macmillan, 1988). The volatile nature of high-tech start-ups makes it even more difficult to study the research problem due to the fact that such studies are greatly dependent on not only the entrepreneur’s capacity to lead the
entrepreneurial processes and activities, as well as to develop the strategic
directions and institutional networks, but also the speed with which the
environment takes up the technology and innovation of the start-up
companies (Bruyat and Julien, 2000; de la Torre and Moxon, 2001).

To understand how high-tech entrepreneurial start-ups strive to manage
the diffusion of their innovations and why their role is often underestimated
in the complex processes of technology development and diffusion, a
holistic case inquiry approach is developed because of its ability to deal
with processural matters and a multiple stakeholder environment (Stake,
2003). In addition, with its own unique history, every case is a complex
entity operating within its own context – physical, economic, ethical and so
on. Therefore, the research is designed to obtain data in a real-life context,
focusing on understanding the interactions of and relationships among
multiple stakeholders involved in each case, as it is believed that ‘...social
interaction is fundamental to organization related processes’ (House, et al.,

This chapter describes the process-oriented case inquiry methodology
which is used to investigate the development process of mobile payment
technologies, and how high-tech entrepreneurial start-ups have played a
critical role in this process in Korea and China. This research design has
been directed at providing a mechanism for connecting theories and
empirical findings into a meaningful whole that can conceptualize the
complex relations between the units at different levels of analysis in real
life organizational settings.

The research design, data collection instruments and procedures, and
data analysis methods are presented in detail in this chapter. The
justifications for the methodology, including discussions about validity,
reliability, objectivity and generaliability, are also outlined, as well as the
limitations of the methodology and ethical considerations.

RESEARCH STRATEGY: A PROCESS-ORIENTED CASE
INQUIRY

An exploratory case study strategy – the research design for studying
phenomenon that are new and poorly understood (Eisenhardt, 1989; Miles
and Huberman, 1994; Lichtenstein, et al., 2006) – was used for this
research. Two kinds of research approaches can be used in case studies: a
variable-oriented approach, dealing essentially with the relations among
well-defined concepts; and a process-oriented approach, following the
events in a specific context over time (Miles and Huberman, 1994). A
process-oriented case inquiry is used to answer the questions outlined previously.

Covering a diverse range of disciplines, entrepreneurship studies, despite their considerable contributions, have failed to consider the complex process, especially interactions and interdependence across different levels of analysis, of start-ups in the development of technological changes (Hoang and Antoncic, 2003; Coviello and Jones, 2004). Just as dynamic processes are central to a rich understanding of entrepreneurship (Bygrave, 1993), research methods that can capture and analyse the dynamic processes by which high-tech entrepreneurial firms strive to find a commercial market for their innovation and how their efforts have an impact on the trajectory of the technological development of that innovation are important, especially if these firms fail to go beyond the initial stage of the technological development.

A process-oriented case inquiry was chosen because process research is concerned with understanding how things evolve over time and why they evolve in this way. Normally, data obtained from process-oriented research consists largely of stories about what happened and who did what when: that is, events, activities and decisions ordered in time series (Langley, 1999). A process-oriented approach has the ability to unfold the evolution of relationships between multiple stakeholders involved in the case and the patterns of cognitions and emotions of these individuals as they interpret and react to the events, activities and decisions which occurred in the case (Peterson, 1998). Gartner’s (1985) conceptual framework describing the phenomenon of new venture creation uses a multidimensional model, comprising four levels of analysis: individual(s), organization, environment and process. It is clear that process cannot be isolated from the actors (entrepreneurs), their context, and the organizational outcomes in entrepreneurship research. As Van de Ven (1992: p. 216, italics added) argues: ‘...the entrepreneur needs a process theory to explain innovation development’. A process-oriented approach, as argued by Steyaert (1997: p. 17), should transcend the distinction between micro (for example, entrepreneurial) and macro (for example, environmental) models of entrepreneurship and become a ‘meso-approach’ where interactions are described in their socio-cultural context.

The process-oriented case inquiry is a qualitative research method that can unfold many substantive issues in entrepreneurship involving identifying and understanding the processes of the development of entrepreneurial firms and the behaviour of entrepreneurs (Gartner and Birley, 2002). For this reason, a qualitative approach is believed to be the best way of undertaking this research as it is a strategy for ‘discovery,
exploring a new area’ of which the processes and patterns are little known (Miles and Huberman, 1994: p. 10).

The qualitative case study approach has been increasingly used in management and international business research (Dunning, 2000), as it is concerned with the meaning rather than the measurement of organizational phenomena (Daft, 1983). Qualitative case research is about the observation of operations in the real context of the case subject over a certain period of time, which is especially preferred when investigators have little or no control over the phenomenon being studied and when the boundaries between phenomena and context are not clear (Yin, 1984). Thus, conducting such research requires accurate description and a subjective, yet disciplined, interpretation of the case. Because case studies allow a researcher to retain the holistic and meaningful characteristics of real-life events, Yin (1984: p. 14) argues that, ‘...as a research endeavour, the case study contributes uniquely to our knowledge of individual, organizational, social, and political phenomena’. Therefore, case studies have the ability to generate data of ‘richness and holism’, which have strong potential for revealing complexity – ‘thick descriptions’ – that are embedded in a real-life context and could have a significant impact in real life (Miles and Huberman, 1994: p. 10).

The most elementary unit of analysis in any social system where behaviours and actions can be analysed is the individual. An individual’s behaviour does not take place in isolation, nor does it occur randomly. Actions are constrained by their surrounding context; thus the actions of any individual are influenced by a multitude of situational and contextual elements (Morgeson and Hofmann, 1999). Drawing on the analytical lenses from the frameworks outlined in Chapters 3 and 4, at least four levels of analysis need to be investigated: the individual entrepreneur(s), the entrepreneurial firms, the industrial settings and the societal/institutional infrastructure. These elements which comprise the units of analysis, however, can exist independently or can form interdependent ‘collaborations’, thus creating a higher level(s) of analysis (Dansereau et al., 1999). In the latter instance, the interactions between the units of analysis have to be taken into account. Therefore, the process in each case study is treated as a holistic unit of analysis, which allows an examination of changes in the levels of analysis’ over time (Dansereau, 1999; Langley, 1999).

Depicted in Figure 5.1, at the operational level, a double-loop research strategy was developed for this study aimed at closing the gap between empirical findings (data) and theory by starting at both ends. This strategy adopts a combination of inductive and deductive approaches, because, as
argued by Langley (1999), rigid adherence to purely deductive or purely inductive approaches will limit the flexibility of conducting research.

Figure 5.1: Research strategy – a double-loop approach

Thus, the case studies have conceptual structures that are anchored in analytical frameworks in relevant literature (Stake, 2003). At the same time, in the process of constructing the case studies, the findings over time provide another channel by which to identify complex, situated, problematic relationships. This two-pronged approach is what might be described as a ‘double loop’. The convergence of the propositions developed from the analytical frameworks and the constructs from the empirical findings of the case analysis enables the formation of a set of abstracted theoretical constructs. In the course of the fieldwork, the research started with guidance from the research issues developed from the relevant literature, and field notes were taken to record what happened in the field. The field notes were reviewed frequently and analytical notes were written to record any tentative conclusions arising from the fieldwork. These tentative conclusions were fed back to the development of propositions which, again, were used in guiding further field research.
The difference between this double-loop approach and the bottom-up one, on the one hand, or top-down one, on the other, lies in the way that the data is collected. The conventional field research of bottom-up strategy, for example, is a loosely-structured, emergent, inductively-grounded approach to gathering data (Miles and Huberman, 1994). However, the double-loop strategy used in this project relies on both conceptual frameworks established in relevant fields, as well as abstract patterns which emerge from the fieldwork, to define any emerging theoretical constructs.

Case study research can be based either on a single case or on multiple cases. Multiple cases add confidence to findings and strengthen the precision, validity, and stability of the findings relative to a single case (Miles and Huberman, 1994). Here, two country-based case studies are conducted for the purpose of investigating the research problem: the contribution of high-tech entrepreneurial firms in the development of mobile technologies in Korea and China. The two case studies are constructed in an eclectic way with a focus on events, drawing in phenomena such as changing relationships and interactions between, as well as cognitions and feelings of, the stakeholders involved. The objective of these case studies is to investigate the dynamic process of each case in the presence of multilayered and changing contexts, multidirectional causalities, and feedback loops that often disturb a steady progression toward equilibrium (Langley, 1999). The two case studies were not chosen with the objective of direct comparison, as, for example, would have been provided by two very similar firms in different places. Instead, each case is conducted in such a way as to concentrate on understanding its own complexities and dynamics. This approach can be described, according to Stake (2003), as a ‘collective case study’.

DATA COLLECTION INSTRUMENTS AND PROCEDURES

Collecting data in a process-oriented case inquiry is difficult (Langley, 1999). Among other things, as Porter (1998: pp. xviii-xix) points out, conducting in-depth case studies requires ‘extraordinary disclosure’ on the part of the participating companies. Therefore, a well-designed research protocol (an action plan) which specifies the most suitable research instruments and procedures at different stages of the research, and the professional administration of such a protocol, is essential for the success of a process-oriented case inquiry. The research protocol for this study is shown in Table 5.1.
Table 5.1: Research protocol

Central research questions: What *roles* do entrepreneurial start-ups play in the emergence and diffusion of a new technology in the networked economy? What are the main *strategic choices* that enable entrepreneurial start-ups to contribute to the emergence and diffusion of a new technology? What major *factors* constrain the innovation strategies of entrepreneurial start-ups?

<table>
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<td>Decision-making style</td>
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<td>CEO-founder</td>
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<td>High-tech start-up firms</td>
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<td>Open innovation</td>
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<td>Processes</td>
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<td>Activities</td>
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<td>Visual mapping</td>
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<td>Decisions</td>
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Selecting the case is often cited as the first and most important step when undertaking case study research (Yin, 1984; Eisenhardt, 1989; Hamel, *et al.*, 1993; Hartley, 1994). Choice of these cases was made on conceptual, not on representative, grounds (Miles and Huberman, 1994); they were chosen because they represented opportunities to study the
research problem of interest. They do not, however, represent a random selection. Therefore, the cases used in this study are a 'purposive sample', building in variety and acknowledging opportunities for intensive research (Miles and Huberman, 1994; Stake, 2003).

In the Korean case, a longitudinal study of a high-tech start-up that invented and first introduced a mobile proximity payment service into the market was carried out by Marina Zhang between 2002 and 2004. During that period, the investigator maintained email correspondence with at least two key informants almost on a weekly basis which helped her establish a dynamic picture of the process of changes. In the Chinese case which is about the development of the mobile payment industry and involves two sub cases, the majority of the primary materials were derived from the investigator’s research and experience in China’s mobile telecommunications industry between 1996 and 2005, including a dedicated fieldtrip to China in 2004. In both cases, 'multiple sources of data', such as internal and external documents, personal interviews and observations were used in the investigation (Yin, 1984).

Both Korean and Chinese cultures are relationship-based and many interactions in the society are based upon mutual trust. Establishing a trusting relationship with the key informants of the subject companies, therefore, was a key consideration in the research protocol. As Lincoln and Guba (1986: p. 105) argue in relation to qualitative research, interactions between the investigator and the informants cannot be eliminated from the research equation, commenting that: ‘...meaningful human research is impossible without the full understanding and cooperation of the respondents’. Unless respondents willingly cooperate with an investigator in uncovering ‘truth’ about themselves and the organizations they belong to, it is very unlikely that the investigator will come to a full understanding of the situation. In undertaking the research for this book, the investigator spent a substantial amount of time building relationships with the informants at different levels. As a result, many critical items of information emerged from informal conversations at meal/drink time.

Process-oriented case studies demand a human instrument: an investigator fully adaptive to the indeterminate situation (Lincoln and Guba, 1986). The investigator needed to utilize her tacit knowledge and adopt methods that were considered the most appropriate to conducting this particular research.

**Interviews**

An interview is a conversation with a purpose. According to Lincoln and Guba (1986), the purposes for conducting an interview include obtaining
here-and-now constructions of persons, events, activities, organizations, feelings, motivations, claims, concerns and other entities; reconstructions of such entities as experienced in the past; projections of such entities as they are expected to be experienced in the future; verification, emendation and extension of information obtained from other sources; and verification, emendation and extension of constructions developed by the investigator. Therefore, the personal interview is an effective research instrument to help the investigator gain an impression of the various perspectives and how they are interconnected, as well as some insight into the interrelations between the interpretation of meanings of events and events themselves (Steyaert, 1997).

Semi-structured interviews were used in both of the cases in this study. In each case, a considerable number of senior managers were interviewed in different locations and at different times. Their positions and identities are described in detail in the respective cases in Chapters 6 and 7. The specific research issues developed from relevant analytical frameworks were used to guide the conversation flow in the interviews, but open-ended questions were used to encourage the interviewees to present their viewpoints without any constraint. Each interview normally took at least two to three hours and, on several occasions, the formal and/or informal conversations with key informants lasted as long as two to three days. This often involved multiple interviews: for example, interviews with the same person in different locations and at different times, and, in some cases, the interview was conducted with two people at the same time. The multiple interviews offered the benefit of triangulation.

Almost all interviews were tape-recorded. Because of the mutual trust developed between the investigator and the interviewees, tape recording did not appear to constrain the free expressions of opinions of the interviewees, as some authors have claimed is possible (for example, Lincoln and Guba, 1986). Tape-recorded interviews formed an important data source, which assured completeness and provided the investigator with the opportunity to review the interview materials as often as necessary in order to derive a comprehensive understanding.

Immediately following the interviews, transcripts and research notes were made for subsequent analysis. Since much of the information obtained from this project was very sensitive, all of the tape records and written notes were stored in a secure place.

**Documents and Records**

Internal company documents and records can be a reliable source of information and were used extensively in this study. Some authoritative
documents and records are especially important in providing detailed information about situations that occurred at some time in the past. These types of documents can be analysed and re-analysed without any ambiguity. For example, the *Industry Standard Documentation – Business Specifications of Mobile Payment Services* document from the China Mobile Communications Corporation (CMCC) provides an official blueprint for the technological development of China's mobile payment industry; and the *Meeting Minutes for the Mobile Payment Standardization* (August 30, 2002) from the Korean Ministry of Information and Communications records the meeting participants' positions on the establishment of a standard for the technological development of mobile payments in Korea. In the Korean case, access was provided by a senior manager to his comprehensive collection of email correspondence (from September 2002 to January 2004), which allowed the investigator to sort out major events and decisions by using appropriate headings related to the chronology of the process. In the Chinese case, access to China Research Corporation’s database provided a full developmental picture of China’s telecommunications industry. Thousands of pages of material were accessed from China Research Corporation’s electronic database.

**Observations**

The investigator’s observations came directly from her interactions with the interviewees, as well as her on-site visits to multiple sites of the subject companies. For example, the observations of nonverbal cues such as ‘significant pauses, raised voices, or emotional outbursts’ (Lincoln and Guba, 1986) during the interactions between the investigator and the interviewees were an important source of information.

For the purposes of this research, meetings were conducted with a range of informants in Seoul, Beijing, San Francisco, San Jose, Sydney and Canberra. The on-site visits to the subject companies’ premises in different locations provided an opportunity to obtain in-depth, first-hand knowledge of the companies operating in their own context.

Field journals are an important tool during data collection. The field journal records the information accumulated from interview transcripts and research notes, recording the investigator’s observations and interpretations of the situation. In this case, it also provided the basis for the reconstruction of the situation after the recorded material had been de-briefed with key informants.
DATA ANALYSIS METHODS

Data collected from process-oriented case studies in real organizational contexts have several characteristics that make them difficult to analyse and manipulate. According to Langley (1999: pp. 691-692), these characteristics are: (1) they deal mainly with sequences of events; (2) they often involve multiple levels and units of analysis whose boundaries are ambiguous; (3) their temporal embeddedness often varies in precision, duration and relevance; and (4) despite the primary focus on events, these data tend to be eclectic, drawing in the dynamic processes of interactions.

In contrast to the traditional positivist research paradigm, process-oriented case studies cannot easily establish causal relationships. Instead, the process built upon the chronological order of a set of events, activities and decisions provides an important means to gaining a full understanding of why and how the organization develops from stage to stage (Langley, 1999). The dynamism of an organization's development is sensitive to the interactions between the events, activities and decisions, as well as these entities themselves (McKelvey, 2004). In fact, the situation is so frequently 'messy', several scholars have argued that chaos theory or complexity theory may offer the potential for a better understanding of organizational processes (for example, Parker and Stacey, 1994; Foster, 2003; McKelvey, 2004). Chaos theory is concerned with the connections, instead of the elements, in a system which is characterized by non-linear feedback loops. Such a chaotic or complex system operates far from equilibrium so that they inherently have dynamic processes (Foster, 2003). Non-linear systems do not have simple additive properties: they exhibit synergy in the sense that they are more than the sum of their components (Parker and Stacey, 1994). Chaos theory argues that any changes in a system (the occurrence of any event) can be magnified and, therefore, the outcome is often unpredictable. Chaos theory emphasizes discontinuous change and self-organization, creative destructive and renewal, and inherently unpredictable outcomes; as McKelvey (2004) puts it, the creativity of entrepreneurial innovation is the means through which market economies adjust and adapt.

Each of the case studies represents a complex system operating in its own dynamic environment, with multidirectional causalities, and feedback loops. Therefore, a holistic or processual approach through which the sequences of events can be established seems more realistic in explaining different development stages of a complex organization than the variance approach which tries to establish a causal relationship between different stages (see Figure 5.2).
Knowing that the relationship between \( X \) and \( Y \) is often moderated by a complex process that cannot be observed directly, a process-oriented approach is, therefore, essential to investigate and explain the underlying dynamics of changes which occurred between \( X \) and \( Y \). This is because while ‘variance theory’ (Mohr, 1982) has the ability to provide the causal links between the input factors (independent variables) and variations in outcomes (dependent variables), it is ‘process theory’ (Mohr, 1982) that explains the dynamics – the ‘black box’ (Rosenberg, 1982) – in the process between inputs and outputs (Van de Ven and Huber, 1990). Thus, this study uses the process as a whole – as the unit of analysis – and attempts to construct the sequences and links between events which can help explain the developmental process of the organizations being researched. The complexity of the data from process-oriented case studies is a reflection of the complexity of the organizational phenomena. The analysis of data
required a means of conceptualizing events and of detecting sequences among them. Langley (1999) calls this method ‘sense-making’. Specifically, ‘narrative strategy’, ‘visual mapping strategy’ and ‘pattern matching strategy’ were all used in the analysis of data for this book.

Narrative strategy is a commonly-used data analysis method in sense-making in process-oriented research. This strategy involves the construction of a detailed story from raw data. Actual quotes are used wherever possible to present the liveliness, originality and accuracy of the remarks. Narrative strategy can be a particularly valuable source of insight about processes (Pentland, 1999). In other words, processes that draw on narrative data are particularly close to the phenomena under study. A visual mapping strategy allows the simultaneous representation of a large number of dimensions, and is designed to easily and clearly show precedence, parallel processes, and the passage of time (Langley, 1999). The map is often a summary of what took place in the case, showing the links between the events. A pattern-matching strategy compares empirically-based findings with one or several alternative predictions developed from the relevant literature; if the patterns coincide, the results can help to strengthen the case study’s internal validity (Yin, 1984). The objective of the data analysis is to find the ‘fit’ between detailed qualitative details and abstract constructs (patterns) from the relevant literature. Two considerations make this task challenging. First, because of the complex nature of this type of investigation, the construction of the case studies needs to be elaborate. Second, the requirement for trustworthiness in qualitative research necessitates detailed quotations and other evidence for the patterns found in the data, together with the sources of the quotations. The challenge lies in uncovering patterns synthesized from the data without losing sight of the richness and detailed sources on which they are based.

In the data analysis task (shown in case analysis chapters), sequential structure, focal actor or actors, narrative voice, evaluative context and other indicators of context were paid close attention to, because these considerations are very useful in helping investigators uncover the constructs that cannot be observed directly; as Pentland (1999: pp. 719-720) calls them the ‘deep structure’. Therefore, the deep structure in which the processes involving events, activities, decisions and actors are embedded is the centre of analysis.

In order to retain the ‘thick description’ (Miles and Huberman, 1994) in the case construction, instead of using a computer-aided text analysis program, such as NVivo, a Microsoft Access database was created to sort, classify and store the data records obtained from the case inquiry, under various headings, by key event, key date and key actor. Every database entry was hyperlinked to the relevant interview transcripts, research notes
or documents and records, instead of coded materials. This database allowed the investigator to establish the various constructs of the case stories, sequences and links of events, as well as patterns of behaviour, without reducing the raw data to numbers.

VALIDITY, RELIABILITY, OBJECTIVITY AND GENERALIZABILITY

Presenting analyses of qualitative data can be challenging, especially when wordy data must be expressed clearly and logically without overlooking the details that provide internal strength of qualitative data. In order to enhance the internal strength of such data, the matter of how and to what extent issues of validity, reliability, objectivity and generalizability are anchored is very important in such entrepreneurship case study research.

Validity, Reliability and Objectivity

Case study research is sometimes criticized for a lack of validity and reliability (Hartley, 1994). However, such criticism may miss an important point, namely, that the conventional criteria for evaluating the ‘trustworthiness’ of a study, such as internal validity, external validity, reliability and objectivity, are designed for positivistic/quantitative research (Lincoln and Guba, 1986). According to Lincoln and Guba, in order to test a study’s trustworthiness against these criteria, the following questions need to be answered:

- Internal validity (true value): How can one establish confidence in the ‘truth’ of the findings of an inquiry for the respondents with which and the context in which the inquiry was carried out?
- External validity (applicability): How can one determine the degree to which the findings of an inquiry may have applicability in other contexts or with other respondents?
- Reliability (consistency): How can one determine whether the findings of an inquiry would be consistently repeated if the inquiry were replicated with the same (or similar) respondents in the same (or similar) context?
- Objectivity (neutrality): How can one establish the degree to which the findings of an inquiry stem from the characteristics of the respondents and the context and not from the biases, motivations, interests, and perspectives of the inquiry?
With the increasing use of qualitative research approaches in social sciences, especially in studies attempting to unfold processual issues in complex systems, many scholars have given new explanations to those criteria (Guba, 1981; Kirk and Miller, 1986; Lincoln and Guba, 1986; Miles and Huberman, 1994; Chandler and Lyon, 2001). For example, validity is considered the establishment of evidence that the operational measurement is, in fact, measuring the theoretical construct (Chandler and Lyon, 2001). Chandler and Lyon (2001) refer to four types of validity in qualitative research (especially in entrepreneurship studies): content validity, substantive validity, external validity, and structural validity. Yin (1984) uses construct validity, internal validity and external validity to assess case studies. Though Chandler and Lyon and Yin use different terms, they are measuring similar constructs: content or construct validity means the establishment of correct operational measures for the concepts being studied; substantive or internal validity means the establishment of a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships; and external validity means the establishment of the domain to which a study's findings can be generalized. The difference is that Yin (1984) uses 'reliability' to measure the capacity of demonstrating that the operations of a study (such as the data collection procedures) can be repeated with the same results; but, Chandler and Lyon (2001) use 'structural validity' to measure the processes of data collection which should be able to be replicated or repeated. Similarly, in justifying the value of using case studies in the naturalistic (interpretist) paradigm, Guba (1981, quoted in Lincoln and Guba, 1986) proposes four new criteria by which to evaluate the trustworthiness of a study: 'credibility' (in place of internal validity), 'transferability' (in place of external validity), 'dependability' (in place of reliability) and 'confirmability' (in place of objectivity).

Objectivity is an ambiguous concept. The 'heuristic assumption' – common in the natural sciences (that everything in the universe, in principle, can be explained in terms of causality) – often misses the point in the social sciences (Miles and Huberman, 1994: p. 10). What social scientists try to explain is the consequence of inner existential choices made by people (Lincoln and Guba, 1986; Miles and Huberman, 1994; Langley, 1999; Stake, 2003).

No matter what definitions are used, validity essentially measures the degree to which the findings of a study are interpreted in a correct way and reliability depends on 'explicitly described observational procedures' (Kirk and Miller, 1986: p. 41). The objectivity of a case study is evaluated on the reliability and validity of its investigators (Miles and Huberman, 1994). In other words, objectivity is the simultaneous realization of reliability and
validity. Therefore, both reliability and validity are critical when evaluating the objectivity of any qualitative research.

In general, in order to achieve validity, reliability and objectivity in case studies, several tactics are recommended, such as: using multiple sources of evidence (essentially taking multiple measures of the same phenomenon); establishing a chain of evidence in the process of data collection; and having key informants review the draft case report (Stake, 2003; Yin, 1984). Essentially, these tactics imply the use of 'triangulation' in case study research.

Triangulation has generally been considered a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation (Stake, 2003). However, no observations or interpretations are perfectly repeatable. Therefore, in a case study, triangulation serves also to clarify meaning by identifying different ways in which the phenomenon is being seen (Yin, 1984; Kirk and Miller, 1986; Stake, 2003). The aim of triangulation is to pick up sources that have different biases and/or different strengths, so they can complement each other (Miles and Huberman, 1994).

Triangulation was effectively used in this research by the comparison of data relating to the same phenomenon but derived from different phases of the fieldwork or at different points in the setting (such as different participants or different locations). No single item of information (unless coming from an unimpeachable source, such as official documents) was given serious consideration unless it could be triangulated.

Generalization and Theory Building

Case study research has also been criticized for a lack of substantiality in theory generalization, because of its individual-focused nature (Yin, 1984; Stake, 2003). If the rationalistic generalization, defined as '...assertions of enduring value that are context-free' (Lincoln and Guba, 1986: p. 110, original italics), is used, this criticism is perhaps true. If a theory is defined as an explanation in a story that describes the process, or sequence of events, that connects cause and effects, from the 'theory as narrative' view (Dimaggio, 1995; Pentland, 1999), the contribution of case studies to theory building is quite obvious. In his justifications for the contributions of case studies to theory building, Stake (1978) introduced the concept of 'naturalistic generalization', which is more intuitive, empirical, and based on personal direct and vicarious experience. He agrees that case studies may not contribute much if rationalistic generalizations are desired; however, he argues, case studies are a powerful means for building naturalistic generalizations. Similarly, Yin (1984: p. 39) uses 'replication
logic’ to explain the effectiveness of case studies in generalizing a particular set of theories. Yin argues that case studies, as with experiments, rely on replication logic, where the investigator is striving to generalize a particular set of findings to broad theoretical propositions rather than to a wide population or universe. He refers to this process as ‘analytical generalization’ (Yin, 1984).

As demonstrated by Eisenhardt (1989), a strength of theory building from case studies is the likelihood of generating novel theory. This is fundamentally an exploratory study, although anchored in the research issues established in relevant analytical frameworks. This is a different approach from the one used by Eisenhardt (1989) in theory building by case studies, which uses an inductive strategy to explore the case, and then pieces together the findings into a novel and testable theory. Her strategy is based on a grounded theory approach (Glaser and Strauss, 1967). Eisenhardt (1989) also argues that theory-building research needs to use between four and ten cases. This argument is itself quite controversial. Some scholars believe that comparisons across organizational contexts of multiple cases ignores the important exceptions of a single case that could be a useful unit of analysis for theory building (Dyer and Wilkins, 1991); the classic case study approach tends to focus on comparisons within the same organizational context with the objective of obtaining a deep understanding of a particular social setting and the benefits of comparative insights (Stake, 2003; Yin, 1984; Lincoln and Guba, 1986). As Vaughan (1992: p. 175) states, ‘...because more than one theoretical notion may be guiding an analysis, confirmation, fuller specification, and contradiction all may result from one case study’. Dyer and Wilkins (1991) also argued that ‘better stories’ are more important in theory building research than ‘better constructs’, as advocated by Eisenhardt (1989). Later, Eisenhardt (1991), however, countered that better stories and better constructs are not mutually exclusive; if journal page limitations were less strict, both should be included. As Pentland (1999: p. 711, original italics) argues, in the domain of process theory ‘stories are constructs’. Therefore, in a process-oriented case inquiry, both stories and constructs are needed. This is what this study of high-tech entrepreneurship aims to achieve: using the double-loop approach, to build in-depth stories, as well as abstract constructs.

According to Whetten (Whetten, 1989), a good theory is one that can both explain and predict, as theoretical insights come from demonstrating how the addition of a new variable (for example, a new case) significantly alters our understanding of the phenomena by reorganizing our causal maps. Detailed knowledge of a case and especially the knowledge about the processes underlying the behaviours and the context of the case can help to specify the conditions under which certain events can be expected
to occur (Hartley, 1994). Nevertheless, as Pentland (1999) points out, to say that stories are constructs is not just a play on words. Instead, abstract conceptual models should be used in stories that explain the observed data.

Though single or a few cases are a poor representation of a population of cases and provide questionable grounds for advancing grand generalizations, they are of value for verifying theory and suggesting complexities for further investigation, as well as helping to establish the limits of generalizability (Stake, 2003). The double-loop approach used here retains the rich descriptions that have the ability to unveil the dynamics of a complex system and act as clear examples of new relationships, new orientations, or new phenomena that current theory and theoretical perspectives have not captured and, at the same time, uses established analytical frameworks as guidance in the implementation of the inquiry.

MERITS OF THE METHODOLOGY

First, the case inquiry uses a process-oriented approach. This is because: (1) the research problem and research issues being investigated are concerned with the process as well as the outcome of the contributions made by high-tech entrepreneurial start-ups in the technological development of mobile payments (which, as discussed before, is under-researched); and (2) the context of mobile payment technologies falls in an emerging area of research. In-depth, story-telling case studies are believed to be the most suitable research strategy to provide a rich understanding of the social interactions (events), to describe the context in which events occur, and to reveal the deep structure on which social networks are built; therefore, theories built from such deep insights into selected cases can be both more accurate and more appropriately tentative due to the fact that the intricacies and qualifications of a particular context are taken into consideration (Lincoln and Guba, 1986; Dyer and Wilkins, 1991; Stake, 2003).

Second, again to emphasize the importance of context, the inquiry was carried out in the natural setting and context of the entities studied. This is because those realities are wholes that cannot be understood in isolation from their contexts, nor can they be fragmented for separate study of the parts (the whole being more than the sum of the parts) (Lincoln and Guba, 1986). Context is crucial in determining whether or not the findings from a study may have meaning in some other context; as Miles and Huberman (1994) point out, it is critical to take into account the influences of the local
context of ‘real life’ events in case study research. Therefore, the research interactions took place with the ‘entity-in-context’ for fullest understanding (Lincoln and Guba, 1986).

Third, the selection of cases in this study was ‘purposive’, rather than ‘random’. This is because this sampling is actually theory-driven; whether the theory is pre-specified or emerges as the cases unfold or both. In this sense, choices of informants, episodes and interactions are driven by conceptual research issues, not by a concern for representativeness; as Miles and Huberman (1994: p. 29) point out, with this kind of research design, ‘...the primary concern is with the conditions under which the construct or theory operates, not with the generalization of the findings to other settings’. In addition, the two cases are embedded in their own unique national contexts, which differ considerably in factors such as industrial policies, national innovation systems, national business systems and national cultures. All these factors can be expected to have an impact on the emergence and development of high-tech activities. For example, in the Chinese case, the government plays a ‘bureaucratic entrepreneurial’ role in the moulding of technological developments by ‘granting’ legitimacy to the technological system that is often owned, but not necessarily developed, by strategically important state-owned organizations, such as China Mobile Communications Corporation (Gore, 1998). According to Gore, this kind of institutional choice of strategically important organizations is not based on wealth maximization and transaction-cost minimization but, rather, is motivated by political and social objectives. In the Korean case, one of the most conspicuous characteristics of the industrialization of Korea is the government’s strong role. In the 1960s and 1970s, the Korean government intentionally created and encouraged large firms, chaebol, to marshal the economies of scale inherent in mature technologies, which had been dominated by early industrialized nations (Amsden, 1989; Kim, 1997). The chaebols’ rapid growth and diversification has had an enormous effect on the industrial structure and market concentration in Korea. According to Kim (1997), the dominant role played by large firms has impaired the healthy growth of entrepreneurial firms which, as a consequence, has left Korea with a weak SME (small and medium-sized enterprise) sector.

There are distinctive advantages in possessing cultural sensitivities in conducting research in this field, as well as specific knowledge about each of the countries researched. As a senior manager with experience in a range of Chinese companies, one author brought considerable contextual knowledge to the research through her understanding of business practices and mores. This also assisted in conducting the Korean research. Knowledge of the Korean business context was complemented by the other
LIMITATIONS OF THE METHODOLOGY

First, given that the inquiry was undertaken around the research issues established by selected analytical frameworks, it is possible that ‘foreshadowed’ positions have been created, concentrating on issue-related observations, and interpreting the patterns of data in ways that transformed these issues into assertions (Stake, 2003). However, the research design used is a double-loop approach: the inquiry was undertaken from both ends. While anchored around pre-developed research issues, the inquiry also took an eclectic approach, using data from the bottom up, thus taking into consideration the contexts and processes of the cases.

Second, both cases are longitudinal studies. During the long course of the research, the danger of becoming too involved with the organizations under study, the people and the processes and, thereby, losing objectivity, was always a risk. To offset this danger, a detailed research journal was kept which recorded the events in their original setting and often triangulated them at the time they occurred. It is believed that this is an important tool in helping to maintain objectivity in the data analysis.

Third, in case writing, no matter which way a case study is presented, the ideas are usually ‘structured, highlighted, subordinated, connected, embedded in contexts, embedded with illustration, laced with favor and doubt’ (Stake, 2003, original italics). This, as a consequence, will pass some, but not other, meanings of the cases to its readers. This problem is often manifested by the readers in a process of adding and subtracting, inventing and shaping, described by Stake (2003: p. 146) as ‘reconstructing’, the contents of the case reports. To reduce the likelihood of misinterpretation in both writing and reading of the cases, apart from using standard research instruments and following consistent procedures, triangulation was used whenever possible.

ETHICAL CONSIDERATIONS

In the case study sections (Chapters 6 and 7) of this book, intensive use of quotes carrying candid personal views and the circumstances surrounding these views could possibly cause exposure and embarrassment, as well as other costs, for the participants in the research, if the materials of the study
were not handled properly. Given these dangers, several ethical considerations have been taken into account.

First, all individuals who voluntarily participated in this research project were provided with an Information Sheet (as required by the Human Research Ethics Committee of the Australian National University) which outlined various matters related to the confidentiality and security of the information obtained in this project and the appropriate use of the outcomes of this research project. All data collection activities for the purposes of this study were based on mutual agreement and were voluntary, as well as satisfying requirements for the ethical conduct of research under the jurisdiction of the ANU.

Second, access to the subject organizations under study was made through personal introductions. Oral consents from the participants for this project were obtained. In the relationship-based cultures of China and Korea, it was not appropriate to seek a written form of consent. To do so would not only have been to cast doubts on the credibility and character of the person providing the introductions, but also would have suggested to the participants that their word was not being taken as their bond. For example, this matter was raised with a senior executive (and one of the key informants) of the Korean company under study in email correspondence on May 20, 2003, saying specifically, ‘...as I mentioned, the case study and research are for academic purposes only. I will sign a confidentiality and research ethics agreement with the university to ensure that all materials regarding Avaro and mobile payment solutions will not be used for any commercial reasons’. He responded on May 21, 2003, saying, ‘...as for any “Agreements”, after some thought, most (if not all) sensitive proprietary information are of technical engineering nature, and even I don’t understand them at times. In considering the focus of your study, I don’t think there is any need for an Agreement between you and Avaro...’.

Despite this assurance, given the sensitive nature of some of the findings, the company’s name, identities of the major management players, and its products are disguised.

NOTES

1. Unit of analysis refers to how data is aggregated and subsequently analysed, while level of analysis refers to the scope of the phenomena being studied.
2. Tracking of Avaro InfoTech, Inc., the subject of the Korean case study, started in September 2002. It ended in May 2004 when the key informants left the company.
3. Almost all of the emails were in English, since several of the senior managers of the company were Americans who did not speak Korean.

4. China Research Corporation (http://www.china-research.com) is a leading market research and consulting firm dedicated to China's telecommunications industry. China Research Corporation (CRC) started to track the development of the Chinese mobile communications industry, including its subscriber base, investments, as well as network capacities, in 1995. After the acquisition of Beijing Pinnacle Consulting in 2001, CRC renamed itself CRC-Pinnacle Consulting Co. Ltd. (http://www.crc-pinnacle.com). The president of CRC-Pinnacle, Mr Bill Wang, is also the Chair of China's Telecommunications Association. Marina Zhang was General Manager of CRC between 1996 and 1997, and has been an associate of the company since 2001.

5. Most of the material was in Chinese.

6. NVivo is a commercial software package used to analyse qualitative research data records including text, images or sound. The key methods used in this program involve examining text and recording the understanding in annotations or memos, coding and reviewing coded material by topic, rigorously searching for patterns, building theories or explanations and grounding them in the data, displaying models and producing convincing reports.
6. The Development of Mobile Payment Technologies in Korea

INTRODUCTION

Korea is at the cutting edge of mobile information technologies and has attracted attention from all over the world for its highly developed network convergence between mobile telecommunications technologies and the Internet. Korea’s success represents an excellent example of its vast broadband applications and achievement in innovation, building a converged network from a very low technological base in mobile telecommunications only a decade ago.

Korea hardly had any advanced mobile telecommunications technologies before CDMA was introduced and commercialized in Korea in 1996. The government policies which encouraged a countrywide embrace of the CDMA technology have contributed to the evolution of mobile networks. According to the ITU case study of Korea’s mobile information society (ITU, 2004c), the second-generation (2G) networks\(^1\) were first upgraded to 3G,\(^2\) firstly to CDMA2000 1x\(^3\) in October 2000 and then to CDMA2000 1x EV-DO\(^4\) in January 2002 and EV-DV\(^5\) in December 2004. In addition, in December 2003, Korea launched WCDMA mobile services in densely-populated areas in Seoul. To Koreans, their mobile handsets often represent their digital connections to friends, family and the whole world. In response to the country’s economic development, the mobile telecommunications industry has emerged as one of the two key export sectors\(^6\) in Korea, with exports reaching US$30 billion\(^7\) in 2004 (ICA, 2004).

Korea leads the world in innovation and development of vast broadband applications as well as mobile commerce (ITU, 2004a). Mobile payment, one of the fundamental applications that facilitates mobile commerce over the converged network between mobile telecommunications and the Internet, emerged early in Korea. Small-amount settlement services (micropayments) via mobile phone handsets became available in Korea in early 2000. This service enabled customers to use a bank account bundled
with the mobile phone (that is, a ‘mobile wallet’), instead of inputting bank account or credit card information every time when paying for digital content or goods purchased. In 2002 this service was expanded to allow customers to certify, remit and transfer funds between users and merchants, as well as among users. The real breakthrough in mobile commerce and mobile payment occurred when point-of-sale (POS) proximity payment solutions were introduced into Korea’s market. The POS proximity mobile payment allows users to record their credit card information onto a mobile phone memory chip or IC chip and this information can then be transmitted to credit authorization terminals (CATs) via infrared communication channels without direct contact.

Based on infrared technology, South Korea’s high technology entrepreneurial venture, Avaro InfoTech Inc., independently developed its proximity mobile payment solution, known as MAYZ Universal Mobile Payment Service (UMPS), and successfully commercialized this technology first in Seoul and subsequently countrywide in April 2002. The founder of Avaro InfoTech, Mr Kyung-yang Kim, was widely credited with launching mobile proximity payments in Korea (Korea Herald, October 14, 2003). This technology pushed the promise of ubiquitous mobile commerce a step closer to reality.

Avaro teamed with LG TeleCom (LGT) to launch MAYZ in Korea. While Avaro’s solution can support mobile payments with smart cards (an approach which has been tried by other mobile players) in its first commercial showcase, Avaro and LGT used the technology of storing consumers’ credit information in their handset memory chip. The handsets allow customers to make payments, for example, for bus or subway fares, and to have the payment billed to their credit accounts. The transaction process is similar to that transmitted with a normal credit card sale using a magnetic strip. The difference is that the UMPS allows a consumer, instead of having a card swiped (sometimes waiting in a long queue), to enter a PIN and press the pay button on his or her mobile phone to effectively ‘beam’ the account information to settle the transaction, using the IrFM (Infrared Financial Messaging) protocol defined by US-based IrDA (Infrared Data Association). In other words, a consumer’s mobile phone set has become a new instrument for credit/debit card transactions.

Behind the scenes, a consumer’s card number and other transaction data are sent in encrypted format through an infrared beam to the module connected to a POS terminal or a vending machine. The customer’s payment information is securely encrypted in the mobile device and can only be activated by a matching PIN. This security is double-reinforced by the fact that the handset itself often requires the input of an ID password. This process has been approved by the Korean government and its financial
institutions as a secure transaction. Essentially, Avaro offers its customers a digital ‘card’ that can be issued, disabled and reissued wirelessly. It is completely safe even if the phone is lost or stolen and the issuer can remotely disable the customer’s card in real-time.

Two months after Avaro and LGT launched its MAYZ solutions countrywide, Korea Telecom FreeTel (KTF), the second largest mobile operator in Korea, launched its own mobile payment system – K-merce⁹ – licensing Avaro’s core technology. Later, the leading Korean mobile operator – SK Telecom (SKT) – responded to the mobile payment opportunity actively by offering its Moneta mobile payment system in the Korean market.

SK Telecom’s Moneta system is a technology where subscribers can insert a smart chip that stores credit card information into the slot of their handsets and pay for purchases. Similar to the MAYZ system, the Moneta system allows users to send their credit card information over infrared to an acceptance device known as a ‘dongle’¹⁰ to settle any payment. The difference is that the Moneta system, instead of relying on storing a user’s credit information on the memory chip of the handset, stores the information on an IC chip which can be inserted into a special slot on the phone handset. The drawback of the Moneta system is that one IC chip can store the information of only one type of credit card, while Avaro’s MAYZ system allows one chip to store information for multiple credit cards. The Moneta’s one-chip-to-one-credit-card mechanism restrains the use of multiple credit cards, unless users own multiple IC chips for multiple credit cards and insert a different chip into the handset slot each time a particular credit card is needed. MAYZ users, on the other hand, can select different credit cards stored on a single chip from the mobile phone keypads. The Moneta mobile payment system has been considered a failure in Korea, though it has created a lot of global interest.¹¹

Despite the convenience mobile payment solutions have brought to consumers, such as avoiding fumbling for their credit or bank cards or cash and getting them past the point of sale faster and easier, mobile payment services did not generate a large market in the early days. By August 2002, Avaro and LGT’s 50,000 MAYZ-enabled handsets had only 1,500 active users.¹² SK Telecom’s full-scale move to update CATs and dongles to mobile-payment-ready kick-started the momentum for the diffusion of mobile payments in Korea. SKT’s effort to establish the infrastructure for mobile payments by introducing 350,000 dongles was followed by the other two carriers: KTF installed 100,000 dongles and LGT 8,000 (ICA, 2004).
With mobile proximity payments, credit card companies can expand their market by increasing the number of merchants offering their credit card payment instrument and the number of credit card holders using it. They also benefit from significant reductions in the costs associated with issuing and delivering physical plastic cards and from less fraud. Mobile carriers gain from increased subscribers using airtime and therefore increased ARPU, strengthened customer loyalty, reduced churn and extra revenue from wireless management and maintenance of the digital 'cards'. All these benefits, however, have not encouraged the mobile carriers to cooperate. The Moneta system is not compatible with either the K-merce or the MAYZ systems, and as a result it causes confusion among consumers as well as fragmentation of the market. This lack of standardization of infrastructure – different systems offered by different carriers – has delayed the diffusion of mobile payments to the mass market in Korea (ICA, 2004).

This is hardly a surprise: while mobile payments introduce new opportunities, it brings complicated issues to all the parties involved in its industry value chain. Avaro’s innovation in mobile payments created a new ‘game’ where there were no established rules among the incumbent industry players as to how all parties would agree on terms and conditions that would ensure the formation of an industry standard. On the other hand, despite being the inventor of mobile proximity payment technology, Avaro was under constant threat of being taken over or destroyed by the industry giant, the country’s number one mobile carrier, SK Telecom (SKT), adding to the challenge of leading the development and diffusion of this emerging technology. As discussed in Chapter 3, managing the development of an emerging technology is not a single economic event, rather a social event; it requires cooperation of multiple players (Rosenberg, 1972; Rogers, 1995).

This chapter, using a longitudinal case study of the emergence and development of Avaro InfoTech Inc., and its mobile proximity payment technology in Korea, illustrates how an entrepreneurial start-up has led the development of an emerging technology; the difficulties it has encountered in creating cross-industry cooperation; and the problems in establishing an industry standard in Korea. It also describes how the company has missed the opportunity to promote its technology in the global market, which is a prerequisite for the diffusion of a network-based innovation (Schilling, 2005). This chapter first introduces Korea’s ‘mobile information society’ – its history, the government policy framework and the key players – and then presents the case of Avaro InfoTech Inc., from its establishment to its journey of seeking capital investment and its internationalization.
KOREA’S MOBILE INFORMATION SOCIETY

The Korean government promotes the vision that the country will be built into a modern ‘mobile information society’ where mobile phones (or other mobile devices) can replace keys, wallets, credit cards and identity cards, as well as function as the central controller for all household networked appliances (ITU, 2004a). Part of that vision has already become reality in Korea. For example, mobile payment services – financial transactions taking place on- and/or off-line via mobile terminals – have attracted users to the bandwagon of mobile commerce in Korea. At present, all mobile operators in Korea are offering mobile payment services; by the end of December 2003 there were nearly 2 million subscribers and more than 470,000 locations in Korea that accepted mobile payments (ICA, 2004).

A decade ago, credit cards started to emerge in the Korean market; before that, few Koreans owned or used credit cards (ITU, 2004a). According to the ITU’s background paper on Korea’s mobile world, today the average Korean consumer has four credit cards. Mobile operators in Korea are actively promoting mobile payment services with the hope of sharing a slice of the booming credit card business with banks and credit card companies. Teaming up with banks and credit card companies to offer mobile payment services, Korean mobile operators are leading the country’s effort in establishing standards, policies and business models that can help generate the best outcome for all parties involved in the mobile payment industry value chain. Despite a joint effort between the mobile telecommunications industry and the financial industry, however, mobile payment services in Korea are still fragmented: all three Korean mobile operators offer their own mobile payment systems that are totally non-compliant with each other.

Nonetheless, the performance in the industry is still ahead of the rest of the world. Strand Consult, a Denmark-based mobile telecommunications research and consulting firm, after nine months extensive research on Korea’s mobile telecommunications industry, concluded: ‘The Korean mobile operators have quietly worked very hard in the last few years and are now three to five years ahead of the rest of the world’ (Strand Consult, 2003). For example, as of the end of 2003, total service revenue generated from 3G (IMT-2000) networks in Korea reached US$10.8 billion, accounting for 0.87 per cent of worldwide revenue; Korea’s mobile phone production revenue reached US$16.2 billion, accounting for nearly 18 per cent of worldwide output; and Korea’s m-commerce expenditures reached US$2.86 billion, accounting for more than 40 per cent of the worldwide total (ICA, 2004).
Not only advanced in wireless networks, Korea is also far ahead of the rest of the world in developing and deploying mobile proximity payments. However, the development of this emerging technology has been protracted and difficult, even for Korea—a country renowned for the rapid diffusion of new technologies (Lee, 2003). While some customers have been early adopters, many others are holding off, awaiting further development of the technology, especially conscious about the standardization of mobile payments.

The Development of the Mobile Telecommunications Industry in Korea

Korea provides a unique example because of the way the country has evolved from complete decimation at the end of Korean War to being one of the world’s most high-tech economies. According to an International Telecommunication Union paper (ITU, 2004c), Korea has the highest level of broadband penetration in the world—about 70 per cent of households in Korea have broadband Internet access. In January 1996, Korea launched the world’s first commercial CDMA (the second generation CDMA IS-95) services and, after network upgrades, Korea is now one of the few countries in the world offering 3G mobile services, and had a mobile penetration rate of 69 subscribers per 100 inhabitants (as of December 2003) (ITU, 2004a).

The success of Korea’s CDMA can be attributed to the cooperation between the Electronics and Telecommunications Research Institute (ETRI), the then research arm of the Ministry of Information and Communications (MIC), and Qualcomm, a small US-based firm which owned seven key CDMA patents in the early 1990s. ETRI and Qualcomm reached a profit-sharing agreement according to which 80 per cent of licensing profits went to Qualcomm and 20 per cent was retained by ETRI. At the time, this agreement was considered disadvantageous to the Korean side. However, by the year 2008, ETRI will be expected to collect an estimated US$200 million in royalties for its share of the CDMA technologies, in addition to the 20 per cent of royalties which ETRI has reinvested in the development of other key technologies (MIC, 2003b). Korea’s mobile communications network has nearly 100 per cent coverage across the peninsula. The number of mobile subscribers in Korea outnumbered fixed-line subscribers for the first time in 1999 (ITU, 2004a). The success of CDMA illustrates the Korean government’s science and technology policies in the past 20 years: the central tendency shifted from the absorption of foreign technology through copying and self-teaching to the adoption of foreign technology through investing in foreign licenses.
and technical assistance (Amsden, 1989; Kim, 1997). Before that, industrialization occurred almost exclusively on the basis of nationally-owned rather than foreign-owned enterprises (Kim, 1997). Economic development has been based on a set of evolving firms and institutions astute at technological learning (Dodgson and Kim, 1997). Korea has had an outstanding growth record because its late industrialization was managed by the Korean government, according to Amsden (1989), with a high level of ‘discipline’, which imposed performance standards as a criterion for price subsidies.

There are three major mobile network operators offering CDMA mobile services for 33.6 million subscribers (accounting for nearly 70 per cent of the population) in South Korea. The market shares of the mobile operators’ subscriber numbers for mobile services and mobile Internet services are shown in Tables 5.1 and 5.2.

**SK Telecom**
SK Telecom (SKT) is the largest mobile operator in Korea, with a 54.5 per cent market share of mobile subscribers and 54.1 per cent of mobile Internet subscribers (as of December 2003). SKT was the first mobile operator in Korea to offer analogue mobile services, under its former name, Korea Mobile Telecommunications Service (KMTS). SKT also launched the world’s first digital CDMA mobile network in 1996. SKT was the first operator in the world offering mobile data services over its 2G cdmaOne (IS-95) network. In January 2002, SKT commercialized its CDMA2000 1x EV-DO (evolution data only) mobile data services in Korea. By the end of 2003, SKT had nearly 17 million mobile Internet subscribers. As the dominant operator, SKT has its service prices closely monitored by the Ministry of Information and Communications (MIC).

**KT FreeTel**
KT FreeTel (KTF) is the second largest mobile operator in Korea with a 31.1 per cent market share of mobile subscribers and a slightly larger (32.7 per cent) share of mobile Internet subscribers (as of December 2003). KTF has its roots in Korea Telecom. The current KTF is the result of a merger between KT’s mobile arm and M.Com in May 2001. KTF offers all types of mobile services over its CDMA networks, including its CDMA2000 1x EV-DV (evolution data and voice) services. KTF was the pioneer in Korea in marketing mobile services to different customer segments.

**LG TeleCom**
LG TeleCom (LGT) is the third largest mobile operator in Korea with a 14.4 per cent market share of mobile subscribers and 13.2 per cent of
mobile Internet subscribers (as of December 2003). Despite its sister company, LG Electronics, being one of the leading manufacturers in the mobile handset sector, LGT has struggled to maintain its market share in the mobile services arena in Korea.

Table 6.1: Market share of mobile services (2002 and 2003)

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>Growth Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SK Telecom</td>
<td>17,219</td>
<td>18,313</td>
<td>6.4%</td>
</tr>
<tr>
<td>KT FreeTel</td>
<td>10,332</td>
<td>10,441</td>
<td>1.0%</td>
</tr>
<tr>
<td>LG Telecom</td>
<td>4,790</td>
<td>4,836</td>
<td>1.0%</td>
</tr>
<tr>
<td>Total</td>
<td>31,430</td>
<td>33,591</td>
<td>6.9%</td>
</tr>
</tbody>
</table>

Unit: 1,000 subscribers

Table 6.2: Market share of mobile Internet services (2003)

<table>
<thead>
<tr>
<th></th>
<th>Mobile Internet Subscribers (A)</th>
<th>Mobile Phone Subscribers (B)</th>
<th>Proportion of Mobile Internet Subscription (A/B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SK Telecom</td>
<td>16,998</td>
<td>18,313</td>
<td>92.8%</td>
</tr>
<tr>
<td>KT FreeTel</td>
<td>10,267</td>
<td>10,441</td>
<td>98.3%</td>
</tr>
<tr>
<td>LG Telecom</td>
<td>4,164</td>
<td>4,836</td>
<td>86.1%</td>
</tr>
<tr>
<td>Total</td>
<td>31,430</td>
<td>33,591</td>
<td>93.6%</td>
</tr>
</tbody>
</table>

Unit: 1,000 subscribers


According to an ITU report (2004c), there have been four distinct stages in Korea’s mobile telecommunications development:

- 1984-1994: Analogue mobile services were started in Korea in 1984 by Korea Mobile Telecommunications Service (KMTS), a subsidiary of Korea Telecom. During the following 11 years, KMTS enjoyed a monopoly in the mobile services sector. This period saw relatively slow growth in its mobile subscribers, and by the end of 1994, the penetration rate was only two subscribers per 100 inhabitants, one of the lowest among advanced Asia-Pacific countries. In 1994, KMTS was sold to SK Group and became the current SK Telecom (SKT).
- 1995-2000: This period witnessed the emergence and strong growth of CDMA digital mobile networks in Korea. In January 1996, the second-
generation cdmaOne (IS-95) digital voice service was launched. During this period, four new mobile operators, Shinsegi Telecom, Korea Telecom FreeTel (now KTF), LG Telecom (LGT) and Hansol (later renamed as M.Com and which became the Personal Communications Services – PCS operator) entered the CDMA mobile services market. In October 2000, KTF, LGT and M.Com launched CDMA 2000 1x mobile (voice and data) services, the first 3G mobile networks in the world. By the end of 2000, the mobile penetration rate reached over 50 subscribers per 100 inhabitants.

- 2001-2003: This period saw a slow-down of mobile voice services; however, it marked the start-up of mobile data communications in Korea. In May 2002, SKT launched its CDMA2000 1x EV-DO (evolution data only) mobile data services. By the end of 2003, these services had been fully commercialized. During this period, the mobile services market was also consolidated with mergers and acquisitions: SK Telecom acquired Shinsegi and KT FreeTel acquired M.Com; by the end of 2003, three major mobile operators, SKT, KTF and LGT, provided 3G mobile services.

- 2004 and beyond: In addition to its CDMA2000 spectrum licenses, the Korean government also granted WCDMA mobile network operating licenses to its operators. SKT currently holds a CDMA2000 license in the 800 MHz spectrum and a WCDMA license; KTF holds a CDMA2000 license in the 1800 MHz spectrum and a WCDMA license; and LGT holds a CDMA2000 license in the 1800 MHz spectrum and a second CDMA2000 license in the 1 GHz spectrum.

**Government Policy Framework**

Korea was one of the first nations to implement the vision of a converged network, a network that merges broadband, telephony (mobile and fixed), and television. This network is changing the way that Koreans access and use information. For younger generations, being Korean means being connected (Korea Herald, October 14, 2003). The Ministry of Information and Communications (MIC), a government body responsible for telecommunications and broadcasting policy and regulation, takes some credit for this achievement. The MIC has been actively promoting and developing the telecommunications industry in Korea since the Asian financial crisis in 1997. One policy the MIC uses to promote the development of the whole industry is to ‘require’ telecommunications operators to contribute to government programs that are considered
beneficial to the industry’s development (MIC, 2003a). For example, in contrast to many western countries, the money and funds (license fees and taxes) from 3G spectrum auctions have been reinvested in the telecommunications industry instead of being transferred to other areas of the government. This investment was used to upgrade infrastructure, pioneer research and build and maintain internal government networks. Obviously, the policy has assisted Korea’s ranking in the global mobile telecommunications industry (ICA, 2004).

Korea’s success in broadband and mobile telecommunications is due to several factors, including local competition, competitive pricing, government involvement and demographic and geographic features. Korea’s policy in fostering certain industries that are considered ‘strategic’ to its national economy has been effective. For example, the government supports small but ‘strategic’ industries from the private sector to evolve into large investment programs (Amsden, 1989). The government role includes not only policy formulation but also the techniques of policy implementation, using an array of direct and indirect incentives and sanctions to harness the private sector in achieving rapid technological learning and, in turn, high growth (Kim, 1997). For example, in the past 20 years, the Korean government encouraged industrial sectors to shift their investment focus from labour-intensive to higher-value technology-intensive products and services. As a result, chaebol (Korean industrial conglomerates) drastically raised their R&D investments and greatly strengthened Korea’s technological competitiveness worldwide (Kim, 1997).

One of the most strategically important decisions the Korean government has made in its mobile communications industry was the introduction of CDMA technologies. The Korean government started to consider pursuing the commercialization of CDMA IS-95 (cdmaOne) in 1991. However, it was not until January 1996 that CDMA IS-95, originally developed by the US-based Qualcomm, was commercialized in Korea. The CDMA choice was a hard decision for the Korean government to make. To switch the country’s mobile communications infrastructure from its heavy reliance on TDMA (analogue technology) to the unproven CDMA (digital technology) in the early 1990s represented a huge risk for an immature mobile market like Korea. However, as the first commercialization showcase of this technology, Korea benefited from the uncertainty around the unproven technology and, therefore, was in a better position to negotiate with Qualcomm over the terms and conditions of using its intellectual property and license options. The choice of CDMA marked the turning point for Korea in its progress to its leading position in the modern mobile communications industry. The benefits of this policy are two-fold:
as a consequence of the commercialization and development of CDMA technology in Korea, Korean mobile carriers are able to provide the most extensive mobile access and the most advanced mobile services to consumers; on the other hand, it has enabled the strong growth (including in exports) of the Korean mobile equipment manufacturers (Samsung, LG Electronics, SKT, Maxon and so on) which has contributed so much to the country’s economy (ICA, 2004).

Another influential policy is the one of subsidized mobile handsets. In 1996, when the CDMA IS95 mobile service was introduced, mobile handsets were very expensive. The high cost associated with using an unproven mobile technology created a big barrier for the CDMA IS-95 to be adopted by consumers in the country. The government, therefore, instituted a policy where mobile operators were allowed to ‘lock’ subscribers into a two-year, exclusive contract in exchange for giving the handsets away ‘free’. In addition, the government set up a ‘maximum’ price that the mobile operators were allowed to charge consumers for the handsets, and this price was high enough for the operators to pay the manufacturers for the handsets (ITU, 2004a). A side-benefit of this policy is it allowed the mobile operators to purchase mobile handsets from the manufacturers in bulk, which greatly reduced unit costs. This policy proved an immediate success in Korea, but was stopped by the Fair Competition Board in the late 1990s; at that point, Korea’s mobile market was mature enough that, without the handset subsidization scheme, users were willing to pay larger sums of money to upgrade their phones and mobile services.

Korea’s mobile industry is characterized by a tightly-woven ‘triangle’ of close relationships between the government, mobile operators and mobile equipment manufacturers. This tight linkage in the industry is credited for the strong growth in the mobile communications industry in Korea; however, the overall model is also criticized for spurring problems in Korea’s economy, such as the financial crisis in 1997 (ITU, 2004a).

AVARO INFOTECH INC. – THE PIONEER IN THE MOBILE (PROXIMITY) PAYMENT INDUSTRY

While many refer to Japan and its dominant mobile carrier’s – NTT DoCoMo’s – i-mode mobile data services when discussing the future of the mobile communications industry, Korea has proven itself to be a successful example of high-speed mobile data communications – 3G services – as well as leading-edge mobile payment systems (Strand Consult, 2003). The best-known mobile payment system in the world is SK Telecom’s Moneta
Plus system. The Moneta Plus system is a smart (IC) chip-based technology where subscribers can insert the smart chip that stores credit card information into the slot of their handsets and pay for purchases. However, it is Avaro InfoTech Inc. (hereafter referred to as Avaro) – a high-tech start-up company – that led innovation and development in Korea’s mobile proximity payment technologies. As reported in an article in Korea’s leading English newspaper The Korea Herald (October 14, 2003), the founder of Avaro, Mr Kyung-yang Kim, was widely recognized as the inventor of mobile proximity payments in Korea.

In April 2002, in collaboration with one of the country’s leading banks, Kookmin Bank, and LG TeleCom (LGT), Avaro launched the world’s first commercial Universal Mobile Payment Service (UMPS) system in Seoul: MAYZ. Relying on infrared, Avaro’s MAYZ UMPS platform creates a communication channel between the mobile network and a transaction network using a mobile device such as a mobile phone or a personal digital assistant (PDA). The transactions of mobile payment services are processed through Avaro’s MAYZ Service Centres. For example, Avaro’s partnership bank can send an electronic credit or debit card to a customer through the MAYZ Service Centre and then onto the customer’s mobile device over the mobile network. A key attribute of the MAYZ payment system is that it can be deployed on the back-end of the existing transaction infrastructure. This advantage can potentially facilitate a rapid deployment (Mansell and Steinmueller, 2000).

Avaro’s success marked the emergence of mobile proximity payments in Korea. It also marked cross-industry cooperation (between the mobile carriers and the banking industry), as well as battles along the way, in the development of the mobile proximity payment industry. Avaro, as a central player in this game, witnessed the twists and turns of the development and diffusion of mobile payments in Korea.

The Establishment of Avaro Infotech Inc.

Mr Kyung-yang Kim (hereafter referred to as Mr Kim) is a deeply patriotic middle-aged Korean businessman who, according to his close colleagues, puts his country’s interests ahead of his own. A graduate of the Korea Military Academy – Korea’s equivalent of the US’s West Point – he became a lecturer teaching modern military management in the Academy. When he realized he could serve his country better by being a businessman than by being a military officer, especially in peacetime, Mr Kim quit the military and subsequently obtained his MBA from the University of Alabama. He started his entrepreneurial career in 1997 when he established a precision-mechanism manufacturing company, Avaro InnoTek Ltd. Mr
Kim’s venture was also engaged in export-related business. He identified the business opportunities of mobile proximity payments when he was working for the US oil giant ExxonMobil. One project his venture undertook was to design and manufacture contactless key chains – the Mobil Express Pass – a radio frequency-controlled IC chip embedded with pre-deposited money value – to pay for petrol. The concept of using a contactless key chain to remotely settle petrol purchases inspired Mr Kim. He started to ask himself: if this kind of key chain could conduct wireless transactions for purchasing petrol, why not expand this new payment instrument to further applications and through other media?

In March 1999, after intensive R&D in mobile payment technologies, and many trials and failures with different wireless communication media, Kim and his team found the solution to mobile proximity payments: relying on infrared – a short-range communication medium – to conduct mobile proximity transactions. Infrared is a pervasive short-range communication medium, widely used in devices such as TV remote controllers. To use the infrared technology in mobile proximity payment services, though, is very new. Mr Kim also decided upon using mobile phones as the payment instrument for mobile payments.

The vision of payments through mobile phones requires the close cooperation of financial institutions and mobile communications operators. This is challenging: financial institutions (banks and credit card companies), for example, avoid sharing their valuable customer information and transaction commissions with mobile telcos; however, telcos were eager to gain a foothold in the payment industry because their markets were reaching saturation. Mr Kim joked that the executives from financial institutions laughed at him when he first approached them with a TV-remote-controller-type-of-device strapped to his mobile phone to demonstrate his mobile proximity payment concept.

Mr Kim anchored his venture in providing services that would bring different industries together for a common goal and create a new service sector: the mobile payment industry. As discussed in Chapter 2, the industry value chain is composed of financial institutions, mobile carriers, merchants, mobile device manufacturers, users and service providers. Avaro aimed to complement its core technology with others to create a securer, more convenient, and simpler mobile payment environment for consumers.

In January 2000, in order to prepare for the commercialization of his mobile proximity payment technology, together with his two partners, Mr Wong (a lawyer specializing in company bankruptcy law) and Mr Bongsung Park (an auditor), Kim established an independent company, Avaro.
InfoTech Inc., focusing on mobile proximity payment technologies and services. Mr Kim became the Chairman of the Board of Directors, as well as the CVO (Chief Vision Officer) of his new venture; Mr Wong was appointed CEO in charge of domestic operations and Mr Park as the CFO. The Board of Directors, composed only of shareholders (investors), oversees all business decision-making in the company.

**Avaro’s business model**

Between the end of 1999 when Avaro completed the development of its core technology – MAYZ – and the end of 2001 when Avaro launched its trial MAYZ mobile proximity payment system in SeongNam – a middle-class suburb of Seoul – Avaro endeavoured, through many channels, to find a successful business model. Avaro’s MAYZ Centre is the most important component of its innovation. MAYZ Centre works like a ‘post office’ – passing messages, initiating and authenticating transactions between consumers, card-issuing banks and credit card companies. Technically, MAYZ Centre services can be extended through a Service Development Kit (SDK) platform to include third party developers.

![Figure 6.1: Avaro’s ‘MAYZ Centre’ business model](image-url)
A business model not only defines a company's key activities, but also frames and limits its search for new innovations. The value of an idea or a technology is often determined by the business model used to bring it to market (Chesbrough, 2003). As depicted in Figure 6.1, the essence of Avaro's business model is to position itself as a ‘hub’ connecting multiple players by building partnerships and sharing profits with them. Its partners include: (1) mobile network operators such as LG TeleCom and KT FreeTel; (2) Korea’s handset manufacturers such as LG, Samsung and Saewon; (3) Korea’s leading financial institutions such as Kookmin Bank, BC Card and LG Card; (4) Korean and world credit card-issuing entities such as VISA International; and (5) the Korean government in the provision of roadway toll payment services. In addition, Avaro has established merchant relationships for payment, ticketing and loyalty services with, for example, Hyundai and Lotte department stores, Starbucks, Tony Roma’s, Kentucky Fried Chicken and TGI Friday restaurants.

**Value creation**

By creating the world’s first Universal Mobile Payment Service (UMPS), Avaro delivers a payment system that bridges mobile networks and the payment infrastructures (backend processing architectures).

For consumers, Avaro’s mobile payment solution provides not only ‘wireless value’ – transactions conducted in a cordless environment – but also ‘mobile value’ (Anckar and D’Incau, 2002), allowing customers to conduct transactions with mobility. The mobile payment solution provides choice, freedom, ease of use and convenience for customers. Its two-way communication mechanism between payment terminals and consumers’ mobile devices provides a new payment instrument using real-time connections to a mobile network. For example, consumers are able to make purchases (digital content and services) when walking down the street; pay bills while they wait for a train; or pay back a debt to a friend immediately after a meal. Consumers also find they can use their credit card over mobile devices to pay in places that previously only accepted cash.

For mobile network carriers, Avaro’s mobile payment solution offers them potential opportunities to obtain a piece of the multi-billion dollar payment business that is currently dominated by banks and credit card associations. The most direct benefit is that carriers can enjoy strengthened revenues because of increased use of airtime (the wireless issuance of digital cards, the management and tracking of defaulters and transmission of SMS or MMS messages to MAYZ users and so on) and increased
average revenue per user. Other side benefits include strengthening customer loyalty and reducing the churn of users.

For financial institutions, Avaro’s MAYZ system offers the potential to be more secure than traditional card-based payments that are very vulnerable to fraud. Improving payment security not only increases the perceived security to the user, but also significantly reduces the cost of fraud protection. A direct benefit for financial institutions is that mobile proximity payments are able to attract new segments of customers that otherwise would not necessarily use bank services. In addition, financial institutions can save significantly from the reductions in the costs associated with issuing and delivering physical plastic cards.

For merchants, the key attraction of the MAYZ system is that a MAYZ infrared module (adapter) can be connected to a serial port of an existing POS/ticketing terminal or vending machine (or in the new generation of products, it can be embedded in the hardware). The merchants can benefit from decreased payment-processing time, massively reduced incidents of fraud, and possibly a boost in sales by offering a foolproof and secure payment methodology.

For manufacturers of mobile handsets and other mobile devices, the mobile payment technology creates additional demand for new devices and the replacement of old ones.

Unlike many other mobile payment solutions, MAYZ incorporates ‘existing’ technologies (i.e., infrared technology used in modern mobile phones) and traditional payment instruments (that is, magnetic strip credit/debit cards, smart cards, and electronic cheques) encouraging rapid deployment internationally. By introducing a new business model (new architecture), Avaro’s MAYZ system rewrites the rules for financial transactions based on mobile devices. An open standard that ensures smooth and interoperable applications on the current payment and processing infrastructure for merchants and financial institutions is vital for the success of mobile payments (Henderson and Clark, 1990; Schilling, 2005). The MAYZ system can improve the efficiency of making payments, reduces costs in the value chain of the payment business, and provides a new, easier, more convenient and securer way of doing business.

**Initial capital, organization and personnel**

Mr Kim and his two friends collected US$1.7 million from savings of their own, their immediate family members and other relatives as the initial capital investment for Avaro. Relying on this initial capital, Mr Kim and his team (80 per cent of whom were R&D personnel) started research and development of mobile payment systems. After two years, in March 1999, the intensive R&D efforts resulted in the creation of MAYZ.
Through the year 2000, Avaro started actively to engage in marketing programs for its MAYZ system, including participating in international tradeshows and conferences in the field. For example, in Korea, Avaro demonstrated its MAYZ technology at the eCash and ePayment Festival of Korean Industries in September 2000, and participated in e-Biz Expo 2000 held at COEX in Korea in December. By the end of 2000, Avaro had gained recognition for its MAYZ technology from the mobile commerce industry in Korea, and in 2000 it was selected by the Korean government as a ‘venture company with the most outstanding technology’: an industry award. This success also attracted attention from institutional investors.

Avaro started to look at the international market in 2001. As a result, Mr Kwang-jack Choi (known as ‘Jack’) was appointed Vice President of Overseas Planning and Development – the first employee dedicated to the development of international activities for the company – in January 2001. Speaking fluent English, Jack brought his extensive experiences in international business to Avaro, including working for the Samsung Group and Korea Telecom. Jack’s appointment introduced new ideas on how the company should build its international viability and expand in the global market.

In January 2001, Avaro participated in the ‘Portable Design 2001’ trade show held in Las Vegas. This was the first time that the Korean venture had demonstrated MAYZ in the international arena. ‘When we were close to completing our development of an infrared-based mobile payment protocol, we met this Korean venture in the show that had already completed its products and solutions based on infrared technology’, commented Mr Damon Burns. Mr Burns was treasurer of IrDA (Infrared Data Association), and one of the three ‘godfathers’ – founding members – of IrFM (Infrared Financial Messaging). He later joined Avaro as the Director of International Marketing, in charge of building relationships with financial institutions in the US and other international markets. Both parties were obviously impressed with each other’s accomplishments and decided to work together.

As a result, Avaro joined IrDA and became an active member of IrFM – the section of IrDA that promotes infrared-based financial message exchange protocols – in January 2001. The alliance with IrDA/IrFM gave Avaro access to other important players in this field and exposure to the international market. Furthermore, Mr Mike Wilson (hereafter referred to as ‘Mike’), one of the co-founders and the president of IrDA, a veteran in the IT and telecommunications industry (including eight years working experience with Hewlett Packard), as well as an experienced entrepreneur, together with his colleagues Damon Burns (hereafter
referred to as ‘Damon’), Nicolas Elsbach (hereafter referred to as ‘Nick’) and Gary Francis (hereafter referred to as ‘Gary’) at IrDA, joined Avaro. Mike and his colleagues became Avaro’s international team. Mike was appointed Senior Vice President in charge of managing Avaro’s international business operations; Nick, Chief Engineer of IrDA, was appointed Avaro’s Director of International Engineering; Gary, the software architect of IrDA, was appointed Avaro’s Director of Software Architecture; and Damon was appointed Director of International Marketing. Mike commented, ‘What attracted us [to join Avaro] was not the infrared side. Actually, it was Avaro’s business model – MAYZ Centre. This is the service side rather than the technology side.’ Since joining the IrDA/IrFM, Avaro moved from its own mobile payment protocol to the IrFM protocol which is accepted as the international proximity payment standard.

No matter what attracted both parties to work together, this alliance seemed a win-win arrangement. As seen in Chapter 4, selling its innovative products and business concepts internationally is very important for a high-tech start-up company like Avaro. Avaro’s new international team endeavoured to ensure that Avaro’s future growth was in the international arena. ‘We are trying to promote the standardization concept to Avaro’s management team, because we know “scale” is essential for Avaro’s future growth’, commented Mike. What Mike and his international team were doing was to educate Avaro’s Korean team: instead of working for one single client and developing specific proprietary architecture which belongs to the specific client, Avaro should develop an open architecture/platform which can be scaled to multiple clients with limited customization. In fact, they believed this open platform approach would be able to develop into the de facto industry standard.

By the time Avaro first commercialized its MAYZ system (that is, in April 2002), both SKT and KTF had failed in their trials in developing competing models for mobile payment solutions. Neither of these two companies had managed to capture the ‘know-how’ of either the infrared technology or the mobile payment business model – the service side – of mobile proximity payment. On the other hand, Avaro’s initial success attracted more competition from the domestic carriers, which, as a result, meant Avaro almost exhausted its limited resources in fights in the domestic market (this will be outlined in detail in the following sections).

By the end of 2002, Avaro had over 50 employees, including four international employees, working in the Bay area in California. Because of the lack of capital, Avaro did not register a legal entity in the US; that left its international employees working as consultants for Avaro (Korea), without any social welfare benefits.
R&D activities
In 2002, more than 60 per cent of Avaro’s employees were engineers, and R&D activities composed the majority of Avaro’s business operations. Although Avaro had started to look at international market opportunities in 2001, it maintained its core R&D activities in Seoul, Korea. This strategy was, in part, to utilize the relatively cheap skilled workforce domestically, and, more importantly, to retain its core technologies in the home country.

Dr Chul-ki Kim, a veteran of Avaro InnoTek, was one of the key members contributing to the success of MAYZ technology. Like Mr Kim, Dr Kim also has a military background and still serves as a professor in the Electronic Engineering Department at Korea’s 3rd Military Academy and the Korea Military Academy. As the Chief Technical Officer, Dr Kim plays an important role in Avaro’s core R&D activities.

The recruitment of the international team brought new blood to Avaro’s R&D activities. Nick’s experience and knowledge in mobile payments brought the new approach of an open architecture/platform into Avaro’s engineering and design thinking.

Avaro’s patents and core products/services
On 14 November 2002, Avaro revealed that it had acquired the patents for all aspects of its card payment services. At its core is an ‘optical settlement transceiver and optical settlement system’ (PCT/KR01/00428) that covers most aspects of Avaro’s business model (MAYZ Centre), wireless downloading of personal financial information into mobile phones, and wireless disabling of digital cards from mobile phones (for example, if they are stolen or there is default on bill payments). Avaro’s patent includes card payment transaction services carried out through various infrared-embedded payment devices, such as card-reading devices (POS terminals), card-reading device slot adapters and infrared devices that attach to serial ports, and infrared relaying devices, through all (any) types of mobile devices, for example, mobile phones and PDAs.

According to Mr Eui-je Cho, a patent attorney at one of Korea’s top international patent and law firms that filed the patent on behalf of Avaro, ‘As the world’s first patent on a mobile phone payment business model, it (Avaro) falls under the category of a financial service product patent. That means it can be introduced to other markets. Since it is an exclusive right, actions such as requesting legal disposition and demanding damages can be carried out in regard to similar services and systems’ (Avaro Press Release, November 28, 2002). This claim was subsequently verified by the MIC when a conflict between Avaro and SKT in respect of mobile proximity payment solutions was brought to the government regulatory body.
Avaro patents effectively gave the company exclusive rights for the next 20 years on payment services and systems using infrared technology. Commenting on the registration of Avaro’s patents, Mr Kim said, ‘Avaro’s activities for the past two years in regard to world infrared standardization was to receive recognition and there is no intention to increase the entry barrier for others with this patent. Instead, effort will be made to go in one direction with such partners as wireless service providers and have Korea lead the world market.’

The rollout of the MAYZ platform requires little or no modification of the existing payment infrastructure. For example, MAYZ can help the major card issuers (Visa, MasterCard, American Express, JCB and so on) and their associated banks to issue virtual cards through a MAYZ Centre. Such a virtual card can be issued wirelessly by downloading the user’s financial information to his/her mobile device over a mobile data communications channel (SMS, WAP, GPRS, i-mode, or 3G) through the MAYZ Centre. Currently, issuing a magnetic strip or smart card costs the financial institution between US$5 and US$25. Through the MAYZ Centre, wireless downloading can provide substantial savings for financial institutions. Meanwhile, wireless downloading (over-the-air) provides a new revenue stream for mobile network carriers.

Ultimately MAYZ can extend beyond financial transactions and become a universal transaction platform between any terminal and any mobile device for any type of transaction. The application of mobile proximity transactions is almost endless: from issuing an electronic credit card to enabling mobile payments at a POS terminal; from issuing an identification card to speeding the security entry to the office building, airport or hospital; from issuing a key code to locking and unlocking the security door.

MAYZ UMPS has two critical components: MAYZ Centre and MAYZ Service Platform. The services are provided either directly by MAYZ Centre or by third-party developers which develop applications based on the MAYZ Service Development Kit (SDK). Avaro’s product portfolio also includes enabling hardware such as MAYZ Terminal Adapters and MAYZ Relayers. However, these products are provided primarily for enablement purposes only.

The MAYZ Terminal Adapter (dongle) is an infrared module which can be added on to existing payment terminals. It can also be achieved by an embedded-solution, either as a board or reference design, in newly-made terminals. It contains media protocols, service and connectivity management layers, and a programming interface allowing the development of terminal-specific services and agents. The stand-alone MAYZ adapter can be plugged into a serial port or a magnetic strip reader.
on a POS terminal, ATM/CD, or a vending machine. A board-level solution as a separate subsystem requires slight design changes for the newly-made terminals. Over 95 per cent of Korea’s payment terminals are adaptable by putting a dongle through a common serial port connection.

The MAYZ Relay Device is designed to increase the security of using credit cards or debit cards. If a customer has a MAYZ mobile card, all he or she needs to do, for example, when paying the restaurant bill or gas bill, is to point and beam his or her phone to the MAYZ relay device and sign the receipt to complete the transaction, without having the card being taken away to the card reader. For additional security, the personal financial information in the MAYZ relay device is automatically erased after the transaction.

The Long Distance MAYZ Base Unit is used to greatly increase the infrared transmission distance to 3-5 meters\textsuperscript{26} and eliminate interference. This unit accomplishes the difficult task of using the MAYZ-enabled phone to pay bills at tollgates, tunnels, parking lots, drive-throughs, and petrol stations, which require transactions to be undertaken over a distance between 3-5 meters.

MAYZ Service Development Kits are designed to provide an open platform for third party developers to develop a wide range of mobile payment applications such as ticket delivery, promotions, or loyalty program services to be delivered through a MAYZ Centre. The SDK contains service and connectivity management layers and a content generation and distribution engine. It provides seamless, smart client connection and service development capability for all service providers and terminal manufacturers. The purpose of the SDK design is to seed the target market with a convenient development tool to quickly and easily develop applications which can be delivered through MAYZ Centres.

**The founder, Mr Kim, and his social networks**

People close to Mr Kim all consider him to be a very visionary man. According to Mike, ‘...he (Mr Kim) is not a typical Korean CEO – a typical Korean manager is very much focused on specific tasks. Mr Kim is an exception...He is very good at visualizing new things and the future, but he is not so good at execution.’ This explains why instead of being the CEO, Mr Kim named himself the Chief Vision Officer (CVO) of his company. Avaro had CEOs for domestic and international operations. However, the title of CVO defines Mr Kim’s role above those of both CEOs. In Mr Kim’s view, the CVO is like a navigating boat that provides the directions for a big ship; however, the CEO is like a captain on the big ship giving orders in relation to day-to-day operations.
Although not following exactly the same business model and decision-making routines as many Korean managers, Mike and Jack believe Mr Kim sometimes finds it difficult to break away from the constraints of his military training and experience. For example, according to Jack, ‘Mr Kim’s strong nationalism sometimes overtakes his business acumen.’ Indeed, such nationalism is seen as ‘...a liability for Korean firms in globalizing their business operations’ (Kim, 1997: p. 76).

Like many Korean businessmen, maintaining very close connections within his social networks is crucially important for Mr Kim. An important perspective of Korean culture is ‘yon-go’: ‘relation-based behaviour’ (Chung, et al., 1997). At the organizational level, power is concentrated amongst the relations of the owners and their close networks. For example, as indicated earlier, Mr Kim persuaded two of his close friends to joint him in investing in and creating Avaro. Mr Wong and Mr Park hold minority shares and are board members of Avaro. Jack observed that sometimes the business decisions made at Avaro reflect the best interests of these shareholders rather than the best interests of the business, and Mr Kim would sacrifice the interests of the business to protect his friendship with his friends as well as to achieve harmony on the board.

In December 2001, Mr Kim invited Dr Jung-uck Lee to join Avaro as Honorary Chairman of the Board of Directors. Known as the ‘Father of CDMA’ – having revolutionized the mobile communications industry by launching the world’s first commercial CDMA mobile communications system – in South Korea, Dr Lee was the CEO of SK Telecom between 1995 and 1998, becoming Minister of the Ministry of Science and Technology in 1999. An IEEE Distinguished Fellow, Dr Lee became a ‘head figure’ for Avaro. His joining this venture ‘endorsed’ Avaro’s technology in Korea (Davidsson and Honig, 2003; Hoang and Antoncic, 2003).

Apart from Dr Lee, Mr Kim invited several other influential people to be outside advisors to Avaro. These advisors obviously have special importance for Mr Kim. They are an extension of Mr Kim’s social networks. According to Mike, these advisors sometimes are irrelevant to the company; a lack of coordination between these capable and influential figures did not actively help Avaro in a real business sense (at least not as much as expected). However, for Mr Kim, to be within such social networks is very important; it ‘helps Avaro to get things done when they are supposed to be done and to prevent things from being done when they are not supposed to be done’.

As Jack commented, ‘...Mr Kim is a controversial person: on the one hand, he is a brilliant creator and inventor with great vision, and more importantly, he knows the route as to how to get there; however, on the
other hand, he is easily influenced by his social networks—his friends and allies, and sometimes he follows their “advice” even he knows they are not necessarily right, because he cannot afford to lose his friends.’ As seen in Chapter 4, this personality type, combining creativity and social networks, is very useful at a venture’s start-up phase, but its value fades away when the firm grows. ‘Mr Kim’s biggest weakness is he cannot separate business relations from his personal networks and his patriotism’, observed Jack. In Korea, networking is exceptionally active among extended family members and among people from the same home town, school or military barracks. Such networks often play an important (but informal) role in bringing about ‘lateral coordination across organizations’ (Kim, 1997: p. 75). At the start-up stage, this network helped Avaro establish and achieve fast legitimacy (Singh et al., 1986; Henderson, 1999). However, when the company reached the fast-growth stage, seeking consensus from this network greatly delayed Avaro’s decision-making and, in fact, became a barrier to its further development (Lechner et al., 2006).

Mr Kim was well aware of his own limitations as a manager running a growing organization. At one point, he was prepared to step down from the top job, but he simply could not turn this decision into action. According to members of the international team, two reasons could explain this: (1) he did not find the right person to replace him; and/or (2) he carried too many burdens to turn his decision into action; he had to seek consensus from his co-founders, friends and advisors, and this was not easy to achieve.

**Decision-making mechanisms**

According to Chung et al. (1997), a feature of Korean business is that owners actively participate in management tasks and the ownership is often preserved within the owner’s family, leading to a high degree of concentration and formalization of power in decision-making. Korean firms generally have a very hierarchical structure with many levels of controls. According to Jack, major decisions, especially those in relation to expenditures, usually go through formal procedures of ‘kyul-jae’ (Chung et al., 1997), meaning ‘approval from upper levels of management’. In decision-making, Korean managers traditionally tend to follow a core ideology of maintaining good relations with their subordinates and stability within the work group, even if it means sacrificing group performance. According to Chung et al. (1997), in recent years, however, the core ideology in Korean society has been undergoing a dramatic change from the traditional ‘inhwa’ (harmony)-driven approach to one which stresses performance.
The decision-making mechanisms at Avaro largely follow this typical hierarchical Korean path (as shown in Figure 6.2): if the idea is from the very bottom of the organization, it often needs to travel a long way before it can reach the top for a decision; and in cases when it reaches the top, it sometimes it loses its original meaning.

Source: Based on descriptions by Avaro staff

Figure 6.2: Decision-making mechanisms in Avaro

Though Mr Kim is considered a very creative man, according to people working closely with him inside and outside of the company, his ‘weakness’ – seeking endless support and consensus from his fellow board members – makes Avaro’s decision-making slow and inefficient. This is especially true when it comes to making decisions in relation to international activities. Mr Kim has had different opinions from his co-founder friends regarding international expansion plans and activities and he had many difficulties trying to convince them to support these plans. As Jack said, ‘...the decision-making process of Avaro is not the most
efficient and systematic, nor as business oriented as I would like it to be'. The key issue is that management decisions cannot be made without the intimate involvement of the board members. As a consequence, the decision may not represent the best interest of the business. Another drawback to Avaro's decision-making process is that it did not take into consideration the growth of the organization. Decision-making is a dynamic process, where, when the organization is very small, everyone is expected to participate in the process; however, when the organization is growing, management decisions should be specialized (Eisenhardt, 1990). In Avaro, all decisions, no matter whether they relate to strategic issues or involving some detail in a business trip, must be approved by the Board of Directors. Mike commented: ‘The decision-making mechanism follows a fixed rationale, and sometimes it simply doesn’t work. It is frustrating for us to understand sometimes. For example, a critical business decision can be made around one single factor, ignoring all other rather complicated factors. You can imagine the disastrous result...’ This internal control mechanism also often hinders the board’s independence in monitoring the performance of the management (Pearce and Zahra, 1991).

The Domestic Battlefield

Avaro’s MAYZ system has contributed to solving the ‘micropayment’ puzzle over electronic transactions which have been faced by financial institutions for a long time: on the one hand, banks and credit card companies would like to cover micropayments in their card-based electronic payment model; on the other hand, it is too costly to manage card-based micropayments in the current payment environment. Avaro’s mobile proximity payment technology provides a cheaper alternative payment instrument for credit card transactions electronically.29 Technically, Avaro holds the pre-eminent position in its products and services in the mobile payment field. However, businesses like Avaro face enormous challenges in diffusing this technology and getting them adopted by the society and consumers. This is especially true in Korea where the social and cultural environment does not traditionally encourage entrepreneurial spirit and venturing activities. Korean industries are dominated by large bureaucratic firms – chaebols – and entrepreneurship is relatively discouraged in comparison to the career development within chaebols or government (Mathews and Cho, 1999). As Amsden (1989: p. 9) claims, ‘squeezed between the state on the one hand and the salaried engineer on the other, the private entrepreneur’s usefulness in the
multidivisional enterprises of late industrialization [in Korea] appears much reduced when measured by the standards of the entrepreneurial histories of advanced countries’. Entrepreneurial start-ups are often in a weaker position to recruit and retain capable personnel. Another disadvantage faced by them is the high transaction costs involved in the typical inter-organizational relations with large firms (Kim, 1997).

In Avaro’s case, Jack observed a similar thing. He said, ‘A man being an entrepreneur or working for an entrepreneurial company has relatively low social status, while a man working for a Korea chaebol such as Samsung or SKT has much higher social status.’ A chaebol is a business group consisting of varied corporate enterprises engaged in diversified business areas and typically owned and managed by one or two interrelated family groups (Kim, 1997). SKT, the dominant mobile carrier, launched a ‘flat marketing’ campaign telling consumers that all mobile proximity payment solutions are just the same in order to undermine Avaro’s real value, though, in the end, the market proved that SKT’s Moneta solution was a comparatively weak one (ICA, 2004).

Patent infringement
Three mobile carriers in Korea compete for the 34 million mobile subscribers by offering all kind of applications, especially in the data communications area. Competition is especially fierce between SKT and KTF, with each one offering a range of new services as they expand from bandwidth to streaming media and music downloads. Mobile payment solutions are just another battlefield among the telcos in Korea.

In April 2001, Avaro received venture capital investment from Kookmin Bank to be used in financing the setup of payment infrastructures for its MAYZ system. The first ever commercial MAYZ system was launched in Korea in April 2002.

Two months later, Korea Telecom FreeTel (KTF) launched its own brand mobile payment services – K-merce – licensing Avaro’s core technology. At the same time, SKT was working on an IC chip-based mobile payment system. However, the mobile carrier experienced difficulties in finding a local card company as a partner (Hankyoreh Shinmun, November 14, 2002). Local credit card companies felt that SKT’s chip-based mobile credit solutions indicated an attempt to enter the credit card business. Despite SKT’s proposal to significantly lower the merchant transaction commission, the reaction from the domestic card companies was cold. Furthermore, domestic card companies, Samsung Card, BC Card and LG Card joined Avaro’s payment protocol (used by both LGT and KTF) following Kookmin Card. Therefore, the major credit card
companies, which hold more than 80 per cent of Korea’s credit card market, rejected SKT.

When the MAYZ technology was demonstrated to SKT in early 2002, SKT was truly impressed, but to Avaro’s surprise, SKT did not want to license Avaro’s technology. SKT wanted to ‘develop’ and ‘own’ the mobile proximity payment standard. Subsequently, SKT invested more than 70,000 million Won (about US$11 million) in its own R&D into mobile proximity payment technologies (in a short space of time) and launched its Moneta Plus Program in partnership with Korea Foreign Exchange Bank (Card) and Woori Bank Card in late October. Avaro considered that SKT’s Moneta Plus Program infringed Avaro’s patents in mobile proximity payments which encompass all devices and payment systems. Although SKT’s Moneta solution uses a method that stores the credit card information in a separate IC chip, which is different from Avaro’s method of using the memory chip in the phone, since both solutions use infrared-based technology to make the payment, conflict seemed unavoidable. On November 14, 2002, Avaro publicly announced, ‘Avaro has acquired the patents on wireless payment devices that uses infrared and business model for the overall system. We may take action against various wireless service providers that are presently pursuing their own wireless service methods’ (Avaro Press Release, November 14, 2002).

Mr Ho-sung Ha, the General Manager of the m-Financing Planning Team at SKT counterattacked Avaro, saying: ‘The patents that Avaro InfoTech has are too over encompassing, with possibility of misinterpretation and other problems. We will receive legal consulting and will submit, within a short period of time, to the legal court a request to nullify the patent.’

Avaro’s patents, which obtained approval in the first half of 2000 and had been evaluated and upgraded in November 2002, held strong and provided no basis for SK Telecom to overturn the patent through any legal action (Avaro Press Release, November 14, 2002). In fact, SKT quickly realized that there was no way to escape the ‘relayers’ of Avaro’s technology and wireless downloading (both of them are Avaro’s core technologies and under the protection of Korean patent law for the next 20 years) in its mobile payment solution. As Mr Bog-heui Kang, the Chief Legal Officer of Avaro, pointed out, the set of its patents allows Avaro to enjoy exclusive rights for network card systems that use wireless Internet and wireless communications to issue (download) cards into the IC chip or memory chip of the mobile phones, and to disable these cards when required.
It was not difficult to understand SKT’s motivation: as the leading mobile carrier, SKT could not take the ‘humiliation’ of following a start-up firm. According to numerous email discussions among key personnel involved in the SKT deal at Avaro, SKT understood that what Avaro was looking for in the alliance with SKT was SKT’s money and market power, therefore it used these as the ‘bait’ to lead Avaro to let go of its core technology bit by bit.

The battle continued between the mobile carriers and was extended to include financial institutions (credit card firms and banks). Unfortunately, Avaro clashed with both parties in the battle. As an entrepreneurial start-up, Avaro did not have enough resources (capital, human or social) to have a confrontation with either party. Avaro was at that time in negotiations with a variety of industry giants (including telcos and financial institutions) seeking a capital injection. Entrepreneurial start-ups are often in a vulnerable position in alliances with industry incumbents (Alvarez and Barney, 2001; Rothaermel, 2001). Apart from a lack of learning ability and absorptive capacity (Deeds et al., 2000), another disadvantage faced by start-ups, especially in Korea, is the high transaction costs involved in inter-organizational relations with large firms, for example, the exploitation of a start-up firm by an industry incumbent occurs in the form of deferred payments or the wide practice of offering financial kickbacks which can potentially raise the start-up firm’s costs (Kim, 1997).

In December 2001, SKT put forward a bid of US$50 million to acquire 40 per cent of the equity in Avaro. This gave Avaro the expectation of the venture being valued at US$125 million.

**Standardization and MIC’s role**

Korea’s leading English newspaper *The Korea Herald* (October 12, 2002) reported, ‘Korea’s mobile carriers and service providers are in a dispute which is delaying the standardization of mobile credit card payment solutions’. This marked the start of a ‘standard war’ on mobile proximity payments in Korea.

Mobile proximity payment solutions can be either locally (region)-based or globalized. A locally based mobile payment solution can be developed in a proprietary platform and used, for example, in a public transport pass, such as the Octopus Pass used in the MTR in Hong Kong. A globally based solution, on the other hand, requires an open standard and platform (Chesbrough, 2003). The success of any payment instruments relies on the ‘scale’ – the boundless cover of payment infrastructures – that allows consumers to conduct financial transactions anywhere in the world. For Avaro, creating an open architecture/platform which encourages and invites many third-party service providers to develop applications on this
platform would provide the vital engine to generate the network effort for a self-sustaining growth in the network economy (Chesbrough, 2003). For mobile carriers such as SKT, to own or sponsor a technical standard almost guarantees success because of network effects in the network economy (David and Greenstein, 1990; Greenstein, 1992; Arthur, 1996; Schilling, 1998; Shapiro and Varian, 1998).

The Ministry of Information and Communication (MIC), the government industry regulatory body, has a very clear vision of promoting Korea’s mobile payment technologies as the global standard. The reason for standardization is that it can build a minimum set of interoperability requirements for card and terminal manufacturers. In order to do so, cooperation between the mobile communications industry and the financial services industry is key. This is because, first of all, the installation of mobile payment infrastructures is costly and should be carried out by both parties; and secondly, global standardization requires coordinated efforts across industry boundaries. However, there are many unsolved issues regarding the cooperation between telcos and financial institutions. Among others, they include such details as how to split revenues, or even the business model for two or more parties to work together, which have delayed progress on streamlining the fledging mobile payment industry.

On August 30, 2002, MIC called a first meeting to discuss mobile payment standards in Korea. The meeting was attended by three mobile carriers – SKT, KTF and LGT; financial institutions, including BC Card, Samsung Card, LG Card and VISA Korea; Avaro (Mr Kim) and IrDA (Mr Wilson); as well as several academic representatives (Dr Shin from Sejong University, Dr Yu from the National Computerization Agency and Dr Lee from Korea University). According to the minutes of this meeting (MIC, 2002), MIC wanted to convey its position to all the players that a coordinated effort was needed in order to avoid incompatible mobile payment solutions and, therefore, to accelerate the adoption of the mobile payment technology in the country. MIC’s concern came from two considerations: (1) to avoid duplication of investment, and (2) to minimize consumers’ confusion and discomfort in regard to adopting and using mobile payments. This meeting emphasized the importance of cooperating with international standard organizations such as IrDA because of the potential opportunity for exporting Korea’s mobile payment technologies.

MIC had recognized Avaro’s contribution in standardization of mobile proximity payments. In early 2002, Avaro MAYZ technology was selected as one of the ‘top 100 global-standard products’ by MIC. Most credit card companies showed their support for Avaro’s standard. For example, at the MIC meeting, representatives from BC Card made the following points: (1)
BC Card has already signed an agreement with Avaro to use its infrared methods for mobile payments/settlements and the security issues have been evaluated by Woori Bank and the Financial Supervisory Service (a government agency); (2) it does not make any sense to wait for something that is not yet out in the market when there is something that is already in existence (MAYZ UMPs); and (3) the agreement to install the Avaro infrared module on CDs (cash dispensers)/ATMs (automated teller machines) is nearly complete (in fact, Kookmin Card, Choheung Bank and Woori Bank already had Avaro infrared modules on their CDs/ATMs). The financial institutes expressed their concern that once the financial infrastructure is established, it is difficult to change. However, Samsung Card and LG Card pointed out that every player should protect its own interests and that they had not decided their direction for the mobile payment standard.

At this meeting, Visa Korea revealed its ambition of being a dominant player in the emerging industry. A ‘Participation Agreement’ with Visa Korea prepared by Mr Cho at Avaro indicated that Visa Korea signed an MOU with SKT to work together in infrared-based mobile payments simply because of SKT’s dominant position in the mobile communications industry, but at the same time Visa was negotiating an agreement with Avaro because of Avaro’s worldwide reputation in the area of infrared technology. Visa Korea did not want to lose on any front.

Avaro stated that in order to make the mobile payment technology a success, there is a need to have a global standard. Avaro also expressed its intention of working with partners and maintaining its position as a service provider, which is core to its business model. In addition, Avaro clarified any confusion about its MAYZ protocol versus IrFM’s protocol. Avaro pointed out that its R&D team had been actively involved in the development of the IrFM protocol and Avaro’s MAYZ protocol was compatible with IrFM’s.

At the meeting, for the first time, SKT openly expressed its ambition to issue its own credit cards for mobile payments.

The conclusion of the meeting was to ‘...make mobile payments a second CDMA’ and ‘...increase Korea’s image’. However, it was not clear how to divide the investment costs among the various parties. MIC declared that the most appropriate standard would be chosen and, once it was chosen, the government would do everything in its power to enforce it (MIC, 2002).

After this meeting, Avaro had an internal meeting to discuss its strategies under different scenarios. The worst-case scenario was that RFID (radio frequency identification) would be chosen as the mobile payment standard, which was not very likely. Avaro’s task was to promote infrared
technology and to try to keep both SKT and KTF in the infrared camp. In the case that IrFM was chosen, Avaro had to launch a campaign to overturn the perception that Avaro’s MAYZ was totally unrelated to IrFM as well as promote the fact that Avaro had led the IrFM initiative. The conclusion of the meeting was that the best strategy for Avaro was to work together with Visa Korea, as well as with the mobile carriers. Consequently, the IrDA officially announced that ‘...it was after Avaro InfoTech, a Korean company, joined the IrDA and became actively involved in the IrFM Special Interest Group that there was acceleration of world-wide activities in this respect (especially in Korea), recognition of the commercial viability of IrFM and actually commercialization and fast migration to full acceptance of IrFM’ (IrDA, 2002).

On September 16, 2002, Mr Kim met MIC officials and answered their questions about the interoperability of MAYZ’s solution and Visa’s. From a technical point of view, following Nick’s suggestion (made in an email to Mr Kim on September 15, 2002), Kim explained the fact that IrFM is the protocol that every mobile carrier should support because it is the architecture for mobile payment infrastructure. However, there are many different profiles (platforms) that work on the IrFM protocol, such as Visa Profile, MAYZ Profile and so on. Visa Profile is a specific platform for Visa users only. The difference between MAYZ and Visa profiles is that MAYZ, an open platform, can support multiple applications.

Nick’s email explained,

...no matter what the government wants, they can’t make all card associations use a single profile (platform). That won’t happen anywhere in the world. Perhaps all mobile carriers would choose to implement Visa Profile because it is Visa’s. However, the government should support many such profiles (platforms). Plus, Visa would not allow any other card companies to use their profile for mobile payments. There must be other profiles for non-Visa payments. In fact, MAYZ Profile already exists in the market to fill in this gap. It has been proven that MAYZ Profile works well for multiple bankcards. At some point in the future, MasterCard and Amex would define their own profiles. It is unlikely that they would take similar approaches as Visa’s.

For Avaro, this represented a great opportunity: instead of waiting for the world to define hundreds of profiles, Avaro could promote MAYZ Profile because it can be used by many smaller bank cards, and for ticketing, coupons and so on other than the big brands such as Visa, MasterCard, Amex and JCB. Nick explained that this is similar to the situation of CATs: ‘it is possible to have a single CAT with a single platform that supports all Visa Cards. But there must be other CATs supporting applications for other cards.’
Following Nick’s advice, Mr Kim emphasized that standardization is about standardizing the architectures and platforms, but not the applications. He recommended at the meeting that the MIC mandate the standardization of IrFM protocol and infrared-based platforms — but not the payment applications for mobile payments.

In an email from Mike to Nick on September 19, 2002, he summarized his phone conversation with Mr Kim the night before. According to Mr Kim, the real issue of the standardization was not from the government, it was from telcos. Three telcos were in talks with MIC and tried to convey their opinion that IrFM and Visa profile would be all Korea’s mobile payment industry needed. Since the MIC is not a group of technical people and since they tend to support the telcos, Mr Kim was worried that MIC may choose to exclude Avaro’s profile in the standardization. On the other hand, with the exception of Visa, the financial institutions were aligning themselves against the mobile carriers’ move and supporting Avaro’s profile. In fact, Visa was misleading: Visa gave the telcos the impression that Visa and its member banks would follow the telcos’ proposal. However, Visa could not dictate to their members in their choice. Mike interpreted Visa’s position as, by supporting SKT, Visa could get access to the EMV (Europay, MasterCard and Visa) terminals in the market for its physical card transactions, which has little to do with IrFM proximity payment. To make things even more complicated and frustrating, Mr Kim was told at a meeting with SKT on September 18 that ‘We [SKT] don’t care about Kookmin Card, BC Card, Samsung Card, LG Card and so on. Even with less than 20 per cent of the market (excluding market shares of Kookmin, BC, Samsung and LG cards), we believe our marketing muscles, coupled with a government mandated standard (IrFM plus Visa), would confuse consumers and we would win more consumers.’

It took more than three months for MIC to decide on the mobile payment standard in Korea. In early December 2002, MIC openly endorsed the IrFM protocol as the mobile proximity payment standard in Korea and financial institutes were allowed to choose their own user profiles (including Avaro’s) if they are compatible with IrFM. This means that both Avaro’s and Visa’s profiles were selected in the standardization. As one of the efforts to support mobile proximity payments, related government agencies drafted a bill which would legalize a financial transaction without requiring a signature in the mobile payment environment: legally, a signature is needed to authenticate a financial transaction in the current credit card-dominated payment environment.

In March 2003, MIC assigned ETRI (Electronics and Telecommunications Research Institute) to establish an ‘agent’ to conduct an IrFM compliance test. The purpose of setting up this ‘agent’ was that it
could certify profiles that are IrFM compatible. The three mobile carriers
would need to get approval from this agency for their future mobile
payment applications (MIC, 2003a). This initiative represented MIC’s
intention of securing domestic interoperability of infrared proximity
payments and minimizing duplicated investment for infrastructure. MIC
recommended that this function be carried out by a Korean company which
should be authorized by IrDA. Dr Jin-man Cho, a researcher specialized in
smartcard technologies at ETRI, was put in charge of this project and
approached IrDA for support (MIC, 2003b). Inside MIC there were
discussions that Avaro should be appointed as a ‘test lab’ and ‘agent’ for
this task.

Despite enthusiasm within Avaro in Korea, Mike’s reaction was rather
negative. In an email to Mr Kim on March 18, 2003, he said, ‘I think this
would be a very big mistake [referring to setting up Avaro as a testing lab
for IrFM in Korea]’.

His rationale was, first of all, that Avaro was not an IrFM company. He
said, ‘Our business success lies in our MAYZ Centre business model rather
than IrFM-enabling products. Our long-term business strategy should be to
develop into an independent agent which supports all profiles compatible
with IrFM protocol. Putting ourselves in a position of an IrFM test lab
would confuse our real clients as well as potential investors.’ Secondly, he
was concerned that Avaro had already stretched itself too thin in many
projects. It was working at the time, for example, with USC (University of
Southern California), Sprint, SKT, NTT Data and KTF, and it would not
have enough engineering resources to become a test lab for IrFM. Thirdly,
and perhaps most importantly, he said ‘there is NO MONEY in being a test
lab’. Lastly, he warned that there existed a potential conflict of interest in
testing their own solutions with their potential clients. He said, ‘A test lab
should be run independently’.

Negotiations and discussions about the standardization of mobile
payments continued in Korea. There are two different levels of factor
influencing the decision of the standard: technical definitions and business
models. These two types of factor arise in respect of all eight major
stakeholders in the industry value chain of mobile payments, including card
associations and issuing banks; chip-card manufacturers; mobile phone
handset manufacturers; mobile carriers; standard-setting organizations;
merchants, application developers and mobile payment service providers.
In June 2003, Mr Kim asked his international team to prepare a
presentation for his meeting with MIC. The key issue was that the payment
standard should support all common card types and multiple applications,
such as ticketing, loyalty programs, vouchers/coupons, identification and
transportation, and the standard should accommodate multiple security mechanisms because security is a key concern of the individual banks and card associations. The most important advice the international team gave to MIC was to take into account the ability to define a payment standard that could be exportable, including coverage of different mobile handset environments and different POS/CAT terminal environments.

At this stage it was hard to decipher the extent to which the government or the industry was driving the development of the mobile payment standard. It seemed that the government was playing an important role as it did in the development of CDMA in Korea. However, evidence from multiple sources (such as the alliance between Visa and SKT and SKT's aggressive proposal) indicates that the government regulatory body was strongly influenced by the incumbent players. The government may simply have been playing a role in facilitating smooth cooperation across industry boundaries. One thing MIC was very clear about was that it did not agree with SKT's plan to issue its own credit cards for mobile payments and it warned that mobile carriers should not clash with each other.

Working with industry giants – competition or cooperation?
As shown in Chapter 4, apart from the benefit of access to information and advice through the alliances with other organizations, start-up firms can benefit from their associations with well-regarded individuals and organizations (Stuart et al., 1999). Often the reputations of the alliance partners can send strong 'signals' that may help start-up firms achieve legitimacy and, therefore, reduce transaction costs and risks. This is because positive perceptions based on a firm's network linkages may lead to subsequent beneficial resource exchange (Hoang and Antoncic, 2003). However, due to the imbalance of learning ability and absorptive capacity between start-up and established firms, start-up firms are often left in a situation that their larger partners appropriate more from the alliances (Alvarez and Barney, 2001; Rothaermel, 2001).

On the morning of January 1, 2003, the head of m-Commerce of KTF enquired if Avaro could be of any help for KTF to adopt IrFM. KTF's stage one mobile payment solution was based on Avaro's MAYZ profile. KTF was planning its stage two mobile solution that was to be an IC chip-based technology following the 'international standard' of IrFM. For its second stage plan, KTF particularly wanted Avaro's support for KTF's cooperation with the four card companies which had already joined the MAYZ club.

Meanwhile, Avaro was making progress in building its relationship with SKT. After dropping its proposal to acquire a major stake in Avaro, SKT instead asked Avaro's help to upgrade its Moneta Plus Program. SKT
openly admitted the failure of its single card based Moneta mobile payment solution. SKT’s request was quite demanding. It required Avaro to be its exclusive solution (technology) provider, which would exclude Avaro’s right to work with either KTF or LGT. In addition, SKT required that a ‘detailed technical proposal’ be signed between SKT and Avaro before the end of March or there was no contract at all. Avaro was facing severe cash flow problems at that time. Despite continuing disputes over patent issues with SKT, these proposals, especially given they were from SKT, brought hope for Avaro, as well as concerns. In an email to Mike, Mr Kim said, ‘I am still very curious about what is SKT’s real intention in regards to the relationship with Avaro’. Mike considered this was a hard question to answer. ‘I don’t really know what SKT’s real intentions are, but the last visit to Korea and my discussions in the US with the SKT people lead me to believe that they really do want to work with us. The problem is that we really need to define the relationship with SKT.’ Mike’s position also reflected his concern about the cash flow problem Avaro was facing. He emailed Jack: ‘We should be careful with our response to SKT because we really want them to invest in developing the new architecture and funding some of this development.’ He suggested that Avaro provide SKT with a ‘high level – to avoid technical details’ proposal that defined the basic requirements and approaches to the development of a multi-card and multi-application platform. He said, ‘...the proposal also should include reference of protecting the elements of the multi-card concept that is Avaro-unique and discussions of the possibilities to export this concept internationally’.

It later became clear that SKT wanted to use Avaro to bridge its relationship with the financial institutions and show to MIC its effort to take a ‘cooperative’ approach in setting the mobile payment standard. Based on the meeting minutes between managers from SKT and Avaro (Avaro, March 31, 2003a), SKT had realized it should not be in ‘conflict’ with the financial community and it really wanted to create a win-win situation, working with the financial community by leveraging Avaro’s relationships with the four banks that had agreed to support Avaro. SKT specifically asked Mr Kim to pass on its message to the financial community that SKT was not hostile to them. SKT also assured Mr Kim that SKT agreed that Avaro’s open architecture/platform proposal for the financial community was the right direction. SKT also admitted, ‘...because it was chased to meet the commercialization target date, there were many areas that were not satisfactory in its Moneta Plus Program and SKT would like to have Avaro help Moneta’s business go well by providing many solutions that are consumer oriented’.
At the meeting, Mr Kim also learned the reason why SKT had set the end of March as the deadline by which to sign the contract. All three mobile carriers were required to present their mobile payment solutions in compliance with IrFM at a meeting with MIC on April 2, 2003. After SKT knew that both LGT and KTF were approaching Avaro for technical advice, it made its proposal to Avaro and invited Avaro to be SKT’s exclusive solution/technical partner. This move was meant to stop Avaro from working with either LGT or KTF.

Taking into consideration all available information, Avaro’s management did not go immediately for the contract with SKT which they had previously wanted so much. Instead, Mr Kim suggested that both parties should work out the terms and conditions of the contract including detailed specifications about the roles for both Avaro and SKT, the revenue model and how the revenues should be shared.

Meanwhile, Avaro continued its negotiations with KTF regarding the possibility for the two organizations to work together in the area of mobile proximity payments. In this deal, KTF had won the support of four major financial institutions: BC Card, LG Card, Samsung Card and Kookmin Card. In the agreement between Avaro and KTF, these four banks would give Avaro six billion Won (about US$5 million) for the infrastructure of mobile payments, contingent upon using a chip-based solution over KTF’s mobile network. Because these banks were supposed to pay for the cost of the infrastructure, they insisted that the banks would control the issuing of credit cards; that meant Avaro would give up the rights to the wireless downloading of financial information into KTF’s mobile phone memory cards or IC cards, one of Avaro’s sources of income. With the major banks at its side, KTF argued that the mobile payment platform should be KTF’s K-merce.

One interpretation of this deal was that KTF wanted to use Avaro as an ‘agent’: the banks would give the money to Avaro for upgrading/replacing KTF’s existing mobile payment infrastructure and all contacts between the banks and KTF would go through Avaro. Mr Kim thought Avaro could make around a 30 per cent margin on this 6 billion Won investment, which was highly valuable when his venture was cash thirsty.

This deal was driven by the four banks’ desire to lead the establishment of the standard for mobile payments in Korea. Avaro’s international engineers, however, were shocked when they learned the terms and conditions of this proposal. They believed that it would obviously constrain Avaro from developing an open architecture/platform. Mike tried to ease their frustration. He emailed Nick who was invited to attend the meeting with KTF, ‘…we really need this to happen…While we should not be bullheaded, we need to define how we make money in any business model
whether it makes sense to us or not ... Apart from this, there is a side complexity you need to watch for which is [that] Mr Kim is using this negotiation to draw in SKT.' In addition, Mike suggested that MAYZ should be kept at least as a sub-brand that would be valuable when consumers crossed networks or tried to use the solution in the international market, as he knew the ideal choice should be a third party brand, such as MAYZ, that carries a certain level of service interoperability.

To the international engineers, the real issue in this proposal was for KTF to license Avaro's technology; it meant Avaro was limited to providing technology only to KTF in Korea. As Mike pointed out, ‘...we should try to be their technology provider, but we should not be held hostage to them through exclusivity provision to KTF’.

Things turned even more dramatic. At the MIC’s meeting on April 2, 2003, KTF announced that if SKT wanted KTF to join its club, SKT would have to pay an astronomical fee to KTF for the conversion of all of its MAYZ legacy phones and infrastructure, as well as to build any new infrastructure, totaling around 180 billion Won: about US$30 million. The alternative was that KTF would continue working with Avaro to provide a multi-card open platform to its subscribers.

The reason for KTF’s turn-around was that SKT kept on asking for a ‘participation fee’ from KTF to join the SKT club. KTF decided it did not want to pay any money to become dependent on SKT’s crippled Moneta Plus Program. KTF felt SKT’s demand for it to pay for a portion of SKT’s infrastructure costs that had already been used to establish SKT’s Moneta service, not to mention the possibility of KTF becoming dependent upon SKT’s technology, was not at all fair.

Soon after the meeting, Mr Cho at Avaro received a call from SKT. It was clear that SKT wanted to somehow mitigate the disaster, meanwhile blaming Avaro for coaching KTF.

Within a few days KTF made an announcement that it would not accept nor be working together with SKT for a ‘Korean Standard’ for mobile payments and would instead be working with Avaro to provide an open platform that would be beneficial to all parties involved. It was a critical win for Avaro. If KTF had decided to join SKT, then there would have been no place for Avaro in Korea. What Avaro was actually hoping for was that with KTF turning its back on SKT, SKT would then be more willing to compromise to work with Avaro for an open platform and a mutually agreeable standard.

In this triangular game between SKT, KTF and Avaro, none of the parties could afford the possibility of the other two working together. For example, KTF would be left in a very difficult position if SKT and Avaro
moved on to a partnership. The best outcome was for Avaro to maintain a neutral and independent company which conducted services for national proximity payments. To achieve this outcome, the MIC’s role was essential. MIC used a multi-card (application) requirement in any mobile payment services as a condition for mobile carriers’ to launch their 3G services. Only Avaro had the core technology of multi-card and multi-instrument solution which could meet MIC’s requirement. SKT was forced to agree to purchase infrared-enabling hardware worth 2 billion Won and pay for the development of various services. LGT also agreed to continue its licensing of Avaro’s technology for its second-stage mobile payment services.

**Avaro’s relationship with Visa**

Visa is the most prominent credit card used worldwide. It is also an innovative product. Avaro had a complicated relationship with Visa due to Visa’s complex organizational structure. Visa has offices in each region; for example, Visa Asia Pacific, Visa North America, Visa Europe, and so on. In each region, Visa also has country-based offices, such as Visa Korea. Each regional office, or even country office, has its own business interests and its own business agenda. Visa International, as the head office, has the capacity to set guidelines and policies, but does not have the real power to influence its regional or country offices. Visa International is really a service organization for the regions. Avaro has a very close working relationship with Visa International because Visa International is an active member of IrDA and a founding member of IrFM, where Avaro is also a founding member. It is well known within Visa International that Avaro contributed greatly to the development of the IrFM 1.0 Specification (Visa International, 2004). If Avaro got support from a regional or country office, Visa International would support Avaro too. But Visa International does not like to get involved in solving problems Avaro has with Visa’s regional or country offices.

Avaro had very a good working relationship with Visa Asia Pacific, too. In August 2002, VISA Asia Pacific signed an MOU with Avaro to support its MAYZ system on the campus of Sook Myung Women’s University with the aim of promoting infrared technology as a suitable mobile payment standard. Bruce Mansfield, Head of Mobile Commerce, Visa Asia Pacific, commented: ‘We look forward to working with Avaro InfoTech to enable their system to accept VISA as a payment option.’ Mr Kim responded, saying, ‘...we are very pleased to work with VISA [Asia Pacific] to expand this service globally. Both VISA and Avaro are committed to global standardization and interoperability in respect to proximity payment that will provide true benefits to customers.’
Visa Korea, however, was driven by SKT because Visa was attracted by SKT’s 30,000 mobile proximity payment terminals in the market that would carry Visa’s virtual cards (Avaro, March 12, 2003b). Visa Korea initially wanted to sign an exclusive agreement with Avaro, but its move towards SKT was in its best interests for short term, because Visa Korea wanted to move from a magnetic strip to a chip-based virtual card quickly and SKT could provide help.

After Avaro’s MAYZ profile was more or less agreed on by local banks as a mobile proximity payment standard in Korea, Visa Korea formed an alliance with Avaro again. With the MIC’s endorsement of IrFM Specification 1.0, Visa worked with Avaro to migrate its infrared proximity payment profile to comply with the IrFM standard (Visa International, 2004).

**Financial Crisis**

While Avaro was making progress in the Korean market, the company was facing severe cash flow problems. In fact, the company, financially, was in crisis.

The first sign of cash flow problems emerged in late 2002. On November 7, Gary (one of the engineers working for Avaro in the US) was concerned that he did not receive his salary. In fact, none of the international team members had received a cent that month. They were told by Director Park (the CFO) in an email, that the company had ‘a bit of cash flow problem’ and that their payment would be deferred.

In December, the same deferment of salaries for the international team members happened again. Nick raised this question in an email to Mike: ‘... is this [the deferring of paying salary and expenses reimbursement] just happening at this time? Or is this a long-term problem? All of us have multiple thousands of dollars in expenses due.’ Without a quick answer from either Director Park or Mr Kim, on December 15, Mike emailed Jack, the cultural bridge between the west and east, inquiring, ‘Please tell me honestly what’s happening. I can’t tell a lie to people here and we have all planned our lives as if we are getting money this month ... Just let me know what’s going on.’

Jack, though very sympathetic to his counterparts across the Pacific Ocean, really did not know what was going on. ‘I get different messages from different people who are involved in payments ... I still wonder what rabbit he [Mr Kim] has.’

On February 10, 2003, Jack informed Mike that their expenses would be settled as soon as Avaro’s accounts showed that they had received a
US$500K investment from KTI, a small Korean venture capital company. Upon receiving this news, Mike expressed his deep concern and disappointment.

Everyone should know that since we have not been paid for five months (October, November, December, January and February), financial planning is extremely critical for all of us. This means we NEED THE TRUTH and we NEED TIMELY INFORMATION. I have paid bills expecting that this money would be in no later than yesterday. I told my wife that we would be reimbursed last week. Now I have to explain to my wife why I am still working for a company that won’t even pay our expenses let alone salary and I will have to cash in more of my retirement fund (with large tax implications) just to cover the checks I sent out this week. I hope people now know why giving us correct information is the only acceptable way of doing business. I expect that Damon, Nick and Gary are in similar positions but I will let them speak for themselves. For now, I am just furious and demand to know exactly what is going to happen...

While on a business trip to Korea, upon receiving advice about a delay in reimbursing their expenses, Nick expressed similar concerns. ‘While I am sympathetic to our financial difficulties, I have no more money. Mike and I SPECIFICALLY made sure that expenses would be paid by a certain date (now well past due) BEFORE I committed to making this trip.’ He added: ‘As a result, I need somebody to show up tomorrow morning at the Plaza Hotel [in Seoul] and pay the hotel bill. I’ve been here for 10 nights so the bill will be significant. Being five months without pay and more than US$5k in debt to expenses (including airfare and other stuff I’ve already paid but not reimbursed), I cannot take this debt... I am as committed as ever but I can take on NO MORE PERSONAL DEBT while I wait for the financial situation to be solved.’

On March 18, 2003, Mike emailed Director Park again asking for Avaro's current financial statements. Mike was told it was impossible for him to have access to such information. Therefore, Mike emailed Mr Kim directly requesting the information. ‘I would appreciate your support in getting me financial information from Director Park. I need a complete set of financials and a cash-on-hand statement from Director Park [the CFO]...’

A week later, Director Park informed Mike that the ‘...financial statement of Avaro will be released to you right after the general shareholders’ meeting on March 28’. After that meeting, Avaro’s board decided to clear all payments they owned to their international employees.

However, the same story happened again. On May 7, 2003, Mr Kim emailed Mike regarding a delay of payment for the international staff. He said: ‘As to the expense you spent last month will be wired the day after
tomorrow (tomorrow is holiday). As to salary, 50 per cent of monthly payment will be sent at the same day. Another 50 per cent can be sent on May 20th thru May 24th. I am very sorry for this delay and late notification. I really hate to tell you like this way.’

Things were going from bad to worse for the international team. Again on May 7, Mr Kim said, ‘I am making the very worst case scenario of our financial projection. According to that, we need to cut some of the budget we are spending for the monthly salaries. I am waiting for that projection for next several months from Dir. Park. Please give me a little time to have that data.’ This email obviously put a fire under Mike. He responded, ‘...I am somewhat confused because I assume that we are getting a note related to the SKT relayer contract and should be paid within a month or so for the NTT Data deal, so I don’t know what you mean by next several months of cutting salaries. Please explain.’

It turned out that the financial situation was far less rosy than anybody had expected. SKT was forced by MIC’s policy and the deal between Avaro and KTF into an agreement to purchase Avaro’s infrared-enabling hardware worth 2 billion Won (US$1.7 million) and pay for the development for various services. It turned out that the projected income from SKT was for the licensing fee of 10,000 Won (US$8.5) per adapter. This would equal a total of 10,000 Won X 20,000 adapters or 200 million Won. However, half of the 20,000 adapters would be given away free of charge to the merchants and the other half will be sold at US$65 (76,500 Won). The distribution would not start until June. SKT would not pay Avaro for the distribution or for the licensing fee until 90 days after the relayers were delivered to merchants. In addition, SKT had already appointed an agent to distribute the adapters for which Avaro had to pay. Therefore, the total revenue from SKT would be just 965 million Won (US$820,000). According to the Agreement, Avaro was responsible for US$100,000 of the manufacturing costs. This brought the overall profit to Avaro down to US$720,000. This money would come into Avaro in equal increments over a three-month period beginning, at the earliest, in October 2003.

This calculation was far beyond Mike’s understanding. He realized that Avaro would not have any money for the time being and that for the foreseeable future (through the end of the year) the only income they could count on was US$400,000 from NTT Data (discussed below) and the US$720,000 from SKT.

The next day, Mr Kim emailed Mike explaining his position, under the pressure of his board members, of introducing a cost-cutting scheme especially in the area of international personnel salaries. He said, ‘I need to
have your idea of budget cut of personnel cost so that I can tie it to the
option price ... Other shareholders want the stock option recalculated to
show some commitment to cut company cost in terms of personnel salary. I
just need your opinion.’

Mike and Mr Kim had several discussions back and forward and reached
the following agreement: (1) Mr Kim would try to get the board to approve
both the stock grants and the exercise price he and Mike had agreed on and
try to complete this before any new investment came in; (2) Mr Kim
promised that the deferred payments (salaries and expenses) to the
international employees should be paid back when the company had a
better financial position; and (3) Mr Kim promised that the salary cut
would be applied for just one year from that time (June 2003).

However, the board considered that the share price agreed by Mr Kim
and Mike was too low. Mike argued that in US start-ups, employees
normally pay one-tenth of what investors pay, but that their shares come
with the same rights as those of investors. In Avaro’s case, the international
employees demanded the same rights as Hikari (a Japanese investor: see
discussion below).

Mike expressed his deep disappointment. ‘Despite all this [deferred
payment for several months], we are still here and working hard for
Avaro.’ Mike started to realize that there might be some serious cultural
differences between the Korean board and the US team. The Korean board
members considered that the international team was too costly and showed
little commitment to Avaro; however, the international team believed they
had been working very hard and, in fact, they had sacrificed a lot for
Avaro. For example, working without a regular consultant employment
contract in the US, they had to pay 20 per cent or more of their salaries to
cover such costs as social security and retirement plans that a standard
employment contract would cover, plus their medical and dental costs;
also, their salaries were way below the industry standards in the US. On
behalf of his team, Mike argued that, ‘...because we believe in Avaro and
the MAYZ technology, we endure all our personal sacrifices. We expect to
get generous option grants if we work hard now.’

In the end, Mike agreed to have a 20 per cent salary reduction
contingent upon the following conditions: (1) any agreed salary reduction
should be compensated for in an equivalent value of additional shares at the
same purchase price per share as the original share grants; (2) a legal entity
should be established in the US which offered a legal consultant
employment agreement and covered standard medical and dental benefits
to its international employees upon receipt of any new investment; (3) the
salary cuts should only, for at most, last a year and should Avaro receive
appropriate investment, they should cease early; and (4) salary reductions should only start once all the deferred pay is reimbursed.

It seemed very hard for Mr Kim to persuade his fellow board members to agree to these conditions, though he personally believed that they were reasonable.

On July 1, Mike and his team received their salaries for May (but not for June). The dispute in Avaro’s boardroom indicated a divide among the board members regarding continuing Avaro’s investment in its international activities.

In late July, Jack emailed Mike, ‘...I see no alternative but to pressure for my “new entity: MAYZ International” plan. We can make changes to this situation, but I really don’t think there are any alternatives except that framework.’

What Jack was referring to was his business plan to create some form of overseas presence that would allow potential international investors to view Avaro as a company truly committed to the international market. In fact, Jack had submitted a proposal back on November 17, 2002 which outlined a detailed business plan to establish MAYZ International, an independent business entity headquartered in London. Among other things, the core concept of Jack’s plan was the establishment of a separate ‘MAYZ International’ that would in effect act as the central command office for all Avaro’s international activities. The objective of setting up such an entity was to stay away from Avaro’s hassled domestic environment and to concentrate on developing international business, including pursuing international capital investment and developing international markets. It was proposed that the entity be self-funded. Though Jack and the international team worked hard to try to convince the top management about the rationale of this plan, the board decided it was too early to establish such an international entity, and that the company needed to focus on becoming successful in Korea first.

**Internationalization**

Since the very beginning of his appointment at Avaro, Jack started to consider how to expand Avaro’s activities in the global market. Mike was a critical contributor to the development of Jack’s proposal for establishing an independent MAYZ International entity.

Avaro started its international activities in January 2000. Owning such an outstanding technology as MAYZ in an emerging industry, Mr Kim understood the importance of promoting his technology in the international arena. During the initial international expansion phase (2000-2001),
Avaro's focus was to promote recognition of MAYZ technology worldwide. During this period, Avaro formed a department dedicated to international planning and development headed by Jack, as well as recruiting the international team based in the US dedicated to international marketing and engineering, headed by Mike. During the second phase of its internationalization (2002-2003), Jack and the international team started to systematically shift their focus to attracting business partners and investors worldwide.

**International beachheads**

The first overseas market Avaro looked at was Japan. In August 2002, Avaro made an approach for a formal relationship with NTT Communications Group in Japan. In September, NTT and Avaro signed an MOU authorizing NTT as MAYZ's market development arm in Japan.

In early January 2003, Jack and Mr Sang-ho So (General Manager, Overseas Planning) had a breakfast meeting with Dr Tachikawa, the Chairman of NTT DoCoMo. The meeting was arranged by Dr Lee and he also attended the meeting. After the meeting, Dr Tachikawa arranged for NTT Data, the system integration arm of DoCoMo, to lead the talks with Avaro. In April 2003, NTT Data signed an agreement with Avaro for technical cooperation and the establishment of a mobile credit card payment system using the MAYZ solution in Japan. This technology tie-up with Avaro would allow NTT Data to gain the system building and operating know-how for the service that Avaro had in Korea (NTT Data Press Release, April 10, 2003). Avaro would make use of this tie-up as a foothold to advance its overseas business beyond Japan. The contract with NTT included three stages: the first, consulting services, that is, analysing existing MAYZ Centre technology for the Japanese market; the second, a trial stage in Japan in which NTT Data would host a MAYZ Centre on a trial basis; and the third, a commercial service in Japan. A consensus among three Japanese mobile carriers would be needed for the commercial roll-out of any mobile payments, because all banks wanted to work with a standard which all carriers would endorse, and consumers would want to have access across different banks and mobile networks.

Even though the United States was far behind Asia and Europe in developing and deploying mobile payment solutions, in September 2002, Avaro was planning to launch a US field trial of mobile payments on the campus of the University of Southern California (USC) along with several other IrFM stakeholders. This trial was approved by the Financial Services Technology Consortium (FSTC). According to the plan, the program would be jointly sponsored by Avaro and the University of Southern California's (USC) Marshall School of Business. The trial system would
allow students and faculty at USC to use standard Handspring Treo Communicators equipped with MAYZ Profile to make payments at infrared-enabled point of sale sites. Cingular Wireless would provide the mobile network and a virtual VISA card would be issued by the USC Federal Credit Union. USC’s Bookstore would be the first merchant in the US to go live with this wireless payment method. In its strategy to become a fully digital campus, USC planned to extend the capabilities of the service to include access services and coverage on and off campus. The possibilities for this technology range from wireless payments and ticketing to wireless entrance permissions into residence halls and laboratories.

The USC trial was a sunk cost for Avaro and there was no near-term opportunity to offset the investment with any kind of revenue. The trial, however, had two objectives. The first objective, driven by Avaro, was to enable an environment where students were able to interact with university facilities and services via a handheld device (mobile phone or PDA); and the second objective was centred on an opportunity for the Centre for Telecom Management in the Marshall School of Business to conduct a comprehensive research project to study adoption behaviours of emerging technologies. USC, Avaro and several of Avaro’s partners also treated this effort as a first step in building and refining enduring products and services for commercial offerings on campus as well as in the larger commercial marketplace (IrDA, 2003).

Europe presented very good international market expansion opportunities for Avaro because it could become a GSM showcase for MAYZ UMPS system and Europe was very advanced in terms of m-commerce and m-payments. On September 17, 2002, Siemens’ communication division, Information and Communications Mobile (IC Mobile), signed a Letter of Intent (LOI) (Avaro and Siemens, October 1, 2002) with Avaro to work together in providing the MAYZ UMPS system in Europe, the initial target being Switzerland, and expanding to other European markets serviced by Siemens. Specifically, a MAYZ Centre would first be established in Zurich, which could act as a support centre by initially servicing all of Europe, starting with Swiss banks UBS, Migrosbank and Postfinance. The two parties were actively negotiating an OEM relationship agreement according to which Siemens would initially build a proximity payment solution that combined a Siemens-managed hosting site using Avaro’s MAYZ Centre technology, and, at the second stage, would expand MAYZ into a generic service and transaction service for retail (loyalty, coupons, vouchers), entertainment (event tickets, content distribution) and transportation (mass-transit pass/ticketing) services in Europe.
On November 5, 2002, after meeting with Siemens, Mike reported that the outcome was ‘extremely productive’. Siemens was willing to work with Avaro to complete an agreement as soon as possible. Mike also met people from the three banks, UBS, Migrosbank and Postfinance, which were working together with Siemens. ‘Siemens has given all of the banks the impression that they have an OEM agreement with Avaro already. So they actually have the same interest as us in making the relationship happen.’

According to the LOI, the two parties would work together to fully develop, test and commercialize the MAYZ system for the European market by the first half of 2003 (Avaro and Siemens, October 1, 2002).

**MAYZ International**

After his meeting with NTT DoCoMo’s Chairman in September 2002, Jack was also approached by Mr Takeshi Sanda, Vice President of JAFCO Investment (Korea) through the introduction of JAFCO (Japan). Mr Sanda expressed his company’s interest in funding Avaro’s further development and requested a visit to Avaro’s office as well as more detailed financial information. Avaro responded to this lead by providing the more detailed information requested. However, as Jack said, ‘Basically, we pretended that we were not in dire need of funds, but rather that we could use the funds to more actively take up the numerous overseas opportunities.’

The reason why Avaro could attract intense international attention was because Avaro was the world’s first firm to commercialize infrared-based mobile proximity payment technology. But gradually, its momentum was fading. From an investment point of view, the best option for Avaro to benefit from its ‘first-mover’ advantage (capitalize on the interest it had generated from the international community) was to establish an international identity for Avaro’s overseas operations. However, it was recognized that the engineering model would need to be upgraded and developed to suit international markets, including carrying out international engineering activities, developing new MAYZ Centre open architecture, supporting regional and country-based engineering activities, and developing, establishing and centrally coordinating MAYZ Centres worldwide.

The sense of urgency that Avaro had to be fast to win the battle of the standard by building a big ‘network’, which only the international market could possibly provide, was one of the driving forces for Jack and his team to pursue their MAYZ International business plan. Jack turned his attention to a wide range of international investment communities. He understood that international marketing required longer-term investment and more resources than Avaro could afford. It would be very difficult to maintain
the viability of the international operations without further investment and such investment would be more likely to come from the international investment community because the venture capital market in Korea would not have the capacity and mindset to finance firms like Avaro's global expansion (Kim, 1997). On the other hand, Korea would not be an attractive target for foreign investors due to its political instability, and different business environment and accounting system. This left Avaro in a dilemma: traditional Korean investors have no wish to invest in international expansion activities; however, the international investment community regarded Korea as a poor choice when making venture capital investment. To solve this dilemma, Jack orchestrated the development of a business plan for MAYZ International which should be self-funded, viable and able to provide value to Avaro Korea. Apart from being a window to attract international investment and develop global business, this plan was designed as well to allow Avaro Korea to concentrate its limited capital and management resources on its domestic business.

Vladimir Morgeson was one of the contacts Jack had in the UK. Morgeson was the owner of Antenova, a company working closely with Ericsson, Nokia, Siemens, T-Mobile, Vodafone and other handset original equipment manufacturers and network operators. He personally had presented to a large number of venture capital companies investing in mobile technologies. Antenova had just raised US$9.4 million in its second-round funding. Vladimir was keen to help Avaro and he expressed his wish to become involved in MAYZ International once the new entity was founded.

On October 7, 2002, Morgeson shared his thoughts with Jack. Considering the nature of MAYZ International, and what was happening with Siemens, he believed that venture capital funding might not be the best source for Avaro, given venture capitalists’ particular attitudes toward ‘exit’ of their investments (quick returns). Instead, he suggested another route, namely, to approach mobile carriers such as Cable and Wireless, which have ‘not-fully-used data centres’. Companies in such situations are willing to ‘pay/invest’ in technology companies to make use of their data centres. He said that if MAYZ Centre could be seen broadly as a data centre, then this made sense; it could be a twist on the better-known ‘vendor’ funding (or corporate venture capital investment (Dushnitsky and Lenox, 2005)), where network infrastructure companies including Nokia, Ericsson and Motorola gave funding to telecom carriers to use network infrastructure equipment. In responding to Morgeson’s question on Avaro’s competition, Jack said:
There are no real competitors that we are aware of in the international arena. In Korea, our ‘competitors’ can be said to be SK Telecom, the largest wireless service provider in Korea. However, they are domestically oriented and have not commercialized as of yet (they do not even have a pilot or trial). We are also considering the possibility of claiming our patent rights with them, but are very cautious since they are someone we want to ultimately work with.

This gave Morgeson a lot of confidence in Avaro’s technologies. He arranged a series of meetings with venture capital companies for members of Avaro’s international team. Between November 3 and 9, 2002, Mr Kim, Jack and Mike were invited to attend meetings with Quester Capital Management, NIF Ventures Co., Atlas Venture and Advent Venture Capital in London. Jack and Mike were preparing for the London meetings while the standard war between Avaro and SKT was heating up in Korea, so these meetings were delayed.

Meanwhile, Mike was meeting various investment banks and venture capital companies in the United States. After months of preparation and several rounds of internal discussions among the international team members, on December 11, 2002, Jack submitted his proposal to establish an independent MAYZ International entity to Avaro’s board. According to this proposal, MAYZ International should be established under the condition that it would be fully responsible for its survival and growth, without a capital injection from Avaro Korea, so that MAYZ International would have complete management independence; though in the MAYZ International structure, Avaro Korea would be a major shareholder, be represented on the board, and maintain the status of ‘technology holding company’.

According to Jack’s proposal (Avaro, December 13, 2002), in the structure of this new entity, MAYZ International would have a perpetual and exclusive technology and marketing license for Avaro Korea’s technology and business model, as well as the exclusive right to sub-license them to its regional and country offices, except Korea. According to the detailed arrangements, Avaro Korea would hold a 40 per cent (Avaro’s three founders 34 per cent and Japanese Hikari Tsushin Capital 6 per cent) equity stake in MAYZ International and the costs of transferring the technology would be absorbed by MAYZ International. In addition to 40 per cent equity in MAYZ International, Avaro Korea would receive a licensing fee for allowing the new entity’s right to use its MAYZ technology and accumulated know-how in regard to MAYZ Centre, as well as a 10 per cent royalty on revenues (after break-even point). The total licensing fee of US$1.5 million would be paid by MAYZ International to Avaro Korea over a two-year period. In order to manage the technology-transfer smoothly, the proposal advocated hiring several key personnel
from Avaro Korea as full-time employees of MAYZ International. MAYZ International would carry all expenses incurred. Mr Kim would serve as the Chairman of the Board of Directors and Mr Wilson (Mike) was recommended as the interim CEO. It was estimated that approximately US$2.5 million would be needed for the first six months. However, this was the minimum capital requirement and that would, according to Jack’s proposal, not leave the new entity any margin for any contingencies.

London was chosen as the prime location for MAYZ International’s head office for the reasons that: (1) Europe was very welcoming of the mobile proximity payment concept, (2) London is the centre of finance in Europe and (3) European investors would be more willing to invest in an entity located in London than in Korea. The head office would be responsible for functions such as corporate governance and operational management, as well as overall development and coordination of business on a global basis (except Korea). The London office would also be the European Regional Office until a separate regional office could be established.

Another international office would be located in Silicon Valley, USA. This office would be the American Regional Office until a separate one could be set up. The primary responsibility of the US office would be to establish and manage international engineering activities such as coordinating with Avaro Korea’s engineering function, and developing global strategic alliances and partnerships.

Mr Kim was the only one in the boardroom who was a supporter of the concept of MAYZ International; other board members found it difficult to accept the proposal. In an email to Mike, Mr Kim expressed his concern about ‘fairness’ – he suggested that the approach should be taken from the Korean investors’ standpoint. He said: ‘...we should not let our investors think that we are stealing the company’. The Korean shareholders believed that they had already invested directly and indirectly about US$2 million in the international activities and at least 40 per cent of this investment – US$800,000 – was a waste for Avaro. Though Mr Kim thought that the international team’s value was far greater than could be assessed monetarily for Avaro’s success, he also had to take into consideration Hikari’s – the Japanese investor’s – opinion (see the discussion on Avaro’s Japanese investor below).

Mike let Mr Kim know exactly what he thought of the Korean management team, particularly Hikari. In brief, he believed they behaved too greedily. In defence of the proposal, Mike said:

...the funding exercise will contribute US$1.5 million dollars back to [Avaro] Korea for licensing of the technology. This essentially pays back most of the
cost invested in international so far. In addition, all new engineering work will be given back to Korea for free for Avaro's use. This is going to be many millions worth of free engineering work over time. Finally, Avaro Korea is still going to get a huge percentage of the new entity's equity... In fact, it is going to be the international team that raises its own capital or otherwise they are essentially out of jobs. This is a very big risk to take and will be one for quite some time.

For the US$2 million 'investment' in international activities, the Korean board members required a full 'road map' in as much detail as possible. In fact, they considered Mr Kim to be biased towards the international team. They believed that '...they [the international team] do not have any outcomes and there will not be any international success if without Korean success'. Mr Kim, however, insisted that the international team had contributed a lot to Korean success. He even offered to set up the international entity with his own money so that he could be more 'independent' of the board of Avaro. Harmonious interpersonal relations are very important for Mr Kim in Avaro's decision making. As Kim (1997: p. 69) claims '...cooperation, consensus, and social solidarity among members of the organization are important in decision making and organizational life, creating distinctive organizational dynamism in Korean firms'.

It is not clear whether Mr Kim was convinced by his colleagues on the board or forced to agree with them to pursue the strategy of focusing on the domestic market. Different from the western ideology of viewing the individual as an isolated entity and as a force reshaping society, Confucian ideology regards 'self' as a centre of relationships, or a collective sense, thereby leading to a special kind of entrepreneurial spirit and managerial style in the communities where Confucian ideology is valued (Redding, 1995), which, in turn, promotes self discipline, consensus formation and cooperation in entrepreneurial activities.

In any event, the difficult debate came to a conclusion in January 2003. On January 24, Jack had to inform Vladimir Morgeson, who had been working actively with venture capital companies in London on Avaro's behalf, that

...our [Avaro's] top management decides that they want to have investors (including overseas investors) to invest first in Avaro Korea. The sad thing is that we are now lacking in money that I don't think I can possibly make a trip to London. What I would like to suggest is that if you have the time you can make the pitch to potential investors, and if there is anyone who is interested in investing in Avaro Korea, then we can start providing them with documentations with the objective of receiving a term sheet from them.
Morgeson expressed his deep disappointment upon learning Jack’s news. ‘I should honestly say that all of this is very disappointing news, since I have spent a considerable amount of time and have used personal connections and favours to warm up a good number of investors about MAYZ International.’ He said that investing in Korea is not a very attractive option for a European-based fund for reasons of remoteness and lack of country-specific knowledge. He said, ‘...you and other Avaro top managers will have to spend a lot of time in Europe in order to raise money (be it for Korea or Europe) – VCs do not invest by correspondence’. In his view, at this point, it might be better for Avaro to raise funds in Asia, though he still believed there was a fair opportunity in Europe. Morgeson concluded, ‘...no matter how good MAYZ technology is, the commercial opportunity will soon be missed’.

The international business plan was proposed to Avaro’s board when Avaro was confronting a serious situation where it found it difficult to manoeuvre: fighting with fierce domestic giants on the one hand, whilst wishing to get their financial support because Avaro’s cash was drying up on the other. Its resources (personnel, engineering and capital) were far below what was required to pursue the market momentum Avaro had built in Korea, Japan, United States and Europe. Jack understood Morgeson’s concern that time was desperately running out and that mobile payments were no longer a novelty: Nokia, Vodafone and T-Mobile would roll out their systems within 12-18 months. Once the momentum in the international market was lost, it would be difficult to re-establish, since the business partners would lose faith in Avaro and its technology’s capacity to keep up with the fast-growing mobile communications industry.

The proposal of establishing the MAYZ International entity not only reflected the international team members’ passion and faith in the MAYZ technologies, as well as their dream of personal wealth, the approach also carried its own strategic value at that time. Specifically, it would allow Avaro/MAYZ International to benefit from: (1) continually building its market position in South Korea by developing cooperative partnerships with domestic players and responding to domestic market developments in a flexible and quick fashion; and (2) boosting its technological leadership position then pushing it as the industry standard by developing and building strategic alliances and partnerships worldwide and absorbing international capital injections.

It seemed that attracting capital investment became a critical success factor for MAYZ International. But the real obstacles actually came from Avaro’s existing investors and board members.
The organizational and capital structure which was proposed is shown in Figure 6.3:

![Diagram of Avaro Holding Company and its share structure]

Source: MAYZ International Business Plan (Avaro, 2002)

Figure 6.3: Avaro Holding Company and its share structure

Avaro’s Capital Structure

The initial capital for establishing Avaro came from the personal investment of Mr Kim and his two friends, Mr Wong and Mr Park. After Avaro’s success in its development of the MAYZ mobile payment technologies, Avaro received a series of small-scale investments from Korean companies. The Korea Development Bank invested in Avaro after it was selected as a venture company with the most outstanding technology in Korea in late 2000. The funds were designed to help Avaro build its international presence. In 2001, Avaro received investment from Kookmin Card and LG TeleCom in funding the commercialization of its MAYZ UMPS system in Korea. In additional, several institutional investors, such as KIS Van Company and KTI Venture Capital, invested in Avaro’s operations.
Hikari Tsushin Capital (HTC)
The Japanese venture capital company, Hikari Tsushin Capital (HTC), represented the first foreign venture capital investment in Avaro. In 2001, Avaro conducted a series of marketing activities in Japan to promote its MAYZ system, including participating in and demonstrating the MAYZ system at the World PC Expo 2001 in Tokyo and presenting it through a guest lecture at the Mobile Commerce World Conference in Tokyo. These activities attracted HTC’s attention. In September 2001, HTC invested US$5 million in return for 15 per cent of Avaro's equity and Mr Nakayama was selected as the representative of HTC to sit on the board of Avaro. This investment put Avaro’s market value at about US$33.34 million at the time.

There are three significant points in regard to HTC’s investment. First, being in the business of retailing mobile devices in Japan, Hikari (the owner of HTC) had a rather short-term horizon for its investment in Korea. In fact, the investment of the US$5 million from HTC was part of a fund that would expire in 2005. As Mike pointed out in his email to Mr Kim, ‘what this means is that Nakayama-san’s view of long-term return and short-term return are different from yours or mine’. In order to guarantee a return on its investment by the end of 2005, HTC wanted to maximize the short-term returns by pursuing any opportunities in Korea, instead of worrying about international activities which would bring long-term value for Avaro. ‘So any investment in projects that don’t start to yield a return until 2005 with lots of investment beforehand looks bad to him [Nakayama-san] and Hikari. I believe that he doesn’t have the luxury of worrying about anything that has a return beyond next year [2005]. So eliminating international spending and focusing only on Korea makes sense for him’, Mike commented. Another complication for HTC was that any further investment would mean a dilution of its investment in Avaro. Initially, HTC had offered Mr Kim US$10 million instead US$5 million when making their investment in Avaro. However, Mr Kim would only accept US$5 million because he feared that a foreign investor (HTC) would take control of his venture. As Mike said, ‘It is a hard decision when the start-up ventures need to take outside finance. Because it means you have to give away your controlling power ... Mr Kim calculated that Avaro needed only US$5 million at that time, though it was a “zero buffer” plan.’ Back in 2001 the extra $5 million cash meant a lot to Avaro. He said, ‘...if we did have that extra US$5 million, we might have developed international market differently. You need cash to develop market and then attract more investors.’
Even though Mike believed ‘Avaro should get rid of Hikari the Japanese investor’, when the company needed support for its international investment plan, he acknowledged Hikari’s initial contribution. Avaro in fact had an ‘anti-dilution’ clause in which HTC’s approval would be required for investment that would go beyond 10 per cent of Avaro’s equity. HTC indicated that it would be willing to consider ‘strategic partners’ (such as SKT), but as far as ‘non-strategic’ partners were concerned, HTC needed to be convinced. Given HTC’s role in Avaro’s decision-making, especially in respect of its international activities, Mike strongly recommended that HTC should be eliminated from any discussions with further investors.

The third point about HTC’s investment was, though holding a minority share, Hikari influenced many business decisions which was not necessarily in the interests of Avaro’s long-term development. Essentially, Hikari ‘pushed’ Avaro into being an opportunist company. When dealing with SKT, Nakayama-san became involved in the detailed business decisions. He tried to push Avaro’s engineers to develop solutions exactly for SKT’s needs and wants. As Mike commented, ‘...this, as a result of a wrong strategic decision, almost killed Avaro’. When the cash flow issue became severe, Avaro’s board, under pressure, was eager to make the company a target for acquisition by domestic giants, such as its enemy, SKT. SKT took every advantage it could of Avaro’s predicament and that inspired Avaro to fight back.

The original venture capital structure influenced Avaro’s investment philosophy: as Mr Kim said, ‘...we don’t want to have any dominating investors from any country other than Korea which potentially will convert Avaro’s Korean identity’. However, this mindset had cost Avaro greatly. For example, in July 2001, Avaro’s MAYZ technology was short-listed in a bid to provide mobile proximity payment solutions in Singapore. At the time, the Singaporean government required the company be Singapore-based. Avaro withdrew its bid because Avaro’s board would not consider registering a Singapore-based entity, fearing that would diminish Avaro’s Korean identity. In fact, the Singapore market potentially meant a lot for Avaro, because, as a GSM market, a foothold in Singapore would help Avaro develop GSM-based solutions and it would become a ‘window’ for Avaro to expand internationally, especially in Europe.

**Olympus Capital Holding Asia**

After the unpleasant ending of his attempts to bringing venture capital into Avaro and achieving his dream of establishing MAYZ International, in early June 2003, Jack decided to give it another try. He met his old university friend, Mr Yong-hak Jung, President of Olympus Capital in
Korea, and discussed with him the possibility of ‘...investing about US$10-20 million for about 30-50 per cent of the company’ (Olympus Capital, 2003).

Olympus Capital is an investment management firm exclusively focused on private equity investments in high-tech companies in Asia. It has a network of experienced investment and operating professionals throughout Asia with offices in Hong Kong, Seoul, Singapore and Tokyo, as well as in New York. Olympus was approaching the end of the investment of its first-round funds of US$700 million which started in 1997 when the company was founded. From the beginning of 2004, Olympus Capital would start a new round of funds of US$1 billion for another seven years. Olympus Capital was considering creating an investment portfolio of five to seven companies for the new round of funds, focusing on mobile communications, personal computer (PC)-based or mobile-based gaming and education. Olympus Capital’s strategy was to make investments with one account manager concentrating on only two to three companies, with actual participation in the board and management.

A few days after Jack’s meeting with Mr Jung, he received a formal Letter of Intent (LOI) and Confidentiality Agreement (CA) from Olympus for Avaro’s review. If these two documents were signed by Avaro, Olympus Capital would require further information (including financial data) from Avaro and would want to conduct due diligence. Olympus expected that the investment decision could be reached within six months.

Jack emailed Mr Kim about the progress with Olympus. He said, ‘The CA [Confidentiality Agreement] does NOT mean we are obliged to provide Olympus with any confidential information, but rather if we do, it will be treated as such.’ Mr Kim suggested to Jack that he should inform Olympus of the existence of the anti-dilution clause in HTC’s investment agreement. Mike was not very comfortable with Mr Kim’s suggestion. He said, ‘I think that HTC should be out of our life since they are unwilling to help us with continued investment. So having them participate in any discussions with future investors is very confusing to me.’ It seemed Olympus was quite confident that the anti-dilution clause with HTC could be eliminated from the agreement.

On June 16, 2003, Mr Jung emailed Jack inviting him to give a presentation on Avaro to one of the Olympus founders from the New York office. However, Mr Kim was not comfortable with Jack being the main focal point between Olympus and Avaro. He personally advised that he would take over the negotiations with Olympus. In fact, Mr. Kim’s position in relation to Olympus was to ‘...try to use the “anti-dilution” clause to attempt to maximize valuation from potential investors’. His argument was
that HTC would be unwilling to approve any investments beyond 10 per cent unless HTC could get a ‘fair valuation’ which was greater than what they had invested. Of course, these tactics meant that Mr Kim would try to control the negotiations so that he could manipulate the situation.

At that point, Jack believed that Olympus wanted to value Avaro at approximately US$50 million. However, the Board of Avaro, knowing that the Korean mobile carriers had been required by the MIC in its standardization effort to use Avaro’s MAYZ technology, wanted to ‘wait’ and tried to go for a higher valuation, close to US$100 million. Mr Kim, who Jack said was ‘too confident’ that the mobile carriers would sign the agreement with Avaro in two to three weeks, believed that Olympus’s offer of US$15-20 million plus taking management control was unacceptable.

Jack was uncomfortable that he was not in a position to negotiate with Olympus further because Mr Kim was personally involved. In order to ‘detach’ himself from the deal, he took a three-week vacation in California with his family. Upon his return, on August 11, Jack emailed Mike inquiring about the progress with Olympus ‘...wondering whether there was any progress after your meetings with Olympus’.

Apparently, things did not work out quite as smoothly as Jack would have hoped. Mike had become very frustrated that Avaro’s board still had not signed the Confidentiality Agreement, let alone carrying out the detailed valuation activities Olympus required such as interviews and meetings with Avaro executives and employees, review of documents, meetings with Avaro’s partners, assessment of financial reports and examination of the business plan.

At long last, Mr Kim signed and returned Olympus’ Confidentiality Agreement. Immediately, Mr Jung emailed Mike (copied to Kim) requesting the proposed business plan from Avaro as well as meetings with KTF about their receptivity to Avaro’s technology versus other mobile payment schemes. Kim replied ‘We will welcome you talking with KTF and LGT, but we will advise you the right time because of other telco’s relationship soon.’ He was referring to SKT’s offer to ‘buy’ Avaro.

On August 25, Mike contacted Mr Jung trying to secure a meeting with Olympus to present the information which had finally been put together by Avaro. He said, ‘...I will present a plan including the contact list for our mobile and bank partners which will help you to evaluate the status of our current business in Korea and internationally. I understand this has taken longer than you wish. I want to personally apologize for any delay in satisfying your expectations ... We are anxious to finally satisfy your request for information.’ Obviously this action was under Mr Kim’s pressure after he realized that his plan to get a ‘higher’ valuation and investment from SKT became uncertain.
On September 7, Jack met Mr Jung in a personal capacity. Though still expecting Avaro’s financial data, Mr Jung was rather taken aback by the terms of the investment plan for Avaro. One critical question for which Olympus required a quick answer was whether the present shareholders/founders/owners of Avaro were willing to even consider a dilution of their shares.

Two days later, Mike asked approval from the board members for his plan to meet Mr Jung and to inform him that due diligence could be carried out. However, Kim replied with ‘I am not sure if Olympus Capital is serious. If not, we do not need to waste our time.’ Mike argued that even though nobody knew, at this stage, how serious Olympus Capital was, it was still worth finding out the real possibility. Mike emphasized the fact that ‘...we need money and it doesn’t appear as if SKT is responding and we don’t have a meeting date set yet with Mr Kim from SKT’. He added, ‘...in fact, the way venture firms work is that if we don’t fit within their investment philosophy, they can always refer us to other VCs that we would fit into. So it is very important for us to keep them happy. Anyway, anything that Olympus would request of us is the same thing that any VC would request, so doing this preparation work through Olympus would still be beneficial to us.’

On September 25, Mr Jung informed Mike that ‘I [Mr Jung from Olympus] am not interested in investing in Avaro anymore’. The reason was that Avaro kept delaying submitting the required documents and Olympus interpreted this as ‘... we [Avaro] are not eager to get funded’. Mike phoned Jack and confirmed the bad news from him. The reason Olympus had turned cold was not only because of the delay in the submission of requested documents, but more importantly because of Mr Kim’s attitude: he was not cooperative and he was showing himself to be too opportunistic. According to Jack, Olympus Capital was still quite keen about Avaro’s technology; however, a condition for Olympus to reconsider the investment plan for Avaro was to replace the CVO, Mr Kim.

Jack suggests that apart from Mr Kim’s attitude, one reason that set Olympus back was miscommunication or misunderstanding: while Mr Kim was talking about and promoting MAYZ technology, Olympus was more interested in the financial growth potential Avaro could bring to the investment. While Olympus was following stringent industry norms of conducting serious due diligence, Mr Kim felt it was too intrusive. Mr Kim used his Korean business approach to deal with venture capitalists; for example, he believed that personal relations would be most important in attracting venture capital investment. Mike said,
Mr Kim thinks how good Avaro's technology is and perhaps he doesn't really understand the process of venture capital investment ... However, venture capital investors no matter where they are, require a serious investigation and process of due intelligence. Mr Kim and his team in Korea were not cooperative in providing the information required. At the end, Olympus insisted that Mr Kim should be replaced as the CVO if investment was made on Avaro.

As seen in Chapter 4, the management of a growing venture is an extremely challenging task, which demands a range of skills different from those required to start the business. This is a process of 'the transaction from entrepreneurship to professional management' (Stevenson, et al., 1989: p. 593). In 2003, with 50 employees, Avaro was a much larger and more formal organization than the one Mr Kim started with of eight employees six years before. This growth required corresponding changes in not only Avaro's business controlling system, but also its decision-making mechanisms. However, in the transition process, the real challenge for Mr Kim and his colleagues on the board was to recognize the need for such changes (Stevenson et al., 1989).

Jack's Role and the Effect of His Departure

In September 2003, Jack decided to leave Avaro to pursue his own business interests. In an email to Mr Jung at Olympus Capital, he said,

It appears there is a market for those who can provide a service of establishing the groundwork for foreign companies' entry into Korea, and therefore I am thinking about setting up a small operation of my own. On the other hand, I am also thinking about providing 'communication bridging and relationship development' services for Korean companies which seek internationalizations ... As for Avaro, there are a few projects I would like to continue working on and focus on, such as pursuing new opportunities in Australia, Malaysia, the Philippines and China, but if possible, I would like to pursue them as part of my new venture under a new relationship with Avaro that is I would work as an advisor or 'consultant' while Avaro would be my 'customer'.

Jack was not the only person who left Avaro at that time. The Director of R&D and the Director of PR (public relations) left, and the total number of employees dropped from 50 to 30. Jack believed that Avaro's management team needed a dramatic change, or transformation. The old management was so inefficient that it basically could not manage the company's development. In common with many entrepreneurs, Mr Kim was very good at creating new things, but he perhaps lacked the capability to manage a larger organization. Avaro's employees in Korea, as important stakeholders in the company, felt the crisis. No open discussions were ever
undertaken to address the issues with the employees, and certainly no information about the company’s situation was given to them. Lack of open communication is a common problem in Korean firms (Chung et al., 1997). Overcoming the communication barriers between hierarchical levels (from top down) is a critical managerial task for a high-tech start-up, especially in a fast changing environment. According to Jack, Mr Wong, the CEO focusing on domestic operations, was not the right person to run the company, especially after it had survived the initial start-up phase. As a bankruptcy lawyer, Mr Wong was very useful at the start-up stage, especially in advising the management on how to avoid typical ‘traps’. However, when the venture developed, his way of handling things (overwhelmingly cautious) became a constraint for the fast decision-making that a growing venture needed. As Dodgson and Rothwell (1991) point out, this is a common threshold facing high-tech entrepreneurial start-ups.

Mr Kim, a naturally optimistic man, managed not to show his fears or worries in front of his employees; maybe because he didn’t feel he had reached the ‘bottom line’. Jack and several people who chose to leave Avaro commented that ‘...we need to be informed with the facts...to feel we are a part of the company’. Instead, Mr Kim was still trying to use his ‘great vision’ to inspire his employees when everybody could feel, as one employee described it, ‘crisis’. One well-known story about Mr Kim among his employees was how he once survived a major crisis in his earlier entrepreneurial venture career. His precision-mechanism manufacturing venture once had products returned which were not meeting the quality standards of a foreign market at a time when his venture owed US$1 million to the manufacturing contractors. Essentially that meant Mr Kim was broke. He didn’t sleep for a week and he lost much of his hair in that week. Eventually, one of his friends lent him the money and rescued him from the crisis. This is one of the reasons why he trusted his friends and why he felt he needed to maintain his personal networks. From Mr Kim’s perspective, Avaro’s situation was not as bad as the one he experienced before.

Jack’s role
Apart from his role as the Vice President of Overseas Planning and Development, Jack had been the ‘cultural bridge’ which linked communication across the Pacific Ocean, especially for R&D projects. For example, Gary once emailed Jack seeking advice on how to understand the ‘Korean Myth’ that Korean engineers worked harder than their American counterparts. He gave an example that during the critical time working for
NTT Data and Sprint (lab trial work), both he and Dave worked long hours plus on weekends, while the Korean engineers seemed to perceive that the Americans were not working hard enough. He said, ‘I would like to know where this crazy notion comes from and that magic things can happen in Korea because the engineers work so hard ... You folks don’t have a clue what life is like in an American start-up – I won’t tell you how many 90+ hour weeks I’ve worked in start-ups at crisis times.’

Basically Gary’s concern was whether the notion that Koreans work harder than Americans was just a piece of Korean culture or specifically related to Avaro – a start-up firm. Jack explained ‘...it is hard for normal Koreans to imagine that you are, in fact, working and making money, without going to the offices’. In addition, there was a different focus for Korean versus Americans engineers when doing their job. ‘Korean engineers seem to just delve into actual product work activities, while the international team works on architecting and planning more than the Koreans.’ Jack said,

The sad thing is ... working absurd long hours on an irregular basis is the norm and expected in Korea. Magic things have happened in the past due to just working absurd long hours without much deep thought or planning ... As a Korean, I would have to confess that it might be more of a socio-cultural-historical factor. However, I would also say at the same breath that Koreans have also shown to be quite resilient and capable of adapting new concepts, processes and systems of improving themselves. However, I am afraid it may take another generation or so for our level to reach a point where you might be satisfied.

Another instance was the NTT Data project. This project, which was located in Japan, involved a project team that was composed of engineers from the US and Korea, none of which could speak Japanese. Managing this cross-cultural and cross-language project became almost painful. Nick, the Director of International Engineering and also the project leader for NTT Data’s project, complained that the Korean engineers did not follow the project management plan and even by-passed him to have direct contact with the Japanese client. As a consequence, this caused unnecessary confusion, embarrassment and a loss of credibility; as the project leader, Nick found he did not know some of the very critical decisions of the project in front of the client. Nick made the comment, ‘If he [Mr Steve Kim, the Korean engineer who was in charge of the project coordination] does attend the [NTT Data project] meeting in Japan, each of our roles have to be CLEAR and we have to be very consistent in presenting roles and acting them out in front of the Japanese’. The issue of
leadership emerged as another barrier to the success of the overseas projects.

Jack tried to soften the situation. After Jack had a long talk with Steve, Steve agreed to be a good ‘project coordinator’ and in that role he would provide support to Nick and let Nick lead the conversations with overseas clients or partners, and he would discuss his suggestions/ideas frankly with Nick before any meetings. However, Jack suggested the Americans not use the terms ‘superior’ and ‘subordinate’; there was possible cultural misinterpretation of these words in Korea. He said, ‘It might track back to the days of Korea’s dictatorship when we all hated these words in Korean.’

The project leader should be defined as the person who would have the overall responsibilities of the project and lead everything in relation to technical matters for the overseas project, and was effectively the ‘boss’ of the project, while the project coordinator should coordinate the activities for the project assigned by the project leader. Jack said, ‘...in international projects it is Nick who leads with support from Korean engineers coordinated by Steve, and for Korean projects there can be various people who lead with support/assistance from international (Nick’s team) coordinated once again through Steve’.

However, as far as Mike was concerned, ‘I think you [Jack] are wrong when it comes to peer-to-peer relationship between Nick and Steve. This completely counters to the way things should work. If Nick is to be the project leader of the overseas project, he is the leader. That means that Steve (for this project at least) would be his subordinate. This is really something that we are trying to get through to everyone. It cannot work any other way. So we had better work it out now.’ He also emailed Nick, ‘You are the technical project leader, therefore you are the superior ... If Steve goes, he should be there at your request and understand that you will drive the communication.’

As Chung et al. (1997: pp. 136-137) argue, ‘At the societal level, a sense of inclusion promotes strong nationalism which creates an antagonistic attitude toward foreigners.’ Korean firms often experience problems of managing cultural differences when they venture into global markets.

When things became really blocked between the engineers across the Pacific, Nick had to ask Mike to get things done through Mike’s direct contact with Mr Kim. Once Mike emailed Kim trying to draw his attention: ‘We have come to the point where we need to accelerate the communication between the engineering team in Korea and the US...’

Having learned of Jack’s departure, Nick emailed Jack, “I appreciate all your efforts and I know how hard this special burden it puts on you to be the cultural bridge. You’re invaluable in this and we all say it frequently
but I'm telling you again that we know and appreciate this. Without you this would be infinitely harder, or impossible.'

Jack continued to provide his advice to the international team as a friend. Jack tried to lead the American engineers to appreciate the importance of social interactions among colleagues in Korea: the ‘yon-go’ – relation-based behaviour. Gary was once in Korea on a business trip and he invited Jack to have dinner and sought Jack’s advice (again) on how to deal with Korean engineers, although Jack had already left Avaro. 'I'd like to take Mr Heo [new manager in charge of overseas business] out to dinner one night – some place with “Soju” [Korean hard liquor] – maybe Mr Park [Steve] as well. Any advice that you have is always appreciated. I think that it will be very important for me to have a good working relationship with the MAYZ Centre team and you mentioned that dinner/drinking is a good thing to do with Mr Heo.' Jack gave him some very practical advice, such as, ‘...in regard to going out for “Soju” with Avaro people, I would advise doing it within this week’. His tips included:

- ‘Focus and talk with Mr Park and Mr Heo even if discussion with other participants might be actually more interesting. They will know you are making the effort and appreciate it.
- Do not discuss business or technical matters. Focus on family, hobbies, trips, food, weather or whatever. Remember, you are trying to develop “human relationship” and not a “working/business relationship”.
- If possible, go for food that you share together. A good dish would be Potato Stew.
- I assume you are buying? If things go well, Mr Park or Mr Heo will buy the next round or at next time.
- By the way, Mr Heo is not a heavy drinker.’

Mainstream Korean culture is based on Confucianism (Redding, 1995). Confucianism came to Korea from China in the 5th century. Though Korean culture has been influenced by both American and Japanese culture in the 20th century, Confucianism has been the dominant influence on Korean society and its legacy remains influential in providing the basis for moral standards and social norms in Korea (Amsden, 1989). According to Chung et al. (1997), Confucian values essentially permeate into every aspect of Korean society: family, organization and social interactions, by emphasizing education, building harmonious relationship and working hard. They argue that ‘Confucian values stress centralized authority, vertical hierarchical order, harmony among employees, diligence and hard work, and seniority-based reward system’ (1997:p. 135). As a native Korean, but proficient in dealing with international issues, Jack’s role as a
cultural bridge was not replaced. Jack's departure effectively marked the end of Avaro’s active engagement in internationalization.

**Mobera**

Three months after Jack’s departure (in December 2003), Avaro was still not able to extricate itself from its financial difficulties, although the contract with KTF had brought in some revenue. The international team also came to a critical point in their career; they had not been paid for six months and the burden and strain on their personal financial situation became severe. Mr Kim appeared to be still seeking investors, but the international team developed doubts that anything positive would happen soon in alleviating the financial situation sufficiently so that their unpaid wages could be paid and viable international activities could be executed. In fact, the international team started to discuss among themselves the possibility of individually quitting Avaro and going on to other things, or somehow maintaining the international group as an independent company of their own.

When Mike phoned Jack to update him on what had happened with Avaro, he told Jack about his desire of maintaining the international group. Although the ideal for him would be for Avaro to somehow find enough money somewhere to pay the unpaid wages and make the international team viable, he had no alternative but to consider the possibility of moving on from Avaro and trying to create a new company with the international group. In fact, the reason Mike contacted Jack was to seek Jack’s support and assistance.

Meanwhile, Jack was in discussions with a Korean businessman, Mr Hong-goo Lee – his former boss at Samsung – who ran a US$200 million fund on behalf of a group of Arabian oil tycoons. Mr Lee wanted to appoint Jack to be the fund manager for his company. Thinking of Mike and his team, Jack recommended that their first venture should be to create a company outside of Korea and completely independent of any influence from Korean companies to pursue mobile proximity payment opportunities internationally.

Subsequently, Mr Lee, Mike, Nick and Jack met at the Shilla Hotel, Seoul on November 8 (a Saturday) while the two Americans were on a business trip to Avaro. The meeting went well, and the decision was made to move quickly on the creation of a new company in the United States. Mr Lee agreed to invest US$20 million to create/register a new company in the US, then hire the Avaro international personnel after they quit from Avaro. Within a week of the meeting, the name ‘Mobera’ was chosen for the new company. It was expected that Mobera would be able to develop a
strong relationship with Avaro to work together in international projects, with Mobera leading the way, more like an international marketing arm for Avaro.

At that point, Jack had mixed feelings. He said, 'It was a difficult decision for me to help Mike and his group. Having also worked for Avaro, I somehow felt that my intentions can be interpreted as somehow trying to carry out a coup or undermine Avaro’s effort, that I was betraying my former company.' However, Jack felt his action could help both Mike’s international team and Avaro, because he believed that:

- The international team, like Jack himself, had a strong desire to make mobile proximity payment technologies a success.
- The international team had already decided that a critical time had come and they were ready to quit Avaro, with or without Jack’s help.
- If left alone, it was rather doubtful whether Avaro would ever be able to extricate itself from its financial difficulties. Mobera would be ideal to help Avaro in developing the international market.
- Mike’s international team was the world’s best team for this product/service and if anyone could make mobile proximity payments successful, it would be this team.

On December 10, Mike emailed his team in Bay Area in California with updates on Avaro’s funding situation. He said, ‘I can’t see any solution to our financial trouble, even for the short-term ... I am going to talk to Mr Kim late this week and start working him towards the concept of separating internationally and letting us help him financially by eliminating our future burden on the company while helping him with transition support so that the opportunities in Korea don’t blow up in his face. I don’t know how he will take this, but my point is to get the process started and find out.’ He had more or less made up his mind and wanted to bet their future on Mobera.

Mike understood very well that two things could possibly save Avaro: first, Avaro needed another partner (investor) to inject cash into its operations; and second, Avaro needed to quickly expand in the international market. It was not possible to pursue either of the options at that time. For Mr Kim, to find the balance between having extra funds and letting go part of his control was very critical. In fact, Mr Kim only wanted to take small investments bit by bit in order that he could keep his control. His argument was that he did not need that much money in one installment and he did not want the value of his company to be diluted so quickly. This mindset was closely related to his business approach: after the success of its R&D, Avaro had to transform itself from a technology-driven venture to
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a market-driven one (Doddson and Rothwell, 1991; Thompson, 1999). Only by doing so could Avaro implement the strategy of developing an open architecture/platform which could be rolled out internationally. However, Avaro had devoted its limited engineering resources to developing customized platforms for specific customers which was not only costly, but also left Avaro owning little of the R&D outcomes (intellectual property). Mike explained how he would have run Avaro differently if it were an American company. ‘First, we would build all products based on an open platform/architecture and attract developers to develop applications on such an open platform. We would develop our products around absolutely no one. Second, we would professionalize the management system and specifically the decision-making mechanism. Avaro decision-making is very much hierarchical and inefficient.’

However, not everyone in his team was convinced. One engineer asked Mike if he would change his mind if Mr Kim agreed to the international plan. Mike explained, ‘In this case, the point I would make to him [Mr Kim] is that while I appreciate his desire to keep and support us, the real issue isn’t how to handle the past, but how we can successfully operate in the future. Anyway, I don’t think he is in a financial position that he can make this offer ... The only way to have a legitimate commitment in the future is to actually have a commitment on funding for the future.’

In late January 2004, Mr Lee, Mr Chris Cho (Mr Lee’s secretary) and Jack flew to San Francisco and met Mike and his team. The meeting went well and everyone stated their commitment to Mobera. On February 1, led by Mike, the international team officially informed Mr Kim that they would quit Avaro and join Mobera. Mike hoped that he could help build a positive and mutually beneficial relationship between Avaro and Mobera.

On February 2, 2004, Avaro issued an official announcement among the media and its clientele that, effective immediately, Avaro would not be responsible for any activities of its former employees: Mike Wilson, Damon Burns, Nicholas Burns, Gary Francis and Dave Stevenson. This announcement, of course, drew immediate attention to the formation of Mobera, which was not fully ready to present itself and had not yet finalized its employment contract with its employees. From Avaro’s point of view, this was a rather emotional decision, because, among Avaro’s international clients and potential investors, the focal point of Avaro was mainly its international employees, especially Mike Wilson. The departure of Avaro’s international employees cast a dark shadow on Avaro’s credibility in fulfilling its continuing contracts with its international clients, such as NTT and Sprint. The future of these contracts was not clear. It
would be extremely hard for Avaro to form another international team with the capacity equivalent to Mike’s team.

After a ‘cool period’, in April 2004, in contrast to what Jack and his team had expected, Avaro did not agree to make an arrangement with Mobera to license its technology or to appoint Mobera as its international marketing agent. Instead, Avaro flatly rejected Mobera’s proposal. Further, Avaro sued Jack for stealing Avaro’s technology and giving it to a foreign company. Placed under house arrest for more than three months, Jack eventually cleared his name. A counter lawsuit from Jack for Avaro’s defamation followed.

**Epilogue**

After the lawsuit, Jack decided to go to the United States to pursue his career as a fund manager for Mr Lee. Apart from mobile payments, he would look at investment opportunities for millimetre wave technology and mobile and on-line games. Mr Lee, as promised, injected the initial US$5 million into the R&D activities of Mobera, which started to develop a new mobile proximity payment architecture and software platform for open applications. This would take at least another 18 months.

In Korea, where the dominating business driving force has been its chaebols such as SKT, it was very difficult for Avaro to find its place. As for Avaro, Mr Kim eventually reached an agreement with a Korean telco consortium of SKT, LGT and KTF. Under this agreement, Avaro’s IrFM-based mobile proximity payment technology became the ‘standard’ in Korea, endorsed by Korea’s MIC. Despite its unique competitive advantage which allows Avaro to link both telcos and financial institutions in its mobile payment solutions by the MAYZ Centre business model, Avaro was squeezed to serve a niche in the Korean market as a programmer, developer or hardware/software contractor for telcos. As Jack said:

> The only short-term solution for cash-flow is from [hardware] contracts with KTF and SKT. I don’t know the total amount from KTF – I believe US$5 million minimum. It is not clear how the KTF investment would affect its [Avaro’s] cash flow since it may be used for further infrastructure roll out in Korea and expansion of chip-based products ... The SKT funding option would be for much more money – at least US$10 million. This has been negotiated from the top down rather than bottom up as in the past. Essentially this means Mr Kim has put Avaro’s financial and management control of the company in the hands of SKT, though it remains independent from SKT, at least legally.
NOTES

1. Mobile services over the first generation (1G) analogue mobile network, Advanced Mobile Phone Services (AMPS), were first offered in 1984. It took about 10 years for the country to achieve a mobile penetration rate of 3 subscribers per 100 inhabitants.

2. Transcending the limits of the second generation mobile technologies which centre on voice communications, the third generation (3G) mobile services represented by IMT-2000 offer high-speed wireless data communications at a speed of up to 2Mbps – the speed which makes many mobile applications such as video phone service, streaming media service, wireless Internet, location-based service (LBS), mobile commerce as well as bulk voice communications, possible.

3. CDMA2000 1X network can offer a transmission speed of 153-307 kbit/s.

4. CDMA2000 1X EV-DO (evolution data only) network can offer a transmission speed of 700 kbit/s to 2 Mbit/s.

5. CDMA2000 1X EV-DV (evolution data and voice) network can offer a transmission speed of 3.1 Mbit/s.

6. The other key export sector in Korea is its semiconductor chip industry.

7. This figure includes export shipments of CDMA systems, as well as CDMA and GSM handsets.

8. Avaro InfoTech Inc. and all the personnel involved in this case are pseudonyms for the purposes of confidentiality.

9. K-merce is KFT’s mobile payment brand name, which was co-developed by KFT and Avaro based on Avaro’s core technology.

10. The Korean name for an infrared adapter which can be connected to ATMs or POS terminals to receive consumers’ financial information.


13. By 2004, the broadband networks in Korea were extensive and most households had access to two or more technologies to subscribe to broadband. ADSL (asymmetric digital subscriber line) is available to 90 per cent of homes and cable television networks could reach 57 per cent of households. In addition to these core technologies, Korea had quite extensive coverage of apartment LANs (essentially Ethernet wiring in the building connected to the ISP via fibre), wireless local loops and satellite connections.

14. The second generation (2G) CDMA IS-95 is also known as cdmaOne, with a transmission speed of 13.5 kbit/s.

15. Established in 1976 as a non-profit government-funded research organization in Korea, ETRI has been at the forefront of technological excellence for more than 25 years. Under its new privatized organizational structure ETRI strives to become a global leader in the R&D of IT and telecommunications industry.

16. For example, in order to meet the MIC’s requirement of maintaining its market share below 50 per cent, SKT had to engaged in ‘demarketing’ – getting rid of their least profitable subscribers and stopping the recruitment of new ones for months – before SKT acquired its competitor Shinsegi Telecom in January 2002.
17. Korea Telecom owned about 40 per cent of KTF’s shares as of December 2004.
18. PCS (personal communications services) is a second-generation mobile network used in Japan.
19. In 2000, the Korea government granted two WCDMA licenses to SKT and KTF through an auction. Each successful bidder had to pay nearly US$1 billion for the WCDMA license. LGT, while having failed in the bid for the WCDMA license, later purchased a second CDMA2000 (3G) license for about US$100 million (1.3 trillion Won). In LGT’s second CDMA2000 purchase, the government offered favourable bank loans to build the CDMA2000 (3G) network in its preferred spectrum in rural areas. The dual auction of third-generation (3G) network licenses – WCDMA and CDMA2000 – reflects a dilemma confronted by Korean policy-makers in its mobile telecommunications industry. On the one hand, the Korean government encourages the mobile operators to develop the WCDMA technologies as it represents a high potential of export opportunities for the relevant manufacturers; but on the other hand, CDMA2000 seems a natural (a faster and smoother) upgrade path for Korea’s second-generation (2G) mobile networks. This dilemma is, perhaps, shown in the delayed action in rolling out WCDMA networks from both SKT and KTF, which are more interested in building up their CDMA2000 networks. The fundamental question is whether users are willing to pay for the WCDMA services while their needs for voice and medium-speed data communications are met perfectly well by the current CDMA2000 networks. In fact, industry analysts and observers are expecting that the WCDMA networks will only be rolled out in densely-populated areas despite the carriers’ huge investment in the licenses.
20. Facing accelerating globalization in the late 1990s, the government once again shifted its policy from regulation to liberalization by revising the Antitrust and Fair Trade Act. Such a liberalization policy was designed to enable chaebols to compete freely in the expanding global market (Kim, 1997).
21. Normally, there are no outside directors on the Board of Directors in Korean companies. All board members are inside executive directors who are appointed by the chairman and perform managerial functions (Pearce and Zahra, 1991).
22. A native Korean, Jack spent many years overseas when his father worked as a diplomat, including in the Korean Embassy in the United States. Jack found it difficult to re-enter Korean society with a slight ‘foreign’ accent in his Korean. Jack earned his bachelor’s degree in economics from Seoul National University and his master’s degree in international relations from John Hopkins University. Subsequently, he worked as a senior manager in charge of international business at several Korean chaebols.
23. IrDA is an independent industry association which has been dedicated to developing and promoting standardization issues for infrared data communications since 1993. IrFM is a special interest group within IrDA, which is dedicated to developing infrared-based mobile payment protocols.
24. Mike Wilson co-founded Calibre Inc in the United States, which was acquired by ZiLOG, a company focusing on embedded web sever solutions for remote and local mobile appliance access.
25. Before he joined IrDA, Nick served as the Chief Architect for Verifone, one of the major manufacturers of POS (point-of-sale) terminals.
26. The normal transmission distance defined by IrFM is less than 50 centimetres.
27. One of the unique features of Korean business is that owners actively participate in management (Chung et al., 1997).

28. In a general conversation, it was revealed that Dr Lee invited himself to join Avaro — bothered by a ‘guilty feeling’ over having introduced a foreign technology ‘CDMA’ into Korea’s market, Dr Lee was excited by the prospect of Avaro’s infrared mobile proximity payment technologies and was determined to help Avaro in promoting this Korea-born technology as one of the world’s standards in mobile payments.

29. Normally, a total of 3 per cent of the transaction value as a credit card payment goes to the financial institution, but only a small proportion of this 3 per cent (between 0.5 per cent to 1 per cent) goes to the card-issuing banks. For micropayments (transactions less than $10), if every single transaction needed to be approved by the card-issuing bank, the process itself would cost more than 3 per cent of the value. Avaro’s MAYZ Centre solution is built on a model that coordinates security platforms between mobile carriers and financial institutions; thus, it does not require approval from card-issuing banks, instead, it passes messages initiating and authenticating transactions between the card-issuing banks and card companies involved. Avaro makes 3 per cent of the 3 per cent transaction commission from its mobile payment services.

30. According to the Korean Census Bureau (2002), Kookmin Bank offers Kookmin Card, the fourth largest credit card (holding 16.5 per cent market share) in Korea after BC Card (31.9 per cent), LG Card (22.6 per cent) and Samsung Card (21.4 per cent).

31. These two card companies together hold less than 20 per cent of the credit card market in Korea.

32. EMV refers to Europay, MasterCard and Visa’s combined chip that is used on terminals defined by a set of requirements to ensure interoperability between smart cards and terminals on a global basis, regardless of the manufacturers, the financial institutions, or where the card is used.

33. SKT sent a delegation of five people to attend the IrDA Marketing Conference in San Jose on December 12, 2002, where Mike Wilson, as the president of IrDA, met with the delegation.

34. FSTC (financial services technology consortium) is a financial industry research organization comprised of banks, financial service firms, industry partners, national laboratories, universities and government agencies. Its goal is to bring forward interoperable, open-standard technologies for the financial services industry that makes possible new products and services. More information can be obtained at http://www.fstc.org.

35. In the trial, apart from a virtual Visa card issued by the USC Federal Credit Union that would serve as the credit-based instrument, a virtual USCard which was based on a closed identification and debit payment system would also be used for payments that settled in a deposit account.

36. For example, CrossCheck, one of the principal sponsors of the IrFM protocol initiative, has been a key force behind the development and release of the IrFM Specification. CrossCheck, known for its cutting-edge-technology in the point-of-sale financial services marketplace, aimed to provide their merchant clients with increased profitability while reducing their financial risks. In addition to bringing over eighteen years of payment guarantee and risk management
expertise to this project, CrossCheck was expected to lend its substantial knowledge of the US payments infrastructure to the success of the USC program.

37. JAFCO is the third largest investment house in the world and the largest in Asia Pacific. Its Asia Pacific head office is located in Singapore, therefore, all its investment decisions – including in Korea – need to go through there. JAFCO's investment policy is to take 10-20 per cent equity of the firms in which it invests and to assist in their international marketing activities.

38. During this period of time, Mike was supposed to be in Europe having meetings with Siemens and its partner banks.

39. Initially, Jack proposed to leave 67 per cent equity stake for Avaro Korea, but Mike suggested this be changed to 40 per cent. His argument was that, ‘...a 67-42 per cent Avaro equity stake in MAYZ International combined with a USD 500,000 annual licensing fee and 10 per cent royalty on revenues (after break point) will be a very difficult concept to sell to other potential equity holders – venture capital companies. And VCs will be concerned about this, as it is their money that is initially funding technology transfer and acquisition, and until the company reaches break-even they will not be making any money while existing equity holders will. It might be useful to look at alternative ways of structuring the deal – reducing the initial Avaro equity stake in exchange for larger royalties in the future. May I also suggest that we keep the USD 500k figure as an indicative/estimated figure, rather than a fixed licensing fee – that way Avaro Korea can build-up to it by billing MAYZ International for specific work (on a rate basis of, say, USD1000/day). This will look a bit more sensible in the eyes of the investors and other equity holders.’

40. Jack made four such attempts while he was working for Avaro.

41. Dave Stevenson officially joined Avaro’s international team in December 2003, although he started to work for Avaro in April. Dave worked together with Gary on the development of software architecture for NTT Data and USC projects.

42. The author had the last meeting with Jack in April 2004 for the purposes of this research.
## APPENDIX

### Table 6A.1: Avaro’s development milestones

<table>
<thead>
<tr>
<th>Date (Month)</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug</td>
<td>Jack was ‘released’ and moved to the US</td>
</tr>
<tr>
<td>Apr</td>
<td>Avaro sued Jack and Jack was under house arrest</td>
</tr>
<tr>
<td>Feb</td>
<td>Avaro rejected Mobex’s ‘agency’ proposal</td>
</tr>
<tr>
<td></td>
<td>International team quit Avaro</td>
</tr>
<tr>
<td></td>
<td>First Mobex meeting in San Francisco</td>
</tr>
<tr>
<td>Nov</td>
<td>Mike, Nick, Jack met Mr. Lee discussing the establishment of Mobex</td>
</tr>
<tr>
<td>Oct</td>
<td>SKT and KTF signed contract with Avaro for IFM hardware</td>
</tr>
<tr>
<td></td>
<td>Jack and several other senior members left</td>
</tr>
<tr>
<td>Sep</td>
<td>The Olympus deal dropped</td>
</tr>
<tr>
<td>Jun</td>
<td>Started negotiation with Olympus Capital</td>
</tr>
<tr>
<td>Aug</td>
<td>IFM was selected as m-payment standard</td>
</tr>
<tr>
<td>Apr</td>
<td>Second MIF standardization meeting</td>
</tr>
<tr>
<td></td>
<td>Signed contract with NTT Data</td>
</tr>
<tr>
<td>Mar</td>
<td>Request from SKT</td>
</tr>
<tr>
<td>Feb</td>
<td>Received $500K investment from KTI Venture Capital</td>
</tr>
<tr>
<td></td>
<td>Release of IFM 1.0.1</td>
</tr>
<tr>
<td></td>
<td>Decision made to against ZI proposal</td>
</tr>
<tr>
<td>Mar</td>
<td>Request from KTF</td>
</tr>
<tr>
<td>Dec</td>
<td>SKT put forward a bid of $50 mil to acquire Avaro</td>
</tr>
<tr>
<td></td>
<td>Dr. Jung-uck Lee joined Avaro as Honorary Chairman</td>
</tr>
<tr>
<td>Nov</td>
<td>Jack’s MIFZ International (MI) proposal</td>
</tr>
<tr>
<td>Nov</td>
<td>Re-evaluation of Avaro’s core patents</td>
</tr>
<tr>
<td>Nov</td>
<td>Declared SKT’s patent infringement</td>
</tr>
<tr>
<td>Oct</td>
<td>Commercialization of NTT’s Moneda</td>
</tr>
<tr>
<td>Sep</td>
<td>Siemens signed LOI with Avaro to market MIFZ in Europe</td>
</tr>
<tr>
<td>Sep</td>
<td>NTT Group signed an MOU with Avaro to market MIFZ in Japan</td>
</tr>
<tr>
<td>Aug</td>
<td>First MIF standardization meeting</td>
</tr>
<tr>
<td>Aug</td>
<td>Visa Asia Pacific signed a trial agreement for Visa/MIFZ in Korea</td>
</tr>
<tr>
<td></td>
<td>Commercialization of KTF’s K-mere</td>
</tr>
<tr>
<td>Jun</td>
<td>Full commercialization of MIFZ with LGT in Korea</td>
</tr>
<tr>
<td>Apr</td>
<td>Visa International signed an MOU with Avaro</td>
</tr>
<tr>
<td>Mar</td>
<td>KTF signed contract to license MIFZ technology</td>
</tr>
<tr>
<td>Feb</td>
<td>MIFZ selected as top 100 global-standard product by MIT</td>
</tr>
<tr>
<td>Feb</td>
<td>Release of MIFZ 0.91</td>
</tr>
<tr>
<td>Dec</td>
<td>Speaking at Strategic Digital Billing Conference in Tokyo</td>
</tr>
<tr>
<td>Nov</td>
<td>Registered patents for core technologies</td>
</tr>
<tr>
<td>Nov</td>
<td>Speaking at Mobile Congress World Conference in Tokyo</td>
</tr>
<tr>
<td>Nov</td>
<td>Trial services of MIFZ in SeongNam city</td>
</tr>
<tr>
<td>Oct</td>
<td>Received Hikari Tsuchin Capital (HTC)’s $5 mil investment</td>
</tr>
<tr>
<td>Sep</td>
<td>Demonstrated in World PC Expo 2000 in Tokyo</td>
</tr>
<tr>
<td>Jul</td>
<td>Shortlisted by Singaporean government in ePayment</td>
</tr>
<tr>
<td>Jun</td>
<td>Received investment for LGT and KIS Van Co.</td>
</tr>
<tr>
<td>May</td>
<td>Participated ‘Card Asia 2001’ in Singapore</td>
</tr>
<tr>
<td>Apr</td>
<td>Received Kookmin Card investment for commercialization</td>
</tr>
<tr>
<td>Mar</td>
<td>Became iDA Board Member and IFM SIG Member</td>
</tr>
<tr>
<td>Feb</td>
<td>Jack and the international team joined Avaro</td>
</tr>
<tr>
<td>Jan</td>
<td>Participated ‘Portable Design 2001’ in Las Vegas</td>
</tr>
<tr>
<td>Dec</td>
<td>Received Korea Development Bank Investment</td>
</tr>
<tr>
<td>Dec</td>
<td>Participated in e-Biz Expo 2000</td>
</tr>
<tr>
<td>Jan</td>
<td>Demonstrated at eCash and ePayment Festival</td>
</tr>
<tr>
<td>Jul</td>
<td>Selected as venture company with the most outstanding technology</td>
</tr>
<tr>
<td>Jun</td>
<td>Avaro InfoTech Inc. established</td>
</tr>
<tr>
<td></td>
<td>Development of MIFZ technology completed</td>
</tr>
<tr>
<td></td>
<td>Mobile payment system R&amp;D commenced</td>
</tr>
<tr>
<td></td>
<td>Design and manufacturing contactless keychain for Mobile Express Pass</td>
</tr>
</tbody>
</table>
7. The Development of the Mobile Payment Industry in China

INTRODUCTION

China’s very fast economic growth since the late 1970s has disproportionately raised the standard of living faster in major urban areas than in rural areas, but modern telecommunications networks now blanket the country and mobile communications are commonplace throughout China.

China implemented its first wireless communications network in Guangdong province in 1987. Since then, China has experienced mushrooming growth of its mobile communications networks. The growth rate of mobile subscribers in China since 1987 has been phenomenal. In 2002, the 219 million mobile subscribers (including the PHS\textsuperscript{1} subscribers) surpassed the 214 million fixed-line subscribers for the first time (CRC Pinnacle, 2004), which also made China the market with the largest number of mobile subscribers in the world (ITU, 2004a).

At the end of 2004, there were over 310 million mobile phone subscribers (excluding PHS users). According to China Research Corporation\textsuperscript{2} – a leading market research and consulting firm in Beijing – this number is expected to reach 380 million in 2005. The penetration rate of mobile subscribers at the national level is about 24 per cent, increasing from about 2 per cent in 1998;\textsuperscript{3} however, the ratio is much higher in major cities and among young people. In recent years, mobile text messaging service (SMS) has become wildly popular, growing from 26.6 million messages in 2001 and 90 million sent in 2002 to 348 billion sent in 2003 (CRC-Pinnacle, 2004). In addition, Chinese manufacturers (for example, Huawei, ZTE, Datang and Great Dragon) now produce high-quality mobile devices and equipment for a global market.

Investment in China’s telecommunications industry has surged as well, significantly ahead of investment in any other types of infrastructure. In the early 2000s, the telecommunications industry experienced what might be described as over-heated investment. For example, in 2000, the total
investment from the telecom operators in fixed assets accounted for 72.3 per cent of their total revenues of 3,083 billion RMB Yuan (about US$372 billion);\(^4\) in 2001, this investment reached its historical peak, accounting for 78.6 per cent of the total revenues of 3,573 billion RMB Yuan (about US$431 billion). In 2002, investment in this sector cooled down a great deal, dropping to 49 per cent of the total revenues of 4,120 billion RMB Yuan (about US$497 billion) (CRC-Pinnacle, 2003).\(^5\) According to CRC-Pinnacle’s statistics, between 1998 and 2002, China’s operators invested a total of 9,675 billion RMB Yuan (about US$1,168 billion) in the country’s telecommunications infrastructure, of which 42 per cent went to the fixed-line networks and 45 per cent to the mobile networks.

Compared to the high-profile telecommunications industry, the development of China’s financial sector has been the focus of much criticism (Kotler, 2001). It has lagged behind the country’s general economic development pace. The payment infrastructures are still particularly old-fashioned, based on the ‘cash is king’ motto, despite the government’s efforts to introduce electronic payment systems in the late 1980s.\(^6\)

2002 marked an important milestone in the history of the development of China’s payment infrastructures. With a total investment of over RMB Yuan 130 million, China UnionPay (Yin Lian)\(^7\) Company (hereafter referred to as Yin Lian) completed the deployment of a nation-wide, cross-bank and cross-region electronic clearance and settlement network, including clearance and settlement capabilities over the country’s ATM (automatic teller machine) and POS (point of sale) networks. According to CRC-Pinnacle’s database, at the end of 2004, ‘Yin Lian’-compatible\(^8\) ATMs accounted for nearly 99 per cent of the 70,000 ATMs installed in the country, an increase from about half of the total 40,000 ATMs installed in 2002, and the ‘Yin Lian’-compatible bankcards accounted for about 48 per cent of the total of 770 million cardholders, growing from 21 per cent of 495 million in 2002. The establishment of ‘Yin Lian’ also marked the conclusion of the famous ‘Golden Card’ project in China.

China UnionPay (Yin Lian) Co. was established in 1992 as a not-for-profit holding company with about 80 banking and financial institutions across China as its members, including four state-owned commercial banks: Bank of China, Construction Bank of China, Agricultural Bank of China and Industrial and Commercial Bank of China, and top private banks, such as Minsheng Bank, Guangdong Development Bank, Shanghai Pudong Development Bank, among others. Unlike inter-bank clearance and settlement networks in developed economies, such as Visa or MasterCard, Yin Lian’s network is almost purely used for debt-based transactions on ATMs and POS terminals. Yin Lian charges merchants for electronic
transactions, varying between 0.8 per cent and 2.0 per cent, depending on
the ‘class’ of status the merchants belong to, and commercial banks for
inter-banking transactions at the (fixed) rate regulated by the People’s Bank
of China. In other words, Yin Lian controls the electronic payment
platform in China. This monopoly position excludes small and even
medium-sized merchants from enjoying the Yin Lian network, mainly
because of its high interchange fees. Another reason for a lack of electronic
transaction facilities among small and medium-sized merchants is the costs
associated with acquiring the point of sale (POS) terminals for debit card
(as well as credit cards) payments. Debit cards utilize the online PIN
(personal identification number) as the sole method of authentication.

Considering the imbalance between the development of electronic
payment systems and the development of mobile communications
networks, the proposal to effectively use mobile phone as a new payment
instrument in China has attracted intense attention. The earliest attempts at
mobile commerce in China were led by the country’s mobile operators.
China’s mobile operators have considered different ways of introducing the
micropayment concept based on their billing infrastructures. For example,
in 2001, China Mobile Communications Corporation (CMCC) – the largest
mobile operator in the world in numbers of its mobile subscribers – required all its provincial subsidiaries to launch a ‘mobile soccer lottery’
service – a micropayment system utilizing the operator’s billing
infrastructure – to allow its users to purchase soccer lotteries before the
World Cup in Seoul, Korea in 2002. This order failed because the
provincial operators could not develop and deliver the service in time.

Shanghai SmartPay (Jie Yin) Co. Ltd, a venture capital-supported start-
up, was among the earliest pioneers exploring business opportunities in the
area of mobile payments in China. Shanghai Jie Yin started its mobile
payment business in 2002. By the end of 2004, Jie Yin had attracted over
40 million mobile payment users.

The most common method of mobile payments in China is known as
‘mobile small amount payment service’: a consumer can use her bank
account (debit) which is ‘bundled’ with her mobile phone account to pay
for mobile phone bills, recharge pre-paid accounts (mobile, IP or IC
accounts), utility bills or on-line games using authorization codes sent
over mobile SMS. This option has gained great popularity in China, where
the inefficient payment infrastructure makes paying bills a troublesome
task. The business model of this mobile payment service is that the service
providers, such as Shanghai Jie Yin, provide and operate the payment
platform, charging 1-5 per cent of the transaction amount as service
commissions.
The real business concern for Chinese companies like Jie Yin is that large state-owned mobile operators may take over the mobile payment business almost instantly as soon as they realize the appeal of the business potential in this area. In fact, as we shall see, Jie Yin’s fears came true soon after it established its position and reputation in the country.

Beijing Union Mobile Pay Co Ltd (UMPay) was formed in August 2003, as a joint venture between China Mobile Communications Corporation (CMCC) and China UnionPay (Yin Lian) Co. Ltd. The ‘marriage’ between CMCC and Yin Lian aims to create and provide more value-added mobile services to almost 200 million CMCC subscribers in China. More than that, the establishment of Beijing UMPay marked the establishment of a new industry value chain for mobile payments in the country.

The regulatory environment and government policy frameworks have been recognized as critical factors that have helped shape the landscape of China’s telecommunications industry (Loo, 2004; Yu, et al., 2004). This ‘top-down’ approach allows resources to be mobilized in order to achieve nation-wide strategic goals. A positive regulatory environment is crucial to the development of China’s mobile payment industry. This chapter examines case studies of the emergence and development of both Shanghai SmartPay (Jie Yin) Co. Ltd. and Beijing UMPay Co. Ltd. to illustrate how a top-down approach creates an environment that encourages cross-industry alliances through which not only the innovations in platforms, but also the adoption of the emerging technology, can be regulated and administered to ensure a relatively smooth trajectory of growth for an emerging industry in China.

CHINA’S MOBILE COMMUNICATIONS INDUSTRY

China began offering wireless telecommunications services for military use in 1981 when the 150MHz cellular system became operational. The market for cellular mobile services started to gain momentum only after the city of Guangzhou launched China’s first commercial analogue 900 MHz TACS (Total Access Communications System) – the first generation mobile network showcase — in November 1987.

By the end of 1995, 1700 cities and counties in all 31 provinces or autonomous regions were providing cellular mobile phone services. The majority of the mobile telephony was based on analogue TACS networks, but 219 cities in 15 provinces had started to offer mobile access to the second-generation GSM networks. Mobile roaming services also became
The Development of the Mobile Payment Industry in China

available after the rollout of the second-generation GSM networks. By the end of 1996, the coverage for the digital GSM networks was extended to include all cities and counties in the eastern and central regions, as well as many economically developed cities and counties in the western region (CRC, 1997b). In July 1997, China passed the 10 million benchmark of mobile subscribers, ranking third in the world, after the US and Japan (Zhang, 1998). In 2004, with over 300 million mobile subscribers, China became the largest mobile communications market in the world (ITU, 2004c).

The Dynamics of the Regulatory Environment and Policy Framework

Apart from very fast economic development, and increasing demand in the domestic telecommunications services, various industrial policies have contributed to the boom in China’s telecommunications industry over the past decade (Loo, 2004; Yu et al., 2004; Fan, 2006).

As experienced by many developed countries during the initial years of deregulation of their telecommunications industries, China’s telecommunications industry has undertaken a similar path from absolute monopoly to limited competition. However, China’s reforms in the telecommunications industry differ from those in the western world in two ways: (1) the state retains ownership of the telecom carriers;15 and (2) the carriers retain substantial influence over the policy-makers to benefit their vested interests (Loo, 2004).

Since the open-door policy and economic reforms in the late 1970s, China has attracted substantial foreign direct investment in most industries, except for the telecommunications services sector and other politically-sensitive sectors such as broadcasting (CRC Pinnacle, 2004). Until 1992, China’s telecommunications industry was under the tight control of the former Ministry of Posts and Telecommunications (MPT)16 which was the telecommunications industry regulatory body, as well as the country’s single public telecommunications network operator.

Introduction of limited domestic competition

1992 was an important milestone in the history of China’s telecommunications industry: the MPT started to allow domestic companies to enter the value-added telecommunications services market, marking the beginning of a series of reforms aiming at relaxing the tightly-controlled telecommunications industry. In the same year, the former Ministry of Electronic Industry (MEI), in conjunction with the Ministry of Railways (MOR) and the Ministry of Electrical Power (MEP), put forward a proposal to the State Council to establish China United
Telecommunications Corporation (China Unicom), targeted at forming head-to-head competition with the MPT. This proposal recommended a strategy to utilize the existing private telephony networks\textsuperscript{17} of the MOR and the MEP, as well as the advanced electronic products and technologies of the MEI to provide telecommunications services for public use (CRC, 1997b). After several rounds of extremely fierce debates between the MPT and these interested parties, in 1993, the State Council finally approved the establishment of China Unicom. After over one year’s preparation, on 17 July 1994, China Unicom was formally established. It was a joint venture between stakeholders from the three Ministries, each investing RMB 100 million, and 13 other significant state-owned corporations, such as China International Trust and Investment Corporation (CITIC), China Everbright International Trust and Investment Corporation, China Resources Group Co., Ltd., and China Huaneng Group Co., Ltd., among others (each of these corporations invested RMB 80 million). The total registered investment for China Unicom amounted to over RMB 1 billion. The creation of China Unicom provided its stakeholders with a gateway to enter China’s public telecommunications services market (CRC, 1997a).

More importantly, the establishment of China Unicom heralded a discontinuity in the country’s telecommunications policy by clearly signaling the end of the monopoly of the MPT’s public telecommunications services. Since then, China’s telecommunications policy has undergone rapid transition and the regulatory framework has been drastically restructured.

Under pressure from the State Council, the MPT started to reform its organizational structure in 1994. The function of the MPT, according to the State Council’s request, needed to change from directly controlling the routine operations of the posts and telecommunications networks to focusing on regulations for and policies of the national posts and telecommunications industry. With the introduction of this reform, the China Directorate-General of Telecommunications (DGT),\textsuperscript{18} also known as China Telecom, was officially established. However, DGT was only an administrative ‘agency’; the provincial Posts and Telecommunications Administrations (PTAs) and the municipal Posts and Telecommunications Bureaus (PTBs), which operated the public telecommunications services network, retained direct reporting lines to the relevant departments of the MPT. Therefore, the MPT still enjoyed its dual role: as a regulator and an operator. This structure left China Unicom in a handicapped position in its competition with China Telecom.
The ‘divorce’ of network operations and policy regulations within the MII
The regulatory environment began a new chapter with the establishment of the Ministry of Information Industry (MII) in April 1998 comprising a merger of the MPT, the MEI (Ministry of Electronic Industry) and the Network Division of the Ministry of Radio, Film and Television (MORFT). The major commissions of the MII, according to the State Council, include ‘development strategy stipulation, policy making and overall planning of the information industry; revitalization of the telecommunications; the administration of IT product manufacturing and the software industry; and promotion of the information of the national economy and society’ (MII, 2004a). The establishment of the MII was a positive step towards further deregulation of the Chinese telecommunications industry. It marked the end of an era in which the MPT acted as both public telecom network operator and policy maker. Since then, the competition between China Telecom and China Unicom has become real.

Foreign influence has been very limited in shaping the structure of China’s telecommunications services industry and its associated policies. However, foreign direct investment and its impact in the telecommunications equipment manufacturing sector, especially the role of foreign influence in the build-up of technological capabilities in this sector (Fan, 2006), is more prominent than in the telecommunications services sector. For example, despite the abolishment of the MPT, its policy banning foreign investment in the telecommunications services (network operations) industry remained valid. According to the MPT Document 675 (MPT, 1993), foreign investors were barred from operating or participating in the operations of telecommunications services in China. Particularly, it said: ‘Entities and individuals outside the territory of China, as well as wholly owned foreign enterprises, Sino-foreign joint equity enterprises and Sino-foreign co-operative enterprises within the territory of China, shall not invest, engage or participate in telecommunications operations.’

In order to solve the problem of financing the rapidly growing market, both China Telecom and China Unicom have, since 1994, started to develop and implement strategies to ‘bypass’ the government’s strict regulations on foreign investment to enlarge their funding pool. For example, in 1997 China Telecom listed its mobile arm, China Telecom (HK) Group, on the Hong Kong Stock Exchange and became the largest IPO in the Hong Kong Stock Exchange’s history by raising US$4 billion. China Unicom took a ‘China-China-foreign’ joint investment approach to attract indirect foreign funds (CRC, 1997a). After the government investigated this funding model and forced all ‘indirect’ foreign investors
out of China Unicom’s operations, in 2000, China Unicom followed China Telecom’s model and listed its subsidiary China Union (HK) on both the Hong Kong and New York Stock Exchanges, raising a total of US$5.7 billion. In both these companies, however, the state holds the majority (about 75 per cent) of the shares. This is the method the Chinese government uses to maintain full control in its regulatory policies of the telecommunications services industry.

In January 1999, the State Council issued a document entitled ‘Several Issues on Speeding up the Development of Chinese Mobile Communications Industry’. From 1999 to 2003, the government allocated 5 per cent of the mobile telephone connection fees as a special grant for R&D activities in the mobile telecommunications area (CRC-Pinnacle, 2003). The success and achievement of China’s domestic manufacturers persuaded the government policy-makers and industry to move aggressively into the prosperous mobile communications sector.23

To face the increasing market demand for broadband data communications (Internet services) and the imminent challenge from foreign competition in this area, in October 1999, approved by the MII, China NetCom was established by the Shanghai Branch of China Telecom, the Shanghai municipal government and the Chinese Academy of Sciences. With a license to operate VoIP24 (voice over IP), one year after its establishment, China NetCom completed the construction of a backbone optical/fibre broadband network and started to run its IP phone services. By then, there were three telecom operators in China: China Telecom, China Unicom and China Netcom, plus Ji Tong, a subsidiary of former Ministry of Electronic Industry (MEI) which runs one of the country’s Internet gateways, ChinaGBN (China Golden Bridge network).

The ‘vertical separation’
Following the establishment of the Ministry of Information Industry (MII) in 1998, this new government agency took two large-scale industry-reshuffling actions targeting the enormous entity, China Telecom. The first revolutionary step taken by the MII in mid-1999 was to split the former China Telecom into four independent groups, namely China Telecom, China Mobile, China Satellite and Guo Xin Paging Company,25 following a strategy of ‘vertical separation’ (CRC, 1997a) (see Figure 7.1). This strategy aimed to separate enterprises from the government administration of former China Telecom. Since then the operational functions of China Telecom have been officially removed from the MII. The MII started to enjoy a relatively neutral and independent status over telecommunications regulations because it was no longer affiliated with any telecom operators. This independent status has enabled the MII to take a more pro-competitive
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stance in facilitating competition in the Chinese telecommunications market.

![Diagram of China Telecom Group]

**Figure 7.1:** ‘Vertical separation’ of the Chinese telecommunications industry

After the ‘vertical separation’ of China Telecom, there were eight telecom operators running different telecommunications services: China Telecom, China Mobile, China Unicom, China Netcom, Ji Tong Group, Guo Xin Paging Group, China Railcom (China Railway Communications Corp) and China Satcom (China Satellite Communications Corporation).

**The ‘horizontal separation’**

In order to consolidate the telecommunications services industry, the second industry reshuffle occurred in May 2002. The former China Telecom was split geographically: 30 per cent of its network resources and ten subsidiaries in north China were merged into China Netcom Group, and the 21 subsidiaries in south China retained 70 per cent of the network and formed the new China Telecom Group (CRC Pinnacle, 2004). This second restructure of reform represented a ‘horizontal separation’ (see Figure 7.2) that aimed to encourage competition among telecom operators.

By means of these reforms, China’s telecommunications services market has shifted from a highly-regulated sector dominated by the monopolistic China Telecom to a fast-growing industry featuring limited market competition. Currently, there are six major telecommunications carriers in China – China Mobile and China Unicom operating the country’s mobile communications networks; China Telecom, China Netcom and China
Railcom operating the country’s fixed-line networks; and China Satcom operating the country’s satellite network – accompanied by thousands of smaller companies providing value-added communications services (CRC Pinnacle, 2004).

![Diagram of Chinese telecommunications industry]

*Figure 7.2: ‘Horizontal separation’ of the Chinese telecommunications industry*

**3G policies**

China’s telecommunications industry has been supported by the government’s ‘development in reform and reform in development’ programs. China’s booming economy, high levels of investment in the telecommunications industry and the imminent advent of the third-generation (3G) networks present the industry with great opportunities. On the other hand, China’s telecommunications industry policy makers are facing challenges of maintaining a healthy regulatory and policy environment to balance the technological and economic benefits of the 3G standard choices as well as to prepare for the next-step competition from foreign telecommunications operators when fulfilling WTO commitments.
The licensing of the third-generation (3G) mobile networks created a spectrum auction fever in Europe in the late 1990s and early 2000s. As discussed earlier, the 3G investment can be described as the largest ‘technology push’ ever witnessed in history. Despite the overwhelming activities of 3G-spectrum allocation worldwide, the Chinese government has maintained a very cautious position. The MII has stated clearly that China will not grant 3G licenses using the general practices adopted by its foreign counterparts. Back on September 11, 2000, Mr Wu Jichuan, the Minister of the MII at the time, said that the 3G auctions in Europe would not be appropriate in the Chinese market, as he ‘...does not wish to see that the development of 3G technology will generate a big bubble in China’. He added, ‘...so far, there has not been a definite standard and feasible service for 3G’. He used Germany as an example to illustrate that it was far from clear what the timeframe would be for the build-up of the 3G networks in order to retrieve its US$4 billion license fees, let alone the huge investment in the network infrastructure. On March 6, 2001, Minister Wu again highlighted his vision of the 3G licensing issues in China. He considered the licensing fees for the 3G spectrums in Europe and America were too expensive and attributed it as being one of the factors that led to the slowdown in the telecommunications industry worldwide. He said: ‘...this will undoubtedly jeopardize the operators’ position...’ Instead, he argued that the Chinese government must take into account the specific context of China’s social, economic and political development and ensure the 3G licenses would be issued in a smoother and more efficient fashion.

Unlike the common issues faced by developed countries when issuing the 3G licenses, such as the methods of the issuing (auction or ‘beauty contest’) and the costs of the licenses, 3G licensing in China has followed different twists and turns. The focus of the 3G license in China is not just about decisions on a new technology and service for the next-generation mobile networks; it is, in fact, about the dynamics of China’s economic and regulatory environment. It has proven a difficult task for policy makers to formulate a harmonized regulatory framework in China for its 3G policies. The MII estimates that China’s 3G markets will be worth around US$100 billion by 2008. Any decision regarding the 3G licenses, therefore, will have significant implications for both operators and (domestic and international) 3G equipment manufacturers. Another distinctive factor explaining why the Chinese government will not auction its 3G-spectrum license is the fact that the licensing fees generated in auctioning would simply mean transferring money from one arm of the government to another, because the majority shareholder of both China Mobile and China Unicom is the state government.
The widespread speculation about the 3G license issue is that the MII has deliberately delayed the 3G laboratory and field trials and the consequent issuance of 3G licenses because it would like to give China's domestic industry and its home-grown 3G standard, TD-SCDMA (Time Division Synchronous Code Division Multiple Access), a chance to catch up with the competition from foreign manufacturers. The viability of the TD-SCDMA is the key to China's potential as a worldwide 3G player.

3G provides a golden opportunity for China's mobile telecommunications manufacturing industry. After decades of 'exchanging' its domestic market for foreign technologies, China has come to a turning point in that it has determined to develop its own industrial standard and expertise based on its huge market potential. If TD-SCDMA proves to be a feasible technology for commercial applications, China will be able to repeat its success in the fixed-line telecommunications manufacturing sector led by domestic vendors such as Huawei and ZTE, which, in turn, will generate new economic growth in China. More importantly, if TD-SCDMA became an accepted industry standard and dominated the Chinese mobile market – a market that covers almost a quarter of the world's population – it is quite possible that TD-SCDMA will be diffused to other countries, especially less developed markets.

However, both China Mobile and China Unicom are (at least partly) publicly-listed companies and their decisions as to which standard(s) to adopt for their future 3G networks should, therefore, reflect their best business interests. For example, back in 2001, Madam Li Mofang, Chief Engineer of China Mobile, clearly indicated that China Mobile would choose W-CDMA (Wideband Code Division Multiple Access) for its major 3G network, complemented by TD-SCDMA in densely populated metropolitan areas, as both standards would enable a smooth upgrading of China Mobile's current GSM networks to 3G. On the other hand, both China Mobile and China Unicom have shown enthusiasm in an effort to support the domestic TD-SCDMA standard by cooperating with Datang Telecom Technology and Industry Group. Both operators have provided network capacities for the field trials of the TD-SCDMA system. Madam Li added, '...If the TD-SCDMA trial is successful and the technology is proven to be a good one, China Mobile is going to adopt this technology (at least partly).'

While China's industrial policy seems to focus on selecting the best technology for its 3G development, and, hopefully, that technology choice would protect and promote its domestic industrial interests, it is very clear that the commercial viability of the TD-SCDMA is a secondary concern of China's industrial policy makers. According to Peter Lovelock, director of MFC Insight, a Beijing-based telecom consultancy firm, '...if it turns
out that TD-SCDMA is also a commercial success for China, it will be a remarkable bonus'.

After nearly three year's waiting, in September 2004 the field trials of the TD-SCDMA network drew to a successful conclusion, following the success of the field trials of its counterparts of WCDMA and CDMA2000 earlier in the year.

At a press conference at the China Mobile Telecommunications Industry Summit Forum held in Beijing on March 29, 2005, the new minister of the MII, Mr Wang Xudong said, 'We are going to develop 3G at an appropriate time in 2005.' This has been taken as a signal of the countdown of the issuance of the 3G licenses in China. He also made comments that his ministry would make suggestions for the development of 3G networks but leave the operators to choose the most appropriate 3G technologies for their businesses. Nevertheless, the decision regarding the 3G licenses in China will have implications not only for China's domestic manufacturers but also for foreign vendors that have occupied nearly the entire second-generation infrastructure (network) market in China.

**Fulfilling the WTO commitments**
The next step facing China's telecommunications industry is to compete with foreign-funded organizations. To fulfil its WTO commitments, China will gradually open its telecommunications services market. Foreign operators will be allowed to be involved in business operations in both basic and value-added telecom services, in the way of co-funding, with limitations on equity proportion, business scope and geographic coverage and time for services. The MII has firmly stated that the government will implement its commitment to market liberation, with open and transparent policies (MII, 2004).

For a long time, China did not have any legal document such as a Telecommunications Act to guide the policy framework in the telecommunications industry (CRC Pinnacle, 2004). The network operators, especially China Unicom, defended their interests by leveraging their individual strengths, without a transparent regulatory or policy framework. In September 2000, the government published its first Telecommunications Regulation: a prototype Telecommunications Act. The MII also promulgated 17 telecom-related Orders of the Minister. In 2001, the government placed the draft of a Telecommunications Act at the top of its priority list. Four years later, the draft still had not been legislated. The official explanation for the long wait is that the law is waiting to become more 'regular'. The underlying sentiment is that the MII wishes to retain the convenience, under the current Telecommunications Regulation, of steering the industry towards its desired directions (CRC
The long wait for the introduction of China’s Telecommunications Act is expected to conclude in 2005. The Act is supposed to provide transparent guidance in the operations of basic and value-added telecommunications services, as well as pricing guidance for all telecommunications services, in the post-entry WTO era.

A Duopolistic Mobile Services Market

It is unlikely that there will be full-scale competition in the telecommunications service market (at the carrier level). This is because of the unique features of investment in the telecommunications services industry, namely, that (1) the initial investment in building the network infrastructure is exceedingly high, and (2) the additional cost of serving one more customer is marginal (Shapiro and Varian, 1998; Mansell and Steinmueller, 2000). It is commonly believed that an oligopolistic structure is a more realistic choice in respect of the backbone telecommunications service market; competition among several big carriers may keep prices from reaching monopolistic levels and enhance the quality of services (Loo, 2004). As discussed in the previous section, in China, the government regulatory and policy framework has played an important role in shaping the industrial structures.

There are currently two mobile carriers in China, China Mobile and China Unicom, competing in the mobile services market. In this market, China has a ‘duopolistic’ structure. As indicated earlier, the real effect of the establishment of China Unicom was that it contributed to the creation of a competitive telecommunications market, particularly in mobile services. The customer’s role in the telecommunications market has been changed too: from passive users to active purchasers. As a result, the market has benefited from a rapid decrease in tariffs and installation fees, as well as shorter waiting times and improved technologies and services.

In the early 1990s, to carry a heavy and clumsy analogue mobile phone handset became a symbol of wealth and social status in China, reflecting the high costs and limited supply of mobile handsets at the time. Local PTAs (Post and Telecom Administrators) were the only source supplying and selling connections for mobile phone services (Zhang, 1998).

The creation of China Unicom ended China Telecom’s monopolistic position in the mobile services arena. Only one year after its foundation, on 17 July 1995, China Unicom launched its first mobile services (GSM) in Beijing, Shanghai, Xi’an and Guangzhou, thus introducing competition into China’s mobile services market. Mobile subscribers experienced the benefits brought by this competition almost immediately, such that the quality of China Mobile’s mobile services was substantially improved, and
the mobile handset price was rapidly reduced. The most significant benefit this competition has brought to the market was the substantial reduction of the per-minute retail tariff, which has greatly enhanced the accessibility of mobile services. According to the ITU’s (1999) World Telecommunication Development Report, the price of using a mobile phone in China was among the lowest in the world at that time.  

With the MII’s support, China Unicom achieved rapid network expansion, especially in 1999 and 2000. China Unicom’s market share jumped from less than 10 per cent in 1998 to more than one third in 2004 (see Figure 7.3).

![Figure 7.3: Mobile subscription growth in China (1998-2004)](source: CRC-Pinnacle Consulting Co. Ltd. (2004))

After the formal establishment of the Ministry of Information Industry (MII) in 1998 and the subsequent separation of China Mobile from China Telecom in 1999, the competition between the two mobile carriers has become severe. For example, in March 2000, China Unicom and China Mobile started a round of price wars over mobile services in Guangdong and Chongqing. Both carriers offered discounted connection fees and tariffs below the threshold set by the government regulations. These price wars came to a stop after the government’s intervention. Since then, any proposals for price reductions for mobile services by the mobile carriers have to be approved by the relevant departments at the MII (CRC Pinnacle, 2004).

The competition between the two carriers, at present, still stays at the ‘price competition’ level, though their pricing strategies are under the close
monitoring of the MII. When the market gradually reaches the saturation stage, the carriers will have to enhance their competitiveness through improved consumer relationships, a more innovative business portfolio and improved services. Nevertheless, competition has been recognized as a strong catalyst for the development of mobile communications in China. Between 1998 and 2004, the CAGR (compound annual growth rate) of mobile subscribers was 49 per cent.

**New Revenue Stream: Mobile Data Communications**

The fast-growing mobile subscriber base in China has not necessarily meant profitability for the carriers. In fact, the ARPU (average revenue per user) per month, the widely-used industry index of a mobile carrier’s profits, does not suggest any optimism for the profit outlook for China’s mobile carriers. For example, for China Mobile’s contract (Global-Tone) subscribers, the ARPU was 101 Yuan in 2004, representing a nearly 32 per cent decline compared to 2002; and for China Unicom’s contract subscribers, the ARPU dropped to 89 RMB in 2004 from 171 RMB in 2002 (CRC Pinnacle, 2004). This decline could be attributed to the reduction in tariff, but it could also indicate an increase in lower-usage subscribers.

Over the past decade, Chinese mobile carriers have focused their resources on ‘catching up’ with the construction of network infrastructure. It is estimated that, on average, the carriers reinvested about 50-70 per cent of their total revenues into fixed assets (mainly network infrastructure), whereas this type of investment usually accounts for less than 30 per cent of carriers’ revenues in developed markets. Intensive subscriber recruitment followed the heavy network construction, with annual subscriber increases of 54.3 million in 2002, 58.5 million in 2003 and 53.5 million in 2004 (CRC Pinnacle, 2004).

The combination of the declining ARPU and the steady but fast growth of subscribers led the mobile carriers to realize that they would have to shift their focus towards generating new revenue streams by offering new and better services.

Since the late 1990s, both China Mobile and China Unicom have introduced a variety of value-added services in order to fully exploit the potential of their network resources (infrastructure and subscriber base). These services include caller number display, voice mail, SMS, call forwarding, call waiting, three-party calls and VoIP long distance calls. In an effort to keep up with mobile commerce developments around the world, both China Mobile and China Unicom launched their nation-wide WAP (Wireless Application Protocol) services on May 17, 2000, World
The Development of the Mobile Payment Industry in China

Telecommunications Day. However, the WAP services, as everywhere else in the world, have not had much success with subscribers.

NTT DoCoMo’s i-mode success in Japan has provided Chinese mobile carriers with valuable lessons in the mobile data communications sector. In November 2000, China Mobile launched its Monternet program. This program is based on DoCoMo’s i-mode business model whereby China Mobile provides and operates an open platform and recruits independent service providers to offer application-based services, through a revenue-sharing scheme. Under this program, independent service providers can access the carrier’s mobile network to provide nationwide mobile data services, with China Mobile keeping 9 per cent of the traffic revenue and the service providers receiving the rest.

This program is known as ‘one-stop shop, China-wide services’. In order to deliver the Monternet program, China Mobile set up a subsidiary, Aspire, in late 2000. Aspire’s role was to construct a Mobile Information Service Centre (MISC) platform, which can be used as a common platform for mobile Internet services for China Mobile across the country. Currently, the MISC can provide a uniform data interface which is open to all China Mobile’s independent service providers and business partners.

The Monternet program generated an overwhelming response from the service providers. By the end of March 2001, 102 service providers had joined the program for cooperation in the mobile Internet market (China Mobile (Hong Kong), 2001). After five year’s development, the Monternet program now offers a variety of value-added services, including message-on-demand, message broadcasting, news, e-mail and mobile commerce.

On January 21, 2001, China Mobile formally launched its General Packet Radio Service (GPRS) network project. The decision to upgrade China Mobile’s circuit-switching networks to packet-based networks has been recognized as an important strategic policy initiative that made mobile Internet and mobile commerce a reality in China (CRC Pinnacle, 2004).

However, the real growth of mobile data services remains in the short messaging services (SMS): one of the simplest value-added data services over the GSM networks. The phenomenal growth of SMS in China is hardly a surprise. By December 2004, China Mobile had signed more than 400 content providers for its SMS. SMS became an important revenue generator that saved a group of Internet portals and ISPs (Internet service providers) in China. For example, the income from non-advertising related businesses accounted for about 40 per cent of the total revenue for the largest Internet portal – sina.com (NASDAQ: SINA) in 2004 (Sina, 2004). The SMS is a substitute for e-mail communications in China. Greetings, jokes, and advertisements are the three major types of SMS messages in China (Xu, 2003). Another reason explaining SMS’s take-off in China is
that it is relatively cheap compared with voice communications. A relatively simple input method (Chinese Pin Yin) also contributes to the explosive growth of SMS. It has been claimed that Chinese cultural factors, such as the Chinese preferring to communicate through the written word instead of direct dialogue and that they like sharing information with friends, may have helped determine the fast acceptance of the SMS (Xu, 2003).

SMS has not only injected much-needed revenues into the Internet portals, service providers and content providers, but has also become a significant new source of revenue for carriers. The SMS model provides an access channel for the service providers to join in the mobile communications value chain. Indeed, the enormous increase in SMS has attracted many new players with the hope of developing the huge potential of the wireless data communications industry. As a consequence, it has boosted further development of SMS in China. As the SMS market continues to mature, more advanced applications such as MMS and JAVA/BREW will provide enormous potential for unique and creative content to be developed.

Since the second half of 2004, the MII began to control the content of text messages sent over the mobile networks. As a result, the number of SMS messages sent in China in 2004 was only 218 billion, which fell short of many industry forecasts (CRC Pinnacle, 2004), and was much less than 348 billion messages sent in 2003.

Nevertheless, China’s mobile carriers and independent service providers are endeavouring to find new technical solutions and applications, as well as new business models for mobile value-added services. Mobile payments is one of these.

**CHINA’S PAYMENT INFRASTRUCTURE**

China’s payment infrastructure consists of inter-bank systems operated by the People’s Bank of China (the central bank), at national level, provincial level, city level and county level, and commercial banks’ intra-bank payment systems.

Bankcards appeared in China in 1986. Various obstacles have impeded the development of bankcards in the country. Low disposable income levels, lack of consumer sophistication, and lack of a unified payment infrastructure are commonly-cited reasons for the low adoption of bankcards in China before the Golden Card Project was launched in 1993 (CRC, 1997a). The Golden Card Project was aimed at constructing China’s
inter-region and inter-bank electronic payment networks. After more than ten year’s development, as of the end of 2004, China had developed about 778 million bankcard holders, though most of these cards are debit cards or charge cards (quasi-credit cards). Real credit cards issued by local banks are still very rare in China.

Two events are considered critical factors pushing for rapid reforms in China’s payment industry. First, as a condition of China’s WTO membership, starting in 2007 the country will officially lift its restrictions on foreign banks entering the financial services markets. The current structure and practices of banks and financial institutions will not provide them with enough power in head-to-head competition with foreign counterparts. Second, the 2008 Olympic Games in Beijing will be a ‘flagship’ event for China, which will attract many foreign tourists relying mainly on credit cards for travel, accommodation and shopping. The current payment infrastructure challenges China’s hopes of hosting this event successfully.

To address these challenges, the central bank decided in 2003 to replace its Electronic Interbank System (EIS), which was developed in the late 1980s and had been serving as the national exchange clearance and settlement centre linking the country’s financial institutions, with the China National Advanced Payment System (CNAPS). The introduction of the CNAPS reflects great progress in the development of China’s payment infrastructure. Meanwhile, China UnionPay (Yin Lian) Co. Ltd. was created to operate the country’s inter-bank transaction network and the nationwide ATM network. The central bank aims to raise the number of merchants accepting cards (debit or credit) from 5 per cent in 2003 to more than 30 per cent by 2008 (Horizon, 2003).

Before the establishment of China Yin Lian, most bankcards in China were restricted in use to a specific region or city, and, in many cases, to a specific bank. For this reason, before 2004, only about 3 per cent of consumer purchases in China were made with bankcards, versus 81 per cent in the United States and 64 per cent in Europe, with the remaining transactions conducted in cash. Furthermore, the electronic payment facilities in China’s retail outlets are also very limited. For example, by February 2003, only 200 ‘premier class’ restaurants, among nearly 40,000 restaurants in Beijing, had installed ‘card-swiping’ facilitates (Horizon, 2003). This is a typical chicken-and-egg dilemma: consumers will not use bankcards unless more merchants provide multiple payment options at retail stores and e-commerce web sites; however, the merchants will not invest in installing more point-of-sale (POS) terminals until more consumers are willing to use bankcards.
China Yin Lian was created to solve this dilemma and has experienced early success: in 2004, the transaction volume of electronic payments in China reached 18 trillion RMB Yuan (about 2 trillion US dollars),\textsuperscript{50} representing an 80 per cent increase compared to one year before. However, China Yin Lian has a tough task ahead: before the Beijing Olympics, the country must install a national data-processing system for cross-region and cross-bank electronic transactions, and, at the same time, it must launch a massive public education campaign to persuade its population – which still regards ‘cash is king’ – to use bankcards. This situation, on the other hand, presents lucrative market opportunities for emerging payment alternatives, such as mobile payments.

**Golden Card Project**

1993 marked a milestone in China’s payment industry when the Golden Card Project was launched with the aim of speeding up the construction of the country’s electronic transaction networks.

The Golden Card Project, referring to the development of bankcards, and IC cards for identification, telecommunications and social security purposes, as well as the deployment of inter-region and inter-bank electronic transaction networks, is one of 12 so-called Golden Projects. The Golden Projects, launched by the former president Jiang Zemin in October 1993, aimed at accelerating the Chinese government’s systematic deployment of information technology (IT) infrastructure in state agencies concerning banking, customs, tax, education, healthcare, agriculture, network security, utilities, auditing, finance, social security and tourism (CRC, 1997b). By 2003, ten years after the introduction of the Golden Projects, the implementation of these projects had accumulated more than 10 billion RMB Yuan in investments by government agencies alone. If the expenditures of other related organizations are taken into consideration, the total investment for the IT and telecommunications products and services generated by the Golden Projects amounted to over 100 billion RMB Yuan (about US$12 billion) (MII, 2003).

The Golden Card Project was jointly managed by the former Ministry of Electronic Industry (MEI), the former Ministry of Posts and Telecommunications (MPT) and the People’s Bank of China. The initial scale of the Golden Card Project was to implement ATM and debit card transaction networks in 12 of the more advanced cities in China. By the end of 2002, the Golden Card Project had extended its coverage nationwide. This success led to the establishment of China UnionPay (Yin Lian) Co. Ltd.
China UnionPay (Yin Lian) Co. Ltd.

China UnionPay (Yin Lian) is a shareholding payment association (similar to Visa and MasterCard) ‘sponsored’ by 84 domestic banks and financial institutions, backed by the People’s Bank of China and other relevant government regulators. The company accumulated a registered capital of RMB 1.65 billion (almost US$200 million) at its official launch on March 26, 2002. Mr Liu Tinghuan, the Vice Governor of the People’s Bank of China, was appointed as the first Chairman of the Board of Directors and Mr Wan Jianhua, a veteran in China’s financial industry, including eight years experience running China Merchant Bank, was appointed as the first president of Yin Lian. Headquartered in Shanghai, the company was established to build and operate a nationwide bankcard information switch and interchange network, to enable the interoperability of bankcards nationwide and to further develop the bankcard industry in China. Specifically, the company aims to enable bankcard holders to use their cards at any terminal, no matter which bank or city they are from, by linking all electronic payment systems across the country.

In December 2002, Yin Lian launched its pilot service of inter-bank fund transfer in Beijing, Shanghai, Guangzhou, Shenzhen and Xiamen. Thirty-seven banks whose headquarters had been connected to China Yin Lian’s switch centre were able to provide inter-bank transfer services through their branches in these five trial cities. This means Yin Lian cardholders are able to withdraw cash and make inquiries at ATMs and make purchases at POS terminals which are connected to the Yin Lian’s network (marked by carrying the ‘Yin Lian’ [Money Link] logo) at various stores, hotels, airports and other sites in these five cities. Though Yin Lian was granted a ‘Prominent Contribution Award for Interoperability in 2002’ by the People’s Bank of China, its urgent task in 2003 was to improve interoperability of the system in which dozens of regions and hundreds of cities used incompatible data-processing infrastructures. After one year’s effort in expanding this service on the ATM networks and the Internet by actively cooperating with issuing banks at all regional levels, by the end of 2003, Yin Lian had achieved substantial interoperability of the inter-bank transactions: the coverage of its inter-region and inter-bank transaction network reached over 300 cities. The ‘Yin Lian’ logo has become a payment ‘trademark’ (like Visa and MasterCard) appearing on ATMs, POS terminals and bankcards.

In August 2004, 16 Hong Kong banks (including Standard Chartered Bank) joined the Yin Lian network. Under the terms and conditions, these Hong Kong-based banks can accept bankcards carrying the ‘Yin Lian’ logo in Hong Kong. Meanwhile, these banks are allowed to issue Yin Lian cards.
to Hong Kong residents so that these cardholders can use their cards at ATMs and POS terminals carrying the ‘Yin Lian’ logo on the mainland.

China Yin Lian has made clear its intention to compete with MasterCard and Visa. ‘We want to become China’s Visa or MasterCard’, Mr Wan Jianhua announced in his inaugural speech as the president of Yin Lian in 2002. In late January 2005, China Yin Lian achieved another breakthrough in its international expansion. Yin Lian signed an agreement with the Hong Kong and Shanghai Banking Corporation (HSBC), which allows Yin Lian bankcard holders to withdraw Hong Kong dollars (up to HK$4,500 a day) from HSBC ATMs in Hong Kong. The HSBC takes this as an opportunity to serve the growing number of mainland visitors to Hong Kong. Apart from Hong Kong, Yin Lian has actively increased its regional presence in the Asia Pacific region. In January 2005, Yin Lian initiated card acceptance programs (mainly used in withdrawing cash to a certain limit) for its cardholders in South Korea, Thailand and Singapore. The restrictions imposed by the People’s Bank of China constrain certain types of payments under these card acceptance programs such as fund transfers or payments for gambling in those countries. Nevertheless, this is the first move by China’s payment association to establish its brand beyond China’s territory.

Yin Lian’s overseas expansion is certainly not one-way traffic. For example, MasterCard has partnered with HSBC and its minority-owned subsidiary, Bank of Communications (BoCom), to issue co-branded bank cards; Visa has teamed up with Bank of China (BoC) to issue co-branded credit cards; and Japanese JCB has reached a working relationship with the Industrial and Commercial Bank of China (ICBC) and the Bank of China (BoC) to issue co-branded credit cards on the mainland. All these international card consortia are trying to win a piece of China’s lucrative payment industry prior to the Beijing Olympics.34

The benefits of using unified bankcards and ATM and POS networks carrying a unified ‘Yin Lian’ logo are considerable. For example, merchants can easily accept a bankcard carrying the ‘Yin Lian’ logo without identifying the issuer bank, especially across regions; and cardholders can use their cards at ATMs and POS terminals carrying the ‘Yin Lian’ logo outside the original location of the issuer bank, including Hong Kong, Macau, South Korea, Thailand and Singapore.

However, Yin Lian’s growth path was not as smooth as was planned by its sponsor, the People’s Bank of China. In early 2004, almost before Yin Lian’s president Mr Wan Jianhua finished his passionate speech at the celebration of Yin Lian’s second birthday on China’s card payment future – which read, ‘China is believed to have endless potential in bankcard industry, with potentially the largest cardholder base and the largest issuer banks in the world’ – a crisis occurred as merchants in Shanghai and
Shenzhen started to reject Yin Lian bankcards due to an ‘unfairly high’ commission fee. Yin Lian was accused of being a ‘monopoly’ player in the banking industry.

In an official statement, Yin Lian ascribed this crisis to a lack of transparent communication between the banks, merchants and consumers. According to Mr Wan, ‘...merchants are paying normal costs in processing inter-bank transactions’ (Time Finance, 2004). In fact, this crisis reflects the fact that a good-will policy was imposed without taking into consideration the realities of the Chinese situation. It is common practice in western societies for merchants to have to pay about a 2 per cent transaction commission. However, 2 per cent seems a big barrier for China’s merchants, especially small ones, to comprehend and accept at this stage. Following the wisdom of ‘feeling the stones when crossing the river’, Yin Lian consequently adjusted its transaction commission from an original 3 per cent to an average of 1 per cent (People’s Bank of China, 2004), below the international standard.

In addition to building and operating a unified inter-region and inter-bank bankcard information switch and payment data-processing network, Yin Lian’s tasks include providing advanced electronic payment technologies and specialized services to its interchange network for banking and financial institutions in China; formulating operational regulations and technical standards for inter-bank bankcard transactions; coordinating and mediating cross-bank transaction disputes; and managing the ‘Yin Lian’ brand name. The Yin Lian card, approved by the People’s Bank of China, issued by Yin Lian’s partner banks and financial institutions, paves the way to achieve nationwide inter-region and inter-bank transactions in compliance with international technical standards. Yin Lian has built a ‘platform’ which is the result of the convergence of multiple technical and operational standards across different banks and financial institutions at different levels. In the first year of its operation, Yin Lian’s partner banks and financial institutions issued more than 110 million bankcards carrying the ‘Yin Lian’ logo, representing about 20 per cent of the total bankcards in use in China. As of the end of 2004, China had about 375 million bankcards carrying the ‘Yin Lian’ logo, accounting for over 48 per cent of the total bankcards in the country, and the total number of ATMs carrying the ‘Yin Lian’ logo reached 67,300, representing nearly 99 per cent of ATMs in China. This ‘platform’ is expected to equip China’s banking and financial industry to compete with leading international players, especially in anticipation of the Beijing Olympics.

Mobile payment, taking advantage of mobile telecommunications networks and Yin Lian’s inter-bank and inter-region transaction networks,
presents a new electronic payment application. On January 21, 2003, partnering with China Mobile, Yin Lian launched a mobile payment services pilot operation in Changsha, the capital city of Hunan province. In this trial site, mobile phone users can conduct virtual bankcard transactions through mobile phone short messages. The mobile payment services make the mobile phone another bankcard terminal device, in addition to ATM and POS terminals. The success of this trial provided a foundation for further cooperation across industries in the future.

THE EMERGENCE OF MOBILE PAYMENTS IN CHINA

In early 2000, e-commerce became a much-hyped word in China’s IT industry. Despite the overwhelming hopes it brought to Internet Service Providers (ISPs), it did not generate real businesses in China, where e-commerce is still limited to the business-to-business (B2B) level. One reason behind such a slow development of e-commerce is the low penetration rate of computer and Internet access. Another important factor is the slow development of an electronic payment infrastructure.

With over 300 million mobile subscribers (as of the end of 2004) in China, the concept of m-commerce has drawn increasing attention among the mobile operators, ISPs and ICPs (Internet Content Providers). The potential scale of the mobile payment market as well as the revenue it represents, either through transaction fees or airtime charges, is attractive enough for any of the players involved.

China already has one of the world’s most successful mobile payment systems: China Mobile’s Monternet essentially allows its users to have access to different sites and pay for downloaded content or information (such as ring tones and icons) on their mobile phone bills. This is the first type of billing-based mobile payment method.

In December 2003, China Mobile Group issued an internal document on the business specifications of mobile payment services. This document outlined the definition of mobile payments, as well as business and management issues (CMCC, 2003). This document is China Mobile’s blueprint for building mobile payment platforms and providing mobile payment services to its users.

The fragmented and immature payment industry and the well-developed mobile communications market in China provide a unique opportunity for mobile payments, which, utilizing the vast mobile subscriber base, short-cuts the way to achieve larger-scale electronic transactions in China. However, the implementation of any mobile payments involves different
frameworks, standards and technologies. To achieve cross-industry and cross-region compatibility is critical for the development of China’s mobile payment industry.

The Industry Value Chain

Based on middleware and third-party service providers, a new value chain for the mobile payment industry, composed of mobile operators, banks and financial institutions, mobile handset manufacturers, merchants, consumers and services providers, has emerged in China. An entrepreneurial start-up, Shanghai SmartPay (Jie Yin) Co. Ltd., is one of the driving forces in the creation of this new industry value chain. However, it is Beijing-based Union Mobile Pay (UMPay) Co. Ltd., a joint venture between China Mobile and China Yin Lian, which has spurred the further development of the industry value chain.

In this value chain, mobile payment platforms play a crucial role in generating value for all of the stakeholders involved. The mobile payment service providers have multiple sources of generating income, such as charging consumers for accessing the mobile payment networks, transaction commissions from the banks, SMS airtime commissions from the mobile operators, and royalty charges from banks and mobile operators. The road to creating this value chain was not smooth. It was again a ‘chicken and egg’ loop: without the support of the operators, banks and financial institutions will not be convinced to join the platform; without banks and merchants, consumers will not be able to use the platform; and without consumers, mobile operators will not support this solution.

The most pervasive mobile payment application in China, at this stage, is the ‘mobile wallet’ based payment solution: the second phase of the mobile payment development. Payments are made with a bank account associated with a mobile phone through SMS (short messaging service) or IVR (interactive voice response) over the mobile networks (over the air). This type of payment instrument offers easy, secure and convenient payment solutions in on-line, phone-to-phone and phone-to-machine transactions, such as paying bills (phone bills and utility bills), topping-up pre-paid accounts (mobile phone accounts, IC cards or IP cards), purchasing digital content/services and paying for goods at vending machines.

The mobile payment platforms provided by mobile payment service providers such as Jie Yin and UMPay are critical in linking all stakeholders, whether they are mobile operators, banks, mobile phone handset manufacturers, merchants or consumers. Perhaps more importantly, these third-party service providers smooth and simplify the
often-complicated cooperative and competitive relationships between the banks and the mobile operators.

**Shanghai SmartPay (Jie Yin) Co. Ltd.**

Shanghai SmartPay (Jie Yin) Co. (hereafter referred to as Jie Yin) operates the first region-based consumer electronic payment service network in China under the brand name ‘Jie Yin’, literately meaning ‘quick money’. Jie Yin’s first and most famous offering is its SMS-based payment service that allows mobile phone users to pay their mobile phone bills or utility bills (such as gas bills or electricity bills) via mobile phone by sending SMS messages. This solves the problem for users of waiting in queues every month at the cash counters of banks or financial institutions nominated by the mobile operators to pay the bills. It operates in a very simple way: in the case of paying mobile phone bills, every month the mobile operator will send the bill directly to a Jie Yin user’s phone through an SMS message; the user can then choose to pay the bill via a return SMS message authorizing the operator to debit the right amount of money from the bank account linked to his/her mobile phone account. The payment is completed on the Jie Yin payment platform which links the operators’ and banks’ networks. The Jie Yin platform provides users with multiple choices of interface, such as IVR, web browser or SMS, to initiate and authorize any transactions. Under the surface, in Jie Yin’s transactions, a mobile phone acts as a ‘digital identity’ that authenticates the user and allows Jie Yin to process the payments.

By the end of 2004, Jie Yin had recruited over 40 million mobile payment users, through its partnership with over 20 banks and numerous merchants in Shanghai, Anhui, Hebei, Jiangsu, Chongqing, Liaoning, Guangdong, Beijing, Zhejiang, Shandong and Sichuan (Jie Yin, 2005). Forty million is not a huge number compared to the 311 million mobile subscriber base in China. However, this achievement reflects Jie Yin’s breakthrough in building a bridge linking multiple mobile operators, banks and merchants, which, as a consequence, contributes to the creation of the industry value chain of mobile payments in China.

**The establishment of Jie Yin**

Jie Yin was founded by Eric Rosenblum in 2002. Having witnessed the daunting experiences of millions of consumers waiting in endless lines at crowded bank counters to pay either their mobile phone bills or utility bills every month, Rosenblum conceived the vision of his business venture. His very first idea was to provide a new payment instrument which would allow consumers to use their mobile phones to conveniently pay their bills.
A Harvard graduate with an MBA from the MIT Sloan School of Management, Rosenblum speaks fluent mandarin Chinese after having lived (he is married to a Chinese) and worked in China for over 10 years (including five years with Boston Consulting Group in Shanghai and Hong Kong). Before founding Jie Yin, Rosenblum worked in DT Intrinsic Technology Ltd. (hereafter referred to as ‘Intrinsic Technology’), a pioneer in the wireless value-added services field, whose linktone.com was the first WAP portal in China. After the dot.com bubble burst in Wall Street in 2000, various mobile commerce and mobile payment solutions (technologies) began to attract the attention of the venture capital community. Rosenblum realized that mobile payment is not about pure technologies; it is more of a concept about services, which is something missing in China. For example, the construction of a mobile payment network requires a dedicated service provider to deal with all the parties involved, including banks, mobile operators and merchants in a one-on-one, face-to-face fashion. With this ‘framework’ of services in mind, Rosenblum successfully persuaded Intrinsic Technology to set up a company to work as the service provider and the agent for building a mobile payment platform in China. Led by Rosenblum, Intrinsic started to investigate the market conditions and possible business models for mobile payments. Rosenblum later revealed that reading the book ‘The Perfect Store: Inside eBay’ by a senior journalist of the New York Times – Adam Cohen – inspired his vision of creating a new business model of providing mobile payments in China.

In August 2001, Rosenblum drafted his business plan for mobile payments, outlining the capital investment he required to start up his venture as well as the sources and timetable of the revenues generated to pay back such investment. Intrinsic Technology and its parent company – AsiaInfo – enjoyed reputation and expertise in the telecommunications field, but Rosenblum needed expertise in the banking and financial sector, especially knowledge and experience of software engineering and systems integration in this sector. A high-tech venture, HiTrust, which independently developed electronic payment systems and implemented financial systems integration for the Hong Kong and Shanghai Banking Corporation (HSBC), became Rosenblum’s target. Coincidently, one of HiTrust’s investors is Acer Technology Ventures – the corporate venture capital arm of Acer Computer Group – which also invested in Intrinsic Technology. With Acer Technology Ventures’ help, Intrinsic Technology and HiTrust became Rosenblum’s first investors.

During that period of time, whenever Rosenblum saw somebody using a mobile phone, the idea of utilizing the huge mobile subscriber base in China to create enormous business opportunities around mobile payments
started to flash through his mind. He became obsessed with his vision of mobile payments in China. Despite many years in the management consulting business, Rosenblum did not have enough technological knowledge and experience. This drawback didn’t become a barrier for him. Instead, he decided to approach Icon Media Lab, a high-tech firm that developed electronic payment standards for Ericsson and Hewlett Packard, and it agreed to join him.

In January 2002, with US$1.4 million in capital investment from Intrinsic Technology, HiTrust, Icon Ventures Asia, Lunar Group and the rest from individual investors and the management team members, SmartPay (Jie Yin) Ltd. was founded in Shanghai.

Rosenblum understood the dynamic and complicated nature of an emergent mobile payment industry in China. He invited an international combination of China experts, as well as technical experts specializing in both banking and telecommunications industries, into Jie Yin’s management team. For example, Rosenblum invited Michael Nip, co-founder and Director of Business Development at NetTV China – an expert negotiator – to join Jie Yin as the Vice President of Business Development; Yu Jiangchun, his Boston Consulting colleague; and Fang Ya’nan, who is considered the pioneer of China’s electronic lottery payment system development, to join Jie Yin.

A slow start
To introduce an emerging technology to the mass market is not an easy task in any country, especially one where the industry value chain has not been defined and established. Rosenblum and his team had planned to work with China Mobile and China Unicom as well as major banks and financial institutions to define the rules for their game. Perhaps not to their surprise, the responses from the dominant operator, China Mobile, and the major banks were not very encouraging.

In early 2003, Jie Yin’s software package for a mobile payment platform was chosen by the Guangdong Mobile Communications Corporation – the largest provincial mobile operator within the China Mobile Communications Corporation – as the payment platform for its mobile-wallet service, winning against competition from such large, well-established names as Huawei, Motorola and Nokia. However, selling a software package was not the ideal business model that Rosenblum and his team had pursued.

It was Shanghai Dazhong Gas Company (hereafter referred to as ‘Dazhong’) – a public utility company – that agreed to give Rosenblum’s proposed business model a try. It turned out to be its first successful showcase and a turning point for Jie Yin. In Dazhong’s mobile payment
deal, Jie Yin worked with the local (Shanghai) branches of seven small and medium-sized banks (China Communications Bank, China Merchant Bank, China Pudong Development Bank, Shenzhen Development Bank, Huaxia Bank, Fujian Industrial Bank and Guangdong Development Bank) to provide consumers with a brand new channel through which they could easily pay their gas bills via their mobile phones over Shanghai Unicom's mobile networks. The payment instrument is very simple: a gas user, who needs to have a bank account with any of the seven partner bank branches that is bundled with his/her mobile phone account with Shanghai Unicom, just sends an SMS message to authorize the associated bank to debit the money to Dazhong Gas every month after the receipt of an SMS invoice. The transaction is conducted on Jie Yin's payment platform. This new payment method offers an easy and secure alternative to paying gas bills by queuing at bank or post office counters within the limited time slots every month. Rosenblum attributes the success of this case to the active participation and support of the partner banks. Though considered conservative and old-fashioned, Chinese banks and financial institutions have shown increasing enthusiasm for enhancing their electronic payment channels and customer-oriented services in order to retain customer loyalty. However, Rosenblum says mobile operators have reacted slowly and passively so far.

The initial success of the relationship with Dazhong has confirmed the validity of Jie Yin's business model as an independent service provider. It also greatly enhanced Rosenblum's and his team's confidence that there is a market for this new payment method. 'What we sell are services, like MasterCard and Visa, providing services to every party.' Rosenblum defined Jie Yin's position as an independent service provider in an emerging industry value chain. He sensed the importance of this position from the past failures of the trials of many isolated mobile payment solutions provided by either banks or mobile operators due to a lack of cooperation. Referring to such failures, he said, '...If you cannot provide size, you will be a niche player.' Indeed, at the start-up phase of an emerging industry, a third-party service provider works like a 'lubricant' which softens the hard edges of all of the parties involved and facilitates cooperative partnerships that may create scale and scope for any new products or services. As Rosenblum pointed out, two reasons eventually convinced Dazhong to choose Jie Yin's payment solution: firstly, once connected with Jie Yin's payment platform, Dazhong Gas can be connected to a group of local banking networks, thus forming one-to-multiple communications with banks; and secondly, once connected with the Jie Yin platform, Dazhong users can enjoy multiple modes of payment,
such as SMS payment over their mobile phones, phone banking or even ATM transactions, provided by Jie Yin.

Despite the success of the venture with Dazhong, Jie Yin’s efforts in persuading the mobile operators, especially China Mobile, to embrace the concept of mobile payment did not generate much result. Rosenblum and his team therefore turned their attention to promoting the concept among mobile phone users.

In the second half of 2003, Jie Yin made a breakthrough. Partnering with Hebei Welfare Lottery Centre and Huaxia Bank in Hebei, Jie Yin launched its ‘Palm Lottery’ service in Shijiazhuang, the capital city of Hebei province. The ‘Palm Lottery’ service offers lottery fans with a new payment method via mobile phone to purchase welfare lottery tickets in Shijiazhuang. To purchase a welfare lottery ticket, a user simply needs to send an SMS message authorizing the Welfare Lottery Centre to deduct the right amount of money from the bundled bank account at Huaxia Bank over Hebei Unicom’s mobile networks. This mobile payment system provides lottery fans with a 24-hour purchasing channel, as well as a fast feedback channel such that an SMS message can be sent to purchasers with the betting results.

This breakthrough not only means Jie Yin’s payment system has been expanded into a new payment area (lottery tickets), but also means its business has reached beyond the Shanghai region.

**Success breeds success**

The success in 2003 brought Rosenblum and his team an initial sense of achievement, but quickly burnt up their limited capital. The first half of 2004 proved to be a tough period, seeking a new round of capital investment while pursuing new business opportunities.

After tough negotiations lasting for months, Jie Yin completed its second round of equity financing of HK$65 million (about US$8.34 million) in late July 2004. In this deal, Jie Yin invited the international law firm Morrison and Foerster LLP to complete this venture capital transaction (Morrison & Foerster, 2004). Under the terms of this financing, 2b Holdings, a leading group of strategic investors and existing shareholders, provided HK$65 million in equity financing for Jie Yin. In fact, a ‘significant percentage’ of the capital raised in this round of financing came from the Lunar Group, founding investor of both Jie Yin and Linktone (NASDAQ: LTON) (Jie Yin, 2004). Rosenblum was very pleased with this further injection of capital, which he planned to use to consolidate Jie Yin’s market position and extend its geographic coverage.

The success of the second round of financing bred further success. In the second half of 2004, Jie Yin launched its mobile payment services in
Shanghai, Anhui, Chongqing, Liaoning and Jiangsu. These projects included:

- In July, partnering with Shanghai Unicom and the Shanghai Branch of the China Merchant Bank, Jie Yin launched the first mobile shopping service in China’s most prosperous metropolitan city – Shanghai.
- In October, together with Anhui Unicom and the Anhui Branch of the Industrial and Commerce Bank of China (ICBC), Jie Yin extended its mobile payment service into Anhui province.
- In November, together with Chongqing Unicom, the Chongqing Branch of the Industrial and Commerce Bank of China (ICBC), and the Chongqing Branch of the Agricultural Bank of China (ABC), Jie Yin launched its mobile payment service in Chongqing, the most populous city in China.
- In December, partnering with Liaoning Unicom, the Liaoning Branches of the Agricultural Bank of China (ABC) and the China Merchant Bank (CMB), Jie Yin launched its mobile payment service in Liaoning province, one of the most important industrial provinces in north-eastern China.
- In December, partnering with Jiangsu Unicom, Jiangsu branch of the Industrial and Commerce Bank of China (ICBC), Jie Yin launched its mobile payment service in Jiangsu.

In these cases, Jie Yin, as an independent mobile payment platform and service provider, bridges the mobile operator – China Unicom – with the partner banks. By the end of 2004, over 40 million mobile subscribers of Unicom chose to pay their mobile phone bills, top-up (recharge) their prepaid mobile accounts, as well as purchase long distance IP (VoIP) cards, ISP (Internet service provider) access, online gaming time and other online products via SMS over Jie Yin’s mobile payment platform.

However, Jie Yin had still not broken through the barrier of China Mobile, the dominant operator in China.

**A strategic acquisition and the replacement of the founder-CEO**

In January 2005, Jie Yin announced that it had entered into an agreement to acquire DT Intrinsic Technology Ltd, one of Jie Yin’s original investors (Jie Yin, 2005). Through its wholly-owned subsidiaries, Shanghai Intrinsic Technology Co Ltd and Shanghai Intrinsic Consulting Co Ltd, Intrinsic Technology provided billing and service management software to China Mobile and China Unicom. Intrinsic Technology was considered one of the earliest innovators and driving forces in the development of value-added telecom services in China’s wireless communications industry. Intrinsic
Technology had been a fast-growing company with its core competence lying in the areas of service provision, systems integration and maintenance, especially in the mobile value-added WAP (wireless application protocol) and 2.5G mobile service areas.

The acquisition of Intrinsic Technology reflects Jie Yin’s intention of consolidating its leadership in the emerging mobile payment industry in China. A more direct benefit of this move, according to Rosenblum, is that it ‘...helps strengthen our (Jie Yin’s) position with mobile operators, especially with China Mobile...’ (Jie Yin, 2005). After this acquisition, Greg Shen, the former CEO of Intrinsic Technology, was appointed as the new Chief Executive Officer of Jie Yin, replacing the foundation CEO, Eric Rosenblum. Shen also joined the Board of Directors of Jie Yin, where Rosenblum retains his position as the Chairman. Several former Intrinsic Technology shareholders who retain their equity with Jie Yin also joined the Board of Directors. Other board members include Derek Sulger, Jie Yin’s CFO and founder and director of Linktone;68 James Ding, the Chairman and a co-founder of AsiaInfo (NASDAQ: ASIA); Goran Malm, a member of the Board of Directors of Samsung Electronics and former head of Asia-Pacific for General Electric; Patrick Benzie, a co-founder of Linktone; Carlos Bhola, managing director of 2b Holdings and a former director of EachNet in China; and Hsiao Wen Lee, the Chairman and the CEO of HiTrust.

Greg Shen, a Shanghai native who originally trained as an engineer at the Harbin Institute of Engineering, has rich working experience in the telecom industry in China. His western education, which includes a Master’s degree in engineering from the University of Wisconsin (1992) and an MBA from Marquette University (1996), makes him a strong candidate to carry forward Rosenblum’s ambitious goal to deliver mobile payment solutions in the country.

The combined entity of Jie Yin and DT Intrinsic Technology, headquartered in Shanghai, employed over 150 people operating in regional offices in Beijing, Guangdong, Jiangsu, Zhejiang, Anhui, Shandong, Liaoning, Hebei and Chongqing.

Challenges ahead
In his business plan, Rosenblum ambitiously targeted around 10 per cent of China’s mobile subscribers. His calculation was based on a total of nearly 200 million mobile subscribers (as of the end of December 2002). 10 per cent of 200 million would result in substantial profits for his venture. However, as Rosenblum admits, the company has not yet made a profit (21st Century Economy Report, 2004).
After many ups and downs, Rosenblum and his team became more realistic about their expectations. They understood that the road ahead of Jie Yin would be difficult. Jie Yin had not been able to persuade any of China Mobile’s branches to adopt its mobile payment platform. In fact, its worst fear came true: China Mobile decided to bypass Jie Yin’s technologies and develop and offer mobile payment solutions to its own users. China Mobile understood its shortcomings: the giant carrier does not have enough experience in managing the payment business. Instead of working with individual banks one-on-one and face-to-face, China Mobile teamed up with China UnionPay (Yin Lian) — the company which owns and runs the inter-bank and inter-region ATM networks in the country — to enter the mobile payment industry in late 2003.

Rosenblum came to terms with the fact that his company would only survive if it stayed in a niche. Jie Yin’s management team readjusted its strategies to focus on pre-paid accounts and networking with smaller banks. In his initial plan, it was the void existing in the distribution and resale of the booming pre-paid mobile accounts and top-up recharge cards that inspired Rosenblum’s ambition to capitalize on the market opportunities existing in the mobile payment industry. He pointed out that huge business opportunities existed in helping mobile operators control their indirect losses in payment receivables which occurred in distributing and selling pre-paid mobile accounts and top-up recharge cards. For example, on average, a mobile operator has to give away about 3.7 per cent of revenues to ‘agents’ for distributing and selling pre-paid mobile accounts and top-up recharge cards. In addition, there are about 6 per cent bad debts when the mobile operators collect the money from these agents. On the other hand, the SMS-based mobile payment method in selling pre-paid mobile accounts and topping up recharge cards can greatly save mobile operators from bad debts as well as revenue sharing. In the mobile payment system, mobile operators have to share about 1.5 per cent of revenues with partner banks and about 1 per cent with independent mobile payment service providers like Jie Yin. After this, mobile operators are still better off than sharing 3.7 per cent of the revenues with the distribution network, let alone the bad debts. Targeting collecting the 1 per cent of commission from selling pre-paid accounts and top-up recharge cards through the mobile payment channel became Jie Yin’s new priority.

Whether Jie Yin will succeed in the end is difficult to foresee. In any event, the investor 2b Holdings’ strong connections in the United States and the appointment of Derek Sulger, the founder of Linktone, as the new CFO, all imply an imminent IPO (initial public offering) plan. In fact, Rosenblum did not hide his IPO ambitions. His timetable was that within one to two years ‘...when Jie Yin achieves 50 million mobile payment
users, we will go to NASDAQ’. An IPO being, perhaps, the ultimate success for a high-tech venture struggling in the waves of an emerging technology.

**Beijing Union Mobile Pay (UMPay) Co. Ltd.**

Beijing Union Mobile Pay (UMPay) Co. Ltd. (hereafter referred to as UMPay) entered the mobile payment industry value chain when mobile payment applications were largely anchored in the niche market of bill payments created by Shanghai SmartPay (Jie Yin) Co. Ltd. The success of Jie Yin’s mobile payment solutions opened the eyes of China’s mobile operators. They realized the huge market potential of emerging mobile payments in China. The establishment of UMPay reflects China Mobile’s proactive moves in this field.

China Mobile has learned an important lesson from the success of Jie Yin, namely, that the take-off of any mobile payment application should rely on creating scale and scope, involving the participation of mass consumers and merchants. To create such scale and scope, alliances between mobile operators, banks and financial institutions, as well as merchants, are necessary.

UMPay was founded in August 2003 by the China Mobile Communications Corporation and China UnionPay (Yin Lian) Company, responding to the emergence of the mobile payment instrument developed by Jie Yin. As an independent service provider, UMPay’s mobile payment platform, according to Mr Cai Zhi, vice president of the company, is based on IBM’s Websphere Portal Server. Since its establishment, UMPay has taken controlling positions in the major components of the industry value chain, simply because its two shareholders – China Mobile and China Yin Lian – are the most powerful players in their respective industries. China Mobile had about 198 million (about 63.5 per cent of the total of 311 million) mobile subscribers (as of the end of 2004). As we have seen, China Yin Lian, a subsidiary of China’s central bank, owns the country’s largest electronic payment platform, as well as the ATM and POS networks, which provide inter-bank and inter-region transactions for all its associated commercial and private banks.

In August 2004, one year after its establishment, UMPay started to offer its ‘mobile wallet’ services in Beijing, partnering with Guangdong Development Bank and Beijing Mobile Communications Corporation (China Mobile’s Beijing branch). In April 2005, the ‘mobile wallet’ service became available in Tianjin, Heilongjiang, Shandong, Hubei, Guangdong, Shanghai, Sichuan, Jilin and Hainan, partnering with more than 10
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commercial and private banks in China. UMPay is expecting to roll out its ‘mobile wallet’ service to the entire country by the end of 2006.

A unique business model – under the protection of China Mobile and Yin Lian

The establishment of UMPay was initiated by China Mobile, originally to work as its mobile payment arm. With the participation of Yin Lian, UMPay has become an important link between China Mobile and the banking industry. UMPay’s most essential role is to maintain the connections between different business parties in order to facilitate smooth business operations. Although, technically speaking, UMPay is an ‘independent’ service provider which is supposed to operate the mobile payment platforms on behalf of China Mobile and Yin Lian, in reality, it is playing an ‘assistant’ role in the creation and operation of the mobile payment platform which records the clearance and settlement of all transactions between China Mobile and Yin Lian.

For China Mobile, UMPay provides a platform through which China Mobile can have access to the expertise of payment management from the banking industry. For Yin Lian, the establishment of UMPay offers a platform through which Yin Lian and its associated banks, as well as its merchant members, can be connected to China Mobile’s subscriber base. UMPay seems a win-win arrangement for both parties. However, this arrangement leaves UMPay limited autonomy in its business operations. According to China Mobile’s internal document regarding the business specifications for the mobile payment services (CMCC, 2003), UMPay can ‘… negotiate and eventually decide the specific business models to work with different merchants and other value-added service providers;’ in consultation with China Mobile and Yin Lian’. In reality, China Mobile retains the ultimate decision-making power in areas such as processing merchant member applications or updating membership status which, according to the document, was supposed to be UMPay’s responsibility. In addition, UMPay is not allowed to provide mobile payment services to subscribers other than China Mobile’s.

To join UMPay’s mobile payment platform, users need to pay a subscription fee, which can be a monthly-based fixed charge or payment of a service charge per use. During the first year of operation, in order to promote the wide adoption of its ‘mobile wallet’ service, UMPay postponed the charging of subscription fees. The applications for UMPay’s subscription (or cancellation of the subscription) can be processed either face-to-face, or through the IVR or SMS channels. China Mobile, however, imposed a ‘discrimination’ policy based on the status of its mobile users when applying for UMPay’s services. For example, GoTone users (contract
subscribers) can choose any of the mobile payment services, but Shenzhouxing ⁷¹ (pre-paid users) and M-zone users (generally youth users) can only access re-charging services for pre-paid accounts or other rechargeable services. Mobile payment services were not available to any of the corporate users under its original policy.

The business model of the UMPay is shown in Figure 7.4:

![Figure 7.4: UMPay's mobile payment model](image)

Source: Adapted from CMCC (2003)

**Clearly defined roles in the value chain**

This arrangement brings enormous benefits for all three parties. UMPay's partner banks can have direct access to all mobile payment users. The banks can send information such as their banking-related promotions (not limited to mobile payment services) directly to all mobile payment users. China Mobile can generate a certain percentage of the merchant charges as its additional revenue, as well as enhancing its reputation by promoting the mobile payment services. UMPay, as a newly-created venture, enjoys new business opportunities under the protection of its powerful shareholders, China Mobile and Yin Lian.

For UMPay's mobile payment services, all relevant parties have clear roles and responsibilities. UMPay, as a ‘bridge’ linking China Mobile and the banks, manages and maintains the smooth business operations; China Mobile provides and maintains robust mobile communications networks as
well as designing and implementing marketing promotional activities for mobile payment services among its mobile subscribers; Yin Lian and its associated banks, utilizing their competitive advantage of risk management expertise, process user authentication for the mobile payment transactions.

Under the current arrangement, all mobile payment transaction records are registered on China Mobile’s BOSS (business operation support system) platform, which is also the base for China Mobile to clear and settle its share of revenues with UMPay. China Mobile also generates its revenues from communications charges such as SMS. Yin Lian and its associated banks have separate agreements with merchants which define the percentage of their commissions based on the relevant regulations of the People’s Bank of China. The banks have opened their connection interface as well as their security standards to UMPay for the integration, which is something that was impossible for Jie Yin (SmartPay) to achieve.

In addition, UMPay’s mobile payment solutions are of considerable benefit to China Mobile’s Monternet mobile commerce services: according to a China Mobile internal document, the service providers (SPs) have to share 5 per cent of the revenues with UMPay and 15 per cent with China Mobile.

**Full-scale service portfolio**

Unlike Jie Yin, UMPay’s mobile payment portfolio includes not only billing payment services and topping-up rechargeable cards, but also mobile financing and mobile commerce (including mobile POS transaction payments, mobile lottery and insurance payments). UMPay’s mobile payment services provide multiple access modes to its users, including: IVR, SMS, Unstructured Supplementary Service Data (USSD), WAP and K-Java. Among these access modes, WAP and K-Java require users to have a subscription to the GPRS (General Packet Radio System) network.

One of the applications that UMPay promotes is purchasing insurance policies via mobile phones. For example, a user can send an encrypted SMS message with the user’s name, ID, beneficiary’s name, insurance policy and so on to China Mobile; this information can be processed and forwarded to UMPay; after user authentication, UMPay will send the purchase request to both the bank where the user has his/her bank account and the insurance company; and finally, the bank will transfer the money to the insurance company and the insurance company will issue the purchased insurance policy and its password to the user via an SMS message. This process provides users with a convenient and safe insurance purchase transaction channel. This application has gained its popularity quickly among business travelers – a group of consumers who travel a lot but do not have time to buy travel insurance – since it was introduced into the
market in August 2004’, said Mr Li Zheng, director of business development of Pacific Insurance Company, which is the partner in the deal with UMPay.

**Future plans**
UMPay’s ambition is to have its business cover the entire country by the end of 2006. In order to achieve this goal, it has a two-phase rollout plan for its mobile payment services: regional-based trial services followed by country-wide commercialization. UMPay’s mobile payment services are not limited to users with national roaming. A merchant can negotiate a deal with China Mobile and UMPay either to provide mobile payment services to roaming users or just limit to the users of its own region (province or city).

**DISCUSSION ON CHINA’S TOP-DOWN APPROACH**

In competition with sustaining technologies, the winner needs to better satisfy customers’ existing needs. In competition with disruptive technologies, the winner has to create a need for an emerging market by offering a different package of attributes that have value only in the markets remote from, and unimportant to, the mainstream markets (Christensen, 1997). A disruptive technology can be an innovation in either technology or the business model, or, in many cases, a combination of the two. No matter how insignificant it appears initially, a disruptive technology or business model has a profound effect on the way in which managers approach technology competition (Adner, 2002) and, therefore, has inevitable potential to disrupt the value chain of the incumbent industry.

In China, mobile telecom carriers have avoided introducing disruptive technologies. Rather, China’s carriers have preferred to adopt mature and proven technologies in a ‘catch-up’ fashion, mainly because the government would prefer the current industry value chain not to be disrupted. Through its ownership of the carriers and the involvement of its regulatory body – the MII – the state often imposes its views on the industry. Challenges to such views from any organization or person are dealt with firmly. This top-down approach has shaped the current structure of the Chinese telecommunications industry. It is also the reason for a comparative lack of innovation in the industry.

The MII, in theory a regulatory body of this lucrative industry in China, in reality wields tremendous power not only through being able to issue
business licenses to basic and value-added telecom service providers, but also by ‘creating’ licenses as it sees fit. For example, after witnessing the rapid adoption and take-off of the IP telephony business invented and promoted by hundreds of entrepreneurial companies, in 1997 the former MPT (the predecessor of the MII) ‘created’ a license for the IP telephony business and licensed it to China Telecom, Unicom and Ji Tong, effectively putting hundreds of private companies in this area out of business overnight. In theory, any company offering either basic or value-added telecom services in China is required to have approved licenses from the MII to operate legally.

Creating a new market, such as mobile payment services, by an entrepreneurial start-up is a highly risky business in China, although the drive to create any innovative technology such as the mobile payment service is more likely to come from the private sector in China, as in most other countries. However, the driving force for the adoption of such technologies often comes from government-sponsored enterprises. In the case of the telecom industry, if a new technology or business model is proven a success, the incumbent carriers can always rely on the government to ‘restrain’ the ‘disrupters’ and take the lead to drive the adoption of such technology. As discussed earlier, China Telecom was the ultimate driving force for the take-off of the IP telephony services in China. China Mobile offers another example, where after having adopted Japanese NTT DoCoMo’s i-mode, it became the driving force for the rapid development of mobile Internet services based on its Monternet.

This happens not only due to the top-down regulatory framework’s hostility towards the disruptions it possibly causes, but also due to the ‘self-protection’ mindset of decision-makers in the state-owned enterprises. For example, the decision-makers in the state-owned telecom carriers do not dare introduce anything drastically disruptive; nobody will be punished for doing nothing, but one’s career can be seriously tarnished for doing one single wrong thing. Therefore, those decision-makers are more likely to introduce something new to China which has already been proven a success elsewhere. Relying on its market power, as well as its influence over the MII, China Mobile has no incentive to move first. In the case of mobile payment solutions, China Mobile waited until the technological and marketing trends in this emerging industry became clear before moving in by forming the joint venture UMPay with Yin Lian and threatening the survival of the first-mover, Jie Yin.

We are not trying to criticize the regulatory framework in China, rather, we are pointing to its ‘strengths’. Indeed, to its credit, China’s top-down system has strengthened economic performance by mobilizing resources to achieve countrywide or industry-wide goals. For example, it took less time
for China, compared to many developed countries, to replace its first-
generation analogue mobile networks with the second-generation digital 
ones.

This top-down system will work well only if the goals are well defined. 
The development of the mobile payment industry is regarded as an 
important strategy to utilize China’s pervasive mobile subscriber base, 
filling a void in the electronic payment sector. The Ministry of Information 
Industry, the People’s Bank of China and the Monitoring Committee of the 
Banking Industry are working together to devise relevant policies regarding 
the rapid development of the mobile payment industry in China. The 
development and deployment of the mobile payment services in China is a 
well-defined goal for Chinese government. Therefore, with its top-down 
support, the take-off of this emerging industry may be considerably ahead 
of many developed markets. The role of high-tech start-ups in China has to 
be considered to be severely circumscribed by this policy context.

NOTES

1. Personal Handy-Phone System (PHS), known as Xiaolingtong (little smart 
phone), is a long-distance cordless phone. Invented in Japan, the PHS 
technology is a low-power mobile service offering only local coverage. Based 
on access to the local public telephony networks, the PHS offers its subscribers 
lower per-minute rates, one-way charge and cheaper monthly subscription fees, 
compared with a mobile phone subscription.

2. China Research Corporation (http://www.china-research.com) is a leading 
market research and consulting firm dedicated to China’s telecommunications 
industry. China Research Corporation (CRC) started to track the development 
of the Chinese mobile communications industry, including its subscriber base, 
investments, as well as network capacities, in 1995. After the acquisition of 
Beijing Pinnacle Consulting in 2001, CRC renamed itself CRC-Pinnacle 
Consulting Co. Ltd. (http://www.crc-pinnacle.com). The president of CRC-
Pinnacle, Mr Bill Wang, is also the Chair of China’s Telecommunications 
Association. In this book, China-related mobile market statistics are mainly 
derived from CRC-Pinnacle’s database unless indicated otherwise. Marina 
Zhang was General Manager of CRC between 1996 and 1997, and has been an 
associate of the company since 2001.

3. These numbers are calculated based on CRC-Pinnacle’s database of mobile 
subscribers against the statistics of the national population abstracted from 
China’s Statistical Year Books.

4. The exchange rate of US$1 = 8.28 RMB Yuan is used in this book.

5. However, this percentage is still much higher than 20-30 per cent which is common in western countries.
6. This refers to the initiation of the so-called Golden Projects. The Golden Card project (one of the Golden projects) was aimed at improving the country’s electronic payment infrastructure.


8. ‘Yin Lian’ compatible means the ATMs and bankcards carry the ‘Yin Lian’ logo that allows cross-bank and cross-region ATM transactions. For example, ‘Plus’ is a logo that appears on many cross-bank and cross-country ATMs and bankcards that allows seamless ATM transactions.

9. The merchants are classified into three ‘classes’ by their profitability. The central bank’s rule is that different classes of merchants pay different rates as transaction fees. For example, hotels pay the highest transaction fee (2 per cent).

10. Credit card transactions are very limited, though they have gained substantial popularity in recent years. The issuance of personal credit cards is still tightly controlled in China.

11. In contrast to China’s online PIN debit card usage, most western countries have both PIN-based and signature-based debit card transactions. Normally, the signature-based debit card transactions charge at a higher rate of interchange fee than the PIN-based debit card, but still lower than that of credit cards.

12. According to CRC-Pinnacle’s data, by the end of 2004, China Mobile Communications Corporation had 197.6 million (out of 311 million in total) mobile subscribers.

13. Pre-paid mobile telephony service, IP accounts (a substitute for regular long-distance phone service at much lower rates) and IC accounts (widely used in public phone service, Internet access service and public transportation cards) are very popular in China. These pre-paid accounts can be purchased or recharged in small retail shops, post offices or telecom service outlets.

14. On November 18, 1987, the Guangdong Bureau of Post and Telecom Administration (Guangdong PTA) launched the country’s first TACS mobile operation with a subscriber base of 150, 3 radio base stations and 40 mobile channels.

15. In China, telecommunications, railway, power, agriculture and petroleum are considered the country’s fundamental industries. The state ownership of these assets is considered strategically important.

16. The MPT had been in operation since China’s liberation in 1949. The MPT owned 31 provincial-level Posts and Telecommunications Administrations (PTAs) which were the public network operators in the country. The MPT can be credited with the establishment and development of China’s modern telecommunications industry.

17. According to ‘China Technology Policy’, the white paper published in October 1985, the transmission networks exclusively for railway, electricity, navigation, petroleum, military, and radio and television uses were listed as the six private (dedicated) telecommunications networks in China.

18. In July 1994, the DGT was renamed China Telecommunications Corporation (China Telecom).

19. The increasingly explosive development of the cable networks of the MORFT raised concerns for the government over the ‘duplicate construction’ of transmission networks in the country.
20. China Telecom transferred the assets of Guangdong and Zhejiang Mobile networks to China Telecom (HK) Group. China Telecom (HK) listed 25 per cent of its stock on the stock exchange. Using the capital raised from its IPO, China Telecom (HK) subsequently acquired another 12 provincial mobile operators from its parent company. China Telecom (HK) was renamed China Mobile (HK) after China Telecom was split into China Telecom and China Mobile in 1999. China Mobile (HK) acquired all remaining mobile operators from its parent company in 2002. China Mobile (HK) is 100 per cent owned by its parent company, China Mobile Communications Corporation.


22. A ‘China-China-Foreign’ joint investment approach allowed China Unicom’s branches, at provincial or city level, to form joint ventures with Sino-foreign joint ventures – non-direct foreign subsidiaries – (with substantial foreign investment from prominent telecommunications players such as Siemens, Deutsch Telecom, Sprint, France Telecom among others), to bypass the restrictions on having direct foreign funds in the China Unicom’s network operations.

23. For example, the success of Chinese vendors in the CDMA area has had a strong influence on the government’s decision to roll out a CDMA network in the country. Following the CDMA trials in Beijing, Shanghai, Xi’an and Guangzhou in the mid-1990s, in January 2001, the MIIT granted a license to China Unicom to launch its CDMA mobile networks. China Unicom was one of the few mobile operators in the world running more than one 2G mobile network, GSM and CDMA.

24. VoIP (Voice over Internet Protocol) refers to the use of the Internet for making telephone calls. The main advantage for users of VoIP connections is that they generally only have to pay their usual (local) Internet connection charges regardless of where they are calling in the world.

25. The Guo Xin Paging Company was subsequently merged with China Unicom in order to enhance China Unicom’s financial position.

26. China Netcom Group also brings in two of China Telecom’s former competitors, the former China NetCom Corporation (CNCC) and Ji Tong Communications. CNCC was founded as an Internet infrastructure company in Shanghai in 1999 and quickly won a reputation for being politically well-connected (the former President Jiang Zemin’s son Dr Jiang Mianheng was one of the founders) and well-managed (the US returnee Dr Edward Tian was appointed the first CEO), so that it was able to attract substantial foreign investment. Before the merger with China Telecom, CNCC had provided significant broadband services in China’s southern provinces and this provided a platform for China Netcom to expand into China Telecom’s territory.

27. China Telecom and China Netcom both have their mobile PHS service networks, however, these networks do not have data communications capability. The PHS networks have brought new life into China’s fixed-line operators, China Telecom and China Netcom, with new users and much needed revenue. But despite record growth in early 2004, the PHS lost much of its momentum in the second half of the year. With major 3G investments looming on the horizon, China’s PHS operators face the difficult challenge of converting cost-conscious PHS users into high-end 3G network users.
28. At the China Mobile Telecommunications Industry Summit Forum held in Beijing on 29 March 2005, industry analysts were speculating about the next possible industry shuffle: China Unicom, the mobile operator operating both GSM and CDMA mobile networks, is expected to be split into two parts and integrated with China Telecom and China Netcom, respectively, before the 3G licenses can be granted to China Telecom and China Netcom.

29. In the early-mover countries such as the UK, Germany and Italy, the 3G licenses were granted in spectrum auctions and, as a consequence, the respective government generated huge amounts of licensing fees. However, in the late-mover countries, such as Austria, Belgium, Australia and Greece, the 3G licenses were granted through ‘beauty contests’, which generated much more modest amounts of revenue for the respective government.


32. Unlike in many developed countries, China Mobile and China Unicom are allocated radio spectrums at no cost to operate their mobile networks in China. In fact, it is individual subscribers who have to pay a so-called ‘spectrum occupation fee’ according to the ‘Radio Spectrum Regulation of the People’s Republic of China’ published in 1993. Currently, the spectrum occupation fee is 50 Yuan (or US$6.06 at the exchange rate of US$1 = 8.28 Yuan) per subscriber per month. This fee is handed over by the mobile operators to the Radio Regulatory Development of the MII, which was formerly known as the State Radio Regulatory Committee.

33. Interview with Madam Li Mao Fang in March 2001 by Marina Zhang, when she was working as the manager of corporate strategies for Ericsson (China).

34. Datang Telecom Technology and Industry Group, also known as Chinese Academy of Telecommunications Technology, which was sponsored by the former Ministry of Posts and Telecommunication (MPT), is credited with the successful development of China’s own 3G mobile transmission standard – TD-SCDMA.

35. Interview with Peter Lovelock in July 2004, in Beijing.

36. From 11 December 2004, China has allowed foreign investments to set up joint ventures, with a maximum of 25 per cent equity, in domestic and international basic telecommunications services. The proportion of foreign equity will rise to 35 per cent in 2006 and 49 per cent in 2009. Geographically, Beijing, Shanghai and Guangzhou are the first to be opened to foreign funds, followed by 17 more advanced cities along the coast. As to business scope, the services open to foreign investment will follow the sequence of value-added services, basic mobile services and basic fixed telecom services.

37. According to this report, the price of monthly subscription plus 100 minutes of mobile phone calls in China (China Telecom) was US$ 10.87, slightly higher than the world’s lowest (US$ 9.74 in Indonesia [Satelindo]), and much lower than the world average of US$ 38.15, as of August 1999.

38. In 1999, the MII required the incumbent operator, China Mobile, to provide a roaming service to China Unicom’s subscribers in the areas where the new entrant operator had not deployed mobile networks.
39. In Guangdong, the Bureau of Price Administration intervened immediately, blaming the carriers for breaching the state pricing policy, while in Chongqing, the MI1 reaffirmed its position and forced both parties to withdraw from their 'promotional' offers.

40. WAP (wireless application protocol) uses Wireless Mark-up Language (WML) for programming content, compared to, for example, HTML (cHTML), a subset of HTML 3.0 for Internet content, for programming, used by Japanese operator NTT DoCoMo's in its i-mode.

41. Monternet, in Chinese, is called 'Mobile Dream Net'.

42. This part of the data is based on a series conversations between the author and Ms Wang Hongmei, the manager of strategy and business development of China Mobile Group between 2000 and 2001, when the author was working as the manager of corporate strategies of Ericsson (China).

43. The subsidiary of the American IT company Hewlett Packard, China Hewlett Packard, owns 7 per cent of Aspire with an investment of US$35 million.

44. Multimedia Messaging Service (MMS), is the more advanced technology used for multimedia messages on 2.5G and 3G networks.

45. JAVA/BREW is a software platform that has been specifically designed to enable the development of applications optimised for use on mobile and portable consumer devices.

46. For example, on August 1, 2004, China Mobile announced that sohu.com (NASDAQ: SOHU), the second largest Internet portal in China, was banned from providing short text messages to China Mobile users.

47. The data is from CRC-Pinnacle Consulting Co.'s database.

48. A charge or quasi-credit card means consumers cannot purchase anything if the deposit in the card-linked account is lower than a threshold level.

49. According to the Asian Banker.

50. According to Mr Wan Jianhua, President of China UnionPay (Yin Lian) Co. Ltd., during an interview with China Central TV Channel 2 on January 12, 2005.

51. Meaning receiving capital investment.

52. Interest rate of US$ = RMB 8.28 Yuan.

53. China Merchant Bank was the first financial institution to operate an inter-region and inter-bank transaction network based on its 'one card for all' in China. After joining China Yin Lian, China Merchant Bank upgraded its network to be compliant with Yin Lian's standards.

54. However, these co-branded cards only carry the foreign logos - no foreign banks have been able to issue RMB cards on the mainland. Currently, these foreign financial institutions are allowed to provide technical assistance to their Chinese banking partners in the credit card sector.

55. China's former leader Deng Xiaoping said that the Communist Party had to 'feel the stones when crossing the river' when leading China's economic and political reforms in the late 1970s.

56. On March 1, 2004, the People's Bank of China approved a policy, 'Guidance of the distribution of the commission generated in inter-bank transactions over the China Yin Lian network'. According to this document, for POS-based transactions, the commission should be divided between the acceptance banks (in most case providing the POS terminals) and Yin Lian. The rates of commission range between 0.8 per cent (general grocery shops, supermarkets,
department stores and the like) and 1.6 per cent (hotels, restaurants, entertainment facilities, jewel and antique/art shops and the like). However, the commission is limited to fixed amounts for several special transactions. For example, the fixed commission charges for real estate and automobile sales are 45 RMB Yuan (40 Yuan to the acceptance banks and 5 Yuan to Yin Lian). No commission is charged for any transactions involving public hospitals and public schools.

57. The information was taken from CRC-Pinnacle’s database.
58. M-commerce can be defined as any transaction with a monetary value that is conducted via a mobile telecommunications network.
59. In contrast, China Unicom runs its not so-successful data network (Uni-Info) providing mobile Internet and mobile commerce services.
60. DT Intrinsic Technology Ltd. is a subsidiary of Asialnfo – a NASDAQ-listed company serving China’s telecommunications industry. In addition, Intrinsic Technology has Acer Technology Ventures and Fidelity Ventures as investors. Intrinsic provides billing and service management software platforms to China’s mobile carriers through its wholly-owned subsidiaries, Shanghai Intrinsic Technology Co. Ltd. and Shanghai Intrinsic Consulting Co. Ltd.
61. HiTrust’s main investors include Acer, HSBC, New World Group, AIG and VeriSign.
62. Icon Ventures Asia is a major investor in Icon Media Lab.
63. Lunar Group is one of the founding investors in Linktone (NASDAQ: LTON), a value-added service provider in the mobile telecom industry in China.
64. The company was initially registered as Summit Mobile Systems. The name SmartPay was adopted at a later stage.
65. ‘Dazhong’ literally means ‘the masses’ in Chinese.
66. Shanghai and Guangdong are the targeted regions for Jie Yin because the people in those regions earn the highest income in China.
67. 2b Holdings, an investment and advisory service firm, was an initial investor in EachNet, China’s leading auction and e-commerce website. 2b’s co-founder, Carlos Bhola, served as a member of EachNet’s Board of Directors, where he engineered the formation of a strategic partnership between EachNet and eBay in 2002, and the subsequent acquisition of EachNet by eBay for US$225 million in cash in 2003.
68. Linktone was separated from Intrinsic Technology and subsequently listed on NASDAQ in 2003.
69. In China, pre-paid mobile accounts and top-up cards are sold in places such as mobile operators’ business outlets, post offices, 7-11 convenience shops, ticket offices or sometimes small vendors selling cigarettes or drinks. Bad debts means the mobile operators will not be able to collect the money from these agents for selling the cards.
70. Beijing Union Mobile Pay (UMPay) Co. Ltd.’s Chinese name – literally means ‘united advantage’.
71. China Mobile’s brand for pre-paid GSM services. It means ‘travelling freely within China’ in Chinese.
72. K-Java is a derivation of Java – it defines a subset of limited Java-commands used in low-memory environments such as modern mobile phones and smart phones. It uses only a minimum of memory to create a complex user-interface, thereby offering better interactivity than i-mode services today.
APPENDIX

Table 7A.1: Milestones of China’s mobile communications industry

<table>
<thead>
<tr>
<th>Event</th>
<th>Year (1987-2004)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanghai SmartPay (Jie Yin) finished the second round of venture funding</td>
<td>1998</td>
</tr>
<tr>
<td>Beijing UMPay launched country-wide ‘mobile-wallet’ services</td>
<td>1999</td>
</tr>
<tr>
<td>In Sep., success of field trial of TD-SCDMA</td>
<td>2000</td>
</tr>
<tr>
<td>China Mobile issued a document regarding the mobile payment standards</td>
<td>2001</td>
</tr>
<tr>
<td>In Aug., the establishment of Beijing UMPay</td>
<td>2002</td>
</tr>
<tr>
<td>In May, MII’s ‘horizontal separation’ resulting in six telecom operators</td>
<td>2003</td>
</tr>
<tr>
<td>Mobile subscribers reached 219 million, for the first time surpassing fixed-line users</td>
<td>2004</td>
</tr>
<tr>
<td>The establishment of Shanghai SmartPay (Jie Yin)</td>
<td></td>
</tr>
<tr>
<td>In May, mobile subscribers reached 100 million</td>
<td></td>
</tr>
<tr>
<td>On March 26, the official launch of China UnionPay (Yin Lian)</td>
<td></td>
</tr>
<tr>
<td>In Jan., China Mobile launched GPRS 2.5G mobile services</td>
<td></td>
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<tr>
<td>In Jan., the new (lower) tariff for IDD came into effect</td>
<td></td>
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<tr>
<td>In Nov., China Mobile launched its Monternet mobile Internet services</td>
<td></td>
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<tr>
<td>In Sep., China Unicom launched its CDMA networks</td>
<td></td>
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<tr>
<td>In Sep., the first ‘Telecommunications Regulation’ was published</td>
<td></td>
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<tr>
<td>In June, the IPO of China Unicom</td>
<td></td>
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<tr>
<td>In May, the IPO of China Mobile</td>
<td></td>
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<tr>
<td>The establishment of China Netcom (license for IP telephony and international gateway)</td>
<td></td>
</tr>
<tr>
<td>‘Vertical separation’ of old China Telecom resulting in China Mobile, new China Telecom, China Sitcom and Guo Xin Paging</td>
<td></td>
</tr>
<tr>
<td>In April, the MII was officially established, marking the end of the MPT era</td>
<td></td>
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<tr>
<td>In Oct., the IPO of China Telecom</td>
<td></td>
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<tr>
<td>In July, China’s mobile subscribers reached 10 million</td>
<td></td>
</tr>
<tr>
<td>China Telecom’s GSM networks covered most areas in China</td>
<td></td>
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<tr>
<td>In July, China Unicom started its mobile telecom services</td>
<td></td>
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<tr>
<td>China Telecom started to offer GSM digital mobile services</td>
<td></td>
</tr>
<tr>
<td>MPT started the reform, resulting in the separation of posts and telecom services and the establishment of DGT (China Telecom)</td>
<td></td>
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<tr>
<td>On July 19, China Unicom was officially established</td>
<td></td>
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<tr>
<td>In Oct., the official launch of Golden Projects</td>
<td></td>
</tr>
<tr>
<td>State Council approved the establishment of Unicom</td>
<td></td>
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<tr>
<td>MEI, MOR and MEP proposed to establish China Unicom</td>
<td></td>
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<tr>
<td>MPT started to allow domestic firms to provide value-added telecom service</td>
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</tr>
<tr>
<td>In Nov., PTA (MPT) in Guangdong launched the first TACS mobile network</td>
<td></td>
</tr>
</tbody>
</table>

8. High-Tech Entrepreneurship: Technology, Firms and International Context

INTRODUCTION

Chapters 6 and 7 presented the detailed processes (major events, activities and decisions) underlying the emergence and development of mobile payment technologies in Korea and China. In these processes, the roles played by particular high-tech entrepreneurial start-ups were examined, and the factors that significantly influenced them were identified and analysed. This chapter, utilizing the two analytical lenses developed in Chapters 3 and 4, interprets these two cases at three levels of analysis: technology, entrepreneurial firms and the institutional context. First, the key technological aspects of mobile payment technologies are discussed using the analysis of the technology from Chapter 2 and the major analytical approaches to innovation outlined in Chapter 3. Second, the chapter discusses the roles played by high-tech entrepreneurial start-ups in the development of emerging technologies with the backdrop of the technological and industrial evolution of the mobile payment technologies. Third, the chapter discusses key factors, including the institutions, government policy frameworks and cultures which play either a supporting or constraining role in the development of mobile payment technologies in the Asian countries studied. The chapter concludes with the key research findings and their implications for entrepreneurs, policy makers and future research.

This book addresses several key questions: What roles do entrepreneurial start-ups play in the emergence and development of a new technology in the network economy? What are the main strategic choices that enable entrepreneurial start-ups to contribute to the emergence and development of a new technology? What major factors constrain the innovation strategies of entrepreneurial start-ups? In order to answer these questions, we consider:
At the technology level, the characteristics of an entrepreneurial start-up firm’s innovation (in this case, mobile payment technologies), the composition of the value chain of the industry which embodies the core innovation, as well as the possible impact of this networked innovation on the existing industry structure and strategic choices of key stakeholders in the industry;

At the firm level, the entrepreneurial start-up’s internal and external resources, its core competencies, business models, as well as its strategic choices about strategic re-orientation and collaboration with industry incumbents. Specifically, the following issues are addressed:

- What influences the firm’s strategic choices in using outside financial capital, such as venture capital, and how does such capital work for or against the firm’s long-term development?
- What attributes does the entrepreneurial founding team have and how do these attributes influence the firm’s strategic direction and actions?
- What factors influence the high-tech start-up firm’s international strategies?
- What factors determine the firm’s decision to form strategic alliances and how do these decisions influence the firm’s survival and long-term viability?

At the institutional level, government regulatory policies, national business systems, and social and cultural influences on entrepreneurial activities. These are examined using the cases of Korea and China, two emerging technology powerhouses, and world leaders in the development and diffusion of mobile payments technologies.

THE MOBILE PAYMENT TECHNOLOGICAL SYSTEM

Mobile payment technologies emerge from the convergence of the mobile communications and payment industries. This convergence, from an innovation perspective, is likely to disrupt the structures of the existing technological and actor systems. The development and diffusion of mobile payment technologies, from a market perspective, is a complex and lengthy process, which, on the one hand, relies on familiar and well-defined infrastructure (mobile communications and payment networks), and, on the other hand, is driven by emerging but sophisticated applications that require consumers to change their behaviour in payment activities.
Mobile payment technologies can be seen as a natural evolution of payment technologies (Visa International, 2004). A wide range of stakeholders from different industries are actively engaged in developing technologies and standards that would enable mobile payments to be diffused in the global arena. There exists a high level of uncertainty about the way various stakeholders should position themselves in this emerging market. For example, financial institutions are natural candidates for macropayments, mobile carriers find themselves having more advantage in micropayments, while third-party mobile payment services providers (for example, Avaro in Korea and Jie Yin in China) may find occupying a niche such as special purchases (mass transit ticketing) or bill-payment a more sustainable option.

Mobile payment technologies are not designed to completely replace traditional payment methods. As an architectural innovation, they are designed to complement the traditional payment infrastructure. Therefore, mobile payment applications are likely to obtain sustainable growth in areas where the traditional payment methods cannot work very well; for example, payments which require fast, secure and convenient transactions, such as toll gates, drive-through restaurants, parking, mass transit and even bills.

From a technological perspective, mobile payment is not an industry that can be easily dominated by a single player. The development and growth of the mobile payment industry requires the collaboration of multiple actors. Technological standards, the industry value chain, and appropriate business models that define the roles of each actor, as well as the way the benefits are shared among the actors in the value chain, are all critical elements. All these elements operate in the context of a nation’s institutional and cultural settings.

**An Interactive Innovation**

Much of the significance of the innovation of mobile payment technologies comes from its impact upon the structures of existing industries. The emergence of mobile payment technologies, in fact, can change the interrelationships between industries and facilitate interactions across industry boundaries. As a result, a new industry, mobile payments, and a value chain connecting the stakeholders of the industry, is emerging. Because mobile payment technologies are an interactive or network-based innovation, where technological standards and network externalities are critical, the development of mobile payment technologies is heavily reliant on the interdependency of the actors along the value chain.
Based on the cases in both China and Korea, mobile payments emerged from an innovation at the architectural level (see Figure 8.1), where diverse components or subsystems (often existing ones) work together in compliance with certain architectural interfaces (technological standards) to form a complex technological system. The sustainable development of such an architectural innovation (that is, mobile payments) requires not only substantial knowledge about the business operations and technological capabilities of both mobile communications and payment industries, but also, perhaps more importantly, new architectural knowledge and know-how across these industrial boundaries. Therefore, innovative business models are recognized as an important tool in managing the development of mobile payments. It is clear that it is very difficult for any firm (large or small) to maintain a controlling position in such a complex industry value chain; thus, collaboration is the key to the success of mobile payment technologies, and the need for new kinds of business and technological interface present opportunities for high-tech start-ups.

Figure 8.1: Network structure of the mobile payment technological system

We use a network structure model, with three levels, to define different technological attributes and their roles as components in this technological system. In the mobile payment technological system, mobile communications and payment networks are at the infrastructure layer; mobile payment platforms (for example, Avaro’s MAYZ Centre and Jie Yin’s platform) are at the architecture layer; and different payment solutions are at the application layer.

Positive feedback loops work across markets as well as within markets (Arthur, 1996), and the diffusion of an interactive technology can leverage
the interdependency (the linkages) among components at different layers within the (technological) ecology (or system), by transferring a user base built up from one layer to another in the ecology (Rogers, 1995). A fundamental attribute of the development and diffusion of an interactive or network-based technology such as mobile payments is that it is influenced not only by the network externalities at the demand (consumer) side, but also at the supply side (various actors along the industry value chain).

From an institutional perspective, the development and diffusion of mobile payments, as a social construction, requires collaboration globally (especially between mobile telephony and payment industries) and appropriate social, cultural, and regulatory environments at national and regional levels.

**Industry Value Chain**

The development of any emerging industry needs the creation of an industry value chain, and the establishment of the position, role and resources of each actor within it. In the case of the mobile payment industry, the value chain, emerging from the convergence of the value chains of the mobile communications and the payment industries, includes: mobile equipment vendors, banks and financial institutions (including credit card companies), mobile operators, mobile payment services providers, merchants, handset vendors (including SIM card manufacturers), and end-users. The result is that the mobile payment industry value chain is a complex one involving a variety of players from different industries. Another factor makes the industry value chain even more complicated: as we have seen, the mobile payment technological system involves multi-layered components and relies on complex and interdependent relationships among them. The complexity of the value chain is even more manifest at the emerging stage; each actor in the value chain wants to have its own interests promoted and protected in the process of setting up the industry standards and the establishment of competitive positions. This, as a consequence, makes standardization a challenging task.

The value chain of the mobile payment industry is therefore dynamic, multi-faceted and complex. Multiple factors determine the success of the development of mobile payment technologies; amongst the most important is the simultaneous management of cooperative and competitive relationships between mobile operators and financial institutions. Drawing on the analysis of both the Chinese and Korean cases, we see how independent mobile payment services providers (often arising from high-tech entrepreneurial start-ups) can create a ‘dialogue’ between industry
incumbents (mobile communications operators and financial institutions),
and play a crucial role in focusing and simplifying the complex
relationships in the value chain.

Industry Standards

Standard setting for a technological system (or an industry) is a highly
social and political event, which must take into account not only
consumers’ choices, but also the position and behaviour of various actors in
the industry value chain. Government policies and industry consortia often
play an important role in the standard-setting process.

Two critical factors influence the development of mobile payment
technologies: (1) the complementary assets at the infrastructure layer, and
(2) the proliferation of customized solutions at the application layer of the
mobile payment system. In other words, the success of mobile payments
lies in taking advantage of existing infrastructure as well as building
innovative applications. Therefore, the mobile payment system lies
between ‘technology push’ (by infrastructure) and ‘market pull’ (by
application). This reinforces the importance of industry standards for the
development of mobile payment technologies: mobile payment
applications need to meet, on the one hand, homogeneous customers’
demands for infrastructure, and, on the other, heterogeneous demands for
applications. The realization of the inherent value of the mobile payment
system, hence, requires the establishment of new value networks
(Christensen and Rosenbloom, 1995); it involves creating markets and
focusing on commercial opportunities, which are often small and poorly
defined initially but can take off once the establishment of industry
standards is achieved.

The establishment of mobile payment standards serves two objectives:
(1) to provide simplified (standard) interfaces between different
components at different layers in the technological system; and (2) to
develop agreements whereby the financial institutions and mobile operators
can collaborate.

In a society where mass consumers do not know very much about
various technological details of the products and services they use, the
social status and market power of the actors that sponsor or support a
certain technological standard determine, to a large extent, herding
behaviour and the rate of the diffusion of that standard. This is because
social status and market power serve as ‘signals’ of quality in the market,
and explains why established firms are more likely to reinforce their
incumbency by using their social status and market positions in standards-
setting activities. The influence of large and powerful firms is especially
manifest when the diffusion of an emerging technology requires scale and scope globally and, in high-tech sectors, these firms are invariably very actively involved in influencing standards setting, either directly or by participating in international cooperative organizations.

**Collaboration across Industries**

Innovation very rarely derives from the actions of individual organizations or people, but from the collaborative networks that leverage resources and capabilities across multiple organizations or individuals. It is the convergence of mobile communications networks and payment networks that has led to the advent of mobile payment technologies. The convergence of technological systems implies a convergence in standards; however, this does not come naturally as it requires cross-industry collaborative efforts. Due to path dependency, differences in products and customers, assets, competencies and capabilities persist, making such cross-industry collaboration a very complex and challenging task. Dodgson and Bessant (1996) argue that success in innovation is not simply a matter of moving a resource from industry A to industry B, but the capability on the part of the recipient to do something useful with that resource. This proposition applies in the convergence of industries: the technological capabilities, business skills and resources from either mobile communications or payment industries cannot simply be mobilized for use in the mobile payment industry. Emerging intrinsic core capabilities and know-how are more important. For example, mobile communications operators are capable of building upon their existing skills and capabilities of mobile communications networks, however, they do not have the critical new business skills and technological capabilities pertaining to payments; and vice versa for financial institutions.

The Korean case suggests that – although the industry has been successful compared to many other parts of the world – one of the biggest impediments to more rapid growth of the mobile payment industry has been a lack of consistency in approaches amongst the players in payment solutions and an absence of consensus on technological standards. Without cross-industry cooperation on these important issues, financial institutions, mobile operators, handset manufacturers and mobile payment services providers continue to develop, in isolation, proprietary solutions to address specific requirements for individual market sectors. Open mobile payment platforms, upon which industry standards can be established, *de jure*, and multiple applications can be developed, are crucial to the development of mobile payments.
Open Platform

The development of mobile payment technologies relies not only on the existing infrastructure, but also on the diversification of applications. The diversification of customized applications is encouraged when they are in compliance with technological standards based on an open platform. The choice of an open or closed innovation platform approach, therefore, can be critical for the success of an entrepreneurial firm that innovates and possesses a standard.

In China, the high-tech entrepreneurial innovator of mobile payment technologies, Jie Yin, positioned itself as an independent services provider: serving an open mobile payment platform through which mobile carriers and financial institutions were connected and, upon which, customized payment applications were developed. On one occasion, Jie Yin's mobile payment platform was chosen by Guangdong Mobile Communications Corporation (GMCC – the largest provincial mobile operator) as its proprietary system. This was at a time when such a business opportunity like this meant a great deal to Jie Yin. However, Eric Rosenblum, the founder of Jie Yin, felt this deal would close the door for the company to run an open platform in the country as an independent provider. He refused to 'sell' his platform to GMCC. This open platform approach proved a successful choice in that it subsequently enabled Jie Yin to develop its market position.

Innovation in Business Models

Teece (1986) points out that if an innovation needs to rely on complementary assets – additional goods or services that enable or enhance the value of the focal innovation – the entrant players that promote this innovation are often in a disadvantaged position because the adoption of this kind of innovation requires the leverage of the resources of incumbent firms. In other words, in the market created by this kind of innovation, incumbents often enjoy the built-in advantages of brand names, customer relationships and deep financial capital, while most high-tech start-ups lack the resources (including relationships) necessary to drive the continuous development and diffusion of the innovation.

In the case of mobile payment technologies, although the innovation has the potential to offer entrepreneurial firms the opportunity to gain significant advantage over incumbent, dominant firms through the technological capabilities of the new architecture (Henderson and Clark, 1990), it takes time for entrepreneurial firms to build specific business skills around their technological capabilities. Dodgson and Bessant (1996)
argue that the build-up of their business skills, especially relationships with the emerging customers, often involves several stages, as innovation is not an ‘instantaneous event’. An innovative business model, which defines appropriate strategies on how to convert technological potential into economic value for high-tech entrepreneurial start-ups (Chesbrough, 2003), is essential for the survival and continuous development of high-tech entrepreneurial start-ups.

In a business environment ‘hostile’ to entrepreneurial start-ups, such as Korea, an innovative business model is even more crucial for the survival of firms like Avaro. Squeezed by the competition between mobile operators and financial institutions (as well as among the individual players in those industries), any direct confrontation with the incumbent and dominant players would be very risky. On the other hand, to form strategic alliances with any of them also poses high risk: incumbent firms can take advantage of their market power and deep learning abilities to ‘acquire’ the technological knowledge of high-tech start-ups. In this environment, an innovative business model that allows high-tech entrepreneurial start-ups to occupy a market niche, utilizing the advantages in their knowledge of the architecture and their technological capabilities, can seem a wise choice. ‘Maintain independence and develop open standards’ was what Avaro’s international team (led by Mike Wilson) advocated; to quote Mike: ‘We are trying to promote the standardization concept to Avaro’s management team, because we know “scale” is essential for Avaro’s future growth.’ Despite the advice from its international team, Avaro led itself into the predicament of working for individual clients (SKT and/or KTF) in developing specific proprietary architectures which belong to the clients, and which, to some extent, caused the fragmentation and lack of interoperability of the industry.

In contrast, the success of Jie Yin, under the pressure of competition from the government-endorsed UMPay, can be attributed to its choice of an innovative business model: focusing on providing an open mobile payment platform and serving a niche market. Jie Yin developed its mobile payment architecture on an open platform which was scaled to multiple clients with limited customization and that enabled Jie Yin’s open platform to become a de-facto standard in the industry. ‘What we sell are services, like MasterCard and Visa, providing services to every party’, commented Eric Rosenblum. After the major competitor, UMPay, entered the market, Jie Yin quickly re-orientated its strategy to focus on providing mobile payment solutions for a couple of unique transactions, such as mobile phone bill payments and pre-paid account top-ups. The bill payment service is the simple but munificent focal application behind Jie Yin’s success. Its
success confirms how innovations with limited technical functionality – such as SMS and i-mode – can create significant competitive advantage. The cases of Avaro and Jie Yin highlight how business model must be dynamic, reflecting not only the development of the technology itself, but the maturity of the market and the institutional environment in which they operate.

**Summary**

This section, using the key analytical approaches of innovation discussed in Chapter 4, has analysed the importance of specific technological attributes and their impact on the development of mobile payment technologies. Specifically, at the technology level, we discussed the characteristics of mobile payment technologies, the composition of the value chain of the industry which embodies these technologies, as well as the impact of the emergence of mobile payment industry on the existing industry structure and the business model choices of key stakeholders in the industry. The nature of the technology system provided opportunities for high-tech entrepreneurial start-ups to develop applications at the architectural layer in the network, and act as a bridge between industries with different technological capabilities.

Some key analytical approaches used in this section are summarized in Table 8.1.

**HIGH-TECH ENTREPRENEURIAL START-UPS**

The development and diffusion of an emerging technology requires our understanding not only of technology strategy and innovation dynamics, but also of behaviour-based theories – the effects of social externalities, matters such as inter-firm relations, social structure and social networks – in addition to the strategic choices of the key actors.

From the discussion in the previous section on mobile payment technologies, it is clear that the development of an emerging industry requires far more than innovative technological activities; it involves creating an industry value chain and standards, networking with other players in the value chain and, most importantly, identifying and implementing suitable business models that allow firms to focus on commercial opportunities which are often initially small and poorly defined. Freeman and Soete (1997) argue that the innovation process can be seen as a channel through which technological possibilities match
market opportunities, involving multiple interactions and types of learning in an institutional setting. From the management point of view, Dodgson et al. (2005) describe the innovation process as the one by which managerial decisions, organizational structures, and combinations of resources and skills together produce innovative outcomes. A key criterion for determining the value of an innovation is whether or not it can address the needs of an emerging market. An emerging market often needs a new technological paradigm (or new value network') which requires a different set of technological capabilities and organizational dynamics.

Despite the technological advantages high-tech entrepreneurial start-ups often have, especially in an emerging technological system like mobile payments, the intrinsically new competences and resources, as well as organizational and strategic dynamics required for further development of the system, as shown in the case analyses in Chapters 6 and 7, often impose multidimensional challenges to such firms. At the firm level, a high-tech entrepreneurial start-up firm’s adaptability and flexibility in managing its resources (technological and non-technological), its social networks and alliance partners, and its interactions with institutions and regulatory bodies within its environment, as well as the formulation and implementation of the right strategies, at the right time, with the right speed, are crucial elements for the firm’s success in managing the development of its innovations in the network economy. In this section, we discuss these elements, as well as the conditions under which they operate.

**The Role of High-Tech Entrepreneurial Start-Ups**

It has long been recognized that some entrepreneurial start-ups offer truly innovative products and services, requiring a new and different configuration of resources (Schumpeter, 1934), while others merely imitate or reproduce existing products or services with limited improvement (Kirzner, 1973). As discussed in the previous section, mobile payment technologies represent innovation at the architectural layer, the development of which requires a different configuration of resources. High-tech entrepreneurial start-ups that invent and own such innovations can enjoy certain competitive advantages which incumbents cannot easily develop. Fundamentally, the advantage of start-up firms comes from their technological dynamism: the ability of such firms to identify and continually develop new technologies with great potential and the entrepreneurial drive to take them to the market (Dodgson, 1991). According to Fontes and Coombs (2001), high-tech entrepreneurial start-ups play two significant roles: (1) a challenging role, implicit in their
Table 8.1: Some key analytical approaches to innovation and their implications in high-tech entrepreneurship

<table>
<thead>
<tr>
<th>Innovation Patterns</th>
<th>Characteristics</th>
<th>Key Players</th>
<th>Key Strategic Choices</th>
<th>Institutional Influences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schumpeterian Legacy</td>
<td>Mark I</td>
<td>Creative destruction</td>
<td>Identifying opportunities based on imperfect information</td>
<td>Technologically related factors, rather than country-specific factors, determine the mode of firm’s innovative activities.</td>
</tr>
<tr>
<td></td>
<td>Mark II</td>
<td>Creative accumulation</td>
<td>Systematic R&amp;D activities</td>
<td></td>
</tr>
<tr>
<td>Technological discontinuity</td>
<td>Increase uncertainty</td>
<td>Entrepreneurial start-ups</td>
<td>Development of standards and wide variety of applications</td>
<td>Collateral assets or co-specialized assets</td>
</tr>
<tr>
<td>Innovation Cycle</td>
<td>Dominant design</td>
<td>Lead to a period of stabilization, the result of a emergence of a technical interface (standard)</td>
<td>Established firms</td>
<td>Social networks, industry standardization, government intervention</td>
</tr>
<tr>
<td></td>
<td>Architectural innovation</td>
<td>Linkages between components are changed, but the components stay untouched</td>
<td>Entrepreneurial start-ups</td>
<td>Destroy the usefulness of established firms’ architectural knowledge, potentially cause destruction of such firms.</td>
</tr>
<tr>
<td></td>
<td>Value Network</td>
<td>Modular innovation</td>
<td>Changes of one or more components</td>
<td>Focus on the design and development of specific components (modules)</td>
</tr>
<tr>
<td></td>
<td>System Innovation</td>
<td>Complex technological systems (clear boundaries and interdependencies at different layers of networks)</td>
<td>Multiple players</td>
<td>Complementary assets, social networks, industry standardization, government intervention</td>
</tr>
</tbody>
</table>


Innovation Patterns | Characteristics | Key Players | Key Strategic Choices | Institutional Influences
--- | --- | --- | --- | ---
Generic innovation | Represents direct end-user application | Multiple players | Commercialization immediately | Regulation
Non-generic innovation | An architectural platform, relying on applications | Multiple players | Development of standards, open innovation approach | Complementary assets, social networks
Open innovation | Relying on a variety of sources for innovation and multiple channels for diffusion | Established firms | Technology licensing, OEM, strategic alliances and partnerships | Social networks

creation, whereby they break the inertia of the existing technological trajectory and act as a source of a technological breakthrough; and (2) a technology transfer role, acting as an 'agency' to mobilize technological capabilities to match market opportunities, by which they commercialize new innovations. These roles can valuably strengthen the development of indigenous national technological capabilities, and explains their encouragement by governments in countries like Korea, China, Japan and Singapore over recent years. In addition, in the development of mobile payment technologies, high-tech entrepreneurial start-ups contributed their unique architectural knowledge and know-how of mobile payment platforms as well as building a 'bridge' between mobile communications operators and financial institutions. These contributions are shaped by a society’s institutional environment.

The contribution of high-tech entrepreneurial start-ups in the development of mobile payments in Korea and China can be seen in the roles they play in the following areas: (1) initiating the technological breakthrough of mobile payment technologies, (2) initiating the diffusion cycle, (3) drawing on a collective effort across industrial boundaries, (4) driving the establishment of industry standards and, (5) shaping the structure of the industry value chain. Through open mobile payment platforms, multiple mobile operators and multiple banks and credit card companies, as well as numerous applications developers and merchants, can be connected into an integrated mobile payment platform. This is the ideal and most efficient business model in mobile payment services. These roles are especially critical at the emergent stage of a new industry value
chain: entrepreneurial start-ups simplified the complicated relationships among different stakeholders in the mobile payment industry value chain and provided an integrated interface for end-users. In some circumstances this integrated effort can provide sufficient marketing forces to educate end-users of mobile payment services and possibly transform their behaviour in payment activities.

The success of a technological breakthrough does not in itself guarantee the commercial success necessary for the continuous development of the technology; nor does it necessarily lead to sustainable growth for the high-tech entrepreneurial firm that provides the breakthrough. It is quite common for high-tech entrepreneurial start-ups – those firms that invent and often first commercialize a new technology – to grieve the fact that competitors and/or imitators (especially incumbents) profit more from the innovation than the entrepreneurial firms themselves (Teece, 1988). Sound legal systems, capital markets, government policies and regulations, and other institutional features are all necessary prerequisites for high-tech entrepreneurial start-ups to make a substantial contribution to industry development.

In summary, entrepreneurial start-ups can be instrumental in the introduction of new technologies into a market. They may contribute to the upgrading of sectors traditionally important for a nation’s economy, and lead to the creation of a valuable pool of distinctive competencies by integrating new technologies and existing capabilities (Lundvall, 1992).

Strategic Choices

A firm’s strategic choices can have a determining impact on the outcome of the diffusion of an innovation. When it is derived from high-tech entrepreneurial start-ups, innovation diffusion depends to a large extent upon the strategic choices these firms make on external capital investments, the restructuring of management, internationalization and strategies towards collaboration.

Venture capital – a facilitator or a constraint?
A high-tech entrepreneurial start-up faces increasing pressure to externalize its innovation due to the shrinking effective life cycle of innovations in the network economy. Another factor driving a high-tech start-up to commercialize its innovation fast is the network effect: an immediate large user base can potentially lead to self-sustaining diffusion of the innovation. The commercialization and diffusion of such innovations requires a large capital resource base, especially if the market is on a global scale. A high-tech start-up will often find it difficult to meet this capital requirement. To
seek a fast diffusion of the innovation, a high-tech entrepreneurial start-up may need therefore to look for affiliations with venture capital partners. As argued by Chesbrough (2003), a high-quality venture capital partner can provide invaluable value-added services for high-tech start-ups, particularly in an open innovation paradigm. High-quality venture capital partners – the ones with deep industry knowledge, the capability to deal with regulatory policies and extensive experiences in financing start-ups in similar industries – are instrumental in helping a start-up firm to make a substantial contribution to the development of an emerging technology.

The injection of venture capital often results in changes in a high-tech firm’s governance and control structure. A common outcome is the introduction of a professional management team into the start-up’s founding team. In financing decisions for high-tech start-ups, venture financiers (especially venture capitalists) commonly look for entrepreneurs who are prepared to consider letting go of their tight grip on their ventures and hand over control to professional management. The founding CEO of Jie Yin, Eric Rosenblum, understood this very well and, although an experienced professional manager himself, he transferred the controlling power of his firm to a professional manager, Greg Shen, after the second round financing injection into Jie Yin.

In contrast, Mr Kim of Avaro did not demonstrate a cooperative attitude towards prospective venture capital investors. He was expecting domestic chaebols, such as SK Telecom, to acquire his venture, and this was his desired exit route. This approach can partly explain his behaviour. Fundamentally, he was not prepared to let go of his, and his friends’ control, over Avaro. Another barrier to external venture financing was that Mr Kim did not use the same business language in dealing with professional venture capitalists. This is not uncommon in negotiations between the venture capital community and entrepreneurial start-ups: the two parties may talk in two different languages; the venture entrepreneur focusing on technology and product, but the venture capitalist focusing on money and management.

Moore and Garnsey (2001) describe this phenomenon as ‘miscommunication’ between the venture capital community and its recipient high-tech ventures. They argue that this ‘miscommunication’ is often caused by (1) an information gap between the entrepreneurial ventures that are seeking financial funds and the potential fund providers, and (2) an asymmetry of interests between the ventures and the potential fund providers.

The choice of outside venture financing is never simple: while high-quality venture capital investment is recognized as being positively related
to the success of entrepreneurial start-ups, the wrong choice of venture capital investment can sometimes be very risky for the survival and sustainable growth of a high-tech firm. If there is a strategic mismatch between a venture capital firm and a recipient start-up firm, it can possibly result in unnecessary structural changes and, sometimes, the demise of the start-up venture. Extensive due-diligence is not only essential for venture capitalists, but also for high-tech entrepreneurs. Avaro’s acceptance of a US$5 million venture capital investment from Japanese Hikari Tsushin Capital (HTC) represented a typical example of such a mismatch. Mr Kim accepted Hikari’s investment in return for 15 per cent of shares after Avaro had already completed its core R&D and commercialized its core products. This investment was brought in with the objective of developing the market for Avaro’s products, particularly internationally. However, Hikari’s fund would expire about three years after the completion of the investment. This meant that Avaro could not engage in any activities that would fail to guarantee a return on investment in three years. As a result, Avaro missed many opportunities, especially in the international market.

**Founder CEO – an asset or a liability?**

An entrepreneurial start-up firm needs to adapt to new logics and mindsets in order to pursue different business objectives (and even business models) as it grows. Alvarez and Busenitz (2001) argue that, at the early start-up stage (in which there is often a high level of ambiguity and uncertainty), due to the very nature of entrepreneurial activities that derive innovative ideas from non-routine decision-making mechanisms, a heuristic-based logic is often a more effective source of competitive advantage. However, if the firm reaches the fast-growth stage, it is required to adopt more systematic decision-making processes and to develop dynamic capabilities. In addition, different types of management skills are needed at different stages of development.

It is critical, therefore, for a start-up firm to strategically re-orientate and adjust its business logic, decision-making mechanisms and management practices to accommodate rapid technological and market changes. Dodgson and Rothwell (1989) argue that the founders of entrepreneurial high-tech start-ups, although they may possess excellent technical skills, are not always best equipped to handle the more formal aspects of management tasks when the firm grows. It is understandable that this kind of managerial transition is often a daunting time not only for founders, but also for the firm as a whole: its employees and social networks. Many entrepreneurial founding teams find it very difficult to acknowledge the necessity of such changes, let alone to consider the replacement of the founder CEO. At one extreme, the injection of venture capital can require
the founder-CEO to be replaced by professional managers in order for there to be a separation of the responsibilities of risk taking (by owners/founders) from those of decision-making (by the professional manager).

A founding team, after leading a start-up firm’s technological innovation, may become a liability because its technology-oriented mindset and entrepreneurial management style and practices can become a constraint on the firm adopting a more market-oriented philosophy. This, as a consequence, may cause the firm to miss many opportunities the changing market presents, especially in the international market; circumstances seen clearly in the case of Avaro.

**International strategy – early internationalization or domestic focus first?**

Because of the shorter life cycle for any innovation and lower physical barriers in protecting technological resources than ever before (Schilling, 2005), firms need to diffuse their innovations more quickly and broadly. It is rare for any high-tech start-up to be able to exist entirely within its domestic market. A global diffusion strategy is commonly imperative for the success of such innovations, because the implied faster rate of diffusion of the innovation and the faster build-up of the user base can lead the diffusion into a self-sustaining process.

In reality, internationalization involves significant managerial challenges for high-tech start-ups. Depending on the level of novelty of the innovation that a new venture offers, the venture needs to adopt different internationalization strategies. Hordes et al. (1995) suggest that three conditions are critical for high-tech start-up firms to become global players (compared with traditional entrepreneurial firms); their ability to: (1) create an instant network of users and to utilize it consistently in a short time frame; (2) generate new knowledge and leverage it to the point of need and apply it in the network of users; and (3) achieve coordination on a global basis to maintain a sustainable competitive advantage in the long term.

In Avaro’s case, the key success factor for its MAYZ mobile payment services was its international strategy and the creation of the independent MAYZ International. Even though Mr Kim had been exposed to international environments (an American education and experience in export businesses), and was aware of the importance of the internationalization of his venture, he could not convince his co-founders and the Japanese investor, Hikari, to pursue the international strategy. His co-founders and Korean advisors, being domestically-oriented business people, fundamentally feared that the Korea-born Avaro might lose its national identify in the international market. As a result, Avaro missed
many opportunities, such as expanding its mobile payment system into the GSM markets in Europe and Singapore.

**Collaborative strategy – tango together or dance alone?**

Social networks are critical for entrepreneurial start-up firms, especially at their founding stage. Social networks contribute to entrepreneurial activities in two ways: (1) by facilitating the exchange of resources (not only tangible resources, but also intangible ones such as information and emotional support, and (2) by enabling entrepreneurs to gain ‘legitimacy’ and overcome the liabilities of ‘newness’ and ‘smallness’ by being associated with, or being endorsed by, well-regarded individuals or organizations with an explicit certification (Davidsson and Honig, 2003; Hoang and Antoncic, 2003). By leveraging their social relationships, entrepreneurial start-ups can obtain the social legitimacy necessary to lead them down the path of sustainable competitive advantage.

The development of an entrepreneurial start-up is a dynamic process which requires a timely and continuing adjustment of not only its management strategies and practices, but also its reliance on, and form of, its social networks. As new ventures grow, social networks need to become more complex in order to function in a greater number of areas and be more embedded, moving from unplanned to planned, and finally, formally structured networks. Although entrepreneurial founders’ personal networks are one of the most important strategic resources at the start-up stage, over-reliance on such social networks can cause problems as the firm grows and develops. In the Avaro case, one of Mr Kim’s failures was that he did not adjust his reliance on his social networks. His world-view and personality determined that he could not easily separate his business decisions from his personal networks; when he relied on his social networks, which are heavily embedded in the web of Korean cultural values (especially harmony among friends) and strong patriotism (for the founders the international expansion plan implied compromising the company’s position as a Korean company), he made business decisions against the best interests of the growth of the company.

A collaboration strategy can be considered an extension of a start-up firm’s more structured social networks. Inter-firm alliances are pathways for the exchange of resources. An alliance with a prominent partner can confer this party’s social status and market position upon the start-up partner and create recognition for the start-up in the society. It can build public confidence in the value of the start-up firm’s products and services and thereby facilitate the firm’s efforts to attract customers and other partners. Due to the imbalance of resources, learning ability and absorptive capacity between the start-up and the established partners, however, the
start-up firm often finds it difficult to achieve a win-win partnership (Dodgson, 1993b).

This leaves a high-tech entrepreneurial start-up in a quandary: on the one hand, to achieve an immediate global critical mass requires such a firm to adopt an open innovation approach, but, on the other hand, such a strategy can be pursued only if the start-up firm enjoys the strength of protectable intellectual property rights. An alternative way for a high-tech start-up to enhance its early technological leadership is by building social and technological legitimacy under conditions of the increasing returns mechanism, where standards become critical for the success of the new technology. For example, the firm might actively participate in an industry or technology forum – an often unofficial ‘club’ formed by competing firms (globally) with a unified aim to promote a specific technical standard – such as IrDA, in which Avaro became such an active member.

**Summary**

High-tech entrepreneurial start-ups have a number of weaknesses, intrinsic to their youth, scarcity of resources and tendency to possess low competence in non-technological areas. These limitations are likely to inhibit the full exploitation of their potential, unless other actors, who complement their efforts, are involved. Garnsey (1998) argues that the structural characteristics of an industry can strongly influence the opportunities for the growth of an entrepreneurial firm, yet growth of the firm depends on the matching of its resources to the opportunities. A successful high-tech entrepreneurial firm is one that possesses the capacity to identify opportunities in the environment and mobilize its resources to match them. A strategy that helps the firm to find a ‘fit’ with its environment is essential for the sustainable success of a start-up firm and this requires difficult choices over capitalization, management structures, internationalization and collaborative strategies.

It is not only managerial decisions, but numbers of environmental factors, such as institutions, public regulatory frameworks and cultures that can play an even more critical role in the diffusion of such innovations.

**THE ASIAN CONTEXT**

From the previous argument, we can conclude that the diffusion rate of an interactive innovation in the modern network economy is heavily influenced by numerous interrelated socio-economic, political, regulatory,
cultural and technological factors. This is because entrepreneurial activities, which have long been recognized as one of the driving forces for economic growth, exist in their contextual environment; and, conversely, environmental factors shape the entrepreneurial activities in a society. The research for this book has been conducted in an Asian context, specifically, in Korea and China. The institutional and cultural contexts of Korea and China establish the boundaries within which high-tech entrepreneurial start-ups made their contribution to the development of mobile payment technologies.

Institutions

A country’s institutions are one of the most important social influences on entrepreneurial behaviour. In a broader sense, a country’s ‘institutional infrastructure’ (Casson, 1990) or ‘institutional profile’ (Bruyat and Julien, 2000) include a regulatory dimension (government policies), a cognitive dimension (widely-shared social knowledge), and a normative dimension (the value systems in a society). Specifically, institutions refer to the common habits, established practices, rules, or laws that regulate the interactions between individuals or groups in a society. Institutions influence entrepreneurial activities in general, and the development of an emerging technology in particular, in three different ways, by: (1) reducing uncertainty by providing information, (2) managing conflicts and cooperation, and (3) providing incentives for or obstacles to innovative activities.

Institutionalization is the process by which an entrepreneurial firm obtains social legitimacy by adopting certain social norms and structural forms. This legitimization process is often critical for the survival and continuous growth of entrepreneurial start-ups. The way in which an entrepreneurial start-up gains legitimacy in a society is influenced by the firm’s political and market power and its social networks. A firm’s legitimization is influenced by its ‘fit’ with certain social conventions. Social conventions are dependent on their being positively identified by powerful authorities, expert opinions and independent third-party intermediaries. Specifically, Jones et al. (1997) argue that social conventions are social interpretations, norms, rules and legitimization processes that constrain action and create typical behavioural patterns in a society.

Pursuing some forms of collaboration, especially with prominent organizations or individuals, or participating in trade associations and industry forums, can be seen as an effective way for start-up firms to gain social legitimacy. For example, the alliance with IrDA/IrFM gave Avaro
access to other important players in the mobile payment industry and exposure to the international market.

Certain social conventions are strongly influenced by the government, and this is seen particularly clearly in the Chinese case where the nature of the relationships between policy makers and large firms strongly affected the influence of the start-up in the market.

When discussing success factors for the development of mobile payments, Arthur D. Little (2005) claim that the most advanced mobile payment markets in the world, Korea and Singapore, have been government-driven. One of the major factors explaining the difference in adoption rates of mobile commerce and mobile payments is national government policy initiatives and approaches to regulation in various countries.

Generally, countries where the adoption rates of mobile payments and other mobile data services have been relatively higher are also countries where national governments have deliberate policies to encourage the adoption of information and communications technologies. Korea is a good example. One of the most conspicuous characteristics of the industrialization of Korea has been the government’s strong role. In the 1960s and 1970s, the Korean government intentionally created and encouraged large firms, chaebol, to marshal the economies of scale inherent in mature technologies, which had historically been dominated by early industrialized nations (Amsden, 1989; Kim, 1997). The chaebols’ rapid growth and diversification has had an enormous effect on the industrial structure and extent of market concentration in Korea. The success of CDMA illustrates the Korean government’s science and technology policies in the past 20 years: the focus shifted from the absorption of foreign technology through copying and self-learning to the adoption of foreign technology, through investing in foreign licenses and technical assistance, to the development of indigenous capability (Dodgson, 2000a).

The government’s role in the development of mobile payment technologies has been evident in Korea in two particular ways. First, it emphasized the importance of standards for the mobile payment industry, not only from the standpoint of interoperability of different systems, but also with the aim of creating potential opportunities for exporting Korea’s mobile payment technologies. Second, the government has played an important role in facilitating smooth cooperation across industry boundaries. Whilst there are many factors that have contributed to the development of mobile payment technologies in Korea, some, such as Korea’s demographics, are highly specific, but others, such as its
government's proactive policies, have the potential to be replicated by policy-makers in other countries.

China's case shows a top-down approach encouraging resources to be mobilized in order to achieve nationwide strategic goals. Rogers (1995) describes this kind of approach as one of 'authority-based decisions'. In some circumstances, authority-based decisions can promote faster adoption of an emerging technology. In China, the government plays a 'bureaucratic entrepreneurial' role in the moulding of technological developments by 'granting' legitimacy to the technological system that is often owned, but not necessarily developed, by strategically important state-owned organizations, such as China Mobile Communications Corporation in the development of mobile payment industry (Gore, 1998). China's industry policies focus on selecting the most 'suitable', not necessarily the best, technologies for an industry: those technologies that fit most comfortably into its institutional and industrial structures and cultural and social conventions. This focus on incumbents, which are commonly state-owned, does have a negative effect on the technological possibilities offered by high-tech start-ups. There is no doubt, however, that the regulatory framework has been crucial to the development of China's mobile payment industry.

Cultural Influences

National culture has a strong influence on entrepreneurial activities in every society. Korean culture – manifested in its business system – is one that does not traditionally encourage entrepreneurial spirit and venturing activities. This cultural background increases the transaction costs for high-tech entrepreneurial start-ups in their inter-organizational relations, especially with large firms. Cultural influences are not only reflected in a broader social context; they also influence managerial behaviour within organizations. For example, harmonious interpersonal relations are a very important factor in Korea and dominated Avaro's decision-making mechanisms. Mr Kim had to support some critical decisions made by Avaro's board of directors even though he did not necessarily agree with them, simply because he could not afford to lose his friendships in the boardroom. An extreme example of cultural influences in Korea is nationalism. Kim (1997) points out that nationalism in Korea can sometimes be considered a liability for Korean firms in their internationalization. Mr Kim's strong patriotism overtook his business acumen and, as a consequence, cost him greatly through missing many vital opportunities, especially in the international market.
Three culturally-based features influence the payment industry in China: (1) preference for payment in cash, (2) very limited usage of private cheques, and (3) consumption based on savings. These features are barriers to consumers changing their payment behaviours. However, younger Chinese consumers have already adopted mobile commerce and mobile payments to purchase digital content. Switching from a traditional payment method to mobile payments using a mobile phone is expected to be easier for this new generation not tied to the old ways. Indeed, a lack of modern payment networks will not delay the diffusion of mobile payment technologies and other advanced payment technologies, such as smart card and contactless cards, in China. For a long time to come, credit cards and other advanced payment technologies will co-develop and co-exist with mobile payment technologies, serving different market segments. In recent years in China there has been an explosion in consumer culture and the standard of living has been steadily increasing, especially in major cities. The pursuit of material wealth has greatly boosted entrepreneurial (sometimes highly opportunistic) activities in the country. The development of China's wireless communications infrastructure has been far out of proportion to the development of the general economy, including the payment industry. Specifically, credit cards, which have driven consumption patterns in the west and become symbolic of the western lifestyle, have never taken off in China. This imbalance has created a 'hotbed' for the emergence and development of mobile payment solutions in China.

CONCLUSIONS

The development of mobile payments has been examined in two countries: Korea, the country leading the world in the innovation and development of vast broadband applications and mobile commerce; and China, the largest market in the world (ITU, 2004c). High-tech entrepreneurship has played an instrumental role in the generation of mobile payment innovation, and whilst the synergies between established large and new small firms have been essential for the development and early diffusion of mobile payment technologies, the broader diffusion of the mobile payment industry relies on the contributions of supportive institutions and cultures.

The creation of technical standards, leverage of high-tech entrepreneurial innovations upon existing infrastructure, and the encouragement of government policies and cross-industry collaborations have been identified as critical factors for the development of the mobile payment industry in Korea and China. Avaro had a distinct early advantage
as it possessed an important technical standard which provided it with the potential opportunity to become a technological leader in the global industry. The fact that it did not achieve this potential is explained by a number of factors that illustrate the limitations of high-tech entrepreneurship in pursuing the development and broad diffusion of an emerging technology, especially in the international market. These factors include the absence of internal resources or complementary assets necessary to fully commercialize technical opportunities; the inability to collaborate effectively with the incumbent players (including prominent venture capital firms) in the industry; and the founding management team’s reluctance to undertake a strategic re-orientation, including the replacement of the founder-CEO. Importantly, traditional Korean business ideology and extreme patriotism played an influential role in the failure of Avaro. In contrast, Jie Yin possessed a technological advantage, modern management capacity and powerful venture capital partners’ support, and even though it had to give way to the government sponsored UMPay eventually, it developed a strong foothold in a lucrative niche market.

Our findings confirm many of the theories in the literature relating to the constraints on the contribution of high-tech entrepreneurial firms to the development and diffusion of an emerging technology, but they accentuate the extent to which such limitations and opportunities are constructed within an Asian cultural and institutional environment. By highlighting how the cultural and institutional contexts of Korea and China restrict and bound the choices of management strategy of high-tech entrepreneurial firms, we aim to contribute to the literature on high-tech entrepreneurship in Asia and elsewhere. In the Korean case, the firm’s social networks constrained its internationalization strategy, and the historical centrality of the chaebol in Korea mitigated against a collaborative solution to the more rapid diffusion of the technology in the country. In the Chinese case, the entrepreneurial firm’s position in the market reinforced how the institutional elevation of strategically important organizations in China is not based on wealth maximization and transaction-cost minimization but, rather, is motivated by political and social objectives.

Based on our study of mobile payments and the literature reviewed earlier, let us return to our central research questions:

- What roles do entrepreneurial start-ups play in the emergence and development of a new technology in the networked economy?

High-tech entrepreneurial start-ups possess entrepreneurial capabilities which enable them to generate new products and services – identify new opportunities – quickly. This type of firm can often do things that large
firms find difficult to do. The roles played by high-tech entrepreneurial start-ups in the emergence and development of mobile payments include: (1) initiating technological breakthroughs, (2) initiating the diffusion cycle, (3) drawing on a collective effort across industrial boundaries, (4) driving the establishment of industry standards and, (5) shaping the structure of the industry value chain.

- What are the main strategic choices that enable entrepreneurial start-ups to contribute to the emergence and development of a new technology?

It is very important for a high-tech entrepreneurial start-up firm to retain its technological leadership by either establishing its innovation as a standard or seeking protection of its intellectual property, such as registering and maintaining patent protection. In the network economy, due to network effects, a critical mass of users is crucial for the development of an emerging technology; and, in some cases (such as Avaro in Korea), early internationalization is a vital strategic choice for a start-up firm with an interactive innovation. It is almost impossible for any firm to have advantages on every front of an emerging technology, therefore, collaboration – sometimes across industry boundaries – is a necessary, but risky, strategic choice for a start-up firm in order for it to leverage the complementary assets of the existing infrastructure. Selecting supportive partners that possess the appropriate resources and are non-acquisitive (when so desired), is a key strategic decision. Choosing the right balance between openness of standards and business model and protection of proprietary knowledge presents another clear strategic challenge. Electing to receive venture capital investments, with appropriate time horizons, when the consequence might be CEO succession presents another key strategic choice.

- What major factors constrain the innovation strategies of entrepreneurial start-ups?

The development of an interactive innovation relies on scale, meaning an open innovation approach is often desirable. Open innovation requires collaboration. However, lack of social legitimacy, market power, resources (human, capital and social) make collaboration with industry incumbents very risky and costly for high-tech entrepreneurial start-ups. Apart from start-up firms’ internal factors (such as flexibility and adaptability in management practice in dealing with dynamic technological and market conditions), contextual factors, such as national institutions, cultural
influences, business systems and ideology, and government policies in a country, also significantly influence high-tech entrepreneurial start-ups’ success or failure.

**Propositions and Future Research**

Based on the literature review and exploratory case studies conducted in this research, the following propositions have been developed which can be examined further in future research.

**Proposition 1:** In the network economy where increasing returns and network externalities (network effects) reign, technological leadership alone cannot guarantee the success of the entrepreneurial firm that possesses this technology. Rather, if this technology becomes an industry standard, the firm will possess greater opportunity to gain more sustainable competitive advantage.

**Proposition 2:** In the network economy, new components of business models such as open innovation, flexibility, fast learning, alliances (with venture capitalists, customers and competitors) and rapid and early internationalization, as well as the successful execution of these strategies at the right time and at the right speed, are critical for a firm aiming to establish its technology as the standard for interactive innovations.

**Proposition 3:** The development and diffusion of an innovation is positively influenced by a clearly identifiable user base of the firm and its affiliates that possesses and/or supports the innovation.

**Proposition 4:** The development and diffusion of an innovation is not just a process of technological evolution; it involves a social adaptive process, which occurs in unique institutional, social, cultural and regulatory contexts: the structures of which are by necessity dynamic.

**Proposition 5:** A high-tech entrepreneurial start-up firm’s early internationalization is influenced by the perceived life cycle and applicability on a global scale of its core innovation. The shorter the perceived life cycle span and the wider the global applicability, the more urgently the firm needs to undertake an early international strategy.

**Proposition 6:** A high-tech entrepreneurial start-up firm’s performance is determined not only by its internal efficiency, but also its social legitimacy, which is often influenced by the firm’s strategic alliances, social networks and participation with rivals in the formation of industry consortia: the structures of which are by necessity dynamic.

**Proposition 7:** A high-tech entrepreneurial start-up’s choice of outside financial investors is critical to the success of the firm. High-quality financial capital can help the firm obtain social legitimacy as well as growth. However, a strategic mismatch between the investor and its
recipient (the start-up firm), for example, over time horizons, can greatly constrain the long-term viability of the start-up firm.

Proposition 8: An entrepreneurial team’s attributes (key members’ personality traits, education, cultural roots and experience) are critical in shaping the pattern of how the start-up firm is founded, how strategic priorities are identified, and how strategic re-orientation is managed, which, in turn, are translated into the firm’s sustainable competitive advantages.

The Contributions of the Book

The first contribution of this book is to enrich our understanding about the importance and nature of high-tech entrepreneurship by locating its process-oriented case studies within their specific national and technological contexts. The case studies, by piecing together the ‘events’ that occurred in a time series (process) in their special conditions and environments, identify the factors (technological, industrial, cultural and social) that influenced the subject firms to make certain strategic choices, and specify the conditions and contexts in which the firms made those choices. The implications of this study are relevant not only to the entrepreneurs who manage a technological development, but also to public policy makers. If they have an understanding of the critical factors that influence the success or failure of a high-tech firm in managing the development of a new technology, managers (entrepreneurs) can formulate their strategic choices in anticipation of these factors. Public policy makers can also consider policies which encourage the contribution of such firms to economic growth.

Many Asian countries are encouraging the creation of high-tech entrepreneurial firms, along the US’s Silicon Valley model. We have seen that in global, network-based technologies and markets such firms can play a crucial role in innovation and diffusion. We have also seen the specifically Korean and Chinese factors that encouraged and constrained the opportunities for high-tech entrepreneurship. Just as the Japanese venture capital industry merged this US phenomenon into a different national context with the result of the emergence of a venture capital industry with Japanese characteristics, we may begin to see the emergence of models of high-tech entrepreneurship with Asian characteristics. In any case it is clear that in this quintessentially global technology, national characteristics remain determining influences over its development. Managers, policy-makers and academic researchers need continually to appreciate the important and enduring legacy of national diversity.
The second contribution of the book is that the case studies are detailed and comprehensively constructed. This serves three purposes: (1) it allows us to track the developmental history of the mobile payment industries in China and Korea; (2) it allows for comparative interpretations and analysis; and (3) it permits us to gain valuable insights into the dynamics of competition in the mobile payment market, in which innovation, entrepreneurship and firm growth strategies are closely interrelated. The "storytelling" approach used in constructing the case studies is a means by which the data explain themselves. As Daft (1983: p. 541) has said: "Stories are theories... Theories simply explain why."

This book also contributes by presenting detailed case studies of companies in East Asian countries, which are notable for their paucity in contrast with European and US cases. The outcomes obtained from these in-depth case studies can be integrated into a framework which can possibly provide practical guidance for high-tech entrepreneurial start-up firms that seek to diffuse their emerging technologies in the global arena.

Given the nature of the research issues, the research approach is multidisciplinary, covering a diverse range of topics such as applied economics, international business, innovation, technology diffusion, sociology and institutional analysis. The last contribution, therefore, lies in the development and use of a "double-loop" research strategy, which links the theoretical frameworks developed from a holistic view of a wide range of literature and the empirical constructs of case studies. This strategy allows a better understanding of how organizations work within their specific contexts. This research approach, hopefully, enriches our understanding of qualitative research methodologies, which are still considered "thin" in the literature (Miles and Huberman, 1994).

Above all it is hoped that the ideas developed in this book will form a resource for future research examining high-tech entrepreneurship in Asia and the developing countries of the world.
NOTES

1. The context within which a firm establishes a cost structure and operating processes and works with suppliers and channel partners to respond profitably to the common needs of a class of customers (Christensen and Rosenbloom, 1995).
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