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The Design and Engineering of Innovative Mobile Data Services: An Ontological Framework Founded on Business Model Thinking

A thesis submitted for the degree of Doctor of Philosophy

By

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6th, May, 2010

ABSTRACT

This research investigates mobile service design and engineering in the mobile telecommunications industry. The mobile telecommunication business is shifting from one that was voice-centric to one that is almost all data-centric; thanks to recent rapid advances in Information and Communication Technologies (ICTs). The underlying reasons behind this shift can be traced back to two main issues that are interlinked. The first and major reason is that telecoms (telecommunication companies) are trying to generate new revenue streams based on data and information transmissions, given the saturation of the voice market. This is rational given the market opportunities in one direction and the pressures being generated by the current economic downturn from the other direction. The second reason relates to the flexibility of data, compared to voice. Indeed, the number of services that can be developed on the basis of data are much greater than those that can be developed on the basis of voice. However, the design and engineering of successful and innovative mobile data services has proven to be a complex undertaking. The number of effective mobile data services is relatively small and the revenue generated from such offerings has generally been below expectations. This research develops an ontological framework to help in changing this situation, and making mobile services engineering more effective and successful, following the design-science research paradigm.

Design-science research, in general, aims to solve unstructured but relevant organizational or social problems through the development of novel and useful artefacts. As the current research aims to help in solving the mobile data services engineering dilemma by developing a purposeful ontological framework, the design-science research paradigm is deemed fitting. Within this paradigm, the author develops a novel design approach specified for ontology engineering, termed “OntoEng”. This design approach is used in this research for developing the ontological framework.

The developed ontological framework is founded on business model thinking. The idea is that creating innovative mobile data services requires developing innovative business models. Indeed, innovative business models can help translate technological

potential into economic value and allow telecoms to achieve their strategic objectives. The ontological framework includes the development of an ontology, termed "V^4 Mobile Service BM Ontology" as well as "Mobile Key Value Drivers" for designing and engineering innovative mobile data services. The V^4 Mobile Service BM Ontology incorporates four design dimensions: (1) *value proposition* including targeting; (2) *value architecture* including technological and organizational infrastructure; (3) *value network* dealing with aspects relating to partnerships and co-operations; and finally (4) *value finance* relating to costs, pricing, and revenue structures. Within these four dimensions, sixteen design concepts are identified along with their constituent elements. Relationships and interdependencies amongst the identified design constructs are established and clear semantics are produced. The research then derives six key value drivers for mobile service engineering as follows: (a) Market Alignment; (b) Cohesion; (c) Dynamicity; (d) Uniqueness; (e) Fitting Network-Mode; and (f) Explicitness.

The developed ontological framework in this research is evaluated to ensure that it can be successfully implemented and performs correctly in the real world. The research mainly utilizes case analysis methods to ensure the semantic correctness of the ontological framework. Indeed, the developed ontological framework is employed as an analytical lens to examine the design and engineering of three key real-life cases in the mobile telecommunications industry. These cases are: (1) Apple's iPhone Services and Applications; (2) NTT DoCoMo's i-mode Services; and (3) Orange Business Services. For further validation, the developed ontological framework is evaluated against a set of criteria synthesized from ontology engineering and evaluation literature. These criteria are: Clarity; Coherence; Conciseness; Preciseness; Completeness; and Customizability.

The developed ontological framework is argued to make significant contributions for theory, practice, and methodology. For theory, this research provides (1) a novel ontological framework for designing and engineering mobile data services; (2) a unified framework of the business model concept; and (3) a new design approach for ontology engineering in information systems. For practice, the current research provides practitioners in the telecommunications industry with systematic and customizable means to design, implement, analyze, evaluate, and change new and existing mobile data services to make them more manageable, effective, and creative. For methodology, the use of the design- science research paradigm for ontology engineering signifies the focal methodological contribution in this research given its novelty. This research also contributes to the understanding of the design-science research paradigm in information systems as it is relatively new. It provides a working example in which the author illustrates how recognizing design-science research as a paradigm is essential and useful to the research in information systems discipline.

DEDICATION

To start with, my heart cannot fully express the gratitude and appreciation that I owe to my precious wife Enas, whose unconditional love, and endless support have made me stronger. Despite the pressure I have gone through, she has never been but a caring, and understanding person. Having her by my side, Enas has proved to me how grateful and proud she feels, and without all of her support, reaching this point would have been hard. I also grant my love to the most precious gift god blessed me with, my baby girl. Sarah has inspired me in completing this thesis. My biggest dedication goes to you both.

I am pleased to dedicate my thesis to my amazing parents. Mom and dad, what can I say, you have always given me nothing but exceptional love, encouragement, and support. You have built the confidence in me and taught me to never give up. I simply thank you for the love and care you show throughout these years. May god bless you and always give me the strength to look up to you and follow your footsteps.

I would like to show my brothers and sisters how grateful I am for their love and support, which has made me enjoy the moments of work and research. Simply, they have always showed me how supportive they are.

At last but not least, I am honoured to dedicate this thesis to my wonderful in laws who have always stood by my side and offered me their unique help, and advice. Their cheerful side indeed have played a major part in inspiring me throughout this journey. I owe you so much.

Thank you all…

With Love,
Mutaz

ACKNOWLEDGEMENTS

First and foremost, I am grateful to express my deepest appreciation to my supervisor *Professor Guy Fitzgerald* who supported me throughout my PhD with his valuable expertise and knowledge, and whom without I could not possibly have finished this work. Prof. Guy continually conveyed a spirit of adventure and excitement in regards to research, his guidance and persistent help have had a remarkable influence on my entire work. He inspired me all the way through, one can simply not wish for a better and friendlier supervisor.

My gracious acknowledgement and sincere gratitude goes to my *Professor David Avison* whose wide knowledge and experience have been of great value for me. My journey started with his understanding, encouragement and guidance which have provided a solid basis for the present thesis. Most importantly he taught me to never give up no matter how hard things get. It was hardly possible for me to thrive in my PhD work without the unconditional support of both of them.

I also owe my warmest thanks to *Prof. Mark Lycett*, *Dr. Sergio de Cesare, and Dr. Anastasia Papazafeiropoulou* for the priceless times we have spent talking, debating and discussing issues related to my research. They offered me assistance whenever I needed that. Their logical and rationale ideas have expanded my way of thinking about research and analyzing the basic hallmarks of a successful career. I have always looked forward to learning from them.

Finally, I am grateful to the department of Information Systems and Computing (DISC) for the homey ambiance and the widely available and easily accessible resources which without, my work could not have been easily completed.

PUBLICATIONS

Publication	Contributions to the Thesis
Al-Debei, M. M., and Avison, D. (2010) 'Developing a Unified Framework of the Business Model Concept'. *European Journal of Information Systems*, 19(3), pp. 1-18, (forthcoming).	Chapter 1 (Section 1.3.3); and Chapter 3 (Sections 3.1, 3.2, 3.3, and 3.4).
Al-Debei, M. M., and Avison, D. (2010) 'Business Model Requirements and Challenges in the Mobile Telecommunication Sector'. *Journal of Organizational Transformation and Social Change*, (Accepted).	Chapter 1 (Sections 1.2.2, 1.2.3, 1.3.2, and 1.3.3); Chapter 3 (Sections 3.4.1 and 3.4.3); and Chapter 6 (Sections 6.2, 6.4, and 6.7).
Al-Debei, M. M., and Fitzgerald, G. (2010) 'Ontology Engineering in Information Systems: The Development of 'OntoEng' Design Approach'. *Journal of Applied Ontology*, (provisionally Accepted).	Chapter 2 (Section 2.5).
Al-Debei, M. M., and Fitzgerald, G. (2010) 'The Design and Engineering of Mobile Data Services: Developing an Ontology based on Business Model Thinking'. International Federation for Information Processing (IFIP 8.2+8.6), IFIP AICT 318, *In Human Benefits Through the Diffusion of Information Systems Design Science Research*, eds. Pries-Heje, J., Venable, J., and De Gross , J. , Boston: Springer, pp. 28-51.	Chapter 4 (Sections 4.2, 4.3, 4.4, 4.5, and 4.6) and Chapter 6 (Sections 6.3, 6.4; 6.5; and 6.6).
Al-Debei, M. M., and Fitzgerald, G. (2010) 'The Design of Innovative Mobile Artifacts: How to Develop Powerful Value Networks?'. *The 5th IEEE International Conference on Management of Innovation and Technology* (ICMIT), (Accepted).	Chapter 4 (Section 4.4); Chapter 5 (Section 5.3); and Chapter 6 (Section 6.6).
Al Asswad, M.M., Al-Debei, M.M., de Cesare, S. and Lycett, M. (2010) 'Conceptual Modelling and the Quality of Ontologies: A Comparison between Object-Role Modelling and the Object Paradigm'. *The 18th European Conference on Information Systems* (ECIS), South Africa, (Accepted).	Chapter 1 (Section 1.3.4); and Chapter 2 (Section 2.5).
Serrano, A.E., Serrano, A., and Al-Debei, M.M. (2010) 'Implementing an e-Business Model for a dot-com SME: Lessons Learned'. *In Proceedings of the 16th Americas Conference on Information Systems*, Peru, (Accepted).	Chapter 7 (Section 7.4).

Publication	**Contributions to the Thesis**
Al-Debei, M.M., Alrouh, B., and Chinea, G. (2010) ‘Developing a Decision-Making Framework for Web Service Security Profiles: A Design Science Paradigm’. In The The International Conference on Intelligent Semantic Web – Services and Applications, ACM, (Accepted).	Chapter 2 (Section 2.4).
Al-Debei, M.M., Panagiotopoulos, P., Fitzgerald, G., Elliman, T. (2010) ‘Rethinking the Business Model Concept with E-Participation’. *Transformational Government Workshop*, March 2010 (Accepted).	Chapter 7 (Section 7.4).
Panagiotopoulos, P. and Al-Debei, M.M. (2010) ‘Engaging with Citizens Online: Understanding the Role of ePetitioning in Local Government Democracy’. *Internet, Politics, Policy Conference 2010: An Impact Assessment*, Oxford Internet Institute, (Accepted).	Chapter 7 (Section 7.4)
Al-Debei, M. M., and Fitzgerald, G. (2009) ‘OntoEng: A Design Method for Ontology Engineering in Information Systems’. *In ACM OOPSLA’09 – Ontology-Engineering Software Engineering Workshop*, USA, Florida, Orlando, October 2009, pp. 1-25.	Chapter 2 (Section 2.5)
Al-Debei, M. M., El-Haddadeh, R., and Avison, D. (2008) ‘Defining the Business Model in the New World of Digital Business’. *In Proceedings of the 14th Americas Conference on Information Systems*, AMCIS’08, 2008, Toronto, Canada, pp. 1-11.	Chapter 1 (Section 1.3.3); Chapter 3 (Sections 3.2, 3.3, 3.4, and 3.5); and Chapter 6 (Sections 6.1, 6.3, 6.4, and 6.7)
Al-Debei, M. M., El-Haddadeh, R., and Avison, D. (2008) ‘Towards a Business Model for Cellular Networks and Telecommunication Operators: a Theoretical Framework’. *In Proceedings of the 13th Conference of the UK Academy for Information Systems*, UKAIS’08, 2008, Bournemouth, UK, pp. 1-15.	Chapter 1 (Sections 1.2, 1.3.2, and 1.3.3); and Chapter 3 (Sections 3.2 and 3.4).

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The Design and Engineering of Innovative Mobile Data Services: An Ontological Framework founded on Business Model Thinking

Chapter One: Research Introduction and Overview

1.1 Overview

This research addresses the design and engineering problem relating to mobile data services. This dilemma is mainly tackled in this research from a Business Model (BM) perspective by following the Design-Science Research (DSR) paradigm. This chapter provides a general introduction to the research by first explaining its main motivations and discussing the related research domains that shape the research context. Next, the research aim and objectives are identified based on the established definition of the research problem and motivations. The undertaken approach in achieving the recognized objectives and eventually the main aim of the research is concisely explored thereafter. This chapter ends by presenting the structure of the rest of this thesis.

1.2 Research Motivations

1.2.1 The Growth of Mobile Services

During the last decade, there has been a significant shift from fixed to mobile cellular services. The growth as well as the distribution of mobile technologies and services has become more evident and noticeable (see Figure 1-1). International Telecommunications Union "ITU" (2009) indicates that:

> "*The spread of mobile cellular services and technologies has made great strides towards connecting the previously unconnected…By the end of 2008, there were over three times more mobile cellular subscription than fixed telephone lines*" (p.3).

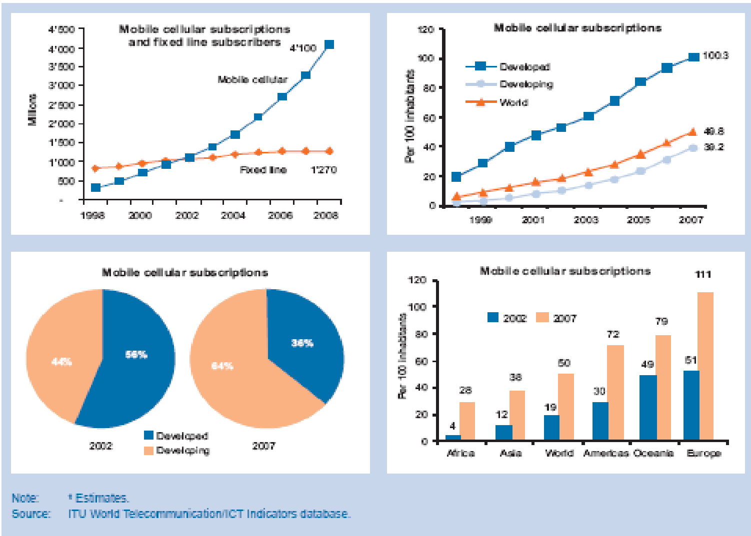

Figure 1-1. Mobile Services Growth and Distribution (ITU, 2009)

Mobility succeeds where it addresses users by means of portable handsets through which different sorts of services and intelligence can be accessed and communicated (Sørensen, 2006). The increasing recognition of the advantages people can get from such technologies has increased the number of mobile users worldwide. Currently, the number of such users is exceeding those of other related technologies such as fixed and wireless broadband (see Figure 1-2). Indeed, the ability to communicate from anywhere at any time presents extraordinary levels of flexibility and expediency, and the stage is now clear for wireless networks and mobile telecommunications to bring tremendous changes to the way businesses are conducted and the way in which we live our lives.

Generally speaking, the mobile telecommunications domain is considered one of the most important and exciting areas for research purposes. This is rational since the newness of this area points out the high intensity of unexplored domains of novel knowledge that have not yet received adequate attention in the relevant literature. Furthermore, the provisioning of new promising cellular technologies such as 3G Universal Mobile Telecommunication Systems (UMTS) and 4G Worldwide Interoperability for Microwave Access (WiMax) represents another key reason for making this research domain highly appealing.

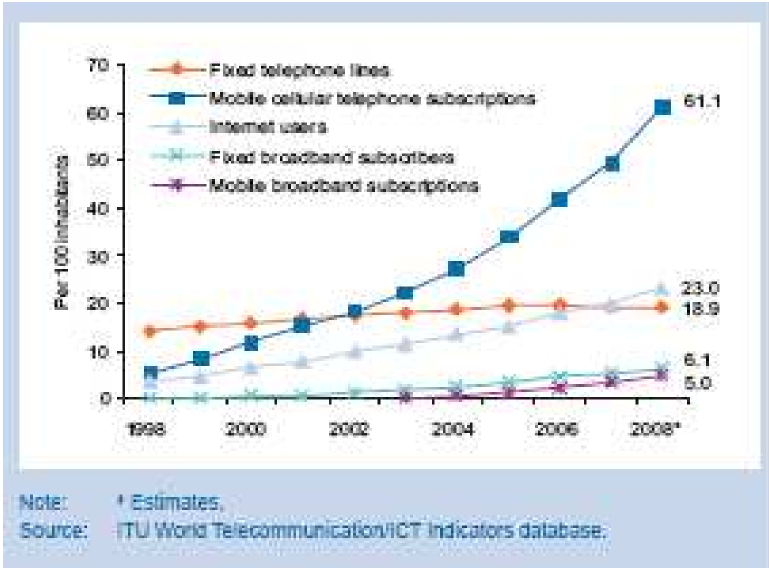

Figure 1-2. Comparison of mobile and other ICTs (ITU, 2009)

1.2.2 The Transformations in the Mobile Telecommunications Industry

The mobile telecommunications industry is undergoing a critical revolution, driven by innovative technologies, globalization, and deregulation. Recent technological advances in telecommunications are touching our intimate spheres changing personal life styles as well as business functions and practices. Cellular technology generations, particularly those starting from Global System for Mobile Communication (GSM) to 3G UMTS and beyond, are continuously enhancing the qualities and capabilities of mobile services and giving valuable opportunities for offering new ones. Furthermore, the convergence of data, Internet, voice, and other technologies has a great potential in enabling mobile users to communicate richer information in unprecedented levels of flexibility and convenience. The main allusion of these technological revolutions is apparent from the shift of the industry from mainly voice to one that is mostly about data (Dodourova, 2003) where new competencies revolve around content, relationships, and customers, rather than technology infrastructure.

At the same time, globalization is radically reducing legacy telecommunications barriers and forcing monopolistic national carriers to compete globally. This provides an environment more amenable to sustainable rivalry. Moreover, the noticeable progress of many countries towards telecoms liberalization is significantly increasing market power leading to severe competitions. Deregulations also have led to shifting the structure of the telecom industry from an ‘autocratic’ state to a more ‘democratic’ one where a more complex and open system including extensive collaboration, communication, and co-ordination are prevalent.

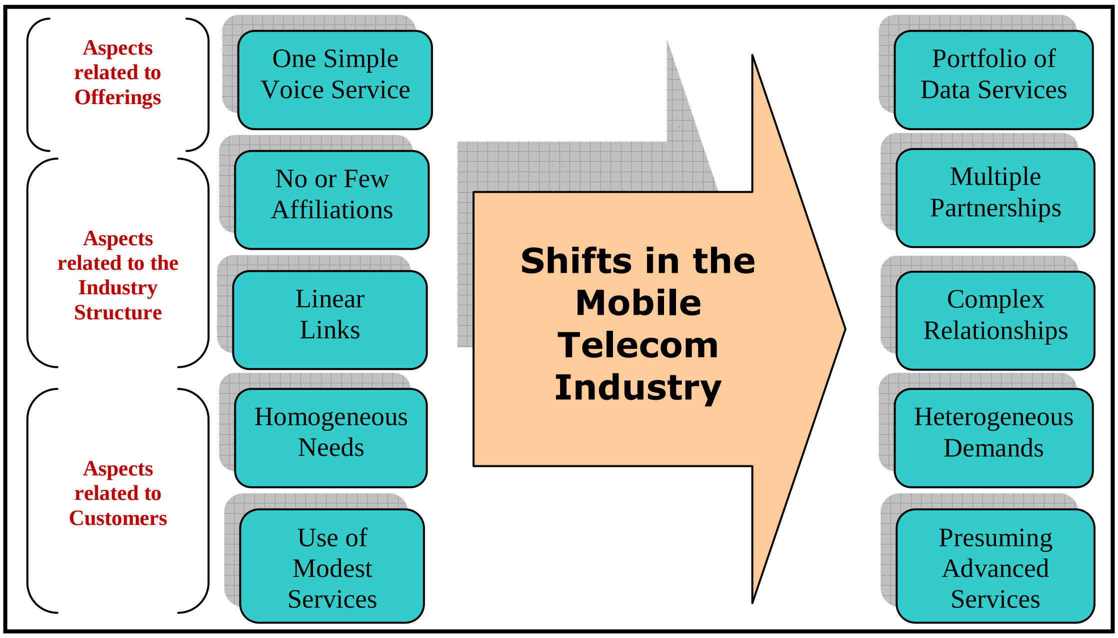

Figure 1-3. Shifts in the Mobile Telecommunications Industry

The implications of these transformations have changed the business rules of the mobile telecommunications industry. As illustrated in Figure 1-3, the major challenges faced by telecommunication providers (from now on shortened to the term telecoms) are the shifts from one simple voice service to a portfolio of mainly convergent data services (e.g. integration of voice, data, and Internet), from no or few affiliations to multiple partnerships (Olla and Patel, 2002), from simple and linear links in the form of value chain to complex relationships in the form of value network (Peppard and Rylander, 2006), from homogeneous to heterogeneous customer demands, and from customers consuming modest services to customers continuously presuming advanced, high qualities services (Kim et al., 2008).

1.2.3 The Dilemma Related to Mobile Data Services

In response to the aforementioned challenges due to the substantial transformations in the telecommunications industry, telecoms have been compelled to repackage their business; that is, overhauling the traditional way in which mobile services are designed and developed. This is particularly pertinent now, with the saturation of the voice market, and the credit crunch. For telecoms to get their strategies right is critical to success as inappropriate decisions can have major adverse effects on performance. However, capturing value from mobile data services has proven difficult. One key indicator is that revenues generated from services other than voice telephony and SMS is below expectations (Tilson and Lyytinen, 2006; Funk, 2007), although the number of mobile users worldwide is continuously increasing (ITU, 2009). For example, in the UK mobile telecommunications industry, the revenue produced by mobile data services is not exceeding 6% of the total revenue from all types of services (see Figure 1-4). Given the large investments telecoms have made to launch mobile data services, the low level of utilization by users represents a major dilemma since it extremely increases the payback period of telecoms sunken investments.

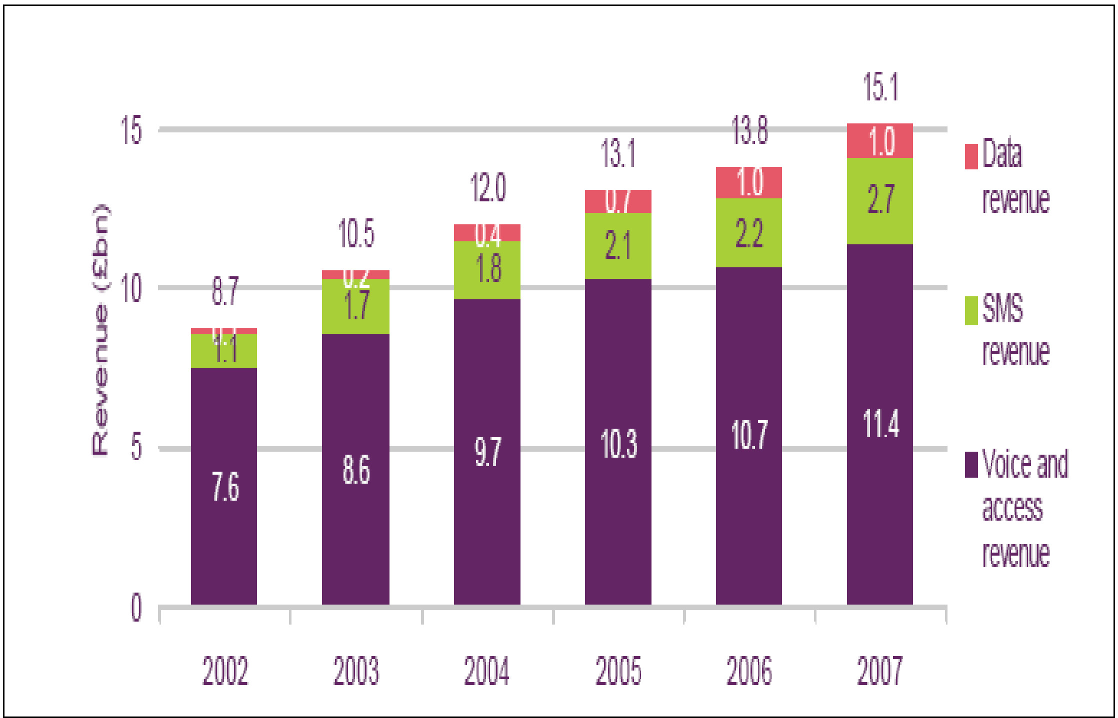

Figure 1-4. Evidence of the Low Revenue by Mobile Data Services (Ofcom, 2008).

In the context of this research, the problem is clearly related to the *design and engineering* of appropriate mobile data services. When it comes to service design and engineering (see also Bullinger et al., 2003) telecoms are facing many issues that are hindering their progress, as follows:

(1) *The absence of a coherent framework*. Telecoms services are not clearly defined; there are no unequivocal and comprehensive identifications of the service related issues such as content, associated values and benefits, needed resources, target segments, financial designs, etc.

(2) *Inappropriate organizational design*. Telecoms structure, infrastructure, and/or technological architectures are not designed to enable efficient development and launch of new services.

(3) *Weak alignment amongst all organizational layers*. The service model is not tightly consistent with telecoms strategic objectives as well as the operational processes, including their information systems.

Retrospectively, there is a significant need to inform and advise service design and engineering in the telecom sector by looking at this issue from an integrated and cohesive view. Services probably need to be developed or re-developed using a comprehensive and effective approach, if they are to be successful. This is now an open research area where the role of researchers and practitioners is to find how best to design and engineer mobile data services.

1.3 Research Domains and Context

The design and engineering dilemma of mobile data services is tackled in this research from a number of perspectives. More specifically, five main domains (i.e. mobile telecommunications, business modelling, service science, management, and engineering -SSME-, Innovation, and Ontologies) are deemed relevant and helpful is assuaging the research problem. Hence, as illustrated in Figure 1-5, the intersections amongst these research domains symbolize the context of the current research.

The relevance of the domain of SSME to the current research is quite clear given the high level of consistency between them; both aim to provide useful insights into how best to conduct service design, development, analysis, evaluation, management, and maintenance functions. But whilst SSME is more comprehensive in a sense that it takes all sorts of services along with their industries into consideration, this research is limited only to mobile data services that are provided in the mobile telecommunications sector. This explains the relevance of mobile telecommunications where innovation is a key element to sustain and thrive in such a highly competitive industry. In this research, understanding mobile telecommunications in terms of technologies, services, characteristics and hallmarks is also considered useful and relevant. The role of the business model concept however comes from the fact that it can fruitfully work as a logical representation of the entire business covering its core functions and practices; and thus provides a more comprehensive and useful way of looking at the research problem. Finally, the need to establish precise, sharable, and reusable common understanding of services design and engineering amongst people and also information systems explains the role and relevance of the field of ontologies. The novel integration of these research domains is considered valuable and constructive as their different but complementary standpoints promise to feed mobile service engineering with significant knowledge and understanding, if properly harmonized.

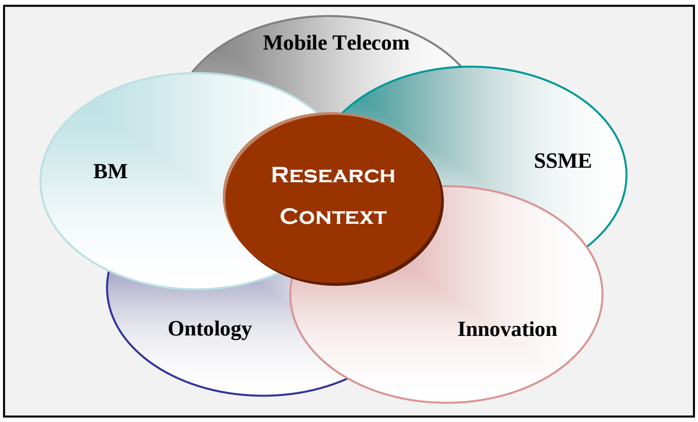

Figure 1-5. The Interrelated Domains within the Research

1.3.1 Service Science, Management, and Engineering (SSME)

The service sector is gaining increasing importance and attention due to the major transformations that occurred within different service sectors such as telecommunications. Having recognized the significance of services and their design, development, and management functions to the improvement of business and social systems, researchers are attempting to establish SSME as a new interdisciplinary scientific domain. This new field of research aims to produce deep integrated knowledge relating to service related functions as well as value creation and realization by combining technology, business model, and social-organizational innovations (Spohrer and Riecken, 2006).

The researcher believes that this step is pertinent. This is because "when comparing the research on service topics to those research activities that focus on material goods, an obvious gap can be observed. While there is a broad range of models, methods and tools existing for the development of goods, the development of services has hardly become a topic of scientific literature" (Bullinger et al., 2003; p.1). Currently, most of the service sectors including the mobile telecommunications are highly competitive. To stay successful, not only service organizations need to fulfil the needs and expectations of their customers, but also to continuously offer innovative services being differentiated or providing values exceed those provided by rivals. Hence, there is a significant need to examine service design and engineering from a more integrated perspective.

1.3.2 Mobile Telecommunications and Mobile Data Services

The recent significant growth in wireless telecommunications is mainly driven by the technological developments in networks, telecommunications, wireless devices, standards, protocols, bandwidths, and applications. Currently, many wireless technologies are accessible including, but not limited to, Bluetooth, Radio Frequency Identifier (RFID), Wireless Local Area Networks (WLANs), Wireless Wide Area Networks (WWANs), and mobile (cellular) communications which is the central focus of this research.

Generally speaking, Wireless communication is "the process of communicating information in electromagnetic media over a distance through the free-space environment, rather than through traditional wired or other physical conduits" (Aungst and Wilson, 2005). There are three unique aspects of wireless and pervasive technologies (Elliot and Phillips, 2004; Sørensen and Gibson, 2008). The first characteristic is *mobility;* that is wireless devices can be taken to different places and still benefit from full network services. The second is *ubiquity;* that is wireless devices are scattered throughout the physical environment. The final feature is *embedding* in a sense that wireless devices along with their computing capabilities are mostly embedded within everyday products such as cars, toys, and appliances. Interestingly, Lyytinen and Yoo (2002b) provides more clarity to this area of research by distinguishing amongst mobile, pervasive, ubiquitous, and traditional business computing based two dimensions: (a) level of mobility; and (b) level of embeddedness, as in Figure 1-6.

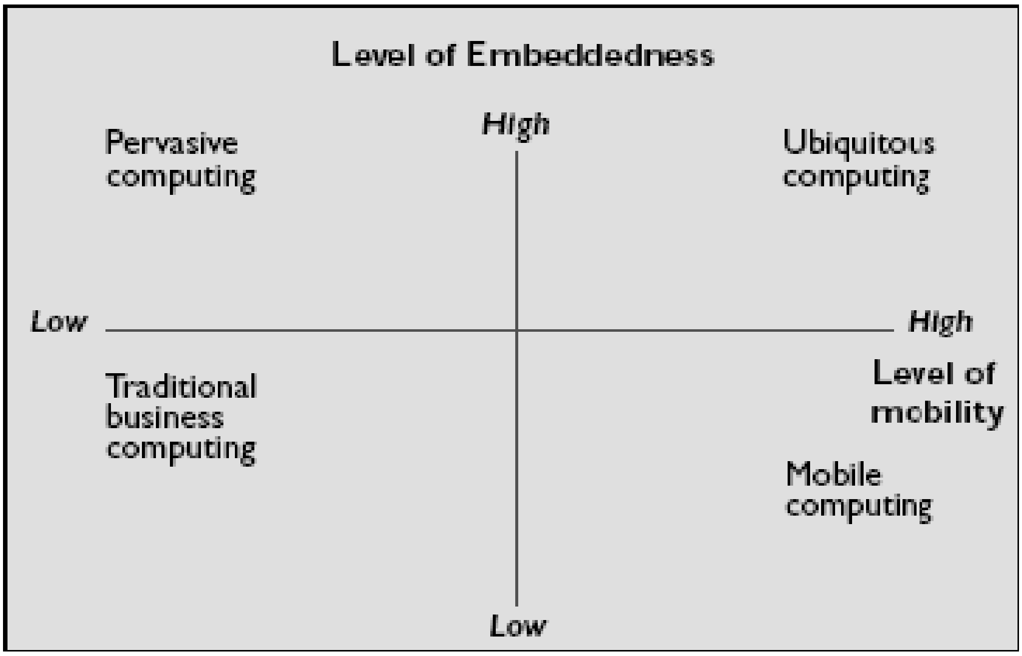

Figure 1-6. Dimensions of Ubiquitous Computing (Adopted from Lyytinen and Yoo, 2002b)

Mobile networks and telecommunications, amongst the different wireless technologies, is what predominantly facilitate the communication of data and information to mobile handsets through the free-space environment. Such networks (see Figure 1-7) are made up of (1) the mobile handsets themselves; (2) individual cells and their associated Base Stations (BSs) or cellsites which communicate with the mobile handsets; (3) a variety of hardware and software including routers and switches along with their applications that handles internal communications for transferring calls and data through the network; (4) the traditional telephone system which is commonly known as Public Switched Telephone Network (PSTN); and (5) external communications for transferring calls and data from the network to other networks such as Mobile Telephone Switching Offices (MTSOs) which work as interfaces between BSs and the PSTN.

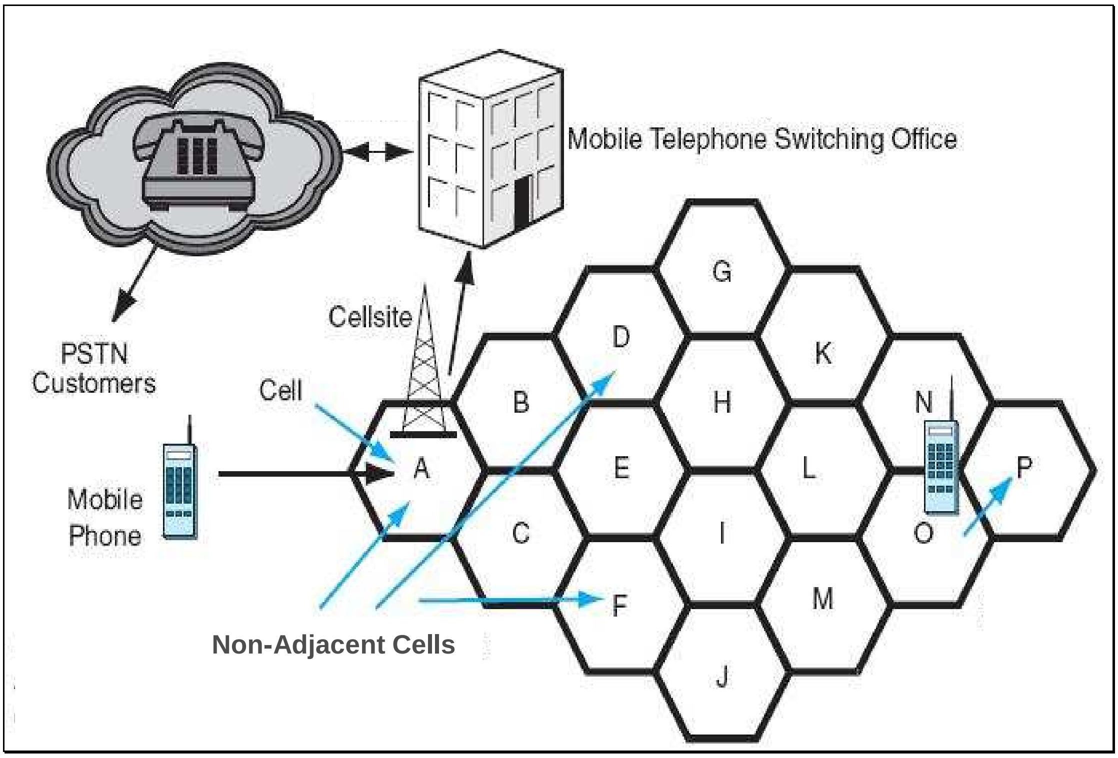

Figure 1-7. A Basic View of the Mobile Network Architecture (Compiled after Panko, 2005).

Four generations of cellular networks and telecommunications can be distinguished. Analogue networks, which were the first cellular networks that appeared in 1980s, are referred to as Advanced Mobile Phone Service, or AMPS. They use frequency modulation (i.e. Frequency Division Multiple Access “FDMA”) to deliver signals and they were classified as the first generation (1G) of cellular technology. Such technology was easy to implement, but wasteful of the limited bandwidth then available (Turban et al, 2006). Although AMPS was very popular, there were some problems. First, their capacity was limited; so they cannot handle as many calls as more advanced cellular networks. The 1G throughput was limited to about 5kbps and was given 50 MHz in the radio spectrum in the 800 or 900 MHz range. This issue had placed serious limitations regarding the number of subscribers that could be served by a single network. Maintaining a high Quality of Service (QoS) level for mobile users was also a problem. Equally important is that 1G technology cannot deliver the same kinds of advanced services, such as browsing the web, paging, and text messaging as digital networks that came later. Hence, the 1G provided the foremost voice service, but no data services (Hart and Hannan, 2004).

The second generation of cellular telephony (2G) was introduced in 1991. Beyond initial expectations, the 2G mobile technology has experienced rapid and widespread acceptance (Grundstrom and Wilkinson, 2004). The 2G systems are based on digital radio technology with maximum data rates of up to 14.4 kbps. It incorporates an advancement of digital voice, and also enjoys the ability to accommodate text messages (i.e. SMS) as the first data service to be launched in the mobile telecommunications industry worldwide. In most countries, the 2G systems have been allocated 150 MHz. This has tripled the number of potential subscribers compared to 1G systems. The 2G technology operates at higher frequencies (i.e. 1,800 or 1,900 MHz) than the 1G technology. This implies that 2G signals do not propagate as far as 1G signals; thus they require more cells to be deployed by telecommunication providers. Although this is more expensive, it allows more channel reuse (Panko, 2005).

In Europe, the selected standard was Global System for Mobile Communication (GSM). GSM is almost the global *de facto* standard except for the USA and Japan. In the USA, the US-TDMA (time division multiple access) coupled with cdmaOne (code division multiple access) and GSM share the market, whilst in Japan Personal Digital Communication (PDC) is the employed standard (Grundstrom and Wilkinson, 2004).

The mobile 2G technologies have gradually been redefined and transmission speeds improved resulting in what is termed 2.5G systems. Examples of the 2.5G systems include Enhanced Data GSM Environment (EDGE) and General Packet Radio Services (GPRS). The main aim of such systems is to facilitate a smooth shift from 2G to 3G technology (Ericsson, 2002). The GPRS technology, in particular, was widely employed throughout the world. It is a packet-based network that has provided the ‘always on’ technology with a speed up to 384 kbps (Hart and Hannan, 2004). In general, the 2.5G systems can communicate limited graphics, such as in picture text messages, or MMS (Turban et al, 2006).

The third generation (3G) cellular telephony is a system of technologies aiming for convergence. It blends the traditional mobile telecommunication with the Internet enabling delivery of “voice, data, pictures, graphics, and other wideband information” (UMTS Forum, 1997; Grundstrom and Wilkinson, 2004). The emergence of 3G networks has significantly improved both speed and coverage. The 3G technologies can boost 2Mbps of data transfer, coupled with substantial increase in coverage (Hart and Hannan, 2004).

Interestingly, although telecoms were the main drivers behind the development of standards for 2G systems, system manufacturers are the ones pushing for the establishment of standards for 3G systems. One reason for this is that with increasingly deregulated telecommunication markets, few telecoms can afford large R&D departments and thus many of them no longer have a deep technical knowledge of the systems they use (Grundstrom and Wilkinson, 2004).

Currently, there are some attempts in developing and employing 4G mobile network such as Worldwide Interoperability for Microwave Access (WiMax). The 4G networks, or otherwise referred to by 3G+, aim to improve the data rate of the network to reach speeds of up to 20Mbps (Hart and Hannan, 2004). It also aims to provide premium QoS levels as well as enhanced security.

Indeed, the continuous evolution of mobile technologies has led to substantial improvements in regards to the nature and types of services that can be provided in the market. Whilst mobile voice communication is the main advantage of the 1G technology, later technologies have extended that to include Internet and information access, life support such as LBS, and other advanced features related to personalization. Mobile technologies and the nature of services provided by each generation seem to be a confusing area and in order to help clarify or simplify it, a summary table (i.e. Table 1-1) is provided.

This research broadly defines mobile data services as any service that includes a communication of any data and information, excluding voice, over mobile networks and telecommunications. Although there is no universal classification of mobile data services, one can find some sensible categories in the relevant literature. For example, whilst Olla and Atkinson (2004) classify such services as mobile entertainment systems, mobile messaging systems, location-based information systems, mobile commerce systems, and any other mobile data systems, Hong et al. (2006) provides a simpler classification as they categorize mobile data services as communication, information content, and entertainment services.

Table 1-1. Mobile Technologies and the Nature of Provided Services

Mobile Tech. Generation	Representative Products	The Nature of Provided Services
First Generation (1G) - 1980	▪ Total Access Communication System (TACS) – Europe ▪ Nordic Mobile Telephone (NMT) System - Europe ▪ Advanced Mobile Phone System (AMPS)- USA	▪ Voice analogue telephony ▪ Paging ▪ Low level of security ▪ Limited Capacity
Second Generation (2G, 2.5G)- 1990	▪ Global System for Mobile communication (GSM) – Europe ▪ Intermediate Standard (IS-95 and IS-136) – USA ▪ Personal Digital Communication (PDC) – Japan	▪ Voice digital telephony ▪ Roaming ▪ Call forwarding ▪ Short Messaging Service (SMS) – 160 char ▪ Low data rate
2.5G ~ 2.75G - 1996	▪ General Packet Radio Service (GPRS) – Stage 1 (2.5G) ▪ Enhanced Data Rate for GSM Evolution (EDGE) – Stage 2 (2.75G)	▪ Multimedia Messaging Service (MMS) ▪ Enhanced Messaging Service (EMS) – simple media ▪ Location-based services ▪ Access to Internet (Web browsing) ▪ Higher data rate
Third Generation (3G) - 2002	▪ Universal Mobile Telecommunication System (UMTS)	▪ Virtual Home Environment (VHE) feature ▪ Video on demand ▪ High speed ▪ Video calls and chat ▪ Mobile TV ▪ Broadband wireless data ▪ High speed internet access
Fourth Generation (4G, beyond 3G) – 2012- 2015	▪ Worldwide Interoperability for Microwave Access (WiMax)	▪ Premium quality ▪ High security ▪ Premium speed ▪ Digital Video Broadcasting (DVB) ▪ Interoperability with existing wireless standards

Having discussed the four generations of mobile communications and technologies along with the types of services that are technically feasible in each generation, the author in the next section introduces the business model concept and discusses its relevance and usefulness to the design and engineering of innovative mobile data services.

1.3.3 The Role of Business Models

The business model concept, although much talked about, is somewhat fuzzy (Seddon et al., 2004; Seppänen and Mäkinen, 2007) and researchers have defined it from different standpoints. Put simply, the business model concept can be described as a "logical story" (Magretta, 2002), or a "blueprint" (Chesbrough and Rosenbloom, 2002) that explains the "way of doing business" (Hamel, 2000) so that strategic goals and objectives can be achieved.

The existing literature in both business and information systems testifies to the importance of the BM concept to the success of companies, particularly those driven by ICTs. The argument is that it is not the technology *per se*, but the business model that is considered to be the primary reason behind the success or failure of mobile and other ICT services and applications (Yuan and Zhang, 2003; Kamoun, 2008). This is equally relevant to mobile data services. For example, the success of NTT DoCoMo’s i-mode in Japan is primarily credited to its well-designed business model in action (Ratliff, 2002). Indeed, the technology of i-mode service was very modest with a speed of 9.6kpbs. In 1999 when the service has been launched, the perception was that current low-band 2G cellular technologies are obstructing telecommunication providers from providing successful data services. Despite the existing technologies by then, NTT DoCoMo was able to offer i-mode as an innovative mobile data service that not only shocked the Japanese mobile sector, but also the global mobile telecommunications industry at large. This success is attributed to the innovative i-mode business model including, but not limited to, (1) i-mode richness in terms of convenient content along with their structure; (2) powerful value system and market structure; and (3) appropriate pricing and billing methods. Contrasting i-mode, the low adoption of WAP (Wireless Application Protocol) is mainly down to the absence of a feasible business model or its inappropriate configurations (Kumar et al., 2003). Indeed, powerful mobile data services require innovative business models to be developed that focus on the achievement of strategic outcomes by aligning mobile data services. However, an in depth discussion and analysis of the business model concept is offered in a dedicated chapter (i.e. chapter 3) as this concept represent the main background theory for this research.

In the next section, the author discusses the notion of innovation and showing that business model innovations is one of its main dimensions. Understating the innovation concept is also highly relevant as *innovative* mobile data services represent the main focal point of this research.

1.3.4 The Role of Innovation

Innovation consists of the generation of new ideas and their successful creation, development, and introduction through new services, processes, or products (Udwadia, 1990). Innovations usually lead to significant value creation on the level of an organization, society, or globally (Urabe, 1988). Innovation implies bringing something new into use (Badawy, 1988) by fulfilling a particular need better, faster, and/or cheaper than existing ones (Yovanof and Hazapis, 2008). One of the ways to enhance the ability of organizations to innovate is by practising knowledge classification and codification (Sørensen and Lundh-Snis, 2001).

The terms invention and innovation although highly related as the former may lead to the latter, are different. Whilst *invention* is the new idea with which to improve a certain system whether the system is a service, process, or product, *innovation* only occurs after the successful implementation and introduction of these new services, processes, or products in the marketplace (Freeman, 1982; Twiss, 1992). The term invention however requires *creativity* and open mindsets. This discussion indicates that the innovation process encompasses all of these three related concepts, as graphically demonstrated in Figure 1-8.

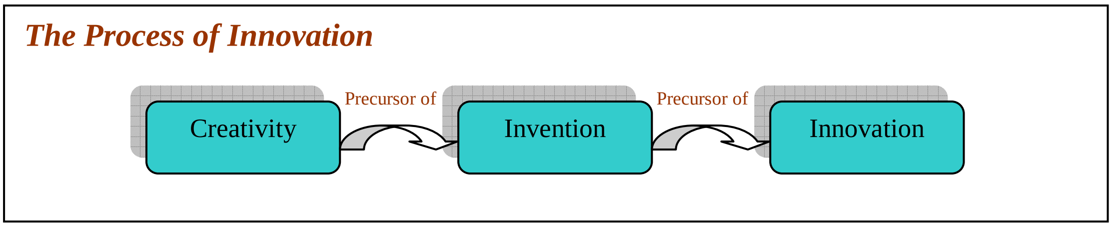

Figure 1-8. The Innovation Process

Innovation in terms of its impact can be categorized as *sustaining* or *disruptive*. Sustaining innovations aim to maintain or strengthen the current core competencies of a particular business organization in its current market. This kind of innovation usually creates value by accumulative or incremental effect (Abernathy and Clark, 1985) and normally developed by business organizations holding a leadership or strong position in their industries (Yovanof and Hazapis, 2008). Disruptive innovations on the other hand change the rules and bases of competition of an existing business market and pose threats to replace or redefine that marketplace. Frequently, such innovations are developed by mature business organizations bringing their own knowledge and entering new markets due to their market expansion strategies. Hence, such organizations along with their innovations tend to be disruptive to incumbents. Examples from the mobile telecommunications industry include Apple with its iPhone and Google with its Nexus one. Disruptive innovations normally begin in a niche market and eventually grow to dominate the business market (Christensen, 1997).

Disruption is a process (i.e. not an event) that may take decades to find their way through an industry (Christensen and Raynor, 2003). The failure to recognize the differences between sustaining and disruptive innovations normally lead successful well-established business organizations to lose their markets (Christensen, 1997).

The main dimensions of innovations can be distinguished in three categories as follows: *product/service innovation*, *technological innovation*, and *business model innovation*. Despite the existing links amongst them, they are considerably different as they arise in different ways, call for different requirements, have different effects on the marketplace, and require different sort of responses from industry incumbents (Markides, 2006). Descriptions of the innovations of each dimension along with real-life examples are provided in Table 1-2.

Table 1-2. Dimensions of Innovations (Compiled after Yovanof and Hazapis, 2008)

Dimension	Innovation Element	Example
Product/Service	Product/Service	▪ Windows 7 (the newest version of Microsoft OS). ▪ Adding multimedia content to an SMS service.
Process/Enabling Technologies	Process	Just-in-Time manufacturing, Business Process Outsourcing, etc.
	Enabling Technology	Internal combustion engine, Internet, Peer-to-Peer (P2P), VoIP, Mesh Networks, etc.
Business Model	Value Proposition	no-frills-airlines, online brokerage, single “local” phone number anywhere in the world (VoIP value proposition)
	Market Segment	Upscale fashion mobile phones (e.g., Prada model by LG)
	Value Chain	Google’s acquisition of YouTube (content provider); Cisco Systems acquisition of Linksys, Airespace, and Navini Networks.
	Value Network	eBay’s acquisition of PayPal.
	Cost Structure, Margins	Wal-Mart’s reliance on IT in Logistics to reduce cost of operations.
	Competitive Strategy	Market skimming to grab market share (the .com model).

The current research defines business model innovation as the discovery of new ways for solving a particular problem that usually incorporates a different approach of configurations related to key business model aspects and components. It is considered that *product/service* or *technological innovations* usually require an organization to adopt a new business model (Yovanof and Hazapis, 2008). Most likely, in such cases, the new business model becomes the main innovation of the organization. In line with Teece (2010), this research deems that service/product or technological innovations do not promise success to the business unless they are equipped and supported by innovative and powerful business models, as illustrated in Figure 1-9. In other words, weak designs of business models make it very hard to translate product/service or technological innovations into economic values so as to achieve strategic goals and objectives of an organization.

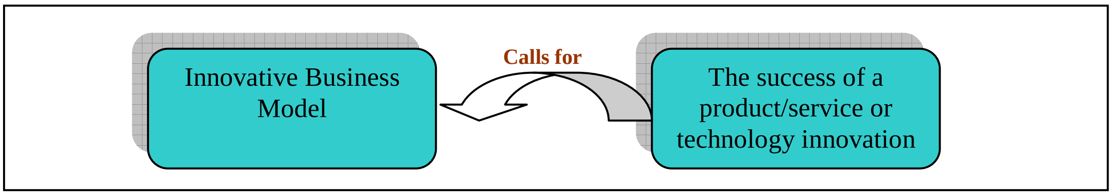

Figure 1-9. Business Model and Service/Product/Technology Innovations

However, for the purpose of achieving clarity and semantic preciseness in the design of innovative mobile data services based on business model thinking, this research deems that it is also useful to utilize the ontology concept. Therefore, the ontology concept is discussed in the next section.

1.3.5 The Role of Ontology and Ontology Engineering

Ontology is a term that originated in philosophy and refers to the systematic explanation and study of the nature of existence, or being (Chandrasekaran et al., 1999). The term has been subsequently borrowed by the information systems and computing disciplines (e.g. Wand and Weber, 1990; Guarino and Welty, 2002) and changed somewhat. For example, Gruber (1995) argues that the philosophical ontology limits the ontological representation to class definitions and taxonomies; thus more constructs such as axioms are required to constrain the interpretation of defined concepts.

An ontology is an "engineering artefact" (Guarino, 1998) representing a particular phenomenon or domain of knowledge. Ontologies are generally composed of concepts, relations between these concepts and axioms to restrict the interpretation of concepts (Jasper and Uschold, 1999), and are *ideally* precise, reusable and signify shared representations of real world phenomena. Consequently, it is important that ontologies are of a good quality, in order that they serve their intended purposes and be shared as well as reused by different applications (Guarino, 2004). The quality of ontological models can be evaluated based on the models' semantic preciseness and richness; that is, the extent to which the ontology is describing a particular phenomenon abstractly, but accurately and meaningfully.

In computational terms, an ontology is most commonly defined as a formal explicit specification of a shared conceptualisation (Gruber, 1993). The inclusion of the terms 'explicit' and 'conceptualization' in this definition is highly significant. The term 'explicit' highlights *knowledge externalization* as one of the main characteristics and reasons for ontology developments; whilst 'conceptualization' is a key attribute of an ontology. Fundamentally, conceptualization is what makes ontologies sharable as it refers to the meanings captured through concepts; not the terms themselves. Furthermore, conceptualization implies abstraction which signifies that an ontology represents only knowledge regarded as core in the specific domain.

Ontology research has attracted increasing attention in information systems design and development (Wand and Weber, 2002; Fonseca, 2007). In this context, ontologies are recognised as useful means for achieving semantic interoperability between different systems. This is because ontologies can capture semantics of information systems to facilitate shared understanding between different parties (Ouksel and Sheth, 1999). Moreover, the importance of ontologies comes from the fact that they are considered important backbones for many organisational applications in areas including, but not limited to, knowledge engineering, information integration and software development. Hence, information systems that make use of explicit and formally defined ontologies have been described as ontology-driven systems (Guarino, 1998). Such ontologies are referred to as IS ontologies (e.g. Smith, 2003), or computational ontologies (e.g. Kishore and Sharman, 2004).

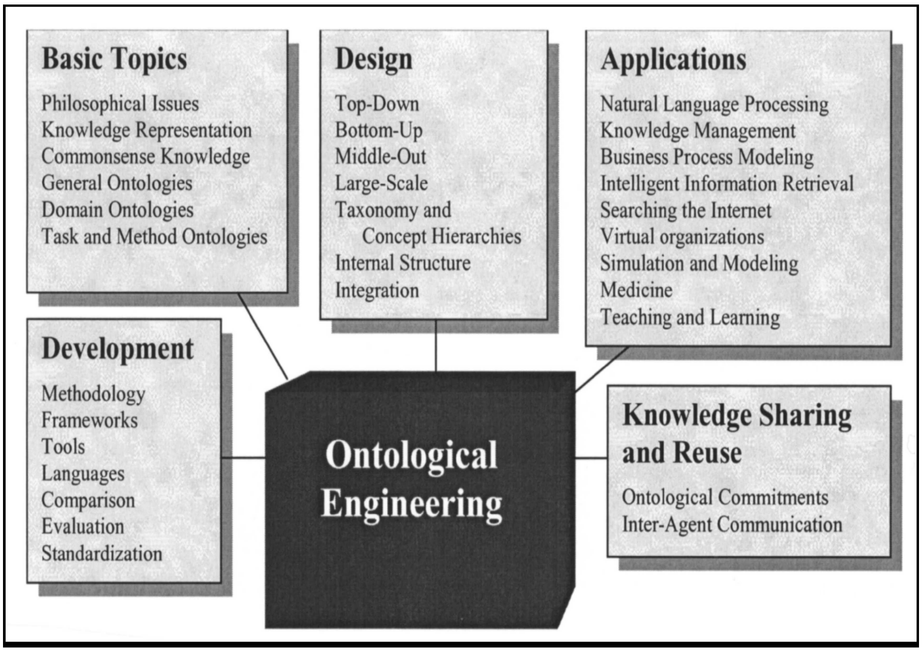

Figure 1-10. Themes of Ontological Engineering (Adapted from Devedzic, 2002)

Ontological engineering on the other hand is a subfield that covers issues related to ontology development and use throughout its life cycle (Gomez-Perez et al., 2004). Basically, it covers the set of activities conducted during conceptualization, design, implementation and deployment phases of ontologies (Devedzic, 2002). In the related literature, ontology engineering is discussed in different contexts and from different perspectives reflecting the diverse themes included under its umbrella (see Figure 1-10).

Developing an ontology for innovative mobile service engineering primarily on the basis of business model thinking would be of value to academics and practitioners alike, particularly those interested in telecoms strategic-oriented IS/IT and business developments. In this research, it is hoped that developing an ontology will enable the precise identification and categorisation of the key concepts and relationships in the telecoms services BM and produce unambiguous semantics of them.

1.4 Research Aim and Objectives

The research motivations section has highlighted that telecoms are in need for an effective framework that is comprehensive, manageable, and creative to guide and systemize the design and engineering course of action of innovative mobile data services. In retrospect, the main aim of this research is:

> *To develop a novel and valuable knowledge framework (Ontology) based on business model thinking for designing and engineering innovative mobile data services that will help telecoms to achieve their strategic goals and objectives.*

In fulfilling this aim, a number of objectives are considered important to be achieved as follows:

Objective 1: Explain the research paradigm, methods, and techniques that fit the current research questions and led to the final artefact of this research.

Objective 2: Develop a conceptual framework of the business model concept that identifies and links the main components of the concept along with its modelling principles, practical functions within organizations, and its relationships with other relevant concepts such as strategy, business processes, and information systems.

Objective 3: Develop an ontology seeking to identify the main design constructs along with their semantics and relationships that are needed to be examined when engineering mobile data services.

Objective 4: Evaluate and validate the ontology through real-life cases in regards to mobile data services.

Objective 5: Explore and identify the key value drivers when designing and engineering mobile data services.

Objective 6: Evaluate the research conclusions in terms of their significance to theory and practice and identify future research directions that are important to continue refining this important area of research.

1.5 Research Design in Brief

To achieve the research aim along with its objectives, this research follows the Design-Science Research (DSR) paradigm. This paradigm is deemed appropriate when a research aims to produce artefacts (i.e. utilities) that address the so-called *wicked problems* (Hevner et al., 2004). The scheme to construct design artefacts is still very broad and two main and general processes are identified as *build* and *evaluate*.

Design artefacts are classified by March and Smith (1995), and anchored by Hevner et al. (2004), into *constructs*, *models*, *methods*, and *instantiations*. The developed ontological framework in this paper represents a *method* artefact that is based on developing an ontological *model* which includes *constructs*. Moreover, the implementation of the developed ontology in Protégé-OWL represents an *instantiation*.

This ontology is produced using an approach developed by the author, termed “OntoEng”; that is a design method for ontology engineering in the field of information systems. OntoEng methodically decomposes the DSR two broad processes (i.e. build and evaluate) in a manner that suits the requirements of an ontology. As the *design* course of action signifies a *process* that calls for a number of iterations before the final artefact can emerge (Baskerville, 2008), the current research utilizes three iterations prior to the construction of the final ontology, as illustrated in Figure 1-11. In each iteration a prototype is produced and evaluated.

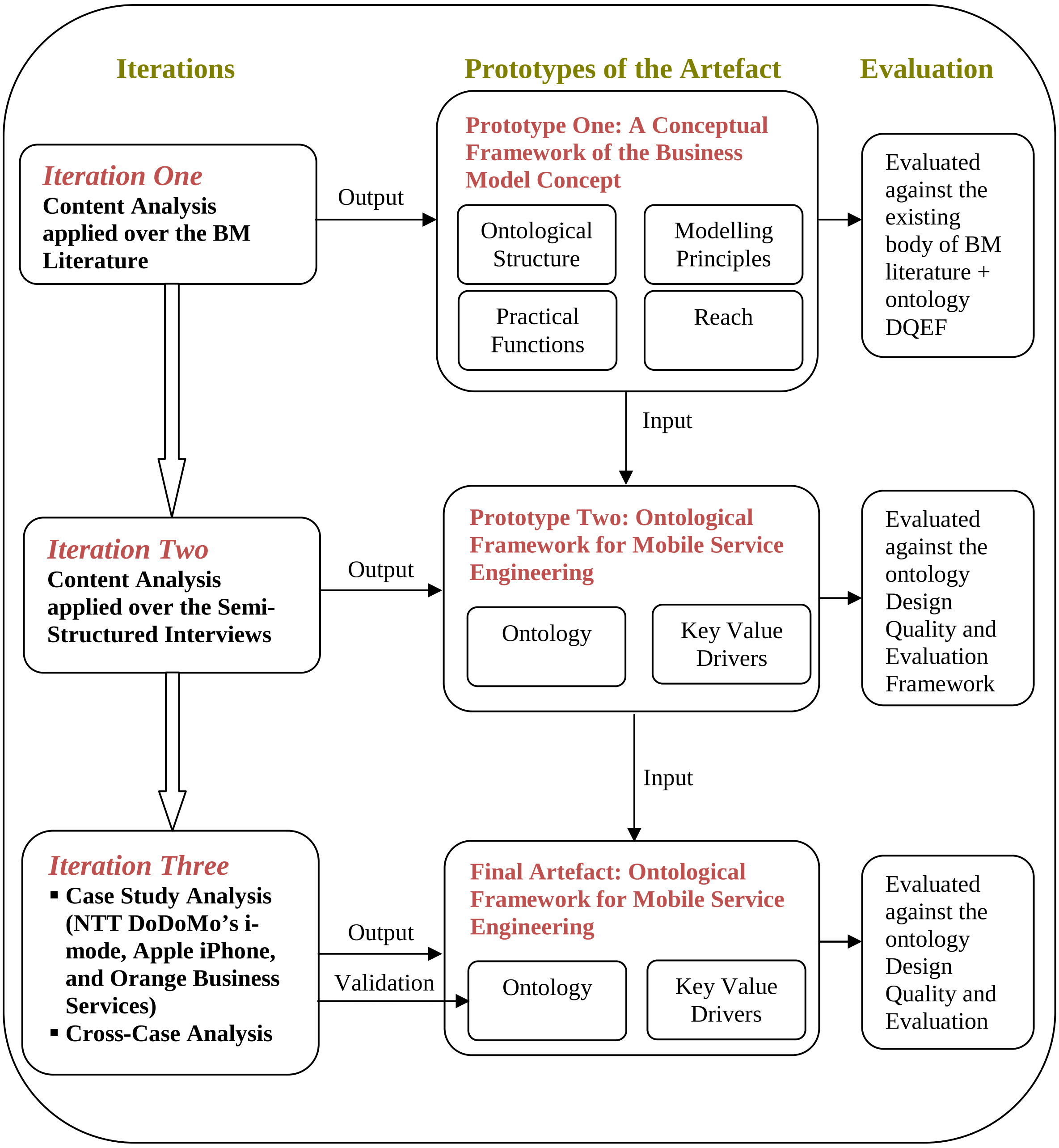

Figure 1-11. Research Design

Essentially, within the design-science paradigm along with the three iterations, the applied approach in this research is best portrayed as a *pluralist* (i.e. multimethod) methodology, as different research methods are incorporated. Iteration one utilizes the business model literature so as to develop a unified BM conceptual framework where the ontological structure of the concept is one of its major aspects (presented in Chapter 3). The output of the first iteration is evaluated against the existing body of business model literature as well as synthesized criteria related to ontology evaluations. Whilst iteration two makes use of semi-structured interviews with key practitioners in the mobile telecommunications industry, iteration three utilizes three real-life case studies (Apple iPhone, NTT DoCoMo's i-mode, and Orange Business Services) of mobile data services. Throughout the last two iterations, each prototype of the ontology is evaluated against a Design Quality and Evaluation Framework (DQEF) which is synthesized from ontology-related literature. Iteration three in particular not only improves the developed ontology, but also provides a practical validation and demonstrates the ontology's efficacy and value.

The employment of a multimethod approach is considered beneficial in this research because, as Mingers (2001) argues, results are richer and more reliable if different research methods are combined together. The author agrees with Mingers since different related research methods have their own advantages and drawbacks but when appropriately combined together, they can provide enhanced value. However, a detailed discussion of the current research design is offered in Chapter 2.

1.6 Structure of the Thesis

This thesis is structured around seven chapters as follows.

Chapter One provides an introduction and background of this research. It explores the underlying motivations for researching mobile service engineering. This chapter also discusses the research context by providing a concise theoretical background of the research related domains. Further, the chapter explains the research aims and objectives and its approach in fulfilling the defined objectives.

Chapter Two discusses those aspects related to research paradigm, methodology, epistemology, and design. This discussion involves justifying their appropriateness, and showing their use throughout the research.

Chapter Three provides in-depth analysis of the business model state of the art literature conceptualizing the business model within the context of digital business in general and mobile telecommunications in particular. This chapter provides a conceptual framework that connects and clarifies the underpinnings of the business model concept. This framework identifies and links the business model primary components, modelling principles, practical function, and reach.

Chapter Four develops a novel ontology for engineering mobile telecommunications services on the basis of business model thinking. It identifies the key concepts along with their relationships, and rules in the mobile telecoms business model domain and produce semantics of them.

Chapter Five provides an evaluation and empirical validation of the developed ontology. The chapter examines cases related to Apple iPhone, NTT DoCoMo's i-mode services, and Orange business services providing practical validation of the constructed ontology. It also evaluates the developed ontology against a constructed Design Quality and Evaluation Framework (DQEF).

Chapter Six explores key value drivers that are highly critical in mobile service engineering as they significantly affect the service success or failure.

Chapter Seven summarizes the research findings and conclusions. It classifies the research contributions in three categories: contributions to theory, contributions to practice, and contributions to methodology. Thereafter, this chapter presents the research implications for theory and practice. Next, directions for further research are explored.

For ease of reference, the structure of this thesis is mapped to its aims and objectives and is summarized in Figure 1-12.

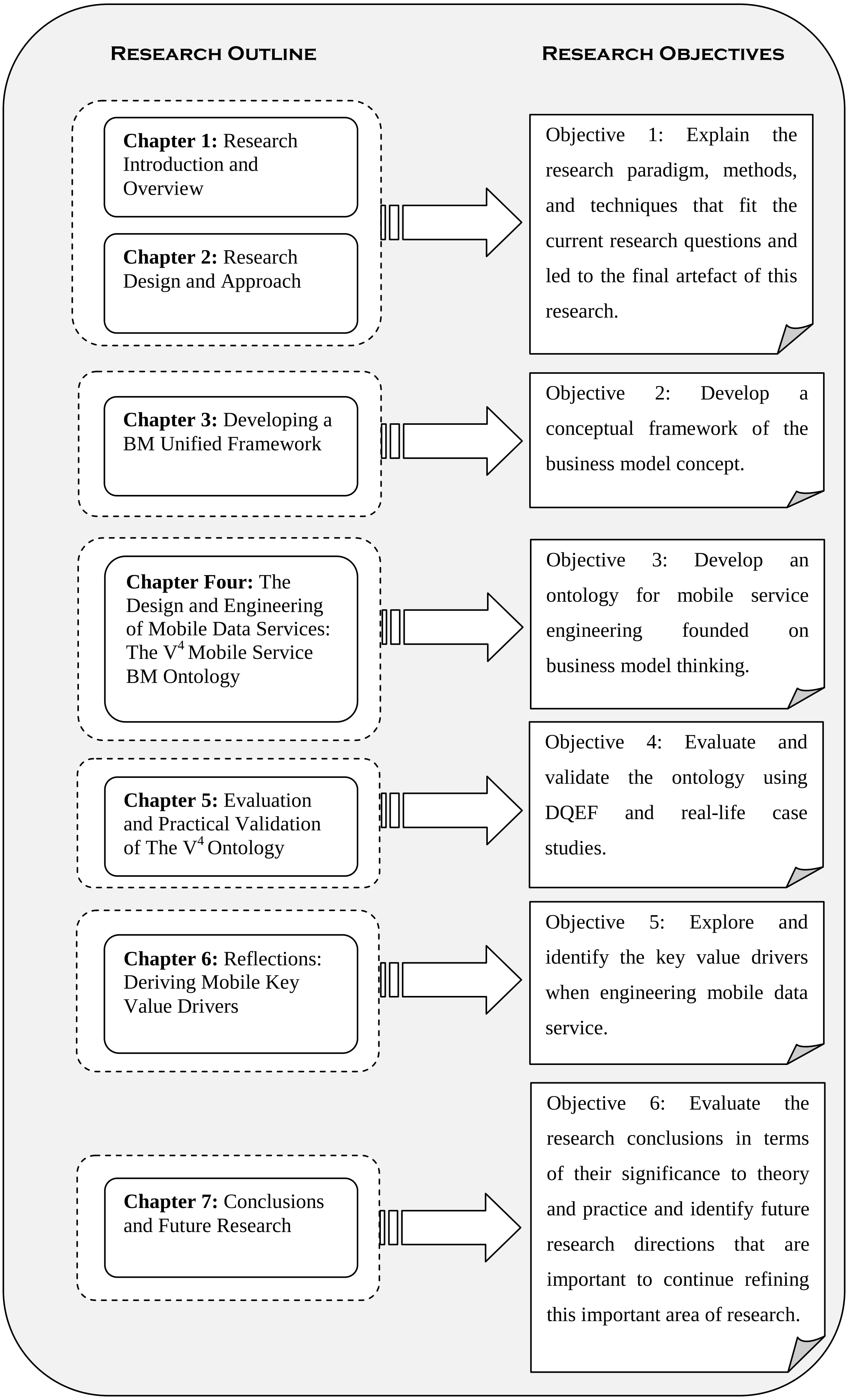

Figure 1-12. Research Outline and Objectives

The Design and Engineering of Innovative Mobile Data Services: An Ontological Framework founded on Business Model Thinking

Chapter Two: Research Design and Approach

2.1 Overview

This chapter explains the research approach used in investigating how best to design and engineer innovative mobile data services that meet various strategic goals and objectives of mobile telecommunications providers. This chapter starts by highlighting the variety of research approaches that can be employed in information systems showing the importance of the decision of which research approach to be adopted so as to answer the research question. Thereafter, the chapter discusses the different philosophical perspectives (i.e. paradigms) in information system research and the rationale for selecting Design-Science Research (DSR) is provided. Next, the DSR paradigm is discussed showing its nature, principles, philosophies, and types of outputs. Furthermore, the employed research approach including its iterations and methods is explored. Before presenting the summary of this chapter, a mapping between the current research details and their counterparts in design science is presented.

2.2 Finding a Fitting Approach in IS

Information systems is a multidisciplinary field; and thus the nature of its research is complex. The contributions to IS study and research come from multiple research domains such as engineering, mathematics, natural sciences, and behavioural sciences (Land, 1992). In retrospect, there is no one single superior approach applicable in all cases, but a variety of research paradigms, approaches, methods, and techniques can be employed in different situations.

Having such diversity of backgrounds and variety of approaches in the IS discipline seems to be worrying to some researchers and appealing to others. Benbasat and Weber (1996) argue that the discipline of information systems requires uniformity and otherwise the discipline will shatter or be taken over, whereas Robey (1996) argues that such diversity is a positive source of strength and enriches research in IS as variety creates flexibility and inspires creativity. It seems that the latter standpoint is more accepted and practiced by researchers in information systems given that current IS research approaches are still substantially varied (see for example Palvia et al., 2006 for a categorization of IS methods).

Having argued that the availability of varied research paradigms, approaches, and methods is favoured by the IS research community, it is important to raise the issue of whether they are:

1- *Substitutable*: any research paradigm, approach, and/or method can be used to investigate any phenomenon and irrespective of the research question.

2- *Unique*: the appropriateness of research paradigms, approaches, and methods is determined by (a) the nature of the research question; (b) the nature of the phenomenon under investigation; or (c) both.

3- *Complementary*: different research paradigms, approaches, and methods can be used within the research to augment the research value.

The first option seems to be very artificial and not realistic, whilst the other two options are possible and represent a dilemma for researchers in the field. Opinions in the IS research community diverge and there is no clear-cut answer whether research paradigms, approaches, and methods are completely unique or could be combined together in some situations. Robey (1996) argues that the existing methodical approaches and strategies differ in their suitability across different research questions, the underlying nature of phenomenon under investigation, and the underlying philosophical stance of researchers. Mingers (2001) believes that there is still room for combining IS research methods to enhance the research value and benefits. However, Orlikowski and Baroudi (1991) argue that by using a plurality of research perspectives, the research benefits can be augmented *only if* these perspectives are employed *effectively* and *appropriately*. Hence, the selection of fitting research approach is a key task during the process of research design whether the researcher follows one perspective or more.

Nevertheless, understanding the whole range of research paradigms, strategies, and approaches is significant as such awareness normally facilitates informed selection and helps reduce any bias that the researcher may have towards one particular approach. This is because this sort of understanding keeps the researcher open to the possibility of other assumptions that may fit their interests and predispositions (Orlikowski and Baroudi, 1991).

Therefore, in the next section, the research paradigms in IS are explored to guide the selection of which paradigm is appropriate to guide the development of an ontological approach for innovative mobile service engineering. The next section also explains the rationale for the selected paradigm.

2.3 Research Paradigms in IS

The set of beliefs or the underlying philosophical perspectives and assumptions which guide the actions and the activities that researchers conduct throughout the research process can be defined as a paradigm (Denzin, 1998; Mingers, 2001). Guba and Lincoln (1994) propose three questions that are deemed important in defining a paradigm as they reflect the underlying beliefs of researchers: What is the nature of reality that is addressed, or what is assumed to exist (*ontology*); what is the nature of valid or true knowledge (*epistemology*); and what is the best approach, or set of guidelines, that helps in generating the desired knowledge and understanding in a valid and reliable manner (*methodology*). Some other researchers (e.g. Mingers, 2001) considered *axiology* or ethics; that is what is of value or considered right, as an important aspect as well.

Traditionally in IS research, three major paradigms can be distinguished as *positivist*, *interpretive*, and *critical* (Chua, 1986; Orlikowski and Baroudi, 1991; Klein and Myers 1999). These paradigms can be summarized as follows:

1- The research can be classified as *positivist* if there is an evidence of hypotheses generation, operational or quantifiable measures of research variables such as the dependent and independent variables, testing of the formulated propositions, and finally the drawing of inferences and conclusions about the examined phenomenon from a sample representing the research population (Orlikowski and Baroudi, 1991). Hence, positivists commonly assume that reality is objectively given and thus can be measured independently of the researcher and the employed instrument (Avison and Pries-Heje, 2005).

2- The IS research is *interpretive* if it assumes the knowledge of reality is shaped by its social context; i.e. can be obtained only through social constructions including, but not limited to, language, shared meanings, consciousness, tools, and documents. As argued by Walsham (1993), the aim of interpretive research is at the "understanding of the context of the information system and the process whereby the information system influences and is influenced by the context" (p. 4-5).

3- The research is categorized as *critical* if the main aim of the research is one of a social critique seeking to assist in eliminating the causes of unwarranted alienation and domination; and hence improves the opportunities for realizing human potentials (Hirschheim and Klein, 1994). This kind of research assumes that "social reality is historically constituted and that is produced and reproduced by people" (Avison and Pries-Heje, 2005: p. 244).

However, lately during the last decade, a fourth paradigm; that is design science, starts to emerge and be established in information systems research aiming to improve the relevance of the IS discipline. The summary of this paradigm is as follows:

4- The research in information systems is considered a *Design-Science Research* (DSR) if the main aim is to change a current situation related to organizational or social systems into a more desirable one through the development of novel artefacts (Hevner et al., 2004). Design science research stresses the importance of iterations in producing the design artefacts and assumes that reality and knowledge emerge throughout the iterations effort (Purao, 2002; Vaishnavi and Kuechler, 2004/5). Design science has its own paradigm; given that "artefacts are both artificial and imbued with adaptive intent, [and thus] their study is philosophically different from natural science" (Baskerville, 2008: p. 442).

A summary of research paradigms in information systems is provided in the following table (i.e. Table 2-1).

Table 2-1. Research Paradigms in IS (Compiled after Vaishnavi and Kuechler, 2004/5)

Basic Beliefs	**Research Paradigms**			
	Positivist	Interpretive	Critical	Design
Ontology	A single reality, knowledge, probabilistic	Multiple realities, socially constructed	Reality is historically constituted.	Multiple, contextually situated alternative world states, socio-technologically enabled
Epistemology	Objective, dispassionate, detached observer of truth	Subjective, i.e. values and knowledge emerge from the researcher-participant interaction	Reality is shaped by its social context, knowledge is grounded in social and historical practices, facts and values are entwined.	Knowing through making: objectively constrained construction within a context, iterative circumscription reveals meaning
Methodology	Observation, quantitative, statistical	Participation, qualitative, hermeneutical, dialectical	Assumptions, beliefs, and values shape and shaped by the investigation.	Developmental, measure artifactual impacts on the composite system
Axiology	Truth: universal and beautiful, prediction	Understanding: situated and description	Descriptive and situated knowledge and understanding of phenomena	Control, creation, progress (i.e. improvement), understanding

In light of the established distinction amongst the research paradigms in information systems and the nature of the research question tackled in this research, the design-science research paradigm is deemed fitting. This research aims to answer *how best to design and engineer innovative mobile data services that would enable telecoms to achieve their strategic goals and objectives*. This issue is highly pertinent to the mobile telecommunications providers as their current practices concerning mobile service engineering do not seem to be effective given the low revenue generated from such services as discussed in chapter one. Aiming to change this state into a more advantageous one, this research develops an artefact in the form of ontological framework. However, the way in which the design science research paradigm is employed in this research along with the methods and approach used are fully discussed in the coming sections.

2.4 The Design-Science Research Paradigm

The research paradigm followed in this research, concerned with analytically designing and developing a service BM Ontology for engineering innovative mobile data services, is that of design-science (Hevner et al., 2004). This research aims, by utilizing design-science research, at producing a technology-oriented utility (i.e. ontology). This ontology identifies and categorizes the key concepts, relationships, and rules in the mobile telecommunication BM domain and produces clear semantics of them. This is highly pertinent in order to leverage the ability of telecoms in engineering (i.e. analyzing, designing, developing, evaluating, managing, and changing) their existing and future mobile data services in an innovative manner.

Design-science research, although not new, has lately received increasing attention in information systems and computing disciplines. It has been argued that design-science research paradigm is yet another *lens* or set of analytical perspectives that could usefully complement the behavioural science pattern -the mainstream IS research- within the cycle of information systems research (Hevner et al., 2004; Vaishnavi and Kuechler, 2004/5; Iivari, 2007; March and Storey, 2008; see Figure 2-1). The increasing interest in design-science research has been coupled with that of *design theory* which has lately been emphasized by, for example, Walls et al. (1992) and Gregor and Jones (2007).

Within information systems, research in design science has been affected by Simon's idea of the science of the artificial (see Simon, 1996), and other disciplines such as engineering, architecture, and computer science (Walls et al., 1992, Baskerville, 2008). The term *design* implies creating something new that does not exist in nature (Vaishnavi and Kuechler, 2004/5). Nevertheless, design-science research extends the notion of *design* to include aspects related to systematic creation of knowledge about and within design (Baskerville, 2008). In the discipline of IS, DSR seeks to significantly improve aspects related to analysis, design, implementation, management, and use of information systems by the creation of useful artefacts (Hevner et al., 2004).

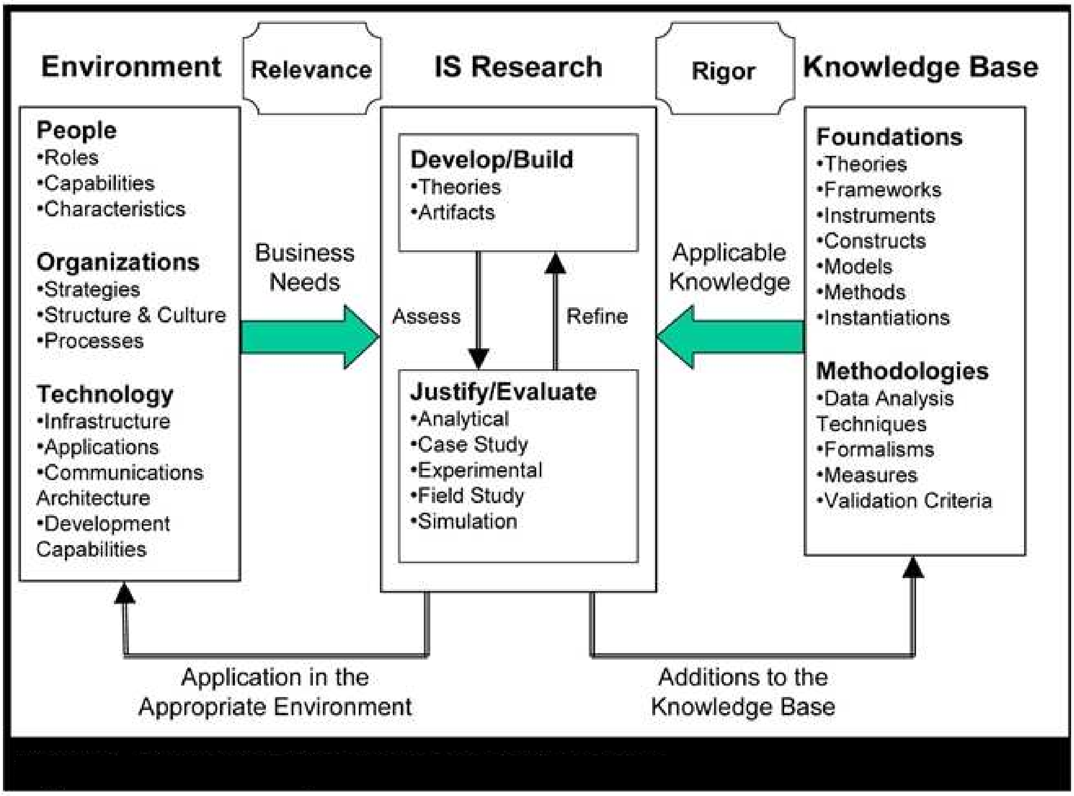

Figure 2-1. Information Systems Research Framework (Source: Hevner et al., 2004)

Unlike the behavioural science paradigm which ultimately aims to *explain*, *understand*, or *predict* phenomena at the intersection of organizations, people, and information technologies as aspects of the natural world (Walls et al. 1992; March and Storey, 2008), design science is primarily a *problem solving* paradigm (Hevner et al., 2004) that seeks to *create* artefacts addressing the so-called *wicked problems* (March and Smith, 1995; Pries-Heje and Baskerville, 2008). In principle, the design-science research attempts to successfully design, develop, and evaluate technology-oriented design artefacts characterized as novel, innovative, and purposeful. Portrayed as *purposeful* implies that these artefacts would potentially provide organizations and humans with recognizable utility since they should address unsolved problems (Hevner et al., 2004), or provide better solutions and thus enhance existing practices (Kuechler and Vaishnavi, 2008). These artefacts provide additional improvements to real-world phenomena (Purao, 2002; Iivari, 2007; March and Storey, 2008). Therefore, while humans could change their life styles through the introduction of these novel artefacts, organizations might change the ways in which they do business so as to exploit the opportunities that emerged due to these artefacts. In the context of this research, whilst the ontological framework (i.e. the V^4 Mobile Service BM Ontology which will be illustrated in chapter 4 and its Key Value Drivers that will be explained in chapter 6) is the main artefact, the design and engineering of innovative mobile data services that would meet strategic goals and objectives of mobile telecommunications providers is the tackled wicked problem.

In the context of design-science research, the term “wicked problems” can be described as unstructured or ill-defined (Schon, 1990) decision-making activities and settings. This is because these types of decisions are normally “poorly formulated, confusing, and permeated with conflicting values of many decision makers or other stakeholders” (Pries-Heje and Baskerville, 2008: p. 731). Indeed, design problems are usually hard to be defined as they do not have precise starting or finishing points, and hence such problems are often solved by a combination of strategies emerge throughout the design process (Schon 1990).

In a more general sense, the term “problem” can be defined as the existence of a gap between the current situation (or state-of-the-world) and the desired situation by human and/or organizational systems. The magnitude of the problem can be determined by the size of the gap or the difference between the current and desired states. The gap however represents the problem space which is either fulfilled or at least shrunk by the introduction of the design artefact. This definition of the term “problem” in the context of information systems DSR is consistent with Simon’s (1996) observation, that “everyone designs who devises courses of action aimed at changing existing situations into preferred ones” (p. 130).

2.4.1 Design-Science Research Artefacts

There is a lack of consensus about what constitutes an artefact in design-science research. Some argue that the IT artefact (Orlikowski and Iacono, 2001, Benbasat and Zmud, 2003) are the only allowed outputs of IS design-science research. Given the fact that the information systems discipline tackles issues related to organizations, social or human aspects, technologies, and their interrelationships, it is also questioned whether pure organizational artefacts are acceptable outcomes of IS design-science research, or not (Winter, 2008).

However, design artefacts are classified by March and Smith (1995), and anchored by Hevner et al. (2004), into conceptualized (1) *constructs* (i.e. concepts) of vocabulary and symbols representing a particular domain as they describe problems and specify solutions; (2) *models* representing reality with appropriate levels of abstraction showing propositions expressing relationships amongst the established design constructs in the domain under examination; (3) *methods* in the form of algorithms (i.e. set of steps) or guidelines used to perform a specific task; and (4) *instantiations* which are implemented systems and/or their prototypes developed as proof-of-concepts.

Moreover, it has also been argued that design-science research could generate better theories through the construction of the design artefacts (Purao, 2002; Venable, 2006; Kuechler and Vaishnavi, 2008). For example, in the context of information systems, Walls et al. (1992) elaborate on the potential of theory building throughout the design course of action showing that *theory* is one of the possible outputs in this domain. Venable (2006) shows the relationships between design-science research activities and theory building courses of action.

Gregor (2006) classifies theories in IS into five categories: analysis, explanation, prediction, explanation and prediction, and design theory (see Table 2-2). Gregor indicates that design theory gives explicit prescriptions on how to do something, but she limits this kind of theory to the construction and development of IS design artefacts and not to the solution (i.e. goal) artefact itself (see also Gregor and Jones, 2007).

Table 2-2. Types of Theories in IS Research (Source: Gregor, 2006)

Theory Type	Distinguishing Attributes
I. Analysis	Says what is. The theory does not extend beyond analysis and description. No causal relationships among phenomena are specified and no predictions are made.
II. Explanation	Says what is, how, why, when, and where. The theory provides explanations but does not aim to predict with any precision. There are no testable propositions.
III. Prediction	Says what is and what will be. The theory provides predictions and has testable propositions but does not have well-developed justificatory causal explanations.
IV. Explanation and prediction (EP)	Says what is, how, why, when, where, and what will be. Provides predictions and has both testable propositions and causal explanations.
V. Design and action	Says how to do something. The theory gives explicit prescriptions (e.g., methods, techniques, principles of form and function) for constructing an artifact.

Adding to this view, Purao (2002) followed by Kuechler and Vaishnavi (2008) distinguish between two types of theories that can result from design-science research: (a) knowledge *as operational principles* that explain aspects of the artefact behaviour and construction (operation theory corresponding to Gregor's design theory), and (b) *emergent theory about embedded phenomena* (theory about the solution or goal artefact). Both of these theories are argued to be legitimate outputs of design-science research. Based on this discussion, the outputs of a design-science research may perhaps be one or more of the artefacts summarized in Table 2-3.

Table 2-3. Design-Science Research Artefacts

(Synthesized from March and Smith, 1995; Hevner et al., 2004; Vaishnavi and Kuechler, 2008)

No.	Design Artefact		Brief Description
1	Constructs		The conceptual vocabulary and symbols describing a problem within a domain
2	Models		A set of propositions or statements expressing relationships between the underlying design constructs; they represent situations as problem and solution statements.
3	Methods		A set of steps used to perform a task – how-to knowledge; method can be tied to particular models; they may not be explicitly articulated but represent tasks and results.
4	Instantiations		The operationalization of constructs, models and methods; it is the realization of the artefact in its environment to ensure its feasibility; e.g. (prototypes or the implemented artefacts).
5	Better theories	Operation Theory	Theories about the construction and development of IS design artefacts.
		Solution Theory	Theories about solution spaces and problem theories related to goal artefacts.

However, creating an artefact through design-science research normally relies on *kernel theories* (Hevner et al., 2004, p.76) that are "applied, tested, modified, and extended through the experience, creativity, intuition, and problem solving capabilities of the researcher" (Markus et al., 2002; Walls et al., 1992). As argued by Kuechler and Vaishnavi (2008), kernel theories are normally originated outside the IS field and based on Gregor (2006) classification of theories, they are kind of "explain" or "predict" theories. Such theories could be useful as they may suggest helpful approaches to IS design problems.

2.4.2 The Design-Science Research Processes and Ontology Engineering

The scheme to construct design artefacts in information systems design-science research is still very broad. Two main and general processes are identified by March and Smith (1995) as *build* and *evaluate*. Whilst building design artefacts demonstrate feasibility, they are evaluated against criteria of value to a community of intended users to ensure utility, quality, and efficacy (Hevner et al., 2004). Similarly, Venable (2006) argues that design-science research activities start with *problem diagnosis* which in turn informs technology invention or *design* that needs then to be *evaluated* to ensure that it fulfils its intended purpose. Kuechler and Vaishnavi (2008) provide additional insights relating to DSR processes. They looked at the reasoning incorporated in the design-science research cycle arguing that (a) awareness of the problem; (b) suggestion; (c) development; (d) evaluation; and (e) conclusion are the five main processes in the DSR. They also have linked these processes to knowledge flows and logical formalisms as in Figure 2-2. Despite the slight differences in the existing approaches that are suggested for design-science research, there is a noticeable agreement that design processes form a loop which is normally iterated a number of times before the final artefact is created (Markus et al., 2002).

However, in the context of IS design-science research, the existing design approaches need further methodical decomposition suitable for different types of artefacts. This is because the types of artefacts that can be produced by following DSR is varied in terms of nature, functionality, and purpose; and thus calling for different steps and activities to be encapsulated within DSR general and broad processes (i.e. build and evaluate). Hitherto, there is a need to define inclusive design methodology with an appropriate level of granularity that would allow smooth and consistent ontology engineering developments for the purpose of this research.

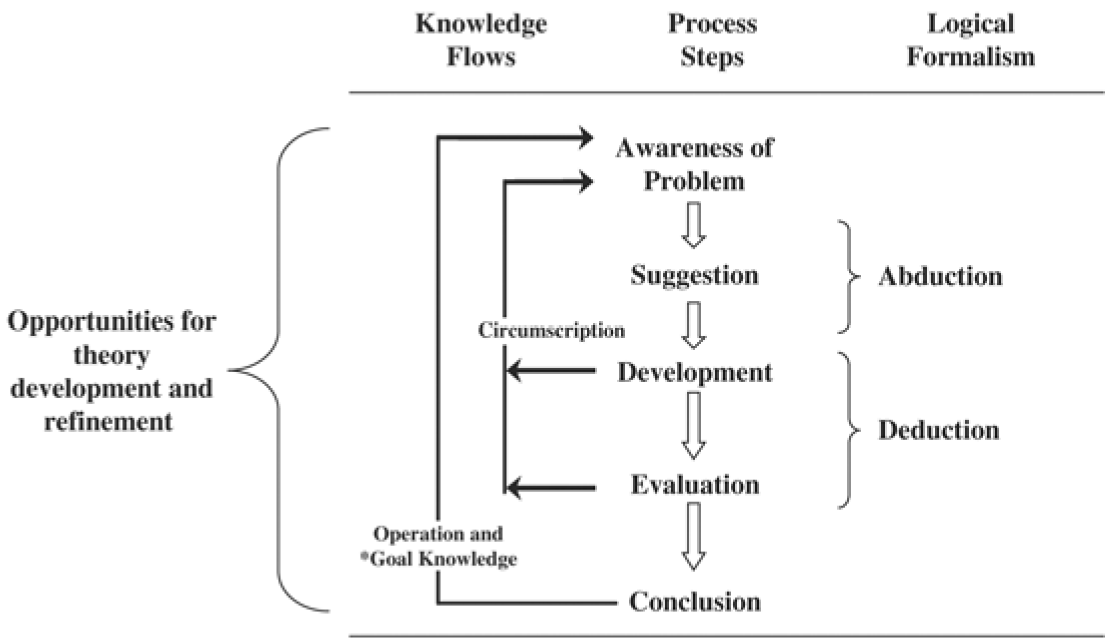

Figure 2-2. Reasoning in the Design-Science Research Cycle (Source: Kuechler and Vaishnavi, 2008)

Having recognized that, this research develops OntoEng as a design approach for ontology engineering in information systems. This is discussed in the next section.

2.4.3 OntoEng: A Design Approach for Ontology Engineering in Information systems

This research defines a systematic design method that the author terms ‘OntoEng’. OntoEng is proposed as a novel design method providing guidance for engineering ontologies. OntoEng not only introduces design and development phases, but importantly also explains different steps and activities within and across phases as well as defines their chronological order.

Within the design-science research paradigm, this research has specifically incorporated, and builds upon, the following existing research domains to develop the OntoEng design method:

(1) *Ontology engineering methodologies* (e.g. Uschold and King, 1995; Uschold and Gruninger, 1996; Fernandez-Lopez et al., 1997; Fernandez-Lopez and Gomez-Perez, 2002; Pinto and Martins, 2004).

(2) *Ontology design and evaluation methods* (e.g. Gruber, 1995; Gomez-Perez, 2001, Wand and Weber, 2002; Guarino and Welty, 2002; Parsons and Wand, 2008; Shanks et al. 2008).

(3) *IS design and development methodologies* (e.g. Nunamaker et al., 1991; Walls et al., 2004; Gregor, 2006; Avison and Fitzgerald, 2006; Gregor and Jones, 2007; Vaishnavi and Kuechler, 2008).

An analysis of these approaches led to the foundation of OntoEng. However, it has then been iteratively refined and extended mainly as a result of experience during use in developing the main ontology of this research (i.e. The V^4 Mobile Service BM Ontology).

Having OntoEng refined and extended based on the gathered experience while developing the ontology is consistent with Kuechler and Vaishnavi (2008). As highlighted in the former section, they argue that process steps in DSR not only generate knowledge or theory about the solution artefact of the specified problem; which is in this research the V^4 Mobile Service BM Ontology, but they also argue that DSR processes produce valuable operational knowledge on how to construct the desired artefact effectively and efficiently; that is OntoEng in the context of this research.

Developing OntoEng as a design approach for engineering the V^4 Mobile Service BM Ontology is deemed useful. This is because although the fundamental action of building or engineering ontologies has lately received considerable attention, but few methodologies have been proposed and the literature does not provide adequate guidance on how to engineer ontologies throughout their life span. There are probably four main reasons; firstly, ontology research is still an evolving field within Information Systems and Computing (ISC) disciplines. Secondly, the majority of the proposed methodologies that do exist are only examined from artificial intelligence and knowledge engineering perspectives. Thirdly, most of these methodologies are domain-dependent and therefore limited in their utility. Lastly, proposals mostly originate from software engineering where the design method in each is skeletal; that is structured into broad phases giving little guidance to ontology engineering practices.

Yet, if it is going to provide more disciplined design and be regarded as a true engineering practice (i.e. not a craft), ontology design needs to encapsulate precise standardized activities and comprehensive systematic methodologies in addition to well-defined design criteria, techniques, and tools (Fernandez-Lopez et al., 1997). Particularly in information systems, it is important to achieve that by delineating ontology engineering principally from the design-science research paradigm. Indeed, if a study of a specific ontology is to be considered design-science research, it is imperative that the study evolves a *qualified ontology* based on a *reliable design method*. Hence, the fact that *Design* implies the use of scientific principles in creating artefacts that perform predefined functions highly effectively and efficiently (Singh et al., 2006) highlights the importance of OntoEng in the domain of ontology engineering.

OntoEng is an iterative design method that encompasses five phases comprising twelve design activities. These are specified in Figure 2-3 (column 1). For each activity, the research identifies the potential research methods, techniques, and/or tools that are likely to be deployed (column 2). In addition, the research explicitly identifies the anticipated outcomes from each design activity; allowing more manageable and creative ontology engineering practices (column 3). The design activities of OntoEng are comprehensive, as are the outcomes, whereas the specified research methods, techniques and tools are just examples, as there will probably be others that could be utilized in different circumstances. Figure 2-3 provides an overview of the final version of OntoEng. In the next section that overview is expanded upon.

OntoEng synthesizes and extends the topical views relating to ontology engineering. To show that, the author creates Table 2-4 within which a mapping between the OntoEng and other major existing methodologies is presented. This mapping only shows theme matching concerning design activities and does not reflect differences in terms of sequences, recursion points, iterations, types and perspectives of the ontology design phases and activities.

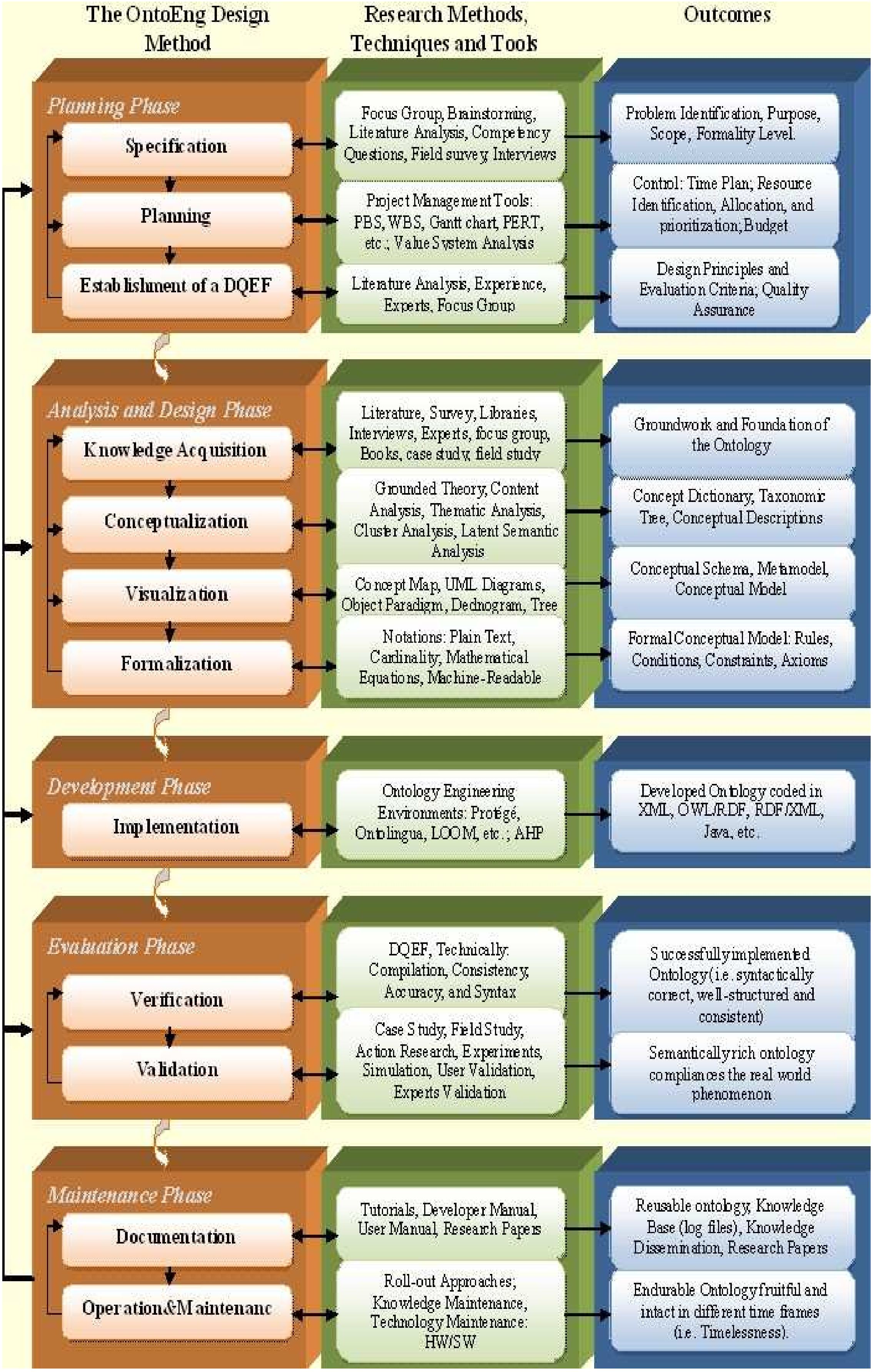

Figure 2-3. OntoEng as an Approach for Ontology Engineering

From a methodological standpoint, OntoEng could be best portrayed as a *multimethod* or *pluralist* design methodology, as many different research methods are incorporated. In developing the V^4 Mobile Service BM ontology in practice, the research uses OntoEng as a design approach, within which the research utilizes different well-established research approaches in the field of ISC. For example, the research principally employs the ethnographic content analysis technique (see Agar, 1980) in a manner similar to grounded theory (Glaser and Strauss, 1967) throughout the *conceptualization* design activity. For *validation and Evaluation* purposes, the research mainly uses real-life cases (see Yin, 2008) of mobile data services. Other methods and tools are used and these are discussed in detail in the next section where an empirical application of OntoEng in developing the V^4 Mobile Service BM ontology is discussed.

Table 2-4. Mapping OntoEng to Existing Methodologies

OntoEng Design Method	**Uschold and King (1995)**	**Gruninger and Fox (1995)**	**Methonology (e.g. Gomez-Perez, 1998)**	**Noy and McGuinness (2001)**	**Pinto and Martin (2004)**
1. Planning Phase					
1.1 Specification	Identify purpose	Motivating scenarios and competency questions	Specifications	Domain and scope determination	Specification
1.2 Planning			Control and quality assurance		
1.3 DQEF					
2. Analysis and Design Phase					
2.1 Knowledge Acquisition	Capture and integrate existing ontologies		Knowledge acquisition; integration	Consider reusing existing ontologies	Knowledge acquisition
2.2 Conceptualization		Informal terminology	Conceptualization	Enumerate important terms; define class hierarchy and properties	Conceptualization
2.3 Visualization					
2.4 Formalization		Formal language terminology, axioms and definitions	Formalization	Define the facets of the slots	Formalization
3. Development Phase (3.1 Implementation)	Ontology coding		Implementation		Implementation
4. Evaluation Phase	Evaluation		Evaluation		Evaluation
4.1 Verification					
4.2 Validation		Completeness theorems			
5. Maintenance Phase			Maintenance		Maintenance
5.1 Documentation	Documentation		Documentation; configuration management		Documentation
5.2 Operation and Maintenance					

A multimethod approach is beneficial because, as Mingers (2001) argues, results are richer and more reliable if different research methods are combined together. The author agrees with Mingers since different related research methods have their own advantages and drawbacks but when appropriately combined together, they can provide enhanced value. Mingers (2001) organizes the designs of pluralist research into five non-mutually exclusive clusters as: sequential, parallel, dominant (imperialist), multimethodology, and multilevel. In the application of the V^4 Mobile Service BM ontology, OntoEng is used as a *multimethodology* design method as a combination of methods is developed specifically for building the ontology. Nonetheless, OntoEng can take the form of any pluralist research designs as appropriate, in future uses and applications.

2.5 The Application of OntoEng in This Research

This section provides an analysis of how the V^4 Mobile Service BM Ontology has been developed by utilizing the OntoEng design approach. Within each design step, the section shows how this research matches the principles of design-science research.

2.5.1 Planning Phase

This phase consists of three main design activities: *specification*, *planning*, and *the establishment of design principles and evaluation criteria*. In the following subsections, the research provides a detailed explanation relating to these design activities and their employment in the practical application concerning this research.

(A) *Specification and Planning*: One of the most influential and decisive stages in ontology engineering practices is planning. At this early stage, ontology developers *specify* what sort of ontology they are going to build, verify and indicate its significance, relevance and importance along with the intended users, and define its boundaries. As any changes to the themes established in this stage may have profound consequences, it is highly recommended to make these ideas as stable as possible.

Having requirements specified, ontology engineers can then conduct the *planning* design activity more easily, accurately, and pragmatically. By planning, the author means establishing time plan, resource (e.g. technological, organizational, tangible, intangible) identification, allocation, and arrangements, in addition to a budget. These actions should help in controlling ontology engineering projects.

At this stage during the current research ontology engineering practice, the study dealt with three main issues: *awareness of the problem* (Venable, 2006; Vaishnavi and Kuechler, 2008), *purpose* (Uschold and King, 1995; Gregor and Jones, 2007), and *scope* (Fernandez-Lopez et al., 1997; Gregor and Jones, 2007). Based on interviewing practitioners as well as conducting extensive review and analysis of the related literature, it has been established that the problem is that mobile telecommunications managers are facing ill-structured decisions regarding the design and engineering of their mobile and other ICT services, as discussed in chapter one. This problem is perceived as highly important as weak designs of mobile data services make it very hard to translate the technological potential into economic values so as to achieve strategic goals and objectives of mobile telecommunication providers.

Diagnosing the research problem at this very early stage is highly significant as it helps in recognizing whether the tackled problem is relevant or not and to what extent. The relevance aspect of the research is highly important given that *problem relevance* is one of seven guidelines suggested by Hevner et al. (2004) when undertaking design-science research.

Consequently, with an ultimate aim of leveraging the engineering course of action (i.e. analysis, design, development, evaluation, management, and change) of innovative mobile data services and make it more manageable, disciplined, and creative, this research develops an ontology that identified the service design constructs, properties, rules, and semantics in the context of mobile telecommunications. As for the scope of this ontology, it is deemed more appropriate for the purpose of this research to limit the ontology focus and scope to mobile and telecommunications services that are provided by mobile telecommunications providers. It is also deemed appropriate to define the formality level of the ontology as semi-formal to ensure satisfactory communication and understanding by both technical and managerial audiences.

Formality in this context exemplifies the structure form of an ontology, and could be depicted using one of these possible values (Uschold and Gruninger, 1996): *highly* *informal* (expressed loosely in natural language), *semi-informal* (expressed in a restricted and structured form of natural language; greatly increasing clarity by reducing ambiguity), *semi-formal* (expressed in an artificial formally defined language), and *rigorously formal* (meticulously defined terms with formal semantics, theorems and proofs of such properties as soundness and completeness). However, in any domain of discourse, it is assumed that acceptable representation and level of formality entails precise, concrete, and rigorous identification of the domain's concepts, relationships, and their semantics and meanings. Specification design activity however is followed by planning where realistic time, resource, and budget plans have been prepared.

(B) *Establishment of a Design Quality and Evaluation Framework (DQEF)*: this step could be viewed as building competency questions (Noy and McGuinness, 2001) for ontology evaluation purposes. It is important to set up a quality system that incorporates objective criteria to guide the design process and also to evaluate the constructed design artefact. This step affects the quality of the final artefact as well as its validity. The evaluation process in particular ensures that the ontology is semantically rich and syntactically correct, and thus it performs correctly in the real-world. Despite its importance, this area is still insufficiently explored. In fact, this activity (i.e. DQEF) is not mentioned or discussed by other methodologies concerning ontology development. Rather, it is only examined as a stage following ontology implementation. Along with the absence of this activity in other ontology design methodologies, there is a limited amount of literature tackling this important domain (e.g. Gruber, 1995; Gomez-Perez, 2001). An analysis of the existing literature tackling the design principles and evaluation criteria of ontologies has led to the identification of the following six criteria.

A- Clarity. An ontology needs to successfully and objectively communicate the intended meaning of defined terms (Gruber, 1995). Defined terms are concepts describing the domain, which will most likely be nouns (i.e. objects), or verbs (i.e. relationships). Creating a list of these terms is important (Noy and McGuinness, 2001), as well as documenting their definitions in natural language (Gruber, 1995). Wand and Weber (1993, 2002), followed by Shanks et al. (2008), argue that the clarity and validity of the ontological expressiveness require the absence of the following deficiencies:

- *Construct overload*: two or more ontological constructs map to one modelling (i.e. grammatical) construct.
- *Construct redundancy*: two or more modelling constructs map to one ontological construct.
- *Construct excess*: an existing modelling construct does not map to any existing ontological construct.
- *Construct deficit*: an existing ontological construct does not map to any existing modelling construct.

The rationale behind the importance of *ontological clarity* is that it affects human understanding of the represented phenomenon (Shanks et al., 2002). The author particularly highlights the value of this criterion when dealing with the business model domain as the main kernel theory used in this research. The business model concept is criticized for being confused mainly with corporate strategy and business process modelling. Hence, the resulting ontology should be clear enough. That is shaping the boundaries and identifying the elements of the business model concept, as well as resolving any conflict it has with other concepts.

B- Coherence. Gruber (1995) argues that an ontology should be coherent. He explains that "if a sentence that can be inferred from the axioms contradicts a definition or example given informally, then the ontology is incoherent" (p.3). Gomez-Perez (2001) agrees, but depicts *coherence* in terms of *consistency*. She explains that "a given definition is consistent if and only if the individual definition is consistent and no contradictory sentences can be inferred using other definitions and axioms" (p.394).

C- Conciseness. According to Gomez-Perez (2001) an ontology is concise if and only if it does not contain unnecessary definitions, and explicit or implicit (i.e. can be inferred) redundancies amongst existing definitions and axioms. However, "unnecessary definitions" can simply be defined as those definitions adding no value to the understanding of the phenomenon under investigation.

D- Preciseness. Precision is a key factor determining the usefulness and the shared agreement of ontologies in general. It entails avoiding 'encoding bias' by founding conceptualization at the *knowledge-level* rather than the *symbol level* (Gruber, 1995). In other words, representation decisions should not be made based only and dominantly on the convenience of notation.

E- Completeness. It is believed in this research that it is more convenient to verify the completeness of an ontology in an inverse way; that is by asking questions of 'what is missing?' type. Incompleteness means that one or more central parts or hallmarks of the investigated phenomenon are not set out explicitly or cannot be inferred through established definitions and axioms (Gomez-Perez, 2001).

F- Customizability. In the language of Gruber (1995), customizability is *minimal ontological commitment* and *extendibility*, while for Gomez-Perez (2001) it is *expandability*. However, this research argues that semantically all of these notions denote customizability as giving better indication for the entire meaning. This research supports Gruber's view (1995) that an ontology is a conceptual foundation that should be designed in a way that leaves room for different users to monotonically instantiate and specialize the ontology so as to fit their particular settings. In other words, an ontology needs to be designed in a way that gives its different users the ability to expand the existing shared vocabulary without altering the existing ones (Gomez- Perez, 2001).

In fact, *customizability* or expandability does not mean completing an incomplete ontology, rather it means taking the ontology to a deeper level of details that characterize a particular user (e.g. certain services of a specific mobile telecommunications provider). Further, engineering a customizable ontology requires a deliberate design that takes into consideration minimal ontological commitments. Ontological commitment is minimized when an ontology engineers define only constructs (objects and relationships) that are critical and crucial to the communication of knowledge consistent with theory (Gruber, 1995). This would lead to a sufficiency state where the representation level is adequate. Nonetheless, it is understandable in this research that achieving the ideal situation where all of the above criteria are completely satisfied is a challenge. The experience gained throughout this research supports the view that designing an ontology requires, to some extent, tradeoffs (Gruber, 1995) amongst the criteria.

2.5.2 Analysis and Design Phase

The next phase in OntoEng is analysis and design. It includes *knowledge acquisition*, *conceptualization*, *visualization*, and *formalization* design activities. This phase is core in engineering the V^4 Mobile Service BM Ontology and thus is discussed here in a more detailed manner.

This section describes the creation of a concept dictionary (see Fernandez-Lopez et al., 1999), a taxonomic tree, and conceptual descriptions with respect to the phenomenon under investigation. In developing the V^4 Mobile Service BM ontology, the research iteratively acquires and analyzes related information and knowledge for the purpose of enumerating the key concepts in the mobile service BM ontology by creating a concept dictionary for *objects* and *relationships* along with the axioms. This is followed by categorizing these concepts, and the objects in a class hierarchy, to build a taxonomic tree of the mobile BM innovation. Finally, the research develops a conceptual model for the ontology by utilizing both; the created taxonomic tree of the objects, and the concept dictionary of the relationships and axioms. The research in this stage follows methods from knowledge and ontology engineering domains while also drawing on content analysis techniques.

(A) *Knowledge Acquisition and Conceptualization*: Knowledge acquisition is essential as a foundation for any ontology as it refers to the acquisition of the basic knowledge needed to build an ontology. Conceptualization on the other hand is required to structure the domain knowledge into a *conceptual model* which demonstrates the problem and its solution (Fernandez-Lopez et al., 1997). This stage is equivalent to the *requirement analysis* phase that normally occurs during the development of information systems and often involves the use of conceptual models (Wand and Weber, 2002).

In this research and after identifying a relevant problem concerning mobile data services and engineering, a review of related literature and theories has been started. This step in particular is equivalent to the *suggestion* design process identified by Kuechler and Vaishnavi (2008). At this stage the research attempted to explore the relevant literature aiming to locate kernel theories that could be useful in developing the ontology. Based on this course of action, five domains have been selected as they were considered valuable in the context of this research. These domains are SSME, ontology, mobile telecommunications, innovations, and business models, which are discussed in chapter one (see Chapter 1, pp. 6-19). By analyzing these domains in the context of this research, it has been recognized that business model thinking is appropriate to be used as the main background theory for building the ontology given the comprehensive nature of the concept; and thus its capability of covering aspects related to other identified domains.

Having recognized the importance of the business model thinking in the context of the current research, the study seeks to draw upon key findings from previous research on BMs in general, e-business modelling, and more essentially on business modelling and service engineering in the telecoms sector. The research analyzes and synthesizes the existing relevant-literature and extends it. This is in fact the first iteration in the ontology conceptualization in this research. In the second iteration, the research primarily utilized semi-structured interviews to collect empirical data from the mobile telecommunication industry. Thereafter, data related to three real-life cases of mobile data services has been collected and analyzed. The three iterations in this research have been based on the classification provided by Palvia et al. (2006).

(A.1) Iteration One: *Library Research/Literature Analysis*

Ontologies have been proposed to build knowledge-based systems by reusing knowledge (Pinto and Martins, 2004). Thus, this research utilizes archived data, i.e. literature, as one source of data to build the desired ontology.

Notwithstanding the general usefulness of library research and the use of the literature as a data source, the business model literature is not well organized or consistent. In fact, it can be characterized as incoherent as a whole, as will be discussed in chapter three. This is because instead of building on each other’s work, researchers tend to propose new-labelled components which are often semantically similar to those existing in literature. Others have misused and confused the business model notion with other concepts such as corporate strategy and ICT-enabled business processes. Moreover, the issue of classifying the business model components in a semantically precise manner has been almost ignored. This is a major limitation since "an effective ontological engineering depends on defining a "good" set of classes to describe the domain" (Parsons and Wand, 2008, p.841). Thus, making constructive use from the related literature is no easy task, but is very necessary. It requires a deliberate analysis that attempts to overcome the shortcomings of the existing literature and provides a cohesive understanding of the business model concept.

To this aim, this iteration analyzes and synthesizes the different viewpoints relating to the business model concept in a conceptual framework. Aiming to work as a solid foundation for the research ontology, this iteration seeks to provide simple, but tight and comprehensive answers relating to the following fundamental issues:

(1) The dimensions and elements of the business model concept; i.e. what constitutes business models, or what aspects need examining when designing, evaluating, and managing business models.

(2) The modelling principles of business models; i.e. what guidelines organizations need to draw upon when modelling their business models, what is characteristic in business models, and what features are included.

(3) The reach of the business model concept; i.e. the positioning of the business model concept within organizations, and what sort of relations exist between the business model concept and other related notions such as strategy, business process, and information systems.

(4) The functions of the business model concept (its rationale and practical roles); i.e. why business models are significant, why companies should care about it, and what are the tasks that would be more effective when they are based on business models.

As these facets of the business model are essential but their related knowledge is fragmented and somehow imprecise and incomplete, there is a need to integrate the existing views within the literature and analyze them to provide a unified framework that clarifies the concept. To do so and enumerate the design constructs in the context of this research, this iteration primarily follows ethnographic content analysis (Agar, 1980) as it enables researchers to include large amounts of *textual* data and then systematically mines, makes inferences, and identifies common shared properties concerning the phenomenon under investigation (Holsti, 1969; Krippendorff, 2004). Thus, content analysis is deemed appropriate in this iteration given that the data source is the existing body of literature that examines the business model concept in the digital business arena and thus the research data is in 'text' format.

Essentially, "there is no simple right way to do content analysis" (Weber, 1990), and Stone et al. (1966) define it as "any research technique for making inferences by systematically and objectively identifying specified characteristics within text". In line with Stone's definition, Holsti (1969) defines content analysis as "any technique for making inferences by objectively and systematically identifying specified characteristics of messages" that are in the form of text. For making systematic and objective inferences, Agar (1980) highlights the importance of data classification when employing content analysis. He also indicates that such a classification technique uses a form of content analysis where the data are read and categorized into concepts that are suggested by the data rather than imposed from outside (see also Orlikowski, 1993).

Retrospectively, the author finds it more useful to understand the BM concept by categorizing its current interpretations in the literature into a classification schema or a taxonomy that contains conceptually meaningful groups of objects that share common characteristics, i.e. classes. Basically, taxonomy is a systemizing mechanism utilized to map any domain, system, or concept, as well as a conceptualizing tool relating its different constructs and elements. However, the terms 'taxonomy', 'classification', 'typology', and 'categorization' have been used interchangeably within the information systems and computing disciplines as they all aim to provide a structured grouping of similar data (although strictly there are slight differences amongst these terms).

Generally speaking, classification methods are of value in satisfying the needs of understanding data and discovery concepts (Zhifang, 1988). Categorizing data based on their shared characteristics is highly useful since it represents the means by which the collected data transforms into more useful information, often called *pre-knowledge*. Subsequently, this pre-knowledge can be analyzed to mine new, valuable knowledge. Furthermore, taxonomical or categorization methods provide simplicity since they aim to reduce the complexity of dealing with many instances (Parsons and

Wand, 2008). Parsons and Wand (2008) also agree that classifying an object supports deductions and inferences about its unobserved properties. In line with this, Clancey (1984) and Fisher and Yoo (1993) argue that classification techniques are useful means for guiding inference and for problem-solving purposes. Interestingly, all of these characteristics match the definitions of content analysis provided by Stone et al. (1966), Holsti (1969), and Agar (1980).

The content analysis approach employed uses the existing BM literature as its main source of data. In order to understand such a fuzzy concept, the author finds it more convenient to delineate the existing business model definitions within IS-related literature in a comprehensive and generic manner. Therefore, definitions are extracted from literature in information systems, eCommerce, eBusiness, the technology and telecoms industry, and business management. The search process relies mostly on the use of electronic libraries (e.g. ScienceDirect, EBSCO, JSTOR, and ACM Digital Library), by means of keywords. The most effective keywords used included the word 'model' (in particular, business model and business modelling). The list of references within the extracted literature represents another valuable source of the targeted information. However, selecting the definitions chosen depended on '*heuristic evaluation measures*', and twenty two definitions are deliberately selected using the following criteria:

(1) Creation of a comprehensive pool (database) of definitions in terms of anticipated knowledge covering all the perspectives from which the business model has been perceived and assessed (see Table 2-5).

(2) Quality Assurance, in terms of content, number of citations, and publication source.

(3) Coverage of an inclusive time frame; from 1998 to 2008. The BM concept had risen to prominence by the end of 1990s and the first recognizable articles on the concept were published in 1998 (e.g. Timmers, 1998).

Having the content identified -the 22 selected definitions as classified in Table 2-5- the author starts analyzing them thematically. The coding is done by assigning 'indicators', 'indexes', or 'keywords' to each extracted definition based on the main 'themes' of each. This is presented in in the 'Thematic Indicators' column (see

Chapter 3, Table 3-1, pp. 72-74). Consequently, based on these indicators, the process of aggregating definitions into individual classes was triggered. The classification technique used here could be depicted as a 'non-predefined' or 'unsupervised' technique (as with grounded theory and unsupervised conceptual clustering); since no one can know the ensuing classes prior to the process. In other words, discovering a category structure in initially unclassified data represents an unsupervised task (Fisher and Yoo, 1993). With hindsight and while the research aims to let the BM classes and concepts emerge from the data, the current application of content analysis in this research is similar to the way it is used in grounded theory (see Glaser and Strauss, 1967). Nevertheless, instead of collecting data empirically from the research site; the data used in this iteration is gathered from relevant literature.

Table 2-5. Selected BM Research

Research Context	**No. of Studies**
eBusiness and eCommerce	8
Strategy and Business Management	6
Mobile Technologies and Business	4
Technologies and information systems	3
eGoverment	1
Total	**22**

Parsons and Wand (2008: p.839) argue that "classification holds that classes do not exist independently, but are constructed as useful abstractions of the similarities of the classified phenomena". Therefore, the research used an *evaluation function* to discover clusters or classes and definitions were clustered into the same class only if they satisfy the following three conditions:

(1) They are thematically similar to each other; i.e. they communicate same or very similar semantics and ideas about the concepts.

(2) They have contextual relationships that complement each other; thus they become more useful if clustered.

(3) The clustered definitions as a whole articulate a unique compositional aspect of the business model concept.

The outcome of this analytical course of action is a taxonomy which encompasses thirteen unique (i.e. mutually exclusive) individual classes related to different aspects of the concept (i.e. dimensions and elements, modelling principles, reach, and functions). Subsequently, to group classes sharing common characteristics with each other, the research employed a *bottom-up* approach in which the thirteen classes have been classified into four compositional aspects of the business model concept, using the same principles and techniques mentioned previously (see the aforementioned evaluation framework; points 1-3). This represents a hierarchical classification schema (see Gordon, 1987) and the author uses a conceptual tree or framework that describes how the classes are related for understanding and communication reasons (see Chapter 3, Figure 3-1, p. 77). However, the author assigns conceptual metaphors to each class within the taxonomy that he believes to be both clear and understandable to ensure the quality of the taxonomy provided (see Michalski and Stepp, 1983).

Within the content analysis, this iteration follows a *deduction reasoning* method utilizing the collected data and information as guidelines to synthesize the BM knowledge into a generic and comprehensive, but concise business model definition. According to Johnson-Laird (1999), "reasoning is a process of thought that yields a conclusion from precepts, thoughts, or assertions" (p.110), and that reasoning is deductive when considering that the truth of the premises positively establishes the truth of the conclusion. Hence, the employed reasoning approach here is deductive as the author believes that the truth of premises in the literature leads to the truth of the developed definition of the business model concept. The deduction technique is useful for the identified purpose as the research follows a process of reasoning (arguing) to infer a general definition of the concept based on individual cases and examples including bits of evidence and other rules of inference. In particular, within the employed deductive reasoning approach, the research follows a systematic incremental methodology; in which the BM definition is rapidly updated as it reacts to each new stimulus and the author works out a definition for the business model using the following three rules of inference (1) The definition should be comprehensive and general; (2) It is not sufficient to define the business model only in terms of its components; and (3) The definition should synthesize the different points of view presented in earlier research.

The first iteration was very useful to this research. Based on this iteration, the main structure of the ontology has been established although some important design constructs have been explored in later iterations. The first iteration identifies *value* *proposition*, *value network*, *value architecture*, and *value finance* (along with 12 constituent design concepts as illustrated in Chapter 3, Figure 3-2, p. 79) as the main design dimensions that need to be examined when designing and engineering mobile data services. Moreover, this iteration highlights some important key value drivers in this context such as cohesiveness, dynamicity, and the fit between the mobile service BM configurations and the external environment. Nonetheless, the first iteration adds very little to the theoretical content of the ontology given the paucity of research tackling mobile services engineering from business model thinking. Therefore, it was highly essential to carry out an empirical research throughout the next iterations whilst utilizing and building on the ontology foundation that has been established at this stage.

However, building the ontology's foundation by reusing and refining the BM ontological-related knowledge within and outside the subject of telecommunications combines and adds to the two reuse processes identified by Pinto and Martins (2004) which are (1) Fusion/Merging; and (2) Composition/Integration. Thus, this research can now add the process undertaken in this study as a third one which could be called Synthesis/Refinement.

(A.2) Iteration Two: *Qualitative Research/Semi-Structured Interviews*

The use of the interview method is deemed useful in this research. By utilizing the interview, this research seeks to enrich the ontology that has been founded in the first iteration by empirically investigating (1) the BM aspects that are influential when designing and engineering mobile data services and the factors that affecting the shape of BM configurations; (2) the different service engineering approaches that are used in the practice by different mobile telecommunication providers; and (3) the key value drivers in this context.

To this aim, an interview agenda has been prepared based on the findings of the first iteration and has been incrementally enhanced after the early interviews reflecting the new knowledge that has been gained (see Appendix 2 for the interview agenda, p. 252). The use of semi-structured interviews is preferred as opposed to fully structured or un-structured interview techniques. This is because semi-structured interviews allow the researcher to focus on the main aspects related to the phenomenon under consideration while at the same time keep the researcher open to any new idea that may emerge during the interview process.

This research utilizes empirical data as its main source and since the BM serves the strategic level of any digital organization, managers in the mobile telecommunications industry were deemed appropriate interviewees for the purpose of this research. Eighteen semi-structured interviews with key practitioners (i.e. managers) in the mobile telecommunications industry have been conducted, as illustrated in Table 2-6. Interviews were recorded and on average lasted about ninety minutes.

Table 2-6. Semi-Structured Interviews

Involved Actors from the Mobile Telecommunications Industry	**Number of Interviewee**
Mobile Telecommunication Providers	12
Content Providers and Aggregators	4
Telecommunication Regulatory Commission	2
Total	**18**

The primary themes discussed with the interviewee managers included the definition of services and products along with their target segments, communication and collaboration with value network actors, resource allocation and configuration, the creation of core competencies, costing and pricing, customer relationship management and intelligence, and services offering related issues. The background and specialities of the interviewed managers were varied, covering marketing/sales, IS/IT, engineering, management, strategy, finance, and governance. This variety facilitates the creation of a wide range of knowledge that is considered helpful in developing the desired ontology.

The conducted interviews were transcribed, verified and then analyzed. After transcribing the interviews, the data has been analyzed thematically by utilizing ethnographic content analysis in a manner identical to that applied over the literature in the first iteration. Thus, content analysis has been employed in this iteration to classify textual material (i.e. transcribed interviews) semantically and provide more relevant and manageable data (Weber, 1990). In other words, when analyzing the collected data, a thematic coding process has been employed. Strauss and Corbin (1998) highlight that the coding process assists in building conceptualization and that the comparison between elements ensuing from the coding course of actions helps in identifying patterns and relationships between the constructs as well as strengthen and support the final model.

However, in indentifying useful classes or constructs, the research follows *cognitive economy* and *inference* criteria that are proposed by Parsons and Wand (2008) as these two factors promise to allow capturing relevant knowledge about a domain effectively and efficiently. Subclasses however have been introduced if one or more of the following conditions is true (Noy and McGuinness, 2001): (1) subclasses having additional properties that the superclasses do not have; (2) having different restrictions; or (3) participate in different relationships than the superclasses do.

The findings of this iteration not only support the prior results, but also enhance the ontology. This iteration primarily provides detailed semantics and fruitful theoretical content about the ontology including its design constructs, relationships, axioms, and key value drivers. More specifically, the analysis conducted within this iteration adds three design concepts to different design dimensions of the ontology. In the value proposition dimension, the concept 'intended-value-element' has been added, whilst 'relationship' and 'role' design concepts have been added to the value network dimension. Some improvements have also been done to the ontology based on this iteration. For example, the design concept 'cost structure' that belongs to the value finance dimension has been substituted by the 'total-cost-of-ownership' concept. This is because the latter is more comprehensive and appropriate to be used with technological artefacts given that their cost includes important aspects other than the cost of acquisition.

(A.3) Iteration Three: *Case Studies*

This iteration, which employs illustrative case analysis, is different to the previous two iterations. This is because the current iteration is utilized in this research only partly for building the ontology and is principally used for evaluating and practically validating the constructed ontology.

Analyzing real-life case studies is well used in the field of information systems as it allows researchers to capture knowledge from practice (Cavaye, 1996; Walsham, 2002) and is also very useful in building theories (Eisenhardt, 1989). According to Yin (2008), when the focus of the research is on a contemporary phenomenon with some real-life context, the case study method is preferred. In line with Yin (2008), Benbasat et al. (1987) argues that for practice-based problems, the case study method is regarded as a convenient well established research method in IS research. The nature of the current research questions fulfilled all of these criteria.

Moreover, the use and analysis of real-life cases is considered a highly appropriate method for answering “how” and “why” questions (Benbasat et al., 2002), and such questions are equal to the ones tackled in this iteration. At this stage, the research aims to validate the constructed ontology and to employ it to analyze how and why only a few mobile data services are effective in practice, whist the majority are struggling. This is beneficial to identify useful key approaches for mobile service design including their key value drivers.

It has also been argued that an approach based on multiple cases is advantageous since it (1) facilitates capturing greater details; and (2) improves the validity of the findings through the ability of undertaking comparisons and cross-case analysis (Benbasat et al., 2002). Retrospectively, this approach is deemed appropriate in this iteration and three real-life cases related to mobile data service design and engineering have been carried out. These cases are Orange Business Services (OBS); Apple’s iPhone services and applications, and NTT DoCoMo’s i-mode service.

Concerning the case of Orange Business Services, data were collected through a variety of techniques including semi-structured interviewing, extensive documentation review, and observation. As for the semi-structured interviews protocol, the research utilizes the same interview agenda that has been developed in the previous iteration but adapts it in accordance with the context of this specific mobile service. The interview agenda has been used with fifteen interviewees; i.e. managers and professionals working within Orange-Jordan as illustrated in Table 2-7. In this iteration dealing with particular mobile services, the research extends the scope of the interviewees and includes three specialist employees to gain some additional operational information and knowledge. Interviews were taped and each lasted on average about sixty minutes.

Many respondents put forward examples concerning Orange Business Service (OBS). This proved useful and the author extended the information base regarding OBS in the course of collecting extensive and appropriate secondary data. The research utilized direct/indirect observation in addition to Orange-Jordan internal business data such as archival documents, business and annual reports, organizational charts, presentation materials, and proposals. External secondary data such as the telecom's Websites has been also drawn on. Consistent with Orlikowski (1993), the author found this "triangulation" useful since it allows 'cross-checking' which strengthens data validity, provides 'multiple perspectives', and supplies more 'complementary' information.

Table 2-7. The Respondents of OBS Case Study

Managerial Level	**Number of Respondents**
Chief Officer, Senior Manager	4
Department Manager	5
Division Manager	3
Employee (Specialist)	3
Total	**15**

However, regarding the other two cases (i.e. iPhone and i-mode), data were collected using secondary sources only. Hence, the research utilizes existing organizational and business data in the form of statistics, published reports, consulting agencies' documents and reports, research databases such as Mintel, available case studies, research articles, and companies' annual reports in addition to their Websites. By utilizing the collected data, this research analyzes these two organizations in the mobile telecommunications industry with the aim of providing more practical validation and constructive evaluation for the developed ontology.

For each set of data concerning the three cases, the research utilized the so-called '*quantitative content analysis*' approach (see Berelson, 1952; Holsti, 1969). Contrasting ethnographic content analysis, quantitative content analysis is transparent, objective, and systematic. Bryman and Bell (2003) define it as follows:

> *"An approach to the analysis of documents and texts that seeks to quantify content in terms of predetermined categories and in a systematic and replicable manner"*.

The approach is appropriate since at this stage of the research the aim is to validate the constructed ontology empirically. The research is now deductive; and the proposed theory represents a hypothesis to be tested empirically using content analysis.

The process of content analysis also holds data coding and analysis functions. All documentary evidence generated by semi-structured interviews, documentation, and observation were examined and coded. The research used here an interpretive approach and thus coded the generated text in terms of subjects and themes. This is logical given that the research phenomenon of interest (Mobile Service BM Ontology) has been already established in the prior phases. The coding procedure could be depicted as 'targeted', since it relied on mapping the generated data to the predetermined categories within the developed ontology. Nevertheless, the research at this stage remains open to any new concept of knowledge that may enrich the ontology. Based on this analysis, the research developed a logical representation from multiple sources of data concerning mobile data services.

As highlighted earlier, this iteration not only evaluated and empirically validated the constructed ontology, but also it improved the ontology. It added 'network-mode' as a new important design concept to the value network dimension. Furthermore, the current iteration enhances the ontology theoretical content and allowed subclasses to emerge. For example, based on the analysis conducted regarding OBS, three subclasses (i.e. elements) were added to the 'pricing-method' design construct, and based on the analysis of i-mode case three other subclasses were added to the 'target segment' design construct. In particular, this iteration was also useful in enhancing and formulating the key value drivers of the mobile service engineering which are discussed in detail in chapter 6.

After discussing the three iterations utilized in knowledge acquisition and conceptualization, it becomes more noticeable that the strategy followed in building the conceptual model of the V^4 Mobile Service BM Ontology is more appropriate to be classified as *middle-out* rather than the classical top-down or bottom-up approaches. Uschold and Gruninger (1996), who identify these three strategies for ontology engineering, argue that although the top-down approach provides a better control for the level of detail in any ontology, it could result in imposing arbitrary high level categories which in turn may affect the stability of the ontology. In this research, this approach has been excluded since the research might at the end find challenges in meeting the established evaluation criteria in general. The bottom up approach has also been excluded because it principally contradicts the *customizability* design and evaluation criteria. According to Uschold and Gruninger (1996), a bottom-up approach results in an ontology that includes a very high level of detail which makes it hard to identify commonalities between related concepts and also increases the risk of inconsistencies, i.e. *coherence* in the established DQEF. The middle-out strategy balances the levels of detail as details only arise as necessary since basic concepts, i.e. the ontology design dimensions, are specified in advance and are more stable having naturally evolved.

(B) *Visualization and Formalization*: The main aim of this stage is to provide an appropriate graphical representation and formalization of the conceptualized ontology. The research at this stage utilizes the concept dictionaries, taxonomic trees and the conceptual descriptions made at the prior stage to generate a more formal metamodel or conceptual model that is clearly visualized and shows cardinality rules and domain-range axioms.

To date, there is no generally accepted or mature notation for representing ontologies. Ontology engineers sometimes use their own notation systems. Most often, they utilize Unified Modelling Language (UML) notation for representation purposes, as we do in this research. UML is a platform-independent software engineering notation. It is primarily used to provide a metamodel of object-oriented design. Its ability to represent class/subclass hierarchies, relationships between classes/subclasses, and axioms that specify constraints makes UML significant in representing ontologies (Kogut et al., 2002), and UML is almost a *de facto* standard for modelling businesses and their computational support systems (Burton-Jones and Meso, 2002). To show its capabilities, Eriksson and Penker (2000), for example, demonstrate how UML modelling language is also very useful in representing business models in the same way as their software models.

As UML facilitates producing visually rich and easy to use models, there is a strong interest and call in the ontological engineering domain to use it for ontology representation (Cranefield and Purvis, 1999; Guizzardi et al., 2004). This attention is understandable since UML is a well-established and standardized graphical notation in analysis and design phases (Kogut et al., 2002), and according to Cranefield and Purvis (1999) has a large and rapidly expanding user community. This research employs UML class diagram along with the cardinality notations to represent and formalize the V^4 Mobile Service BM Ontology in the form of a conceptual model. At this stage, according to Wand and Weber (2002) conceptual models are useful in (1) supporting communications between users and the development team; (2) helping system analysts in understanding the domain under investigation; (3) providing rich input for the design and implementation processes; and (4) documenting the original system requirements for future references.

2.5.3 Development (Implementation) Phase

This phase is concerned with the implementation of the ontology using one of the ontology engineering environments or any other development platform. At this stage, the research is concerned with a process called forward engineering (Fernandez-Lopez and Gomez-Perez, 2003) in which the constructed conceptual model is translated into an implemented ontology (see Figure 2-4).

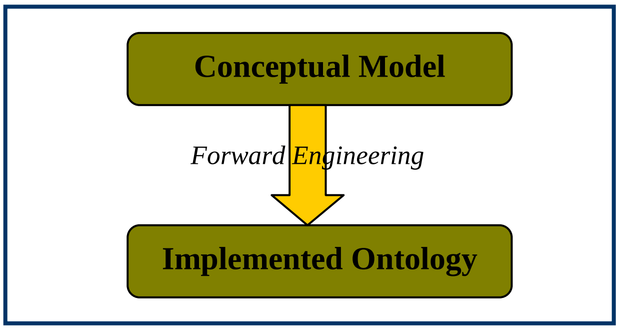

Figure 2-4. Forward Engineering Process

The main question here is which ontology-engineering environment to use? Corcho et al. (2003) provide a comprehensive review of the major environments and tools developed for ontological engineering purposes. They classify these environments into two clusters called first and new generations. First generation ontology-engineering environments, e.g. *Ontolingua Server*, *Ontosaurus*, and *WebOnto* have been criticized for having strong relationships with specific languages and for not providing expandability facilities. These issues, it is argued, have been resolved in the new-generation environments such as *Protégé-OWL*, *WebODE*, and *OntoEdit*.

Amongst the new-generation environments, Protégé-OWL -which is developed at Stanford University- is chosen and used as the development platform for engineering the V^4 Mobile Service BM Ontology. This is because Protégé is a new-generation environment; it is authorized by the World Wide Web Consortium (W3C), and it has been recognized as a leading ontology-engineering environment for more than a decade (Knublauch, 2005). It is also an open source integrated environment, a standalone application, and enjoys an extendible architecture with several plugins (Corcho et al., 2003). However, after implementing the ontology in Protégé-OWL, the research represents it using RDF/XML language given that it is a general-purpose language for representing information in the Web. Representing the developed ontology in RDF/XML (see Appendix 3, p. 254) makes it formal and gives flexibility to different telecoms and other beneficiaries to use or reuse the ontology in different existing and future applications.

2.5.4 Evaluation Phase

Evaluation is decisive since it assesses the extent of success of the constructed ontology. In other words, it ensures that the created ontology is successfully implemented and performs correctly in the real world. Evaluation is a broad term that encompasses both verification and validation (Fernandez-Lopez et al., 1997; Gomez-Perez, 2001). While *verification* mainly refers to technical activities that ensure the syntactic correctness and cleanness of an ontology, *validation* refers to *semantic correctness*; that is the process of ensuring that an ontology corresponds to the phenomenon that it is supposed to represent.

Having built the design quality and evaluation framework in a very early stage in the produced ontology engineering method (i.e. OntoEng) allows the evaluation process to start early. Evaluation of the developed ontology in this research is a continuous process. In each and every design activity, the research refers to and ensures a satisfactory level of all of the criteria described in the established design quality and evaluation system. However, the identification of this particular stage comes from the need to evaluate the entire constructed ontology in a cohesive manner. For verification, this research employs Protégé tools and plugins to technically verify that the created ontology is clean and implemented correctly. Tools such as *Run ontology tests, Check Consistency, SWRL Rule Validation,* and *WonderWeb OWL Ontology*

Validator are used for technical verification purposes in relation to consistency, accuracy, and syntax. As discussed earlier, for validation, in addition to the established Design Quality and Evaluation Framework (DQEF), the research employs illustrative case analysis with the aim of providing practical validation of the V^4 Mobile Service BM Ontology. The cases examined for evaluation course of action are: (1) Apple's iPhone Services and Applications; (2) NTT DoCoMo's i-mode services; and (3) Orange Business Services.

2.5.5 Maintenance Phase

This is the last phase in OntoEng although the design process is iterative. At this stage, documentation as well as operation and maintenance as the two main design activities included within this phase are discussed. Ontology documentation is important since poor documentation of ontologies is one of the main barriers to effective knowledge sharing and dissemination. In addition, documentation plays a key role in facilitating ontology maintenance, use, and reuse. Therefore, documentation clarity and simplicity are considered major issues affecting ontology and knowledge-base research usefulness and value. Hence, the way this research is documented is designed to address the needs of both managerial and technical audiences.

The *operation* design activity is novel in this context and refers to the process in which the ontology is put into practice and is used. Maintenance is highly tied to the operation activity since it ensures that the ontology is fruitful and intact in different time frames of use. Maintenance is highly significant given that today's environment is very turbulent and dynamic. Transformations could take place in the software tool used to implement the ontology, the hardware which accommodates the ontology, and, most importantly, the knowledge included within the ontology. While software and hardware maintenance are key to verify that the ontology successfully performs with the current and future technological trends, the latter (i.e. knowledge maintenance) is highly significant since it is the way in which researchers and practitioners validate that the ontology is constantly compliant with the real world phenomenon.

2.6 Mapping This Research Facets to Design-Science Research

This section aims to explicitly and simply map the current research process and outputs to design-science research reasoning and artefacts respectively. The research process is mapped to design-science research reasoning as suggested by Kuechler and Vaishnavi (2008) (see Figure 2-2, p.36). On the other hand, outputs of current research are linked to the synthesized design-science research artefacts (see Table 2-2, p.34).

(A) Research Process

1- *Awareness of the Problem*: This research starts by presenting the research problem, in chapter one, and more specifically in the 'research motivations' section. The problem has been described as although the number of mobile users is continuously increasing, the revenue generated from data services is yet below expectations. In diagnosing the problem, it has been argued that one of the most important reasons leading to this dilemma is related to weak designs of mobile service BMs. This stage aimed at establishing the research relevance and significance.

2- *Suggestion*: Based on reviewing the literature related to mobile service design and engineering in the information system field and other related domains, it has been established that kernel theories related to business models, SSME, innovations, mobile telecommunications, and ontologies are relevant and helpful in developing the desired ontology (presented in chapter 1). A further analysis suggested that business model thinking is appropriate to be used as the main theoretical background in this research.

3- *Development*: Three main iterations have been utilized to develop the core of the ontology. The first iteration tackled the business model concept aiming to build a sound theoretical groundwork for the ontology (see Chapter 3). This has been enhanced in the second and third iterations when empirical data has been collected using semi-structured interviews and real-life cases. In each of the three iterations, the findings were evaluated against the established DQEF to ensure their validity and quality.

4- *Evaluation*: The analysis of the three real-life cases of mobile data services, although contributing to the ontology construction, is the main method used to evaluate the developed ontology. This represents a practical validation for the ontology in the natural environment. Three cases have been analyzed related to key mobile data services globally introduced in the mobile telecommunications industry (see Chapter 5). These cases are: Apple iPhone, NTT DoCoMo's i-mode service, and Orange Business Services (OBS). Based on this evaluation, the developed ontology is deemed useful in design and engineering innovative mobile data services.

5- *Conclusion*: The research introduces a BM unified framework (see Chapter 3), an ontology for designing and engineering innovative mobile data service (see Chapter 4), explores the key value drivers in this context (see Chapter 6), and also initiates OntoEng as a new approach for ontology engineering (see Chapter 2). These are the main contributions which are summarized and presented in chapter 7.

(B) Research Outputs

1- *Constructs*: The individual classes of the developed ontology represent a design constructs artefacts. The ontology presented in chapter 4 contains four design dimensions including sixteen design constructs in addition to their constituent design elements. The key value drivers, which will be presented and discussed in chapter 6, signify other important design constructs in the context of this research.

2- *Model*: One of the current research outputs is models in the form of ontological frameworks. In fact, the conceptual model of the developed ontology is an example where the research shows how different design dimensions and concepts interrelate and interlink with each other. The research also expresses the hypothesized relationships between the design constructs graphically through the model.

3- *Methods*: Although not highly formalized, the ontological framework for mobile service engineering presented in chapter 4 and its key value drivers that are discussed in chapter 6 represents a method artefact where the research identifies the major function and provides guidelines to design and engineer innovative mobile data services effectively.

4- *Instantiations*: developing the conceptual ontology through Protégé-OWL and representing it through RDF/XML is an example of instantiations artefacts that are developed in this research.

5- *Theories*: OntoEng; that is a design method for ontology engineering in information systems symbolizes an *operation theory* that has emerged due to the gained experience throughout this research. This research suggests that by employing the OntoEng design method, ontology engineers would be more able to build, evaluate, and maintain high-quality ontologies in a systematic and creative manner. On the other hand, The V^4 Mobile Service BM Ontology represents a goal or *solution theory*. In fact, Ontology is an engineering artefact (Guarino, 1998) that could also be depicted as a theory. Chandrasekaran et al. (1999) portray ontologies as content theories. Another view of an ontology as a 'theory' is that of Smith (2003). He defines IS ontology as a formal theory within which not only definitions but also a supporting framework of axioms is included. Guarino and Giaretta (1995) find it more apposite to define the term ontology as a theory, and more specifically as an 'ontological theory' which represents common knowledge and differs from an arbitrary logical theory which may represent a simple specification of particular epistemic states. Moreover, Fonseca and Martin (2007, p.139) consider that "ontologies are theories that explain a domain by revealing it as a coherent whole". Linking ontology to Gregor's (2006) taxonomy of theories, the research suggests it is a design theory, although it incorporates analysis, explanations and predictions.

2.7 Summary

In this chapter, the research approach in addressing the dilemma related to how best to design and engineer innovative mobile data services is discussed. The chapter provides a brief discussion of the difficulty of choosing an appropriate research methodology in information systems, but also highlights its importance for research validity and rigor. The research paradigms or philosophical perspectives in IS are explored and the rationale for selecting the design-science research paradigm is justified. The chapter then provides an analysis of design-science research showing its artefacts and research processes. Consistent with design-science research paradigm, OntoEng as a design approach for ontology engineering is explained and its application in this research for developing the V^4 Mobile Service BM Ontology is examined in detail. To summarize the current research design and explicitly show its associations to design-science research, the chapter presents a mapping between the DSR reasoning activities and artefacts and the current research processes and outputs.

The Design and Engineering of Innovative Mobile Data Services: An Ontological Framework founded on Business Model Thinking

Chapter Three: Developing a Unified Framework of the Business Model Concept

3.1 Overview

Recent rapid advances in Information and Communication Technologies (ICTs) have highlighted the rising importance of the Business Model (BM) concept in the field of Information Systems (IS). Despite agreement on its importance to an organization's success, the concept is still fuzzy and vague, and there is little consensus regarding its compositional facets. Identifying the fundamental concepts, modelling principles, practical functions, and reach of the BM relevant to information systems and other business concepts is by no means complete.

This chapter, following a comprehensive review of the literature, principally employs the content analysis method and utilizes a deductive reasoning approach (as illustrated in Chapter 2, Iteration 1, pp. 47-53) to provide a hierarchical taxonomy of the BM concepts from which to develop a more comprehensive framework. This framework comprises four fundamental aspects. First, it identifies four primary BM dimensions along with their constituent elements forming a comprehensive ontological structure of the concept. Second, it cohesively organizes the BM modelling principles; i.e.

guidelines and features. Third, it explains the reach (i.e. scope) of the concept showing its interactions and intersections with strategy, business processes, and IS so as to place the business model within the world of digital business in general and mobile telecommunications business in particular. Finally, the framework explores three major functions of BMs within digital organizations to shed light on the practical significance of the concept.

Hence, this chapter links the business model facets in a novel manner offering an intact (i.e. integral and precise) definition. In doing so, this chapter provides a unified conceptual framework for the business model concept that is argued to be comprehensive and appropriate to the complex nature of the mobile telecommunications business today. Producing such a unified framework of the concept is significant for this research. This is because business model thinking is the main background theory guiding the development of the mobile data service ontology. For example, the BM ontological structure that the author synthesized from literature provides the baseline for the main design constructs that need to be incorporated within the desired ontology.

The remainder of this chapter is structured as follows. In the next section, the underlying rationale for developing a unified framework of the business model concept is provided. Next, the chapter highlights and analyzes the different viewpoints of authors within the IS field researching into business models and a table is constructed showing the different views. Then, the synthesized conceptual framework is presented showing and discussing the business model compositional facets which the researcher hopes will lead to a consensus. This section discusses the four main concepts and values of the concept along with their building blocks and their interactions which positions the BM within the organization. The section also demonstrates the reach and the major modelling principles of business models. To establish its practical relevance, the chapter identifies three main functions of the business model concept in digital business and more specifically in the mobile telecommunications industry. Before presenting a summary of the chapter, a concise definition of the business model concept is provided.

3.2 Why a Unified BM Framework is Needed?

The business model is fundamental to any business organization (Magretta, 2002). This is because business models provide powerful ways to understand, analyze, communicate, and manage strategic-oriented choices (Pateli and Giaglis, 2004; Shafer et al., 2005; Osterwalder et al., 2005) amongst business and technology stakeholders (Gordijn and Akkermans, 2001). The concept is also of importance as it informs the design of information systems supporting the business model of an organization and its products and services (Eriksson and Penker, 2000). Consequently, no one organization can afford "fuzzy thinking" about this concept (Magretta, 2002).

Having realized the high significance of the BM, there has been an increasing interest (from the time when business modelling had risen to prominence by the end of 1990s with the growth of hi-tech businesses) in delineating the concept and providing further understanding. For example, some attempt to define the concept (Timmers, 1998; Shafer et al., 2005; Osterwalder et al., 2005), others its relationships with information systems (Hedman and Kalling, 2003), and other business concepts, such as corporate strategy (Mansfield and Fourie, 2004), and business process modelling (Gordjin et al., 2000), and yet others seek to identify its constituent elements (Mahadevan, 2000; Gordjin and Akkermans, 2001; Chesbrough and Rosenbloom; 2002; Pateli and Giaglis, 2003).

Researchers have also looked at the BM concept in the context of different domains. The majority of research into business models in the information systems field has been concerned with eBusiness and eCommerce, and there have been some attempts to develop convenient classification schemas. For example, definitions, components, and classifications into eBusiness models have been suggested (Alt and Zimmermann, 2001; Afuah and Tucci, 2003). Some researchers have applied the BM concept in the domains of business management and strategy (Linder and Cantrell, 2000; Magretta, 2002), the telecom sector including mobile technology along with its services (Kallio et al., 2006; Ballon, 2007; Bouwman et al., 2008), software industry (Rajala and Westerlund, 2007), eGoverment (Janssen et al., 2008), and other emerging industries where IT innovations and technologies are of importance (e.g. MacInnes, 2005; Markides, 2006).

However, although the concept is instinctively appealing and promises to “fill a niche” (Hawkins, 2004), the IS-related literature reveals a clear lack of consensus regarding its underpinnings. To date, the business model concept is still considered an ill-defined ‘buzzword’ (Seddon et al., 2004; Seppänen and Mäkinen, 2007). Porter (2001) suggests that the business model concept is “murky” at best. Some other researchers argue that the concept is underdeveloped (Magretta, 2002; Chesbrough and Rosenbloom, 2002). In addition, the BM concept has sometimes been misperceived as a substitute of corporate strategy, business process, or business case. This murkiness could be due to the following three main reasons:

(1) The youthfulness of the BM concept and its associated research; the BM concept has only recently appeared frequently in scholarly reviewed journals (see Osterwalder et al., 2005).

(2) The fact that it comes from diverse disciplines such as eBusiness and eCommerce, information systems, strategy, business management, economics, and technology (Pateli and Giaglis, 2004; Shafer et al., 2005).

(3) The newness of sectors within which the BM concept is being investigated. A particular case in point concerns new technological ventures such as telecommunication providers along with their products and services.

Nevertheless, the research appreciates the vital role that the business model can play in today’s complex and turbulent environment. Hence, this chapter is motivated by the need for a comprehensive, generic, sound, and tight conceptual framework for the business model concept in the IS domain. This is pertinent now as there is little consensus on the essential BM attributes and aspects (Morris et al., 2005). The BM domain knowledge is *fragmented*, indeed, the concept is rarely clarified explicitly (Chesbrough and Rosenbloom, 2002). Such clarification is therefore required to unify the different points of view into one comprehensive framework providing a common understanding, language and labelling in order to leverage communication in this context and our utilization of the concept.

The main aim of this chapter is to provide a cohesive understanding of the business model concept; that is supplying a solid and complete foundation for researchers and practitioners. This includes those looking to utilize the concept in their practices and applications. To this aim, the chapter analyzes and synthesizes the different viewpoints relating to the business model concept in a conceptual framework. Aiming to work as a unified model, this chapter seeks to provide simple, but tight and comprehensive answers relating to the following fundamental issues:

(1) The dimensions and elements of the business model concept; i.e. what constitutes business models, or what aspects need examining when designing, evaluating, and managing business models.

(2) The modelling principles of business models; i.e. what guidelines organizations need to draw upon when modelling their business models, what is characteristic in business models, and what features are included.

(3) The reach of the business model concept; i.e. the positioning of the business model concept within organizations, and what sort of relations exist between the business model concept and other related notions such as strategy, business process, and information systems.

(4) The functions of the business model concept (its rationale and practical roles); i.e. why business models are significant, why companies should care about it, and what are the tasks that would be more effective when they are based on business models.

As these facets of the business model are essential but their related knowledge is fragmented, imprecise and incomplete, there is a need to integrate the existing views within the literature and analyze them to provide a unified framework that clarifies the concept.

3.3 The Business Model Groundwork: State of The Art

The digital era has meant that the availability of appropriate levels of information and knowledge have become critical to the success of the business. Telecoms and other organizations need to adapt in order to survive and succeed as their business domains, processes and technologies change in a world of increasing environmental complexity. Enhancing their competitive positions by improving their ability to respond quickly to rapid environmental changes with high quality business decisions can be helped by adopting suitable business models for this new world of digital business.

However, the business model concept is still seen to be unclear, and researchers in this area have depicted the business model from different perspectives. Most often, researchers only consider one or a few pieces of the whole. Each definition exemplifies only one or at most a few branches of the entire narrative without considering the research in other related fields (Pateli and Giaglis, 2004). In other words, researchers in this field are seeing different aspects of the BM by gazing through different lenses (Shafer et al., 2005). This section provides a first level of clarity by chronologically presenting and examining a classification of twenty two selected scholarly definitions of the business model concept, as in Table 3-1, covering the years 1998-2008. The content of the 'Thematic Indicators' column represents initial indicators used for building up the conceptual framework presented in the next section.

Table 3-1. Selected Scholarly Descriptions of the Business Model Concept

Authors	BM Descriptions	Thematic Indicators
Timmers (1998: p.4)	An architecture for products, services and information flows, including a description of various business actors and their roles; a description of the potential benefits for the various business actors; and a description of sources of revenues.	Architecture, Value Proposition, Business actors and roles, Revenue sources.
Venkatraman and Henderson (1998: p.33-34)	A strategy that reflects the architecture of a virtual organization along three main vectors: customer interaction, asset configuration and knowledge leverage.	Architecture, Organization strategy, Customers, Asset configuration, Knowledge leverage.
Linder and Cantrell (2000: p.1-2)	The organization's core logic for creating value. The business model for a profit-oriented enterprise explains how it makes money.	Business logic, Value Capture, Revenue sources.
Gordjin et al. (2000: p.41)	A BM answers the question: "who is offering what to whom and expects what in return?". A BM explains the creation and addition of value in a multi-party stakeholder network, as well as the exchange of value between stakeholders.	Value proposition /exchange, Stakeholder network.
Petrovic et al. (2001: p.2)	A business model describes the logic of a "business system" for creating value that lies beneath the actual processes.	Business logic, Value proposition, Intermediate theoretical layer.
Amit and Zott (2001: p.4)	A business model depicts the design of transaction content, structure, and governance so as to create value through the exploitation of new business opportunities.	Value proposition, Structure, Governance.
Torbay et al. (2001: p.3)	The organization's architecture and its network of partners for creating, marketing and delivering value and relationship capital to one or several segments of customers in order to generate profitable and sustainable revenue streams.	Value proposition, Architecture, Network of partners, Relationship capital, Customer segments, Revenue.

Table 3-1. Selected Scholarly Descriptions of the Business Model Concept

Authors	BM Descriptions	Thematic Indicators
Stähler (2002: Online, p.6)	A model of an existing business or a planned future business. A model is always a simplification of the complex reality. It helps to understand the fundamentals of a business or to plan how a future business should look.	Abstract, Simplification of current and future business reality.
Chesbrough and Rosenbloom (2002: p.532)	The business model provides a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic inputs. The business model is thus conceived as a focusing device that mediates between technology development and economic value creation.	Coherent framework, Mediating construct, Technology, Economic Value.
Magretta (2002: p.4)	The business model tells a logical story explaining who your customers are, what they value, and how you will make money in providing them that value.	Value proposition, Customers, Revenue sources.
Bouwman (2002: p.3)	A description of roles and relationships of a company, its customers, partners and suppliers, as well as the flows of goods, information and money between these parties and the main benefits for those involved, in particular, but not exclusively the customer.	Roles and relationships: company, customer, partners, Value proposition, Revenue.
Hedman and Kalling (2003: p.49,52-53)	Business model is a term often used to describe the key components of a given business. That is customers, competitors, offering, activities and organization, resources, supply of factors and production inputs as well as longitudinal process components to cover the dynamics of the business model over time.	Key business components, Resources, Customers, Value proposition, Network, Architecture, Structure, Dynamic.
Camponovo and Pigneur (2003: p.4)	A detailed conceptualization of an enterprise's strategy at an abstract level, which serves as a base for the implementation of business processes.	Conceptual, Intermediate theoretical layer.
Leem et al. (2004: p.78)	A set of strategies for corporate establishment and management including a revenue model, high-level business processes, and alliances.	Strategy, Revenue, Alliances.
Shafer et al. (2005: p.202)	A representation of a firm's underlying logic and strategic choices for creating and capturing value within a value network.	Business logic, Strategy, Value proposition, Value network.
Osterwalder et al. (2005: p.17-18)	A conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value relationship capital, to generate profitable and sustainable revenue streams.	Conceptual tool, Business logic, Value proposition, Customer segments, Architecture, Network of partners, Revenue.
Haaker et al. (2006: p.646)	A blueprint collaborative effort of multiple companies to offer a joint proposition to their consumers.	Blueprint, Network of firms, Customers, Value proposition.
Andersson et al. (2006: p.1-2)	Business models are created in order to make clear who the business actors are in a business case and how to make their relations explicit. Relations in a business model are formulated in terms of values exchanged between the actors.	Business actors and relations, Value exchange.
Kallio et al. (2006: p.282-283)	The means by which a firm is able to create value by coordinating the flow of information, goods and services among the various industry participants it comes in contact with including customers, partners within the value chain, competitors and the government.	Value proposition: information/goods/services, Industry participants: customers/partners/ competitors/government.

Table 3-1. Selected Scholarly Descriptions of the Business Model Concept

Authors	BM Descriptions	Thematic Indicators
Rajala and Westerlund (2007: p.118)	The ways of creating value for customers and the way in which a business turns market opportunities into profit through sets of actors, activities and collaborations.	Value proposition, Set of actors, Revenue.
Janssen et al. (2008: p.204)	A business model reflects the core business of an organization and is useful to describe (and even prescribe), the organization from the perspective of its main mission, and the products and services that it provides to its customers.	Business logic, Value proposition, Customers; Current or future business.
Rappa (2008: Online)	A method of doing business by which a company can sustain itself, that is, generate revenue. The business model spells out how a company makes money by specifying where it is positioned in the value chain.	Revenue sources, Position in the value chain.

Unsurprisingly, the applied analysis over the existing BM definitions within the literature (see Chapter 2, Iteration 1, pp. 47-53) illustrates the lack of consensus regarding the BM theoretical foundations (Magretta, 2002; Chesbrough and Rosenbloom; 2002; Morris et al., 2005; Kallio et al., 2006). It is more obvious now that the IS-related literature contains a wide variety of different views regarding the business model concept. The author agrees with Linder and Cantrell (2000) that researchers mean different things when they write about business models. To give just a few examples, for Hedman and Kalling (2003) the business model concept is used to describe the key components of a given business, whilst for Rappa (2008) it is the method of doing business in which a company generates revenue. Venkatraman and Henderson (1998) on the other hand depict the concept as a strategy reflecting the architecture of virtual organizations, and Janssen et al. (2008) understand the business model as a way of describing an organization from its mission perspective as well as the products-services it offers to customers. Another example is that of Andersson et al. (2006) who describe the business model as a mechanism that makes the business actors' relations more explicit.

Another notable issue is that some researchers have described the business model only through its components or even on one or some of its components. For example, Timmers (1998) considers products-services architecture as well as actors and their roles and benefits in addition to sources of revenue as the BM primary constructs. Magretta (2002) puts emphasis on customers, value elements, and revenues as the main components of business models; whilst the BM elements for Bouwman (2002) are actors (customers, partners, and suppliers) and their roles, relationships, and flows-communications.

The applied analysis (see Chapter 2, Iteration 1, pp. 47-53) also reveals that the other business model fundamental details concerning modelling principles, reach, and functions are somehow available within the literature, but indirectly, incompletely, fragmentally, and sometimes lacking a consensus. To give just a few examples, Stähler (2002) characterizes the BM as “abstract” in a sense that it provides a simplification of current or future business reality. Similarly, Camponovo and Pigneur (2003) typify it as “conceptual tool”, and Haaker et al. (2006) symbolize it as a “blueprint”. Moreover, Hedman and Kalling (2003) demonstrate the BM as “dynamic”, appreciating the turbulent nature of businesses today.

Nonetheless, the views diverge on the reach of the BM concept. For example, Leem et al. (2004) defines the business model as a strategy; whilst Petrovic et al. (2001) perceive it as an intermediate layer between strategy and business processes. The latter view however highlights the “alignment role” of the business model concept. The view of Chesbrough and Rosenbloom (2002) exemplifies another role of the concept as a “coherent mediating framework” between technological artifacts and the achievement of economic values.

It is more evident now that knowledge about the BM is disjointed and unclear. All of these issues maintain, and probably add to, the blurred view held of the business model and keep the BM-related knowledge fragmented. This suggests that the domain is fuzzy and vague and still in its conceptualization phase, despite its perceived significance. To consolidate and classify these views, we present a hierarchical taxonomy in the next section which organizes these different perspectives.

3.4 The Synthesized Conceptual Framework

The use and application of content analysis over the extracted definitions of the business model concept (see Chapter 2, Iteration 1, pp. 47-53 for the applied content analysis; and Table 3-1 pp.72-74 for the selected BM definitions) facilitates the construction of a taxonomy that classifies the different points of view about business models into thirteen mutually exclusive classes or ‘clusters’ briefly described in Table 3-2.

Table 3-2. A Hierarchical Taxonomy of the Business Model Concept

BM Facets	BM Classes	Brief Description	Representative Literature
V[4] BM Dimensions	**(1) Value Proposition**	A way that demonstrates the business logic of creating value for customers and/or to each party involved through offering products and services that satisfy the needs of their target segments.	Magretta, 2002; Amit and Zott, 2001; Petrovic et al., 2001; Osterwalder et al., 2005.
	(2) Value Architecture	An architecture for the organization including its technological architecture and organizational infrastructure that allows the provisioning of products and services in addition to information flows.	Venkatraman and Henderson, 1998; Timmers, 1998.
	(3) Value Network	A way in which an organization enables transactions through coordination and collaboration among parties and multiple companies.	Amit and Zott, 2001; Gordjin and Akkermans, 2001; Bouwman, 2002.
	(4) Value Finance	A way in which organizations manage issues related to costing, pricing, and revenue breakdown to sustain and improve its creation of revenue.	Timmers, 1998; Linder and Cantrell, 2000; Rappa, 2008.
Modeling Principles	**(5) Conceptual**	A conceptual tool, an abstraction and a blueprint of the existing business and/or the future planned business.	Stähler, 2002; Osterwalder et al., 2005; Haacker et al., 2006..
	(6) Multi-Level	A way of designing, analyzing and evaluating different units or levels within organizations such as products and services, business unit, an organization, or even a network of organizations.	Magretta, 2002; Kallio et al., 2006; Bouwman et al., 2008.
	(7) Dynamic	A dynamic concept as the BM configurations and design change over time reflecting internal and external variations.	Hedman and Kalling, 2003; MacInnes, 2005.
	(8) Granular	A grainy controllable way of designing and evaluating business as the concept is subdivided into manageable elements.	Gordjin and Akkermans, 2001; Shafer et al., 2005; Osterwalder et al., 2005.
	(9) Coherent	A comprehensive way of depicting a particular business entirely taking into consideration the interlinks between its different aspects.	Chesbrough and Rosenbloom, 2002.
BM Reach	**(10) Intermediate Layer**	An interface or a theoretical intermediate layer between the business strategy and the ICT-enabled business processes. Nevertheless, it intersects with both: strategy and ICT-enabled business processes. The BM intersection with strategy represents a set of organization's strategic-oriented choices for business establishment and management, whilst its intersection with processes signifies a set of business implementation practices and functions.	Leem et al., 2004; Shafer et al., 2005; Morris et al., 2005; Kallio et al., 2006; Rajala and Westerlund, 2007.
BM Functions	**(11) Alignment Instrument**	A theoretical tool of alignment providing a crucial instrument (i.e. bridge) for improving harmonization and consistency amongst strategy and business process including their supportive information systems.	Camponovo and Pigneur, 2003; Osterwalder et al., 2005.
	(12) Interceding Framework	A mediating construct or framework that connects technological potentials and innovations with the realization of economic value and the achievement of strategic outcomes.	Chesbrough and Rosenbloom, 2002; Kamoun, 2008.
	(13) Knowledge Capital	An intangible and tactical information/knowledge asset useful in supporting strategic decision-making functions; and thus valuable in providing the organization with an enduring competitive advantage.	Venkatraman and Henderson, 1998.

The deducted thirteen classes complement each other as they are concerned with different but linked aspects of the business model concept. Thus, they can be considered constituent elements (i.e. subclasses) of a higher level of ontological abstraction. This research suggests that V^4 *BM Dimensions*, *Modelling Principles*, *BM Reach*, and *BM Functions* as four top-level classes to encapsulate the original thirteen classes that have emerged from the collected data (see Table 3-2). This hierarchical taxonomy of the business model defines the concept comprehensively. It not only highlights the major facets and aspects related to the concept, but also it reveals their important inter-relationships (see Figure 3-1).

As exemplified in Table 3-2, the first four classes - value proposition, value architecture, value network, and value finance- represent the primary dimensions of the BM concept. The terminology used signifies that these fundamental dimensions are value-based. This is to indicate that only *core arrangements* are delineated within these four dimensions. Each aims to provide the market with *desired values* through the provision of services and products so as to capture *economic and other values* in return.

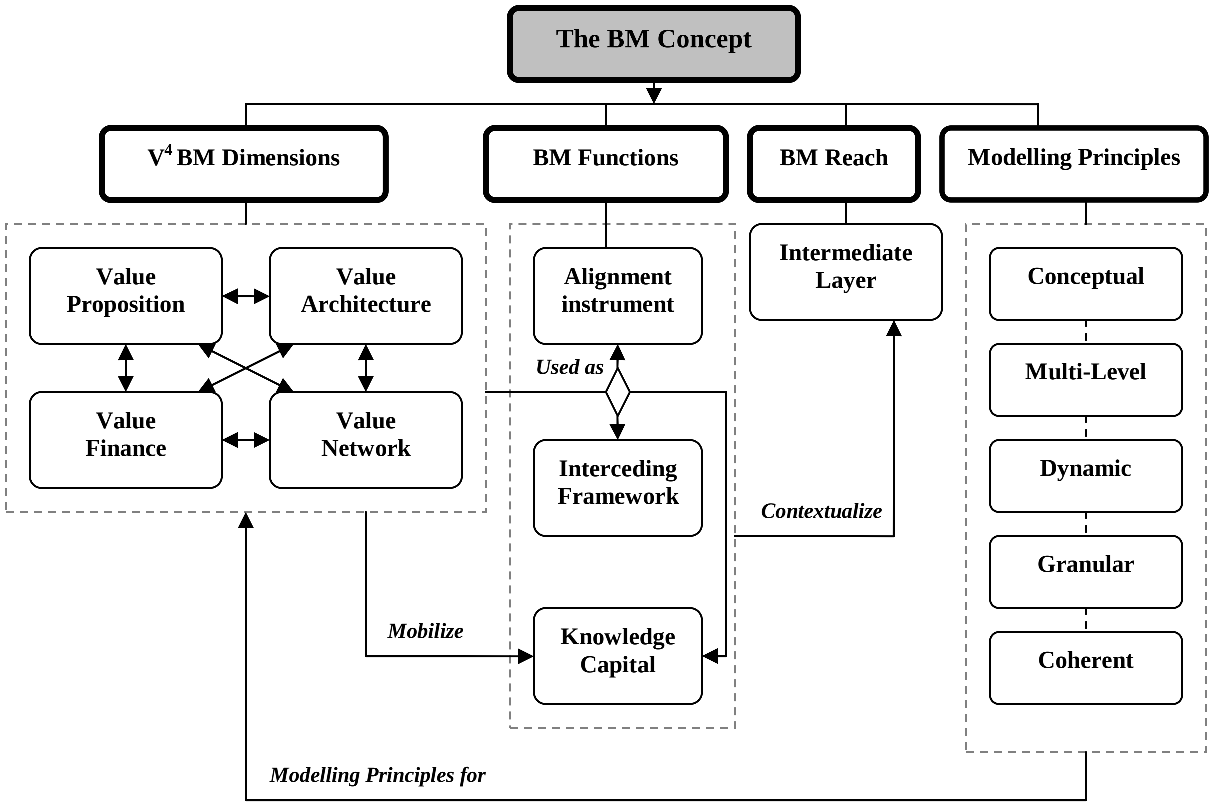

Figure 3-1. A Unified BM Conceptual Framework

The taxonomy also shows the principles and features those guide the modelling function of business models. The applied analysis (see Chapter 2, Iteration 1, pp. 47-53) reveals that the business model is a coherent conceptual framework that provides a holistic but abstract understanding of the underlying business logic of an organization. The business model is also dynamic and could be utilized at different levels and for varied purposes within organizations.

As for the reach of the BM concept, the conducted analysis (see Chapter 2, Iteration 1, pp. 47-53) indicates that the business model is an intermediate layer between business strategy and business processes including their supportive information systems. Hence, the business model is a substitute for neither corporate strategy nor business processes, but does sustain and align both of these business layers as business models encompass information helpful in translating strategic objectives into implementation tasks and functions.

Concerning the practical roles of the concept, the applied analysis (see Chapter 2, Iteration 1, pp. 47-53) suggests that the business model can be usefully employed as a conceptual tool of alignment, a mediating construct between technology and the attainment of goals and other values, and finally as knowledge capital useful in supporting decision making functions. A more detailed discussion and analysis of the identified BM facets are provided in the following four subsections.

3.4.1 The Ontological Structure of the Business Model Concept

The ontological structure of business models is a taxonomical tree that explains the primary components of the concept. Clarifying the BM ontological structure is useful in this research as it describes the main constructs to be examined when designing and engineering mobile data services from a business model perspective.

When comparing the research on mobile telecommunications business and services that is based on business model thinking with the relevant research on eBusiness, management and strategy, it becomes noticeable that the latter is more advanced in terms of the (1) number of studies; and (2) the definition of business model components. Whilst BM-mobile telecommunications research is relatively uncommon and mostly examines the basic dimensions of the concept, the research in the other areas is richer and goes a further step into defining the BM constituent elements. Only a few studies have attempted to research the interrelationships between the components of business models (e.g. Gordjin and Akkermanns, 2003; Osterwalder et al., 2005).

Generally speaking, the relevant research on mobile telecommunications business (e.g. Camponovo and Pigneur, 2003; Van de Kar et al., 2003; Kallio et al., 2006; Ballon, 2007; Bouwman et al., 2008) defines the BM concept in terms of four high-level dimensions: Service, Enabling Technology, Network Formation, and Revenue Streams. Moreover, in such research, issues related to organizational infrastructure, configurations, culture, and design are typically neglected. On the other hand, although the BM research related to eBusiness, management and strategy goes beyond the general BM dimensions, the research in this context shows more varied views toward the concept; and thus fewer consensuses concerning the BM components. For example, for Osterwalder et al. (2005), the eBM components are categorized into four pillars encompassing nine components as follows: Product (value proposition), Customer Interface (target customer, distribution channel, relationship), Infrastructure Management (value configuration, core competency, partner network), and Financial Aspects (cost structure, revenue model). Alternatively, for Afuah and Tucci (2003), the eBM is composed of nine elements: customer value; scope; pricing; revenue sources; connected activities; value configuration; implementation; capabilities; and sustainability.

However, the applied content analysis in this research (see Chapter 2, Iteration 1, pp. 47-53) reveals that Value Proposition, Value Network, Value Architecture, and Value Finance comprehensively embody the business model concept, as illustrated in Figure 3-2. In relevant literature, the business model has been frequently described as a way in which organizations create value (Amit and Zott, 2001; Kallio et al., 2006) with two different approaches for the value proposition:

(1) The ways in which an organization, along with its suppliers and partners (business actors) create value for its customers (Magretta, 2002; Osterwalder et al., 2005; Rajala and Westerlund, 2007).

(2) The ways in which an organization along with its stakeholders create value for each party involved (Stähler, 2002; Andersson et al., 2006).

This view highlights the *value proposition* dimension (Magretta, 2002; Hedman and Kalling, 2003) of the business model concept. This dimension implies that a business model should include a description of the products/services a digital organization offers, or will offer, along with their related information. Furthermore, the BM needs also to describe the nature of targeted market segment(s) along with their preferences. Matching products and services nature and characteristics with customer desires and needs promises to enhance the value captured by both the provider and the recipient of the service. Innovations relating to this particular dimension are of high concern to modern ICT business organizations such as telecoms in order to attract and sustain a large proportion of customers.

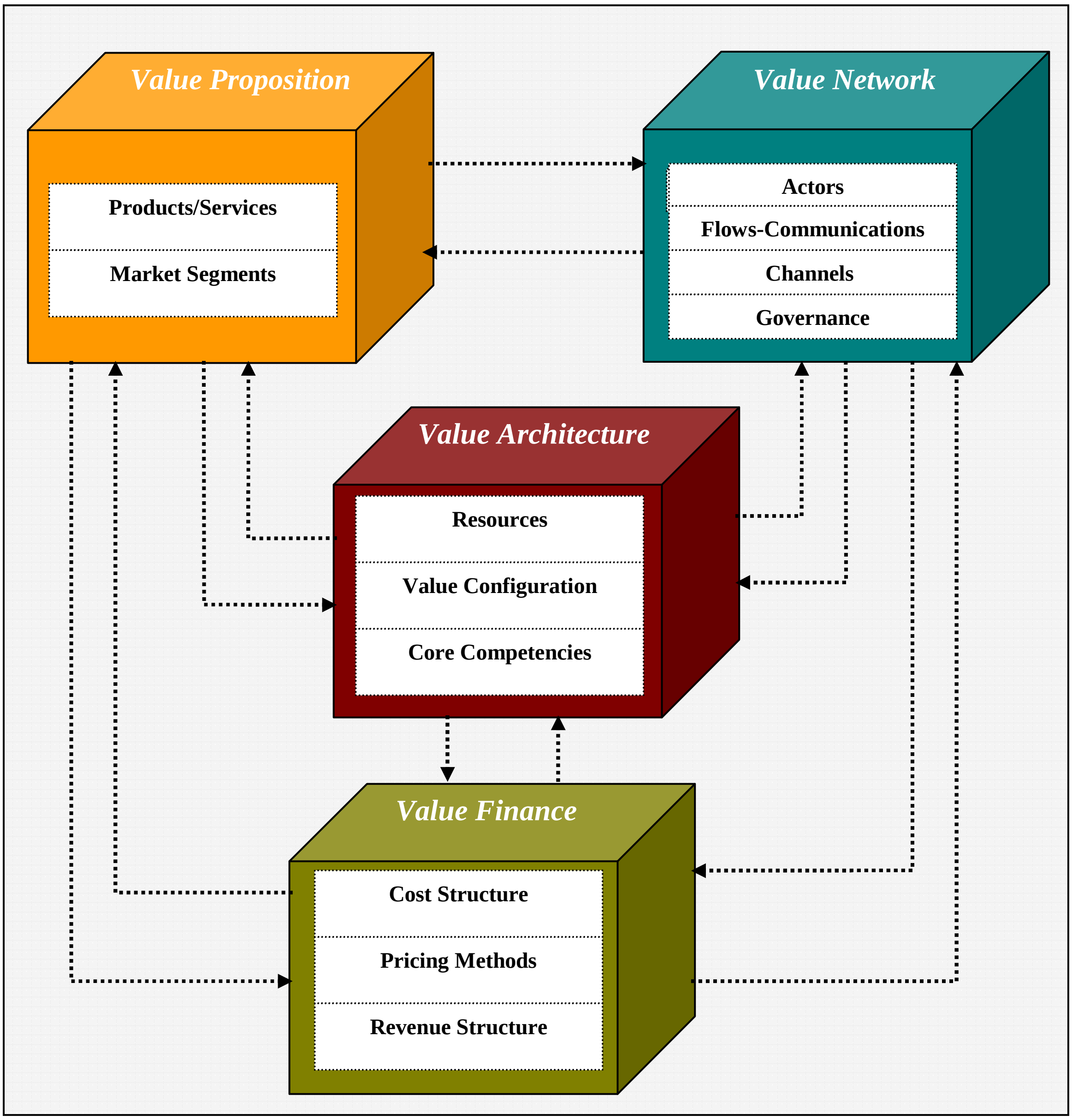

Figure 3-2. The V^4 BM Ontological Structure (synthesized from literature)

Another view which places emphasis on the *value architecture* branch of the business model (Timmers, 1998; Torbay et al., 2001) portrays the concept as a holistic structural design of an organization, including its technological architecture, organizational infrastructure, and their configurations. This comprises tangible and intangible organizational assets, resources, and core competencies. The foundation of the value architecture construct is in the Resource-Based View (see Wernerfelt, 1984; Barney, 2001) which assumes that each company is a bundle or resources.

In this context, Hedman and Kalling (2003) indicate that for any business organization to serve the market effectively it needs resources and inputs that could take human, physical, and organizational forms. They also argue that such resources need to be organized and configured in an appropriate manner that facilitates a competitive value proposition in the market. The point is that the economic value of a digital business is determined by its ability to absorb ICT resources and align them along with the existing resources, and then diffuse them in activities which should be managed to create value propositions at lower cost and/or higher quality than rivals. Therefore, we consider resource configuration as a key driver of core competencies (see Hamel and Prahalad, 1990). Based on this discussion, it is considered that business models also need to represent an organization's resources, their configurations, and the resultant core competencies.

The *value network* class represents the third position from which the business model concept has been examined. This construct depicts the cross-company or inter-organization perspective towards the concept and has gained much attention in the BM literature. Several researchers have described the concept as a way in which transactions are enabled through the coordination and collaboration amongst *actors*; multiple companies and stakeholders (Shafer et al., 2005; Andersson et al., 2006). According to this point of view, a business model is a description of the position of an organization in the value system (Rappa, 2008) and its relationships with different stakeholders. Hence, it is considered useful in showing explicitly how the value is exchanged -flowed and communicated via channels- amongst stakeholders (Gordjin et al., 2000), as well as to explain which actor(s) is governing or being dominant (Amit and Zott, 2001; Haaker, 2006) in the business value network.

Interestingly, the term *actors* in the value network dimension has been used in a quite comprehensive mode. In its basic use, the term has been employed to depict different business organizational actors, those involved in the main functions relating to the offering, such as value creation, marketing, and delivery (Timmers, 1998; Rajala and Westerlund, 2007). In a wider perspective, the term has been also used to include competitors (Hedman and Kalling, 2003) as well as public organizations such as governmental bodies and agencies (Kallio et al., 2006). Given that all previously mentioned actors are some kind of organization, one can include all of them under one umbrella; i.e. 'organizational actors'. However, not only are organizations actors within the value network, but customers as well (Bouwman, 2002). Therefore, the value network could be best perceived and presented as a *multi-party stakeholder network* (Gordjin and Akkermanns, 2001). However, this adds actors (organizational actors and customers), flows and communications, channels, and governance as concepts to be addressed within the design of business models.

Considering the primary dimensions of the concept, the last recognizable view is that a business model is a way in which organizations generate revenue (Linder and Cantrell, 2000; Rappa, 2008). The business model seems to be strongly connected with economic and financial designs within organizations. Whenever the concept is used, many people assume that the user is going to address financial arrangements with respect to revenue generation. Nevertheless, we believe that the business model is more comprehensive and that value finance represents only one dimension of the whole narrative. However, being financially relevant indicates that the *value finance* dimension depicts information related to cost structure, pricing methods, and revenue structure (Shafer et al., 2005; Osterwalder et al., 2005) and concerns the other three dimensions and most particularly the value proposition arrangements. Hence, efficiency is most likely the main factor in this dimension.

Having identified the primary dimensions of a business model concept along with their constituent elements (see Table 3-3 and Appendix 1), it is important to highlight the fact that they are substantially interrelated and interdependent. Designing a BM requires a balance of different and often conflicting design requirements presented within the four dimensions and their building blocks. To give just an overview, based on an external environment scanning course of action, an organization could determine its targeted value customers as well as their wants and needs in relation to its offerings. An organization's products-services should match customers' preferences for superior performance (Kasper et al., 1999). However, the characteristics of the provisioned products-services are highly correlated with the value architecture arrangements. On the other hand, the value architecture is dependent on the organization's internal resources as well as the resources it acquires from its value network. Value finance on the other hand is concerned with all needed financial arrangements regarding the other three dimensional arrangements.

Table 3-3. The V^4 BM mapped to Literature

V^4 BM Dimensions	V^4 BM Components	Hamel (2000)	Linder and Cantrell (2000)	Petrovic et al. (2001)	Chesbrough and Rosenbloom (2002)	Stahler (2002)	Camponovo and Pigneur (2003)
Value Proposition	Product/Service	Products	Value proposition	Value model	Value proposition	Value proposition	Value proposition
	Target Segment	Market segment			Market segment		Target customers
Value Network	Actor	Network			Value chain, value network	Architecture	Business partners
	Flow-Communication	Information and anticipation	Commerce relationship	Marketing and service model			
	Channel	Relational dynamics	Channel model	Distribution model			
	Governance						
Value Architecture	Resource	Resources		Resource model			
	Value Configuration		Commerce process model, organization form	Production model		Architecture	
	Core Competency						
Value Finance	Cost			Capital model	Cost structure		
	Pricing Method	Price structure	Pricing model		Profit potential		
	Revenue Structure		Revenue model	Revenue model		Revenue model	Revenue flows
V^4 BM Dimensions	**V^4 BM Components**	**Afuah and Tucci (2003)**	**Gordijn and Akkermans (2003)**	**Hedman and Kalling (2003)**	**Osterwalder et al. (2005)**	**Bouwman et al. (2008)**	**Kamoun (2008)**
Value Proposition	Product/Service	Customer value	Value offering	Offering	Value proposition	Value proposition	Value proposition
	Target Segment	Scope	Market segment	Customers	Target customer	Customers	Market segment
Value Network	Actor	Sustainability through partnerships	Actors	Suppliers	Partner network	Business actors	Value chain arrangements
	Flow-Communication		Value object		Relationship		Customer relationship
	Channel		Value port, value interface		Distribution channel		Distribution channel
	Governance					Governance	Resources
Value Architecture	Resource			Resources		Technology domain	
	Value Configuration	Connected activities: value configuration	Value activity	Activities and organization, scope of management	Value configuration	Value activities	Capabilities
	Core Competency	Capabilities			Core competency	Resources and capabilities	
Value Finance	Cost				Cost structure	Cost	Cost structure
	Pricing Method	Pricing	Value exchange				
	Revenue Structure	Revenue sources	Value exchange		Revenue model	Revenue	Revenue model

3.4.2 Modelling Principles of Business Models

After examining the ontological structure of the BM concept, the author now addresses the principles that direct the modelling course of action of business models. The ontological structure of the BM spells out the concept as a *coherent framework* given that it depicts the business logic comprehensively. The business model provides a holistic view (Chesbrough and Rosenbloom, 2002) of a particular business which is not only useful in understanding its internal structure and functions, but also in realizing how an organization is connected to its external environment and how it interacts with it.

Nevertheless, this depiction of business logic is *abstract* since the BM is a conceptual tool or a blueprint that covers only the key business components (Janssen et al., 2008) and thus considered a simplification that reflects the business reality (Stähler, 2002). One of the inferences generated through the applied analysis (see Chapter 2, Iteration 1, pp. 47-53) demonstrates the business model as a *granular* concept in a sense that its components could be broken down into dimensions which could as well be subdivided into elements. Granularity in this context is highly significant given that the concept is comprehensive and covers a wide range of business aspects. It is also useful as it allows more focused designs of business models.

The constructed taxonomy (see Table 3-2) also demonstrates that the business model is a *versatile* concept. Enjoying this particular feature implies two main issues related to versatility. Firstly, it indicates that business models could be utilized to understand the business logic at different levels: (a) individual organizations (e.g. Venkatraman and Henderson, 1998; Linder and Cantrell, 2000; Camponovo and Pigneur, 2003), or even (b) part of an organization such as business units, products/services, and product/service bundles (e.g. Timmers, 1998; Chesbrough and Rosenbloom, 2002), and (c) business networks that consists of more than one organization (e.g. Gordjin et al., 2000; Torbay et al., 2001; Haaker et al., 2006). In its second sense, versatility specifies that the business model could be used for different purposes within organizations: (a) alignment instrument; (b) mediating construct; and (c) knowledge capital.

The modern ICT-based world of business imposes a vital need for business models with high levels of adaptability to accommodate the ongoing changes more efficiently. Within today's business environment, the business model should also be enjoying *dynamicity* in order to cope successfully with the continuous changes. Characterizing the business model as dynamic (Hedman and Kalling, 2003; MacInnes, 2005) is essential mainly because many industries nowadays, such as telecommunications, are undergoing continuing revolutions driven by innovative technologies, globalization including deregulations, and market changes. Indeed, the business environment has been greatly transformed. Unlike the traditional world of business which is characterized by stability and low levels of competition, the world of digital business is complex, dynamic and has high levels of uncertainty and competition, as illustrated in Figure 3-3. Hence, in the more complex and sometimes unique digital business, the business model needs to be explicit and more flexible.

3.4.3 The Reach of Business Models

The reach of the BM concept is another aspect that has been tackled within the literature. BM reach is about understanding the position of the concept within digital organizations and its intersections with other business layers. Yet business model researchers are beginning to determine its boundaries, and relationships with information systems and other business aspects, such as business processes and business strategy. There is already some consensus regarding the differences between the business model and the ICT-enabled process model (Gordjin et al., 2000; Pateli and Giaglis, 2003; Morris et al., 2005). Although the overall goal of conceptual modelling is to support decision-making activities (Gordjin et al., 2000), business process modelling supports operational decisions, and the process of creating the business model provides support for strategic decision-making.

On the other hand, the debate on the difference between the business model and business strategy has not yet been resolved (Porter, 2001; Stähler, 2002; Pateli and Giaglis, 2004). Some researchers view them as identical and use the terms interchangeably. Leem et al. (2004) and Kallio et al. (2006), for example, depict business model components as a set of business strategies. Some researchers, mainly from the business discipline, argue explicitly that the business model is not a strategy, and yet they include the strategy and/or part(s) of its elements (e.g. mission, strategy, competitive strategy) within the business model components or vice versa (for example, Chesbrough and Rosenbloom, 2002; Shafer et al., 2005).

Other researchers suggest an alternative way of looking at the BM concept which the author sees as more helpful. They argue that even though both concepts are related, they represent different levels of information, useful for different purposes. They see the business model as an interface or an intermediate theoretical layer between the business strategy and the business processes including their information systems (Osterwalder, 2005; Morris et al., 2005). Showing the differences between the business model concept and business strategy, Magretta (2002), for example, argues that the business strategy explains how business organizations hope to do better than their rivals, whilst the business model describes how the pieces of a business all fit together.

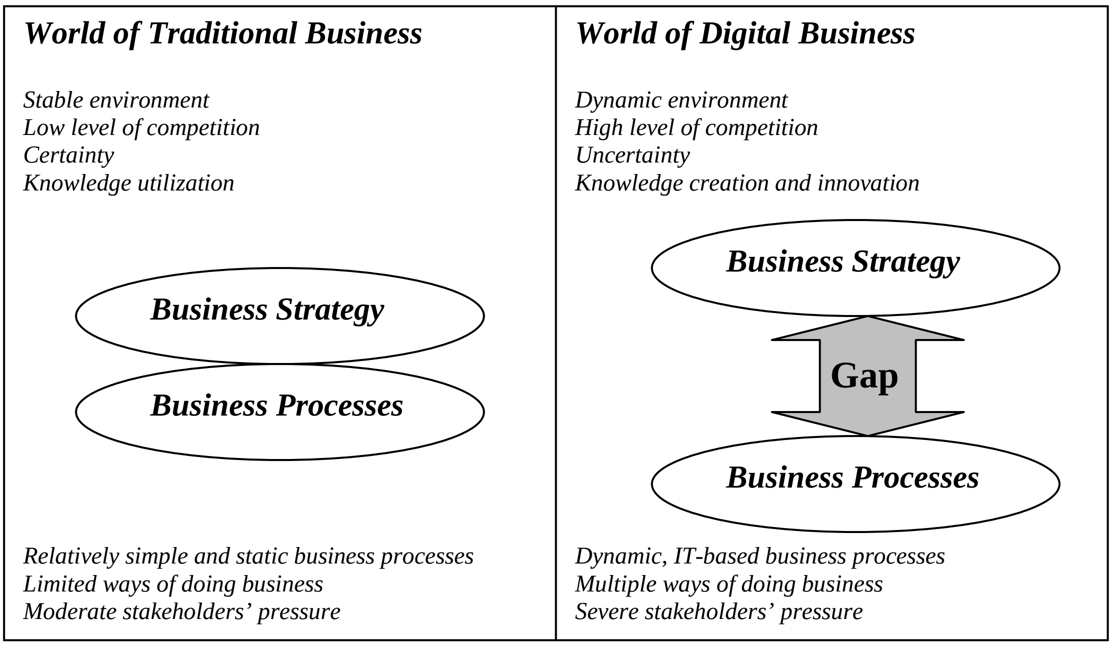

Figure 3-3. Comparison between the World of Traditional and Modern Digital Business

The main reason behind this confusion in the author's context is the shift that the business world experienced from the traditional ways of doing business to the new ways of digital business, which feature a high level of complexity and rapid change. As illustrated in Figure 3-3, this transformation has created a gap between strategy and processes which calls for new ways of thinking about business models.

Nonetheless, the business model is by no means independent; it intersects with the business strategy as well as the business processes including their supportive information systems, as illustrated in Figure 3-4. Thus, it creates a unique strategic, operational, and technological mix. These intersections represent two crucial transitional points to be followed by business organizations.

(1) ***Business strategy to business model.*** This is depicted by the first intersection point which represents the first transitional stage. According to Porter (1980), business strategy is a way by which a business organization positions itself within its industry through adopting one of the following generic strategies: cost leadership, differentiation, and focus. However, at this stage, the business organization translates its broad strategy into more specific business architectural, co-operational, value propositional and financial arrangements needed to achieve the strategic goals and objectives of the business. Moreover, the business model in the first intersection point is dependent on and derived from the business strategy.

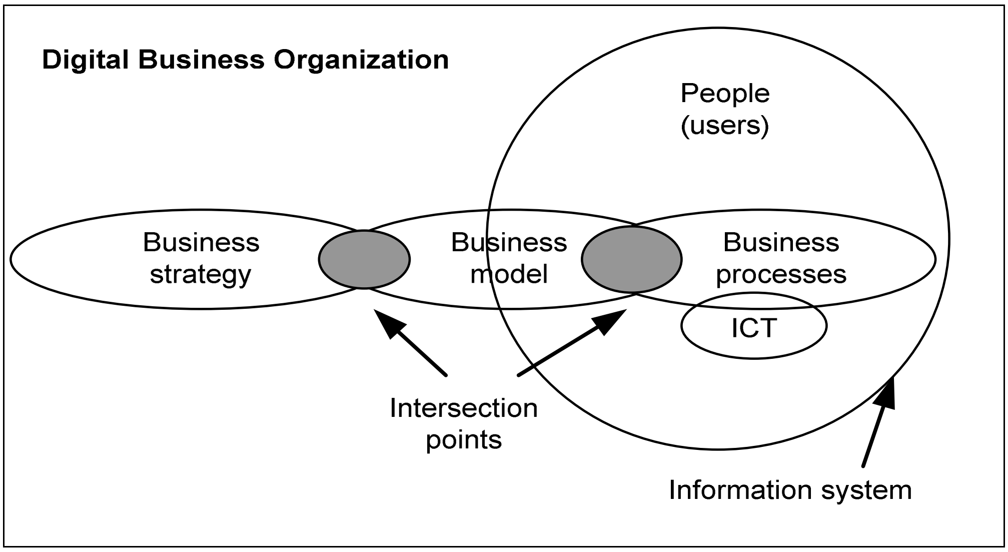

Figure 3-4. Business Model Intersection Points

(2) ***Business model to business process model along with their information systems.*** This is the second transitional stage represented by the second intersection point. At this stage, the business model acts as the base system from which the detailed and operational business process model along with its information systems should be derived. A business process is defined in terms of process elements (activities) whose united behaviour allows the provision of a particular service (de Cesare et al., 2003).

Information systems, on the other hand, continuously emerge from the adaptive usage made by the users of ICT systems, in combination with processes so as to make businesses function (Paul, 2007). However, although business processes and information systems are derived from the business model, the latter does not define precisely how processes and information systems are executed and run in a specific environment. But, it implies options on which to design different business processes and information systems. For instance, having an Internet Enterprise Resource Planning system (IERP) as one of the technological resources would affect the configuration of value network related processes and information systems. However, they still can be designed and configured in a flexible manner.

3.4.4 Practical Functions of Business Models

The useful roles of the business model and the benefits organizations can achieve by appropriately employing the concept are highly significant as they show the practical importance of business models design. Generally speaking, as illustrated in Table 3-4, research into business models has looked at the business model at three different levels of analysis; at the organization level, network of organizations, and at the level of a particular technological service or product.

Table 3-4. BM: Levels of Analysis

Levels of Analysis	Brief Description	Representative Literature
Organization	This is the typical way of looking at the business model. At this level of analysis, research is mainly about defining an 'organization' business model; differentiating it from business strategy and studying the interplay between both concepts. It also examining organization business model components, development and change methodologies, evaluation criteria and success factors.	Linder and Cantrell (2000); Petrovic et al. (2001); Amit and Zott (2001); Weill and Vitale (2001); Chesbrough and Rosenbloom (2002); Afuah and Tucci (2003); Osterwalder et al. (2005).
Network of Organizations	The focus here is on how a network of organizations collaborate and cooperate together in order to provide value through offering technological innovations to the targeted customers.	Gordjin and Akkermans (2001, 2003); Haaker et al. (2006).
Service (Single or Packaged)	The focus here is on the offered technological artefact (product/service), whether it is a single or integrated (packaged). In other words, how to capture financial and other sorts of value from a potential capability of a specific technology.	Van de Kar et al. (2003); Kamoun (2008).

Applicable at all of these levels, the applied analysis (see Chapter 2, Iteration 1, pp. 47-53) reveals interestingly that the business model is a multi-purpose concept as its utility is diverse; and that the concept can be used for three main functions within digital organizations, such as telecoms, as follows:

(1) ***Conceptual tool of alignment.*** Having established the reach of the BM concept as an intermediate theoretical layer, the research now moves a further step towards the contextualization of the BM concept as a conceptual alignment layer. In this modern digital world as opposed to the traditional one, translating business strategy into business processes has become much more of a challenge. Business processes are now mainly ICT-enabled. In addition, today's business environment is more dynamic, characterized by ongoing fast changes and severe stakeholders' pressure all adding to the complexity of managing modern ICT-based businesses. Therefore, the business model has risen to prominence as a conceptual tool of 'alignment' to fill the gap between corporate strategy and business processes including their information systems, and to provide a crucial harmonization amongst these organizational layers, as illustrated in Figure 3-5. Nevertheless, for businesses to survive and succeed, the business strategy, business model, and business processes along with their information systems, should be treated as a harmonized package. This package should be reviewed continually to ensure its consistency with the external environment as well as the stakeholders' interests.

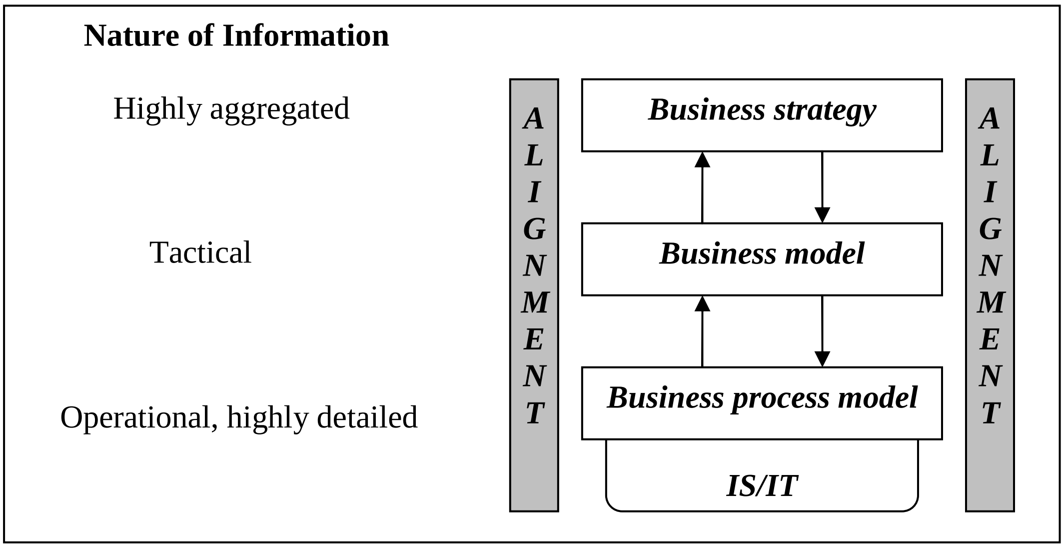

Figure 3-5. Digital Business Layers

(2) ***Interceding Framework.*** The business model signifies a mediating construct between technological artifacts and the fulfilment of strategic goals and objectives

including the creation of the essential economic value, as demonstrated in Figure 3-6. Indeed, Chesbrough and Rosenbloom (2002) argue that “a successful business model creates a heuristic logic that connects technical potential with the realization of economic value [and that] the business model unlocks latent value from a technology” (p. 529). Similarly, Kamoun (2008) argues that the “BM becomes the blueprint of the way a business creates and captures value from new services, products, or innovations.” (p. 638). In line with this approach, Yuan and Zhang (2003) argue that it is not the technological application itself, but rather the business model behind the technological artefacts that makes for success and allows hi-tech companies to achieve their strategic goals and objectives.

Based on this standpoint, the business model portrays a sound translating method essential to obtain and capture values from the proposed digital innovations. Indeed, the technology is positive only if it addresses the requirements of its users in an efficient and effective approach. The business model has been perceived as the primary reason behind technologies’ success or failure. In the telecommunications sector, for example, the success of NTT DOCOMO’s i-mode mobile services is primarily credited to its well-designed business model in action (Ratliff, 2002; Ballon, 2007). On the other hand, the low adoption of WAP (Wireless Application Protocol) services is mainly seen as being due to the absence of a feasible business model and its inappropriate configurations (Sigurdson 2001; Kumar et al., 2003).

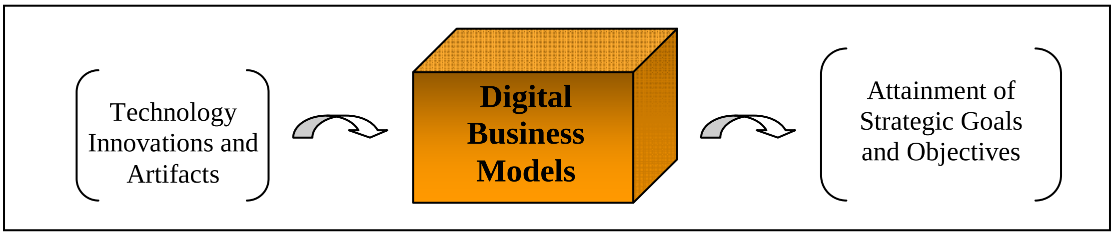

Figure 3-6. The Function of the Business Model as an Interceding Framework

Appreciating this particular function for the BM, the author believes that the concept can be perceived fruitfully as a *backbone* (i.e. central and cohesive framework) providing a consistent and systematic approach for designing, evaluating, and managing different technologies and their connected services and products, as illustrated in Figure 3-6.

(3) ***Strategic-Oriented Knowledge Capital***. The business model is highly critical given that it portrays the *underlying logic* of a business system, demonstrating the ways in which businesses are performed and strategic objectives are achieved. Moreover, the importance of the business model to any digital organization comes from the fact that it is considered as a strategic-functional algorithm demonstrating high-level business rules and practices. Thus, it answers questions related to value creation and configuration in addition to value exchange; i.e. value created as well as value captured. Despite its significance, business models of organizations are rarely articulated or defined explicitly (Alt and Zimmermann, 2001). Most often they represent a tacit knowledge in the minds of one or few key managers within organizations and are seldom communicated to others.

Describing the business model explicitly has become a vital necessity and one of the most important organizational assets. An explicit business model enhances digital business managers' control over their businesses, and enables them to compete better due to the appropriate and necessary level of information that the business model provides. This level of information also extends digital business managers' knowledge of how business organizations will adapt their strategy, business domains, business processes, and information systems to cope with the complex, uncertain, and rapidly changing digitalized environment. Thus, there are potential improvements in organizations' abilities in achieving their strategic outcomes given that the information that the business model offers is neither highly aggregated, which is in the case of business strategy, nor highly detailed, which is the case of the operational business process model.

The author here suggests that an *explicit* depiction of the BM could be positively employed to mobilize organizational knowledge capital at last useful in enhancing strategic decision-making functions and at the same time leveraging the practice of the business model in action. The business mode - if explicit - forms a critical organizational asset or resource promising to provide a digital organization with the longest enduring competitive advantage. Hence and consistent with Suchman (1995), the author argues that by designing the business model explicitly and making it more visible, a more initimate view of the business settings is realized.

These three functions of the BM concept are not mutually exclusive. They can be utilized simultaneously for different purposes and objectives within organizations. However, the author assumes that the realization of the importance of business models and their functions explains the significance behind the rise of BM research with the advent of IT-centred businesses, such as those in telecommunications.

3.5 A Concise Definition of Business Models

In this section, the author utilizes, in a systematic manner, the developed hierarchical taxonomy as a guideline to integrate the concept's details into a comprehensive and concise definition. The opening point in this discussion is concerned with the meaning of the term 'model'. Osterwalder et al. (2005) define a 'model' as a "simplified description and representation of a complex entity or process". Others argue that it is an abstraction, simplification, and/or representation of reality (Stähler, 2002). Since we are here concerned with the business term, the following provides a starting point:

The business model is an abstract representation of a business.

Many ways can be used to represent a real entity such as a business. For example, these may include conceptual, textual, and/or graphical representations. Most researchers consider the business model a concept. Neuman (2003) suggests that the concept is an idea which could be expressed as a symbol or in words (Lambert, 2006). Further, Palvia et al. (2006) indicate that a model could be communicated mentally, physically, and/or verbally. Thus the definition of a business model has been enhanced as follows:

The business model is an abstract representation of a business, be it conceptual, textual, and/or graphical.

Economists depict a business as a production system that adds value to the environment (March and Hevner, 2007). Parkin (2000) argues that the overall goal of the business is to maximize its long-term value. ISO/IEC14662 (1997)(E) defines a business as a series of processes, each having a clearly understood purpose, involving more than one organization, realized through the exchange of information and directed towards some mutually agreed upon goal, extending over a period of time. It also defines an 'organization' as a unique framework of authority within which a person(s) act, or is designated to act, toward some purpose. Drucker (1999) argues that the next information revolution underlies the new definition of a business organization as the "creation of value and wealth". Moreover, he is questioning for whom the business organization is actually creating value.

However, many researchers have not distinguished between the business goals and the means by which they are achieving their goals and objectives. Organizations are conducting their business to achieve different goals and objectives based on their classification, for example, whether it is a business-oriented (for-profit) or governmental (not-for-profit) organization. Creating value for customers is only one of the means by which organizations achieve their objectives and goals. Therefore, the business model definition has been extended as follows:

> ***The business model is an abstract representation of an organization, be it conceptual, textual, and/or graphical, of all arrangements that are needed to achieve its strategic goals and objectives.***

As we saw, most researchers have defined the business model concept based only on some of its components. Nevertheless, based on the provided taxonomy (see Table3-2), we provide a more inclusive view that includes value proposition, value architecture, value network, and value finance along with their building blocks. Accordingly, the business model definition has been updated as follows:

> ***The business model is an abstract representation of an organization, be it conceptual, textual, and/or graphical, of all interrelated architectural, co-operational, and financial arrangements designed and developed by an organization, as well as all products and/or services the organization offers based on these arrangements that are needed to achieve its strategic goals and objectives.***

Abstraction implies simplification. This means that the BM cannot represent all aspects and/or details related to the organization, but represents the business hallmarks that depict the underlying business logic. Thus the word "core" has been added to the definition.

> ***The business model is an abstract representation of an organization, be it conceptual, textual, and/or graphical, of all core interrelated architectural, co-operational, and financial arrangements designed and developed by an organization, as well as all core products and/or services the organization offers based***

on these arrangements that are needed to achieve its strategic goals and objectives.

Further, the business model is not only designed and developed for existing businesses, but also for future planned businesses (Stähler, 2002; Janssen et al., 2008). Accordingly, to show the dynamics of BMs, a definition of the business model is finally presented as in Figure 3-7.

The business model is an abstract representation of an organization, be it conceptual, textual, and/or graphical, of all core interrelated architectural, co-operational, and financial arrangements designed and developed by an organization presently and in the future, as well as all core products and/or services the organization offers, or will offer, based on these arrangements that are needed to achieve its strategic goals and objectives.

Figure 3-7. A Concise Definition of Business Models

This definition has the following characteristics:

1- It is comprehensive and general: the proposed definition is comprehensive as it encompasses all BM compositional facets; since BM fundamental constructs (V^4 Dimensions), characteristics, scope, and BM primary purpose are all integrated. It is also general given that it is applicable and useful to any modern ICT-based organizations.

2- It demonstrates the flexibility of the business model representation: there is no single way for a business organization to describe its actual business model. Representing the business model is a flexible process; since it could be represented conceptually in an oral way, textually in a document, graphically for visual aid purposes, or by using a mixture of these. These means of representation are all included in the definition.

3- It identifies the location of the business model within the digital business organization: the business model concept is an intermediate layer between the corporate strategy and ICT-enabled business processes including their information systems. This inclusion of this feature is mainly achieved through demonstrating the nature of information the business model delivers. Moreover, the inclusion of "strategic" in this definition shows that the business model is mainly strategic-oriented within different business organizations.

4- It represents the importance and the reasons behind designing and developing the business model: this requirement is achieved through emphasizing the kind of arrangements needed to offer the desired value proposition in order to achieve an organization's strategic outcomes.

3.6 Summary

Despite awareness of the significance of the business model to an organization's success in business, in particular digital business, there has been little consensus about its basis. The business model concept is relatively young but has been used subjectively in various contexts. Consensus about business model compositional aspects is crucial since it represents a framework or a theoretical underpinning which researchers may apply to different industries within different contexts. It is also fundamental to practitioners since the business model could be utilized as a reference measure for their business performance analysis.

To address these issues, this chapter clarified the business model concept. The author reviewed the IS-related literature, classified the business model definitions, and extracted a hierarchical taxonomy which was used as a guideline on which to develop a more comprehensive and general business model conceptual framework. In this chapter, the research provided a comprehensive ontological structure of the BM concept showing that value proposition, value network, value architecture, and value finance are the main dimensions. This chapter also reveals the modelling principles of business models as conceptual, multi-level, dynamic, granular, and coherent.

Furthermore, the research has shown that the business model is an essential conceptual tool of alignment in digital business. It can be depicted as an intermediate layer between business strategy and ICT-enabled business processes in order to fulfil the missing link created by the complexity of the digitalized environment. The business model is derived directly from the business strategy on which the business processes and the required information system is derived. This chapter also showed that making the business model more explicit helps digital organizations assess the value of intangibles in their businesses since the information provided by the business model mobilizes knowledge capital that supports organizational strategic decision making. Further, this mobilized knowledge signifies an organizational asset that enables a digital business to achieve sustainable competitive advantage in its market.

The business model is also an important backbone for technological artifacts as it leverages their success and facilitates the attainment of strategic aims including economic value. However, for business organizations to survive and to succeed, a well designed business model that ensures harmonization among business strategy, business processes, and information systems is crucial. Moreover, a business model for a digital business should be reviewed continually to ensure its fit with the complex, uncertain and rapidly changing external environment. Adding to the body of BM scientific knowledge helps practitioners such as managers, business model designers and evaluators, and industry consultants realize the most appropriate BM to achieve their strategic goals and objectives.

The author in this chapter proposed a novel unified BM framework which takes into account the different views expressed in the IS literature and incorporates new mined knowledge based on the applied analysis utilizing content analysis methods. It is hoped that this generic, comprehensive, and unified business model framework works as a reference model and enables consensus that has not yet been achieved.

THE DESIGN AND ENGINEERING OF INNOVATIVE MOBILE DATA SERVICES: AN ONTOLOGICAL FRAMEWORK FOUNDED ON BUSINESS MODEL THINKING

CHAPTER FOUR: THE V⁴ MOBILE SERVICE BM ONTOLOGY

4.1 OVERVIEW

This chapter aims to inform and advise mobile service design and engineering by looking at this issue from a rigorous and holistic perspective. To this end, this chapter puts forward a novel ontology based on business model thinking. The developed ontology builds upon the four primary dimensions that have been introduced in the previous chapter (See Chapter 3, pp. 78-84) for the purpose of effectively designing business models of mobile data services. These four design dimensions are: *value* *proposition*, *value network*, *value architecture*, and *value finance*. Within these dimensions, sixteen key design concepts are indentified along with their elements, interrelationships and rules in the telecoms service business model domain and clear semantics are produced.

The developed ontology is of value to academics and practitioners alike, particularly, those interested in telecoms strategic-oriented IS/IT and business developments. Employing the developed ontology would systemize mobile service engineering functions and make them more manageable, effective, and creative. The research approach to building the mobile service BM ontology follows the design-science research paradigm, as discussed in chapter 2.

4.2 Introduction to the V4 Mobile Service BM Ontology

Mobile telecommunication providers have recently placed more emphasis on data services and their associated products. This is because telecoms consider that the number and types of services and applications that can be developed on the basis of data are way beyond those that can be created on the basis of voice; and thus data are more flexible. This consideration however highlights the strategic importance of data services to telecoms as they promise to expand their customer bases and generate more profits. This specific issue is highly pertinent especially with the saturation of the voice market and the economic downturn.

Designing and engineering mobile data services is a complex undertaking (Lyytinen and Yoo, 2002a; Bouwman et al., 2008). It is a multifaceted process that requires a thorough examination of a number of critical concepts along with their interrelationships. Mobile service engineering, if seeks for innovations, usually requires involvements from one or more departments within mobile telecommunication providers in addition to the participation of many parties within and outside the telecommunications industry (Fontana and Sørensen, 2005; Yoo et al., 2005). The main aim of such mobile innovations, however, is to create enhanced value to customers and hence, subsequently, maximize the captured value (e.g. revenues, knowledge about market, reputation, etc.) by telecoms.

Aiming to advise and inform mobile service design and engineering in the mobile telecommunications industry, this research develops a novel ontology that identified the main design constructs along with their properties and semantics. The author now provides an introductory summary about the developed ontology. This summary is further elaborated in the following sections.

This research suggests that when telecoms are going to engineer mobile service BMs, they need to address sixteen critical design concepts, organized in the following four dimensions, as illustrated in Figure 4-1: `VALUE-PROPOSITION`, `VALUE-NETWORK`, `VALUE-ARCHITECTURE`, and `VALUE-FINANCE`. These dimensions represent the upper-level constructs of our ontology and we term this the "V^4 Mobile Service BM Ontology".

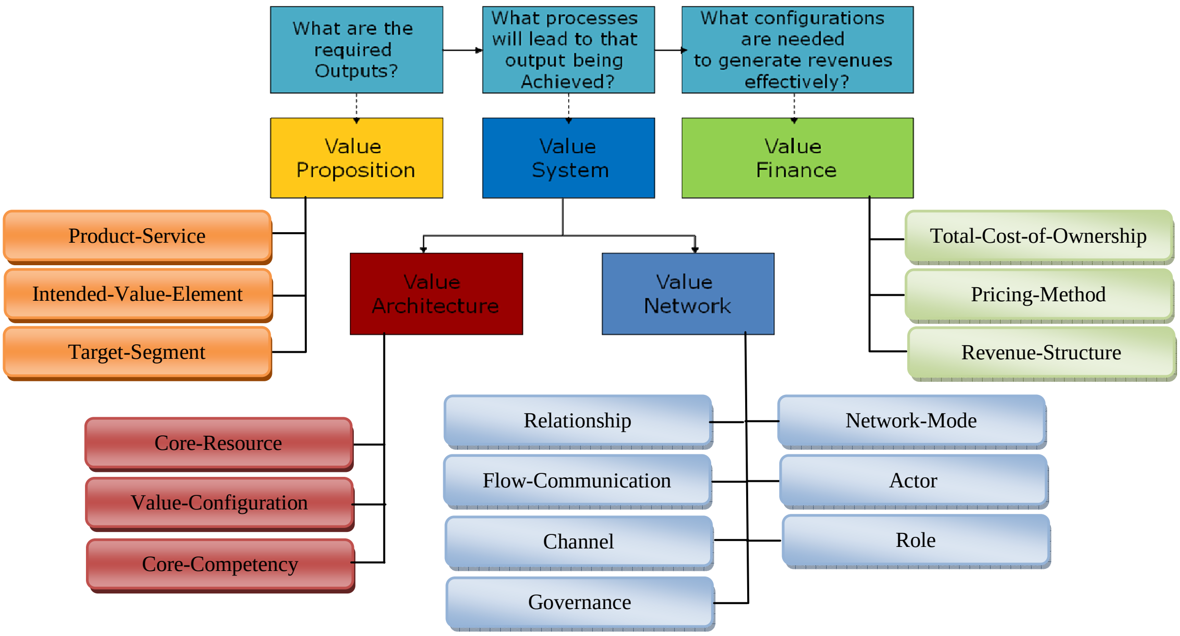

Figure 4-1. Design Dimensions and their Constituent Design Concepts

The dimension of *value proposition* defines the mobile data service in terms of functions and requirements, and their add-values besides mobility and ubiquity. It also includes a definition of the target segment for this particular service including the market(s) and sector(s) that the telecom is targeting by this specific service. *Value architecture* is a broad plan that specifies all necessary core technological and organizational arrangements in terms of resources and their configurations, as well as core competencies that a telecom is equipped with in order to be able to deliver its mobile offering in an effective manner. The *value network* dimension is concerned with the development of needed core collaborations and co-operations with other related businesses. Finally, the *value finance* dimension is concerned with configuring the financial details of the service in a way that ensures it economic viability and profitability.

However, the design and engineering of mobile data services and products is a complex undertaking. Not only the number of aspects examined in such a process is large, but also these aspects are diverse in nature. The design constructs; i.e. dimensions and concepts along with their constituent elements, are very much interdependent, as demonstrated in Figure 4-2. Hence, addressing them separately without taking into consideration their interrelationships is neither sufficient nor effective. One action or alteration in one concept would normally trigger changes in other concepts so as to keep the service feasible and successful. This is because, for example, what is financially viable may not be viable for value proposition purposes, or may be difficult to configure and maintain, or may even be hard to acquire through the value network actors. Thus, a holistic alignment and a coherent trade-off amongst the service BM components are necessary. Telecoms must consider that design concepts interact with one another and should also ensure that they enforce each other. However, this issue pertaining to the interconnectivity of design concepts allows normally the design process of innovative mobile data services to go through a number of iterations before the final version of the service evolves.

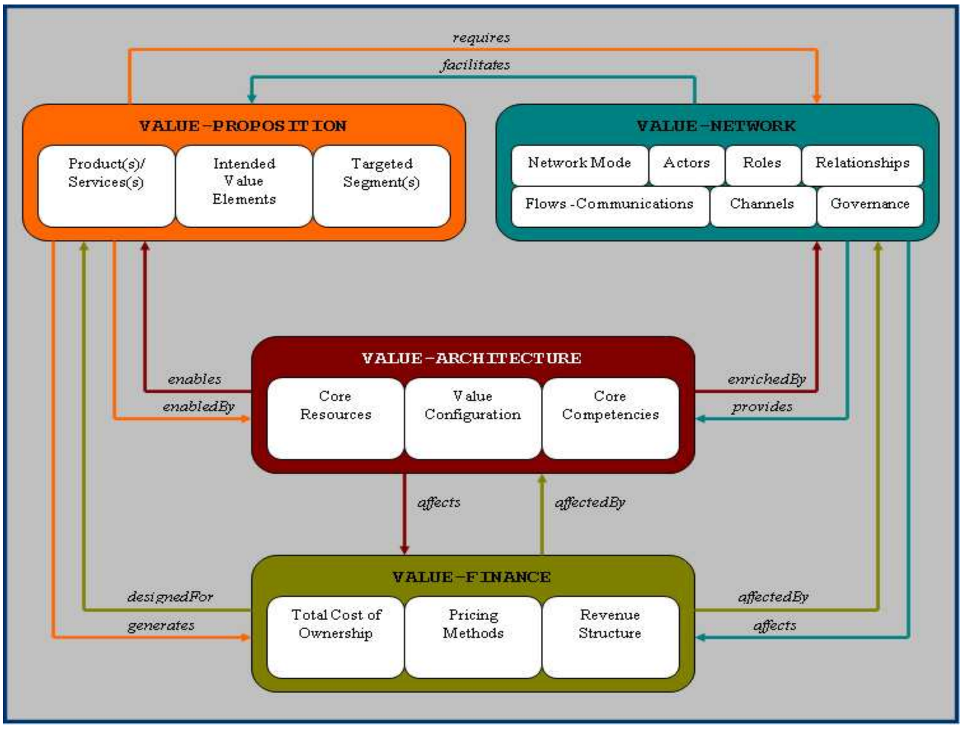

Figure 4-2. V^4 Mobile Service BM Upper Ontology

The defined constructs and tasks within the developed ontology do not necessarily follow a linear sequence; rather a set of tasks for collecting, processing, and analyzing relevant data and information that can fruitfully guide processes and decisions related to mobile data service design and engineering. In the next sections, a more in-depth discussion for each dimension is provided clarifying the mobile service design concepts in addition to their constituent elements and interdependencies.

4.3 Value Proposition

The `VALUE-PROPOSITION` dimension embraces the first three concepts of designing mobile data services: (1) `PRODUCT-SERVICE, (2) INTENDED-VALUE-ELEMENT, and (3) TARGET-SEGMENT,` as demonstrated in Figure 4-3. This refers to the following questions: "what is the offering of a particular telecom?", "what sort of value is incorporated within that offering?" and, "who are the targeted customers that are most likely to desire the proposed offering"?

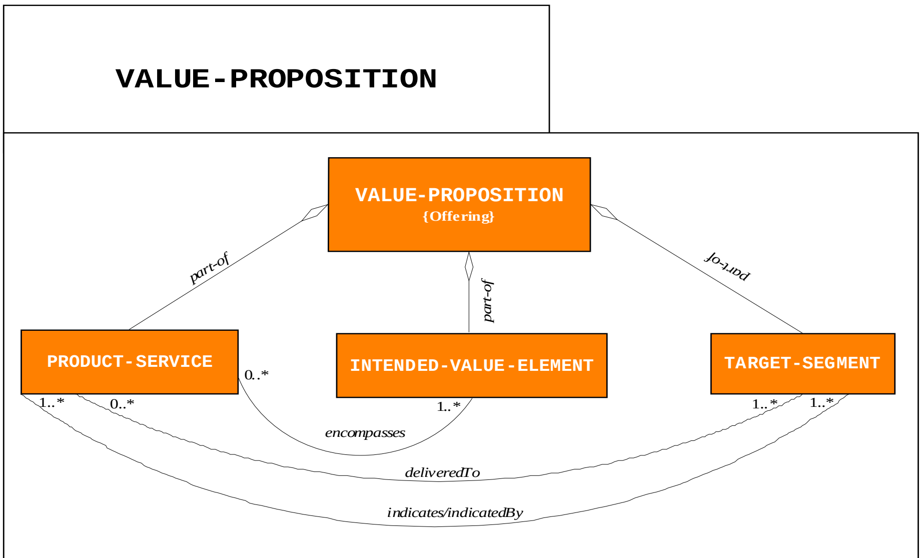

Figure 4-3. `VALUE-PROPOSITION` Dimension

4.3.1 PRODUCT-SERVICE

This concept describes the potential mobile service(s) along with the information provided to target segments. New services are described by attributes such as; name, type, functions, and technical/non-technical requirements. Consider this example; Orange offers a service called *click it*. This service is categorized as an *entertainment* *service* where its main functionality is to provide *information on demand*. The sort of information the service provides includes the latest in movies, sports news, general news, quotes, and weather forecasts. For customers to utilize this service, they need to be *Orange subscribers* and to have a *phase 2+ handset* devices.

This sort of information is useful since (1) it gives an indication about segments seeking and willing to use such services; and (2) it helps in judging the service's feasibility through estimating the size of target segment and matching the features of the service with customer details. For example, Orange has estimated that 100,000 of its youth customers are potential users of the *Clickit* service. But if only 10% of these customers have *phase 2+ handsets*, the size of the target segment is significantly reduced (to 10,000) which may affect the *click it* service feasibility.

At this phase, it is also of great importance to establish the strategic objective of the new service and to make sure it is consistent with the telecom's overall strategy. There are a number of reasons why services may be designed and launched. For instance, some services are launched to *build or sustain the telecom's image* in the market, thus primarily not for *revenue generation*. In some other cases, the target could be to generate *cash flow* or even to *adhere to regulations*. Moreover, some services are *disruptive* whilst others are ordinary *structural* services. The reason why the identification of the service objective is significant is that configurations within the design concepts differ substantially across different objectives. Proceeding with the design while objectives of services are unknown is likely to have serious negative consequences.

When examining mobile data services, innovation becomes a key concept as it is a main source for gaining competitive advantage and also a key driver of economic escalation. Innovation however is a dynamic process that is initiated by an idea and afterwards is fully transformed into practice. Since the telecoms industry is highly dynamic, experimentation of ideas through, for example, simulation software, focus groups, and/or market surveys becomes essential to the development of thriving new services. In this context, experimentation could be depicted as a battle of right versus might where only successfully experimented ideas come true. In other words, since a mobile service is valuable only if it fulfils customer needs or solves business problems, only those specific services that add value to the targeted customers might be considered as candidates.

Innovation in mobile data services facilitates the introduction of novel services that are not only new to the telecoms offering them, but also to the whole telecom industry. It is the discovery of different products/services that aim to increase the economic value either by attracting new customers, increasing the traffic generated by the existing ones (Markides, 2006), or reducing cost and ensuring efficiency.

Innovation however does not necessarily entail a radical overhauling of the telecoms' existing services. It could be due to the provision of a new product or service. It may also come from discovering a new way of delivering an existing product or service. Associating new values with existing services represents another source of innovation. It is also possible through adopting new pricing methods to existing products and services.

4.3.2 INTENDED-VALUE-ELEMENT

This concept mainly looks at the kinds of value telecoms intend to give to customers. Adding value depends on the ability of a telecom to provide customers with services that meet their preferences throughout their life cycle. This is vital since customer satisfaction leads to customer retention and lock-in. Value is basically created when the benefits associated with services are equivalent or exceeding the offering's total price where the latter includes (Slater and Narver, 2000): search, operating, and disposal costs in addition to the purchase price. But in the telecoms highly competitive market, this is not sufficient to guarantee success. Unless delivered values are different or unique, they should surpass those delivered by competitors to win the market.

The notion of *value* in the mobile telecommunication industry can be examined from different standpoints. From a technical perspective, mobile value can be established by many factors such as time-critical arrangements, efficiency ambitions and those relating to on-the-road situations (Van de Kar et al., 2003). Indeed, the mobility feature is considered a primary value element in the mobile telecommunication industry as it provides users with mobile solutions not restricted by time and space factors. But to enhance the mobility value element, aspects related to connectivity, availability, and reliability are essential to be considered by telecoms on a continuous basis.

Value offered to mobile customers can also be categorized as *quality* and *economy* related. Whilst the design of economy-based values are simple as they only depend on the cost of services in addition to the adopted pricing and billing methods, the design of quality-based values is multifaceted as the assessment criteria of mobile Quality of Service (QoS) is wide-ranging. Factors related to mobile QoS could be categorized as (Chae and Kim, 2001): *Connection* (stability and responsiveness), *Content* (objectivity, believability, amount), *Interaction* (structure, navigation, presentation, design and ease of use, size, colour), and *Contextual* (timeliness and promptness). In m-commerce applications, *security* and *privacy* are also considered key quality factors. Furthermore, "*quality of life*" factors (Amanatiadis et al., 2006) in terms of *free utilities* and services which depicts how friendly and generous a telecom is; *environment* which shows the extent to which a telecom is acting in an environmental-friendly manner; *entertainment* that depicts the sort of amusement that is communicated to users; and *public inference* related to radio spectrum allocation are also relevant.

From another standpoint, value can be perceived as *utilitarian* or *hedonic*. Utilitarian value is the effective achievement of a utilitarian goal which is often suitable for customers classified as problem-solvers (Pura, 2005). Location-based services is one example of mobile services providing utilitarian values such as finding the nearest petrol station, although such services can also provide location-based games which deliver hedonic values. Essentially, hedonic values are delivered when mobile services successfully provide users with fun and enjoyment. Further examples of hedonic services include mobile music and video-clips.

The value delivered by mobile services could also be recognized as *emotional* in that it fulfils people's needs, for example in relation to status and independence. Technology is also playing a role here as it has the potential to deliver what is called *epistemic value* (see Sheth et al., 1991) that entice customers looking for curiosity and novelty experience as well as new knowledge acquisition. The value of *time* is also relevant. Users may favour a particular telecom because it provides them with novel services and products faster than rivals do, or even because the telecom responds to their queries and questions more promptly. In the telecoms sector, there are also very powerful *network effects* and *brand values* that can be communicated to customers.

Having discussed sorts of values in the mobile telecommunication sector, the question here is what sort of value elements should service designers and engineers encapsulate within the new service? Although this issue is complex and has no easy answer, this research suggests that no matter what are the selected value elements to be delivered to customers, they should (1) meet the terms of the service objective, (2) comply with the telecom's overall strategy and vision, (3) be consistent with the target segment nature and behavioural patterns, (4) be able to be delivered efficiently and effectively through telecom's infrastructure, structure, technological architecture, and value system, and (5) be positioned successfully both; internally within the existing service portfolio, and externally within the services offered in the market by other rivals.

4.3.3 TARGET-SEGMENT

This concept describes the nature of the targeted segment by a particular telecom service. Segmentation of customers implies clustering them into different groups based on shared common properties and characteristics. Segments might involve customers identified as individuals, groups, or organizations. In choosing their desired customers, telecoms could focus on a niche or a mass market. This might be considered as a local, regional, or even international marketplace. Usually when customers are individuals, segmentation is done by utilizing their demographic details including income, patterns and trends, and cultural norms. If customers are enterprises, segmentation is done on the basis of one or more of these factors: enterprise capital, size, revenue generated from the enterprise, sector, industry, and so on.

The high level of dynamics in today's marketplace makes, in particular, managing and tracking this information one of the most essential aspects to ensure services are successful. Segmentation is vital since targeting is about choosing profitable clusters. It helps in responding to changes in demand more promptly and effectively. Segmentation is also fruitful in evaluating existing groups or segments, and deciding which one to ignore, add, or cultivate.

4.4 Value Network

Contrasting the design of the mobile voice service which is traditionally carried out by each single telecom, the development of mobile data services, due to its complexity, calls for participation and collaboration amongst many actors possessing different expertise.

The implications of this have changed the business rules of the telecommunications industry. For instance, cellular infrastructure deployment is no longer a major problem, but how to co-operate in a much more complex system to launch innovative services efficiently and effectively is much more of a concern. Currently, it seems that analyzing the mobile telecommunications industry in terms of a *value chain* is no longer an appropriate or valid mechanism (Peppard and Rylander, 2006; Ballon, 2007; Bouwman et al., 2008). This is because this concept has been developed when the relations between firms were somehow simple and linear. To deal with this particular issue, the concept of a *value network* has emerged to be used as a more appropriate analytical lens when looking at today's complex collaborations including non-linear relationships such as the relationships amongst mobile network operators, content providers, content aggregators, etc. in the mobile telecommunications industry.

Designing powerful value systems is critical to the success of mobile data services. In explaining why i-mode services are generating high revenues in Japan, while data services in Europe and USA are struggling, Takeshi Natsuno, the NTT DoCoMo's managing director for i-mode services, argues that the problem is related to market arrangements and structure (Natsuno, 2003). He believes that proper value systems that support the creation and delivery of mobile services are still absent in Europe and the USA.

The concept of a value network might be best perceived and presented as a 'multi-party stakeholder network' (Gordijn and Akkermanns, 2001), as it depicts the cross-company or inter-organization perspective towards creating and capturing value from innovations. This concept demonstrates the way in which transactions are enabled through the coordination and collaboration amongst parties, multiple companies and stakeholders (Campanovo and Pigneur, 2003).

Developing effective value network is a very challenging aspect as it includes actors and issues uncontrollable by the telecom. The applied analysis in this research reveals that if telecoms are to fruitfully design powerful value networks, they need to methodically examine seven design constructs and their interrelationships (See Chapter 2, iterations 1-3, pp. 46-59), as signified in Figure 4-4. The identified design constructs are as follows: `(1) NETWORK-MODE; (2) ACTOR; (3) ROLE; (4) RELATIONSHIP; (5) FLOW-COMMUNICATION; (6) CHANNEL; (7) GOVERNANCE`. The issues to be delineated while considering each design construct and their relations to other constructs are discussed below.

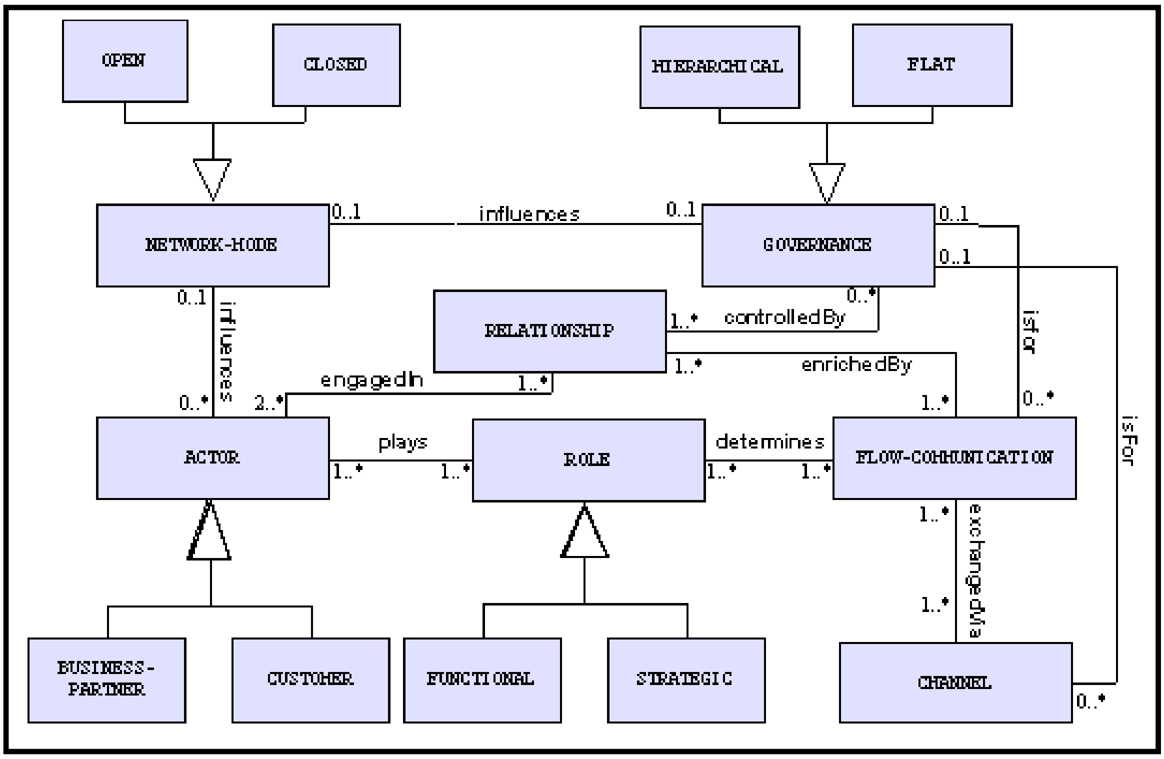

Figure 4-4. `Value Network` Dimension

4.4.1 NETWORK-MODE

Concerning the development of innovative mobile data services, telecoms can create networks ranging from being fully open to totally closed. The design of open networks implies that any actor can participate through offering ideas. On the other hand, the initiative of closed networks entails that ideas and contributions can only come from a selected number of actors who are considered eligible to participate. Sometimes, the mode of the value network is neither totally open nor fully closed.

This is normally the case when the initial value network establishes certain criteria and rules for participation and if actors stratify these criteria then their participation in the network becomes possible. Such value networks are normally called “walled-garden”. In this research, the walled-garden model is considered as one type of closed network given that the rationale behind this model is consistent with closed networks.

However, we postulate that selecting the most fitting mode for the network is a challenging course of action. This is because different settings and requirements call for different sorts of configurations. Supporting the idea of open networks, Chesbrough (2006) claims that this kind of network design is the only way to thrive in the new innovation landscape. The argument is that creating open networks allows firms to harness external ideas while at the same time leveraging their in-house R&D outside their current operations.

Unlike Chesbrough, Pisano and Verganti (2008) argue that there is no one single approach that is successful at all times and that deciding on how best to leverage outsiders’ power is no easy task. Because of the applied analysis in this research, the author aligns his views with those of Pisano and Verganti. To give just a few empirical evidences supporting this standpoint, consider the following examples. Both SMS and WAP have been developed following an open mode. Whilst SMS is recognized as a massive success, WAP is largely considered a failure (Kivimaki and Fomin, 2001). On the other hand, i-mode service and the iPhone have been developed following a closed mode and are both considered successful; though i-mode service is not perceived as such outside Japan (Hung and Yeh, 2006). In retrospect, the current research postulates that each network mode has its own trade-offs; thus telecoms has to choose what best suits their settings, as illustrated in Table 4-1.

Indeed, open networks attract a wide range of ideas from varied domains and perspectives, but screening them is time-consuming and expensive (Pisano and Verganti, 2008). Moreover, aligning interests and goals of participant actors is challenging when an open network mode is followed. It is also harder to manage and coordinate with open networks. On the other hand, when a telecom comprehends the needed knowledge domains; users and market requirements; and which parties and actors to draw on, then a closed network model is considered highly effective as it would facilitate the development of the best possible solution or innovation. However, it seems that it is more difficult for a telecom to form a closed network where the number of needed actors is large and when these actors are coming from different knowledge domains. Moreover, following a closed network model may lead telecoms to lose valuable opportunities and ideas available outside the scope of the selected actors.

Table 4-1. Network Modes (Compiled after Pisano and Verganti, 2008)

Mode	Advantages	Challenges	When to use
Open	• Attract a wide range of knowledge domains.	• Screening ideas is time-consuming and expensive. • Aligning different objectives of participants is more challenging. • Harder to manage and coordinate.	• You can evaluate the proposed solutions cheaply. • The requirements are not well-defined.
Closed	• You receive the best solution easier and quicker as contributions are most likely to be more qualified and trusted.	• You have to know how to identify the right knowledge domains and pick the right actors. • You have to fully identify user and market requirements.	• You need a small number of problem solvers. • You know the needed knowledge domain. • You have the requirements well-defined. • You know which actors to draw on. • You can afford the possibility of losing valuable opportunities.

The decision whether to follow open or closed network mode would highly affect the success of the developed mobile data services. From the researcher standpoint, neither closed nor open mode guarantees absolute success. It is the best match between the telecom's attributes and the features of the two collaboration models that allows telecoms to engineer more innovative mobile services.

4.4.2 ACTOR

This design construct is concerned mainly with identifying the core economic actors (i.e. business partners) the telecom need to collaborate and co-operate with in order to engineer, launch, and deliver particular mobile services effectively. In the case of adopting an open network mode, the telecom is first required to screen all received ideas and decide which ones are to be implemented. Thereafter, those parties who have provided the ideas to be implemented will be regarded as the network actors. But, if the telecom is pursuing a closed network mode, then the telecom would be able to immediately identify the actors to be involved based on the defined requirements.

In both cases, the next step is to explicitly define the knowledge domain(s) of each actor and link the actor with the requirement(s) it would contribute to. This would eventually identify the positions of actors in the entire value system and their possible contributions.

The 'ACTOR' concept however does not only include business partners, but extends to incorporate customers, other organizational stakeholders such as regulatory bodies, and even competitors. Examples of business actors include engineering equipment and cellular infrastructure vendors, IS-IT application vendors, manufacturers of cellular devices, content providers and aggregators, telecoms retailers, intermediaries, distributors, and ISPs.

Other actors which might provide complementary services also need to be identified. For instance, in the case of provisioning mCommerce services, telecoms establish relationships with actors from the financial sector (e.g. banks) to handle and manage payments and billing issues. For example, for NTT DoCoMo i-mode service, building collaborative relationships has extended the telecommunication sector to include actors from the outside. Although NTT DoCoMo is the actor handling the billing function within the i-mode value network and rewarding itself for this extra role by applying a 9% commission on service subscription, it has also partnered with leading banks developing new forms of payment and money collection. It has also partnered with Coca-Cola allowing i-mode users to use their handsets with Coca-Cola vending machines and charge transactions to their i-mode bills. To build a strong base for these international collaborations, NTT DoCoMo established, in 2000, a strategic alliance with AOL-Time Warner to provide rich content and marketing for i-mode in the English language.

As telecommunication regulatory commissions are playing key roles in deriving and shaping the telecom sector, these legal bodies are also considered key actors with which telecoms need to interact and adhere to. Indeed, regulatory bodies are relevant as they manage issues related to privacy, security, radio spectrum availability, licenses, patents, and intellectual property (IP).

4.4.3 ROLE

Describing the main role(s) of each actor is the main theme of this design construct. While the role of different customers could be simply described as service supplicants, they could also play different significant roles in service development (e.g. Lacucci et al., 2000). However, the roles played by enterprise actors (i.e. business partners and other organizational stakeholders) are much more varied; thus the current research places more emphasis on this issue to enhance the understanding in this context and help telecoms developing more powerful value networks.

This research distinguishes between *functional* and *strategic* roles played by enterprise business actors in telecoms value networks. This distinction is based on how telecoms need to recognize the contributions of actors concerning value creation and the overall success of the telecom. The functional roles of actors are diverse based on their knowledge domain, experience, and specialty, as illustrated in Table 4-2. For example, the functional role of content providers may simply be defined as creating and supplying original content in the form of text, audio, graphics, and/or video, whereas the functional role of equipment vendors could be defined as providing cellular radio infrastructure, devices, network applications, and/or handsets. Furthermore, actors in the value network might also play contributing functional roles in service-product provisioning, and mediating roles between the telecom and its target segment in which they provide channels and conduct function such as distribution, sales, and marketing. They might also perform after-sale functions.

Banks may provide a source of finance in terms of loans and credits to establish, expand and run the telecom business. They can also act as payment gateways in which they manage issues related to payments and reconciliations. Further, regulatory bodies play major roles concerning pricing, entry to market, competition regulations, patents, and intellectual properties.

Table 4-2. Main Actors and their Functional Roles

Category	Actor	Functional Role
Hardware Vendors	Access Device Manufacturer	Provide the physical cellular devices such as cellular phones, personal digital assistants (PDAs), and smartphones.
	Network Engineering Equipments Vendors	Provide the physical cellular network and telecommunication infrastructure and access equipments such as transceivers and backbone switches and routers.
	Computing Equipment Vendors	Provide computing equipments along with their network-oriented and security hardware. This includes servers, workstation, computers, switches, firewalls, and routers.
Content and Technology Application Providers	Network engineering application vendors	Provide the soft infrastructure such as network and telecommunication management, control, network diagnostic, and optimization systems.
	Middleware and Integrators (software interfaces)	Required to run software over telecom's hardware for technical management and users' usage purposes. For example, software interfaces are needed to technically manage different switches and routers; remote access applications are required to maintain distant infrastructure; and operating systems could be required to be installed on handsets for content transmission and application-run reasons.
	Software and Application Providers	Provides needed software such as operating systems, development platforms, and simulation software.
	Portals	Enable telecoms customers to access different services through multiple virtual communication channels.
	Content providers	Provide needed data, information, graphics, and applications to be communicated to cellular customers.
	Content Aggregators	Syndicate and fuse the provided content information which includes "customization-to-fit" process.
Third Parties and Payment Gateways	Payment Gateways	When mobile commerce is offered, payments gateways represent an intermediary (third party) which provides different methods of payments to cellular users.
	(Wireless) Application Service Providers	Usually they remotely host and manage and number of applications and services for telecoms.
	Finance and Billing Services	Mobile networks and telecom operators frequently rely on a third party to manage the billing services.
	Retailers and Distributors	Perform distribution, marketing, and sales operation for telecom services.
Network and Service Providers	(Wireless) Internet Service Providers	Provide Internet accessibility to cellular customers using mobile internet services.
	Other Mobile Telecommunication Providers (Competitors)	Provide additional services to their customers such as access and roaming.
	Mobile Virtual Network Operators	Buying or (leasing) network capacity which is then utilized to provide services under their own brand names.
Regulation Authorities and Bodies	Government, Telecommunications Regulation Commissions	Manage issues related to privacy, security, spectrum availability, licenses, patents, and intellectual property (IP).

The *strategic* roles on the other hand refer to what key objectives and benefits a telecom is achieving by having a particular actor within its value network. The combined strategic roles played by all involved actors signify the main motives for telecoms to create and form their own value network. This research identifies eight main *strategic roles* as follows.

- *Resource Allocation*: principally, telecoms may not have sufficient resources to offer competitive and novel mobile data services. Thus, they establish relationships with different economic actors to get access to external resources and link them to their own assets. Sometimes, building relationships with particular actors is not even a choice but rather a necessity. This is mostly the case when the situation includes factors as rarity of needed resources, patents, and the existence of technological fabrication secrets (Camponovo and Pigneur, 2003).

- *Efficiency*: consistent with transaction-cost theory (see Williamson, 1985), telecoms may find it more efficient to collaborate with other business actors to acquire needed resources and specialized skills than possessing all resources by its own.

- *Risk Mitigation*: especially when the cost of investment is massive and the success is not quite guaranteed, it is advantageous for telecoms to cooperate with partners to create new services rather than doing it by itself. This factor has become one of the major motives particularly after the current economic downturn.

- *Effectiveness*: when designing new data services, telecoms may recognize that this could be launched only by the existing resources and capabilities. But, if so the new service would lack some important values that are essential to make it unique and competitive. Telecoms in such cases may find it more effective to add a new actor possessing distinctive resources and capabilities so as to launch competitive, high quality services. Co-branding is an example of the core competencies resulted from the collaboration in this context.

- *Time-to-Market*: the telecommunication sector is highly competitive and time-to-market has become one of the main approaches giving telecoms sustainable competitive advantages by being market leaders and pioneers. Many ideas for new services are shared amongst telecoms where the role of each is not only to find the most appropriate services to launch, but also importantly to launch them before other rivals do, if it is to become a winner. Retrospectively, telecoms may approach new actors if they could aid in shortening services' time to market.

For example, regarding i-mode service, it was more efficient and also more effective for NTT DoCoMo to collaborate with content providers and handset manufacturers than playing their roles by itself. This is because the latter calls for huge investments and a learning curve that is most likely to (a) prevent the telecom from getting the first mover advantage; and (b) eliminate the advantage of employing the existing PDC-P as a network infrastructure that was good enough to make the service successful by then; given that technological innovations are emerging rapidly.

• *Agility*: In the dynamic and fast growing telecommunication sector, value network formation might be the best way of achieving flexibility and providing faster response to changing needs.

• *Intelligence*: telecoms through collaboration, cooperation and joint R&D can create a 'collective mind' (Fontana and Sørensen, 2005); thus facilitating intelligence in relation to new opportunities and means of creating, delivering, and exchanging advanced value.

• *Enlarging customer bases*: by collaborating with other organizations, telecoms may aim to expand the size of their customer bases by having the opportunity to access and interact with the customers of the actors they collaborate with. For a telecom, this is an easier, faster, and more effective way of acquiring new customers than undertaking this important issue solely by its own.

However, understanding roles from this perspective allows a telecom not only to identify its position within the network, but also the positions of other actors. This is pertinent as it gives better indications of the possible value to be captured by the telecom. This issue is also important as it helps telecoms in understanding, managing, and controlling its different links with the various actors included in its value network. Indeed, this method of analysis would allow a telecom to accurately identify the functional and strategic contributions of each actor. The size of each actor's contribution should be reflected on its proportion of the captured value so as to keep the business network healthy and sustainable. For example, one of the important reasons that have facilitated the creation of sustainable and powerful value network for i-mode in Japan is related to NTT DoCoMo not being greedy and allowing actors to capture fair values based on their contributions.

4.4.4 RELATIONSHIP

This design construct is about identifying the sorts of links telecoms need to establish with their value network actors. The relationships between telecoms and network actors could take the form of strategic alliances and partnerships, affiliations, joint ventures, mergers, acquisitions, or any other sourcing type. The importance of role(s) each actor plays indicates the appropriate kind of relationship the telecom needs to build with that actor. For example, a sourcing relationship seems sensible for acquiring middleware and other software systems, whilst some sort of strategic partnership appears to be more rational when establishing an association with actors like content and internet service providers as their roles are more substantial in mobile data services.

Establishing appropriate relationships with value network actors is important given that actors follow different approaches with different types of relationships. The differences in the approaches include the level of information exchange along with the type of this information, the level of accepted change to be taken place, and the level of willingness to collaborate and cooperate. Therefore, this research advocates that the success of telecoms BMs depends to some extent on the types of relationships it maintains with various players within the value system.

The kind of relationships telecoms develop and maintain with their customers represents another facet in this concept. Customers are the main sources of revenue; thus creating positive relationship dynamics with them is vital. This helps create intimacy and positive relationships with customers (Hamel, 2000). Telecoms however need to collect relevant information concerning their customers based on the established relationships. Based on analyzing the collected customer details, telecoms need to profile and segment their different kind of customers and provide them with customized services that fulfil their needs.

Telecoms could start building their relationships with their target customers at a very early stage. Customers could be utilized as a source of ideas. In this sense, telecoms are respondents to customers' requests and needs. Telecoms could brainstorm a new service idea with its potential customers, listen to their anticipations and expectations, and collect major information that could help in later stages of the service development. Before the roll-out stage of different services, customers could be utilized as service testers, and after the provision of services they could be employed as service evaluators. Retrospectively, customer involvement at different stages is very helpful to telecoms as not only because it could be considered as an enabler of offering successful services, but also because it gives customers the feeling that they are important and part of the telecoms corporation. This issue however would enhance the intimacy, satisfaction and loyalty of customers.

4.4.5 FLOW-COMMUNICATION

This concept addresses the objects communicated amongst various actors connected in value networks. Hence, it helps service engineers in representing value exchange streams amongst the involved actors so as to make them more controllable, manageable and effective.

The importance of this construct comes from the fact that relationships with different actors are enriched by materials communicated between them. These materials can take the form of information, knowledge, money, products, services, hardware, software, documents, agreements, and any other relevant objects. There are two scenarios for objects' communication or flow; objects flowing between (1) telecoms and customers, and (2) telecoms and enterprise actors. In the former case, consider this example; telecoms create intelligence by collecting information about potential customers. Based on that, they provide them with purposeful services**.** In response, customers allow telecoms along with other network actors to capture value through communicating money and providing other intangible benefits such as feedback information. In the latter case, consider this example; content flows from content providers to content aggregators. The aggregators cleanse, format, edit, customize and combine relevant content and communicate it to telecoms to be used by services. After revenue is generated as customers paying for delivered services, each participating economic actor (i.e. business partner) receives its share from the captured value.

4.4.6 CHANNEL

Examining the communication media or ports used to communicate materials amongst actors as a result of their established relationships is the main theme of this design construct. Channels could be physical or electronic, and can range from being manual to fully-automated where technological systems talk directly to each other. Within the value network of innovative mobile data services, employed channels could be physical or electronic, and can range from being manual to fully-automated, where technological systems talk directly to each other.

The versatility of channels depends on the characteristics of the channel on one hand and the attributes of the objects to be communicated with value network actors on the other hand. Thus, a channel could be *limited* in a sense that only one kind or class of objects can be communicated through that channel, or *versatile* in a sense that more than one class of objects can be flowed through this particular channel. From another perspective, channels can be distinguished based on the number of objects that can be communicated or flowed through one specific channel at the same time; i.e. concurrently. If only a maximum of one object is to be communicated through a channel at a single point of time, then this channel is regarded as *atomic*; where as if the channel is able to carry a number of objects (more than one) simultaneously, then the channel is considered *gigantic*. Given the complexity of mobile value networks and the variety of established relationships and diversity of objects to be exchanged, we recognize that it is important for telecoms to employ different channels since communication ports are used with different actors for different functions including, but not limited to, design and engineering, customer relationship management, collaboration and communication, distribution and logistics, customer service, and marketing of innovative mobile data services.

Furthermore, arrangements in value networks include constructing interfaces with customers. In addition to physical communication channels including intermediaries, telecoms are exploiting the Internet and other associated technologies such as portals and CRM tools to develop valuable virtual communication mechanisms with their customers. The number, type, customer reach capabilities, and the quality of communication channels telecoms build and maintain with their customers and other network actors (e.g. business partners) are critical to success.

This design concept is highly related to the former one (i.e. flow-communication) as service designers and engineers need to select the most appropriate channel at each single flow of objects amongst value network actors. For example, information concerning potential customers could be communicated virtually to telecoms using software agents as channels; whilst to communicate particular mobile services to customers, special handsets may be used as communication media as in the cases of Apple iPhone and i-Mode which are fully discussed in the next chapter. Another example is the use of 'iD payment terminals' by i-mode NTT DoCoMo users. These terminals are used as contactless channels where users need only to wave their i-mode compatible handsets over the merchant terminal to complete the financial transaction and pay using their mobile handsets.

4.4.7 GOVERNANCE

The concept of governance here can be viewed at two levels: (a) the mobile telecommunications industry; and (b) the value network. At the level of a mobile telecommunications industry, governance is managed and tackled by regulatory commissions and other legal bodies. These regulative bodies are in charge of setting out rules and regulations for the industry as a whole. They issue licenses for telecoms concerning different mobile standards and technologies; manage telecoms' patents and intellectual properties; control radio spectrum and allocate frequencies for different services, standards, and technologies; deal with prices and pricing methods of telecoms services; control and manage the number of players within the industry along with competition concerns; and other issues related to regulations. Principally, telecoms are normally responsive and should adhere to the actions, rules, and regulation set out by the regulative bodies. But, in some cases, telecoms can play active roles where they initiate a campaign and collaborate with regulative bodies to change existing rules and norms. For example, in the UK mobile telecommunications industry, British Telecom (BT) and 3UK have initiated the so-called "Mobile Termination Rate"[1] (MTR) campaign and submitted in October, 2009 a petition in this regard to the regulatory body Ofcom. So far, more than 135,000 signatures have been collected to support this petition. The main aim of MTR is to reduce mobile terminations rate so as to reflect their actual cost and subsequently reduces the price per minute for mobile users.

[1] http://www.terminatetherate.org/

At the level of value network, governance tells who, within the value network, has which form of control and power over what kind of objects (Maitland et al., 2005), e.g. data, relationships, channels, functions, and transactions. Typically, actors try to achieve more power and control in order to augment the value captured. This research suggests that keeping track of this sort of information is important as telecoms could utilize it to (a) identify new opportunities where they can have more power and control; (b) evaluate risks associated with existing configuration of governance, and (c) establish reference points for accountability purposes.

There are two main types for governing business value networks. They could be *hierarchically* governed or managed in a *flattened* mode. Hierarchical approaches mean that one of a few actors predominately control and manage the innovation process. The motive for this approach for governing actors is to enlarge their shares of the value captured. Nonetheless, this approach is very risky and may lead to catastrophic results if actors in charge do not have the needed capabilities and knowledge to define problems and evaluate proposed solutions (Pisano and Verganti, 2008).

Managing value networks by employing a flattened method entails that all actors are sharing costs, risks, knowledge, capabilities to collectively solve the innovation problem (Pisano and Verganti, 2008). This is normally the case when the innovation requires a wide range of knowledge domains scattered across various actors coming from different backgrounds. By following this governance method, the shares of the value captured across all actors are approximately the same.

Although such an approach may lead to better solutions, it is usually time-consuming as all actors should agree a solution for the innovation characterized as mutually beneficial. This however may increase the innovation 'time-to-market', which subsequently has the potential to negatively affect the competitiveness of the proposed innovation. Therefore, the fitting choice between hierarchical and flattened governance approaches is considered as one the elements deriving the success of mobile data innovations.

4.5 VALUE-ARCHITECTURE

VALUE-ARCHITECTURE dimension adds three new important concepts when designing new mobile data services: (1) CORE-RESOURCE, (2) VALUE-CONFIGURATION, and (3) CORE-COMPETENCY, as shown in Figure 4-5. In this context, value-architecture can be defined as a broad plan that specifies all necessary (a) technological architecture arrangements that enable mobile communications to operate efficiently and effectively; and (b) organizational infrastructure arrangements including a telecom structure, key processes and functions, task force, management mindsets, and culture that are needed to enable telecom service provisioning as desired. The applied analysis in this research reveals (See Chapter 2, iterations 1-3, pp. 46-59) that for telecoms to tackle the aforementioned aspects appropriately, they need to examine the following three design constructs.

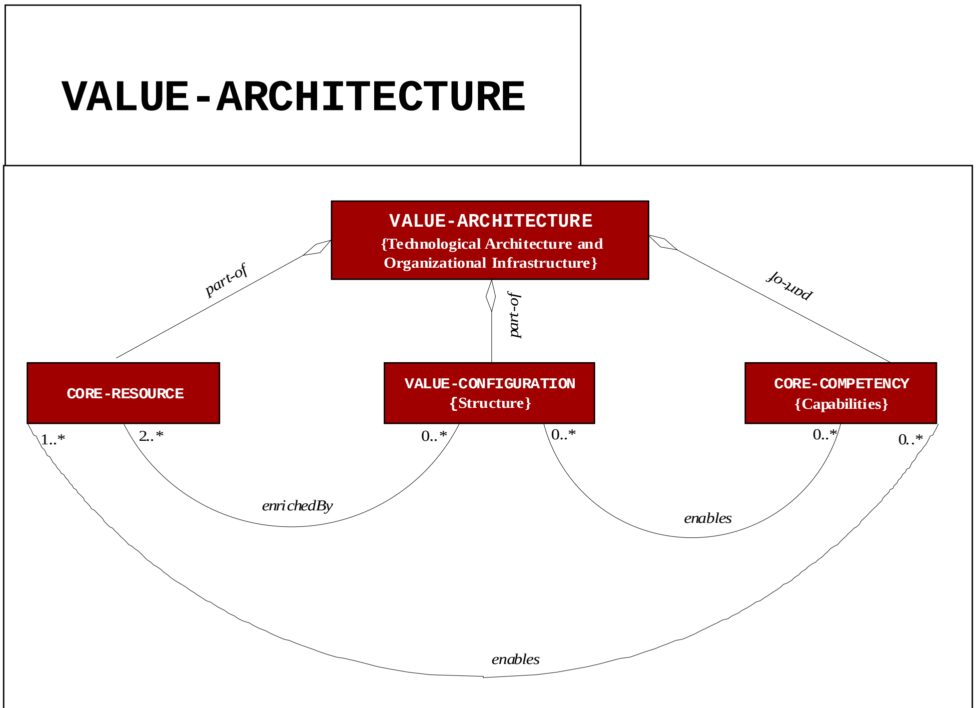

Figure 4-5. Value Architecture Dimension

4.5.1 CORE-RESOURCE

This concept is about examining and creating useful information of the needed assets and resources to develop new services. The Resource-Based View (see Wernerfelt, 1984; Barney, 2001) is highly relevant in this context. The resource-based view assumes that each firm is a bundle of resources. More specifically, it puts emphasis on the strategic importance of *resources* coupled with their integration and *configuration* to the generation of capabilities or *core competencies* and thus sustainable competitive advantages to the firm.

In mobile services, *core-resources* are cornerstones for value creation. Offering what is valued by telecom customers in the value proposition dimension requires adequate and appropriate resources in the value architecture dimension. To be more concise in explaining the aforementioned association we limit the following discussion by considering only the cellular infrastructure.

To give just a general overview, the first generation (1G) of cellular technology can only provide voice cellular service. The second generation (2G) is a digital cellular technology not only enhances the cellular network capacity in general, but also introduced text messaging (SMS) as the first data service in cellular technology. This shift from voice-centered to a data-centered cellular telecom industry has been enriched by the introduction of 2.5G cellular technology which is an 'always-on' technology that adds valuable data services such as web browsing, location-based services, and audio/video downloading. The delivery of voice and advanced data services coupled with high speed has been introduced in the third generation (3G) of cellular technology. Fourth generation technologies (4G) are IP-based integrated systems capable of providing premium speed, quality, and security. The deployed cellular technology, however, not only affects the type and quality of services offered, but also determines the possible pricing methods. For example, GSM (2G) cellular networks only support per-minute and flat-rate charging models (Olla and Patel, 2002), but no others such as volume-based pricing.

For this design concept, the main role of service engineers is to indentify and classify core-resources along with their characteristics. As for classifications, the developed ontology distinguishes human, organizational, informational, physical, financial, legal, and relational (Seppänen and Mäkinen, 2007), in addition to technological types of resources. Also at this point of design, it is essential to connect resources with the specific services they contribute to. This is because the value can be optimized for the customer and the firm by identifying the link between a specific resource and a specific service (Pynnönen, 2008).

4.5.2 VALUE-CONFIGURATION

This concept refers to the ability of telecoms to fruitfully integrate organizational and technological core-resources in a way that allows efficient and effective roll-out of successful services. New sources of value are generated through novel deployments of resources (Moran and Ghoshal, 1996). To create new or revamp existing services, it is sometimes sufficient for telecoms to restructure and reorganize their existing resources. But in other cases, they also need to combine and integrate new sorts of resources.

The *value-configuration* concept is important in mobile service design and engineering. This is because unless resources are constantly superior, acquiring and possessing them would not directly allow telecoms to create unique value and gain competitive advantage. It is the manner in which resources are continuously utilized, deployed, and configured within existing structures, culture, and other organizational and technological characteristics that normally gives sustainable competitive advantage. This research considers value-configuration as a key enabler of combinative capabilities (Koruna, 2004) and core competencies that are important in enabling telecoms to conduct their business more effectively than their rivals do.

Given the dynamic nature of the telecom industry, this design concept has also a significant link with dynamic capabilities (Eisenhardt and Martin, 2000). Dynamic capabilities refer to the ability of a firm to transform its resource base to fit the changing nature of the market including customers as well as the industry that the firm belongs to. This transformation ability is based on learning processes (Teece et al., 1997) on how and when firms should create, integrate, (re)combine, (re)configure and release resources.

However, telecoms at this stage of design need to identify and examine the key processes by which a number of resources linked and configured in a way that allows core competencies to emerge. This indicates that links are needed to be established between resources and key processes, then with core competencies before being finally linked to new services along with their values. Equally important is the link between core business processes and the customer journey. This is essential as customers go through many phases throughout their life span that call for different supplies. Thus, telecoms must ensure the existence of effective processes guiding, supporting and leveraging each of these phases. Any misalignment here would cause huge losses to telecoms.

4.5.3 CORE-COMPETENCY

This concept holds information about the range of *core-competencies* or *capabilities* a particular telecom possesses. Core-competencies (see Prahalad and Hamel, 1990) could be identified through answering the question of what can the telecom do more efficiently and effectively than its competitors? Core-competencies can also be viewed as repeatable patterns of action in the use of assets and the deployment of acquired resources to create and offer services to target segments (Osterwalder and Pigneur, 2002).

Three core competency approaches (after Treacy and Wiersema, 1993; Ballon, 2007) have been identified to reach optimal customer value.

(A) *Operational Excellence*: it is the efficiency of telecoms in conducting their internal and inter-organizational processes and operations. This efficiency allows cost savings which if translated into competitive prices can attract more customers.

(B) *Service Leadership*: is about effectiveness and quality of the services offered by telecoms. It is the innovative ways in which new services are configured and packaged that give premium quality. This quality could be due to organizational infrastructure, technological architecture, or combination of both. Often, innovative services are the result of extensive R&D efforts which play a key role in determining the nature of values offered to customers. This may lead to offering unique services that are difficult for rivals to imitate. Technological competency in particular may provide substantial enhancements to QoS such as reliability, availability, and performance in general.

(C) *Customer Intimacy*: it is the customer experience that builds customers intimacy, or not. When telecoms cannot afford any of the prior strategies, customer experience becomes the main and sole competitive weapon.

> Telecoms need to address customer relationship management to provide customer intimacy and ensure their loyalty and retention.

When core competencies are created through the aforementioned approaches, telecoms need to guarantee the consistency between the undertaken approach and the overall strategy. By referring to Porter's (1980) classification of strategies, this research argues that operational excellence fits well those operators following a *cost-leadership* strategy, while product leadership fits well for telecoms having *differentiation* as their principal strategy.

At this point of design, services designers and engineers should identify the core competencies along with their complexity levels. Thereafter, fundamental links should be established between telecoms' core competencies and the intended value elements to be communicated to customers through the services offered.

Interestingly, business models of innovative companies engaged in digital business have been labelled, patented, and communicated based on their main competencies and capabilities. In eCommerce business, the Amazon business model is depicted as "one-click" portraying its main competency of being simple, easy to use, and fast in terms of processing and transaction time. Dell in the personal computer industry (Kraemer et al., 2000) has originated a successful and innovative business model known and depicted as "direct sales" and "build-to-order" showing Dell's capability of reaching their targeted customers by their own and providing them with customized and tailored computing devices and equipment. In the telecom industry, the slogan of O_2 telecom in the UK which is "we're better, connected" aims to portray its coverage, accessibility, availability, and reliability as main capabilities.

4.6 Value-Finance

The `VALUE-FINANCE` dimension is composed of three main design concepts: (1) `TOTAL-COST-OF-OWNERSHIP, (2) PRICING-METHOD,` and (3) `REVENUE-STRUCTURE,` as presented in Figure 4-6. Value finance is a description of the core arrangements needed to ensure the economic viability of the offering which includes costing and pricing methods. It also describes the way in which a telecom seeks to generate revenue from their offering (Timmers, 1998), and how this revenue is shared amongst different stakeholders.

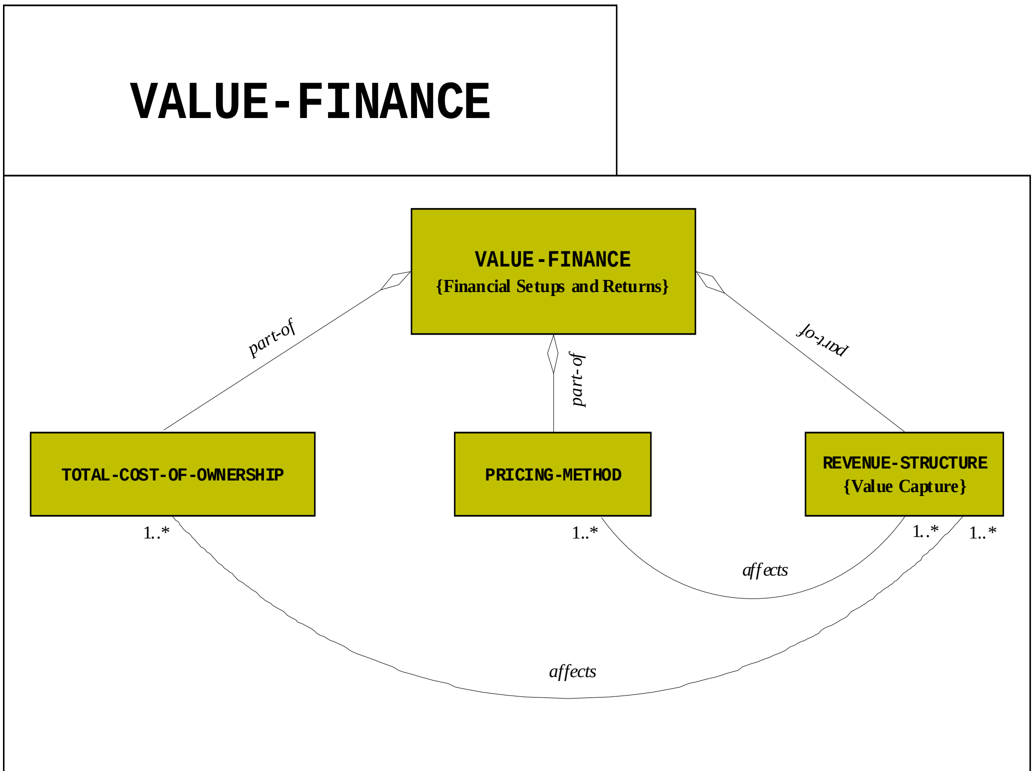

Figure 4-6. VALUE-FINANCE Dimension

4.6.1 TOTAL-COST-OF-OWNERSHIP (TCO)

This concept is fundamental as it deals with financial information about the overall costs with respect to all core arrangements that are needed to create, provide, market, deliver, and maintain mobile services throughout their life spans. TCO not only includes the cost of setup tangible materials such as the cost of access and radio networks, but also covers the cost of development, support and maintenance of equipment and applications. It also includes the cost of collaborations telecoms conduct with other value network players. However, although the one-time cost (e.g. setup equipment and applications) appears to represent most of telecom's expenditure, the telecom's running cost (maintenance and upgrade) most often exceeds the one-time cost over time.

Hence, the concept of TCO represents the entire cost of any telecom including both the fixed and the variable costs. TCO is very important to the competitiveness of services provided by a telecom. Efficiency approaches deployed by a telecom may lead to TCO of services lower than it rivals. This in return gives a telecom more flexibility and competitiveness in setting up the profit margins for different services in a way that makes them more attractive to customers and more revenue generating to the telecom. Thus, the weight of this design concept refers to its significance in service pricing and profitability.

4.6.2 PRICING-METHOD

This concept holds information about the prices of different telecom services along with the employed pricing mechanisms and billing methods. Pricing methods in the telecoms sector can be generally classified as fixed, dynamic, and a mixture of both. The fixed pricing-method implies that customers pay from time to time a certain amount of money to get a predetermined use of certain services and facilities. Typically, fixed pricing is applied in the form of contracts and packaged services. On the other hand, dynamic pricing implies that the price of a certain service differs across usage levels. This research distinguishes *time-based*, *transaction-based*, and *volume-based* as three subcategories of dynamic pricing methods. For example, surfing the internet using your handset and being charged on the basis of the number of minutes is an example of time-based pricing method, whilst charges based on the number of downloads is an example of transaction-based method. If the charges are on the basis of the size of downloaded files, then it is volume-based pricing method.

The role of service designers and engineers here is not only to set up appropriate prices for the new services, but also to choose an appropriate pricing method. But, this is complex as many factors affect the pricing of any mobile data service. Nonetheless, this research suggests that aspects related to the new service objective, TCO, uniqueness and other features, category, perceived value by customers, affordability, competition level in the market, and whether the service is offered individually or within a bundle of other services are extremely important in guiding the design in this particular concept.

4.6.3 REVENUE-STRUCTURE

This concept contains information concerning the generated revenue. It portrays the profitability of different service classes across customer segments. The concept of *revenue-structure* also shows how the generated revenue is broken down amongst different economic participating actors (Bouwman et al., 2008). The distributions of costs, risks, and revenues should be made explicit and the way in which revenue is divided amongst the economic actors should reflect the division of costs and risks.

The volume of the generated revenue is important to telecoms. It ensures telecoms' financial sustainability and competitiveness. Furthermore, it encourages further investment and leaves greater room for R&D. The revenue generated through a service over a period of time gives an indication of the telecom's ability to translate the value underpinned by technological innovations to financial and economic values. In other words, it indicates the level of the service BM appropriateness at that point in time.

After examining the developed ontology, the research now sums up the discussion by providing a cohesive representation of the design concepts and their interdependencies in Figure 4-7. The ontology is graphically represented in UML as discussed in chapter 2, pp. 59. Moreover, since the ontology is implemented in Protégé- OWL as discussed in chapter 2, pp.60-61, an OWL representation is also provided.

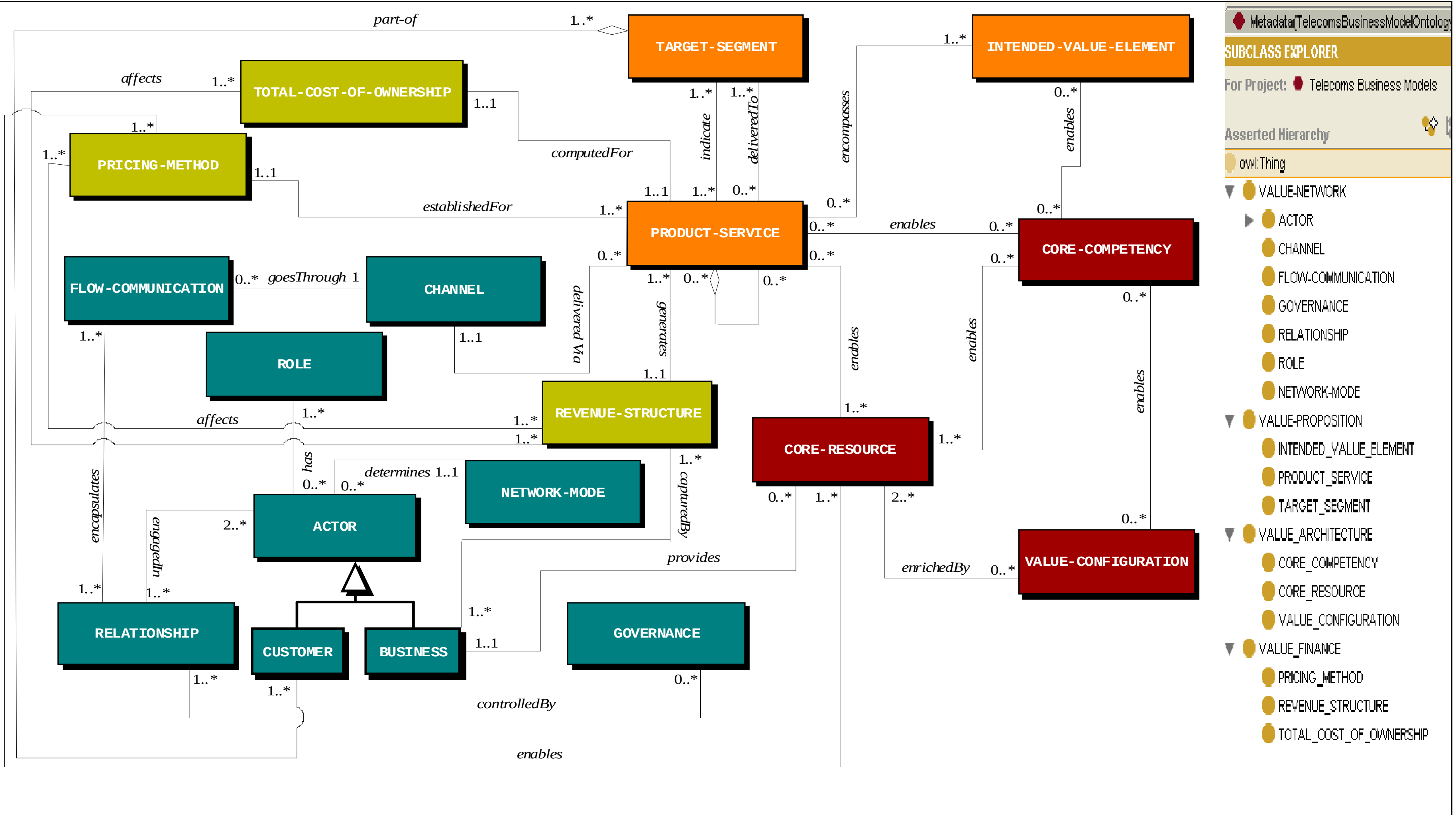

Figure 4-7. The V4 Mobile Service BM Ontology: UML and OWL Representation

4.7 Summary

This chapter examines mobile service design and engineering from an inclusive view; utilizing the BM concept as a method to structure related critical functions. In a rigorous and semantically rich approach, the V^4 ontology has been developed to define dimensions, elements, properties, and semantics of mobile data service business models. The contribution comes from the novel integration of relevant research topics that provides a harmonized ontology extending current research and taking an important step towards systemizing and leveraging mobile service design and engineering functions.

This chapter spells out the BM concept as a coherent framework for mobile service design as it provides a holistic view of a particular business which is not only useful in understanding the internal structure and functions, but also in realizing how telecoms are connected to their external environment and how they interact with it. This chapter demonstrates that designing new mobile data services requires the examination of their value proposition issues and looking closely at the service definition as well as matching the target segments patterns and trends with services value elements. To engineer successful mobile services, it is also vital to have a strong technological architecture capable of providing high QoS (Quality of Service) standards, as well as a suitable organizational infrastructure, including appropriate managerial mindsets.

Delineating the communication and collaboration issues telecoms have with various actors is also crucial, because the structure of the telecom industry is shifting towards a more complex and open system characterized by extensive collaborations amongst many actors. The consideration of the service financial aspects including total cost of ownership, pricing methods, and revenue models is also fundamental. In addition, and in view of the fact that different aspects of service engineering are interrelated, this chapter reveals that it is also important to look at these aspects cohesively and to consider their interdependencies.

The ontology developed contributes to both theory and practice and provides a complete foundational framework for mobile service design and engineering. It is of value to academics and practitioners alike, particularly those interested in telecoms strategic-oriented IS/IT and business developments. The ontology developed not only provides a common language and terminology amongst information systems and software agents to enhance their interoperability, but also amongst people. Furthermore, the V^4 ontology enables capturing and reusing of application-independent knowledge and semantics (i.e. knowledge reuse rather than software reuse). From a practical perspective, this comprehensive ontology enhances telecoms ability to design, create, communicate, compare, analyze, evaluate, and modify their existing and future mobile data services, using a systematic and effective approach.

While this ontology has been developed specifically for mobile data services, the author argues that it would be equally appropriate to the design and engineering of other technological services and products, e.g. eServices, broadband services, and telecom services and products, etc. indeed, the V^4 Mobile Service BM Ontology has been adopted by one company in Latin America to design and develop not only a mobile business application, but also an eApplication for business.

THE DESIGN AND ENGINEERING OF INNOVATIVE MOBILE DATA SERVICES: AN ONTOLOGICAL FRAMEWORK FOUNDED ON BUSINESS MODEL THINKING

CHAPTER FIVE: EVALUATION AND PRACTICAL VALIDATION OF THE V^4 MOBILE SERVICE BM ONTOLOGY

5.1 OVERVIEW

This chapter discusses the evaluation and practical validation of the V^4 Mobile Service BM Ontology using real-life cases of mobile data services in addition to evaluation criteria (see Chapter 2, Iteration 3, pp. 55-59). Evaluation is highly important to prove that the constructed ontology is semantically rich and verify its compliance with the modelled real-world phenomenon. The developed ontology is utilized to analyze and examine three real-life cases of mobile data services. In particular, the author examines the current business model configurations in use for Apple's iPhone services and applications, NTT DoCoMo's i-mode service, and Orange Business Services (OBS). The underlying reason behind choosing these cases is that each one is unique in nature and signifies an innovative artefact in the mobile telecommunications industry; thus they are deemed appropriate to provide a comprehensive evaluation of the developed ontology. Indeed, the use of real-life cases is one of the main evaluation methods in design-science research (Hevner et al., 2004; Pries-Heje et al., 2008).

Apple's iPhone is a recent innovative mobile artefact coupling a large number of mobile services and applications with a special handset. Including this case as a part of the research evaluation course of action is deemed significant. This is because iPhone is identified as a success in the mobile telecommunications industry. As for i-mode in Japan, it is actually the first recognizable successful mobile data service platform that has been launched on the basis of modest technology. Notwithstanding, i-mode outside Japan is less successful and this fact make it even more interesting. Whilst both of the former cases are developed primarily for individual customers, the portfolio of Orange business services is created fundamentally for business users. This portfolio also extends mobile services to include other relevant telecommunication services. These three cases together provide a real-life evaluation of the V^4 Mobile Service BM Ontology.

The use of these three cases for the evaluation course of action is analytical in nature. The author utilizes these cases in a retrospective manner to examine and analyze the way in which each mobile service case has been designed and engineered through the lens of the developed ontology. On the other hand, the author also argues that the developed ontology could also be useful for designing new innovative mobile services and this issue represents one main avenue for future research (see Chapter 7, Section 7.4, p. 227). This is because the ontology identifies the main domains –in terms of constructs- that should be examined when designing and engineering innovative mobile data services. Indeed, developing ontological constructs is important as they represent a language by which problem and solution spaces are defined, analyzed, and communicated (Schon, 1990; Hevner et al., 2004). The developed ontology also leaves room for flexibility since it does not specify precise starting or finishing points, but rather the important domains to be considered.

In addition, the develop ontology appreciates the important interrelationships amongst the developed ontological constructs. The importance of these interrelationships comes from the fact that if you change one aspect in one construct, it will probably have an effect on aspects related to other constructs (Schon, 1990) within the ontology. Hence, awareness about such interrelationships would enhance the design and engineering process of innovative mobile data services.

5.2 Apple iPhone

The iPhone incorporates a large number of services and applications and it is one of Apple products. Apple Corporation was founded by Steve Jobs and Steve Wozniak in April, 1976. By then, the official name for the company was *Apple Computer Inc.* reflecting its main focus on designing and manufacturing personal computer hardware, software, and peripherals. In 2007, the name has changed to *Apple Inc.* reflecting the company's growth and expansion strategy. The vertical market Apple created for TV, music, and movies has been expanded and enriched by the design of the sleek device *iPhone*. This kind of design triumph has brought the company into the telecommunication industry with an astonishing potential for growth. The financial impact for the company, the strength of its value network partners, and the expectation that customer base could be substantial were enough reasons for Apple to develop the iPhone (Macedonia, 2007).

The introduction of Apple iPhone on 29th of June, 2007 has brought in a number of business model innovations pushing the mobile telecommunication industry to a new level of competition. The way the device along with its services-applications (starting from its first-generation to the latest third-generation) are developed and configured, the way Apple utilizes its resources and competencies, and the way it enriches its capabilities through the well design and management of its value network as well as the revenue structure have demonstrated that clearly.

Indeed, the iPhone has been recognized as a success not only in the United States, but also in other countries where this artefact is provided. In many articles and Weblogs, the iPhone has been described as *the invention of the year* (Grossman, 2007), and even as *the most successful innovation of the 21st century* (Miller et al., 2007; AT&T Annual Report, 2008). It has also been referred to as a *cutting-edge* mobile platform (Mickalowski et al., 2008).

Apple's achievement with the iPhone warrants particular attention in regards to what lessons can be derived about the future of mobile data services and products as well as comprehending the underlying key value drivers behind such effective services. It is also interesting to delineate how a *new entrant*, such as Apple in the telecom industry, could not only penetrate a new marketplace and achieve an immediate success, but also take the industry to a higher level of competition. Hence, at this point, the design and engineering of the Apple iPhone platform is examined and analyzed by the means of the V^4 Mobile Service BM Ontology that has been discussed in the previous chapter (i.e. Chapter 4). The application of the developed ontology on the case of Apple iPhone is conducted by utilizing the ontology's design constructs as well as their relationships and semantics. A mapping is carried out between the details of the V^4 Mobile Service BM Ontology and their counterparts in the Apple iPhone case.

5.2.1 The iPhone's Value Proposition

A. *The iPhone Services and Applications*

Apple has developed the iPhone as an *entire solution* in the mobile telecommunication industry with several added-values and convenient advantages in terms of functions and design for personal and professional use. For its iPhone, Apple employs the so-called device-centric model, where the main platform of services is encapsulated or connected directly with the mobile device (Ballon and Walravens, 2008). Indeed, the iPhone is designed and developed as a convergent platform that blends a number of products and integrates numerous services and applications in a simple and user-friendly manner. It is not only a mobile handset, but also a widescreen iPod with touch controls, an up to 3.0 megapixel auto-focus camera, a GPS device, an Internet communication device, and much more. Developing the iPhone as a multifunction platform seems to be logical as the set objective for the product is to "reinvent the phone", as declared by Steve Jobs, the co-founder and CEO of Apple Inc, when introducing the iPhone at the Macworld Expo in January 2007.

As a convergent platform, the iPhone includes numerous bundled services and applications. In addition to text messaging, the iPhone features highly developed email capability, voicemail, music player, Safari browser for Web surfing, video recording and editing, voice control, storage up to 32GB, and many other built-in applications such as calendar, weather, sports, news, navigation, etc. that are to some extent similar to those found in other smartphones and PDAs. Having this large number of services and applications is sensible given that the iPhone is a closed, pre-programmed artefact. The functionality of the iPhone is locked-in where users in principle cannot install or add any application or program, but Apple can do so through remote updates. This limitation is down to security reasons, as argued by Steve Jobs.

Notwithstanding, it seems that the iPhone hacking community has found their way to manipulate the iPhone configurations. They were not only able to hack the operating system in its first generation, but also they hacked the operating systems of its second and third generations. The hacking community has developed so-called *Jailbreaking* that allows iPhone owners to download many applications that are not available through Apple App Store as they come from unofficial parties such as Cydia App Store. However, having the iPhone Jailbroken seems causes problems. At the beginning of November 2009, an Australian student aged 21 developed the first iPhone virus worm called *iKee* that can only infect Jailbroken iPhones by taking advantage of a security hole within the employed SSH client network protocol for data exchange (Whitwam, 2009). Although this worm is not malicious and only changes the iPhone wallpaper, it highlights the issue of security when the iPhone is Jailbroken (Andersen, 2009).

For conducting activities across various wireless networks and to access the Internet, iPhone users are offered many wireless capabilities through the product. This includes Bluetooth up to 2.1 + EDR, Wi-Fi 802.11 b/g, GSM, and EDGE. The second version ‘iPhone 3G’ and the latest version ‘iPhone 3Gs’ provide even faster connection to the Internet using 3G technology including UMTS and HSDPA. The ‘iPhone 3Gs’, in particular, is capable of more advanced features including Internet tethering which allows users to surf the Internet from anywhere using their computers and without the need of Wi-Fi hotspots. This is because users can share the 3G connection on the iPhone devices with their laptops or personal computers.

To leverage the device's utility and convenience, Apple has designed the iPhone with a relatively large touch-screen size; i.e. 3.5-inch, considering its entire size. This is because iPhone lacks a keyboard and instead deploys a multi-touch widescreen display with embedded soft or virtual keyboard. Not only the size of the screen makes it more useful, but also its ability to provide sharp images due to its relatively high resolution (i.e. 480 x 320 resolution at 163 pixels per inch), and its accelerometer that automatically responds to the position and proximity and hence changes the screen format (e.g. portrait to landscape) when the phone is tilted or rotated. This is argued to be one of the reasons why iPhone users surf the Internet more than other users (Rubicon, 2008). Another reason, however, for increased Web browsing is that iPhone's applications appear to run as Web activities (Ling and Sundsoy, 2009).

However, Apple provides only *limited* multitasking through its iPhone OS due to its limited processing power, limited memory, and battery life in comparison to a PC. Examples of concurrent services on the iPhone include playing music in the background while surfing the Web. Another example is that the email is checked periodically in the background while users perform other tasks. On the other hand, some other applications and services cannot be running simultaneously. For instance, applications must be closed before users are able to engage in a voice conversation; i.e. call. Recognizing Smartphone limitations and aiming to improve the iPhone performance, Apple make it very clear in its SDK (Software Development Kit) that *"*only one iPhone application can run at a time, and third-party applications never run in the background. This means that when users switch to another application, answer the phone, or check their email, the application they were using quits*"* (Apple, 2009a). Moreover, Apple in its SDK of the iPhone encourages developers to take into consideration the ability of users to switch amongst applications seamlessly and smoothly.

B. ***The iPhone "Intended Value Elements"***

Apple creates a great deal of *quality* and differentiated value for their customers by offering products and services that are convenient, unique, and hard to be imitated (West and Mace, 2007). Given, in particular, the iPhone's unique and simple design, features and the large number of its services and applications, there are many value elements communicated and delivered to its customers. Principally, the iPhone reflects Apple’s well-known “differentiation” strategy (McGrath, 2000) that leverages the company’s capabilities in designing and developing various solutions for customers with advanced ease-of-use, seamless integration, and innovative industrial design. The device’s content and its simple interaction mechanisms (Ling and Sundsoy, 2009), as well the excellence of its after-sale services (Zhang, 2008) in addition to its high call quality are good examples of the value elements delivered to customers, but what predominantly differentiates the iPhone from other smartphones resides in its *cool factor*. The iPhone is an aesthetic, beautifully engineered device; although it is slim at about 11.6 mm, it is loaded with capabilities in terms of computing, communications, and graphics hidden under its user friendly screen. Furthermore, given that the iPhone is a product of Apple Inc., the brand, in this case *Apple* is another value element conveyed to customers.

The iPhone as a fashionable hi-tech device also allows its owners -especially those caring about the look-and-feel of the product- to achieve the so-called ‘emotional’ value element chiefly pertaining to *status* and also independence. Another key value element iPhone delivers to its users is *convergence*; since the device blends a number of products and integrates thousands of services and applications. Convergence has become one of the key value elements in the telecommunications industry. This is due to the fact that people used to shift amongst different roles, using various devices with different modalities, and sometimes over different networks to accomplish their duties and fulfil their needs. Hence, people may find it advantageous, as it maybe more feasible and economical, to have only one device capable of doing many, if not all, of the required functions.

The iPhone as convergent device allows the communication of both hedonic and utilitarian value elements. Utilitarian value is the effective achievement of a utilitarian goal which is often suitable for customers classified as problem-solvers (Pura, 2005). Hedonic values on the other hand are delivered when mobile services successfully provide users with fun and enjoyment. Service applications such as Clock app, Healthcare Apps, Maps app, Compass, Flight Track, and Mail are supported mainly to deliver utilitarian values; whilst iPod app, iTunes, and PocketGuitar for instance, are designed primarily to communicate hedonic values particularly to users classified as music lovers. However, the iPhone features many service applications capable of providing utilitarian and/or hedonic value elements such as video recording, AIM for social networking, Safari and Internet access.

Furthermore, as the design and functions of the iPhone have been perceived as something new or even revolutionary in the mobile telecommunication industry, some people have adopted the device in order to achieve *epistemic* value (see Sheth et al., 1991) that entice customers looking for curiosity and novelty experience as well as new knowledge acquisition. Hence, the idea is that customers would possess the device to explore the *buzz* surrounding it aiming to gain novelty experience and to acquire new knowledge.

C. *The iPhone "Target Segment"*

The marketplace Apple has targeted for its iPhone gradually and rapidly moved from local to global market. Initially, the iPhone was launched in the United States marketplace. Thereafter, the market for the iPhone has been expanded to include Canada and six European countries before being marketed globally worldwide.

The choice of target segments within markets has also expanded over time. Apple frequently introduces its products and services in niche segments and charges premium for its innovative, state of the art design. The choice of the target segment for the iPhone reflects Apple's favoured business strategy with new product-service launches, i.e. *focused differentiation*. Simply put, by means of this uniquely designed product, Apple has originally targeted the "tech-elite" and shown its youth appeal (Macedonia, 2007). This seems rational as the youth market is a fast-growing one in the telecom industry.

Although iPhone customers could be viewed as wide-ranging due to the artefact's versatility and convergence competences, it seems that initially Apple finds young people characterized as technologically advanced and at the same time fairly affluent to be its right target segment for the iPhone roll-out. This seems rational as the original price of the device was considerably high, as was its running cost. Moreover, for Apple, affluent users are more profitable as they potentially generate more revenue from the entertainment facilities supported by the iPhone, such as music and movie downloads. Interestingly, Rubicon consulting research (2008) has shown that more than 50% of iPhone users are aged 30 or younger. The Research also revealed that most iPhone users are technically sophisticated and are richer than the average.

Apple has been rational in positioning itself within the telecommunication industry and more specifically within the mobile handheld device manufacturing market. Instead of principally targeting corporate users as other Smartphone manufacturers, Apple through its iPhone has mainly targeted a segment (discussed above) that is almost overlooked by rivals. This allows Apple to penetrate a market with much less competition.

After penetrating the telecommunication market successfully, Apple has expanded its target segment responding to pressure from professional customers. Indeed, Apple with the new versions of iPhone has also started targeting the enterprise segment. Enterprise users of the iPhone are now able to utilize their Microsoft Exchange accounts to send and receive emails, manage their calendars and contacts through the platform. This is because iPhone communicates directly and securely with the enterprise Microsoft Exchange Server via Microsoft Exchange ActiveSync (EAS) and iPhone configuration Utility. The new versions of the iPhone are also useful for network engineers to conduct critical and time-sensitive operations as the device offers an advanced VPN connectivity solution for remotely communicating with Cisco security appliances that exist within most organizations nowadays. However, by adding ‘professionals’ to its iPhone original target segment, Apple has expanded its market segment for the iPhone offering.

It is noticeable that Apple moves from ‘focused differentiation’ to ‘broad differentiation’ with its offering over time and especially after becoming well-established. Normally Apple introduces new versions of the offering with limited features and cheaper prices after having the original offering deep-rooted in the market so as to fuel more growth (e.g. shuffle in portable music players and Mac mini). Thus, the author postulates that it is still possible to consider (maybe now and in the near future) the iPhone’s target segment as a broad mass market given its various and broad services, functions, and features as well as its noticeable reduction in the price over time and across different versions.

5.2.2 Value System: How the Value Proposition (iPhone) has been developed?

Having discussed the iPhone value proposition including its services, applications, the created value elements, and its target segment, the question now is how Apple has been capable of launching such an innovative designed artefact, despite its lack of experience in the mature telecommunications industry? Broadly speaking, Apple architecture including its convenient resources and competencies is a key driver. However this is extended and improved through Apple's powerful value network.

5.2.2.1 Value Architecture

A. ***Apple "Core Resources" for developing the iPhone***

Apple holds various tangible and intangible resources that were useful and effective in creating the iPhone. Apple owns almost the entire system; i.e. operating system, hardware and software, needed for designing and developing their products and services. The company's core physical resources, including its factories, equipment, and production lines in addition to its own distribution channels, such as its own Websites and company-operated stores, were fundamental to the flourishing development of the iPhone. The capital, which is another primary resource, needed for research and development investment in the iPhone was on hand, given the success Apple has achieved with its former products and services including Mac computers, the iPod, and iTunes.

Human resources on the other hand were imperative to innovations with regards to the iPhone. Apple has built its management system so as to develop distinctive products and services (Morrison, 2009a). Highlighting this issue, Apple in its annual report (2009b) clearly declared that "the Company's success depends largely on the continued service and availability of key personnel" (p.20). Apple seems to have strong leadership and maintains knowledgeable, creative and committed employees. Steve Jobs is not only a co-founder of Apple, but most importantly a CEO whose decision making capabilities have sustained and helped the company during the last decade (West and Mace, 2007). Along with Jobs, Apple's deliberately-selected engineers and other employees at large including their skills, knowledge, expertise, innovative capabilities, and their relationships are key drivers to the successful development of the iPhone. It seems that Apple has created a culture within the company where innovation is the main notion. Apple is encouraging its employees to *think differently* (Morrison, 2009a); as a method of conducting their tasks when it comes to service and product developments. However, although it does make sense to perceive Apple's engineers as the heart of the company, Apple without its marketing and public relation teams would be less likely to attain what they have achieved with the iPhone.

Furthermore, the seamless experience and the material Apple has gained and accumulated over more than thirty years while manufacturing their former hardware products (e.g. iPod including its components and especially its long-life battery) and software services and applications (e.g. iTunes) has also been a cornerstone in developing the iPhone. This has put Apple at a closer point to its target as these valuable resources have reduced the time and money needed in the iPhone's research and development phase, and hence reduced the iPhone Time-to-Market (TTM) as well as its entire cost. Another important core resource that contributes to the iPhone success is Apple's effective brand and its reputation as a source of innovation and quality. This has created significant value elements that have attracted many people towards the iPhone, thanks to Apple's marketing and advertising efforts.

From a legal point of view, Apple has been granted a patent for a multi-touch user-interface and other related technologies, many of which have been integrated to develop the iPhone. Apple has also created a patent for the iPhone as a handheld computing device. This legal resource aims to protect the product (including its different versions, e.g. Pre) and its services, features, and applications from being copied or mocked by rivals and others.

B. *Apple "Configurations" for developing the iPhone*

B.1. *Organizational Configurations*

In addition to the aforementioned resources, the method in which Apple is structured, managed, and designed has also helped the company in achieving its objectives including the development of the iPhone. Apple's management style, practices, culture, and organizational structures are critical, contributing elements to its approach for innovation and creating distinctive services and products. Apple makes use of "flatten sprawling hierarchies" where the majority of decisions are taken by

Jobs and his immediate deputies (Morrison, 2009a) and hence centralized and controlled.

Apple is structuring itself and segmenting its employees in different groups that are usually located in different places and receive different treatments and management practices. This segregation is normally based on the link Apple establishes between the type of the task and the talent and skills employees possess. For example, while strict close supervision and precise ruling is the normal Apple practice with its rank-and-file employees who are doing routine tasks, talented and creative employees, who are normally assigned critical jobs related to design and development of products-services (e.g. Apple's Industrial Design Group), are empowered, cultivated, rewarded, and treated in a first-class manner (Morrison, 2009a).

Apple is an experienced company in employing a self-contained, i.e. closed, working style that enforces communication prohibitions and secrecy pertaining to its information assets. As Apple believes that its information-knowledge is a key element in achieving competitive advantages, disclosing one minor detail would be enough reason for Apple employees to, at least, lose their jobs (Lewis, 2007). Perhaps, it is common to expect secrecy to be practiced between the organization and its external world, but the way Apple has practised secrecy internally and with its main partners is unusual. Within Apple, the culture is unique. This becomes more evident when you know that teams working on components do not know which product they are for; most of the employees and managers have no idea what their colleagues are working on; and each product is coded differently amongst different teams (Stone and Vance, 2009). Furthermore, not only have major development partners- i.e. AT&T, Yahoo, and Google- glimpsed the product shortly before its introduction, but also some senior managers within Apple were seeing the iPhone for the first time during its introduction by Steve Jobs at Macworld Expo in 2007 (Sharma et al., 2007). Retrospectively, it becomes clear that Apple is utilizing secrecy alongside its patents as the main shelter protecting the company from its outside threats. Another advantage credited to the employed secrecy is that it has played a great role in creating the "buzz factor" (Lewis, 2007) which has attracted significant numbers of people towards the iPhone.

Apple is also experienced at maintaining an introspective (i.e. stop, step back from your artefact, and take a closer analytical look) operating style that insists on creativity through deep thinking, and quality through deliberate and careful design. Apple is prepared to spend the money required to make everything they develop "ideal" since they considered that as their mission (Breillatt, 2009). As reported by Morrison (2009a), "current and past [Apple] employees tell stories about products that have undergone costly overhauls just to improve one single detail. Other products are cancelled entirely because they don't fit in or don't perform up to par".

To maximize the potential of a high-quality design, Apple has created and utilized several methods and techniques (Breillatt, 2009). They have employed the so-called "10 to 3 to 1" design approach where Apple designers are expected to design 10 different qualified mock-ups of any new feature under consideration. Thereafter, using specific criteria, the 10 designs are narrowed down to 3 options from which the one final best concept is picked up as it is judged to truly represent their best design for production. Moreover, they set up a number of various types of meetings with different numbers of participants, frequencies, and objectives. Paired design meetings are for teams of designers and engineers to get together and discuss major design issues twice every week. Brainstorming meetings have got no rules as they are meant to be for creative thinking. Production meetings are for structuring and organizing "fuzzy" ideas that have got great potential. In such meetings, Apple defines how to, why, and when questions related to the task in hand. Finally, pony meetings keep decision-makers posted and informed with the explored design directions and are scheduled every two weeks. These actions are consistent with Apple strategic approach given that 'quality and uniqueness' is the main value element that wraps up all other values and benefits communicated to customers.

B.2. Technological Configurations

From a technological perspective, the ability to access and maintain iPhone customer data directly is one of the innovative technological configurations made up by Apple (Ballon and Walravens, 2008). Apple has managed that by requiring each customer to use iTunes software before being able to use the iPhone platform. The iTunes software in turn requires an Apple ID that customers need to create. By creating their profiles and then using iTunes online store, Apple is having a full profile and financial information pertaining to its iPhone users at a very early stage.

One of Apple's most important technological configurations is related to the iPhone's operating system. Unlike most smartphone manufacturers that have adopted Symbian, Palm, and Microsoft CE operating systems- which to some extent have been created by several companies in a shared and sometimes open manner- for their products, Apple has developed a specially adapted (i.e. stripped down and customized) version of its desktop *Unix-based OS X operating system* on an ARM processor for the iPhone. This course of action has resulted in a number of advantages. This way, the designed iPhone fully complies with Apple's strategy aiming to maintain integration of its systems across all products. The iPhone with this configuration synchronises with iTunes similar to an iPod and its software is not only compatible with Mac notebooks, but also with Microsoft PCs. Moreover, the adapted OS has allowed Apple to efficiently utilize some of its well-established desktop software such as TCP/IP, Web browser, and its QuickTime media player to leverage its iPhone (West and Mace, 2007). This also gives Apple iPhone effective email and Internet capabilities with rich HTML. Thus, the iPhone with its desktop-class Web browser is of good quality in regards to streaming and rendering different Websites and WebPages.

Nonetheless, the iPhone's Safari mobile browser lacks Flash support causing customers to miss a large chunk of the Internet. This is because lacking Flash means missing all Flash-enabled Websites and applications to be viewed or run on the iPhone. Adobe Flash Player is a multimedia platform that is capable of running animations and a host of applications. Recently, Adobe introduced Flash Player 10.1 which can run across several devices such as PCs, Laptops, Netbooks, and Smartphones. By adopting this new version, nearly all Smartphone platforms- such as Blackberry, Android, Palm, Symbian, Windows Mobile, and others (except iPhone)- are no longer running a Flash Lite version with modest capabilities. Instead they now run a version (10.1) with full Flash capabilities that allows all Flash contents to be accessible giving users uncompromised access to the Internet (Ludwig, 2009).

Although there is no clear cut answer to why Adobe Flash Player is not on the iPhone, a number of reasons can be suggested. The nature of the Flash platform seems to contradict Apple principles in regards to the iPhone applications. The iPhone SDK agreement makes it clear that “an application may not itself install or launch other executable code by any means, including without limitation through the use of a plug-in architecture, calling other frameworks, other APIs, or otherwise…no interpreted code may be downloaded and used in an application except for code that is interpreted and run by Apple’s published APIs and built-in interpreter(s)” (in Myslewski, 2009). As opposed to iPhone requirements, Adobe Flash can run applications, games, videos, and even malicious codes and software on its platform. Hence, adding Adobe Flash Player to the iPhone is problematic from Apple’s point of view. If Apple supports Flash, it would marginalize its approval process for the App store, compromise its control over iPhone applications, and create a security hole by opening a backdoor for Flash application to run on the iPhone (Chen, 2009). Not only will iPhone security and other competencies be affected this way, but also it will impact on revenue generated from the Apple’s App Store. If users become able to run games and software application via the Flash platform, there would be no need to buy them from the App Store.

Apple has configured its iPhone Safari Web browser in a way that leverages iPhone security aiming to maintain Apple’s principles pertaining to iPhone applications. As indicated by ISE (2007), an independent security evaluators’ company, “only JavaScript code can be executed in the [iPhone] Safari Web browser, ensuring that all such code executes in a “sandbox” environment. Many of the features of Safari have also been removed, such as the ability to use plug-ins such as Flash. Likewise, many file types [such as dmg or zip files] cannot be downloaded. These actions serve to reduce the attack surface of the device”, but definitely have not made it totally secure (Miller et al., 2007).

C. *Apple “Core Competencies” for developing the iPhone*

Apple has been able to equip its iPhone with a number of significant and unique core competencies by, predominantly, utilizing its breadth of technological and other powerful resources and also through its intuitive organizational and technological design. As argued by Porter (2008) “particularly when new entrants are diversifying from other markets, they can leverage existing capabilities and cash flows to shake up competition” (p.3). The key capabilities of Apple and its iPhone resulting from this can be summarized in the following points.

• *Innovative Product-Service Design*. Inherited from Apple's general design innovation, the iPhone is *unique* and enjoys outstanding quality in terms of hardware, software, OS, services, and applications. It is pretty and stylish with durable glowing metallic finish. It has supreme, scratch-resistant, and large touch-screen, and its battery life is quite long. The iPhone services and applications are in general comprehensive and fitting. They are powerful, interactive, and easy-to-use with a good level of security. The iPhone also enjoys flexibility when it comes to service delivery. This is because services can be sent via online or offline mediators such as a personal computer (Ballon and Walravens, 2008).

• *Service Application Choices*. Apple App Store contains a growing list of over 140,000 applications. These cover many, if not all, of user needs. While no rival has even 15,000 applications (MacMillan et al., 2009), Apple's number of effective application choices is one of its core competencies and a major driver for its iPhone success. Moreover, seeing that the iPhone is open to any new application, the offering is also responsive to changing market demands.

• *Convergence*. Apple is capable of building convergent devices given its infrastructure and the iPhone is a good example. The iPhone is an all-in-one solution given that it is a portfolio of products, services and applications. It is equipped with iPod, Internet communication, PDA, and mobile phone services and capabilities. Not only the breadth of services and applications that makes iPhone powerful, but also their categories which are favoured by its target segment.

• *Compatibility*. The vertical integration Apple intentionally accomplished facilitates compatibility. The iPhone works seamlessly with Apple's products and services such as Mac notebooks, iTunes, and Apple TV as well as Microsoft PCs. Furthermore, it enjoys a high level of compatibility with several Mac OS software toolkits; hence providing the iPhone with great potential for upgradability.

• *Usability*. The iPhone is *natural*, i.e. touch-look and feel, when it comes to users' interactivity with the product. Obviously, "[Apple] creates a whole new kind of interface, a tactile one that gives users the illusion of actually physically manipulating data with their hands-flipping through album covers, clicking links, stretching and shrinking photographs with their fingers" (Grossman, 2007). Nowadays, the iPhone seems to be the most popular product in utilizing a finger-operated touch-screen (Hoggan et al., 2008).

• *Security*. The iPhone as a closed platform; due to the restrictions against running third-party applications, is highly immune against different types of viruses and malicious codes. Limitations in terms of (a) the number of applications on the device, and (b) the functionality of those applications have reduced the iPhone exposure to potential vulnerabilities (Miller et al., 2007), despite their depressing effects.

• *Strong Leadership and Design Force*. Steve Jobs and his team work in an atmosphere stimulated by creativity and innovation culture. *Perfect Design* seems to be the target where all enthusiastic enough and capable of achieving.

• *Brand Reputation*. Apple's history is promising when it comes to a new offering launch as it is a brand name that customers trust. The company is publicly recognized as a provider of differentiated, high-quality products. It is well-known for its technological innovations ever since the original Macintosh. This brand awareness has served and at the same time been enriched by the iPhone.

• *Quality Marketing and Sales*. Apple is experienced in utilizing different methods in marketing their offerings, showing and effectively conveying the value customers can get by having one of its offerings. Apple places a great emphasis on customer buying experience and they do their best to make it impressive through their knowledgeable teams. The company also maintains direct contact with their customers, which is critical to its success.

5.2.2.2 Value Network

In developing the original iPhone including its services and applications, Apple practised a *closed* network-mode where only a few number of selected business actors were to some extent involved. For the purpose of this closed model, Apple has built up and leveraged strategic alliances and partnerships with particular key business actors inside and outside the telecommunication industry. The largest U.S. mobile and telecommunication provider with more than 80 million subscribers, i.e. AT&T (formerly Cingular Wireless), is the main strategic partner for Apple from the mobile telecommunication sector. Apple has also extended that and developed strategic relationships with Google, the world's leading search-engine company; Yahoo!, the world's biggest email service provider; and YouTube, the world's dominant video sharing company.

The Apple-AT&T partnership set AT&T as the exclusive provider of the iPhone for use on its network in the United States. However, this deal has served Apple very well. AT&T was not demanding in the deal, but rather made compromises that no other mobile handset maker has ever had in such agreements (Yoffie and Slind, 2007). AT&T has given Apple almost full liberty in regards to the iPhone design, development, distribution, branding, and its financial issues. AT&T, as a U.S. major telecom, is also a co-distributor (along with Apple) of the iPhone and has been a chief player in kicking off its sales. Although AT&T does not provide access to the iPhone, the telecom is an essential Internet Service Provider (ISP) for its services and applications. Moreover, the AT&T mobile network infrastructure, i.e. GSM/UMTS, has been an advantage to Apple (McLean, 2009). This mode of technology allows the same model of iPhone to be distributed to other countries due to the high potential for compatibility of such network infrastructure with other networks worldwide. For example, if the iPhone is distributed by Verizon telecom it would be probably limited largely to the United States as Verizon employs CDMA/EVDO technology that is much less common globally. However, AT&T nowadays is the fastest 3G provider in the U.S. enforcing an even more solid base for its relationship with Apple.

The partnership with Yahoo! enables Apple to provide effective and customized email services. The iPhone syncs with contacts stored on Yahoo!, but not with some other Web-based mail systems such as hotmail, and AOL. Yahoo! Mail on the iPhone enjoys powerful features that mean to give users a unique experience. In addition to its entire inbox facilities, it enjoys features such as push/pull instant notifications when users get new emails, user-friendly search facilities, and unified address book.

The partnership Apple's has set up with Google helps in providing a variety of powerful search services to iPhone users. For Apple iPhone, Google has developed an optimized and innovative mobile application featured as fast, rich in terms of content and facilities, and easy to use. The application enjoys streamlined navigation with a very user-friendly interface. It also features customization when it comes to the menu bar that allows users to have straightforward access to their favourite applications.

Speedier Gmail is another facility that instantaneously shows new emails and makes composing emails faster. The iGoogle gadgets are also available on the iPhone. Whatever users have setup on their iGoogle, such as stocks and weather, will be directly shown on their iPhone.

The Apple-YouTube partnership on the other hand allows iPhone users to enjoy the content of YouTube. To this end, Apple has designed an application that streamlines the content of YouTube to iPhone users wirelessly, whilst to ensure high-quality content and longer battery life on the iPhone, YouTube has encoded their videos in H.264 format. Furthermore, Apple has also included other visible and powerful partners for the iPhone such as Disney that helps in facilitating the users' ability to view popular movies on the iPhone (Mickalowski et al., 2008).

The advantage Apple has gained from such deals even exceeds the functional benefits to cover strategic ones. Indeed, Apple has entered the mobile telecommunication industry with almost zero experience in this market. Hence, it was rational to develop the iPhone with one of the key experienced telecoms in the U.S. market (i.e. AT&T). Having Google, Yahoo!, and YouTube as strategic partners was also highly useful. Each one of these companies is very successful and even dominant in its marketplace. Furthermore, these companies have already established huge customer bases of Web users that Apple aims to attract. These partnerships have created more *intelligence* pertaining to the iPhone development and helped Apple to create a more *effective* artefact (i.e. highly competitive with superior quality) than one it would make up by itself.

In addition to these fundamental relationships, following the iPhone launch, Apple has further extended the iPhone *geographical reach* by creating new partnerships with telecommunication providers located outside the United States. Telecoms such as Telefonica O2 in the United Kingdom, Deutsche Telekom's T-Mobile in Germany, and Orange in France have all had agreements with Apple that afford them to be the exclusive providers and distributors of the iPhone in their respective nations. As these deals have a time constraint, that is usually a 2-year service contract, new distributors have emerged breaking Apple's 'one country-one provider' rule and allowing the existence of dual and triple providers (and perhaps more in the near future) of the iPhone in the same country. Just to give one example, in the United Kingdom, starting from 10th of November 2009, Orange has become the second provider of the iPhone. Currently, Apple iPhone is provided in 77 countries by almost 105 country-particular telecoms.

Moreover, Apple is also collaborating with other companies in regard to the iPhone. For example, record companies provide content which Apple makes available to customers via its iTunes online store. Another example is that of Apple and Cisco working together to provide security features for the iPhone when it comes to networking and communications technology and services.

The way Apple managed its closed value network in regards to the iPhone is innovative. Apple has been able to enjoy nearly complete governance in terms of power and control over its iPhone network actors. Apple has maintained a value network that gave Apple full freedom to decide who to participate (i.e. closed) and which ideas to be developed (i.e. hierarchical) in regards to the iPhone. Actually, this closed-hierarchical model is favoured by Apple as the company believes in this way it can control the device along with its design and development of the iPhone primary components and services. This (a) ensures a unique customer experience as intended, and (b) maintains the important compatibility-driven integration Apple wants to keep amongst the hardware, software, peripherals of the entire offering of the company. Highlighting this issue, Mark Collins, the vice president of AT&T's consumer data services, indicates that contrasting the approach with other handsets where AT&T defines the applications to be used and the service offering issues, "with the iPhone, Apple decides what products and services to load on the device. It is a completely different business model" (in Reardon, 2007). For example, although Google is one of Apple's main partners in developing the iPhone, Apple has not yet accepted Google Voice application that has been submitted to Apple App Store. This is because Apple believes this application alters the iPhone's core functionality affecting its distinctive user experience competency (Apple, 2009c).

Noticeably, concerning its deal with AT&T, Apple all but remodelled the relationship between mobile handset makers and mobile network operators (Yoffie and Slind, 2007). It is the first time that a handset manufacturer receives a direct share of the revenue a mobile operator generates from voice and data services. This is clear as the traditional scenario usually puts mobile operators in the strong position, not handset makers. In establishing deals with other operators worldwide, Apple has imitated its agreement with AT&T. In the author's context, the reason why AT&T and other mobile network operators accept this revolutionary deal that push them to make some concessions relates to the intangible and tangible gains operators believe they get from such an agreement. It seems that mobile networks operators consider iPhone as almost risk-free business. They also consider that being chosen by Apple to provide its iPhone will (a) enhance their image in their respective markets, and (b) significantly increase the size of their customer bases. It seems that these benefits are worth the sacrifice they make, from the mobile network operators' point of view. Just to give one example, Mintel Research on Telecoms indicates that O2 has "boosted its image as an innovator" being the first and the only distributor until November, 2009 of the iPhone (Mintel, 2009).

Interestingly, the development method of iPhone applications, in particular, has changed over time. As highlighted earlier, it initially followed Apple's preferred model that is best characterized as *closed* and *hierarchal* where applications were chosen and approved by Apple, but developed through Apple and its selected actors. After the iPhone became more established, Apple has moved from a totally closed to a walled-garden model in regards to application development following a growth strategy (Pisano and Verganti, 2008). Apple with this move aims to expand the iPhone customer base by mitigating its depressing effect being pre-programmed. To this end, Apple has launched a Software Development Kit (SDK) -in March 2008- that enables third-party developers to create applications compatible with the iPhone OS platform.

Third-party developers are not only individuals, but also groups, companies and software houses. For example, Oracle has developed a series of business applications for the iPhone such as Oracle Business Indicators that provide users with real-time, secure access to critical information of their business performance. This way Apple has reduced Time-To-Market (TTM) for these applications and at the same time allows more capacity and potential to create numerous applications that might fulfil the needs of a larger customer base. Although Apple provides a SDK for third part developers, it is still hierarchical when it comes to approval of software applications. After developers submit their applications, it is Apple that decides whether this application is approved -through its formal application approval process- to be listed on its App Store, or not. In other words, the only official method to distribute iPhone applications is through the Apple App Store.

5.2.3 Value Finance: How the iPhone is priced and how revenue is generated and broken down amongst participating actors

Apple's practices concerning its resource acquisition and development, organizational and technological configuration, and value network creation and design are on the one hand very central to its remarkable achievements being 'value drivers', but on the other hand represent 'cost drivers' that have influenced the cost of Apple's offerings. The iPhone is no exception. This in turn has influenced iPhone pricing and revenue.

In calculating the entire cost of the iPhone per unit, Apple not only includes its design and engineering cost, but also its marketing, distribution, sale/after-sale, maintenance, and protection expenses. On that basis, Apple decided to sell its original iPhone for $599 (8GB), and $499 (4GB). Actually, it was not the price of the platform, but the pricing method Apple employed for its iPhone that was unprecedented. To obtain the iPhone, customers had to pay a full retail price for the handset in one shot at the beginning of their contracts. With this move Apple changed the industry rule of thumb that allows customers to pay the retail price of devices through monthly instalments throughout the contract lifetime.

The revenue sharing model Apple practiced with AT&T and other mobile operators was also unprecedented. Apple was able to manage contracts with mobile network operators whereby it would receive a big percentage in terms of money for each iPhone sold in addition to exceptional provisions that offered Apple 10% to 40% of revenues generated by iPhone services. Indeed, it was the first time that a mobile manufacturer shares *service revenue* with mobile network operators.

The financial model in regards to the iPhone retail price has changed over time aiming to keep the iPhone competitive within the mobile telecommunications dynamic market. For example, only after two months of launching the iPhone, the price was reduced significantly; from $599 to $399 for the 8GB version, and from $499 to $299 for the 4GB version. Currently, the second and third generation iPhones were offered with more competitive prices and at the same time more advanced features.

Furthermore, more options are now available across different versions aiming to suit different preferences and budgets.

The pricing method has also changed. Customers today don’t have to pay the full retail price to get the iPhone. Instead, they can enter a contract with mobile operators providing the iPhone and split the iPhone total price over the duration of the contract. In this case, customers pay on a monthly basis- for the duration of the contract- a certain amount of money for the whole package that includes the device, number of minutes and texts, and usually an unlimited usage of the Internet. However, some available plans require customers to pay a portion of the iPhone retail price at the beginning of the contract.

The service revenue sharing model was also no exception to change. Apple in its following contracts with different mobile operators in about 70 countries has declared that it is no longer sharing service revenue with operators. The manner in which Apple generates revenue now in regards the iPhone is through selling (a) the iPhone; (b) its applications, and (3) advertisements within applications. If the application is approved by Apple and is not free in its App Store, Apple receives 30% whilst developers get 70% of the revenue.

5.2.4 Conclusions: Apple iPhone

The iPhone has exposed a noticeable success while almost all other telecom providers are struggling to generate revenue from data services. Hence, this phenomenon has received a great deal of attention in theory and practice which might make upcoming mobile data offerings more powerful.

The existing literature, particularly in strategy and business economics, emphasizes the challenges and barriers faced by new entrants or newcomers to different industries. For example, in discussing the five competitive forces, Porter (2008) identifies seven major advantages for incumbents over new entrants: supply-side economies of scale, demand-side benefits of scale, customer switching costs, capital requirements, incumbency advantage independent of size, unequal access to distribution channels, and restrictive government policy. In highlighting potential risks of new entrants, Segarra and Callejon (2002) argue that when newcomers decide to enter new industries that are driven by intensive R&D efforts, and characterized as highly innovative and competitive environments, the survival rates are low.

Notwithstanding, what Apple has demonstrated through its iPhone overrides the aforementioned barriers and risks. Indeed, Apple as a new entrant into the telecom industry and in particular the mobile handset manufacturing market has been not only able to thrive, but it has also been able to push the competition boundaries further. Employing the V^4 Mobile Service BM Ontology as a mean of analysis has assisted in understanding effectively and comprehensively Apple's arrangements and configurations that led to the iPhone success. When compared to other smartphone technologies such as Blackberry, it becomes noticeable that the iPhone technology is not superior or unprecedented. But interestingly, it seems that the iPhone success is primarily driven by its well-fitted business model in action including but not limited to technology aspects.

The Apple iPhone has demonstrated stronger links between the design and development of services and applications on the one hand, and the engineering of mobile handsets on the other. This is interesting as recently there has been a trend to establish Service Science, Management, and Engineering (SSME) as a new scientific domain (see Magoli et al., 2006; Spohrer and Magoli, 2008). For example, some universities in the United States have created new academic programmes for this emerging field. The underlying principle behind this new domain is that design, development, management, evaluation, maintenance, etc. of services are significantly different from those of products and thus require different paradigms of thinking; hence different approaches and methods. But, the iPhone case has suggested that the design and engineering of mobile data services and products are greatly interrelated mainly due to its unique operating system. This could indicate that in the telecom industry, designers may be needed to examine mobile data services and products as one package instead of distinguishing between the two. However, this is only one indicator that could open our eyes to new ways of thoughts, but the future will definitely show us what this highly dynamic and competitive industry could bring and whether the distinction between services and products are needed in the mobile design and engineering exercise or vice versa.

As for the reaction of the industry to iPhone success, it seems that Apple has put tremendous pressure on mobile handset makers such Nokia, Motorola, Samsung, and Sony Ericsson. In response to this pressure, a consortium of 47 hardware, software, and telecom companies guided initially by Google has formulated the so-called *open handset alliance* which has released the *Android* mobile operating system in 2008. Android is an open source Linux platform that allows developers to manipulate the underlying code; hence giving a flexibility to build tailored applications and features (BBC NEWS, 2008b). The latest Android OS has been used to launch Google Nexus One platform on the 5th of January, 2010. The Android platform is also used by other handsets including but not limited to Samsung i7500, HTC Hero, and G2 Touch. Whilst the iPhone has employed nearly a closed network model, Android is totally utilizing an open network model. Although it is still too soon to judge which one is more effective, the author believes that the future will favour the one that can create and maintain a positive difference over time.

This analysis of the Apple iPhone case provides an evaluation and empirical validation of the V^4 Mobile Service BM Ontology. The collected data concerning the Apple iPhone fits the design constructs as well as their relationships and semantics that are identified in the ontology. Indeed, this evaluation seems to indicate that the constructed ontology is coherent and well integrated. It also reveals that the developed ontology is semantically precise as it allows faithful representation of real-world phenomena. Moreover, the case of Apple iPhone provides more support to the idea that innovative mobile data services call for innovative business models to be designed and developed.

This stage of evaluation has also been useful in enriching the developed ontology. Indeed, based on analyzing the Apple iPhone case, the ‘network-mode’ has been added as a seventh design concept in the value network dimension within the ontology. Not only this, but the applied analysis on Apple iPhone also facilitates the derivation of key value drivers that telecoms should place more emphasis on when designing and engineering mobile data services. For example, the case of the Apple iPhone indicates that uniqueness, dynamicity, and fitting network mode are key value drivers of innovative mobile data services. A more detailed discussion about the derived mobile key value drivers is presented in chapter 6.

5.3 NTT DoCoMo's I-Mode

I-mode is an innovative platform of mobile Internet services that was first to succeed. I-mode was rolled out in Japan on the 22nd of February, 1999 by NTT DoCoMo telecommunication provider. It was launched as a modest and low-band mobile service, but it was primarily enriched by its always-on feature. The "i" in i-mode refers to Internet, information, interaction, and I -myself- (Barnes and Huff, 2003) reflecting the nature of the service. In Japan, the number of i-mode users is substantial and they are now exceeding 48 millions.

Building on its success in Japan, NTT DoCoMo has put a tremendous effort to distribute i-mode in a global basis. In 2002, i-mode service has been launched by E-Plus in Germany and KPN in The Netherlands. This has been followed by it launch by BASE in Belgium, Bouygues Telecom in France, Telefonica in Spain, WIND in Italy, O2 in UK, and others such as Cosmote in Romania. Not only has i-mode been spread in Europe, but also in other continents such Australia by Telstra and Asia for example by Starhub in Singapore. Not long after, many of these telecom partners have either completely phased-out i-mode services (e.g. O2 in UK, Telstra in Australia, and E-Plus in Germany), or at least stripped it down to a very smaller scale serving only a niche market. Hence, the author postulates it is reasonable to argue that i-mode generally failed to succeed outside Japan. In retrospect, the author believes it is worth delineating why the i-mode service is very successful in Japan and is not in the overseas markets where the service has been launched.

To this end, the author utilizes the V^4 Mobile Service Business Model Ontology as an analytical lens for analyzing and evaluating the differences of i-mode diffusion between Japan and overseas markets. Besides evaluating the developed ontology, this analysis is deemed useful as significant practical implications can be drawn and important lessons can be learned so as to be reflected later on the design and engineering of future mobile data services and applications. Based on this analysis, eleven reasons are suggested in explaining why i-mode is successful in Japan and is not in the overseas markets:

1- Market conditions including existing substitute technologies and their adoption levels may matter.

2- Creating rich and well-balanced portfolio of convergent services and contents may matter.

3- Fitting the service to its target segment may matter.

4- Delivering valuable added value elements may matter.

5- Organizational settings may matter.

6- The compatibility of technological architecture may matter.

7- The appropriate choice of network-mode along with its structure may matter.

8- The alignment amongst strategic goals and objectives of collaborative actors may matter.

9- Employing diversified service channels (i.e. handsets) with customer actors may matter.

10- Governance issues may matter.

11- Billing systems may matter.

A more detailed discussion of these eleven reasons is presented in the following sections.

5.3.1 Issues related to Market Conditions

First, we look at market conditions including existing substitute technologies and their adoption level may matter. One of the key elements that led to the success of i-mode in Japan is related to unique aspects of the Japanese Internet market and its technologies (Keryer and Nara, 2001). The customer profile and market conditions in Japan have smoothed the progress of i-mode diffusion. Most young people in Japan spend much time socializing outside in the restaurants, cafes, streets, and other public areas. Most often, they use trains and subways for transportation where making voice calls is forbidden (Baldi and Thaung, 2002). These factors have to some extent attributed to the popularity of mobile data service in Japan.

Equally important is that, by the time when i-mode was launched (i.e. 22nd of February, 1999), many Japanese still had not experienced the Internet. The fixed-line Internet penetration was very low in Japan mainly due to the high cost of broadband technology. Therefore, i-mode has been perceived as the most promising and feasible way to get this new knowledge and experience. Having users with no or little Internet experience seems to be advantageous to NTT DoCoMo in Japan as this eliminates the PC-based Internet being a point of reference for comparison purposes; thus reducing the possibility of users suffering from a gap of expectations. This market condition was also beneficial as it allows NTT DoCoMo and its content providers to charge customers for downloaded data and Website subscriptions. However, such a unique and privileged condition was less evident in overseas markets and especially Europe as the fixed-line Internet penetration rate was significantly higher than for Japan. For example, in Western Europe, mobile Internet has been marketed as an alternative means of accessing the Web (Baldi and Thaung, 2002).

Although mobility and integration of content are noticeable advantages for i-mode, it seems that PC-based Internet was favourable for European and other international market users especially with the emergence of wireless technologies (i.e. 802.11). Not only elements related to usability, speed and richness in terms of content has made fixed-line Internet favourable to i-mode, but also economic reasons have played a key role. This is because unlike i-mode, fixed-line Internet allows users to access Websites and download data for free. The shift from 'free to fee', that is associated with i-mode, is definitely not welcomed in international markets unless add-values are substantial.

5.3.2 Issues related to Value proposition

Second, we argue that creating rich and well-balanced portfolio of convergent services and contents may matter. Originally in Japan, i-mode is a portfolio of a well-balanced mixture of entertainment, information, database, and transaction services (Natsuno, 2000; see Figure 5-1). Users can employ their i-mode compatible handsets not only for email functions and information retrieval, but also for engaging in a range of mobile commerce activities (Ratliff, 2002). Services provided by i-mode include but not limited to cooking recipes and hints, weather and general news, transportation schedules, financial market news, and stock quotes. Users of i-mode are also able to play games, view videos, download Disney characters and ring tones, check the status of their friends and contact them, and create personal pages. With i-mode, users can even do more advanced financial transactions. For example, they can conduct different banking activities, trade stocks, and engage into Internet commerce. Having such a diversification of content with the portfolio of i-mode service fulfils a wider range of needs; thus attracting a variety of users in Japan.

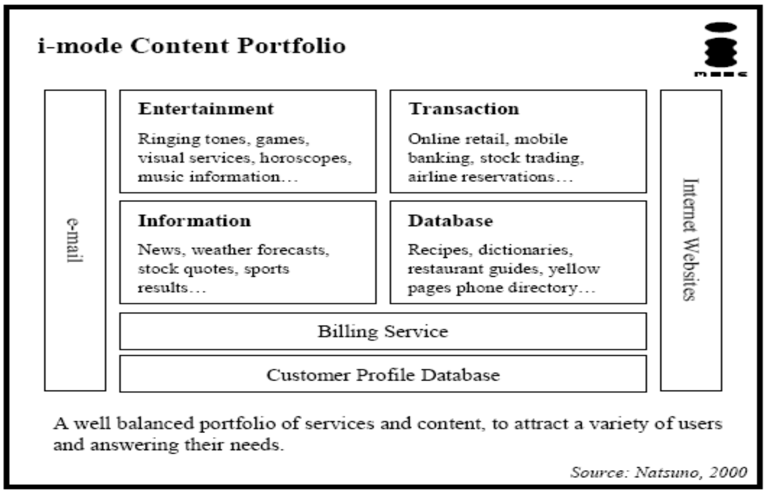

Figure 5-1. Content Portfolio of i-mode

From the time when i-mode has been provisioned in February 1999 up till now, a number of new services and features have been added to i-mode aiming to leverage the platform and increase its Japanese customer base. As demonstrated in Table 5-1, these developments have been started by the Java-based i-appli service in 2001 that offers automatic updates for information provided by i-mode including news and stock prices. I-appli also makes it possible to play new games without accessing the Internet as games can be downloaded and stored. The last update was in 2006, by which i-mode users can now search i-mode platform using keywords.

Table 5-1. I-mode service developments in Japan (Synthesized from nttdocomo.com)

Launching Date	Service	Brief Description
Jan. 2001	i-appli service	This service group consists of software (programs) used with i-mode compatible mobile phone terminals. Downloading the software makes it possible to automatically update the news and weather forecast displays as well as to play new games.
Jul. 2001	i-area service	This is DOCOMO's location information service. The i-area service enables the user to check the weather forecast, traffic and store information and other convenient information for local areas as well as the map information to the user's current location.

Table 5-1. I-mode service developments in Japan (Synthesized from nttdocomo.com)

Nov. 2001	i-motion service	This feature refers to video distribution programs for i-mode mobile phone terminals and the contents. The high-speed packet communication of **FOMA** entertains you with the latest movie theater information and details of the sports highlights available in video.
Jun. 2002	i-shot service	A function that supports transfer of still images captured with an i-mode compatible phone. The images may also be sent to mobile phones of other carriers and PCs.
Jan. 2003	i-motion mail service	This service transfers video captured with an i-motion compatible mobile phone via e-mail. It features a transmission speed of up to 15 frames/sec, thus permitting smooth motion video to be enjoyed with a mobile phone.
Jul. 2004	"Osaifu-Keitai"	This service provides mobile phones with wallet functions so as to facilitate mobile commerce.
Sep. 2005	i-channel service	This service distributes the latest news, weather forecasts and other information to i-channel compatible i-mode phones. The information is displayed on a standby screen without any special operation and users can access to more detailed information with a press of a button.
Nov. 2005	"ToruCa"	This feature offers info-capture function.
Dec. 2005	"iD"	This feature provides credit card brand.
Apr. 2006	"DCMX"	This feature offers mobile credit services.
Oct. 2006	keyword search service for i-mode	This feature allows users to surf i-mode platform by utilizing keyword searching facility.

The i-mode platform provides direct access to official Websites, i.e. those approved by NTT DoCoMo to ensure quality and variety. However, i-mode is also open to other Websites, but users need to key in any compatible site by typing its URL or through search engines. In total, i-mode provides users with access to more than 95,000 Websites simply by pushing the dedicated 'i-mode' button on their handsets.

The original language for i-mode is Japanese. Shortly after its launch and due to i-mode market expansion strategy, some services started to have foreign language versions (e.g. iMenu in English) and Websites start emerging with content in English, Spanish, Italian, etc. However, the number of i-mode compatible Websites differs significantly by language with Japanese being dominant (Vincent, 2001). For example, where, in 2003, the number of official websites was nearly 3000 in Japan (Barnes and Huff, 2003; Macdonald, 2003), those in the Netherlands, Taiwan, Belgium, and France in 2006 were around 60, 130, 60, and 90 respectively (Hung and Yeh, 2006). This gives a clear indication of the significant difference in terms of i-mode content between Japan and other markets. Hence, the author considers that lack of content has made the service less appealing to customers in many European and other countries; and this affects its spread in those regions. Moreover, the equilibrium of content in international markets has been an issue. In Japan, as illustrated earlier, i-mode content is significantly varied in terms of nature and type, whereas the small amount of content in most of the overseas markets lacks such an important variety.

Third, we argue that fitting the service to its target segment may matter. Within its main marketplace (i.e. Japan), NTT DoCoMo focused on a consumer market rather than the professional corporate market. This decision was not arbitrary or based on gut feelings; rather it was principally founded on market research led by marketing specialists: Muri Matsunaga and Takeshi Natsuno. Those specialists championed the idea of targeting affluent consumers and more specifically urban youth as the ideal early adopter for i-mode services given the fact that they are constantly on the go and have grown up addicted to electronic gadgets (Ratliff, 2002). Thus, the initial focus of NTT DoCoMo was on entertainment content matching the needs and wants of i-mode potential early adopters. Nonetheless, given the diversity of the i-mode service portfolio, the platform, after only a short period of time, has become not limited to the aforementioned category of users. It has actually expanded its user base to cover almost everyone; from young teenagers to elderly people (Macdonald, 2003). Essentially, the selected content for i-mode was principally adapted to the Japanese society (Baldi and Thaung, 2002). In other words, the choice of content was meant to match the Japanese users profile with more emphasis placed at the beginning on convenient entertainment and other content matching the desires of i-mode early adopters.

Having recognized the success it achieves with i-mode in Japan, NTT DoCoMo started considering launching the service in the European and the U.S. market with the intention of making i-mode the de facto standard worldwide. This is because NTT DoCoMo seems to believe that i-mode success is not shaped by its context; thus such a success is replicable elsewhere. The initial emphasis was to launch the service in affluent countries where people usually have high levels of disposable income; as such countries were deemed more favourable and appropriate (Ratliff, 2002).

Examples of these markets are Germany, the Netherlands, Italy, United Kingdom, and others

I-mode services and content that have been launched in overseas markets were copied from those offered in Japan, where language is the only recognizable change. It seems that telecom partners believed that i-mode can succeed by itself and hence ignored studying the market and investigating whether i-mode service along with its content would be appealing to their customers without any substantial modifications. The issue of delineating the right potential market segment and which sort of services and contents matches their needs has been overlooked. In the author's view, market along with cultural differences does matter. The kind of i-mode services that are admired in Japan such as games, horoscopes and downloading Disney characters may not be successful everywhere.

Fourth, we argue that delivering valuable added value elements may matter. When comparing the value elements that can be delivered through i-mode to users in Japan with those can be delivered to users in overseas markets, a substantial difference can be recognized. These differences however are to some extent inherited from the issues discussed previously. For example, lack of rich and convenient services as well as content in international markets significantly decreases the platform's (1) utilitarian value elements that can be achieved for example through i-mode transaction and financial services; and (2) hedonic value elements that can be delivered for example through i-mode entertainment services. Even some services that have been offered in Japan and also in overseas markets differ in the value they communicated to their users. One example is related to the i-mode email service that delivers a great utilitarian value to it users in Japan as it is the first of its kind there. This value is much less appreciated in other countries due to the existence of SMS substitute technology. The delivery of epistemic value that entices customers looking for curiosity and novelty experience as well as new knowledge acquisition is higher in Japan than in other international markets. This is because i-mode in Japan represents the first practical way for exploring the Internet whilst it is not the case in most of the overseas markets due to their significantly higher penetration rate of fixed-line Internet using PCs and other electronic devices.

Furthermore, the interaction quality of service factor in terms of service structure, navigation and presentation differs in its appropriateness between Japan and the overseas markets. This is because the bundled services within i-mode are organized as a highly structured menu aiming to make the whole platform easy to use and simple to navigate through. This manner of organization seems to be fitting the Japanese culture as their norms and values are based on hierarchy and order. Nonetheless, there is no evidence that this manner of service presentation is suitable in other overseas markets. Whilst this structured menu might seem very much organized for Japanese users, it might look boring and unexciting for some other users. The issue of choosing the right service structure for overseas markets, although important, seems to have been overlooked by NTT DoCoMo and its telecom partners. For example, when i-mode menu has been introduced in English, the only thing that has been changed is the language while the platform structure remained the same.

The value of time is highly relevant in the mobile telecommunications industry where change is very rapid. In Japan, the i-mode service was launched in 1999, more than 2 years before the provision of 3G technologies. In that time, telecoms and customers were waiting for 3G technologies so as to be able to offer and receive effective data services similar to what has been provisioned by i-mode in Japan. Hence, the author considers that the time in which the service has rolled-out has made i-mode a very competitive and innovative service given the available technologies then. Indeed, this has allowed NTT DoCoMo to build a large customer base for i-mode very quickly which in turn (1) facilitates the communication of powerful network effects, and (2) attracts mobile handset and content providers as the service represents a new innovative way for generating revenue with economies of scale advantages. Being the first to launch data services from this kind in the mobile telecommunication industry also gives NTT DoCoMo a great deal of valuable experience in this context as opposed to its counterparts worldwide (Vincent, 2001). On the other hand, the i-mode service has been available internationally from only 2002 where most telecoms either upgraded or were in the process of upgrading their cellular infrastructure to 3G. The time in which i-mode started targeting international markets has made, perhaps, i-mode less appealing to international telecoms and customers and negatively affected its perceived value and efficacy given the high promise of 3G technologies by then.

5.3.3 Issues related to Value Architecture

Fifth, we argue that organizational settings may matter. NTT DoCoMo, before market liberalization in Japan, was part of NTT (Nippon Telephone and Telecommunications) which had a well-known reputation, brand and a nationwide installed base (Barnes and Huff, 2003; Bouwman and MacInnes, 2006). In 1992, NTT DoCoMo spun off from NTT but inherited the strong reputation, knowledge, experience, technologies, and customer base from its mother company (i.e. NTT). Interestingly, NTT DoCoMo decided not to follow NTT's long and tedious approach pertaining to developments of services, products, technologies, and standards but favoured a more flexible method where room is dedicated to experiments along with their risks or benefits. The new flexible and creative approach was mainly supported by a valuable mix of skills and perspectives (Vincent, 2001; Ratliff, 2002) represented by NTT DoCoMo's first president, Koji Oboshi, along with Takeshi Natsuno (Internet entrepreneur) and Muri Matsunaga (marketing and promotion entrepreneur). As a result, i-mode has been developed to test a new business model related to mobile data services. Such an innovative artefact would not have been developed without NTT DoCoMo's philosophy, culture, and management mindsets that encourage innovation thinking.

Elements related to NTT DoCoMo's powerful market position as being a giant telecommunication provider in Japan with the highest market share (around 51%) along with its brand and reputation has been attributed to the success of i-mode in Japan through attracting many customers. On the other hand, such contextual advantages cannot be communicated to users in international markets as (1) NTT DoCoMo is not popular and not recognized as a well-known brand in Europe and other countries; and (2) telecoms partners in overseas markets are in general not considered leaders in their markets and usually do not enjoy high brand recognition. Except for some allies such as the KPN mobile in the Netherlands, telecoms partners were only in third or fourth position in their markets (Hung and Yeh, 2006). Therefore, their relative resources and competencies in their markets could be regarded as modest compared to those of NTT DoCoMo in the Japanese mobile telecommunication industry. As telecom allies are not in the leadership position in their markets, emotional benefits with regard to status and perceived practical value elements with regard to quality were much more difficult to communicate to users in international markets. This holds back diffusion of i-mode in those markets.

Sixth, we argue that the compatibility of technological architecture may matter. NTT DoCoMo utilized its existing technologies and predominantly its proprietary dedicated packet network (PDC-P) with an average rate of 9.6kbps for i-mode purposes. For i-mode, this technology costs NTT DoCoMo almost nothing as it was already in place (Ratliff, 2002). Unlike the GSM circuit switching that has been initially used for WAP services and requires establishing a connection (dial-up) each time the user need to access the Internet, i-mode technology has some advantages as it is based on packet switching giving i-mode users a constant connection to the Internet. Furthermore, although PDC-P is a 2G cellular technology, it does leverage volume-based pricing which is not supported by GSM. However, later on, NTT DoCoMo upgraded its cellular infrastructure to 3G (W-CDMA) increasing its upload and download speed up to 64kbps and 384kbps respectively. This not only improved i-mode service, but also enabled the telecom to launch, in 2001, its 3G service FOMA (Freedom of Mobile Multimedia Access).

Nonetheless, the NTT DoCoMo's dedicated packet network suffers from considerable limitations as it is a closed technological standard that is only available in Japan. This has caused compatibility issues when the service has been exported to overseas markets as they were mainly based on GSM technologies (2G) and then GPRS technologies (2.5G). Adapting i-mode to GSM/GPRS technologies calls for joint R&D between NTT DoCoMo and its international telecom partners which also requires considerable time, money and effort. This has led telecom allies to focus more on technology aspects rather than on the content and this is a problem as it is the content that customers care about. Having different cellular technology standards also calls for different models of i-mode compatible handsets to be produced by handset manufacturers. Given the low volume required by most of international i-mode providers due to their small customer base, most handset manufacturers were reluctant to support them because there are no economies of scale. Hence, in line with Gawer and Gusumano (2002), the author argues that the local and proprietary i-mode standard has drawbacks concerning its technological compatibility which hinders its global expansion possibility.

5.3.4 Issues related to Value Network

Seventh, we argue that the appropriate choice of network-mode along with its structure may matter. In developing the proprietary i-mode service, NTT DoCoMo has adopted a closed network mode. A closed network entails that only selected parties or actors can participate and provide ideas pertaining to the potential innovation. As NTT DoCoMo utilized its existing technologies and predominantly its dedicated packet network (PDC-P) for i-mode service, the need to add cellular infrastructure providers to its value network has been eliminated. Nonetheless, the telecom recognized the need to build close cooperative relationships with many content providers to feed the service with different forms of useful and innovative content. As i-mode Websites need to be developed using cHTML (Compact Hyper Text Markup Language) which run on a micro-browser, adding handset providers and manufacturers to the i-mode value network was essential to take full advantage of the service potential. To this end, NTT DoCoMo created an environment for sharing R&D with a selected group of mainly local handset manufacturers (e.g. NEC, Sony, and Fujitsu) enabling technologies to be improved in an incremental and continuous manner, e.g. the development of Java-enabled handsets in 2001. This type of collaboration allows the telecom to bring appropriate channels (i.e. handsets) to the Japanese market enabling users to successfully communicate with the i-mode service.

For NTT DoCoMo, building collaborative relationships has extended the telecommunication sector to include actors from the outside. For example, although NTT DoCoMo is the actor handling the billing function within the i-mode value network and rewarding itself for this extra role (i.e. a 9% commission on service subscription), it has also partnered with leading banks developing new forms of payments and money collection. Moreover, it has partnered Coca-Cola allowing i-mode users to use their handsets with Coca-Cola vending machines and charge transactions to their i-mode bills. With the intention of making i-mode the de facto standard worldwide, NTT DoCoMo built a number of strategic partnerships with many telecoms in different parts of the world. To build a strong base for these international collaborations, NTT DoCoMo established in 2000 a strategic alliance with AOL-Time Warner to provide content and marketing in the English language.

However, the problem that occurred from the author’s perspective is that NTT

DoCoMo practiced along with its telecom partners the same closed network mode that the telecom has employed in Japan despite the situational differences. Pisano and Verganti (2008) argue that a closed collaboration approach is preferable when a company (1) needs only a small number of collaborators or problem solvers; (2) comprehends the required knowledge domain and both user and market requirements are well defined; and (3) knows which actors to draw on. When applying these conditions to NTT DoCoMo's case, it seems that adopting a closed network mode was appropriate for NTT DoCoMo in Japan given that user and market requirements were clearly defined following the market research the telecom has conducted, led by marketing and Internet technology specialists Muri Matsunaga and Takeshi Natsuno. The number of actors needed was reasonably small as well. A closed model was also deemed appropriate as the telecom was able to determine the required knowledge domains for the i-mode service and which parties to collaborate with given its long and sustainable relationships with many and different types of actors inside and outside the telecommunications sector. Further, NTT DoCoMo's extensive R&D capacities as well as its wide and deep knowledge in telecommunication standards, infrastructure, services, and devices signifies another reason justifying the appropriateness of a closed network mode in this case.

Notwithstanding, the author believes that an open network mode where any party can participate and provide ideas related to the innovation was more appropriate to be used by the international telecom partners. Although NTT DoCoMo has put a lot of effort in connecting the telecom partners with content providers and handset manufacturers, those actors were mainly part of the local market of Japan, with no or little experience in European and other international markets (Hung and Yeh, 2006). Therefore, local actors who have better understanding of local overseas markets were missing, perhaps, due to the inexistence or weak market structure of mobile data services. Therefore, a clear identification of needed actors to draw on in the international market was not there. Another reason justifying this argument is that user and market demands were not clearly defined in the international markets. Hence, the author postulates that whilst employing a closed network mode was appropriate in Japan, continuing this approach in international markets where convenient conditions for such an approach is missing represents one of the reasons leading i-mode to fail outside Japan.

Eighth, we argue that the alignment amongst strategic goals and objectives of collaborative actors may matter. The strategic goals towards i-mode considerably differ between NTT DoCoMo and its telecom partners. NTT DoCoMo aims to make i-mode along with its technologies a global standard. For example, NTT DoCoMo strategically aims to publicize its W-CDMA (Wide Code Division Multiple Access) standard concerning cellular networks throughout the collaboration with its strategic partners. To this aim, NTT DoCoMo updates i-mode regularly with new features and services and makes tremendous efforts in regards to the service's marketing, supporting technologies, and value system. Telecom partners on the other hand do not seem to have the same strategic vision towards i-mode. This is perhaps related to their initial commitment to the open standard WAP (Wireless Application protocol) where offering i-mode seems to be only a step in getting some useful experience needed to offer 3G mobile data service effectively. This diversion on strategic goals is another reason explaining why i-mode did not succeed outside Japan.

Ninth, we argue that employing diversified service channels (i.e. handsets) with customer actors may matter. Generally speaking, there are some technological and other requirements needed to be fulfilled before users are able to use the i-mode service. Users are required to (1) acquire i-mode-enabled mobile handsets; and (2) subscribe to the i-mode service through NTT DoCoMo or one of its partners in countries other than Japan. Another limitation of i-mode is that users can only access Websites developed using cHTML (a Compact Hyper Text Markup Language). Amongst these limitations, the only difference between Japan and overseas markets is related to the availability of handsets along with their various brands. Whilst in Japan, i-mode compatible handsets are available in many different models and from different handset manufacturers which are well-known and admired there such as NEC, Sony, Fujitsu, Sharp, Mitsubishi, Panasonic, and others; only two main types of handsets are available overseas (Hung and Uh, 2006), i.e. NEC and Toshiba, which do not enjoy the same popularity and attractiveness as mobile handsets in overseas markets as in Japan. For example, in Europe, mobile handset manufacturers such as Nokia and Eriksson are perhaps more experienced in what users in this region may require and admire (Quigley, 2002). Therefore, the author considers that lack of varied and highly appealing i-mode compatible handsets is one of the key reasons hindering the service diffusion in the international markets.

The underlying reason behind the significant differences between Japan and the overseas markets in terms of numbers and varieties of handsets is related to the handset manufacturers' economic viability. At least 500,000 units represent the economic volume for manufacturers to produce a new handset model, which is mostly required to be pre-ordered by a telecom (Funk, 2001). This significantly exceeds the requirements of international telecoms given their small scale of i-mode users. Perhaps, this would not have been a problem if the technology of i-mode compatible handsets is the same in Japan as international markets. This way, for example, handset ordering might be done centrally and then distributed to different telecoms based on their requirements. This however was not the case as the technology of i-mode compatible handsets in Japan were based on PDC/PDC-P technology, whilst those in international markets were mainly based on GSM/GPRS technology.

Tenth, we argue that governance issues may matter. The value network of i-mode is hierarchical when it comes to governance. NTT DoCoMo is the dominant actor directing and managing the innovation and its value creation. For example, to qualify for official status which includes having their Website accessible directly through the i-mode menu, content providers are required to undergo a lengthy qualification process fully controlled by NTT DoCoMo. Another example is that NTT DoCoMo specifies in detail what kind of handsets are required to meet the requirements of the i-mode services and its updates and developments, rather than modifying the service to meet the requirements of the existing handsets. This has worked considerably well in Japan and not in international markets. Given the low adoption of fixed-line Internet and the large base of i-mode customers, content providers in Japan have found that i-mode is very promising as their principal technology for capturing value and revenue from their Websites along with their contents. For handset manufacturers, i-mode provides a market for innovative and feature-rich handsets (Vincent, 2001) and thus symbolizes a new stream of revenue generation. Thus, it was rational for content provider to undergo the qualification process and handset manufactures to accept receiving requirements from NTT DoCoMo in Japan as benefits seems to surpass the drawbacks. However, these favourable conditions did not exist in the outside markets as PC-based Internet adoption as an alternative technology is high and the numbers of i-mode customers is very low. Thus, actors in the international markets were more reluctant to engage.

5.3.5 Issues related to Value Finance

Eleventh, we argue that billing systems may matter. One important element that makes i-mode so appealing to its users in Japan is that it makes it possible for them to stay connected to the Internet at all times, while only being charged for actual traffic rather than the time spent. This is thanks to i-mode packet-switched technology. NTT DoCoMo has set very competitive prices for i-mode aiming to attract a large volume of customers. Keiji Tachikawa, NTT DoCoMo's president, believes that low pricing is the key to building demand for i-mode service given that it is a consumer product (Grech, 2003). In fact, I-mode users are required to pay only about $3/month for i-mode subscription. The traffic charge is approximately $0.003/packet. For some official Websites, users also have to pay a service subscription fee ranging from $1-$3 per Website per month. Currently, NTT DoCoMo gives the user the freedom to choose between flat-rate or packet-based charging methods providing more flexibility to the service.

Given the market conditions in Japan, these prices seems to very encouraging for users, but not to the same extent for content providers given the limitations imposed by NTT DoCoMo. These limitations can be summarized as follows: (1) flat-rate subscription method is employed and there is no room for transaction-based charging due to the complexity of micro-payment billing, and (2) maximum subscription fee for a Website per month is around $3. For NTT DoCoMo, such a simple pricing method gives advantages for users as they receive only one bill coming from one economic entity (i.e. NTT DoCoMo). For the telecom itself, this method is advantageous as it reduces operation and management cost of billing functions. Moreover, NTT DoCoMo considers that it is easier to communicate the pricing method to the market (Grech, 2003) and to make it highly understandable by customers.

On the other hand, in international markets, pricing methods for i-mode were not effective in general. Many telecom allies offered i-mode with flat-rate plans in a very early stage, even before establishing the demand for the service and without giving the choice to customers to switch to packet-based charging methods. Indeed, i-mode pricing is a very critical issue to the service success especially in international markets due to the availability of free content over the traditional Internet (fixed-line) coupled with its high penetration rate compared to Japan. Many users there are not used to pay for content available on the Internet. But, perhaps, the adoption level of the i-mode service would have been higher in the international markets if telecoms adopted more appropriate revenue generating method. For example, it seems that advertising-based revenue generating method is more sensible there than subscription-based. Moreover, if telecoms also seek to charge customers, it seems that telecoms should only charge for content regarded as valuable when the user is mobile such as location-based and time-critical services.

5.3.6 Conclusions: I-Mode Service

NTT DoCoMo introduced mobile data platforms to the world through its i-mode service. Although i-mode was built on a modest technology, its highly appropriate business model made the service very successful in Japan. After a few years from its roll-out in Japan, NTT DoCoMo launched the service in many other countries in different parts of the world. This was possible due to the strategic partnerships NTT DoCoMo established with telecoms in the selected overseas markets. Unlike the service success in Japan, however, i-mode seems unsuccessful in the chosen international markets.

The application of the V^4 Mobile Service BM Ontology as a part of its evaluation to analyze why i-mode is very successful in Japan, whilst it is not in the overseas markets reveals important details. The analysis and evaluation conducted shows that successful mobile business models are those fitting the context of mobile data services in terms of space (i.e. market) and time. Thus, effective mobile service business models need to be adapted according to each market, and also need to be dynamic to cope with changes happening in the environment the service operates in. This stage of the evaluation also supports the assertion that selecting a fitting network mode when creating value networks is one of the key value drivers of mobile data services.

As we have seen throughout the analysis, the dilemma of i-mode being successful in Japan and not in the overseas markets cannot be explained by one single factor. Issues related to value proposition, value network, value architecture, and value finance are highly relevant and important. This fact seems to indicate that the ontology is cohesive.

The case of i-mode has added to and enriched the evaluation of the developed V^4 Mobile Service BM ontology. Unlike the Apple iPhone case where the ontology is utilized to examine the success of the platform in general, the i-mode case uses the ontology to explain why the service is unsuccessful in overseas markets despite its success in Japan.

5.4 Orange Business Services (OBS)

Orange is the commercial brand of France Telecom Group; one of the world's leading telecommunications operators. Currently, Orange covers 123 million customers worldwide. It is the number two mobile and Internet service provider in Europe, and a world leader telecommunications services for enterprises. Having the expansion strategy listed in their agenda, Orange is now operating in more than 30 countries on five continents. In the majority of countries where the company operates, Orange is the single brand for Internet, television and mobile services.

In 2007, Jordan Telecom Group, which constitutes the base for the telecommunications renaissance in Jordan, has adopted the Orange brand for all its fixed, mobile, internet, and content services. For mobile and telecommunication services, Orange has become the new brand replacing MobileCom, i.e. the old GSM mobile operator for Jordan Telecom Group.

Following this significant transition, Orange aims at providing the Jordanian end-customers and business market continuously with the highest quality of differentiated telecommunications services at affordable prices and in line with its values and philosophy to fulfil the requirements and meet the needs of the local market. Meanwhile, Orange also aims to become the integrated operator of choice not only in Jordan, but also in the whole Middle East by transforming the company into a fast moving and service-oriented organization where the customer is at the heart of its approach to innovation.

Telecommunications in Jordan is a very advanced and immensely competitive four telecoms market. Currently, Orange-Jordan is the number two telecom operator in

Jordan following Zain and leading both Uminah and Express telecoms. Nevertheless, it is almost the leading operator when it comes to telecoms services for enterprises. Orange serves more than 1.8 million subscribers out of around 5.5 million inhabitants in Jordan. In the following subsections, this research discusses the business model configurations of Orange Business Services (OBS) in Jordan, using the developed V^4 Mobile Service BM Ontology.

5.4.1 OBS Value Proposition

Orange Business Services is the banner for business communications solutions and services in France Telecom which was originally launched on June, 2006 to specifically serve the business market. In 2007, to open up new opportunities, Jordan Telecom Group has adapted the OBS brand for its corporate services, inspired by Orange creativity, plus the innovation potential of France Telecom Group. In doing so, Jordan Telecom Group plans to optimally serve Jordan's business market through its enterprise business unit covering all types of bundled services including data, fixed and mobile, as illustrated in Figure 5-2.

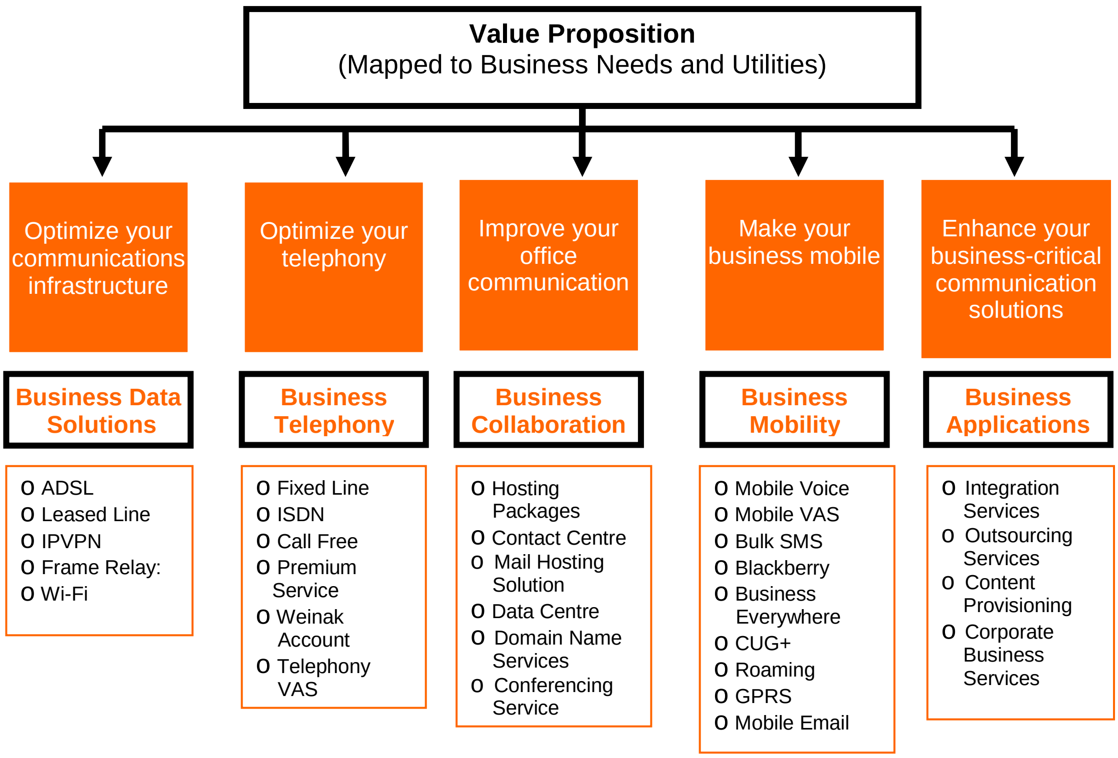

Figure 5-2. Orange Business Value Proposition

The target market segment of these services is Jordanian small, medium and large enterprises in all industries. This includes manufacturing companies, banks, airports, hotels, universities, and any other public or private institution. Given this large scale, the telecom is deliberately designing its ICT-service bundles to meet the different wants and needs of their varied business customers.

The notion of 'one size fits all' is not listed within the concepts of the telecom. Instead, Orange considers developing tailored solutions that best suit different business challenges. Moreover, as a telecoms service provider in Jordan, Orange commits itself to provide the Jordanian enterprise market with the most innovative, integrated and end to end solutions that will secure their business continuity. Indeed, this promise was declared following the strategic partnership established with Orange. In particular, the intended role of this major move has been settled by the Chairman of the Board of Directors of Jordan Telecom Group during the announcement of the complete introduction of Orange services in Jordan as follows:

> *"Our customers will be enjoying Orange's competitive range of telecom solutions and top quality services, enjoying the premium offering that will meet their needs to full satisfaction through this single and reputable provider"*.

The proposed value of Orange in Jordan is that of quality. Orange intends to bring high performing, secure, and easy-to-use solutions which are also simple, flexible, and cost-effective. Having enterprises as their target segment, Orange business services primarily addresses utilitarian value elements which are intended to add value to the business performance. Yet, by means of its value proposition, the telecom aims to deliver the following benefits to the Jordanian business market.

(1) Removing barriers to business success.

(2) Enhancing business contribution by opening up opportunities.

(3) Removing complexity and making technology work for more businesses.

The aforementioned value elements are to be delivered by all types of services within the bundle, but each single category aims to provide more specific values as explained in Figure 5-2. For example, business data solutions aim primarily to optimize the communication infrastructure of business customers, whereas business mobility services aims to provide business users with state of the art mobile technologies and services.

Following its strategic partnership with Orange, Jordan Telecom Group is now also able to provide the value of the Orange *brand* to its business customers conveying the quality and reliability of the services offered. Interestingly, the annual report of 2007 points toward that as follows.

> *"2007 was an outstanding year for Jordan Telecom Group… … Adopting Orange brand gave us the inspiration to enhance our services and provide our customers with exceptional products along with more determination to achieve excellence in order to remain our position as the leading group in the Jordanian market".*

Basically when the customer is a business enterprise, the QoS levels between the telecom and the enterprise need to be agreed beforehand and to be documented in a service level agreement (SLA). Therefore, assuring that offering meets the agreed standards is decisive. Actually, Orange is adhering to these elements of value in general, and more specifically to the quality issues related to the provided services through so-called *application-based* SLAs which are reviewed internally and on a quarterly basis for quality assurance purposes.

5.4.2 OBS Value Network

The capacity of Orange-Jordan in providing the Jordanian corporate market with such a value proposition has been significantly leveraged through its value network actors. Diversified resources that rarely exist within one telecoms organization are needed to allow the offering of Orange bundled business services. Hence, Orange-Jordan considers that it is extremely important to establish relationships with its main value network actors in the form of strategic relationships and affiliations.

Jordan Telecom Group were signifying a consortium of four companies as illustrated in Table 5-2, which then, in 2006, has been restructured into six business units:

Orange Fixed, Orange Mobile, Orange Internet, Orange Innovations and Corporate Integrated Solutions Business Unit, Wholesale Business Unit, and Jordan Telecom Group Foundation. This kind of national association represents a *micro* value network for Orange-Jordan. However, as a major step into extending its *macro* value network, the telecom set up strategic partnerships with France Telecom Group along with its affiliates. This move has made the structure of the value network more complicated, but at the same time has strengthened the network significantly.

Table 5-2. Original Companies within Jordan Telecom Group

Jordan Telecom Group	**Core Business**
Jordan Telecom	*Fixed Line Operator*
MobileCom	*Mobile Operator*
Wanadoo	*Internet Service Provider*
e-dimension	*Data and Content Provider*

This progress allows Orange-Jordan to acquire and maintain strategically high quality complementary services and resources in a cost-effective manner. Orange-Jordan believes that these kinds of assortments play a fundamental role in enhancing the consistency of the strategic goals among each party involved leading to a 'win-win' situation.

Many managers pointed to the role of actors within the Orange-Jordan value system with pleasure, as evidence of the actors' positive roles. Remarkably, this viewpoint has been reflected in many Orange-Jordan documents. One internal document declares the particular role of Orange as follows:

> *"Based on Orange heritage of revolutionizing norms, we are moving into the future with new and exciting products and services for multinationals…… The backing of France Telecom Group's network and carriers opened wide perspectives for our Group and placed it as a major player in the Middle East"*.

Orange-Jordan is also conducting and maintaining other external arrangements in terms of communication and collaboration with other businesses. To give just two examples apart from technical infrastructure requirements, Orange-Jordan has signed agreements with 263 operators within 125 countries, enabling its business customers to keep in touch with their organizations when traveling. Whilst, to act as a content provider, it has partnered with other local, regional and international content providers. Orange value network actors play different roles within the network and communicate varied materials such as money, data, experience, knowledge, HW, SW, services, and products. When it comes to suppliers, Orange-Jordan bears in mind decreasing the degree of dependency on specific suppliers in an attempt to sustain stability and gain a mixture of technological and other experiences.

Orange-Jordan assumes that the main role of these affiliations, consortia, strategic partnerships, and other types of relationships with different actors within its value system would not only enhance its strategic position as the telecom operator, but would also reinforce its position as an integrated operator providing fully fledged services to the corporate sector. Founded on that, Orange-Jordan has attached a *wholesale business unit* to its organizational structure. This unit specializes in handling the complexity associated in managing the diverse relations amongst its value network actors including all national and international operators.

Constructing interfaces and communication channels with business customers is also of high concern to Orange. The telecom believes that such utilizing appropriate channels would establish worthy relationships with its enterprise customers. Hence, Orange has put in an *enterprise business unit* within its organizational structure as a commercial business unit handling the business market, and a single point of contact for all solutions. More specifically, the enterprise business unit consists of three dedicated directorates; namely, sales, marketing, and customer care. The business unit aims to handle the requirements of enterprises customers. In addition to physical communication channels which include on-site visits, Orange-Jordan is exploiting Internet and other related technologies such as portals and Customer Relationship Management (CRM) systems to develop valuable virtual communication mechanisms with their business customers. From the IS viewpoint, Orange considers these communication channels critical not only to disseminate information for its business customers, but more importantly to collect information about their behaviors, attitudes, needs, and trends that would enable them to offer premium services.

Despite its complex value network, Orange-Jordan represents a bridge between the entire value network and customers. It provides a single interfacing point to communicate with customers; single authentication point to get access to the entire-network; single access point to benefit from services offered by the whole value network, and a single financial settlement point to profit all the actors within the value network. Through permitting such simplicity in communications, Orange-Jordan intends to optimize the customer experience.

Founded on that, Orange seems to be the principal orchestrator of value within the network. The telecom controls customer information being in constant contact with them, mines useful intelligence out of the collected data, and fuels the network with novel ideas and market knowledge. This in turn gives Orange the power to lead innovations within the value system. Nonetheless, Orange system is open not only to customers, but also to business partners. Orange perceives innovation as a joint process where parties share and exchange ideas, contributions, and expertise.

5.4.3 OBS Value Architecture

In the previous subsections it became evident that Orange-Jordan can offer Orange Business services through its *integrated resources* including those absorbed from its value network. At this point, the author discusses in more detail the architectural arrangements carried out by Orange to offer the Jordanian market with OBS.

Orange-Jordan understands value architecture as a core tangible (e.g. ICTs) and intangible (e.g. Knowledge Capital) resource to deliver its intended functionality. In relation to OBS, functionality is explained in terms of provisioned business service types along with their quality standards. Not surprisingly, Information and Communication Technologies (ICTs) have been perceived to constitute fundamental resources for Orange. Selected examples of the telecom core ICT resources are presented in Table 5-3. For example, as customer information is one of the key resources to telecoms, Orange has managed to access critical customer information including localization data through the core database management component of its mobile version of CRM systems.

Interestingly, Orange understands the great role of its human resources represented through their knowledge capital. Although the telecom appreciates the role of its ICT resources, Orange-Jordan considers its staff knowledge to be the differentiator. This is reflected in many of Orange’s documents, highlighted by many managers, and confirmed by one senior manager as follows:

"Our success is driven by our ICTs and their associated arrangements, enriched by our staff knowledge and experience… … both are essentially important, but the human part is harder to allocate; thus more influential".

Configuration of resources is crucial to Orange-Jordan. Indeed, the obtained resources such as its brand, technologies, collective expertise and knowledge enable the OBS offering. The success of OBS in Jordan is largely based on the methods in which the resources and expertise of value network actors (e.g. Equant, Orange, France telecom along with its affiliates, and Jordan telecom group) are combined.

Table 5-3. Selected Examples of the telecom ICT Resources.

Category	Representative cases
Engineering Infrastructure Equipments	Public Switched Telephone Network, Mobile telephone switching office, base stations, transceivers, and backbone switches and routers.
Cellular Technologies	Global System for Mobile Communication, and General Packet Radio Service.
Network Management Applications	Planning, optimization, and control systems.
IS/IT Applications	Billing System, CRM, portals, and Oracle ERP.

But perhaps, that would not be the case if Orange-Jordan did not give enough attention to maintain high levels of synergy and alignment between its internal resources and the acquired ones. Resources alignment, as a major step of resource configuration, is not all about technological compatibility. It should also address other organizational aspects such as structure, management mindsets, and culture. Principally, Orange-Jordan seeks to employ its diversified resources to get along with its paradigm, structure, and culture. Orange-Jordan considers this aspect of alignment crucial since they perceive technology as an enabler of change, rather than being a change itself. Such a view signifies a shared culture among its members, which in turn provides them with helpful insights allowing more achievable and manageable communication, collaboration, and information dissemination. In view of that, one departmental manager noted the following:

"Orange Business Services are about people rather than technology".

The telecom argues that this conviction and understanding smoothes the progress of providing tailored solutions that best fit different business needs and creates seamless experiences. Through aligning attained resources to existing ones, Orange aims to run smooth processes that would allow the creation of its value propositions at lower cost and higher quality than its rivals. Interestingly, one footnote within a division manager presentation refers to this as follows:

> *"Tools have been designed by taking the complexity of technology, molding the appropriate pieces into a contributive blend and putting it all to work, efficiently and effectively"*.

On the other hand, creating new value propositions may affect the structure of an organization. In the previous subsections, we have seen how Orange-Jordan restructured its business into six units with one of them, i.e. enterprise business unit, mainly dedicated to OBS offering. While another, i.e. wholesale business unit, managers its relationships with the value network actors. This restructuring exercise undertaken by Orange-Jordan has been inspired by France Telecom Group principally to ensure consistency between the two strategic partners. They believe that this new structure will leverage the integration of each company's specialization into tailored service packages which have the potential to add superior value.

In essence, the creation of core competencies requires a proper utilization and appropriate configuration of the overall resources possessed by any telecom. The core competencies are utilized to constitute the main source of sustainable competitive advantage for the telecom. Concerning OBS offering, the available resources along with their configuration arrangements let the development of the following four core competencies.

(1) Convergence: This is could be depicted through the ability of bringing together voice, video, data, and mobile services that meets varied business needs and helps businesses to communicate and share information.

(2) Customer Service Effectiveness and Simplicity: JTG believes that customer service is one of the key differentiators in today's telecom market. Thus, through its restructuring program, the telecom business customers have a single point of contact for all solutions, namely the Enterprise Business Unit.

(3) *Stability and Investment:* France Telecom Group as a stable and long term partner enhances Orange-Jordan stability and encourages the telecom to open up wider perspectives with new services, new technologies, and a worldwide presence.

(4) *Global / Local Capability*: The consolidated potential of the telecom along with Orange in innovating and developing ICT services is explained through the fact of delivering many consistent telecom solutions in 220 countries and territories.

Yet, we have shown the Orange-Jordan value proposition, co-operational, and architectural BM arrangements regarding its Orange Business Services offering. The financial BM arrangements, however, are discussed in the next section.

5.4.4 OBS Value Finance

Typically, demonstrating a clear return on investment is fundamental to any telecom business. In such a complex environment, ensuring the financial viability of the provisioned services is of high concern to Orange-Jordan. Aiming at that, Orange-Jordan carries out a variety of arrangements that could be briefly categorized into three aspects: Total Cost of Ownership (TCO), pricing methods, and revenue structure.

Total cost of ownership is the entire cost of Orange-Jordan core arrangements needed to provide services as intended. TCO not only includes the cost of ICT resources, but also the cost of development, support, and maintenance as well as the cost of essential collaboration and communication the telecom conducts with its value network actors and customers. TCO could be depicted more simply as the summation of the telecom total cost of assets and operating expenses. Although, at first glance, the cost of total assets such as property, plant, and equipment appears to represent the highest source of the telecom's expenditure, the telecom views operating expenses (running cost) as the major cost since it appears to exceed the former one over time.

The operating expenses of the telecom are cost of services, administration expenses, selling and distribution expenses, government revenue share, management fees, and brand fees. Actually, the cost of services is the major one. For example, in 2006 and

2007, cost of services represented more than 150% of the sum of all other expenses. Cost of services includes interconnection fees paid to other operators of other telecoms networks, license fees, and technical costs such as those related to technical personnel as well as network operating and maintenance expenses.

Interestingly, some of Orange-Jordan operating expenses appear in the form of revenue sharing. For example, pursuant to the mobile license agreement between the telecom and the telecommunications regulatory commission, the government revenue share equals 10% of Orange Mobile business unit net revenue. Whilst, for using the Orange brand in all JTG subsidiaries, Orange revenue share equals 1.6% of the telecom's operating revenues. Moreover, the telecom is subject to other types of fees and taxes such as a corporate income tax at a rate of 25% on a non consolidated basis, and Jordanian university fees are calculated as 1.0% of profit before income tax.

As we have seen, managing costs related to telecoms is not easy task. Many activities and functions with varied requirements are involved. Orange-Jordan attempts to address and manage these issues sensibly. In doing so, the telecom assumes to set prices of its services in more effective methods which in turn affect its revenues. Pricing mobile and telecommunication services is not a straightforward process. The decision is multifaceted since many criteria are taken into consideration. This fact has been confirmed by Orange managers, and one departmental manager summarized it as follows:

> *"Many factors affect the pricing of any of our services. For example, aspects related to its total cost, category, perceived value by corporate customers, affordability, competition level in the market, and whether the service is offered separately or within a bundle of other services are extremely important"*.

Further, in relation to OBS pricing, Orange-Jordan applies dynamic, fixed, and revenue-sharing methods. The idea of dynamic pricing is rooted in charging customers based on different measures such as number of transactions, transferred volume, or duration of service usage. The fixed pricing scheme is based on giving its business customers the ability to control their budget by paying fixed amounts to get unlimited usage of services during a predetermined period of time. On the other hand, the revenue sharing model reflects a collaborative process where the telecom is in charge of supplying, installing, and maintaining telecom equipment among sites where services are offered. Representative and illustrative examples concerning OBS pricing methods are presented in Table 5-4.

Table 5-4. Representative Examples of OBS Pricing Methods.

Pricing Methods		Service Name	Financial Details
Fixed "Flat Rate"		**Surf and Talk**	1) Aggressive discount on international traffic for the top countries. 2) Simplicity: One monthly bill that includes all the components of the bundle.
		Leased Line	1) One flat rate for unlimited usage, usually per year.
		Domestic IPVPN	1) Reduces the Total Cost of Ownership (TCO) of the corporate customer through a one-time fee in which includes: Installation, transfer, upgrade and downgrade. 2) Monthly rental fees that depend on: IPVPN type, class of service, access method and bandwidth.
		Weinak Account	1) A service of accounts for corporate business and residential customers with high values of pay as you go calling credit; JD50, JD100, JD300.
		CUG+	1) A solution that gives free unlimited talk time within company group with monthly fees for as low as JD2/month.
Revenue Sharing		**Wi-Fi**	1) works on a Revenue-Share model with restaurants, cafés, universities, airports …etc.
Dynamic	***Time-based***	**Internet Roaming**	1) Customers only pay local phone call charges. 2) Hourly Fee
		Internet Fax Away	1) The minimum fax away charge is 60 seconds with incremental charges incurred every six seconds.
		Mobile Voice Corporate Offer	1) Customers talk for as low as 4 piaster/minute to any Orange Business Services or Jordan Telecom subscribers day and night. 2) Loyalty program: JD1 Spent = 1 Point Earned.
	Transaction -based	**Bulk SMS**	1) Charges are based on the number of the number of messages.
	Volume-based	**Hosting Packages**	1) Prices for different volumes: 25MB, 50MB, 100MB, and 200MB.
		GPRS	1) Billing for the amount of data sent or received which range from 10 MB to unlimited. 2) Neither monthly nor connection fees.

As for revenues, Orange-Jordan structures them according to its business segments, namely; fixed line, mobile, and data communication. Within each business segment, revenues are organized with respect to service bundles type. This kind of structuring allows the telecom to easily compare the performance of each segment along with its bundled services.

To sum up, based on their BM arrangements, in 2007, the telecom reported 15% Return on Investment (ROI), and registered 9.6% increase, from the year 2006, in consolidated revenues. The fixed line segment recorded JD243.5 million, while mobile segment recorded JD183.5 million. The fixed line segment also generated JD14.1 million.

5.4.5 Conclusions: OBS

In this case, the author has shown how Jordan Telecom Group translated its strategy into more systematic BM arrangements, on which JTG's operational processes were built on. Further, the case study highlights the underlying reason behind the business model's value architectural, co-operational, financial, and propositional arrangements. Orange-Jordan believes that the BM arrangements would enhance its strategic position in the Jordanian telecom market through enabling the achievement of JTG's strategic goals and objectives.

Moreover, the case study regarding OBS shows us that BM representation is a flexible process. The presented case information is a result of consolidating and integrating data that was previously disjointed in varied formats. Modelling methods in general can be classified as explicit or tacit. Explicit modelling includes graphical and textual techniques, while tacit ones indicate that modelling is performed within individuals' minds; thus not easy to be disseminated. In this context, the author finds it important to acknowledge triangulation in data collection. While secondary data offers pieces modelled graphically and textually, interviews as well as observation were effective means in soliciting implicitly modelled data.

The OBS case study highlights a number of promising aspects covering the overlooked areas within related research and practice. The author underlines major ones as follows. First, the JTG initiative of establishing a micro value network in forms of national associations, as well as reinforcing its macro value network through strategic partnerships with major players, is enormously appealing. This innovative model could act as a reference to be followed by other telecoms, given that JTG noticed the associated positive effects within the first year. And second, when addressing the design and engineering of mobile and telecom services, most research put forward cases related to Business-to-Customer (B2C) models (for example, Van de kar, 2003; Maitland et al., 2005). The presented case however tackles the overlooked aspect concerning Business-to-Business (B2B) approach. Examining this area (i.e. mobile and telecom business services) as a part of evaluating the V^4 Mobile Service BM Ontology reinforces its empirical validation.

5.5 Summary

The author has validated the constructed V^4 Mobile Service BM Ontology via real-life cases of mobile data services that demonstrate the business model arrangements in use for Apple's iPhone, NTT DoCoMo's i-mode, and Orange Business Services. The applied analysis over the three cases indicates the efficacy and value of the developed ontology. It also reveals that an appropriate and unique business model is a critical backbone that leads to the success of mobile data services by allowing providers to achieve their strategic goals and objectives. It has been also indicated that this conclusion holds true even if providers are new entrants to the telecoms highly innovative and competitive industry, as with the case of Apple iPhone. Retrospectively, the author agrees with Chesbrough (2005) that "successful innovation often demands an innovative business model at least as much as it requires an innovative product offering".

In design-science research, the use of evaluation criteria to validate the research output(s) is significant (March and Smith, 1995; Hevner et al., 2004). Hence, the author refers now to the criteria established within the Design Quality and Evaluation Framework (DQEF) of ontologies in chapter 2 (see pages 43-46) to verify that the developed ontology satisfies all of the six criteria established. Through the examination of the three case studies, this research shows that the V^4 Mobile Service BM Ontology is:

1- **Clear**: This is because the author defines unambiguously the terminologies in the context of this research (4 design dimensions and 16 design concepts along with their constituent elements) and their relationships. The author also provides detailed semantics of these design dimensions and concepts (i.e. constructs).

2- **Coherent**: The details related to each design construct complementing the other details belong to other design constructs. There are no contradictions between concepts and their semantics.

3- **Concise**: The developed ontology identifies constructs that are mutually exclusive and unique; and thus, no redundancies are available. Moreover, the ontology only defines concepts regarded as highly significant and influential so unnecessary details are ignored.

4- **Precise**: As precision is founding on undertaking the conceptualization course of action at the *knowledge-level* rather than the *symbol level* (Gruber, 1995), the developed ontology is deemed precise. This is because (as discussed in chapter 2, iteration 1-3, pp. 46-58) the collected data are analyzed by utilizing the content analysis method in a way similar to grounded theory. Therefore, design constructs along with their relationships and rules have been emerged as suggested by the data since they have not been imposed from outside.

5- **Complete**: All generated data related to each of the three case studies fit smoothly into the developed V^4 Mobile Service BM Ontology. From one side, this detail points towards the structure *validity*, while the other side represents a sign of its *inclusiveness*. However, the way the author designed the case study sections intends to indicate these two messages. This phase of the research confirms that the employed ontology signifies a coherent framework that depicts the underlying business logic from an abstract, but comprehensive point of view.

6- **Customizable**: In the developed ontology, the author defines three formal levels. That is (1) *Thing*: Mobile Data Service Business Model; (2) Four design dimensions; (3) sixteen design concepts along with their elements. These three levels are general and thus could be applied and utilized by different telecoms. However, individual telecoms still can take the ontology to a deeper level of detail that symbolizes their specific arrangements. For example, *Technological-Resource* as an element of the *Core-Resource* design concept can be subdivided by a particular telecom concerning a specific mobile data service into: hardware equipments, applications, and operating systems.

Evaluating the developed ontology is highly important in showing its validity and usefulness. This research utilized the developed ontology to analyze Apple iPhone, NTT DoCoMo i-mode, and OBS so as to ensure the ontology's completeness and effectiveness. The ontology has proved its usefulness as the author, through its utilization, was able to analyze the underlying reasons behind the success of Apple iPhone and OBS. The ontology is also useful in analyzing why i-mode is very successful in Japan and is not so in the overseas markets. In each of the aforementioned cases, it has been demonstrated how the design and engineering of innovative mobile data services significantly depends on the creation of effective business models. Indeed, utilizing the V^4 Mobile Service BM Ontology to analyze three key mobile and telecommunication services indicated that the ontology is clear, coherent, concise, precise, complete, and customizable. Hence, the author argues that the V^4 Mobile Service BM Ontology will be fruitful to telecoms and will enhance their current practices in regards to the design and engineering of mobile data services.

The Design and Engineering of Innovative Mobile Data Services: An Ontological Framework founded on Business Model Thinking

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Chapter Six: Reflections – Deriving a Framework of Mobile Key Value Drivers

6.1 Overview

In this chapter, the author utilizes the collected data from the semi-structured interviews as well as the literature to understand what makes mobile data services successful, or not. It is also appropriate now to step back and look at the three real-life cases that have been examined in the previous chapter to analyze the key decisions made by Apple, NTT DoCoMo, and Orange so as to derive the *key value drivers* when designing and engineering innovative mobile data services based on business model thinking.

On the basis of analyzing the data collected from the three different sources; i.e. literature, semi-structured interviews, and case analysis (see Chapter 2, iterations 1-3, pp. 46-59), we identify six key value drivers in the context of mobile service engineering, as presented in Figure 6-1: (1) *Market Alignment*; (2) *Cohesiveness*; (3) *Dynamicity*; (4) *Uniqueness*; (5) *Fitting Network Mode*; and (6) *Explicitness*.

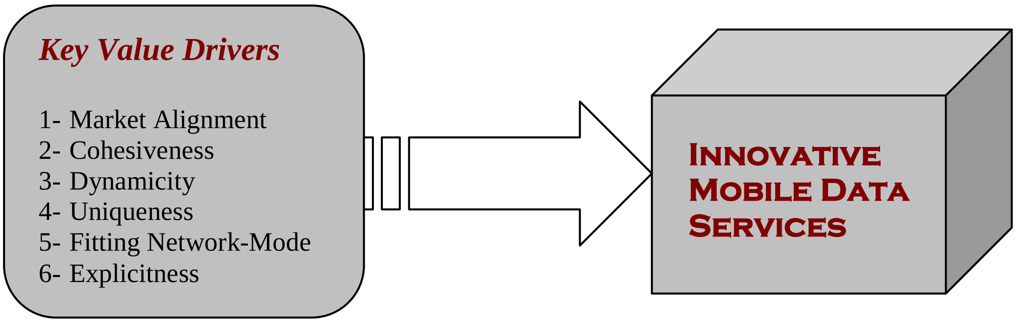

Figure 6-1. A Framework Depicting the Key Value Drivers of Innovative Mobile Data Services

6.2 Market Alignment

This research suggests that there is no direct proportional relationship between the technological excellence of the provisioned mobile services and the outcomes that can be generated by them. This is because such a relationship is mediated by social context as the importance of social and cultural factors is significantly increasing due to the regional and international expansion strategies adopted by many telecoms. Furthermore, the variability of environmental factors such as size of customer-base and nature, market opportunities, competition level, laws and regulations, and technological advances, also affect mobile data services BMs viability and value. To give just one example, NTT DoCoMo's i-mode is a successful BM in Japan that had more varied results in the European market (Kallio et al. 2006), as we have seen in the previous chapter (see Chapter 5, pp. 157-172).

Therefore, telecoms need to continuously expose and sense the outside world since market-orientated mobile business seems to be needed in order to launch effective and innovative services. Slater and Narver (1995) argue that a market-orientation is important since it focuses the business organization on:

(A) Continuously collecting useful information such as those about target customers' needs and preferences, and competitors' capabilities and competences.

(B) Using this information to create superior customer value.

Indeed, telecoms need to listen deliberately and carefully to their customers and appreciate the gathered ideas and resources by exploiting those that fit the telecoms' capabilities. Since a mobile data service is only valuable if it fulfils customer needs or solves business problems, only those specific mobile services that add value to the targeted customers within the current market conditions might be considered as candidates.

The current research reveals five main market-related factors affecting the design of mobile data services business models, as illustrated in Figure 6-2. A discussion about each one of these factors is provided in the following five sections.

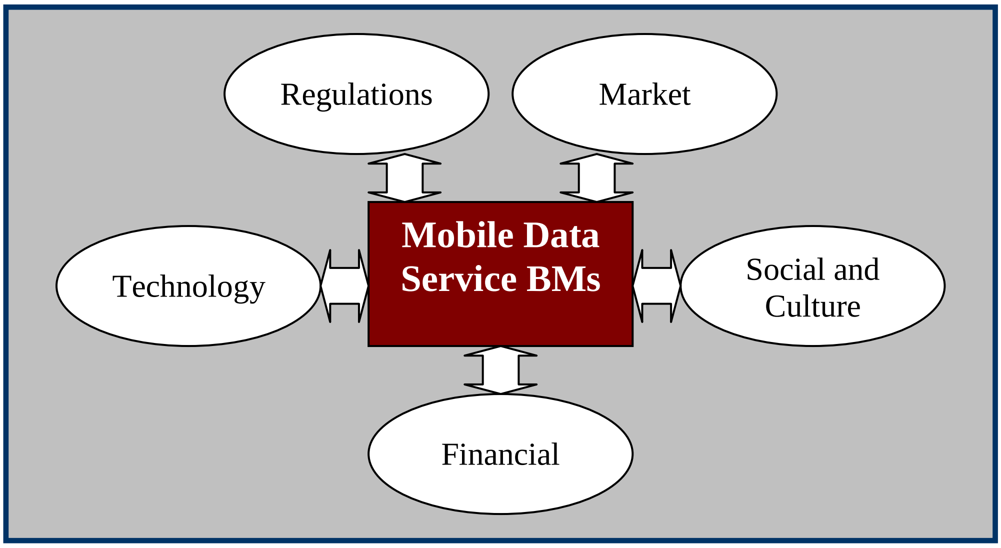

Figure 6-2. Market-Related Factors influencing Mobile Service Design and Engineering

6.2.1 Market Competitive Factors

Along with the implications of the telecommunication revolution on the internationalization of market boundaries, the recent issues associated with liberalization, privatization, and deregulation have critically transformed the telecom industry in many markets worldwide. The hallmark of these changes is the harsh competition among different mobile telecommunication providers. The competition space in most of the telecommunication markets is becoming more difficult to define due to blurred market boundaries.

Bouwman and MacInnes (2006) argue that market competitive factors are the most prominent in prompting ongoing opportunities for the innovation and development of mobile services and products offered by telecoms. But the harsh business environment of telecoms has led to competition based principally on price (Maitland et al., 2002; Peppard and Rylander, 2006). This implies that telecoms are reducing their profit margins to be competitive. Consequently only a few telecoms can afford the budget required for Research and Development. As an indication, Grundstrom and Wilkinson (2004) argue that while telecoms were the main drivers behind the development of standards for 2G systems, system manufacturers are pushing for the establishment of standards for 3G systems. They also attribute this to the increasing deregulation in telecommunication markets, and argue that its consequences are apparent. Moreover, with the growth in the telecom market (Barnes, 2002)**;** barriers to entry are increasing in some countries such as the UK. Such barriers however may negatively impact innovations in service and product developments in the mobile telecommunications industry (Olla and Patel, 2002).

To cope with this highly competitive environment, telecoms need to hold on to their positional niche, establish and widen their customer base, and create value based on customer preferences since the customer base appears to be the most viable resource of revenue for telecoms. The force of competition in most of the telecommunication markets requires telecoms to be innovative and thus sufficient budgets need to be allocated to R&D departments. But, telecoms need to configure the business models of their mobile data service in a way that matches the market structure and competitiveness, if their services are to be effective and successful in the market.

However, the author also considers that the level of competition depends on the number of telecoms competing in the market, and the nature of the market structure as well. For example, availability of a powerful value system in a particular market would facilitate the provision of new innovative mobile data service. Another example is related to the market position of a specific telecom. If the telecom is in a strong position within the market, the adoption of the services provided by that telecom may be easier due to its reputation.

6.2.2 Financial Aspects

In addition to the cost of maintaining the cellular network which is evolving over time, the cost of establishing a mobile telecommunication business represents a huge investment. Building up complete cellular networks and telecommunications is a major sunk cost to be paid back over a period of time by the generated revenues. Radio spectrum licenses represent another main source of cost, being so scarce. In Europe, most licensed 3G operators are not independent, but subsidiaries of larger telecommunication organizations (Maitland et al., 2002), and were thus more able to afford the 3G UMTS license. Acquiring the licenses for operating the 3G networks and beyond is another sunk cost (Olla and Patel, 2002). The costs of furnishing debt can also be substantial due to the expansion strategies of many telecoms (Maitland et al., 2002). Furthermore, the costs of acquiring customers are also high (Peppard and Rylander, 2006).

Despite all these costs, telecoms need to show positive return on investments (ROI). For such positive ROI, telecoms within the current financial situation need to design powerful business models that leverage the benefits coming from the collaboration and cooperation with economic actors within and outside the mobile telecommunications sector. For outstanding performance, a telecom value network needs to encompass only players enabling the telecom to provide mobile services in better quality and lower prices than its rivals.

Moreover, it is necessary that telecoms take into account the economic and financial viability of mobile data services. This is because offering affordable mobile products and services affects telecom's economic value and maximizes the achievement of goals and objectives. In addition to the subscription fees, a decision between fixed, transaction-based, volume-based, time-based, and revenue sharing pricing methods is needed.

6.2.3 Mobile and Disruptive Technologies Issues

Wireless communication can be defined as the process of communicating information (e.g. voice, text, images) in electromagnetic media over a distance through the free-space environment (Pelton, 1995; Aungst and Wilson, 2005). In view of that, cellular value configuration is a complex process; since much less control is available over the transmission path. Given that the cellular communication is a radio frequency (RF) transmission, broadcasted signals are susceptible to many unpredictable conditions that interfere with reception, and may then lead to propagation problems such as shadow zones, rapid attenuation, multi-path interference, electromagnetic interference, and frequency-dependent propagation problems (Panko, 2005). Therefore, geographical variations across market environments normally call for different configurations pertaining to the mobile cellular network including its cell sites, devices and equipments.

Moreover, the emergence of disruptive technologies such as ad hoc and self organized networks (WLANs) presents a threat to cellular technologies (Camponovo and Pigneur, 2003). These disruptive networks could utilize the 802.11 hot spots (Wi-Fi), which are access points offering Internet access in public places and have the potential to cover the globe. While WLAN offers speeds up to around 70Mbps - much higher than 3G systems offer - the latter offers more capacity. The author suggests that 3G and other wireless technologies such as WLAN need to be treated by telecoms as complementary, rather than competitive. If telecoms include these disruptive technologies within their mobile services and products, the value proposed to mobile customers would be enhanced and the possible negative impacts of these disruptive technologies on mobile business may be reduced. Moreover, the author assumes that ‘privacy’ and ‘security’ issues will be differentiators giving advantage to one over another. Thus, telecoms need to allocate more efforts to these two facets if telecoms are going to provide successful and innovative mobile data services.

6.2.4 Regulatory Issues

Broadly speaking, the role of regulatory factors in shaping the structure of the telecom industry has been significantly increasing (Maitland et al., 2002). Governmental policies, regulations (and deregulations), and competition rules usually aim to reduce market dominance and ensure an evolution of a self sustaining competitive market structure, in which telecoms act in a competitive manner. For example, deregulation and internationalization have radically changed the European telecom industry (Peppard and Rylander, 2006). Further, price regulations such as those related to interconnection charges and retail prices affect telecoms’ profits.

Internationally, regulation could play a bi-directional role. For example, liberalization enables market expansion and competition, while strict entry regulations can lead to market dominance. Kallio et al. (2006) argue that markets that have had governmental support have taken off quickly relative to those that have not. Such support includes infrastructure investment, regulatory policies, education of its citizens, maintenance of customer prices at reasonable levels, policies that support fragmentation in an industry that rewards economies of scale, and the promotion of pricing transparency among consumers.

As telecommunication regulations differ from market to market, telecoms penetrating new markets need to change their business model in use to match the new market rules and regulations. Even within one market, telecoms got no choice but to adhere to these changing regulations through redesigning their existing business models of their mobile data services.

6.2.5 Social and Cultural Aspects

Technology is shaped by its social context. It is crucial to develop technologies that are ‘social, culture, and user friendly’. It is most likely that mobile users will reject any technology that violates health, social norms and values, culture, privacy, control, and/or ease of use (Lyytinen and Yoo, 2002a; Wiredu and Sørensen, 2005). For example, health concerns may force mobile operators within a market to share a single infrastructure or reduce the number of deployed base stations (Camponovo and Pigneur, 2003). The consequences on telecoms can be major. Sharing infrastructure would reduce the network capacity, while shrinking the number of base stations might reduce its coverage. Cultural norms and values may, for example, prohibit the use of cameras embedded within mobile handsets or some of its other services in some countries, which would affect the diffusion of those handsets along with their attached services. Therefore, social and cultural issues need to be taken into consideration when designing mobile data services.

To sum up, the author considers that valuable mobile data services are those consistent with the external environments they operate within along with their industry forces. A successful mobile data service in one market may not be successful in other markets. In the previous chapter (see Chapter 5, pp. 157-172), for example, we have seen how the success of NTT DoCoMo's i-mode depends largely on the market characteristics in which the service is functioning. Japanese unique customer profile and market conditions have facilitated the progress of i-mode diffusion and success in Japan. On the other hand, the absence of similar conditions in the overseas markets has made it very hard for i-mode to be adopted outside Japan, given the service attributes. Hence, the author postulates that the fit between service and market details significantly affect the success of innovative mobile data services.

6.3 Cohesion

This research also considers *cohesion* as one of the key value drivers for mobile data services. Cohesion is a comprehensive construct in this context as it addresses consistency and harmonization in the following four main vectors which are demonstrated in Figure 6-3: (A) Consistency in regards to mobile business model configurations; (B) Harmonization amongst the telecom business layers; (C) Consistency amongst the strategic objectives of value network actors; and (D) The fit between the new mobile service and the existing portfolio of the telecom mobile data services.

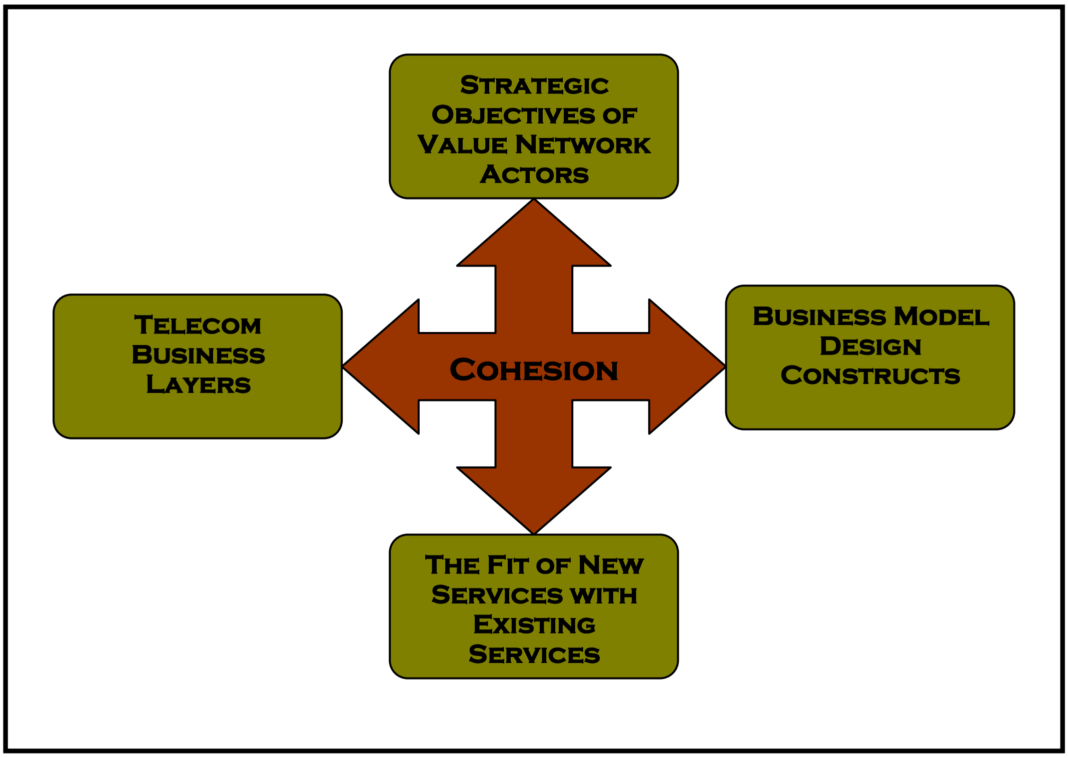

Figure 6-3. Aspects of the Cohesion Key Value Driver

6.3.1 Business Model Dimensional Arrangements

Designing a mobile service BM is a multifaceted process. As discussed earlier (see Chapter 4), it entails consistency amongst different dimensions, interests, and requirements of varied stakeholders. As business models of mobile data services encapsulate four interrelated dimensions: value proposition, value network, value architecture, and value finance, cohesion in terms of holistic alignment and coherent trade-off amongst the configurations and design of these dimensions along with their design concepts is essential. For example, although telecoms need to consider launching services that are possible through the existing resources and capabilities, if services are to be effective, their functionalities, value elements, and pricing methods need to fit with the requirements of the target segment. Only if offerings satisfy customers, will there be economic value to telecoms.

In the previous chapter (see Chapter 5, pp. 173-185), for example, we have seen how Jordan Telecom Group (JTG) reorganized its organizational structure to be consistent with its strategic partner (i.e. Orange and France Telecom) as well as to be able to offer it new OBS platform. Moreover, Orange has adapted the OBS in terms of service nature and prices to match the requirements of its business target segment in Jordan. Indeed, this adaptation of the service attributes is one of the major reasons explaining the success of this service in Jordan.

6.3.2 Organizational Business Layers of Telecoms

The BMs of innovative mobile data services should harness the organizational layers of the telecoms. For an entire harmonization, mobile service BM needs to be viewed as an intermediate conceptual layer linking the overall strategy of the telecom and its technological business processes including their associated information systems. Arrangements in the business model layer and beyond should work towards achieving the strategic goals and objectives. In other words, clear links should be made between the telecom processes including their information systems and its business model dimensional arrangements. Similarly, links are also needed between BM arrangements and strategy elements (e.g. goals and objectives, mission, vision), if mobile services are to be successful.

Apple with the iPhone (as we have seen in Chapter 5, pp. 134-156), for example, has shown that telecoms needs to understand the overlap between strategy and business model and make sure that both are directed towards the same end. The iPhone structural arrangements have been fully consistent with its *differentiation* strategy. Apple in this context has been very deliberate in assuring outstanding quality. For example, the way Apple has consciously selected its partners for development and distribution purposes in regards to the iPhone reveals its high attention to the quality of the final artefact. This is noticeable in the iPhone hardware design as well as its operating system, services, and applications. The simplicity and the employed navigation mechanism also illustrate the high quality of the platform. On the other hand, Apple’s ability to achieve what it has accomplished with the iPhone has been largely supported by its powerful design knowledge and experience, strong and visionary leadership, and its existing technological resources.

Another Example is related to OBS (see Chapter 5, pp. 173-185). The vision of Orange in Jordan is to become the integrated telecom providing fully fledged services to the region. To this end, it offers OBS as a complete solution to the business market in Jordan aiming to fulfil their varied requirements. The BM arrangement of Orange business services fits Orange-Jordan strategy very well. The service integrates a large number of purposeful mobile services which are highly needed in the market. To support this bundle, Orange-Jordan has also restructured its operations and structure in a way that matches the requirements of OBS. Integrating aspects of strategy with BMs, and linking BM arrangements with operational functions is one of the main reasons explaining the success of OBS in Jordan.

6.3.3 Value Network Actors

Telecoms, for a number of functional and strategic reasons (illustrated in chapter 4, section 4.4.3; pp. 110-115), collaborate and cooperate with many actors within and outside the mobile telecommunications industry. Consistency amongst BM actors is highly important since conflicts in their strategic interests would most likely have negative effects on each actor within the established network.

The expected benefits from participating in mobile value networks are not achieved easily; as actors might pursue different business logics, and chase different strategic goals and objectives with the collaboration (Yoo et al., 2005; Bouwman et al., 2008). For example, whilst some actors are keen to generate revenue from this collaboration, others may seek knowledge and experience to help achieve their future plans. But, actors need to collectively and primarily focus on the customers. To this end, actors need to align their strategic outcomes and ensure their consistency so as to successfully capture desired values out of the collaboration (Fontana and Sørensen, 2005). In other words, making sure that actors belonging to the same value network are pursuing consistent strategies would allow them to achieve 'win-win' situations, and improve their economic captured values.

6.3.4 The fit between the New Service and Existing Services

The effectiveness of new services is leveraged if they are well positioned amongst the telecom's portfolio of existing services. The new service should not be redundant or negatively affect existing services offered in the market by the telecom if the service is to be innovative and effective. New services are effective if they have their own space within the telecom's portfolio of existing services, and if this space fulfils a need in the market, as illustrated in Figure 6-4.

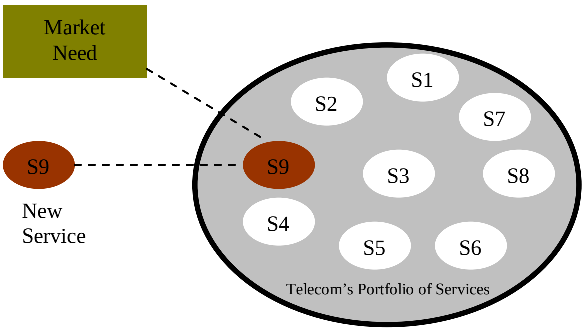

Figure 6-4. The Fit of New Mobile Data Services

For example, the iPhone (see Chapter 5, pp. 134-156) fits well with Apple's other products and services. Although some could argue that the iPhone is an iPod plus other products and services, the iPhone in general complements Apple's existing offering rather than being redundant. This is because of the large number of services and products it integrates within the platform. For instance, the iPhone integrates well with the existing offering such as iTunes being fully compatible. The same is applied to both i-mode and OBS. I-mode was a new type of service offered by NTT DoCoMo and thus complementing and leveraging its existing service. On the other hand, OBS for Orange Jordan is the new banner of services targeting the business market while the existing services before OBS were mainly for individual users.

6.4 Dynamicity

Telecoms need to adapt to the surrounding turbulent hi-tech business environment as the viability of mobile data services BMs is time-dependent. Continuous transformations in the customer and market side may entail significant changes to take place at the mobile business model's side. Otherwise, telecoms along with their value network actors will create mobile services matching the needs of no mobile users. Therefore, BMs of mobile data services need to evolve and change continuously over time to stay successful.

Highlighting the importance of BM dynamicity in general, Barack Obama, the president-elect of the United States, attributed the auto industry crisis to the "unsustainable business models" in use by automobile companies, and argues that their BMs "failed to adapt to changing times" (BBC NEWS, 2008a). Dynamicity in mobile data services BMs is similar as it is about linking telecoms with their external environment continually to assure consistency. The dynamicity of a telecom represents its flexibility and readiness to adapt to its dynamic environment.

Dynamicity in this research is defined in terms of *flexibility*, *agility*, and *extendibility* which are very much interlinked. Flexibility can be defined as the ability to smoothly change the existing business model configurations and design in order to reflect and cope with internal differences such as technology and structure as well as external variations related mainly to market dynamics. Agility on the other hand is about achieving the essential change and moving to the new state of business model effectively and quickly, whilst extendibility represents the ability to grow and expand the mobile data service BM gracefully.

For example, the iPhone (see Chapter 5, pp. 134-156) business model is dynamic and this has been shown through the smooth and prompt changes that happened mainly to the value proposition, value network, and value finance dimensions so as to keep the offering successful in the market. Recognizing that the telecommunication industry is undergoing continuing revolutions driven by innovative technologies, globalization including deregulations, and market changes, Apple has provided three major generations of the iPhone within less than two years. Each new generation offers significant improvements in terms of quality and features. As for the development of iPhone applications, Apple has moved from a totally closed to a walled-garden network model over time in order to the keep the iPhone successful by increasing its potential to meet the needs and wants of different customers through offering more varied applications as fast as possible. In regards to the iPhone value finance aspects, Apple to stay competitive over time has changed its pricing methods allowing customers nearly to pay the price of the handset through monthly instalments that usually spans over the contract lifetime. Moreover, Apple has changed the revenue share mechanism it employed with mobile network operators. Currently, Apple is no longer sharing with mobile operators the revenue generated from mobile data services used over the iPhone. Hence, the author postulates that in the more complex and sometimes unique digital business such as telecoms, the business model needs to be dynamic and more flexible than conventional BMs.

Another example is related to NTT DoCoMo's i-mode. We have seen in the previous chapter (see Chapter 5, pp. 157-172) that i-mode value proposition has been enhanced over time by adding new features and services to the platform aiming to attract more customers and keeping the existing ones satisfied. Moreover, NTT DoCoMo also changed its pricing method by giving the customers the ability to choose between volume-based or flat-rate pricing methods. These changes are necessary to cope with changes happening to the market to keep offerings successful.

The dynamicity of mobile service BMs can also be distinguished as: *technological* and *organizational* dynamicity; encompassing technology application, organization structure and arrangement, and people. Technology characteristics and readiness that enable changes to the business model signify the telecom 'technology dynamicity'. This research categorizes the *technological* characteristics of dynamicity as follows:

(A) ***Scalability*.** Those characteristics of mobile technology structure that allow it to grow gracefully. In other words, this refers to the ability of the telecom along with its applications to expand efficiently to accommodate changes. Clark and Pasquale (1996) argued that networks must be designed with scalability in mind from the outset; and that truly scalable network architecture is the one able to accommodate growth in several dimensions, such as bandwidth, number of users, and number of connections.

***(B) Interoperability*.** The ability of telecoms including their hardware and software to communicate across all platforms, i.e. platform-independent. The author considers this characteristic as crucial to market growth, because it offers lower-cost services that are not only easier to be installed and maintained, but also are faster to market with more options for customers and suppliers (Lee, 2001; Aungst and Wilson, 2005).

(C) *Modularity*. Modularity is determined by the ability to organize and modularize mobile system components into subsystems which can be (re)used for the same or different functions. This feature is very useful in managing mobile business complexity. In the mobile business, modularity should exceed the network issues to include service and product concerns. For example, modularity would allow one or more subsystems of a particular service to be utilized within the provision of other new services. This research suggests that modularity would be useful to telecoms in two major aspects: reducing complexity and increasing efficiency.

In the context of this research, telecom organizations are viewed as complex systems; hence modularity in non-technical organizational arrangements seems to be also significant. Modularity provides simplicity, since it allows us to reduce the number of distinct elements, interdependencies, and communication interfaces in the work system by grouping elements into subsystems (Langlois, 2002). Simplicity enhances telecoms' control over their business, and thus promises more dynamicity in terms of flexibility and adaptability.

(D) *Versatility*. Versatility addresses the potential of a telecom's technologies to incorporate other technologies such as Wi-Fi to achieve the desirable extended capabilities. This is important as people satisfy their needs by shifting between diverse roles and using different mobile appliances with varied forms, requirements, and facilities over different networks and technologies. Moreover, people receive bills related to these services in various ways and at different times. Mobile versatility is the key to resolve this dilemma by integrating different but complementary technologies together in one platform. This research suggests that versatility would be, in the near future, one of the most important aspects providing telecoms with sustainable competitive advantage.

(E) *Adjustability*. This is the ability of telecoms to modify and change their mobile technologies incrementally, rather than radically. An important factor in adjustability is mechanism variety. In other words, this refers to the number of mechanisms that can be used or deployed to adjust existing mobile technologies, including a self-adjusting option.

On the other hand, 'organization dynamicity' revolves around the design of telecoms' flexibility and adaptability to change in terms of: organizational structure, non-technical configurations, management practices, and internal social and cultural aspects. Coping with the rapid pace of change in mobile business, management of telecoms needs to perceive 'change' as a process rather than an event, and enforce this philosophy within the telecom's culture. Making the organization structure more flexible and flat, and embracing teamwork would enhance telecoms' responsiveness to external forces. Human resource continuous development (e.g. training) is also vital, since it ensures equipping telecoms' managers and employees with skills needed to (a) manage changes imposed by the external environment and respond advantageously; and (b) cope with the consequences of these changes. For example, following a change, mobile processes (e.g. maintenance and billing services) could be improved or replaced, and this in turn may require new skills to be run appropriately.

Based on this discussion, this research considers that dynamicity is one of the key value drivers for mobile data services. Indeed, only when mobile service BMs are dynamic, can telecoms adjust their business models without any substantial limitations.

6.5 Uniqueness

Another identified key value driver of innovative mobile data services is *uniqueness*. The author agrees with Porter (1996) that "a company can outperform rivals only if it can establish a *difference* that it can preserve" (p: 3). Indeed, when the business model of mobile data services is positively unique, the potential of success is highly leveraged. The mobile business model is unique when it is significantly different from those of counterparts. In the context of mobile data services, the significant difference can come from one or more of the V^4 Mobile Service BM Ontology dimensions including their constituent design concepts. For example, the mobile BM can be considered unique when employing novel and effective pricing methods, or when using innovative cutting-edge technology not accessible by other rivals which has the potential to influence the offering positively, or even when delivering new added-values and benefits. It is also unique, when telecoms target original markets, sectors, or segments overlooked by existing rivals, but deemed to be profitable. Uniqueness can also be achieved when telecoms incorporate new actors not considered before within the value network, or when telecoms are linked to the traditional actors in new innovative manners.

In this context and by referring to the iPhone case (see Chapter 5, pp. 134-156), the question here is how Apple differentiates its iPhone BM from those of other established competitors. Noticeably, the uniqueness factor in the iPhone BM is multifaceted. The first fundamental element however is related to its value proposition along with its target segment. Whilst almost all other smartphones such as Blackberry, Nokia E71, and Palm pre were designed principally for professional users, the iPhone with its features target personal users as its fundamental segment; creating for itself a *unique position* within the market. This in turn has affected the design and engineering of the iPhone services and applications in terms of their functionalities and their look-and-feel aspects. Other elements in this context contributing to the iPhone uniqueness are related to its operating system, usability due to simplicity, convergence, and the unprecedented number of available iPhone applications along with their diversity that make them more powerful.

Unlike other telecoms and in particular mobile handset manufacturers that distribute their products and services through almost all possible channels, the way Apple distributes its iPhone only through exclusive and selected mobile operators in addition to Apple itself, also contributes to the uniqueness of the iPhone BM. It was almost a rule of thumb not only in the telecom industry but also in many other industries if not all that increasing the number of distribution channels would increase the number of sales by attracting more customers as the product or service becomes more accessible in this way. Apple's philosophy seems to be completely different. Apple for its iPhone has created an important *psychological effect* on customers as well as mobile operators by limiting the distribution channels. While making it harder to get the iPhone, Apple has attracted a great deal of attention by public, businesses, researchers, and other stakeholders. Many stakeholders became very curious to explore this new artefact and follow its development. Due to this image that Apple has shaped for its iPhone, customers in particular have started to look at it as a precious artefact giving them prestige and status in addition to great utility. Apple's philosophical approach in this context has also given the company a tremendous power in negotiating deals with different mobile operators. Apple has been able to make mobile operators feel advantaged if they are chosen to distribute the iPhone. The bottom line is that the Apple approach for the iPhone distribution has been unique and successful in making both customers and mobile operators think they are privileged when having the iPhone.

Moreover, by applying the concept of uniqueness to i-mode and OBS services, one can easily recognize that i-mode was unique simply because it was the first mobile data platform to be launched not only in Japan but also in the entire world. As for OBS, it complements the services offered by Orange-Jordan as it addresses the requirements of the business market comprehensively.

6.6 Fitting Network-Mode

The *fitting choice between closed vs. open network models* signifies the fifth recognized key value driver. Chesbrough (2006) argues that the open business model where anyone inside and outside the company can participate through offering ideas is the right and only way to thrive in the new innovation landscape. Chesbrough (2007) also argues that the open business model addresses two major issues:

(A) *The rising cost of technology development and shorter product life cycles*: by saving time and money in the innovation process through leveraging outside R&D resources.

(B) *The revenue sources*: by either licensing resources to other companies, or by creating new products and services by licensing resources from other companies.

Currently, these two issues are particularly substantial in the mobile telecommunications industry. Telecoms are suffering from financial problems due to many reasons, such as the cost of 3G licenses, and the cost of debt due to its expansion strategies. Also, telecoms are looking forward to new sources of revenue in order to shorten the pay back period of the incurred sunk cost of establishing the business. Given that, telecoms could act as broadcasters of ideas within the value network. Telecoms are in a significant position; they own customer bases and have direct contact with end users. Accordingly, they are more able to discover market opportunities and pinpoint the changing user needs than other players within the network.

Unlike Chesbrough, Pisano and Verganti (2008) argue that deciding how best to leverage outsider's power is no easy task. In their view, partnerships and external collaboration can be distinguished as open or closed. They also argue that each mode has trade-offs; thus companies have to choose the one that best suits their settings, if they are to be successful in their markets.

Based on analyzing the collected data (see Chapter 2, iteration 1-3, pp. 46-59), the author aligns his views more with the perspectives of Pisano and Verganti (2008). This can be explained by referring to the iPhone and i-mode cases. As for Apple iPhone case, Apple (see Chapter 5, pp. 134-156) has demonstrated that the closed network model is highly effective as it facilitates the creation of the best solution or innovation when the company recognizes the knowledge domains needed and which parties to draw on to develop the new service effectively. Even when Apple has moved to a walled-garden mode, it has not opened its network and the only facet that has become available to outsiders is the one related to application development. The iPhone hardware design, operating system, and core services and applications are still fully controlled by Apple and its closed network.

NTT DoCoMo i-mode (see Chapter 5, pp. 157-172) follows a closed network mode as well. In developing the i-mode service, NTT DoCoMo has adopted a closed network mode given that user and market requirements were clearly defined following the market research the telecom has conducted, led by marketing specialists Muri Matsunaga and Takeshi Natsuno. A closed model was also deemed appropriate as the telecom was able to determine the required knowledge domains for the i-mode service and which parties to collaborate with given its long and sustainable relationships with many and different types of actors inside and outside the telecommunications sector.

Further, NTT DoCoMo’s extensive R&D capacities as well as its wide and deep knowledge in telecommunication standards, infrastructure, services, and devices signifies another reason justifying the appropriateness of a closed network mode in this case.

With hindsight, the author suggests that the decision whether to follow an open or closed network model highly affects the success of the mobile data services developed. From the author’s standpoint, neither a closed nor open network mode is appropriate at all times and regardless of telecoms particular situations. To offer innovative mobile data services, telecoms need to apply the most fitting network mode to their situation.

6.7 Explicitness

Mobile service BM explicitness is a process of mobilizing highly useful knowledge capital from ‘loosely coupled’ data and information existing in different formats. Explicit BMs (textual and/or graphical) seem to enhance business understanding, facilitate knowledge sharing and dissemination, and support mobile telecoms in analyzing and evaluating the feasibility of their BMs in action.

The representation of mobile business models enjoys flexibility as they can be depicted orally, textually, and/or graphically. But, being ‘explicit’ includes only textual and graphical techniques. The business models of telecom mobile data services can be characterized as ‘cognitive’ knowledge in most cases, ‘sticky’ to managers’ minds (i.e. tacit or implicit). From a knowledge management perspective, making knowledge visible, manageable and transferable is a multifarious process due to its tacit nature (Nonaka, 1994), its stickiness (Hipple and Tyre, 1996), and its distributed nature (Tsoukas, 1996). Carlile (2002) argues that knowledge is both a source of and a barrier to innovation since it is localized, embedded, and invested in practice. Hence, the process of externalizing this knowledge to create an explicit business model is complex, but significant. The author suggests the importance of knowledge explicitness concerning mobile service business models in three main areas as follows:

(A) Knowledge regarding each dimension along with its design concepts of the mobile data service business model.

(B) Knowledge regarding the interrelationships and interdependencies amongst mobile service business model design dimensions and concepts.

(C) Knowledge regarding the links between the mobile service business model and other organizational layers, that is corporate strategy and technology-enabled business processes including their information systems.

Explicitness as a key value driver facilitates organizational learning, since it incorporates creation of new knowledge that has the potential to influence actions. Making business model knowledge of a telecom mobile data services more explicit would enhance its ability to sustain and innovate, and most importantly to speed up the adaptation and innovation levels.

6.8 Summary

The mobile business environment is uncertain, turbulent, and hypercompetitive. Telecoms are challenged with the fast pace of change, driven by innovative technologies, (de)regulation issues, and competitive market factors. In view of that, telecoms face a paradoxical challenge; that is functioning efficiently to sustain and innovate effectively. These observable facets add to the complexity of designing mobile service business models.

In this chapter, the author developed a framework in which it is suggested that by designing and developing *Market-Aligned, Cohesive, Dynamic, Unique, Fitting Network Mode, and Explicit* business models of mobile data services, telecoms would be more successful in the long term; through being able to improve their BMs sustainability and innovation capabilities. These key value drivers address different spheres of the mobile business. For example, while ‘cohesive’ and ‘explicit’ key value drivers are telecom-oriented, ‘open/closed’ and ‘dynamic’ key value drivers are industry-oriented.

The viability of a mobile service BM is dependent on the market attributes in terms of structure and competitiveness, social/cultural characteristics, financial and regulatory details, and technological revolutions and trends. The fit between the service configurations and the market attributes is key to success and innovation.

A mobile service BM encapsulates four dimensions: value proposition, value network, value architecture, and value finance. Cohesion on the one hand is required among these dimensions. Moreover, given that a mobile BM represents an intermediate layer between the telecom's strategy and its ICT-enabled business processes including information systems, cohesion is also required between these organizational layers. These layers need to be treated as a harmonized package that should be reviewed continually to ensure its consistency with the external environment. Mobile service BMs need to be flexible in the mobile telecommunications industry. Technological as well as organizational dynamicity is essential to assure the vital consistency with the changing external environment in general, and more specifically the turbulent mobile business sector.

To outperform rivals, telecoms need to offer innovative mobile data services characterized as unique. Mobile data services can be made unique, for example, due to their features, value elements, and/or pricing methods. Moreover, the potential of providing unique and innovative mobile data services is increased when the telecoms follows a network model that fits its situation and requirements. Constructing explicit BMs of mobile data services and forming these cohesive links textually and/or graphically would facilitate knowledge sharing and dissemination, and support telecoms in analyzing and evaluating the feasibility of their mobile service BMs in action.

THE DESIGN AND ENGINEERING OF INNOVATIVE MOBILE DATA SERVICES: AN ONTOLOGICAL FRAMEWORK FOUNDED ON BUSINESS MODEL THINKING

CHAPTER SEVEN: CONCLUSIONS AND FUTURE RESEARCH

7.1 OVERVIEW

This chapter summarizes the research conclusions and presents future research directions. It starts by summarizing the research along with its findings. This summary however is organized based on the research chapters showing the main theme and rationale of each. Thereafter, the research contributions are discussed. This section is organized in three sub-sections: *contributions to theory*, *contributions to practice*, and *contributions to methodology*. Next, significant future research avenues that would provide further development to this important area of research are suggested.

7.2 Research Overview and Findings

The research presented in this thesis aimed at providing an ontological framework characterized as manageable, effective, and creative into how to design and engineer innovative mobile data services from a business model standpoint. The author organized the thesis in seven chapters. As we are now in chapter 7, a summary of the previous six chapters in addition to their findings is provided.

Chapter 1 is the starting point of this thesis in which the author first explored the main motivations for conducting this research. The author explained the importance of mobile data service to mobile telecommunication providers (i.e. telecoms) as a new and promising avenue for generating revenues and achieving their strategic goals and objectives. The author also showed that although the number of mobile users is continuously increasing, revenues generated from mobile data services are still considerably below expectations. This signifies a major problem to telecoms given the investment they have made in infrastructure (e.g. migrating to 3G and beyond technologies) so as to be able to launch such services. Based on these arguments, the author suggested that engineering innovative mobile data services calls for innovative business models to be designed and developed.

To put the research in its context, the author discussed the related research domains showing that (1) *Service Science, Management, and Engineering* (SSME); (2) *Mobile Telecommunications*; (3) *Business Models*; (4) *Innovations*; and (5) *Ontology* research are highly relevant and important areas to draw on as a theoretical background. Amongst these domains, the author argued that *business model thinking* is the most fitting one to be used as the main theoretical background for this research given its inclusiveness; and thus its ability to accommodate and incorporate other related domains that have been identified.

After establishing the research context, chapter one presented the research aim along with its objectives revealing that developing an ontological framework for designing and engineering mobile data services from business model thinking is the main aim of this research. Thereafter in chapter one, the author briefly explained how he used the Design-Science Research (DSR) paradigm to achieve the research aim.

In **Chapter 2**, the author explained the research design and the approach undertaken in order to solve the research problem and achieve its objectives. At the beginning of chapter two, the author classified information systems research paradigms into four categories: *positivism*, *interpretive*, *critical*, and *design* and he showed why this research fits the design paradigm. The author argued that this research aims to produce a technology-oriented artefact; that is predominantly a Mobile Service BM Ontology. By using this artefact, it is argued that the *status quo* of mobile data services can be changed into a more valuable one. Thus, given the nature of the research problem, process, and the type of output it produced, it was argued that the research fits the design paradigm more than the other identified paradigms.

Having explained the suitability of DSR, the author then in chapter two discussed this paradigm more in-depth and more specifically in the context of this research. The author clarified how DSR is argued to complement the conventional behavioural research in information systems and enhance the relevance of the IS discipline. The author identified that DSR is a problem solving paradigm addressing complex problems. The author also made clear that such a paradigm produces fives types of artefacts (constructs, models, methods, instantiations, and theories) that are not only novel and innovative, but also purposeful. To show more evidence about the fit of DSR to the current research, the author explained the links between the aforementioned DSR details and their counterparts in this research.

Next, the author moved to discuss the DSR reasoning and processes that would lead to the construction of the artefacts. In that section he argued that the design science process are still broadly defined through *build* and *evaluate* processes. The author then argued that such processes need further methodical decompositions into more manageable activities according to the type of the artefact to be developed. Having argued that, OntoEng which is a design approach for ontology engineering that is developed by the author is introduced and its application in this research is discussed. Through presenting the application of OntoEng, the author explained the iterations this research went through to develop the final artefacts. It was made clear that literature analysis, semi-structured interviews with telecoms key practitioners, and case analysis are the three main iterations conducted within this research.

Moreover, the author identified and explained an ontology design quality and evaluation framework that was synthesized as reference criteria for evaluation courses of action so as to ensure the quality of the developed ontology. The author also explained how the three examined cases (Apple iPhone, NTT DoCoMo i-mode, and Orange Business Services) not only contribute to the ontology development, but also were employed as the main method for the artefact evaluation besides the synthesized criteria. Before presenting the summary of chapter 2, the author links DSR processes and outputs to their matching parts in this research.

In **Chapter 3**, subsequent to a review and analysis of the literature using principally the content analysis method (see Chapter 2, iterations 1-3, pp. 46-59), the author developed a framework of the business model concept in order to understand the business model within the world of digital business in general and mobile telecommunications business in particular. This framework comprises four primary facets. First, it considered value proposition, value network, value architecture, and value finance as the main BM dimensions. Second, it revealed the BM guidelines and features that are highly useful when designing or engineering business models. For example, the author argued that business models are conceptual and can be utilized at different levels within organizations. If they are to be effective, the author argued that business models need also to be dynamic, granular, and coherent. Third, the framework explained the reach of the concept showing its interactions and intersections with strategy, business processes, and information systems. The author argued that a business model represents an interface or a theoretical intermediate layer between the business strategy and the ICT-enabled business processes and intersects with both of these layers. In this context, the author explains that the BM intersection with strategy represents a set of organization's strategic-oriented choices for business establishment and management, whilst its intersection with processes signifies a set of business implementation practices and functions. Fourth, the framework explored three principal functions of BMs highlighting its practical usefulness. The author argued that the business model can be usefully utilized within digital organizations including telecoms as an alignment instrument, interceding framework between technology potential and strategic objectives, and/or knowledge capital supporting a strategic-oriented decision making course of action.

The author also argued in chapter 3 that developing such a unified framework of the concept is highly significant for this research as business model thinking signifies the main background theory guiding the development of the mobile data service ontology. Indeed, this chapter signified important groundwork for the developed ontological framework.

In **Chapter 4**, the author presented the final version of the main artefact of this research; that is a novel Mobile Service BM Ontology. The developed ontology utilized the four primary design dimensions (value proposition, value network, value architecture, and value finance) that have been introduced in chapter 3 as groundwork for the purpose of designing appropriate business models of mobile data services. The identified dimensions are then decomposed further into sixteen design concepts which in turn have their own constituent elements. The relationships between the design dimensions and concepts along with their axioms that restrict their interpretations are revealed in the context of mobile telecommunications and mobile data services.

More specifically, the author argued that value proposition dimensions encompass three design concepts: product-service, intended value elements, and target segment. The author argued that when designing and engineering mobile data services, they need to be defined in terms of name, type, functions, and technical/non-technical requirements. The author also revealed that the service objective has to be consistent with the overall strategy of the telecom, if new or revamped services are to be innovative and successful. It has also been explained that the value elements to be communicated and conveyed to customers need to be identified. Then, such value elements are required to be evaluated so as to ensure their usefulness. For outstanding performance, services along with their value elements need to match the requirements and behaviour of their target segment.

As for value architecture, the author argued that telecoms are required to tackle three design concepts in this dimensions. The value architecture design concepts are: core resources, value configuration, and core competencies. Each of these concepts includes both technological and organizational aspects of the service architecture. The author relied on the Resource-Based View (RBV) theory to explain core resources and he identified the different sort of resources needed for mobile data service development. This includes technological, legal, relational, financial and other types of resource. The author recognized that such resources could already be available within telecoms or acquired through value network actors. However, the author argued that the value of resources is maximized if they are properly configured. Next, the author explained how proper configurations of resources lead to valuable core competencies providing telecoms with competitive advantages.

This chapter also showed the high importance of the value network dimension to the mobile data services engineering course of action. The author explained that such a practice normally calls for different expertise that is rarely available within one telecom. This highlights the significance of this dimension along with its constructs. The design concepts identified in this dimension are: network-mode, actor, role, relationship, flow-communication, channel, and governance. Network mode explains whether the telecom needs to follow an open or closed business model, whilst the actor concept is about identifying possible actors in the value network. The author also argued that the telecom needs to identify the functional and strategic roles of actors and based on that determines their contribution and eligibility to participate. Next, it has been recognized that appropriate relationships need to be established with the selected actor, and suitable channels are required to be employed for material flows between actors including customers. Then, the author argued that governance of the network is recommended to be analyzed as it reveals important information related to power and control aspects.

Finally in chapter four, the author discussed the value finance dimension. In that part of the chapter, the author argued that total cost of ownership, pricing methods, and revenue structure are the main three design concepts from the service economic perspective. Total cost of ownership represents the summation of the total fixed and variable costs related to service engineering. This concept gives a clear indication about which price is feasible to be assigned to the service. But the telecom also has to choose a proper pricing method possible by its value architecture and at the same time competitive in the market. The last issue here is regarding the revenue generated from service along with its structure. The author argued in chapter 4, that revenue breakdown amongst value network actors needs to be fair reflecting actors' shares in terms of cost and risk, if the telecom is willing to keep the network healthy and sustainable.

Chapter 5 presents the evaluation course of action concerning the developed Mobile Service BM Ontology. The evaluation is mainly done by utilizing three cases related to key innovative mobile data services in the global mobile telecommunications industry. These cases are: Apple iPhone, NTT DoCoMo i-mode, and Orange Business Services. In chapter 5, the author utilized the developed ontology to analyze these important cases so as to ensure the ontology's completeness and effectiveness. As for Apple iPhone, the author uses the ontology to understand how a newcomer to the mobile telecommunications industry introduces a revolutionary mobile data platform founded on a different business model to those of existing services in the market and achieves a noticeable success. As for the i-mode case, the ontology used an analytical lens to understand why i-mode is very successful in Japan but not so in overseas markets. In the last case, the introduction of OBS by Orange-Jordan is analyzed showing its business model configurations. In each of these cases, the author was able to reveal important details on how the design and engineering of innovative mobile data services significantly depends on the existence of well-fitted and appropriate business models. Thanks to the V^4 Mobile Service BM Ontology.

At the end of chapter 5, the author showed how the developed ontology corresponds to the evaluation criteria established in chapter 2 (see Chapter 2, The Design Quality and Evaluation Framework, pp. 43-46) based on its application on the three real-life cases. This provided more validation to the developed ontology. Indeed, utilizing the V^4 Mobile Service BM Ontology to analyze iPhone service and applications, i-mode mobile data platform, and Orange business services seems to indicate that the ontology achieves a good level of clarity, coherence, conciseness, preciseness, completeness, and customizability.

In **Chapter 6**, the author complemented the developed ontology with key value drivers. In particular, the author identified six key value drivers that would increase the possibility of developing innovative mobile data services. These key value drivers are partly established based on analyzing the data collected from the literature coupled with those gathered through the semi-structured interviews conducted with telecom practitioners. The final identification of these key value drivers came after the analysis and evaluation conducted over the aforementioned three cases by examining the key decisions made by each of the providers concerning the provisioned mobile services.

The author argued that for designing and engineering innovative mobile data services, telecoms need to ensure that the service is totally aligned with market needs and compatible with market forces. It is also argued that ensuring cohesiveness between business model dimensional arrangements, consistency amongst value network actors, harmonization amongst the telecom business layer, in addition to the fit between the new services and existing service, would maximize the likelihood of coming up with successful and innovative services. For superior offerings, telecoms are recommended to incorporate uniqueness within the attributes of their services. To cope with the highly turbulent and hi-tech environment, telecoms need to ensure that their mobile service BMs are dynamic and flexible enough. Otherwise, their service would be phased-out over time. Given the high significance of the value network dimension, the author argued that choosing the appropriate network mode for mobile services signifies a critical decision. This is because such a decision affects not only the rest of the design concept in the value network dimensions, but also the configurations concerning other business model dimensions. Finally, the author argued that to work as a valuable knowledge base that would enable effective strategic-oriented decision-making and make this process faster, mobile data service BMs are recommended to be documented and communicated explicitly through textual and graphical means.

7.3 Research Contributions

The contributions made throughout this research are diverse covering theoretical, practical, and methodological facets. This thesis adds value to research and practice communities concerned with mobile technologies, mobile data services, innovations, and business models in addition to those interested in ontology and ontology engineering. The novel integration of these relevant research domains also enhanced the value of contributions made in this research.

The current thesis provides a harmonized ontological framework extending current research and taking an important step towards systemizing and leveraging mobile service design and engineering functions. This ontological framework is useful for researchers and other stakeholders, such as telecoms, those interested in the design and engineering of mobile data services. Before discussing the most important contributions to theory, practice, and methodology, the author shows through Table 7-1 how this research meets the objectives established in chapter 1.

Table 7-1. Accomplishments of The Research Objectives

Research Objectives	Accomplishments
Objective 1: Explain the research paradigm, methods, and techniques that fit the current research questions and led to the final artefact of this research.	This objective was achieved in **chapter 2** although **chapter 1** highlights some other important details related to the research approach and problem. In chapter 2, we explained that DSR is the most fitting paradigm for such research, and also explored the use of OntoEng as a design approach for engineering the V^4 Mobile Service BM Ontology.
Objective 2: Develop a conceptual framework of the business model concept that identifies and links the main components of the concept along with its modelling principles, practical functions within organizations, and its relationships with other relevant concepts such as strategy, business processes, and information systems.	We accomplished the second objective in **chapter 3** as we provided a unified framework of the business model concept given it is the main background theory for the current research. In chapter 3, we identified the main dimensions of BMs, its modelling principles and features, and its intersections between the strategy concept and the ICT-enabled business processes. Moreover, we also identified the main practical roles and utilities of the business model within digital organizations in general and telecoms in particular.
Objective 3: Develop an ontology seeking to identify the main design constructs along with their semantics and relationships that are needed to be examined when engineering mobile data services.	The third objective was achieved in **chapter 4** where we discussed the developed ontology along with its design constructs in addition to their relationships and semantics in the context of mobile data services.
Objective 4: Evaluate and validate the ontology through real-life cases in regards to mobile data services.	We accomplished this objective in **chapter 5** as in that chapter we utilized the V^4 Mobile Service BM Ontology to examine three significant cases in the domain of mobile services: Apple iPhone, NTT DoCoMo i-mode, and Orange Business Services (OBS). In addition to the use of case analysis as an evaluation method, we referred to synthesized DQEF criteria to provide further evaluation of the developed ontology.
Objective 5: Explore and identify the key value drivers when designing and engineering mobile data services.	We achieved this objective in **chapter 6** where we identify that market alignment, cohesion, uniqueness, dynamicity, fitting network-mode, and explicitness are six key value drives in the context of mobile service engineering.
Objective 6: Evaluate the research conclusions in terms of their significance to theory and practice and identify future research directions that are important to continue refining this key research field.	The objective in achieved in this chapter and more specifically in the following three subsections in addition to this table.

7.3.1 Contributions to Theory

The contributions of the current research to theory are multifold. The key contributions can be summarized as (a) the development of an ontological framework for designing and engineering mobile data services (point 1 and 2 in Figure 7-1); (b) the development of a unified framework of the business model concept (point 3 in Figure 7-1); and (c) the development of a design approach for ontology engineering in IS (point 4 in Figure 7-1).

1- Developing a useful ontology founded on business model thinking. On the basis of its evaluation, the constructed ontology has the capability to make the design and engineering of mobile data services more manageable, effective, and also creative.

2- Developing a framework that explains the key value drivers for designing and engineering innovative mobile data services.

3- Providing a unified and comprehensive framework of the business model concept exploring and bridging its multiple facets. Despite its high significance for the purpose of this research, this framework is general and thus can be utilized by researchers looking forward to exploiting the concept in other research domains.

4- Developing OntoEng as a design method for ontology engineering in the field of information systems. The efficacy of this method was verified through its real-life application to develop the V^4 Mobile Service BM Ontology.

Figure 7-1. Contributions of the Current Research to Theory.

(A) The Development of an Ontological Framework for Designing and Engineering Mobile Data Services

The main contribution of this research stems from the research problem that has been identified in chapter 1 (see Chapter 1, pp. 2-6). The fact that mobile telecommunication providers are struggling in generating revenues and achieving their strategic goals and objectives from mobile data services, even though such services are appealing and promising, has highlighted the need for an effective and inclusive design approach in this context. Aiming to enhance the understanding of mobile data service design and engineering and make it more effective, this research provides an ontological framework. This framework is composed of the V^4 Mobile Service BM Ontology (chapter 4), along with its evaluation through three real-life cases (Chapter 5), in addition to the framework explaining mobile key value drivers (chapter 6). The main implications and contributions of the developed ontological framework can be summarized as follows:

- **Inclusiveness.** The developed V^4 Mobile Service BM Ontology in this research is comprehensive. It covers a wide range of aspects that are considered highly relevant in this domain. The value proposition dimension is about examining the nature and features of the new or revamped services and making sure that they communicate valuable value elements to the right target segments in the market. For such desired services to be successfully implemented in practice, telecoms need to confirm that available resources are powerful and configured in an optimal way that adds significant core competencies. The efficacy, however, of mobile data services is enriched by creating a well-balanced and sustainable value network. Value networks provide knowledge as well as other resources and benefits to the telecom and increase the potential of mobile data services. The value finance dimension, on the other hand, tackles the service financial attributes by examining cost, pricing, and revenue design aspects of mobile data services. Given the aspect it covers, the developed ontology is deemed inclusive. This inclusiveness feature enhances the utility of the constructed ontology and makes it more rational and practical to its stakeholders.

- **Manageability**. Despite the wide range of aspects covered in the created ontology, it is designed in a way that makes it manageable and useful. The Ontology is organized in four dimensions. Within these dimensions, sixteen design concepts along with their constituent elements are identified. The relationships between the dimensions as well as the concepts are established and clear semantics in the context of mobile data service engineering are produced. The relationships between the constructs are highly important to show the interdependencies amongst the design configurations. They can also be used to control changes that happen to different design concepts by tracing their potential consequences. On the other hand, the importance of the ontology semantics comes from the fact that they enhance ontology understanding and use.

- **Creativity.** Besides the V^4 Mobile Service BM Ontology, the developed ontological framework incorporates key value drivers for innovative mobile data services. These key value drivers are not only important for developing innovative new services, but also vital when analyzing and evaluating existing mobile data services so as to verify their efficacy. This is important as such analysis is useful in guiding which configurations need to be modified in order to make services more creative and effective.

The framework of mobile key value drivers suggest that innovative mobile data services are those aligned with market needs and at the same time consistent with organizational configurations. Mobile data services also need to be dynamic and flexible if they are to be powerful. This is because dynamicity allows mobile services to cope with changing trends in the market smoothly. To win the market, innovative mobile data services need to be different from similar services offered in the mobile telecommunications industry. The creativity in mobile data services is highly associated with the decision telecoms undertake concerning the value network mode, whether it is open, walled garden, or closed. Finally, to manage mobile data services effectively, telecoms need to depict explicitly their business models in action.

- **Relevance and Purposefulness**. The developed ontological framework is significant not only because it novel and innovative, but also because it is relevant and purposeful. The relevance of the ontological framework comes from that fact that this framework addresses a real-world problem that is highly significant to its stakeholders. It is significant to (1) research communities concerned with the design and engineering functions of mobile data services, (2) telecoms as providers of mobile services, and (3) the society as users of such mobile technologies. On the other hand, the developed ontological framework is purposeful as it would improve the current theories and practices related to mobile service engineering functions; such as analysis, design, development, evaluation, maintenance, and change.

The developed ontology, in particular, is also deemed intuitive and significant. This is because it provides a common language and terminology amongst information systems and software agents to enhance their interoperability. This unified terminology also enhances the communications and understanding in this context amongst people (i.e. researchers and stakeholders). It also enables capturing and reusing of application-independent knowledge and semantics, i.e. Knowledge reuse rather than software reuse.

- **Convenience and Practicality.** The developed ontological framework in this research is convenient and practical. This has mainly been verified by evaluating the V^4 Mobile Service BM Ontology using case analysis methods (see Chapter 2, iteration 3, pp. 54-59 for the case analysis approach; and see Chapter 5 for discussion of the cases). By utilizing the developed ontology, the author was able to analyze three key mobile data services (Apple iPhone, NTT DoCoMo's i-mode, and OBS) in the telecommunications industry. Moreover, the presentation of this thorough analysis in chapter 5 is useful to many stakeholders, such as telecoms and researchers, as illustrative cases of the ontology. This is deemed to be helpful in enhancing stakeholders' understanding of the created ontology and therefore their utilization and application of it in their practices.

(B) The Development of a Unified Framework of the Business Model Concept

The critical analysis of the existing views toward the business model concept in this research has highlighted important gaps. The concern that the concept is still fuzzy and ill-defined, the consideration of business models as substitutes for strategies, the partial views and definitions of the concept as its related knowledge is fragmented, and the fact that its practical functions are not yet clearly defined have highlighted the need for a conceptual framework that integrates the existing views and analyzes them to add novel mined knowledge to this important area of research. In the light of these arguments, the implications and contributions of the constructed BM conceptual framework can be summarized as follows:

- **Fruitfulness**. This unified framework synthesized the BM compositional dimensions (ontological structure, modelling principles, reach, and functions) in a novel manner. It provides a complete foundation for researchers and practitioners who are looking forward to utilizing the business model concept in their practices and applications. Furthermore, it represents a *versatile* instrument that can be of assistance to the BM scientific research community as well as practitioners since (a) it organizes and manages the BM foundational knowledge and hence it is helpful in assuaging the "fuzziness" problem which has been associated with the BM concept; (b) since the propagation of many synonyms and labels adds to the haziness of the BM concept at this stage; this framework achieves parsimony and establishes a common language and terminology to reduce this problem; and (c) from a practical perspective, this unified view enhances organizations' ability to design, create, communicate, compare, analyze, evaluate, and modify their existing and future business models.

• **Completeness of the BM Ontological Structure.** This research defines the BM as an abstract representation of an organization, be it conceptual, textual, and/or graphical, of all core interrelated architectural, co-operational, and financial arrangements designed and developed by an organization presently and in the future, as well all core products and/or services the organization offers, or will offer, based on these arrangements that are needed to achieve its strategic goals and objectives. This definition indicates that value proposition, value architecture, value finance, and value network articulate the primary constructs or dimensions of BMs. The developed framework also synthesizes the constituent elements of these dimensions forming a complete ontological structure of the concept.

• **Practical Functions of the Business Model Concept**. This novel BM framework explores three main practical functions for the concept. The applied analysis reveals that the concept is *versatile* in a non mutually exclusive mode since it can used concurrently for alignment functions, technology leverage, and decision making practices. The idea of utilizing the business model as a *conceptual tool of alignment* is significant as most of the existing 'alignment' research addresses this issue at the strategic level only. Business models on the other hand promise to align business organizations by harmonizing all organizational layers. Thus it is seen as an essential intermediate conceptual layer. BM improves cohesively organizations' internal alignment.

Looking at the business model as a *mediating construct* between technological artefacts and the attainment of strategic outcomes is also useful. Particularly in information systems, there seems to be an agreement that a technology does not succeed by itself; rather the perception is that a consistent and effective organizational setting and structure are needed in addition to technological architecture if the technology is to be successful and useful to its intended users. The business model however fulfils these requirements due to its comprehensive configurations discussed previously.

This research has also introduced the idea of utilizing the business model as novel *strategic-oriented knowledge capital* to enhance an organization's innovation capability and decision making practices. In this research, the business model concept represents a distinct form of knowledge. This research suggests that an organization's understanding of its BM could be viewed as novel strategic-oriented knowledge capital that is crucial for business organizations in an emerging, turbulent, and digital business environment. The BM, as knowledge capital, could serve as executives' guidance with respect to strategic-oriented decision-making practices.

• **Granularity for Flexibility and Reusability.** Characterizing the business model as *granular* in addition to other characteristics is novel. In particular, understanding the business model concept as granular implies flexibility in its related functions such as design, management, evaluation and change and also facilitates the reusability of the components for new business models. This highlights the concept as an efficient and effective framework essential to digital organizations in general including mobile telecommunication providers.

(C) The Development of OntoEng as a Design Approach for Ontology Engineering in IS

Developing OntoEng as a design approach for ontology engineering in the field of information systems and its application in constructing the V^4 Mobile Service BM Ontology is significant. This is mainly due to two reasons. First, the established processes of the design-science research are broad and general; thus they require consistent breakdown suitable for the type of the artefact that are desired to be developed (i.e. in this case an *ontology* design artefact). Second, literature on ontology engineering methodologies does not provide adequate guidance on how to engineer ontologies throughout their life span.

Such limitations explain the underlying reasons behind developing OntoEng. OntoEng defines five design phases and their twelve activities along with their succession and recursion points. Further, it explicitly links design activities with different useful research approaches and tools. It also defines the deliverables of each design activity within ontology engineering practices. OntoEng is an extension of the topical related views. It draws upon artificial intelligence, software engineering, knowledge engineering, and IS development thinking to address the design dilemma concerning ontology engineering from the design science paradigm.

This research suggests that OntoEng is also a significant contribution to design science research. By employing the OntoEng design method, ontology engineers would be more able to build, evaluate, and maintain high-quality ontologies in a systematic and creative manner. The author also believes that this research has important implications on theory and practice concerning design science as well as ontology engineering. In design science research, *maintain* should be regarded as a third main process complementing *build* and *evaluate*. This is because the author considers that the delivered value is augmented, if the artefact is designed while bearing in minds its maintainability and scalability. Reflecting this belief, OntoEng decomposes design science broad processes into more measurable design phases and activities that also extend the recent thinking relating to ontology engineering.

7.3.2 Contributions to Practice

The clearest contribution this research makes to practice is the rich knowledge and insights it supplies to practitioners concerned with IS/IT strategic-oriented and business developments in the context of mobile data services engineering. The current research provides practitioners in the telecommunications industry with valuable, systematic, and customizable means to design, implement, analyze, evaluate, and change new and existing mobile data services to make them more manageable, effective, and also creative. As the ontological framework is comprehensive, the speciality of practitioners within the mobile telecommunications industry for whom the ontological framework adds value is wide-ranging. This includes those concerned with information systems and technology, engineering, business and collaboration developments, marketing, and financial aspects of mobile data services.

Moreover, the conducted examination and analysis of Apple iPhone, NTT DoCoMo's i-mode, and Orange Business Services is significant and beneficial to practice. This is because such critical analysis reveals essential insights on what makes mobile data services innovative and successful, or not. It also provides practitioners in the telecommunications sector the opportunity to learn from other telecoms experiences that have been already tested in the marketplace.

The author assumes that such benefits would improve the current practices and functions of telecoms in regards to mobile data service engineering. This improvement would be reflected on (1) telecoms, by allowing them to achieve their strategic goals and objectives through better utilization of technology potentials; and (2) mobile users and community in large, by providing them with useful services stratifying their needs and enhancing their quality of life.

7.3.3 Contributions to Methodology

The use of design-science research in information systems is relatively new. Therefore, this research analysis and synthesis adds to the general understanding of this important paradigm. It is essential for the IS research community in general to recognize DSR as a paradigm and not as a methodology. This is because DSR offers a new philosophy about doing research, but it does not provide precise and special methods and techniques for this purpose. Building on this argument, this research provides a working example in which the author illustrates how recognizing DSR as a paradigm is essential and he also clarifies the need of using a compatible methodology within this paradigm.

The main methodological contribution of this research relies on the use of the design-science research paradigm for ontology engineering. Although ontologies are widely accepted as design artefacts, linking the views of ontology engineering and DSR is normally overlooked. In a novel manner, this research develops OntoEng as an approach for ontology engineering. The development of OntoEng is founded on design-science research principles. Another important contribution of this research is the use of multiple methods within OntoEng design activities to develop the V^4 Mobile Service BM Ontology.

Although this research follows a design-science research paradigm, the key methods used in this research (e.g. literature analysis and content analysis, semi-structured interviews, and real-life cases) are normally used for research classified as positivist, interpretive, or critical. However, the rationale and the way they are used in this research are different as they aim here to build the knowledge-base needed for developing the desired ontological framework. This difference is due to the philosophical variations amongst these paradigms. This has significant implications as it (1) reinforces the idea that design-science research is a paradigm and not a methodology; and (2) indicates that existing research methods and techniques used with conventional behavioural research can be used for design-science research but with different rational, perspective, and use.

7.4 Future Research

In addition to the significant contributions made in this research and briefly highlighted in the previous section, the current research also provides some important directions for future research in order to continue developing this vital research domain.

• **The Extendibility in Use of the V^4 Mobile Service BM Ontology**. This research developed the V^4 Mobile Service BM Ontology particularly for designing and engineering mobile data services. Nonetheless, the author argues that it would be equally appropriate to the design and engineering of other technological artefacts, e.g. eServices, broadband services, and telecom services and products, etc. However, the author recognizes that the ontology semantics in particular are much harder to be extended to other domains such as eGoverment, but the ontology structure seems to be appropriate for use with a wider scope of digital services.

This research has highlighted this issue when the author used the ontology to analyze Orange Business Services. Indeed, OBS includes not only mobile data services, but also extends that to incorporate other telecommunications services. Another indication that the ontology can be used within other digital domains comes from the fact that the V^4 service BM ontology has been adopted by a company in Latin America to design and develop not only a mobile business application, but also an eApplication for business. Moreover, the author along with other researchers is examining the ontology within the context of eGoverment services such as those of ePetitioning systems. Initial indications show that applying the ontology on a wider scope of digital services would be useful and effective although some design concepts seem not to be applicable in the context of specific services. To give just one example, pricing methods and revenue design concepts are not applicable in the context of ePetitioning systems. Further analysis and examination of this particular area would reveal the extent to which this ontology could be generalized.

• **Action Research by Using the V^4 Mobile Service BM Ontology.** In this research the constructed ontology was evaluated mainly through case study. The examined cases were related to services already launched and offered in the marketplace. Hence the ontology was mainly used as an analytical lens through which the cases were analyzed and examined. This was important to evaluate the ontology as well as to derive mobile key value drivers.

Despite all of these advantages, the author considers that it is also important to utilize the ontology in designing and developing new mobile data services by, for example, following action research. This would reinforce our understanding as researchers in this domain and provide more useful insights that could be reflected on the ontology design. This may also lead to more formalized steps to be formulated within the developed ontological framework. Using the ontology to develop new mobile data services would also be beneficial to practice by showing its efficacy, practicality and usefulness. This would also reveal areas considered as highly challenging when designing or engineering mobile data services.

• **The Marginal Degree of Importance of Design Constructs and Value Drivers.** This research has already identified the primary BM dimensions and their sixteen design concepts that would guide mobile service engineering. However, different industries/businesses may place dissimilar emphasis on those design constructs. For example, while manufacturing companies may draw more attention to their value networks as they belong to tight supply chain systems, telecommunication providers are likely to lay more emphasis on their value architectures as being the primary enablers of value propositions. Researching this particular concern has significant theoretical and practical implications.

Furthermore, this research has identified six key value drivers of innovative mobile data services. Examining and revealing the marginal degree of importance of each by, for example, employing survey or questionnaire instruments would add substantial theoretical and practical value. This can be investigated further by comparing the marginal degree of importance of each key value driver across different types of mobile data services.

- **The BM as an Alignment Instrument**. Although we have provided theoretical insights concerning the role of the BM in providing the needed fit between the business strategy and information systems, there is still a need for future research in this particular area. In fact, this function for the concept is still a theory to be tested. Researching this particular issue using for example a case study approach, would add to our knowledge. Further, addressing the characteristics of the digital business and testing how each feature affects the mapping of business strategy to the BM and the BM to ICT-enabled business processes has strong theoretical and practical implications. Moreover, identifying the intersection elements that represent two transitional stages in the mapping process would be particularly useful.

- **The BM as Strategic-Oriented Knowledge Capital**. Exploring the relationship between an organization’s knowledge, decision-making, and its strategic position from a business model viewpoint appears not only to be theoretically interesting, but also to have strong practical implications. Potential value may also be offered through researching the differential influences amongst the different approaches of representing BM knowledge (oral, textual, graphical) on strategic decision-making practice and in turn on the organization’s strategic position.

- **The Scope of OntoEng Utility.** This research has developed OntoEng as a novel design method for ontology engineering. This approach has been tested empirically within the current research as it has been applied to construct the V^4 Mobile Service BM Ontology. However, it is advantageous to conduct further testing and validation for OntoEng. Utilizing OntoEng to engineer varied ontologies within a wide range of domains is important for future research. This would refine the method if needed and reinforce its efficacy and value. The author hopes that this step will help in providing additional validation for OntoEng as a domain independent method for ontology engineering in the field of information systems.

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Appendix 1: BM Components in the Literature

#	Source	BM Components	Cnt	Context	Research Approach	Granularity
1.	Burns and Stalker (1961); Ali et al. (2005)	**Product Innovation; customer relationship; infrastructure management; and Financial aspects.**	**4**	Innovation, Organization theory, eBusiness	Theoretical framework (Dimensions)	Organization-centric
2.	Viscio and Pasternak (1996)	Governance; business units; services; and linkages	4	Strategy	Theoretical framework (Building blocks)	Organization-centric
3.	Horowitz (1996)	Price; product; distribution; organizational characteristics; and technology	5	General (computing marketing)	Theoretical framework (Building blocks)	Organization-centric
4.	Timmers (1998)	**Architecture for the product, service and information flows, including a description of various business actors and their roles; potential benefits for the various business actors; and sources of revenues.**	**3**	Electronic markets, eCommerce	Theoretical framework (Dimensions); case studies	Network-centric
5.	Markides (1999)	**Product innovation; customer relationship; infrastructure management; and financial aspects.**	**4**	Strategy, innovation	Theoretical framework (Dimensions)	Organization-centric
6.	Donath (1999)	Customer understanding; marketing tactics; corporate governance; and internal/external capabilities	5	eBusiness	Theoretical framework (building blocks)	Organization-centric
7.	Mahadevan (2000)	**Value stream; logistical stream; and revenue stream**	**3**	Strategy, eCommerce (B2C)	Theoretical framework (Dimensions)	Organization-centric
8.	Hamel (2000)	**Customer logic**: customer service, information and anticipation, relational dynamics, and price structure; **Strategy**: objective, products and market segments, differentiation compared to competitors; **Resources**: skills, strategic resources methodologies, and manufacturing process; **Network**: suppliers, partners, and alliances.	**4**(13)	Strategy	Theoretical framework (dimensions and building blocks)	Organization-centric
9.	Klueber (2000)	**Business architecture; rules; IS architecture; potential benefit; and sources of revenue**	**5**	eCommerce	Theoretical framework (dimensions)	Network-centric (service-specific)
10.	Linder and Cantrell (2000)	Value proposition; Internet-enabled commerce relationship; commerce process model; channel model; organization form; pricing model; and revenue model.	7	Strategy	Theoretical framework (building blocks), 70 interviews with CEOs	Organization-centric
11.	Petrovic et al. (2001); Auer and Follack (2002)	Value model; resource model; production model; **customer relations model** (distribution model, marketing model, and service model); revenue model; capital model; and market model.	**1**(9)	eBusiness	Theoretical framework (one dimension and BB)	Organization-centric
12.	Amit and Zott (2001)	**Transaction content; transaction structure; and transaction governance**	**3**	Strategy, eBusiness	Indirect empirical (59 case studies).	Organization-centric

#	Source	BM Components	Cnt	Context	Research Approach	Granularity
13.	Alt and Zimmermann (2001)	Mission; structure; processes; revenues; legal issues; and technology	6	eBusiness	Theoretical framework (BB)	Organization-centric
14.	Weill and Vitale (2001)	Major actors: business and customers; flows: product, information, and money; returned revenue and other benefits to actors; core competencies and key business processes; position of each player in the value chain; organizational form; IT infrastructure capability; control: customer relation, data, and transaction	8	eBusiness	Indirect listing of building blocks; survey research	Organization-centric
15.	Applegate and Collura (2001)	**Business Concept**: market opportunity, product and service offered, competitive dynamics, strategy for capturing a dominant position, and strategic options for evolving the business; **Capabilities**: people and partners, organization and culture, operating model, marketing/sales model, management model, business development model, and infrastructure model; and **Value**: benefits returned to all stakeholders, benefits returned to the firm, market share and performance, brand and reputation, and financial performance	**3**(17)	Strategy, ICTs	Theoretical framework (dimensions and building blocks), illustrative examples	Network-centric
16.	Chesbrough and Rosenbloom (2002)	Value proposition; market segment; value chain; cost structure and profit potential; value network; and competitive strategy	6	Technology	Theoretical framework (building blocks); case studies	Organization-centric
17.	Dubboson-Torbay et al. (2002)	**Product innovation**: target customer, value proposition, and capabilities; **Customer relationship**: get a feel, serving, and branding; **Infrastructure management**: resources/assets, activities/process: value network, and partner network; and **Financial aspects**: cost, revenue, and profit.	**4**(12)	eBusiness	Theoretical framework (dimensions and building blocks); case studies	Organization-Centric
18.	Stähler (2002); Schubert and Hampe (2005)	**Value proposition**: for customers, and value partners; **Product or service**; **Value architecture**: market design, internal architecture (resources: core competencies and strategic assets, value steps, communication channels and coordination mechanism, and demarcation to external value architecture), external value architecture (customer interface, value partners, and communication channels and coordination mechanism); and **Revenue model**	**4**(3(9(8)))	Strategy, eBusiness, Technology	Theoretical framework (dimensions and three levels of building blocks)	Organization-centric
19.	Magretta (2002)	**Who are the organization's customers; what does the customer value; what is the underlying economic logic that explains how an organization delivers value to its customers at an appropriate cost; how an organization makes money in its business**	**4**	Strategy	Formulating the dimensions indirectly as questions	Organization-centric

#	Source	BM Components	Cnt	Context	Research Approach	Granularity
20.	Pigneur (2002)	**Product innovation:** customer segment, value proposition, and capabilities**; customer relationship:** information strategy, feel and serve, and trust and loyalty**; infrastructure management:** resources, activity configuration, and partner network**; and financials:** revenue model, profit/loss, and cost structure	**4**(12)	Mobile Business and Technology	Theoretical framework (dimensions and building blocks)	Organization-centric
21.	Afuah and Tucci (2003)	Customer value; scope; pricing; revenue sources; connected activities: value configuration; implementation; capabilities; and sustainability	8	eBusiness	Theoretical framework (building blocks)	Organization-centric
22.	Van De Kar et al. (2003)	**Service formula including customer value; network formation and coordination; enabling technology; revenue model**	**4**	Mobile (cellular) technology	Theoretical framework (dimensions); illustrative case	Service-centric
23.	Krueger et al. (2003)	Revenue; content; infrastructure; cooperation; and growth	5	Online news industry	Theoretical framework (building blocks); illustrative example	Organization-centric (service-specific)
24.	Camponovo and Pigneur (2003); Camponovo (2002)	**Value propositions; target customers; business partners; and revenue flows**	**4**	Mobile (cellular) technology and industry	Theoretical framework (dimensions)	Organization-centric
25.	Gordjin and Akkermans (2001, 2003)	Actors; value object; value port; value interface; value exchange; value offering; market segment; and value activity	8	eBusiness, information systems	Theoretical framework (building blocks), illustrative examples	Network-centric
26.	Hedman and Kalling (2003)	Offering; customers; suppliers; resources; activities and organization; scope of management; and longitudinal dimension	7	Information systems; ICTs	Theoretical framework (building blocks); illustrative case	Organization-centric
27.	Voelpel et al. (2004)	**New customer value proposition; Value network (re)configuration; and leadership capabilities.**	**3**	Strategy	Theoretical framework (dimensions)	Organization-centric
28.	Yip (2004)	Value proposition; nature of inputs; how to transform inputs (including technology); nature of outputs; vertical scope; horizontal scope; geographical scope; nature of customers; and how to organize	9	Strategy	Theoretical framework	Organization-centric
29.	Osterwalder et al. (2005)	**Product**: value proposition; **Customer interface**: target customer, distribution channel, and relationship; **Infrastructure management**: value configuration, core competency, and partner network; and **Financial aspects**: cost structure, and revenue model	**4**(9)	Information systems, eBusiness	Theoretical framework (dimensions and building blocks)	Organization-centric

#	Source	BM Components	Cnt	Context	Research Approach	Granularity
30.	Morris et al. (2005)	**Factors related to offering; Market factors; Internal capability factors; Economic factors**	**4**	Entrepreneur-ship	Theoretical framework (dimensions)	Organization-centric
31.	Shafer et al. (2005)	**Strategic choices**: customer (target market, and scope), value proposition, capabilities/competencies, revenue/pricing, competitors, output (offering), strategy, branding, differentiation, and mission; **Create Value**: resources/assets, and processes/activities; **value network**: suppliers, customer information, customer relationship, information flows, and product/service flows; **capture value**: cost, financial aspects, and profit	**4**(20)	Strategy	Theoretical framework (dimensions and building blocks): based on reviewing 12 definitions using affinity diagram	Organization-centric
32.	Kontio et al. (2005)	**Customers and segments; product and service offering; distribution model and partners; and revenue model**	**4**	Software companies	Theoretical framework (dimensions)	Organization-centric
33.	Tikkanen et al. (2005)	**Structure:** organizational structure, governance; **business network:** customer relationship portfolio, supplier relationship portfolio, product development network, extra-business relationships; **operations:** process architecture, resource, capability and competence base, product and service offering; **Finance and accounting 'financial reporting'**	**4**(9)	Managerial cognition, business management	Theoretical framework (dimensions and BB)	Organization-centric
34.	Maitland et al. (2005)	**revenue model and benefits**; and **Inter-firm service network**: actors and roles, and governance	**2**(2)	Mobile (cellular) technology	Theoretical framework (dimensions and BB); case studies	Network-centric (service-specific)
35.	Rajala and Westerlund (2005, 2007, 2008)	**Value proposition or offering; needed resources; revenue logic:** revenue, price-quotation principles, and cost structures; and **relationships with other actors**	**4**(3)	Information systems, entrepreneur ship, software industry	Theoretical framework (dimensions and BB)	Network-centric
36.	Tadayoni and Henten (2006)	**Value proposition; technology solution; cooperation platform; and financial design**	**4**	Mobile (cellular) technology	Theoretical framework (dimensions)	Service-centric
37.	Lee et al. (2006)	**Value propositions:** choice of focal customer benefits, target segment**; scope of offerings:** customer decision process, product or service contents**; unique resource system:** resources and capabilities, logistics and delivery systems**; and revenue and growth models:** revenue models; **Value chain positioning**	**5**(7)	eCommerce	Theoretical framework (dimensions and BB)	Organization-centric
38.	Kallio et al. (2006)	Product development strategy; sales and marketing strategy; servicing and implementation strategy; value creation strategy; customer base; government policy and regulations; technological advances and constraints; and value chain dynamics	8	Mobile (cellular) technology	Theoretical framework (building blocks); illustrative cases	Organization-centric (MNOs)
39.	Derballa et al. (2006)	**Value proposition; targeted customer segment; and revenue source**	**3**	Mobile commerce	Theoretical framework (dimensions)	Service-centric

#	Source	BM Components	Cnt	Context	Research Approach	Granularity
40.	Ballon (2007)	**Value network:** combination of assets, vertical integration, and customer ownership; **Functional architecture**: modularity, distribution of intelligence; and interoperability;**)** and **Financial model**: cost (sharing) model, revenue model, and revenue sharing model; and **Value proposition**: positioning, user involvement, and intended value)	**4**(12)	ICT services, products, and systems	Theoretical framework (dimensions and building blocks)	Network-centric (service-specific)
41.	Pousttchi et al. (2007)	**Value proposition model; capital model; distribution and communication model**	**3**	Mobile payment service	Theoretical framework (dimensions); 24 case studies	Service-centric
42.	Janssen and Kuk (2008)	Organizational entities involved in the service delivery; service offering; coordination; business processes; shared resources; dynamic capabilities; longitudinal dimension	7	Electronic Government	Theoretical framework (building blocks)	Network-centric (service-specific)
43.	Al-Debei et al. (2008a,b)	**Value proposition; value architecture; value network; and value finance**	**4**	Digital and Mobile business, ICT services	Theoretical framework (dimensions)	Organization-centric (MNOs)
44.	Lambert (2008)	Value proposition; customer; value in return; channel; **value adding process: (**resources, activity, capabilities, and organization structure); supplier; and Ally	**1**(10)	eCommerce	Theoretical framework	Organization-centric
	Kamoun (2008)	**Value proposition**; **value creation system**: resources, capabilities, and value chain arrangement; **value deliverance**: market segment, customer relationship, and distribution channel; **value capture model**: revenue generation model, and cost structure	**4**(8)	Information systems, RFID technology	Theoretical framework (dimensions and BB)	Organization-centric (service-specific)
45.	Haacker et al. (2004, 2006), Faber et al. 2003, 2004), Bouwman et al. (2004, 2005, 2008), Reuver et al. (2008)	**Service domain; organization domain; technology domain; and finance domain**	**4**	Mobile (cellular) technology	Theoretical framework (dimensions)	Network-centric (service-specific)

Appendix 2: Agenda for the Semi-Structured Interviews

Interview Agenda

Name of the Interviewee:
Company:
Position:
Speciality:
Years of experience:

Themes under Examination

1. The definition of mobile data services; how telecoms shape mobile data services in terms of types, functions, and technical/non-technical requirements. How telecoms decide about the choice of the target segment and market as well as the selection of the added-values to be incorporated.
2. What is the role of customer relationship intelligence and management in generating new ideas related to novel mobile data artefacts?
3. What are the sources of new ideas in the context of mobile data services?
4. How telecoms determine the nature of value intended to be delivered to customers through different mobile services and products.
5. What sort of objectives mobile data services are developed to meet?
6. How telecoms ensure the consistency between the service's objective and the overall strategy of the telecom?
7. What sort of resources (technological, organizational, managerial, tangible, or intangible, etc.) the telecom is equipped in order to be able to launch mobile data services, and how the acquisition of such resources affects the telecom's success?
8. What kind of capabilities (core competencies) the telecom has drawn on to competitively and successfully offer innovative mobile data services and products?
9. How different resources are configured and aligned cohesively to enable distinctive capabilities?
10. What are the technological key value drivers (or critical success factors) when designing and engineering mobile data artefacts?
11. What are the organizational and technological key value drivers when designing and engineering mobile data services?
12. The value system (supply chain, value network, etc.): the sort of business partners, suppliers, distributors, intermediaries and others involved in the service entire roll-out and offering.
13. What kind of roles played by different business actors in the value chain or network and how they affect the design and engineering of mobile data services and products?

14. Discussion regarding the calculation and estimation of the cost of the service (Total cost of ownership), pricing methods, and revenue breakdown amongst stakeholders.
15. Other factors affecting service design (internal and external).

Appendix 3: The RDF/XML Coding of the implemented V^4 Mobile Service BM Ontology in Protégé-OWL

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BM Ontology.owl#designedFor">
    <rdfs:domain rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#VALUE_FINANCE"/>
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      <owl:inverseOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#generates"/>
      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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   </owl:ObjectProperty>
   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
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      <owl:inverseOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#determines"/>
      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#determines">
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BM Ontology.owl#determinedBy"/>
      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
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BM Ontology.owl#enables"/>
      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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BM Ontology.owl#enabledBy"/>
      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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BM Ontology.owl#enablesCompetency">
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BM Ontology.owl#CORE_RESOURCE"/>
               <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE_CONFIGURATION"/>
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            </owl:unionOf>
         </owl:Class>
      </rdfs:domain>
      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#enablesProduct">
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BM Ontology.owl#CORE_RESOURCE"/>
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      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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   </owl:ObjectProperty>
   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#enablesValue">
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      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#encapsulates">
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Ontology.owl#RELATIONSHIP"/>
      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#FLOW-COMMUNICATION"/>
   </owl:ObjectProperty>
   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#encompasses">
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Ontology.owl#INTENDED_VALUE_ELEMENT"/>
   </owl:ObjectProperty>
   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#engagedIn">
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      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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   </owl:ObjectProperty>
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   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#enrichedBy">
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        <owl:inverseOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#provides"/>
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Ontology.owl#VALUE-NETWORK"/>
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BM Ontology.owl#enrichedByconfig">
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        <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#VALUE_CONFIGURATION"/>
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   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#establishedFor">
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Ontology.owl#PRICING_METHOD"/>
        <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#PRODUCT_SERVICE"/>
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   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#facilitates">
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Ontology.owl#VALUE-NETWORK"/>
        <owl:inverseOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#requires"/>
        <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#VALUE-PROPOSITION"/>
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Service BM Ontology.owl#goesThrough"/>
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        <rdfs:subClassOf>
            <owl:Restriction>
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Service BM Ontology.owl#encapsulates"/>
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BM Ontology.owl#VALUE-NETWORK"/>
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BM Ontology.owl#ACTOR"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#ROLE"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#RELATIONSHIP"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#CHANNEL"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#GOVERNANCE"/>
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    <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#generates">
        <rdfs:domain rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#VALUE-PROPOSITION"/>
        <owl:inverseOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#designedFor"/>
        <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#VALUE_FINANCE"/>
    </owl:ObjectProperty>
    <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#generatesRevenue">
        <rdfs:domain rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#PRODUCT_SERVICE"/>
        <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#REVENUE_STRUCTURE"/>
    </owl:ObjectProperty>
    <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#goesThrough">
        <rdfs:domain rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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        <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#CHANNEL"/>
    </owl:ObjectProperty>
    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
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        <rdfs:subClassOf>
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                <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#controlledBy"/>
                <owl:minCardinality rdf:datatype="&xsd;int">0</owl:minCardinality>
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        </rdfs:subClassOf>
        <rdfs:subClassOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
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        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#ACTOR"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#ROLE"/>
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      <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
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      <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#FLOW-COMMUNICATION"/>
      <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#CHANNEL"/>
   </owl:Class>
   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#hasRole">
      <rdfs:domain rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#ACTOR"/>
      <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#ROLE"/>
   </owl:ObjectProperty>
   <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
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      <rdfs:subClassOf>
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            <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#encompasses"/>
            <owl:minCardinality rdf:datatype="&xsd;int">1</owl:minCardinality>
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      <rdfs:subClassOf>
         <owl:Restriction>
            <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#enablesValue"/>
            <owl:minCardinality rdf:datatype="&xsd;int">0</owl:minCardinality>
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      </rdfs:subClassOf>
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BM Ontology.owl#VALUE-PROPOSITION"/>
      <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#PRODUCT_SERVICE"/>
      <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#TARGET_SEGMENT"/>
   </owl:Class>
   <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#NETWORK-MODE">
      <rdfs:subClassOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE-NETWORK"/>
      <rdfs:subClassOf>
         <owl:Restriction>
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Service BM Ontology.owl#determines"/>
            <owl:someValuesFrom>
               <owl:Restriction>
                  <owl:onProperty rdf:resource="http://www.owl-
ontologies.com/Mobile Service BM Ontology.owl#determines"/>
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               </owl:Restriction>
            </owl:someValuesFrom>
         </owl:Restriction>
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            <owl:someValuesFrom>
               <owl:Restriction>
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ontologies.com/Mobile Service BM Ontology.owl#determinedBy"/>
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Service BM Ontology.owl#determines"/>
            <owl:someValuesFrom>
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ontologies.com/Mobile Service BM Ontology.owl#determinedBy"/>
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            </owl:someValuesFrom>
         </owl:Restriction>
      </rdfs:subClassOf>
   </owl:Class>
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   <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#partOfsegment">
       <rdf:type rdf:resource="&owl;TransitiveProperty"/>
       <rdfs:domain rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#CUSTOMER"/>
       <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#TARGET_SEGMENT"/>
   </owl:ObjectProperty>
   <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#PRICING_METHOD">
       <rdfs:subClassOf>
          <owl:Restriction>
             <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#affectsRevenue"/>
             <owl:minCardinality rdf:datatype="&xsd;int">1</owl:minCardinality>
          </owl:Restriction>
       </rdfs:subClassOf>
       <rdfs:subClassOf>
          <owl:Restriction>
             <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#establishedFor"/>
             <owl:maxCardinality rdf:datatype="&xsd;int">1</owl:maxCardinality>
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             <owl:minCardinality rdf:datatype="&xsd;int">1</owl:minCardinality>
          </owl:Restriction>
       </rdfs:subClassOf>
       <rdfs:subClassOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE_FINANCE"/>
       <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#TOTAL_COST_OF_OWNERSHIP"/>
       <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#REVENUE_STRUCTURE"/>
   </owl:Class>
   <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#PRODUCT_SERVICE">
       <rdfs:subClassOf>
          <owl:Restriction>
             <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#computedFor"/>
             <owl:minCardinality rdf:datatype="&xsd;int">1</owl:minCardinality>
          </owl:Restriction>
       </rdfs:subClassOf>
       <rdfs:subClassOf>
          <owl:Restriction>
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            <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#enablesProduct"/>
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      <rdfs:subClassOf>
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Service BM Ontology.owl#deliveredVia"/>
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Service BM Ontology.owl#deliveredTo"/>
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      <rdfs:subClassOf>
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            <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#encompasses"/>
            <owl:minCardinality rdf:datatype="&xsd;int">0</owl:minCardinality>
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            <owl:maxCardinality rdf:datatype="&xsd;int">1</owl:maxCardinality>
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      </rdfs:subClassOf>
      <rdfs:subClassOf>
         <owl:Restriction>
            <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#generatesRevenue"/>
            <owl:minCardinality rdf:datatype="&xsd;int">1</owl:minCardinality>
         </owl:Restriction>
      </rdfs:subClassOf>
      <rdfs:subClassOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE-PROPOSITION"/>
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        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#TARGET_SEGMENT"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#INTENDED_VALUE_ELEMENT"/>
    </owl:Class>
    <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#provides">
        <rdfs:domain rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#VALUE-NETWORK"/>
        <owl:inverseOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#enrichedBy"/>
        <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#VALUE_ARCHITECTURE"/>
    </owl:ObjectProperty>
    <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#providesResource">
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Ontology.owl#BUSINESS"/>
        <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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Ontology.owl#RELATIONSHIP">
        <rdfs:subClassOf>
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                <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
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        <rdfs:subClassOf>
            <owl:Restriction>
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        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#controlledBy"/>
                <owl:minCardinality rdf:datatype="&xsd;int">1</owl:minCardinality>
            </owl:Restriction>
        </rdfs:subClassOf>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#CHANNEL"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#ROLE"/>
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        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#ACTOR"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#GOVERNANCE"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#FLOW-COMMUNICATION"/>
    </owl:Class>
    <owl:ObjectProperty rdf:about="http://www.owl-ontologies.com/Mobile Service
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        <owl:inverseOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#facilitates"/>
        <rdfs:range rdf:resource="http://www.owl-ontologies.com/Mobile Service BM
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        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
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        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#PRICING_METHOD"/>
    </owl:Class>
    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#ROLE">
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            <owl:Restriction>
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Service BM Ontology.owl#hasRole"/>
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            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE-NETWORK"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#ACTOR"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#RELATIONSHIP"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#FLOW-COMMUNICATION"/>
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      <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#CHANNEL"/>
      <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#GOVERNANCE"/>
   </owl:Class>
   <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#TARGET_SEGMENT">
      <rdfs:subClassOf>
         <owl:Restriction>
            <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#partOfsegment"/>
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         </owl:Restriction>
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      <rdfs:subClassOf>
         <owl:Restriction>
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Service BM Ontology.owl#deliveredTo"/>
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      </rdfs:subClassOf>
      <rdfs:subClassOf rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE-PROPOSITION"/>
      <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#PRODUCT_SERVICE"/>
      <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#INTENDED_VALUE_ELEMENT"/>
   </owl:Class>
   <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#TOTAL_COST_OF_OWNERSHIP">
      <rdfs:subClassOf>
         <owl:Restriction>
            <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#affectsRevenue"/>
            <owl:minCardinality rdf:datatype="&xsd;int">1</owl:minCardinality>
         </owl:Restriction>
      </rdfs:subClassOf>
      <rdfs:subClassOf>
         <owl:Restriction>
            <owl:onProperty rdf:resource="http://www.owl-ontologies.com/Mobile
Service BM Ontology.owl#computedFor"/>
            <owl:maxCardinality rdf:datatype="&xsd;int">1</owl:maxCardinality>
         </owl:Restriction>
      </rdfs:subClassOf>
      <rdfs:subClassOf>
         <owl:Restriction>
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Service BM Ontology.owl#computedFor"/>
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         </owl:Restriction>
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BM Ontology.owl#VALUE_FINANCE"/>
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BM Ontology.owl#PRICING_METHOD"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#REVENUE_STRUCTURE"/>
    </owl:Class>
    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#VALUE-NETWORK">
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BM Ontology.owl#ACTOR"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#CHANNEL"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#FLOW-COMMUNICATION"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#GOVERNANCE"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#NETWORK-MODE"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#RELATIONSHIP"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#ROLE"/>
                </owl:unionOf>
            </owl:Class>
        </rdfs:subClassOf>
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        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE-PROPOSITION"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE_ARCHITECTURE"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE_FINANCE"/>
    </owl:Class>
    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
Ontology.owl#VALUE-PROPOSITION">
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                <owl:unionOf rdf:parseType="Collection">
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BM Ontology.owl#INTENDED_VALUE_ELEMENT"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#PRODUCT_SERVICE"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#TARGET_SEGMENT"/>
                </owl:unionOf>
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            </owl:Class>
        </rdfs:subClassOf>
        <rdfs:subClassOf rdf:resource="&owl;Thing"/>
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        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE-NETWORK"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE_ARCHITECTURE"/>
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    </owl:Class>
    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM
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            <owl:Class>
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BM Ontology.owl#CORE_COMPETENCY"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#CORE_RESOURCE"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE_CONFIGURATION"/>
                </owl:unionOf>
            </owl:Class>
        </rdfs:subClassOf>
        <rdfs:subClassOf rdf:resource="&owl;Thing"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
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        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE-NETWORK"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service
BM Ontology.owl#VALUE_FINANCE"/>
    </owl:Class>
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        <rdfs:subClassOf>
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Service BM Ontology.owl#enrichedByconfig"/>
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        </rdfs:subClassOf>
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            <owl:Restriction>
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Service BM Ontology.owl#enablesCompetency"/>
                <owl:minCardinality rdf:datatype="&xsd;int">0</owl:minCardinality>
            </owl:Restriction>
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        <rdfs:subClassOf rdf:resource="http://www.owl-ontologies.com/Mobile Service BM Ontology.owl#VALUE_ARCHITECTURE"/>
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        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service BM Ontology.owl#CORE_COMPETENCY"/>
    </owl:Class>
    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM Ontology.owl#VALUE_FINANCE">
        <rdfs:subClassOf>
            <owl:Class>
                <owl:unionOf rdf:parseType="Collection">
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM Ontology.owl#PRICING_METHOD"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM Ontology.owl#REVENUE_STRUCTURE"/>
                    <owl:Class rdf:about="http://www.owl-ontologies.com/Mobile Service BM Ontology.owl#TOTAL_COST_OF_OWNERSHIP"/>
                </owl:unionOf>
            </owl:Class>
        </rdfs:subClassOf>
        <rdfs:subClassOf rdf:resource="&owl;Thing"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service BM Ontology.owl#VALUE_ARCHITECTURE"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service BM Ontology.owl#VALUE-PROPOSITION"/>
        <owl:disjointWith rdf:resource="http://www.owl-ontologies.com/Mobile Service BM Ontology.owl#VALUE-NETWORK"/>
    </owl:Class>
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