

MOBILE TELECOMMUNICATIONS MARKET INNOVATION: THE TRANSFORMATION FROM 2G TO 3G¹

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Abstract

Current research focuses on the dynamics of mobile telecommunications market innovation from the perspectives of technology innovation or service adoption. However, because there is a mutual dependency between them, each perspective alone can only partly explain the pace and direction of change we currently witness in this market. This research-in-progress combines them into one framework to pursue a holistic understanding of mobile telecommunications market innovation. We examine the interrelated action and actor layers of the market change. In the action layer the market innovation is identified as composed by the infrastructure innovation and the adoption of innovation. The actor layer defines the social network comprised by providers, users and institutions. This framework allows us to find the mutual influence of infrastructure innovation and innovation adoption, and discloses how the mobile telecommunications market shapes and is shaped by actors in the social network. We use the systems of innovation approach, diffusion of innovation theory and institution theory to identify the roles of the actors involved in different stage of market innovation, and explain the motivation mechanisms for the actors. Based on the characteristics of our research, we draw upon hermeneutics to guide the research design. We aim to test the explanatory power of our framework by understanding the transition from 2G to 3G in Scandinavia.

Keywords: infrastructure, innovation, hermeneutics, mobile telecommunications, market, Scandinavia

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1 INTRODUCTION

Recent decades bear witness of the dramatic changes in telecommunications technology and service. A recent estimate is that 80 per cent of EU citizens have a mobile phone. In addition telecommunication operators have invested huge amount of capital into acquiring licenses for the next generation mobile telecommunications technology, so-called 3G. The 3G technology allows a broadband wireless access to Internet, which may provide individuals with location, time and context based services and enable mobile business functions (May, 2001). The difference between 2G and 3G technology resembles more a radical technology change than a smooth technology evolution (Shapiro and Varian, 1999). This calls for a fresh approach to analyze the migration from one technology paradigm to the next.

Current research focus on the market dynamics of mobile telecommunications market from two perspectives. Either as technology innovation or as service adoption. There is much literature on standardization of 2G technology from a social construction point of view (e.g. Funk and Methe, 2001; Haug, 2002). Also research efforts have analyzed the business model and the usability of technology (Funk, 2001; Muller-Veerse, 2000). Yet, we challenge that each perspective alone can only partly explain the dynamics and pace of change we currently witness within mobile telecommunication market. In this research-in-progress we combine the two perspectives into one framework with the goal of pursuing a holistic, theoretical investigation of mobile telecommunications market innovation during the expected transition from one technology paradigm to the next.

2 RESEARCH QUESTIONS

We assume the mobile telecommunications market as a social-technological system, and its change as an innovation. Mobile telephony is a complicated technology where the mobile phone itself is just a small fraction of the various components that need to be in place for the proper operation and use of the technology. Examples of components are billing system, physical masts, licenses, roaming agreements, standards and users. The components together comprises a sophisticated and highly interdependent infrastructure. Mobile telecommunication infrastructures are emergent in nature and they are grown not built (Ciborra, 2000).

The market is built upon this infrastructure. The infrastructure supports a series of technology applications and enables different sorts of services for the potential adoption of the users. From diffusion of innovation perspective it is clear that individual users will only adopt a technology insofar it is perceived superior to not to adopt it. This is as perceived by the potential adopter based on the fit between the technology's immediate properties and adopter characteristics. Which in return are influenced by the availability of the supporting infrastructure. Hence market innovation covers both the issues of infrastructure innovation and innovation adoption. These entities are depicted in the top part of Figure 1.

We assume there are three principal actors involved in market innovation through various mechanisms. These are the providers, the users and institutions. Institutions cover government and public authorities, trade and industry associations, standard setting bodies and EU related institutions. The three types of actors are depicted in the lower part of Figure 1. We pursue our objective of capturing and explaining the mobile telecommunication market innovation by answering the following questions.

- 1) What roles do the actors in the mobile telecommunication market innovation play? What are the characteristics of their interactions in the social system?
- 2) How do the innovation of mobile telecommunications network, and its complementary technologies and services happen? How do the infrastructure innovation and innovation adoption

co-depend? What is the role of path dependence and path creation for infrastructure innovation and innovation adoption?

- 3) How does the social structure determine the market innovation, and in return how does the market innovation situation influence the formation of the social structure?

3 THEORETICAL BACKGROUND

We build our theoretical framework on the premise that the mobile telecommunications market innovation is a process of simultaneous infrastructure innovation and innovation adoption (Figure 1). It involves different actors that form a social network. Therefore, we examine the interrelated action and actor layers of the market.

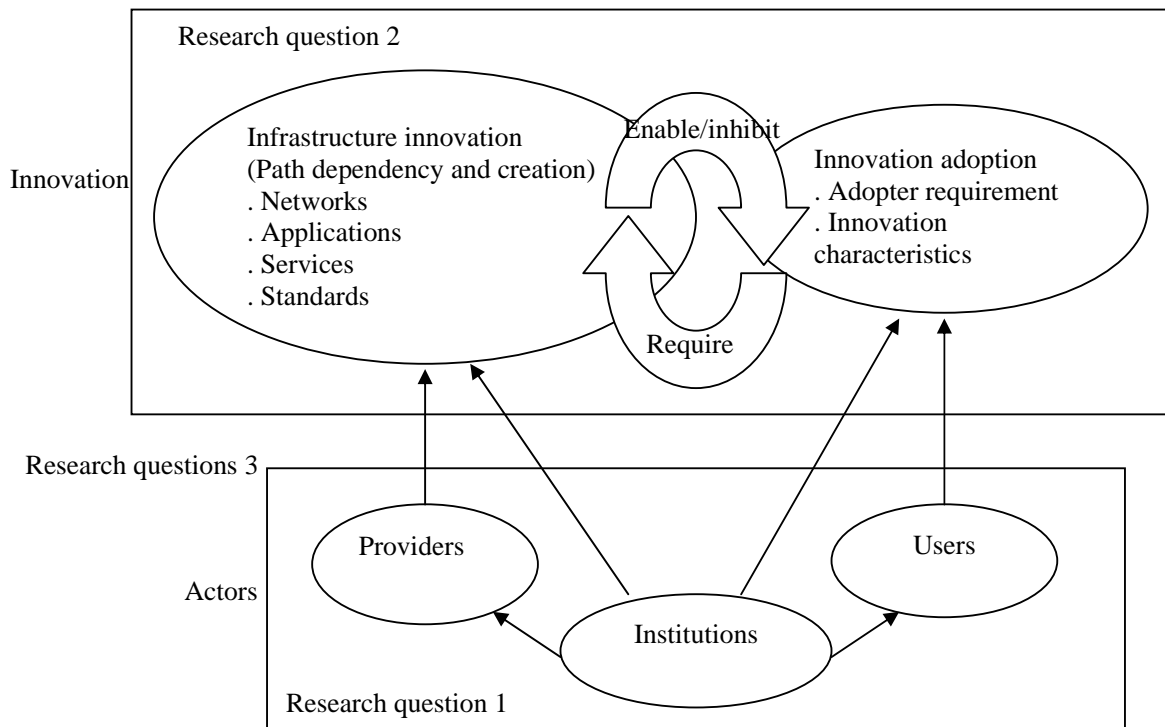


Figure 1. Analytical framework

One component of the action layer is the adoption of infrastructure innovation, for which diffusion of innovation theory (DOI) is an appropriate tool of analysis. According to Rogers (1995), there are four elements that characterize a successful diffusion process of an innovation: 1) an innovation and its characteristics, 2) that they are communicated through specific channels, 3) to the members of a social system 4) over time. A general DOI model predicts diffusion of innovation over time and space by associating a set of variables with an adoption outcome (Wolfe, 1994). Often DOI theory seeks to find the best mix of innovation characteristics that increases adoption. Accordingly, scholars have applied DOI theory to explain diffusion with a small set of factors, like relative advantage, compatibility, complexity, management support, champion, size, centralization, technical sophistication (Rogers, 1995; Tornatzky and Klein, 1982).

Although the traditional DOI theory has provided many useful insights to understanding the adoption and diffusion of technological innovations in the past, recent empirical studies of the diffusion of the complex, networked information technology point out its limitations (Lyytinen and Damsgaard, 2001).

When studying the diffusion of complex social-technological systems, like the telecommunications market, infrastructure must be included as a dimension (Lyytinen and Yoo, 2002). From diffusion of innovation perspective it is clear that individual users will only adopt a technology insofar it is perceived superior to not to adopt it. This is as perceived by the potential adopter based on the fit between the technology's immediate properties and adopter characteristics. Yet because a telecommunications service is dependent on a supporting infrastructure the analysis on user adoption must be expanded to take its networked properties, standard depended features, and institutional arrangements into account. For network technologies each individual adoption decision impacts the value of using the technology. It adds one vote in favor of a technology, but each additional adopter also expands the need for institutional arrangements. This creates a positive feedback loop directly linked to the actual adoption and consequently it must be incorporated into the diffusion analysis (Arthur, 1990). The continuous growth of the infrastructure also changes the properties of the innovation as perceived by the potential adopters. It lowers adoption risks and creates a bias towards the technology. It also guarantees stability of the promoted technology and triggers learning and thereby reduces costs. At the same time, the emergence of the infrastructure lowers the knowledge threshold to adoption and reduces the complexity of the technology (Attewell, 1992). The infrastructure also invites technology providers to produce standard compliant products and services. In combination this shifts the innovation's properties in favor of adoption.

The infrastructure that favors adoption can over time become an inertia that constrains innovation (Van de Ven, 1993). So, whilst the infrastructure becomes firmly established it locks the technology properties into a certain trajectory (Arthur, 1989). Specifically the telecommunications infrastructure is built on the specification and implementation of standards, like GSM and WCDMA for the 2G and 3G mobile telecommunications networks (Funk and Methe, 2001; Haug, 2002). Legitimacy, regulation and standard setting of technology production and use impact this infrastructure (Van de Ven, 1993). There are competing standards and competing interpretation of the standards, for example for 3G networks. In general the market change is an evolutionary process, but is punctuated when the old infrastructure is substituted by a new one based on a new generation standard, notably 2G to 2.5G and to 3G. The infrastructure innovation is therefore a process of path dependency and path creation. Each infrastructure supports different kinds of technology applications and services, which are enabled by the provider community and subject to the appropriation of users.

The telecommunications market is socially constructed. The infrastructure innovation and its adoption must be based on the establishment of an ecologic social system (Star and Ruhleder, 1996). Hence our framework includes an actor layer. The social network is composed by providers, users and institutions. In different stages of market transformation there are different market actors involved. Different from 2G market where the network operators alone play a dominant role, for the 3G mobile telecommunications market there exists a provider community composed by technological vendors including handset manufactures and operating system developers, content providers, network operators, service aggregators, service providers etc (Muller-Veerse, 2000). The efficient cooperation between different providers based on a specific business model is imperative for the technology innovation and adoption. Generally the government plays a different role in the 2G and 3G market. Hence the study of innovation and diffusion of complex technological systems, like mobile telecommunications market, must involve the theory of systems of innovation (Equist, 1997) and institution theory (King et al, 1994), which allows the explorations of social network around the technology instead of focusing on marketing strategies and changes in consumer behavior (Damsgaard and Lyytinen, 2001).

The innovation adoption drives the infrastructure building and vice versa. The mobile telecommunications market shapes and is shaped by the social network. A combination of these accounts offers plausible explanations to mobile telecommunications market innovation hence form our theoretical fundamentals for analysis (Table 1). As an example of illustration, we can recall the development of SMS. GSM system started with major providing voice communications. Afterwords SMS services was enabled. As this service is provided through control channel which means it does

not involve additional cost for the operator hence a low price has been set for its consumption, and at the same time it is convenient to use for customer, it turned to be a welcomed service. This encouraged the operators to extend SMS to business field, and promoted the market to move from 2G to 2.5G that was capable of providing better data services. Hence, as we have argued above, the change of mobile telecommunications market covers the issues of both infrastructure innovation and innovation adoption.

	Infrastructure innovation	Innovation adoption
Key Drivers	Innovation of infrastructure and technology	User value
Unit of analysis	Providers and institutional actors	User
Key theoretical references	Systems of innovation (Dosi et al, 1988; Equist, 1997); Institutional theory (King et al, 1994); Network economics (Arthur, 1989, 1990; Van de Ven, 1993)	Diffusion of innovation theory (Rogers, 1995; Tornatzky and Klein, 1982)
Data collection method	Interview	Interview, survey

Table 1. Summary of innovation and infrastructure perspectives.

4 RESEARCH METHODOLOGY

We study mobile telecommunications market innovation within Scandinavia in the process of transforming from 2G to 3G. We select Scandinavia for its pioneering position in implementing mobile telecommunications. Besides, countries in this area adopt various innovation patterns. Just look at the role of government in issuing 3G license we may find this difference. For example Finland adopted a “beauty match” method but Sweden and Denmark used a bidding system.

Our approach of studying this phenomenon is a multiple case study (Walsham, 1995). Because of its hermeneutic nature of the answers sought, we draw upon Klein and Myers (1999) in desinging our research methodology. Taking the hermeneutic circle as a fundamental principle, we will probe into the characteristics of the market innovation through relating different technologies and actors to the whole infrastructure and social network. This is an iteration process that will last until a plausible explanation is reached. By the contextualization principle, we will investigate the dynamics of mobile telecommunications market by positioning it in the historical and social, cultural, political context. Following the multiple interpretation principle which encourages the researchers to analyze the viewpoints of different stakeholders, from early to mid 2004 we will perform interviews with key actors including operators, research institutions, government and pseudo-government institutions, manufactures of devices and networks, and content providers. The interviewees should be in different administrative levels covering broad backgrounds including strategy, marketing, and technology. We will also conduct survey on users. Besides we will gather archival data in order to corroborate and complement our interview results. We will use Figure 1 and Table 1 to identify potential interviewees and develop an interview guideline. As the principle of dialogical reasoning suggests, we will rationalize our current theoretical assumptions as the data collection moves forwards. For the purpose of abstraction and generalization, we use systems of innovation method, institution theory, DOI, and network economics to draw specific implications for the market innovation issue.

In addition research partners in South Korea and USA perform similar field studies there. We have a common agenda for data collection. We will share data and data analysis results. This research is carried out as a part of a research project that aims to design business models and conduct experiments on the provision of location-based mobile services in collaboration with two technology manufactures, three content providers, and one operator. This project runs from 2003 to 2005. It provides a micro field for understanding the social network for the market transformation.

5 EXPECTED CONTRIBUTION

The execution of the study is expected to make several important theoretical and empirical contributions. First, to the diffusion of innovation literature, our study will expand the social construction perspective of innovation and diffusion. In particular, our study will provide an integrated theoretical perspective on the process of innovation of mobile telecommunications market. We hope to justify that our framework can be generalized to studying other networked technologies from our case study.

Second, to mobile telecommunications literature, our study will provide new insights on the innovation paths for specific services, and the mobile telecommunications market to transform from 2G to 3G.

References

- Arthur, W.B. (1989). Competing technologies, increasing returns and lock-in by historical events. *Economic Journal*, 99, 116-131.
- Arthur, W.B. (1990). Positive feedbacks in the economy. *Scientific American*, 262(2), 80-85.
- Attewell, P. (1992). Technology diffusion and organizational learning: the case of business computing. *Organization Science*, 3(1), 1-19.
- Ciborra, C.U. (2000). From Control to Drift: the Dynamics of Corporate Information Infrastructures. Oxford University Press.
- Damsgaard, J. and Lyytinen, K. (2001). Building electronic trading infrastructure: A private or public responsibility? *Journal of Organizational Computing and Electronic Commerce*, 11(2), 131-151.
- Dosi, G., Freeman, C., Nelson, R. and Soete, L. (1988). *Technical Change and Economic Theory*. London.
- Edquist, C. (1997). *Systems of Innovation: Technologies, Institutions, and Organizations*. London.
- Funk, J.L. (2001). *The mobile Internet: How Japan dialed up and the West disconnected*. ISI Publications Limited.
- Funk, J.L. and Methe, D.T. (2001). Market- and committee-based mechanisms in the creation and diffusion of global industry standards: the case of mobile communication. *Research Policy*, 30, 589-610.
- Haug, T. (2002). A commentary on standardization practices: Lessons from the NMT and GSM mobile telephone standards histories. *Telecommunications Policy*, 26(3, 4), 101-107.
- King, J.L., Gurbaxani, V., Kraemer, K.L., McFarlan, F.W., Raman, K.S. and Yap, C.S. (1994). Institutional factors in information technology innovation. *Information Systems Research*, 5(2), 139-169.
- Klein, H. K. and Myers, M.D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly*, 23(1), 67-93.
- Lyytinen, K. and Damsgaard, J. (2001). What's wrong with the diffusion of innovation theory? In *Diffusing Software Product and Process Innovations* (M.A. Ardis and B.L. Marcolin Ed.). 173-190. Kluwer Academic Publishers.
- Lyytinen, K. and Yoo, Y. (2002). The next wave of nomadic computing. *Information Systems Research*, 13(4), 377-388.
- May, P. (2001). *Mobile Commerce: Opportunities, Applications, and Technologies of Wireless Business*. Cambridge University Press.
- Muller-Veerse, F. (2000). *Mobile Commerce Report*. Durlacher Research Ltd, London.
- Rogers, E.M. (1995). *Diffusion of Innovations*. The Free Press, New York.
- Shapiro, C. and Varian, H.R. (1999). *Information Rules: A Strategic Guide to the Network Economy*. Harvard Business School Press, Boston, Mass..
- Star, S.L. and Ruhleder, K. (1996). Steps toward ecology of infrastructure: Design and access for large information spaces. *Information Systems Research*, 7(1), 111-134.

- Tornatzky, L.G. and Klein, K.J. (1982). Innovation characteristics and adoption-implementation. *IEEE Transactions on Engineering Management*, 29(1), 28-45.
- Van de Ven, A.H. (1993). A community perspective on the emergence of innovations. *Journal of Engineering and Technology Management*, 10, 23-51.
- Walsham, G. (1995). Interpretative case studies in IS research: Nature and method. *European Journal of Information Systems*, 4(2), 74-81.
- Wolfe, R.A. (1994). Organizational innovation: Review, critique and suggested research directions. *Journal of Management Studies*, 31(3), 405-431.