# 1 INTRODUCTION

## *1.1 Background*

The development of information and telecommunications technology has been rapid during the last years. In Finland telecommunications plays an important role both in private and public sector and in the highly developed information society people are dependent on modern telecommunication products both in their professional and private lives. Mobile telecommunications is gaining importance in the economy both due to its direct effects, such as positive contribution to employment (OECD 2000a), and its indirect effects, e.g. through facilitation of business practices. The penetration of mobile phones in Finland is one of the highest, approx. 90 % (EMC), in the whole world (U.S. Commercial Service Finland 2002), although the diffusion speed has not been as fast as in the countries that have adopted mobile telecommunications later on. Laggard countries have faster within-country diffusion rates (Dekimpe, Parker and Sarvary 2000, p. 12). A technological innovation introduced later in a country results in faster diffusion as the consumers in lag market have an opportunity to learn about the new product from the consumers in the lead market (Ganesh, Kumar and Subramaniam 1997, p. 214).

As the telecommunications is important subject in Finland, it is important to know, which factors affect the diffusion of mobile phones and cellular subscriptions and how it is possible to control the diffusion. For the telecom operators it is vital to understand the supply characteristics of products and services of telecommunications, such as the impact of pricing and competition, because by understanding for example the meaning of effective pricing it is easier to make products and consumers to meet each other in the markets. Also identifying the effects of various market- and product related characteristics on the development of market penetration could help managers of the companies in strategic decisions like timing, but also in marketing mix decision, such as price, on operational level (Puumalainen 2002, p. 1). However, neither the users nor the telecom operators are interested in the penetration itself: the users seek for utility and the mobile operators for revenue (Frank and Heikkilä 2002, p. 1).

Finland was among the first countries where the competition was liberalised and the liberalisation has had major effects on diffusion speed. According to Koski and Krechchmer (2002) increased competition tends to accelerate mobile phone diffusion. Competition is also found to lower prices. Also the number of competitors on the market is expected to influence demand via prices. (Koski and Krechchmer 2002, p. 5, 15)

Diffusion has been studied in many fields of science, like in chemistry and biology. In the field of business the research eventually commenced in the 1960s. Various researchers, like Rogers (e.g. 1995), Mahajan (e.g. 1985), Dekimpe (e.g. 2002) and Puumalainen (e.g. 2002), have studied diffusion and the factors (e.g. social system norm, product compatibility) affecting it. According to Nelson and Winter (1982) one should note when discussing diffusion theory that, although the frameworks used are quite general, different innovations in different industries will vary in their diffusion patterns. One should therefore be cautious of generalisations. Thus, even with technological products, generalisations cannot be made.

Research on diffusion has concentrated on low technology products, with few exceptions (Robertson 1986, p. 1). Also the supply-side has not received as much interest as the demand side of the diffusion. The supply-side, which includes among others pricing and competition, demands more extensive study, and therefore the effects of pricing and competition are worthwhile to study. The pricing schemes are very complex and vary across countries, and it is therefore very difficult to assess the effects of pricing on the diffusion process, and because of the complexity of pricing it has not gained much attention in the diffusion research. The aim of this thesis is to bring new information about the effects of pricing and competition on diffusion, because we are still lacking this kind of information, especially in the field of telecommunications and service pricing. The information of these effects may be very useful for setting a price for mobile phone subscriptions and for predicting the diffusion of subscriptions. Gaining a better understanding of the various factors influencing the adoption of mobile communications services is valuable for almost all companies inside the mobile communications industry. The pricing of a cellular subscription is also crucial for the successful diffusion, and there is an increasing

need for marketers to understand consumer price sensitivity to new and existing subscription services.

The study is a part of the research project "Global Diffusion of Innovations in Telecommunications" conducted at the Telecom Business Research Center at Lappeenranta University of Technology. Further studies of the project give some guidelines for this paper. The objective of this research is to study empirically what effects the prices of subscriptions and mobile phones have on the diffusion of telecommunications. The effect of competitive situation is mainly explained with the results of former studies. The focus of the thesis will be on domestic markets, because of the difficulties related to information availability.

## *1.2 Research Problem*

*Research objective*

The objective of this study is to fill the gap in the diffusion research related to the inadequate information about the effects of pricing and competitive situation, since price and competition are inseparable, on diffusion of high technology products and enhance the knowledge of these effects. The other aim of the research is to find out what kind of effects price has on the diffusion of cellular subscriptions in Finland and how competition has affected the general price level.

*Main research question*

How to explain the effects of price and competitive situation on diffusion of telecommunications?

*Sub questions*

What kind of innovation is mobile phone subscription?

What are the issues related to the diffusion of innovations in telecommunications?

What kind of form takes the diffusion curve of mobile phone subscriptions in Finland?

How does price affect the diffusion of innovations?

How does competitive situation explain the diffusion of innovations?

What is the interconnection between competition and price?
What kind of effect competition has on pricing strategies?
How to set a price?

### *1.3 Literature Overview*

*Diffusion*

Diffusion phenomena have been widely studied in the literature, also in other disciples than business, and there seems to be abundant amount of research of diffusion. In the field of business Rogers (1963) can be seen as a pioneer of the diffusion research. Rogers has collected all the main themes on diffusion to his book *Diffusion of Innovations* (1963, 1983 and 1995). The book discusses such issues as elements of diffusion, diffusion research, the innovation-decision process, attributes of innovations and the rate of adoption. Most of the publications, like journals, written about diffusion refer in some level to Roger's theories and authors consider his theories as a basis of diffusion. *The theory of diffusion of innovations* is also used as a theoretical basis in this thesis.

Until the end of eighties diffusion research within marketing had nested primarily in the behavioural domain, but despite of this empirical research on diffusion from a behavioural perspective has almost totally ignored competitive factors (Robertson 1986). The paradigm of Rogers (1983) had been adopted by researchers without much qualifications. Research on diffusion tended to focus at the individual consumer level (e.g. Rogers (e.g. 1983) and Gatignon (e.g. 1985, 1989)), and the amount of research projects focusing on organizational adoptions of innovation was limited. Moreover, the research of diffusion concentrated also mostly on low technological products. (Robertson 1986, p. 2) Consumer adoption of the diffusion dominated the research with some exceptions such as Zaltman, Duncan and Holbek (1973) and Ozanne and Churchill (1971). Additionally, the demand side of diffusion was studied more extensively than supply-side, in which price and competition belong, so there is not much literature available about the fact how price and competition affect diffusion. It was not until the beginning of 1990s when the research of the diffusion of technological products and supply-side factors

commenced in more extensive scale then earlier. For example Danaher (e.g. 2002) has made some research on pricing of a subscription and the effects of competition has presented for example by Gruber (e.g. 2000). In addition, e.g. Moore (1999) has studied adoption of technological products and the issues related to it.

The diffusion of high technology products is studied only in some level, and traditional consumer goods have gained more attention in the research of diffusion than the technological products. For example Hanna, Guy and Arnold (1995) have studied the diffusion of information technology, but still we are lacking accurate information about the fact what determinants affect the shape of the diffusion curve in telecommunications field.

Two types of diffusion models are distinguished within diffusion research. First are the models that aim to gain understanding of diffusion process as whole. These models are analytical representations of a diffusion process at the aggregate level (Mahajan, Muller and Bass 1990). These models are often referred to as diffusion models. The other class of the models has the objective to gain insight in the determinants of the individual adoption decision. (Frambach, Barkema, Nooteboom and Wedel 1998, p. 161)

*Innovation*

Most of the theories of innovation focus on technology push or process innovations and there are some general literature about innovations, such as Rogers' (1983) *Diffusion of Innovations* and Hölttä's (1989) *Multidimensional Diffusion of Innovations*. According to these authors innovation is risky, but essential. This thesis does not discuss innovation as such, but their diffusion. Theories of innovation diffusion no longer focus exclusively on explaining the rate at which innovations diffuse or the sequence in which they are adopted, but theories also focus on explaining why some innovations diffuse faster than the others and why some innovations fail in the market, e.g. Christensen's *The Innovator's Dilemma* (1997) approaches the topic why and under what circumstances new technologies have caused great firms to fail. In addition, adoption of innovations is quite a research topic in the diffusion studies. For example Moore (1999b) discusses the different

adoption groups in his book *Crossing the Chasm*.

*Pricing*

Pricing in general is quite researched attribute, but however service pricing in general and pricing access services in particular have not received adequate attention in literature. For example Kotler (2000) discusses how a price should be set on a product, how it should be adapted to meet various circumstances and opportunities and how a price should respond to a competitor's price change. Theories for pricing and pricing strategies can be found from the basic books of marketing, such Hollensen's (2001) *Global Marketing*. Theory of price and diffusion is a more difficult area, because the information consists mainly of the information collected from the different journals and the supply-side of the research of diffusion has not gained much interest. There is neither a unified framework for incorporating price into the diffusion models. Neither have the high technology products gained interest in diffusion research. Most of the diffusion models that include pricing are made for durable goods and technology products have left out of attention.

*Competition*

The relationship between competition and diffusion is more extensively described in the literature of the diffusion of innovations than the relationship between price and diffusion. The effects of competition on diffusion have been conducted by such names as Gruber and Verboven (2001) and Dekimpe (1998-2000). The basic theories of competition can be found from the basic books of marketing. For example Porter (1985) and Moore (1999) give suggestions in their books about competition strategies. These strategies can also be adapted in telecommunications business.

### *1.4 Theoretical Framework*

Theory of diffusion of innovations is a basis of this thesis. It has been studied quite extensively in the field of marketing. The research has been divided into supply- and demand side, but like previously noted the research has mainly concentrated on demand side factors. This thesis discusses telecommunications and the diffusion of mobile phone subscriptions. Figure 1-1 illustrates the theoretical framework of the

present study. Framework illustrates how pricing and competition are placed in the research of diffusion of innovations, and therefore this thesis focuses on explaining the left side (supply-side) of the framework.

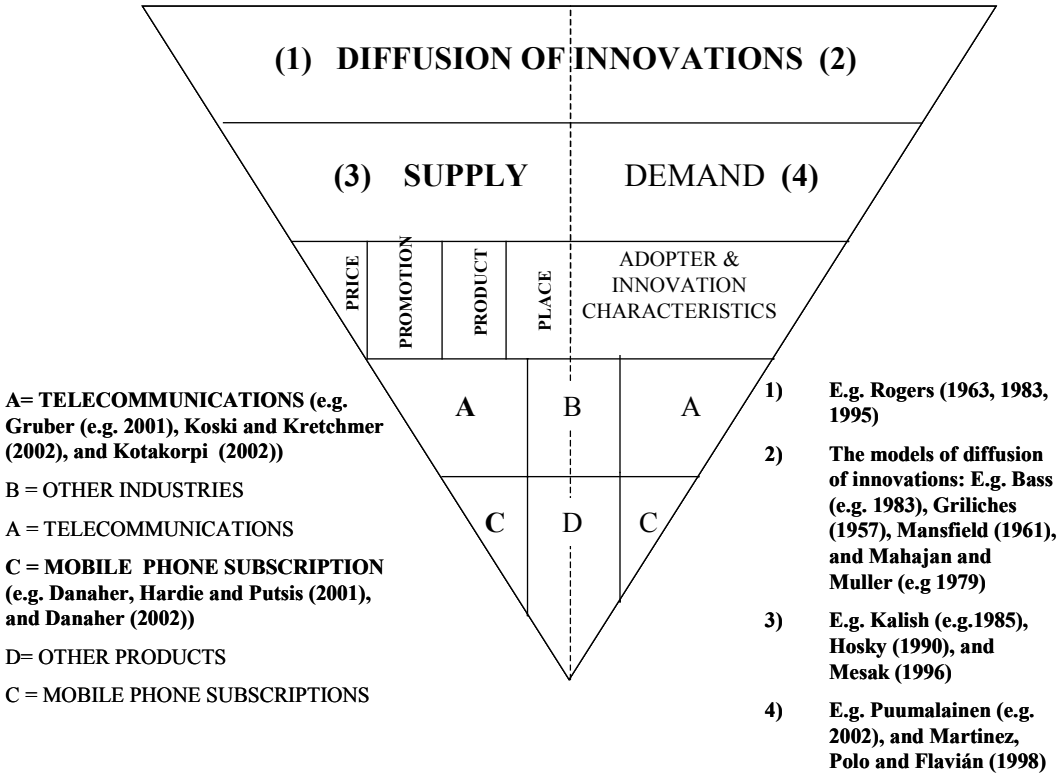


**Figure 1-1 Theoretical Framework of Diffusion of Cellular Subscriptions**

The aim of this study is not to review the theories concerning price, pricing and competition as a separate, but to combine the diffusion models in some level. As well as the theoretical framework shows the place where price and competition are placed in the diffusion research it also illustrates the amount of research made on diffusion. Some examples of the studies that are conducted are presented in Figure 1-1. Theories of diffusion in the field of marketing have existed since 1960s but there are not extensive and coherent studies of all the factors affecting diffusion. The factors that affect diffusion are mostly studied as separate and the basic models of diffusion do not either incorporate any other independent variables besides time, and therefore provide no tools for managers to assess the effects of marketing decisions on the

diffusion pattern. Therefore, it is useful to look at how price and competition interrelate with diffusion.

One of the main focuses of the thesis lies in the theory of innovation diffusion; i.e. how the innovation is communicated through different channels over time among the members of a social system (Rogers 1985, p. 5). Innovation is any idea or practise that is perceived as new. (Rogers 1995, p. 10) The diffusion speed depends on the characteristics of the innovations and the rate of adoption, which means the relative speed with witch an innovation is adopted by members of a social system (Rogers 1995, p. 22). Telecommunications service market has become more competitive and turbulent than ever and the exceptionally fast growth can be explained by both demand and supply-side factors. The impact of competition and price on diffusion speed needs to be evaluated, because not only adopter-side variables significantly influence diffusion of innovation, but supply-side variables as well. On the supply-side, technological developments, development of common standards and deregulation has led to declines in costs of both transmission and switching, i.e. the investment costs of connecting a mobile subscriber have declined (Gruber and Verboven 1998). It is also said that increasing competition tends to speed up diffusion (Koski and Kretchmer 2002, p. 5, 15). Thus, it is important to know how price and competition affect the diffusion in highly turbulent telecommunications market.

### *1.5 Delimitations*

The survey is restricted only to Finnish markets. Finland was one of the first countries where mobile phones were taken into extensive use and markets were liberalized for fully competition. Only the diffusion of GSM subscriptions is studied. In addition, the penetration rate is one of the highest in the whole world. In December 1998, Finland became the first country where the number of mobile phones exceeded the fixed phones (U.S. Commercial Service Finland 2002). Finland has also lower calling fees than other countries (OECDb 2002). Pricing system of calls is also very complex, which makes analysing very challenging and difficult. Because of these factors the models created based on Finnish markets may not be

valid in other countries that are different in nature. The diffusion has been slower in Finland than in the countries who have adopted wireless communications later, although diffusion of mobile phones started earlier than in most of the countries (EMC). So Finland can be seen as one kind of innovator in this field. International comparison cannot be made because the data is limited to domestic markets. International comparison would give more applicable results to other markets and the results would also be more reliable.

To estimate the effects of price on diffusion both the mobile tariffs and the mobile phone prices are used in the analyses. The mobile tariffs are chosen instead of some other service price, because most likely the call prices affect more the diffusion of cellular subscription than, for example, short message prices. Although non-voice services are important for operators, still the greatest revenue comes from the calls (Sonera 2002). Therefore, the call prices are chosen. Mobile phone prices are used as well, because having a subscription depends on the fact whether a user has a cellular.

The data of Finnish markets is limited to the information acquired from secondary sources. The amount of subscribers per operator is possible to achieve but the information of the number of users of different subscription types is not available. It was not possible either to get monthly pricing information. Thus, the survey does not necessarily give the correct information about competition and how prices affect diffusion. However, conclusions about competitive situation and the effects of both mobile phone prices and cellular tariffs on diffusion in Finland can be derived from the analysis.

### *1.6 Definitions*

**Adoption** is a decision to make full use of an innovation as the best course of action available. Rate of adoption is the relative speed with which members of a social system adopt an innovation. (Rogers 1983, pp. 21-23)

**Competition** includes all the actual and potential rival offerings and substitutes that a buyer might consider (Kotler 2000, p. 14). The effort of two or more parties acting

independently to secure the business of a third party by offering the most favourable terms (Webster 2002).

**Diffusion** is a process by which the innovation is communicated through certain channels over time among the members of social system (Rogers 1983, p. 5).

**Innovation** is an idea, practise, or object that is perceived as new by individual or other unit of adoption (Rogers 1983, p. 11).

**Price** is the cost at which something is obtained (Webster 2002).

**Telecommunications** means communication at a distance (as by telephone). (Webster 2002)

### *1.7 Method of Research*

The empirical part of the study discusses the diffusion of different mobile phone subscriptions in Finland. The aim of this thesis is to examine empirically the effects of price on diffusion. Other object is to explain the impact of competitive situation on the prices. Based on the literature hypotheses were formed and tested with the help of data acquired from Finnish Ministry of Transport and Communication and EMC mobile telecommunications database, which lists the cumulative number monthly mobile subscriptions broken down by technologies and telecom operators. The data includes both the total number of subscribers of different operators and a price index, which is calculated from Sonera's and Radiolinja's average prices.

For the analysis, the data was coded into the SPSS –statistical analysis program. The analysis part consists of different statistical analyses and tests.

The method of the present research is quantitative. Quantitative research study incorporates a formal research design to test a hypothesis with validated measures. Quantitative research method gathers information in numeric form. The object of the quantitative study is to describe and analyse the data. (Heikkilä 1998, p. 17)

### *1.8 Structure of Research*

The study is divided into a theoretical and an empirical part. In the first five chapters the aim is to define the diffusion process and factors affecting it and the remainder of the thesis is dedicated to testing and explaining the theory in practice. The structure of the study is demonstrated in Figure 1-2.

*Chapter Two* introduces the special characteristics of telecommunications business. The industry structure of telecommunications and technology development are also discussed.

*Chapter Three* concentrates on explaining the diffusion of innovations. First, the basic concepts of innovation diffusion are defined. Then, the theories of diffusion are presented briefly and the factors that affect diffusion are discussed as well. Finally, the chapter takes a look at the diffusion in telecommunications field.

*Chapter Four* gives a framework for understanding the meaning of a good competitive strategy. The chapter takes also a look at the nature of competition in telecommunications. The central concern of the chapter is, however, to explain the effects of competition on diffusion.

*Chapter Five* approaches the difficulties of pricing in a turbulent and fast changing business environment. In addition, the most common pricing systems in telecommunications are described. A quick look is given to elasticities of demand as well. Finally, the issues related to the effects of pricing on diffusion are introduced.

*Chapter Six* introduces the current situation of Finnish telecommunications market. Country profile of Finland is presented as well as regulation policy in telecommunications market. Also, the different phases of GSM era (from the year 1992 until today) are briefly discussed.

*Chapter Seven* analyses the current competitive situation. Also different subscription types and the pricing systems are introduced. The price levels of both mobiles and

mobile phone calls are introduced as well.

*Chapter Eight* clarifies the impact of competition on price level. The effect of price on diffusion is also analyzed. The method applied for this was non-linear regression analysis. The hypotheses are analyzed based on the regression results.

*Chapter Nine* draws the conclusions from both the theoretical and empirical parts. Also few aspects are given for further research.

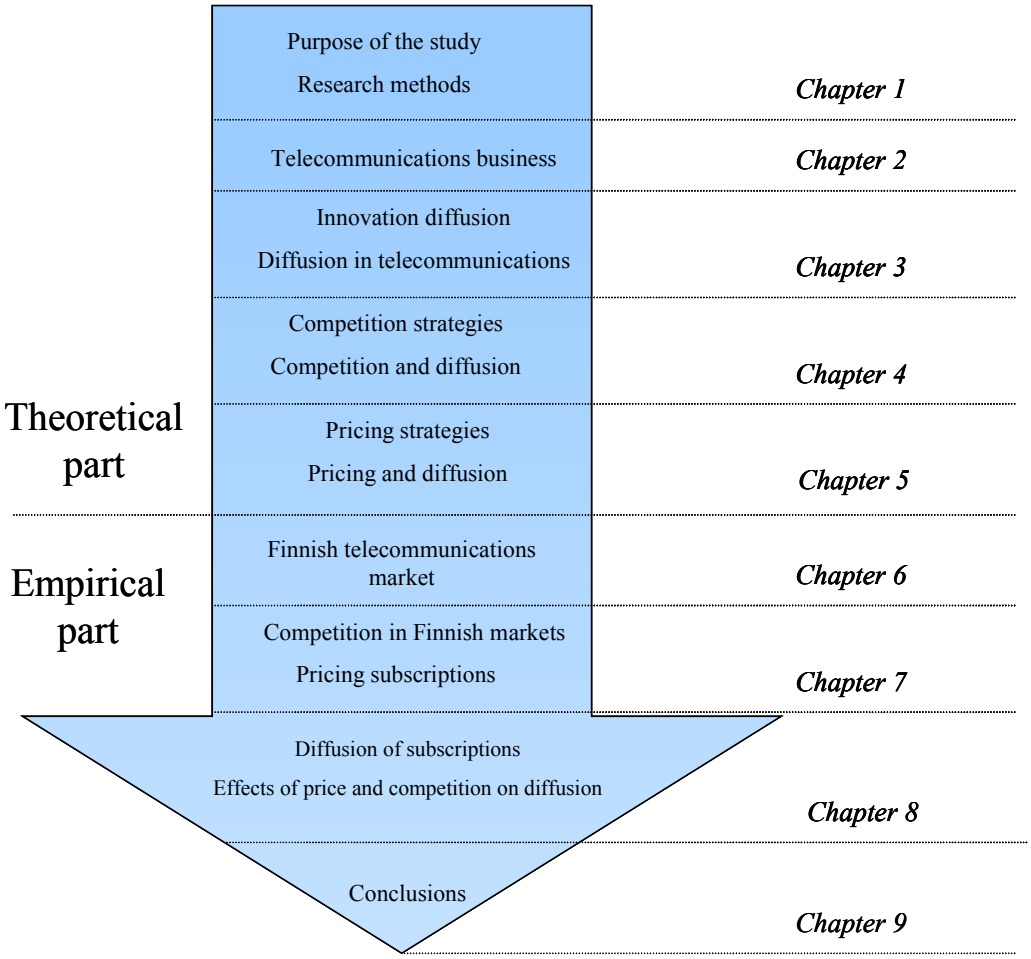


**Figure 1-2 Structure of the Study**

# 2 INTRODUCTION TO TELECOMMUNICATIONS BUSINESS

Information technology (IT) forms the platform that enables or enhances communication and information flows. Although IT can be embedded in product and process technologies, it often comprises software that makes the devices and equipment work. (Capon and Glazer 1987, pp. 1-14) There often appears difficulty in understanding which firms can be called high technology companies, because of the difficulty in making demarcation between low and high technology. According to Rajala (2000, p. 1) companies that invest in R&D over 10 percent are high technology companies. Product can be defined a high technology one when it includes the newest technology available, and a high level of knowledge intensity is embedded to the product. High technology industries are the fastest growing sectors in the world economy. The emergence of new technology, which makes the existing technology obsolete very rapidly, is one of the most typical features of high technology industries. The rapid changes in all the features of the products characterise such industries as electronics and *telecommunications*. (Rajala 2000, pp. 1-2) Telecommunications products tend also to have unique characteristics as compared with other industrial or consumer goods (Dekimpe et al. 2000, p. 47).

## *2.1 Special Characteristics of Telecommunications*

Telecommunications has many special characteristics such as network externalities, prevailing complexity, high technological and market turbulence, existing competing technologies, convergence and the fact that services have lower observability than products. The telecommunications industry is a prime example of a network industry. Telecommunications products often exhibit network externalities, in which consumer benefit from other consumer's use of a product based on the same technology. The technology's value depends on the total size of the adopter population. In addition, new telecom innovations have quite high degree of complexity, but despite this fact they are diffused quite fast for example in Finland. In addition, when new technologies are involved diffusion may be slowed down because consumers face uncertainty about which technology will eventually become the standard. Moreover,

services have lower observability than products. The low observability leads to lower adoption rate and slower diffusion. In telecommunications both high technology and market turbulence increases consumers' perceived risk of adopting new services. (Rogers 1983; Puumalainen, Sundqvist and Frank 2001)

Access industries, like telecommunications, share four salient characteristics. First of all they have low marginal cost: provided that capacity is available, the marginal cost of serving a customer is very low, to a large extend, independent of the consumer's usage rate. Secondly, these industries are also very competitive and they offer differentiated products and services. Thirdly, their capacity is often constrained, which means that firms can allow only a limited number of consumers to access the service simultaneously at any time, and this capacity constraint is fairly rigid in the short run. And finally, one special characteristic is the usage heterogeneity, which means that consumers have different usage rates for the service. Users can be roughly categorized into two groups; heavy and light users. (Essegaier, Gupta and Zhang 2002, p. 140)

### *2.2 Industry Structure of Telecommunications*

State owned companies used to monopolise the telecommunications markets and the regulatory impact on the telecommunications business is higher than in many other industries (Puumalainen 2002, p. 36). The telecommunications environment has undergone fundamental structural changes; the liberalisation, internationalisation and privatisation processes have changed the market structure and now most of the operators are privately owned. Even now, when the markets are liberalised there are various types of regulations, for example the entry of new operators is strictly regulated. Although the structure of telecommunications industry has become more complex through liberalisation and the lowering of technological barriers to entry, still the number of operators has grown in certain extent. Nevertheless, regulations of the markets limit the wide increase of new entrants. However, competition ensures improvements in service provision and quality, price reductions, service innovation and network expansion and modernisation. (Feng and Whalley 2002, p. 458)

In order to understand the functioning of the telecommunications industry, it is worthwhile to distinguish between different performers of the industry. There are many various types of players in telecommunications industry; for example Fertig, Prince and Walrod (1999) have classified the players into six diverse types, such are operators, service providers, resellers, integrators, customers and end users. The telecommunications business is ever changing and telecommunications industry is undergoing a radical transformation creating existing new opportunities and new challenges for infrastructure and service providers. (Feng and Whalley 2002, pp. 451-458) Telecommunications industry is also undergoing a transformation from being a supply-dominated industry towards a demand driven industry (Andersson and Bengt 1997, p. 453). The increasing information need has outcome in stronger demand for better, more varied and less costly communication and information services. Rapid technological developments and increasing market turbulences have also added new dimensions to an already complex situation. Many tools and techniques have become obsolete in ever changing markets. Because of these radical changes in telecommunications business all players must revise their strategies and market positions and make decisions how to keep up with the competition as the competition increases in telecommunications. (Feng and Whalley 2002, pp. 451-458)

### *2.3 Mobile Network and Technology Development*

First mobile phones were designed only for voice transmission and during 1990s also SMS (Short Message Service) were taken into use. For now, the mobile telephone is being increasingly used for other than calls and SMS messages. Nowadays SMS messaging is the most popular value added service. (Telecommunications statistics 2002, p. 39) New technologies and advanced terminal devices are opening up opportunities for a broader range of services and implementation of new innovations (Radiolinja 2003). As the mobile phone services increase, the utilities of mobile phones develop more from communications to multidimensional service activities and even now mobile phones have become personal computers for the users. Mobile phones enable people to transact and even entertain themselves without spatial and temporal restrictions and the mobile phone services compared with fixed phones are available regardless the time of day. (Eriksson, Hyvönen, Raijas and Tinnilä 2001)

The future of telecommunications business looks complex. New technologies are emerging all the time and it is expected that new technologies will bring new possibilities to add the amount of services, decrease prices and bring mobile services available for diverse user groups. Mobile network technology has already now gone through many phases starting from NMT (Nordic Mobile Telephone System). The development and the introductory years of new technologies are presented in Figure 2-1.

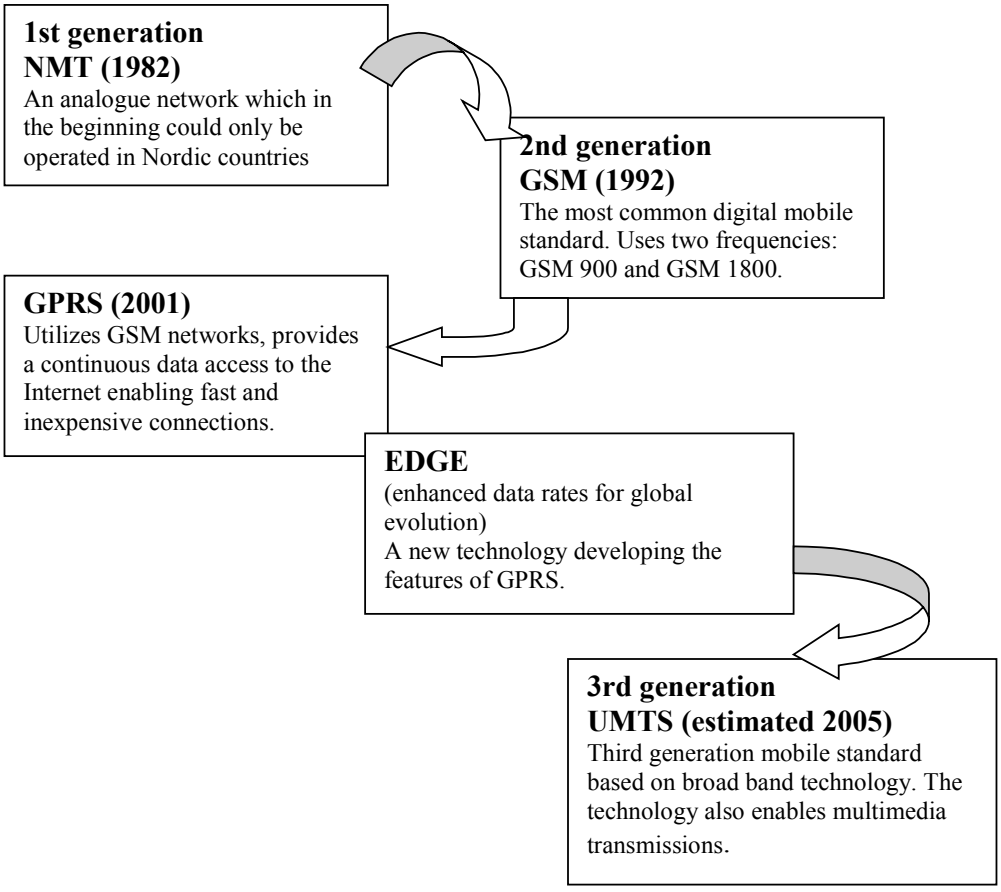


**Figure 2-1 Mobile Network Technology Development (Saurio 2001)**

The diffusion of 2G (Second Generation) began in January 1992, when the first wireless telecommunication network was opened in Finland. GSM (Global System for Mobile communications) was taken into use along side with NMT. The first generation of mobile telephones never reached high levels of penetration. The launch

of digital mobile telephony meant a drastic increase in the efficiency of spectrum use and in service quality. (Koski and Kretchmer 2002, p. 6) GSM has already eased the communication enormously between individuals. New network GRPS (General Packet Radio Services) has also taken into use and the network enable the use of some new functions, for example picture transfer. GRSP is considered a major intermediate phase before building the third generation (3G) mobile phone network UMTS (Universal Mobile Telecommunications System). (Eriksson et al. 2001, p. 2) According to Paananen, Kolari and Veistola (2000) UMTS can be put into use in Finland only in 2005, because building the network is expensive and it is time consuming and it will take some time before UMTS services become firmly established. Also the development of fourth generation technology is already under way (Paija 2002, p. 54). The new technologies affect also diffusion speed, because new attributes in mobile phones attract people to use them.

# 3 DIFFUSION OF INNOVATIONS

The main concepts and definitions related to diffusion of innovations are discussed in this chapter. The basic theories of diffusion are introduced as well. Also the factors that affect diffusion speed are introduced briefly. Finally, after these theories, the present chapter approaches the adoption process of an innovation.

## *3.1 Definitions*

According to Rogers (1983, p. 5) diffusion is *"the process by which an innovation is communicated through certain channels over time among the members of a social system"*. The four main elements (innovation, communication channels, time and social system) can be identified from this definition. Innovation refers to any good, service or idea that is perceived as new by an individual (Kotler 2000, p. 355). Innovation can be almost anything, as long as it is new for the adopter. However, innovation does not mean the same as invention. Innovation has to have commercial value, invention not. An innovation is the act of bringing the idea or product into commercial use. Diffusion is a particular type of communication (Rogers 1983, p. 17). Information of new ideas diffuses among the participants through a communication channel, such as television, newspapers and face-to-face contacts. Time refers to the length and the rate of the diffusion period and social system is a group of units that achieve same main goal. Social system can be composed for example of individuals, organisations or informal groups. (Rogers 1983, pp. 5-24)

Innovation can be defined and classified in different ways. According to their newness innovations can be classified into three types, such as a *continuous innovation*, a *dynamically continuous innovation* and a *discontinuous innovation* (Brown 1981, p. 2). Continuous innovations refer to the normal upgrading of products that do not require adopters to change behaviour whereas change-sensitive products are called discontinuous innovations (Moore 1999b, p. 10). A dynamically continuous innovation refers to the creation of a new product or the alteration of an existing one (Brown 1981, p. 2). In the research literature it is also common to

discuss a *radical* and an *incremental innovation*. Moore (1999b) defines radical innovation as follows: "*new technology paradigm and requires customer to change"*. Thus, radical innovations can be described as fundamental changes that represent revolutionary changes in technology. On the contrary, incremental innovations are minor improvements or simple adjustments in current technology.

The process when a new innovation is first perceived and finally adopted through different phases is called the *innovation-decision process*. The diffusion process is considered to pass sequentially through knowledge, persuasion, decision, implementation and confirmation of the innovation. The first phase, *knowledge*-phase, occurs when innovation is perceived and the functions are understood by individual. Next step is to form an attitude toward an innovation and that is called *persuasion*. *Decision* occurs when individual decides whether to achieve the innovation or not. In the next phase, *implementation* phase*,* the innovation is put into use. The final step, *confirmation,* occurs when an individual seeks reinforcement of an innovation decision that has already been made. (Rogers 1983, pp. 20-21)

Furthermore, it is essential to define the *innovation diffusion process*. Hölttä (1989, p. 11) defines the innovation diffusion process as "*the process by which an innovation spreads from the sources*". The process ends when all potential consumers have adopted the product and when it leaves the markets.

A distinction between adoption and diffusion should also be made. The diffusion of innovation involves the adoption of the innovation. "*Adoption is a decision to make full use of an innovation as the best course of action available"* (Rogers 1983, p. 21). So, adoption is individual process of accepting innovation. Rejection, on the contrary, is a decision not to adopt a product. Rate of adoption means the relative speed with which members of a social system adopt an innovation. (Rogers 1983, pp. 21-23) Adopters can be categorised into five groups: 1) innovators, 2) early adopters, 3) early majority, 4) late majority, and 5) laggards based an their innovativeness and adoption timing (Moore 1999b, p. 12). Adoption of innovations will be discussed further in this chapter.

Moreover, the difference between diffusion models and adoption models is worthwhile to explain. Diffusion models are models of aggregate rate of adoption of a technology or a service whereas adoption models try to specify the conditions and requirements for adoption. Mahajan and Wind (1992, p. 15) define the difference of these two models as follows: "*Whereas the adoption models capture richness and reality, the diffusion models embrace simplicity and parsimony."*

In the present study, mobile phone subscriptions are a continuous innovation, which spreads in a society. The adoption of a subscription and the factors affecting adoption and diffusion process are also under critical assessment.

### *3.2 Basic Theories of Diffusion*

Diffusion research is multi-discipline and according to Rogers (1983, p. 40) the research started in the late of 19th century. Gabriel Tarde (1903) observed certain generalisations about the diffusion of innovations that he called "the laws of imitations". Tarde can be regarded as the father of diffusion research (Rogers 1983, p. 40). However, "the diffusion of innovations" as a phenomena was first defined by Ryan and Gross (1947) in their study of the diffusion of hybrid-seed corn. As well as the study structured the diffusion paradigm theoretically; their study also established a prototypical methodology for conducting a diffusion investigation. (Rogers 1983, pp. 54-56) Afterwards, diffusion research has been extensively conducted in many disciplines such as sociology, marketing, geography and economic science and both the diffusion of different types of products and services are widely researched.

In all the studies of technology diffusion, the central question is, why all the products that enter a market do not diffuse at the same speed or why all potential users do not adopt a new, superior technology immediately. The consumers accept some products or services very quickly, while other products remain in the market for a lengthy period of time until a majority acquires them. A potential adopter will not adopt a new technology innovation, if the benefits from adoption exceed the costs. As the adopters are usually not an entirely heterogeneous group, their perceptions of the costs and benefits differ. (Heikkilä 1995, p. 134) Thus, to understand how the

products and services are diffused in a social system, it is worthwhile to know the behaviour of the members who make up that system. The characteristics of the individuals who make up each adopter category group have effects on diffusion speed. The speed of adoption of a new idea is dependent on the reception of information. Each adopter groups accept the information in different time. (Martinez, Polo and Flavián 1998, pp. 323-324)

It is stated by various researchers that the natural growth of many products can be depicted by an S-shaped pattern (Mahajan, Muller and Wind 2000, p. 3). The S-shaped curve shows the number of individuals adopting a product or a service in certain period on a cumulative basis (Rogers 1983, p. 243). Although the diffusion of most innovations can be described with the S-shaped curve, the exact form of each curve may differ in terms of different products (Mahajan and Peterson 1985, p. 8). Geroski (2000) claims that also the usage of new technologies over time typically follows an S-curve. The S-shaped curve is depicted in Figure 3-1.

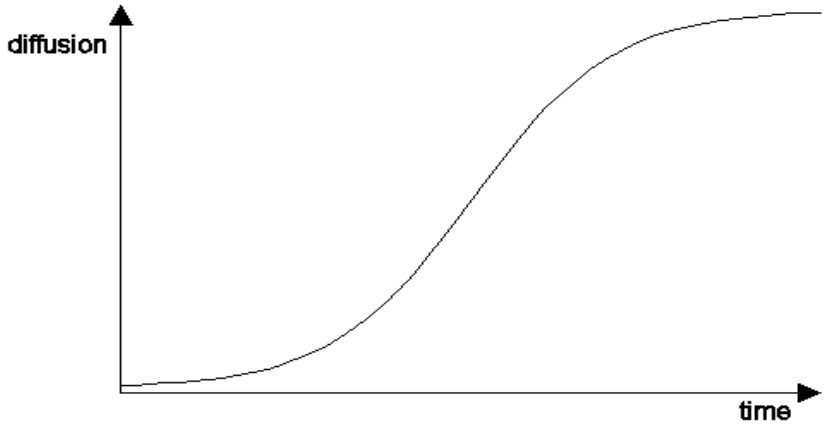


**Figure 3-1 S-Curve of Innovation Diffusion**

The most commonly used explanation for S-curve is *epidemic* spread of information (Geroski 2000, p. 603) and most of the modern work on diffusion theory has its origin in the epidemic approach to the diffusion phenomenon (Baptista 1999, p. 109). This approach is based on theories modelling the spread of diseases. Mansfield

(1961) was a forerunner in the epidemic approach to diffusion (Martinez and Polo 1996, p. 34). Epidemic in diffusion means that the information diffuses in a society like an infective disease; once an innovation is introduced, it spreads like an epidemic, where non-adopters are influenced by adopters as they contact them, leading to an eventual adoption (Kalish 1995, p. 1569). Epidemic effects arise from informational diffusion and reduction of uncertainty (Koski and Krechmer 2002, p. 14).

### 3.2.1 Diffusion Models

In marketing diffusion models have been used to forecast the demand of a new product and numerous models have been set forth to explain the S-shaped nature of the diffusion curve. The purpose of a diffusion model is to depict the successive increase in the number of adopters or adopting units over a time. The aim of diffusion model is also to represent the rate of speed of acceptance of innovation within a group of adopters, in terms of a mathematical function that depends on time. (Mahajan and Peterson 1985, p. 10)

Diffusion research may be categorised into different levels: macro, micro and geographical level innovation diffusion. Diffusion models are part of the macro level innovation diffusion research, whereas adoption and consumer behaviour belong to micro level (Sundqvist, Taalikka, Puumalainen and Frank 2000). According to Ganesh et al. (1997) time dimension of diffusion have been investigated by researches representing a wide variety of disciplines, spatial diffusion has, for the most part studied only by geographers. Macro level diffusion models can also be categorised into diverse groups. Models can be either external- (non-epidemic), internal- (epidemic), or mixed-influence models. External influence is the direct influence on the innovative behaviour of an individual such as the marketer of a new product exerts through various promotional activities like mass media advertising. Internal influence, on the other hand, is the influence that the members of a social-system exert on one another as a result of social interaction. (Mahajan and Muller 1979, p. 59) In addition, mixed-influence models combine both external and internal influences.

#### 3.2.1.1 Bass Model

The main diffusion model used in marketing is the mixed-influence model of Bass (1969), which assumes that potential adopters of an innovation are influenced by two means of communication: external and internal influence. The Bass model is widely used, and it is the combination of the logistic (Mansfield 1961) and modified exponential models (Fourt and Woodlock 1960) and it gives rise to an S-shaped graph (see Fig. 3-1). The Bass model describes the diffusion process of a new product by way of the following differential equation (Bass 1969):

$$f(t) = \frac{dF(t)}{d(t)} = [p + qF(t)][1 - F(t)] \qquad (1)$$

where *F(t)* is the cumulative fraction of adopters at time *t* and *f(t)* is the rate of diffusion at time *t*. Bass has referred to *p* as the coefficient of innovation and *q* as the coefficient of imitation. These coefficients are also termed as the coefficient of external influence and internal influence (Mahajan et al. 2000, p. 4). If *m* is the total population of potential adopters, the cumulative number of adopters at time *t* is *mF(t)* (Mahajan et al. 1990, p. 38). Integration of the equation (1) yields the S-shaped cumulative adopter distribution (Bass, Krishnan and Jain 1994, p. 203):

$$F(t) = (1 - e^{-(p+q)T}) / (1 + q/p * e^{-(p+q)T}). \qquad (2)$$

The density function then becomes:

$$f(T) = ((p+q)^2 / p) e^{-(p+q)T} / (1 + (q/p) e^{-(p+q)T})^2. \qquad (3)$$

The Bass model is non symmetrical, and more flexible compared for example to the logistic model.

#### 3.2.1.2 Epidemic Models

The logistic function is one of the most used diffusion functions. Griliches (1957) was one of the first ones who used logistic function in his hybrid-seed corn study. Another researches such as Mansfield (1961) and Dodd (1958) have also supported the model. Mansfield (1961) described the spread of various industrial innovations among firms, whereas Dodd (1958) generalised empirical findings about the processes through which certain leaflet messages spread in a community. Logistic function is internal-influence model and it is based on the contagion hypothesis such that diffusion occurs only through interpersonal contacts (Mahajan and Peterson 1985, p. 17). The logistic model assumes that the diffusion rate at a given point is proportional to the remaining distance to some determined saturation level as well as to the instantaneously attained diffusion level (Lekvall and Wahlbin 1973, p. 182). In mathematical terms logistic function is represented as follows (Mahajan and Peterson 1985, p.15):

$$\frac{dN(t)}{dt} = bN(t)\left[\overline{N} - N(t)\right] \qquad (4)$$

where $N$ is a number of adopters by the time $t$, $\overline{N}$ denotes the saturation level (the asymptote of the curve), $b$ is a constant proportionality, and $t$ refers to time. Integration of the equation (4) yields the following function:

$$y(t) = \frac{y^*}{1 + e^{-(a+bt)}} \quad . \qquad (5)$$

Equation (5) tells the total number of adopters in time $t$. In equation (5) $y^*$ refers to the potential number of adopters, parameter $a$ is timing of the diffusion process and it defines the location of the diffusion curve, and parameter $b$ is diffusion rate of information.

Another epidemic model for diffusion is Gompertz model, which also considers only

internal influence. The Gompertz function is widely used in technological forecasting. The model can be expressed as (Mahajan and Peterson 1985, p. 16):

$$\frac{dN(t)}{dt} = bN(t)\left[\ln \overline{N} - \ln N(t)\right] \qquad (6)$$

where the variables are the same as in the logistic model. The difference between logistics and Gompertz is that the latter reaches the maximum rate of growth when total number of adopters is about 37 percent and the maximum rate is reached by logistics curve when the total number is 50 percent of the potential market. (Mahajan and Muller 1979, pp. 59-60) Furthermore, logistic curve is symmetric while Gompertz is non-symmetric.

### 3.2.2 Factors Affecting Diffusion

In diffusion theory several variables are identified to influence the adoption and diffusion of innovations. New product sales growth in a given nation is affected by many factors. Word-of-mouth has been found to be the most important factor that characterises diffusion process (Moore 1999b), although latest researchers have been uncovering the role of marketing mix variables such as price. Sundqvist et al. (2000) suggest that the factors that affect diffusion can be divided into four main groups: 1) market characteristics, 2) product characteristics, 3) product-market characteristics, and 4) other concerns. All of these factors have effects on the shape of diffusion curve, market potential, and the rate of diffusion. These effects can be direct, indirect or linear or non-linear. The factors affecting diffusion are illustrated more closely in Figure 3-2.

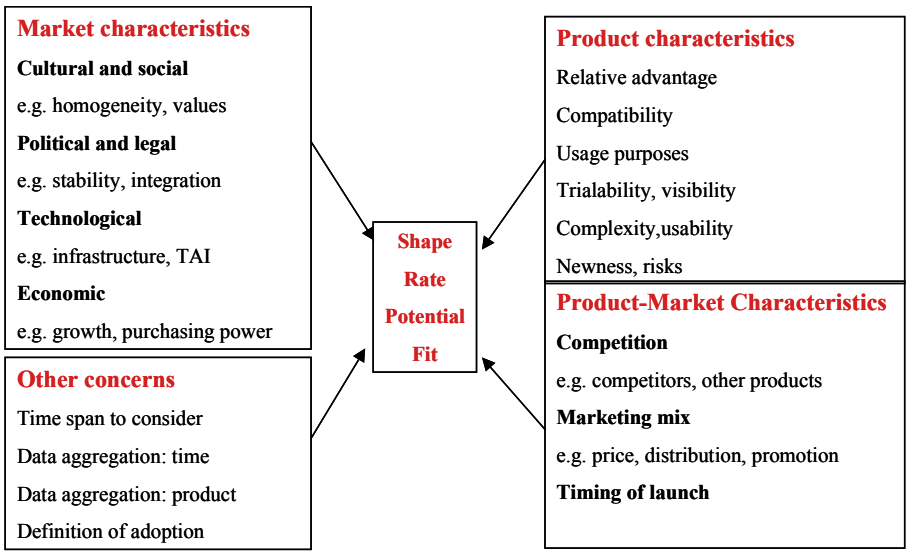


**Figure 3-2 Factors Affecting Diffusion (Sundqvist et al. 2000)**

Although many factors affect diffusion, this thesis concentrates only to explain the effects of product-market characteristics, mainly price and competition, on diffusion.

Competition has consequential effects on diffusion and in fact competition consist of many things. Number of competitors in the market affects diffusion rate; the higher is the number of the competitors the higher is the diffusion rate. In addition, the market shares of competitors have effect on diffusion. Both competing products and complementary products affect diffusion rate and potential as well. Competing products indicate the lower rate and potential, whereas complementary products normally cause higher diffusion rate and potential. (Sundqvist et al. 2000) Competition have other effects on diffusion than mentioned in Figure 3-2 as well, for example the number of competitors in the markets will lead to higher product awareness and competition also generally results in lower prices and via these factors competition affects implicitly diffusion (Koski and Kretchmer 2002).

Like competition also the price is an important factor, which affects diffusion. With lower price diffusion rate and potential are most likely higher than with the superior prices (Sundqvist et al. 2000). In general, higher prices within the range will result in

a lower density of adoption among the target population and vice versa (Brown 1981, p. 105). Both competition and price will be discussed more detailed in the chapters four and five.

### *3.3 Adoption of Innovations*

In order for the diffusion process of an innovation to take place, it is necessary that this innovation is adopted by a series of individuals or adoption units (Martinez et al. 1998, p. 323). All potential adopters of a new product do not adopt the new product at the same time. Consequently, adopters can be classified into adopter categories on the basis of their innovativeness. (Rogers 1983, p. 241) Development of adopter categories is important because they can assist in targeting prospects of new product, developing marketing strategies for penetrating various adopting categories and predicting the continued acceptance of a new product (Mahajan, Muller and Srivastava 1990, p. 37). Rogers (1995) suggests that the ideal types of adopter categories are innovators, early adopters, the early majority, the late majority and laggards. These five categories are assumed to differ from each other based on individual characteristics i.e. socio-economic, personality and communication behaviour. Innovators are the ones who pursue new technology products aggressively. Early adopters buy into new product concept very early in their product life cycle as well, but they are not technologists like innovators. The early majority, on the other hand, is driven by a strong sense of practicality and they want to see well-established references before investing substantially whereas the late majority waits until a product has become an established standard. Laggards are entirely different than the other groups, because the only time they achieve a technological product is when it is a necessity. (Moore 1999b, pp. 12-13)

The adoption process consists of several stages, and therefore adoption is not a simple function of knowledge, but also requires evaluation and trial. Much of the information necessary to support the diffusion of an innovation flows through personal contacts. (Baptista 2001, p. 31) It has been hypothesized by Sundqvist et al. (2000) that there would be three sets of factors affecting the individual's personal adoption decision of innovations, such as factors related to innovations, adoption

units and environment. Differences in the product's characteristics are an obvious cause in diffusion patterns. Rogers (1983) have classified the differences into relative advantage, complexity, compatibility, observability and trialability (Rogers 1983, pp. 223-233). According to Chaudhuri (1994) these attributes serve to act as indicators of future rates of adoption. The success of innovations depends on the extent to which these traits are present. Different characteristics of adopters, on the other hand, explain the behaviour of adopters and environmental issues refer for example cultural and social factors that affect adoption (Sundqvist, Frank and Puumalainen 2001). It is worth noting that personal characteristics determine the degree of innovativeness of consumers and innovation adoption by consumers will be primarily driven by the desire to satisfy individual's needs (Frambach et al. 1998, p. 162).

When analysing diffusion process it is also reasonable examine the number of adopters in time:

$$\frac{dy}{dt} = \frac{quantity}{time}. \qquad (7)$$

The diffusion effect has been defined as the cumulatively increasing degree of influence on an individual to adopt or reject an innovation and when adoption of innovation data is represented on a cumulative base, the adoption of innovation follows "S" form curve. According to Rogers (1983) the number of adopters at some time *t* (see formula 6) instead follows a normal, bell-shaped curve (see Fig. 3-3)

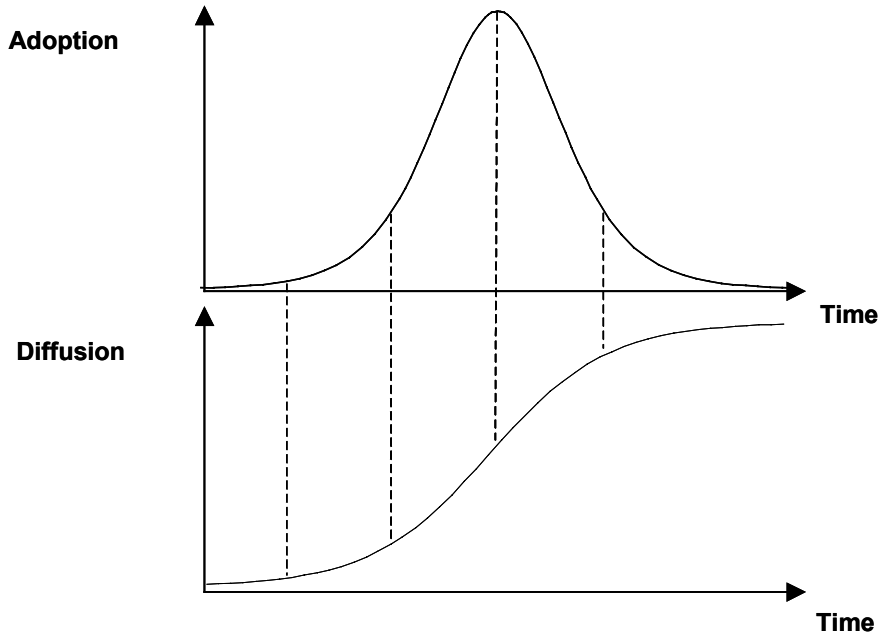


**Figure 3-3 Combination of Innovation Diffusion and Adoption (Rogers 1983, p. 243)**

It has to be noted that both of these curves are for the same data, the adoption of an innovation over time by the members of a social system.

### *3.4 Diffusion of Innovations in Telecommunications*

Technological diffusion is the process by which innovations spread within and across economies. Technological diffusion occurs simultaneously in time and space, but the adoption of new technologies varies geographically. Baptista (2001) argues that the diffusion of new technology products may occur faster in geographical areas where the density of sources of knowledge about such technologies is higher. Also in the case of the countries that have adopted mobile telecommunications later, the diffusion speed has normally been faster (Gruber 2001, p. 19).

Bourreau and Dogan (2001) claim that the telecommunications industry is one of the most dynamic industry sectors and dynamic industries are characterised by a high speed of innovation. Like previously noted, the growth of telecommunications sector

can be explained both by demand and supply side-factors. In addition, wireless communications is often described with enormous uncertainty and high turbulence (Puumalainen et al. 2001). In the telecommunications sector, there is a long history of innovation. Innovations are mainly two types, either innovation for new services or innovation for alternative network infrastructure. The nature of innovation affects diffusion via adoption and the difference of diffusion speed between different innovations can mostly be explained with the innovation attributes.

New innovations in the field of telecommunications differ greatly from 'traditional' innovations, because the rate of uncertainty is believed to be larger in the case of technological products. In addition, for the consumers new services are usually more difficult to understand and use than most of the 'normal' products (Rogers 1982, p. 230), and the usefulness of the new service might be uncertain, or it may be difficult to shift from the old service to the new one, for example because of time constraints (Frank and Heikkilä 2002, p. 2). Also innovation adoption environment is very complex. Thus, there are plenty of factors that differentiate telecommunications from other usual business environments such as the customer uncertainty, rapid product development, shortening life cycles, churn and network externalities. (Puumalainen et al. 2001)

High rates of technical change increase product complexity and risks of obsolescence cause technological uncertainty. In other words, the high technological and market turbulence increase consumers' perceived risk of adopting new services. This may affect diffusion speed negatively, because consumers are not confident about the choice they should make among the available technologies. They do not know, which technology will eventually become a standard. For the consumers it is also difficult to assess the relative advantage of adopting a new service prior to purchase, and therefore the impact of both positive and negative word-of-mouth communications may increase. (Puumalainen et al. 2001)

Network externalities are significant in many important industries. They have long been recognised in the context of physical networks as the telephone industries (Katz and Shapiro 1985, p. 823). Thus, network externalities are having a large effect on

the diffusion of telecommunications' products. Figure 3-4 represents the network effects on the S-shaped curve.

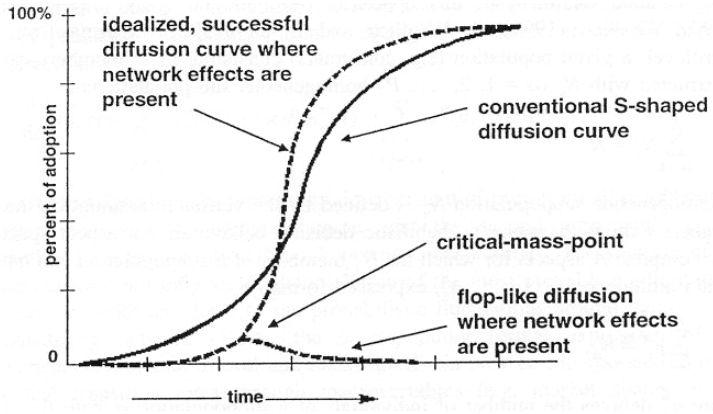


**Figure 3-4 Critical Mass and the Diffusion Curve (Adapted from Mahler and Rogers 1999)**

In the beginning, the existence of network effects may inhibit the diffusion, and the speed can be exceptionally fast after a critical mass has been achieved (Puumalainen 2002, p. 36). However, it should be noted that critical mass is not always achieved. This kind of situation is illustrated by the lowest curve in Figure 3-4. Technologies subject to network externalities have unique characteristics and they also have traditional explanations for that how the innovations diffuse (see e.g. Rogers 1983). The value of a network for its subscribers depends on the amount of users; the value increases with the number of its adopters and the benefit received from the particular good depends on the collective amount of users. (Puumalainen et al. 2001) Telecommunications services are interactive innovations, which are of little use to adopting individuals unless other individuals with whom the adopter wishes to communicate also adopt (Rogers 1995, p. 313) Thus, the network also becomes more attractive to nonsubscibers as the network grows (Kauffman, McAndrews and Wang 2000, p. 61). Consumers' value for product arises when another consumer has a compatible or identical good.

Network externalities can be either direct or indirect. It should also be noted that

there can also be negative network externalities in telecommunications, for example if the increase of the number of users causes congestion on network (Kotakorpi 2002, p. 6). The case of mobile phone subscription is an example of direct network externalities, e.g. the use of mobiles depends on the total number of consumers with similar access. (Puumalainen et al. 2001)

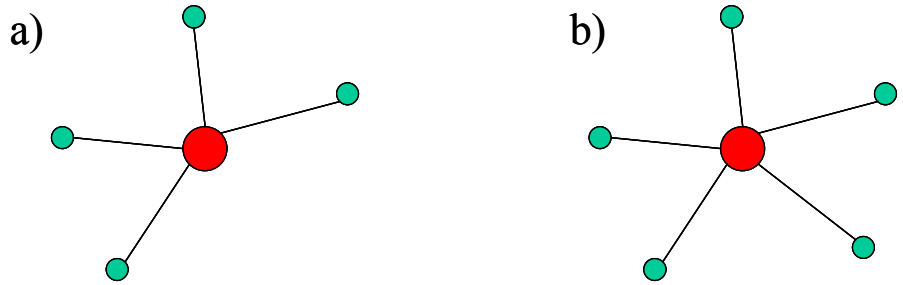


**Figure 3-5 Example of the Network Effects (see e.g. Valente 1995)**

Figure 3-5 demonstrates the networks effect. If there are *n* components in the network, the number of possible connections is $n(n\text{-}1)$ (Economides 1996, p. 7). Two types of externality are relevant: the call externality, which is the benefit of a call to the individual receiving it without having to pay for it, and the network externality which results from a welcoming a new network user (Bousquet and Ivaldi 1997, p. 221). In the example shown in Figure 3-5, first in the network there are four subscribers and twelve possible connections. In the other case, the number of possible connections arises to 20 when only one new subscriber is connected to the network. However, this is not the real amount of applied connections because everyone does not need to communicate with each other.

Furthermore, common wisdom says that the product life cycles are shortening over time (Puumalainen, Sundqvist and Huiskonen 2002), especially in high technology products, and that might cause that some innovations do not diffuse everywhere, or that they diffuse faster. People may not adopt a certain innovation, if they know that the superior innovation follows soon after. In telecommunications, this may occur,

for example, in the case of fixed phones in some developing countries. These countries may start directly to use cellular phones and they bypass the fixed phone era. (Sundqvist et al. 2001)

As noted before, the customer turnover (i.e. churn) also characterises the telecommunications business and it affects also the diffusion of mobile phone subscriptions. Many subscribers frequently churn from one provider to another in search of better rates or services or for the benefits of signing up with a new carrier. In fact, it is estimated that the average churn rate for the mobile telecommunications is 2.2 percent per month (Wei and Chiu 2002, p. 103). In the diffusion research of telecommunications the high rate of churn means that the number of new subscriptions sold cannot be used for diffusion modelling (Puumalainen 2002, p. 18).

Moreover, the special characteristics of telecommunications make forecasting and the use of diffusion models more challenging and difficult and these problematic characteristics also favour the use of neural networks instead of traditional statistical methods in finding suitable analogies for forecasting the macro level diffusion curves (Puumalainen at el. 2002). The diffusion models assume that the nature of an innovation does not change over a time, but in fact the nature of telecommunications products changes quite rapidly and that makes using the models more complex. According to Sundqvist et al. (2001) macro level diffusion of a new telecommunications product is dependent on many factors that interact in a way that is very difficult to specify a priori. Additionally, there are plenty of empirical data of the factors, but the data is often deficient. The problem of the data is that in most cases when enough data is available, the forecasts are no more practically useful, because in predicting the diffusion of new products many data points are required (Puumalainen 2002, p. 4; Mahajan, Muller and Bass 1990). These facts make the use of traditional statistic methods in forecasting often insufficient.

# 4 COMPETITION STRATEGIES

Kotler (2000, p. 217) states that "*Poor firms ignore their competitors; average firms copy their competitors; winning firms lead their competitors*". In other words, competition is at core of the success or failure of the firms. Therefore, competition is also an important factor when thinking of product or service diffusion, because competitive environment affects diffusion. This chapter gives a framework for understanding the competitive forces operating in industry that are crucial to developing competitive strategy. The present chapter takes also a look at the nature of competition in telecommunications. The central concern is anyhow the effects of competition on diffusion. Firms can affect the diffusion of their products by making right competitive strategies. This chapter seeks to gather all the relevant information of the effects that competition have on diffusion together by incorporating former studies.

## *4.1 Industry Structure*

Industry structure and sustainable competitive advantage are the two fundamental factors that determine profitability. Industry structure determines the profitability of the average competitor and sustainable competitive advantage allows a company to outperform the average competitor. These two underlying drivers of profitability are universal; they transcend any technology or type of business. At the same time, they vary widely by industry and company. (Porter 2002, p. 66) To find an answer to the question " How can the mobile phone be used to create economic value?" one has to look beyond the immediate market signals to these fundamental factors that determine profitability.

Industry structure has a strong influence in determining the competitive rules as well as the strategies potentially available for the firm. Competition in an industry is rooted in its underlying economic structure and goes well beyond the behavior of current competitors. (Porter 1980, p. 3) Whether an industry is new or old, its structural attractiveness and the state of competition can be determined by the five

underlying forces of competition: the intensity of rivalry among existing competitors, the barriers to entry for new competitors, the threat of substitute products or services, the bargaining power of suppliers, and the bargaining power of buyers. In combination, these forces determinate how the economic value created by any product, service, technology or way of competing is divided between, on the other hand, companies in an industry and, on the other, customers, suppliers, distributors, substitutes, and potential new entrants. (Porter 2001, p. 66) These measures of competitiveness are interrelated and, in turn, affect e.g. pricing philosophies (Robertson and Gatignon 1986, p. 88). Although some have argued that today's rapid pace of technological change makes industry analysis less valuable, the opposite is true. The five competitive forces still determine profitability even if e.g. substitutes, or competitors change, but it has to be noted that the strength of each of the five forces varies considerably from industry to industry. (Porter 2001, p. 66)

The five forces determine industry profitability because they influence the prices, costs, and required investment of firms in an industry. Buyer power influences the prices that firms can charge. The power of buyers can also influence costs, because powerful buyers demand costly services. The intensity of rivalry influences prices as well as the costs of competing in areas such as advertising and sales force. The threat of entry places a limit on prices. Additionally, the bargaining power of suppliers determines the cots of raw materials and other inputs. (Porter 1985, p. 5)

### 4.1.1 Industry Concept of Competition

Kotler (2000, p. 220) defines the concept of industry as follows: "*An Industry is a group of firms that offer a product or class of products that are close substitutes for each other*". The starting point for describing an industry is to specify the number of sellers and whether the product is homogeneous or highly differentiated. These characteristics give rise to four industry structure types, such as pure monopoly, oligopoly, monopolistic competition and pure competition. (Kotler 2000, p. 220) However, it has to be noted that an industry's competitive strategy can change over time.

Pure monopoly refers to the situation where only one firm provides a certain product or service in a certain country or area. An unregulated monopolist might charge a high price, do little or no advertising, and offer minimal service. Instead, oligopoly means that a small number of (usually) large firms produce products or services that range from highly differentiated to standardized. The only way for the companies who operate in the oligopoly markets to gain a competitive advantage is through lower costs. The situation where many competitors are able to differentiate their offers in whole or part is called monopolistic competition. Competitors focus on market segments where they can meet customer's needs in a superior way and command price premium. In pure competition many competitors offer the same product and service. Because there is no basis for differentiation, competitor's prices will be the same. Advertising is only made when it can create psychological differentiation. (Kotler 2000, pp. 220-221)

According to Shapiro and Varian (1999, pp. 24-25) only two market structures are sustainable in network economy. The first market structure is one, in which single firm dominates, because it is able to amortize the high fixed cost over a larger number of customers. The second market structure is one, in which many firms compete with differentiated products. A firm's competitive strategy will depend on what kind of industry it occupies. If a firm is in a differentiated products industry, its strategy should be to differentiate its products to meet its customer's needs. If a firm competes in an industry that has a dominant single firm, then its strategy should be to achieve cost leadership.

Competition helps setting the price within the parameters of cost and demand. Depending on the marketer's objectives and competitive position, it may choose to compete directly on price or elect for nonprice measures. The marketer may have no choice but to respond, if competitors who focus on price are eroding a firm's position. Some marketers can instead fend off price competition by emphasizing other elements of marketing mix, like advertising, even if they are at an absolute disadvantage in price. (Czinkota and Ronkainen 1995, pp. 562-563)

### 4.1.2 Designing Competitive Strategies

Firms can be classified by the role they play in the target market: leader, challenger, follower, or nicher (Kotler 2000, p. 231).

*Market-leader strategies*

Many industries have one firm that is the acknowledged market leader, but who can be a leader is a difficult question. Greve (1996) suggests that the leader should be highly visible, so that others can pick up the signal their actions may send. Havemann (1993) adds that leaders should be seen by other firms in their industry as successful. Leaders should be large, as size and success is perceived to be connected. However, the market leader has the largest market share and market leader creates the market for other competitors (Moore 1999b, p. 31). It usually leads the other firms in price changes, new-product introductions and promotional intensity. Unless dominant firm enjoys a legal monopoly, its life is not altogether easy. It must maintain constant vigilance. A product innovation may come along and danger its position. There is also a constant fear that the leader might misjudge its competition. The dominant firm may also look old-fashioned against new entrants. (Kotler 2000, p. 231)

Market leaders must find ways to expand total market demand. Secondly, the firm must protect its current market share, and third the firm can try to increase its market share further, even if the market size remains constant. (Kotler 2000, p. 231)

*Market-challenger strategies*

The firms that are market-challengers must first define their strategic objectives. They can attack the leader and other competitors in an aggressive bid for further market share (Kotler 2000, p. 240) and they must be aggressive in challenging (Moore 1999a, p. 188). Attacking the market leader is a high-risk, but makes sense if the leader is not serving the market well. (Kotler 2000, pp. 240-241) However, a challenger must remember that market leader tries to prevent challenger becoming a number one (Moore 1999a, p. 187). The challenger can also attack firms of its own size that are not doing the job and are under financed or alternatively it can attack

small local and regional firms. Challengers simply seek a larger market share. (Kotler 2000, pp. 240-241)

*Market-follower strategies*

Many companies prefer to follow rather than challenge the market leader. A market follower must know how to hold current customers and win a fair share of new customers. Each follower tries to bring distinctive advantages to its target market, e.g. services. (Kotler 2000, p. 244)

*Market-nicher strategies*

An alternative to being a follower in a large market is to be a leader in a small market, or niche. Market nicher strategies, focusing on a limited sector of the total market, make particular sense for small and medium-sized companies (Hooley, Saunders and Piercy 1998, p. 347), because smaller firms normally avoid competing with larger firms by targeting small markets of little or no interest to the larger firms. However, firms with low market shares can be highly profitable through smart niching. The key idea in nichemanship is specialisation. (Kotler 2000, pp. 245-247) The only way for a niche enterprise to get a proper return is to become the number one vendor within the target segment. To achieve such success requires a whole product commitment that solves a critical problem for the niche and at same time differentiates you from other vendors in your product category. (Moore1999b, p. 54) In addition, to start business it is important to select strategic target market segments to begin with (Moore 1999a, p. 73).

### *4.2 Competition in Telecommunications*

Nowadays, telecommunications is no longer considered as natural monopoly. In industrialized countries most of the markets have been liberalized. The telecommunications industry requires interconnection, standardization, coordination, and other shorts of cooperation with competitors (Shapiro and Varian 1999, p. 307). Networks have their own subscribers, and they interconnect with other networks along with the payment access charges to one another. As such, the setting of interconnection charges has become one of most important policy concerns in

telecommunications. (Hahn 2000, pp. 3-4) Finally, companies forming networks must determine the conditions on which others will be permitted to interconnect with or join their network (Shapiro and Varian 1999, p. 308). This two-way access (interconnection) problem differs in its nature from one-way access case, where an integrated monopolist alone owns a single network and provides access for competitors. However, each network still has a monopoly at least in providing access to its own network for its rivals. (Hahn 2000, pp. 3-4)

There are two different models of competition in the provision of mobile phone services: service based competition or facilities based competition. Service based competition means that entrant operators do not build their own network, but buy access to the incumbent's network. If entrants instead build their own networks that is called facilities based competition. (Kotakorpi 2002, pp. 11-12) Regardless of which form of competition there is in a certain market, access pricing will play a crucial role in the functioning of the industry.

Competition can improve productive efficiency by giving better incentives for cost minimization. Competition will not eliminate the fixed costs of network provision. A possible justification for network competition in telecommunications is the increase in variety brought by competition. If consumers value variety, and if the services of different networks are differentiated, then competition brings additional benefits that are not captured by the productive or allocative efficiency trade-off. (Kotakorpi 2002, pp. 10-11)

The telecommunications market is in many ways very competitive. Some companies win and others loose. In between, almost everybody tries to partner at least in some level. (Rhemann 2000, p. 99) But from customers point of view competition between firms is only positive, because in telecommunications, it has been argued that competition creates additional incentives to reduce costs, to innovate and to eliminate distorted prices (Gruben and Verboven 2001). Competition will also create pressures for companies to offer attractive packages of existing services and new services (Shapiro and Varian 1999, p. 311).

### *4.3 Competition and Diffusion*

Because diffusion research has almost exclusively concentrated on demand side, also the effects of competition on diffusion have in certain level been ignored. However, competition has consequential effects on diffusion.

As noted in the chapter 4.1 competition is rooted in the industry structure. Robertson (1986) has proved that there is interconnection between industry structure and diffusion. He has stated that the structural characteristics of the industry affect the speed of diffusion and total market potential; the competitiveness, reputation, the competitive standardization of the technology and, the level of vertical coordination all affect the speed of the diffusion. The rate of diffusion of proprietary technology will depend on both the particular industry and also the type of a product. With some products it is easier to compete than with others. The more complex the technology, the more specialized the required technical personnel, the greater the critical mass of research personnel required, or the greater the economics of scale in the research function, the slower proprietary technology will tend to diffuse. (Parker 1980, p. 173) One should note that market competition and competitive advertising, which make new communication technologies more beneficial and acceptable for potential adopters, are intended only to influence a firm's own market performance but have the unintended effect, particularly of new communications technologies, of accelerating the diffusion of new technology (Redmond 1991, pp. 170-184).

Capacity seems to be a first crucial factor in explaining the effects of competition on the diffusion of mobile penetration. When capacity is constrained, as under the analogue technology, the effects of competition on mobile penetration are likely to be modest. The effects of competition are potentially much larger under the digital technology when capacity constraints are relaxed and thus, introducing competition between operators has a significant impact on the growth of mobile diffusion. Capacity plays a major role in explaining the magnitude of the competition effects. (Gruber and Verboven 2001, pp. 1191-1194) Additionally, consumer switching costs are a potential determinant of the competition effects in the mobile industry (see e.g. Valletti and Cave 1998). Switching costs may induce firms to compete more

aggressively for market share during the early phases of competition. Some theoretical models suggest that deregulation of entry generally gives incentives for cost minimisation and forces prices closer to the marginal cost level, which in turn speeds up diffusion (Koski and Kretchmer 2002, p. 9). In telecommunications, it has been argued by Laffont and Tirole (2000) that competition creates additional incentives to reduce costs, to innovate and to eliminate distorted prices. Competition also decreases mobile service prices, and thus facilitates mobile diffusion (Koski and Kretchmer 2002, p. 28).

The diffusion depends also on the industry concept of competition. It is shown by Gruben and Verboven (2001) that during the first years, firms compete vigorously to build up market share to exploit market power in the future stages. Once an installed base is built up, competition becomes softer. Competition especially induces diffusion during the early years. According to afore mentioned researchers introducing competition has a strong immediate impact on diffusion, but a weak impact afterwards. Moreover, sequential entry has a stronger impact than simultaneous entry. To conclude, increased competition (as measured by entry by additional operators) tends to accelerate mobile diffusion. Timing of (first) entry has also an impact on the performance of the technology than just diffusion. The timing at which second licenses are introduced turns also to be very relevant. (Gruber and Verboven 2001) Koski and Kretchmer (2002, p. 12) state that the timing of first entry resembles an epidemic model of technology diffusion. Although competition has important effects on diffusion the diffusion of telecommunications services has been affected more by technology and the timing of the first licences than by introduction of competition. (Gruben and Verboven 2000, p. 578)

According to Koski and Krechmer (2002) standardisation accelerates diffusion though it seems to result in less aggressive price competition than between standards competition and be positively related to mobile service prices. With standards the market should therefore grow faster. Standards tend to benefit consumers as they reduce their search and switching costs. But there is also the risk that a selected standard is not the most efficient one and that it becomes difficult to switch or develop a better one. (Gruber and Verboven 2001, p. 1190) Between firms

competition is found to lower prices and accelerate diffusion as expected. Liberalising markets for older technologies is also found to accelerate the timing of entry into the next-generation technology. Standards competition and competition between firms have greatly influenced 2G diffusion patterns and service prices. Service price have been affected by competition particularly when there have been at least two entrants at the time of introduction of 2G services. The monopolistic position of early entrants, instead, has lead to less aggressive pricing strategies. (Koski and Krechmer 2002, pp. 1-3) In other words, passing from monopoly to duopoly can accelerate the speed of diffusion, and this will further expand with the number of firms (Gruber 2001, p. 30).

# 5 PRICING DECISIONS

The pricing of a new innovation is crucial for its successful diffusion. Telecommunications industry is an access service industry, which means that when using telecommunications services, consumers pay for privilege of accessing the firm's facilities but do not acquire any right to facility itself (Essegaier et al. 2002, p. 139). A firm's pricing decision in access industries frequently comes down to a single choice among a fixed price for a given period, usage pricing or a combination of these two pricing methods, dual pricing. However, it is not so simple for firms to make the choice, because pricing new or existing services is a challenge in the current state of the communications industry, with new industrial structures, fast technical change and varying degrees of competition and regulation. Thus, choosing a pricing structure is far more complex in access industries than in other industries.

This chapter approaches the pricing strategies in a turbulent business environment and the factors that affect pricing decisions. Also the most common pricing systems in telecommunications are discussed. Moreover, the effects of pricing on diffusion are reviewed as well.

## *5.1 Pricing Strategies*

Generally pricing policy is one of the most important of all the elements of marketing mix, because the only source of profit to the firm's comes from revenue, which in turn is dictated by pricing policy (Hollensen 2001). That is why forming a good pricing strategy is vital for companies. When making the strategy many issues, both internal and external, has to be taken into account and designing an appropriate pricing strategy for a product is a very challenging task because it involves the complex dynamics associated with the diffusion of the product in a given market. Figure 5-1 demonstrates more closely the pricing framework.

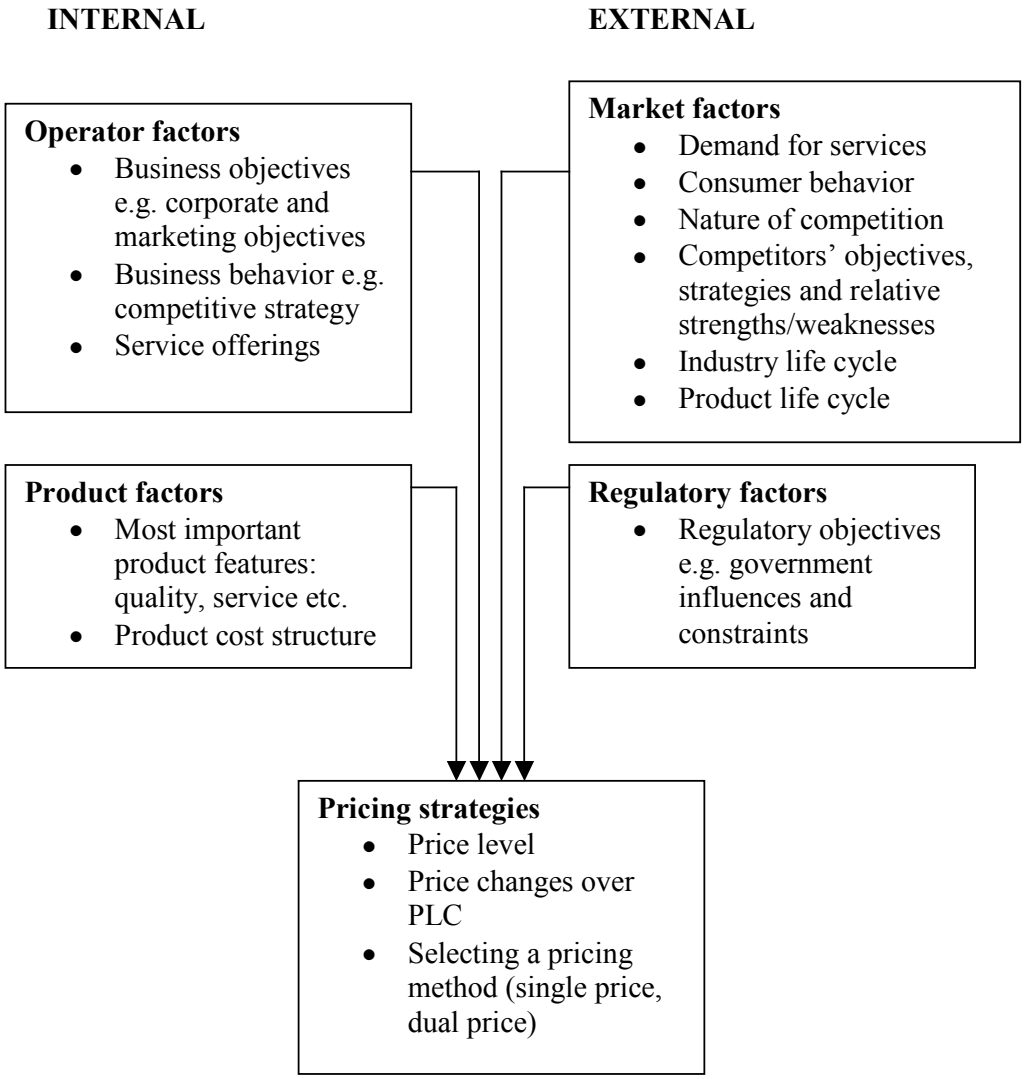


**Figure 5-1 Pricing Framework of Mobile Phone Subscriptions (Buchanan 1998; Hollensen 2001; Kotler 2000).**

In today's business environment, characterized by changes in consumer demographics and by new forms of competition, the importance of developing a good pricing strategy is increasing. It is very important to set a price that will ensure that the sales revenue generated at least covers the cost incurred. Factors affecting pricing decisions can be divided into two main groups (internal and external) and four subgroups: operator, product, market and regulatory factors. The optimum mix of these factors varies by product, market and corporative objectives. The pricing

strategy (price level, pricing method) of a firm should be derived from the above-mentioned factors. For example in telecommunications, when the distribution of customer types is unknown or when it is unlawful to offer different pricing schemes to the different segment of a market, the solution is to propose an array of options allowing the customer to 'self-select' the best offer (Bousquet and Ivaldi 1997, p. 221).

*Internal factors*

Pricing is influenced by past and current corporate philosophy, organisational and managerial policies, but it is worth pointing out that the business strategy, an important subject in itself and related to pricing, does not tell directly how the pricing decisions should be done (Buchanan 1998). Business objectives, such as maximising revenue or market share, give anyhow guidelines for the pricing decisions.

It is not recommended that price would be set on a basis of covering the fixed costs and instead should be determined by acceptance in the marketplace, in other words pricing should be done according to consumers value. In network industries cost-based pricing just does not work. Value-based pricing leads naturally to differential pricing. (Shapiro and Varian 1999, p. 3)

Pricing decisions for new products are also closely tied to the development of the previous-generation product (Danaher, Hardie and Putsis 2001). For example, Padmanabhan and Bass (1993) suggest that the optimal pricing strategy depends on the degree of substitutability across the two generations. In the case of mobile phones the prices of calls have, at least in the beginning, followed the prices of the calls made by using NMT technology.

*External factors*

Market and regulatory factors are external to the firm and thus uncontrollable. Good pricing starts with good knowledge of the customers. Consumer needs and behavior must be considered when setting a price, because it is the consumer who decides between buying, walking away, or waiting to see if more attractive prices may be offered by the firm in the future. One of the key uses of customer data is to determine

the differing price sensitivities and elasticities across customers. (Wind and Mahajan 2001, pp. 372-379) The buyer's purchase decision is frequently based on total cost of a product and complements, rather than on the cost of the product itself (Porter 1985, p. 419). For example, buyers usually measure the cost of a mobile phone subscription by the total monthly payment required, rather than for looking solely at the price of monthly access, SMS price or minute rate. In telecommunications, customers' total costs customarily include a one-time installation cost, a fixed monthly charge, a minimum per call charge, and a price per minute (Wind and Mahajan 2001, p. 387).

Customers purchase products for the benefits they anticipate by using the products. Hence, before even beginning the process of pricing, it is important to understand what the most valuable product attributes are from the perspective of the consumers. By conducting the market research and listening their customers, firms can better understand what product attributes contribute to value and to what quantitative extend of each attribute is important. Also by improving the communication and information flow between customers and operators, better product strategy and pricing will result. (Wind and Mahajan 2001, p. 364)

Network effect is said to be "diminishing" in nature and when formulating a pricing strategy that needs to be taken into consideration. Later adopters are usually not as willing to pay for entrance to the network, as are the first adopters (see Figure 5-2). The price, which the users are willing to pay needs to be higher than the production cost, or the business is not profitable. In order to get service diffused rapidly, the starting pricing strategy should be anyhow as follows: A lower price would increase the expected utility of an individual by increasing his expected usage and by increasing the expected number of users (Frank and Heikkilä 2002, p. 2).

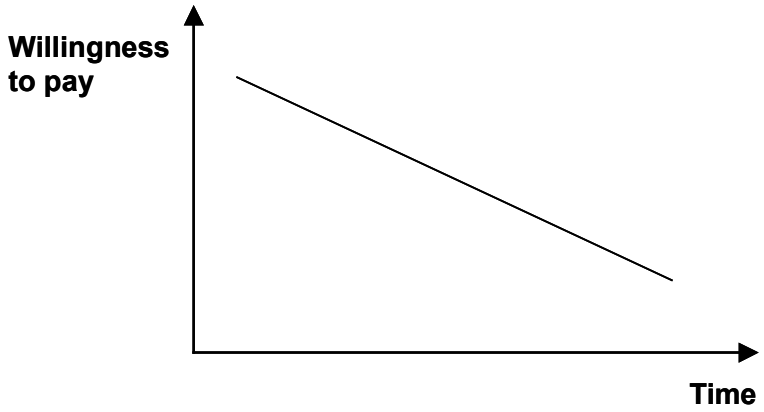


**Figure 5-2 Willingness to Pay**

The number of competitors in the markets, the concentration rates and the mobility barriers, which competitors are able to erect generally assesses industry competitiveness. These measures of competitiveness are interrelated and, in turn affect for example competitor's pricing strategies. (Robertson 1986, p. 4) The pressure of competitors affects pricing. The operator must offer competitive price if there are other operators in the market, in addition they must also respond to competitors' price changes. Furthermore, price wars are likely to occur when sales growth is a peak. Under pure competition, price is set in market place and all of the players in the markets ought to react the price war. It has to be noted that the prices go down after a new entry, and the demand increases as a result of price sensitivity. (Buchanan 1998; Hollensen 2001; Kotler 2000)

Prices charged by the firm vary by stage of the life cycle, because products evolve through time (Bradley 2002, p. 362). It is appropriate to consider the concept of product life cycle, where in the early in the life of a product or a service there may be an opportunity to price by value until competition and possibly regulation brings about a regime where price is more closely related to cost. (Buchanan 1998, p. 865) Also when the value-to-customer increases, higher prices can be charged (Wind and Mahajan 2001, p. 364). In addition, at the maturity stage the firm has far less discretion over selling prices (Bradley 2002, p. 364). Industry passes also through a number of phases: introduction, growth, maturity, and decline. Inflection points in the rate of growth of industry sales define these stages. This industry growth follows an S-shaped curve (see Figure 3-1). Pricing depends much on the phase where the

industry is.

Regulatory factors have a great influence on pricing decisions especially in telecommunications, because telecommunications has been, at least in the past, one of the most regulated industry sectors. Regulations may have many kinds of effects on pricing. For example as a function of regulations tariffs may be required to be closely related to costs and operator's scope for setting tariffs is thus partly determined cost allocation. Alternatively the tariff determination can be taking place in a context of little or no regulation and limited competition, in which case the basis for pricing may be more closely related to pricing by value, in other words "what the market can bear". (Buchanan 1998, p. 864)

### 5.1.1 Single Price

Like previously noted, the operator has to choose among the tariff packages what they will offer to customers. Basically, if an operator wants to charge a "single price", the provider can implement a fixed price for a given period, e.g. a monthly rate, or a usage-based price (e.g. a minute rate). These pricing methods are variations of a single price. If this pricing method is used all costs of the service must be covered by the usage price. (Frank and Heikkilä 2002, p. 3) Pre-paid mobile service is a prime example of a single price system. These services are services where the consumer buys a phone card of a certain value from an operator. After the credits have been used, the customer can reload the card. Calls are paid in advance and there is no monthly fee. A dual price is anyhow more commonly used than a single price among the network goods (Frank and Heikkilä 2002, p. 3).

### 5.1.2 Dual Price

A dual pricing system that comprises a monthly access fee and usage charge is quite common for network goods and it requires consumers to pay a fee up front for the right to buy a product. Consumers then pay an additional fee for each unit of the product in this case calling minutes they wish to consume. The operator must decide whether to charge a high monthly access fee and a low price for the calls or,

alternatively, to charge low monthly fee and charge average price for the calls or charge high price for the calls, but give the monthly access free (Kotler 2000, p. 476; Pindyck and Rubinfeld 2001, p. 386; Parker 2000). Usually operators offer several pricing packages to cater to differing customer needs. To illustrate different pricing schemes an example is shown in Table 5-1.

**Table 5-1 Different Pricing Schemes (Parker 2000)**

| Subscription type | Firm A | Firm B | Firm C | Firm D |
|---|---|---|---|---|
| Fixed costs | 10 € | 20 € | 30 € | 0 € |
| Variable costs | 0,20 € | 0,15 € | 0,10 € | 0,50 € |
| User type | Light user | Medium user | Heavy user | Occasional user |

A firm may also offer several different plans, but a firm's choice for optimal price depends on the fact whether heavy or light users are more valuable in terms of willingness to pay on a per-unit capacity basis (Essegaier et al. 2002, p. 139). From a consumers point of view, the choice A is best suited for someone who uses a mobile only occasionally and wants to spend as little as possible on the monthly access, e.g. grandmother. The most expensive plan is suited for very heavy cellular user, perhaps a salesperson who makes calls throughout the day and wants to minimize per-minute costs. Consumer will choose a subscription type that best matches their needs. The two-part tariff works best when consumers in each user group have identical or very similar demands.

One argument behalf a dual price is that it provides a diminishing marginal cost. In other words, a dual price diminishes the average cost of a consumer the more she or he buys the good. Consider a subscription for heavy users with a monthly fee of 30 euros and a minute fee of 10 cents. Now, if the user calls 100 minutes in a month, the average cost for a minute is (30+(100*0,1))/100 = 0,4 euros/ minute. If he calls 200 minutes the average minute cost is (30+(200*0,1))/200 = 0,25 euros/ minute. Thus, the more the user buys the good, the cheaper the average price of the good. (Frank and Heikkilä 2002, p. 4)

To conclude, a dual price is a good solution if the aim is to increase the usage. Also by implementing a dual price, not only the usage is increased but also the adoption

and the diffusion of mobile subscriptions is accelerated. (Frank and Heikkilä 2002, p. 5)

### *5.2 Elasticities of Demand*

An elasticity measures the sensitivity of one variable to another. Specifically, it is a number that tells us the percentage change that will occur in one variable in response to a 1-percent increase in another variable. The price elasticity of demand measures the responsiveness of the quantity demanded to a change in price. This can be written in mathematical forms as follows (Pekkarinen and Sutela 1982, p. 28):

$$E_p = \frac{\Delta Q / Q}{\Delta P / P} = \frac{P}{Q}\frac{\Delta Q}{\Delta P}. \qquad (8)$$

Normally, the price elasticity of demand is usually negative, because when the price of a good increases, the quantity demanded usually falls. The demand can be called price elastic, when the price elasticity as a number is greater than 1 in magnitude, whereas the demand is said to be inelastic, when the values are under 1. (Pindyck and Rubinfeld 2001, p. 31)

Empirical studies have shown that the magnitude of elasticities can be used for separating different types of products. The more inelastic the demand is more likely the good can be considered as necessity good. In extreme case completely inelastic demand could mean that consumers want to get the good with any price. On the other hand, the goods with high price elasticity can be considered as less important for the consumer. (Pekkarinen and Sutela 1982, p.30)

The price is not usually considered to be of great relevance for the demand for telecommunications services. This has to do partly with the complexity of used pricing systems. Modelling of business telecommunication demand and effects of the price on the demand is even more complicated. Special behaviour of price elasticities must also be expected for different kinds of telecommunications services. (Hackl and Westlund 1996, p. 244) The price elasticities in telecommunications can be

influenced by the actions of an individual company or its competitors.

### *5.3 Pricing and Diffusion Research*

The effect of price on diffusion has not gained much attention in the diffusion research. Currently no unified framework either exists to provide guidelines on the inclusion and specification of price variable into models of innovation diffusion. Because the price variable is not included in the basic models of diffusion, estimation of the effects of pricing is also quite difficult. (Bottomley and Fildes 1998, pp. 539-540) However, some researchers have estimated the impacts of price on diffusion. Kalish (1985) stated that price and previous adopters affect the market potential. Jain and Rao (1990) and Kamakura and Balasubramanian (1988) also show that price affects the market potential via the coefficients of external and internal influences; while Chow (1967), Jeuland (1981) and Horsky (1990) give also support to the assertion that price affects the market potential. In addition, Parker (1992) has shown in his empirical study that while price affects the rate of diffusion for some products, it affects either the coefficients of innovations or imitation for some others. Price is also assumed to affect the market potential of the adoption equation (Mesak 1996, p. 1008). To conclude, all the studies above assume that price either affects the market potential or adoption probability of an innovation.

Most of the researchers, with few exceptions, have derived optimal pricing policies using Bass model (1969) as the basic framework. Since the Bass model has no price variable in it, researchers first had to incorporate price in the model, and then derive the optimal pricing policy using these extended Bass models (see Table 5-2). Additionally, almost all the research conducted is for durable goods. Also, in the diffusion literature, the marketing mix variables, like price, is either incorporated through a coefficient of external influence, or indirectly through the determination of market potential, or through the market potential left at period $t$ such as in the Generalized Bass Model (Bass et al. 1994).

**Table 5-2 Diffusion Models Incorporating Price Variable**

| Authors | Model Proposed | Results | Innovation |
|---|---|---|---|
| Robinson & Lakhani (1975) | Sales = $(M-Y)(p+qY)e^{-k*\Pr(t)}$ Y= Cumulative sales | With positive discount rate and experience-curve based on costs, price mimics diffusion. Price affects adoption rate. | Illustrative example: semiconductor device |
| Bass (1980) | Sales $(t) = f_{Bass}(t)*K*Pr^{\eta}$ Price affects market potential. | Price decreases monotonically. | 6 durable goods |
| Jeuland (1981) | Individual level model is built using uncertainty, information flow, and price. Same as Robinson and Lakhani. | Price affects both market potential and adoption rate (indirect). | Not available |
| Kalish (1983) | Sales $(t) = f_1(Y) f_2(Pr)$<br><br>Sales $(t) = [M(Pr)-Y][p+qY]$<br><br>Price affects market potential. | Optimal price mimics diffusion with any cost function and zero discounting.<br><br>If sales decrease monotonically, optimal price also declines monotonically. Policy is not clear for the case of increasing-decreasing sales. | Durable goods |
| Thompson & Teng (1984) | Models that contain Bass's demand growth model and the Vidale-Wolfe and Ozga advertising models, and production learning curve, and exponential demand function. | Price affects the rate of diffusion. | Not available |
| Kalish (1985) | Adv. influences awareness; price is a trade-off for uncertainty; previous adopters create awareness and reduce uncertainty. | With no uncertainty, optimal price mimics diffusion.<br><br>Price and previous adopters affect market potential. | Durable goods and repeat purchase goods |
| Kamakura & Balasubramanian (1988) | Discrete-time formulation of the Bass model was used to incorporate the effects of price. | Price affects the market potential and the rate of diffusion. | Durables, e.g. vacuum cleaners, blenders |
| Horsky (1990) | Individual level model is built on product benefits, income, and price, and then aggregated. Contagion process is modelled at aggregate level. An income-price dependent logistic adoption equation. | Price is largely controlled by diffusion in the sense that a low coefficient of imitation suggests a monotonically declining pricing policy, and a high coefficient of imitation suggests an increase-decrease policy.<br>Price affects market potential. | Durable products, e.g. dishwasher, microwave, VCR |
| Jain & Rao (1990) | Price variable is added to Bass model. Model estimates certain specifications of the price variable in Bass model. | Price influences consumer's decisions on whether or not to buy and the diffusion process governs the timing of purchase given the decision to buy. | 4 consumer durables: air conditioners, clothes dryers, TVs and can openers |
| Parker (1992) | Modelling is based on the Bass model. | Price is found to play a role even for some low priced durable goods. | 17 consumer durables |
| Mesak (1996) | Single equation diffusion model: price response function. | Price affects the coefficient of innovation. | Cable TV industry |
| Bottomley & Fildes (1998) | Empirical estimation of the role of price in models of innovation diffusion. | The incorporation of prices into models of innovation diffusion does not enhance the explanatory power of those models compared of the basic models of diffusion in most of the cases. | Consumer durable goods, e.g. refrigerators and toasters |

| Author | Model Proposed | Results | Innovation |
|---|---|---|---|
| Krishnan, Bass & Jain (1999) | Price variable is added to Bass model. $X(t) = t + \beta\left[\ln \frac{Pr(t)}{Pr(0)}\right]$ | Most products seem to have either a monotonically decreasing pricing pattern or a pricing pattern that does not necessarily follow the sales curve. Price affects the sales growth in two ways: through its affect on the size of the potential market, and through its impact on the speed with which the product diffuses in the market. | Durable goods, such as Colour Tv, Clothes dryer |
| Danaher, Hardie & Putsis (2001) | Model for the diffusion of successive generations of a technological innovation that captures the effects of marketing-mix variables. | The pattern of declining price elasticities holds in a multiple-generation environment and there are likely to be price responds interactions between generations. | 2 generations of cellular phones |
| Danaher (2002) | Generalization of Hausman and Wise (1979) model. | Access and usage price have different relative effects on demand and retention. | Subscription services |
| Jun, Kim, Park, Park & Wilson (2002) | A choice based substitutive diffusion model. | The model provides the flexibility to include marketing-mix variables as in the regression analysis. | Mobile telecommunications service market |

Many of the presented models assume that the price of many durable goods appears to be more or less monotonically declining over time (Bass 1980). That may cause the market potential to grow over time. Another important factor that may influence adopters' buying decisions are their expectations about price movement over time. Demand of goods at any rate depends not only on the current price but also on buyers' expectation about future prices. Consequently adopters may buy the product sooner if the price is low enough (Kalish and Sen 1986, p. 90). Many researchers also suggest that as the price drops down in the potential market, the probability of adoption increases. The increased adoption probability will manifest an increased adoption demand of the product. (Kamakura and Balasubramanian 1988, p. 2) The absolute price can also be expected to affect the sales growth in mainly two ways: through its effect on the size of the potential market, and through its impact on the speed with which the product diffuses in that market (Krishnan et al. 1999, p. 1654).

In particular, market presence by multiple firms will lead to higher product awareness, and the likelihood of aggressive non-price competition increases, further influencing incentives to adopt. The size of installed user base may also be related to

mobile service prices. Greater number of users means higher potential benefits from scale economies in service provision and thus lower service prices. (Koski and Kretschmer 2002, pp. 15-17) Mahajan, Green and Goldberg (1982) comment that the price package for subscription services has a major impact on their adoption and retention.

# 6 FINNISH TELECOMMUNICATIONS MARKETS IN BRIEF

## *6.1 Country Profile*

Finland is a highly industrialized, free-market economy. The key economic sector is manufacturing – mainly telecommunications, wood and metals. The economic growth in traditional sectors has not been especially fast, and growth in Finland has centered on electrical equipment production, especially mobile telephones. Nowadays telecommunications has replaced the paper industry as the most important export sector in Finland. The Finnish economy has recovered from the severe recession in the early 1990s caused by economic overheating and depressed foreign markets. (CIA World Factbook 2002)

Finland is a sparsely populated country with 5, 183 million people (July 2002 est.) of which 66,9 percent are 15-64 years old (CIA World Factbook 2002). Almost all from 15 to 39 years old use mobiles regularly. Even of people over 60 years old, 36 percent of the women and 54 percent of the men uses mobiles (Nurmela 2000). The average wage of a Finnish worker in a month is 2141 euros (Tilastokeskus 2003) of which 17 % of mobile phone subscribers use less than 16,8 euros in a month for calls, 35 percent are willing to pay 16,8-33,5 euros, 23 % spend between 33,5 and 50 euros, and the rest of the users use more than 50 euros.

## *6.2 Telecommunications Regulation in Finland*

The Finnish telecommunications market has traditionally been one of the most liberalized in Europe. In 1994, more than three years before than most of the other European countries, the whole Finnish telecommunications sector was fully liberalized. Liberalization process in Finland has been much easier than in other European countries, because a part of the telecommunications sector has always been privately owned. (Ministry of Transport and Communications 2002)

Since 1994, every segment of telecommunications market has been subject to

competition and because of the fact that Finland was among the first to open its telecommunications market has resulted in strong competition. This has had effects on both on telecommunications know-how and pricing. (Ministry of Transport and Communications 2002)

The Ministry of Transport and Communications (MTC) regulate the provision of telecommunications services and they also issue all telecom licenses. The MTC must be notified by new operators intending to provide public telephony services or build public data and closed group networks, but the license is not required. However, a license is required in order to build and operate mobile communications network.

### *6.3 Mobile Communications Market*

There are currently four regional telecom operators in Finland – Sonera, Radiolinja, Telia Finland, and Suomen 2G. Sonera (used to be Tele) opened its first analogical mobile network, NMT, already in the beginning of 1980s. The first operator in digital GSM network market was Radiolinja. It started its operations in December 1991. Sonera followed Radiolinja soon after in July 1992. Sonera and Radiolinja began their operations with GSM 900 technology. At present, GSM 900/1800 technology is used. Telia Finland has held its licence since October 1997, but the third network was built only in 1998. Suomen 2G began its operations in 2001. DNA, which was formed by a group of local telephone companies, operates under Suomen 2G. (EMC) Additionally, there are many service providers in mobile phone markets that do not own their own networks, such as Jippii, Elisa, ÅMT, and RSL Com Finland (Ministry of Transport and Communications Finland). Competition will be analysed more deeply in chapter seven.

### *6.4 The GSM Era*

In 1990, the provision of mobile communications services was opened to competition. Both PTO (Public Telephone Operator) and Radiolinja received a digital GSM licenses. Radiolinja became the first operator in the world to offer commercial services when it launched in December 1991. PTO launched services

soon after in July 1992. GSM service permitted subscribers to make roaming calls throughout Europe, unlike NMT. According to Kopomaa (2000) the years from 1990 until 1995 can be called the period of “mass markets”. In 1990, the mobile phone penetration was 5,2 %, and five years later 1995 penetration had risen to 20,4 %. GSM speeded up the mobile phone diffusion. The new services, like SMS, attracted especially the younger segments. The decreasing prices brought expenses to an acceptable level for the average consumer.

Kopomaa (2000) claims that since 1995 we have been living the “differentiated mass market” stage. Mobile phones and the services have been tailored for certain user groups. Mobiles include also special features, like radios. The mobiles can also be personalised by ringing tones and logos. Also new groups have become users, for example children under seven.

# 7 COMPETITIVE SITUATION AND PRICING POLICIES

The effective competition exists in the Finnish market. Mobile call prices are one of the lowest in the world (see Appendix 1), the services are of the highest quality and the most advanced, and the mobile network available to customers is geographically extremely extensive. The competitive situation of Finnish mobile communications market is analyzed in this chapter. Also the different pricing schemes of cellular subscriptions are approached.

It should be noted that when the mobile communications market is highly competitive especially after the entrance of fourth or fifth operator, people might possess a number of subscriptions. Many users have more than one subscription and this does not necessarily mean that he or she uses all of these subscriptions actively. Statistic that are used in this thesis do not represent the number of subscribers, but the number of all subscriptions that one user may own more than one.

The information of total amount of subscribers used in the analysis is based on EMC database. Pricing and other information is collected from operators' web pages (Sonera 2003, Radiolinja 2003, and DNA 2003) and from the report of Finnish Ministry of Transport and Communications (2002). Other references that are used in the analysis part are mentioned in the text.

## *7.1 Nature and Extend of Competition*

Sonera and Radiolinja have dominated the Finnish market ever since the beginning of "GSM era". In the end of year 2002, Sonera had the biggest market share. Radiolinja was second with a market share almost 30 %. The third biggest was Suomen 2G (DNA), and fourth was Telia (see Fig. 7-1).

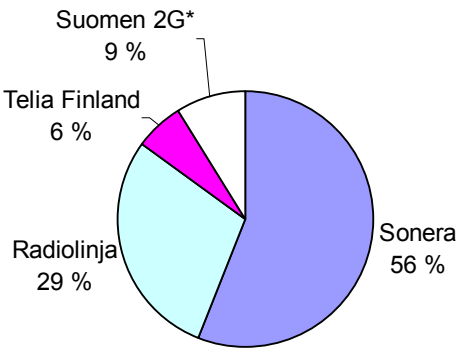


**Figure 7-1 Operators' Market Shares (EMC)**

When GSM was taken into use along side NMT the monopoly era in Finnish mobile communications ended. Since then, Finnish mobile communications industry structure has been oligopolistic and telecommunications markets have been in many ways very competitive. A small number of quite large firms have offered mobile communications services that range from highly differentiated to standardized. In NMT era, only one firm dominated the mobile communications markets and nowadays many firms compete with each other with the differentiated products. In 1991, Radiolinja got a GSM license and it became challenger for Telecom Finland. Radiolinja succeeded to challenge Telecom Finland well, because it had the biggest market share in 1993. Radiolinja initially positioned itself as "new alternative" in contrast to Telecom Finland. Radiolinja also offered lower prices than Telecom Finland, which then gave Radiolinja a somewhat "cheap" image. During the later years Radiolinja anyway managed to rid itself out from that image. Back then the effective pricing strategy anyway helped Radiolinja to achieve larger market share than Telecom Finland. But ever since 1994, Telecom Finland (Sonera) has been the market leader. It skilfully used its position to build reputation of quality services due to its experience and a long history in mobile communications. However, the beginning of GSM era was not easy for Sonera, because it did not enjoy legal monopoly. Sonera may have misjudged the competition in the beginning and that led to the situation where Radiolinja was a market leader in 1993. Development of competition in Finnish market is illustrated in Figure 7-2. The lines of the figure

present the total number of NMT and GSM users and the numbers illustrate the years when operators have come to the market.

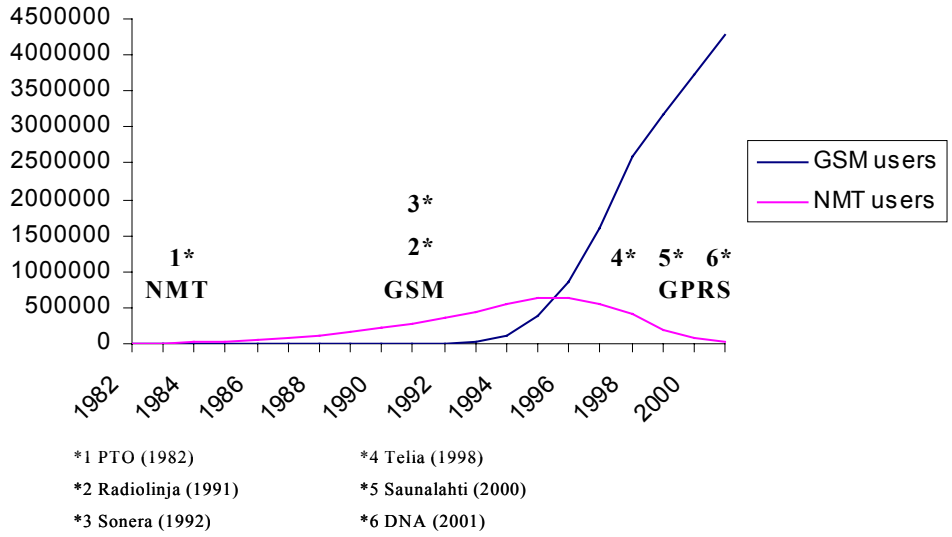


**Figure 7-2 Development of Mobile Communications Market**

Both Radiolinja and Sonera have worked hard to increase coverage in Finland. Today the total coverage is almost 100 percent. During the 1990s their networks grew from cities and towns to rural and even remote areas. Sonera and Radiolinja have also been forerunners in introducing advanced services and features.

The new entrants, like Telia and DNA, are niche enterprises, focussing on rather narrow business segments. Telia Finland received a nationwide GSM license in 1995, but it found it too expensive to build its own network to cover entire country. The problem was that not many were attracted by Telia's services, which were restricted to three biggest cities in Finland. Only most cost-conscious segments, like students, were willing to change their operator. DNA launched its services in February 2001. Its aim was to achieve 170,000 users by the end of year 2001 and DNA managed to achieve its goal by having 200,000 users in the December 2001. In January 2003 it had 403,800 subscribers, which is a way over its expectations. In the beginning of DNA's business, most of the calls made by DNA subscribers went outside the network, because there were only few DNA subscribers, and therefore it was difficult for it to compete with price. However, nowadays DNA's main

competition strategy is low prices. DNA has also mainly focused its marketing efforts to younger user groups and it has managed to attract big interest groups to change their subscriptions into DNA.

The actual competition in mobile communications, when many operators offer the same service, started in practise only in 2001 when DNA launched its services. Ever since, even the two biggest operators, have been forced to lower their prices. It is estimated that in the near future competition will get even harder. New legislation, which will be taken into use in July 2003, enables subscribers to retain their "original" phone number when changing an operator. However, most of the subscribers are willing to change an operator only if they see significant benefits. The new legislation will favour cheap operators. (Hankkila 2003) The change of an operator is not as simple as it seems, because when changing an operator user must consider many things, such as who are the ones he needs to call, because calling to another operator's network is more expensive than calling to same operator's network. Exit barriers are not that high, if the ones to whom you call are willing to change an operator as well.

In 2002, the business was affected by the increasing price competition and the subsequent price erosion. Competition for customers clearly tightened from the previous year. (Radiolinja 2003) Additionally, old customers are today more important for operators than new customers, because penetration starts to be close to maturity. Until now competition has mainly concentrated on achieving new customers and operators have almost totally ignored their old customers. Marketing campaigns have been dominated by free airtime offers and various free gifts given in connection with new subscriptions. Operators have offered even 100 euros free airtime for new users. Now when operators have started to concentrate on their old customers for example Radiolinja has started a big campaign that is aimed to its present customers. It has also taken a new pricing system into use. Radiolinja encourages consumers to call more by giving a certain amount of discount every month, which depends on the total sum of the phone bill: the more you call, the more you can get discounts. (Hankkila 2003)

### *7.2 Elasticities as Measure of Competitive Situation*

Sales figures do not necessarily indicate how a firm is performing relative to its competitors. Rather, changes in sales simply may reflect changes in the market size or changes in economic conditions. The firm's performance relative to its competitors can be measured by the proportion of the market that the firm is able to capture. This proportion is referred to as the firm's market share. Market shares compared to changes in prices can be used to describe the market behaviour and how the prices have affected competition or vice versa how the competition has affected prices. This is called market share elasticity. Market share elasticity can be calculated like price elasticity (see Formula 8) but quantity, as a value, needs to be replaced with market share. Price elasticities cannot be used in this analysis as such in describing the effects of price on competition, because we are lacking information of call durations. Thus, the market share elasticity is an effective way to describe the competitive situation. The market shares and elasticities of Sonera and Radiolinja are presented in Table 7-1. Market share elasticities are calculated by using the general price index, which is shown in Fig. 7-3.

**Table 7-1 Market Share Elasticities of Sonera and Radiolinja**

| | SONERA | | RADIOLINJA | |
|---|---|---|---|---|
| **YEAR** | **MARKET SHARE** | **ELASTICITY** | **MARKET SHARE** | **ELASTICITY** |
| **1993** | 42,3 | | 57,7 | |
| **1994** | 56,1 | -8,2 | 43,9 | 10,5 |
| **1995** | 66,7 | -5,3 | 33,3 | 10,6 |
| **1996** | 68,3 | -0,1 | 31,7 | 0,3 |
| **1997** | 64,9 | 0,7 | 35,1 | -1,2 |
| **1998** | 61,4 | 0,8 | 37,7 | -0,9 |
| **1999** | 61,3 | 0,0 | 36,7 | 0,3 |
| **2000** | 61,2 | 0,1 | 33,4 | 2,9 |
| **2001** | 57,8 | 1,9 | 31,7 | 1,7 |

In oligopoly markets each firm wants to capture the greatest market share. If one firm increases the sales the others will immediately notice it. The increased sales can be taken place at either the existing price or at a lower price. If one firm increases its market share that is another's loss. Price elasticities presented in Table 7-1 show that during the first four years Sonera and Radiolinja competed in certain level with price, e.g. between 1993 and 1994 Radiolinja lost its customers to Sonera. During the first

years firms competed vigorously with price to build up market share to exploit market power in future stages. Even small change in price caused a large change in market shares and in competitive situation. Radiolinja's positive market share elasticity figures mean that when the price declined a certain amount Radiolinja lost its market share. Sonera's negative figures, on the other hand, mean that when price declined Sonera achieved more users.

From 1996 until the end of 1999, prices had not much or any impact on operators' market shares. It can be concluded from the market share elasticities (elasticities are close to zero) that price competition between Sonera and Radiolinja had practically come to an end.

The price competition started again in 2001 when DNA started its business. Both Sonera and Radiolinja lost their market shares to newcomer. DNA confined its activities to specialist niche, thereby not posing a major threat to the dominant firms. However, it affected competition and market shares. Bigger operators lost mainly young customers to DNA. During 2002, DNA decreased its prices radically and the others were obligated to follow. It is not clear yet how this affects market shares and competition in the future, but price competition is most likely going to occur still a while. Actually, price competition is possibly to be stimulated by the new mobile communications legislation in the summer 2003 when consumers do not have to change their numbers when changing an operator.

Even no competition is highly distorted in Finnish mobile communications market. The pricing of the calls that are made from one operator's network to same operator network distorts the competition, because these calls are under-priced. Operators are free to price their calls like they want, but however the price differences between the calls made from one operator to same network, competitors' network, or fixed phone are too vast. This cannot be justified with access fees, because today the access to another operator's network is not expensive anymore. To prevent distorted competition MTC may intervene to the pricing policies in the near future. (Nykänen 2003)

### *7.3 Current Situation of Finnish Mobile Communications Operators*

*Sonera – Market-leader*

Sonera has maintained its position as an undisputed market leader and it fulfills all the requirements of a market leader: Sonera is highly visible and it is large in size. Sonera has also a well-defined brand in Finland, but still it has to work hard to maintain its position. In marketing it has until today focused on adults, but in the future Sonera should aim the marketing for younger people as well. Sonera's keys of success are functionality and reliability of services and its focus on a customer. The merger of Sonera and Swedish Telia has created the leading telecommunications group for the Nordic and Baltic region. However, for the time being Sonera is owned by the state (52,9%) and only 47,1 % by distributed share ownership. (Datafile of European Telecommunications 2002; Seies 2003)

*Radiolinja - Challenger*

The mobile operator Radiolinja is an affiliate of Elisa Communications. Radiolinja's strategic objective has always been to offer lower prices than Sonera and it has simply sought larger market share during its existence. The year 2002 was difficult for Radiolinja. Price competition increased the churn rate of Radiolinja's subscriptions. Although Radiolinja has a strong and well-known brand name, it has to make a lot of efforts to sustain its current position. DNA will be its biggest threat in the near future. Radiolinja must also try to brighten up their image again. It has always been customer-oriented and reliable and it is increasingly focusing on the maintenance of good customer service and development of services. For serving customers' needs better, Radiolinja introduced a pre-paid subscription into the market in 2002. (Radiolinja 2003; Seies 2003)

*DNA - Nicher*

DNA tries to become a leader of some market sectors, especially younger age groups. DNA has been a success story of the year 2002. It managed to develop an effective brand and it marketed itself as "different" than the others. DNA Finland has attributed its phenomenal rate of growth to a successful media campaign, competitive pricing, strong brand backing, and its attraction to the youth market. Until today

DNA has attracted especially younger segments and DNA was voted in 2001 top operator in the age group of 15 to 24 years old. According to Finnet Groups CEO Matti Makkonen (2003) DNA should try to keep its current customers and increase the sales even more, because DNA has had higher churn rate than the others. Makkonen (2003) also states that DNA's aim is to achieve 25 percent market share in the near future. (Korva 2003) If DNA manages to achieve its goal it will threat Radiolinja's position as a second biggest operator in Finland. (Datafile of European Telecommunications 2002; Seies 2003)

*Telia - Nicher*

During 2002, Telia grew about 25 percent despite the difficulties it faced. Telia is a market leader in pre-paid business. Telia's brand will disappear from the markets as soon as Telia-Sonera sells its business activities. Telia's marketing efforts have been quite modest, because after the summer 2002 Telia has advertised only offerings. (Seies 2003) Telia's competition strategy can be called facilities based competition, because it has built its own network.

*Jippii/Saunalahti - Nicher*

Jippii lost one third of its customers during the year 2002. Jippii has taken the old Saunalahti brand into use and its main goal is to change diminishing sales into increasing. Jippii operates in Sonera's network. Its competitive weapon is to offer its customers cheaper calls and text messages than the others. (Seies 2003) Jippii does not have its own network, and therefore it trusts service based competition strategy.

### *7.4 Subscription Types and Pricing*

Customer needs to choose a subscription from the many different subscription that operators offer. Operators have different kinds of subscriptions that are meant for different user groups. It is not easy to find a right subscription, because it is quite difficult to compare the prices of mobile subscriptions. By selecting an appropriate tariff package, users can make mobile services more affordable for themselves without operators necessarily lowering their overall prices. Opening fees, monthly access fees and fixed charges and prices that change whether you call during the day

or night time or whether your call to the same operator's or competitor's network creates a situation where a subscriber does not necessarily know how much his or her calls cost. When choosing a best alternative consumer should carefully consider many things, such as his main contact groups, how much he calls, when does he call, does he call to fixed or to mobile network, and is the phone meant also for other purposes than just for calling. In Table 7-2 the different subscription types of two biggest operators are introduced. In addition, examples of the prices of some subscriptions are given in the following Table.

**Table 7-2 Sonera's and Radiolinja's Pricing Schemes for Subscriptions**

| **Subscription** | **Costs** | | **User type** |
|---|---|---|---|
| **Sonera**: Business, Business Duo<br>**Radiolinja**: Käyttöliittymä, Tandem Pro | Calls are cheap at daytime, but expensive at evenings. Monthly access fee is high. | Tandem Pro: From RL's to RL's network all the time 0,14 €. From RL to fixed phone and another operators' network: day 0,20 €, evening 0,16 €. Monthly access fee 9,02 €. | Heavy users like businessmen. For professional use. |
| **Sonera**: Classic, Classic Duo<br>**Radiolinja**: Perusliittymä (Basic subscription), Tandem | Traditional subscription type. Monthly access fee is low. Daytime fee is not too high and evening calls are not the cheapest ones. | Perusliittymä: From RL's to RL's network all the time 0,15 €. From RL to fixed phone and another operators' network: day 0,39 €, evening 0,15 €. Monthly access fee 5,05 €. | Light users. This subscription suits best for those people who speak as much in the daytime than in the evenings. Affordable for leisure time use. |
| **Sonera**: Privat, Privat Duo<br>**Radiolinja**: Freetime | Calls are expensive during the days and cheaper than other subscriptions during the evenings. Monthly access fee is fair. | Freetime: From RL's to RL's network all the time 0,12 €. From RL to fixed phone: day 0,41€, evening 0,12 €. From RL to another operators' network: day 0,41 €, evening 0,17 €. Monthly access fee 3,20 €. | Light users. This subscription is meant for private persons who use mobile outside office hours. For leisure time use. |
| **Radiolinja**: Tandem Aina, Tandem Yö, Tandem Aina Tekstari (Tandem Always, Night, Text) | Tandem Always: always the same rate for calls and text messages.<br>Tandem Always Text: always one price for calls and fixed rate for text messages. | Tandem Night: Night prices for fixed price. Monthly access fees are low.<br>Tandem Aina: Call rate 0,17 €/ minute all day long, monthly fee: 3,33 €. | Medium users. These subscriptions are especially for those who talk regardless the time of a day. Tandem night is also for those who talk mostly in the nights and Tandem Tekstari is for those who send plenty of text messages. |

* RL = Radiolinja

Radiolinja has also introduced a pre-paid subscription into the market. DNA has

subscriptions that can be compared to those with Sonera and Radiolinja. DNA has Perusliittymä (Basic subscription), dna Vakio (standard), dna Liittymä (dna Subscription), and dna Maraton. Vakio is like Radiolinja's Tandem Aina, dna Liittymä like Sonera's Business subscription, and dna Perusliittymä like Sonera's Classic. In addition, dna Maraton offers affordable calls everywhere in Finland if the user calls to other DNA subscription. Dna Maraton offers unlimited voice calls and SMS messages between non-business DNA users for a fixed monthly charge. The subscriptions types of Telia, Jippii, and RSL COM are also equivalent with afore mentioned subscriptions, and thus and because of their little market shares their subscription types are not presented in more detailed. Pre-paid cards are examples of single price system and Telia is a market leader in this area.

The attractiveness of pre-paid cards for their users is evident in a number of different facets. The most obvious advantage is that without a monthly charge users have greater control over their costs. In addition, pre-paid-cards have enabled mobile services to be available for many users who would not otherwise have had a credit rating sufficient to qualify for traditional pricing packages. It could be assumed that pre-paid cards would be attractive for users paying for mobile services for some other users, e.g. parents could buy pre-paid cards for their children or for the occasional user type, who does not call regularly. For some strange reason pre-paid has not achieved a great interest in Finland, although for example in France most of the subscriptions sold are pre-paid cards.

The pricing schemes are very complex. In addition, there are differences between countries, e.g. in the U.S.A one is charged both for receiving calls and outgoing calls, but in Finland one pays only for making calls. Moreover, the price issue is complicated by the fact that the user is not necessarily the one who pays the charges, e.g. mobile phones and subscriptions provided by the employer. To set a price is difficult because of the complex pricing system. In Finland, most of the mobile phone calls are priced by using a dual pricing system. Pre-paid card is an only example of a single pricing system. The price normally contains an initial connection fee, a monthly rental charge, plus a tariff per minute of usage.

Calls made within an operator's network are priced cheaper than calls to numbers in competing operators' networks, which often makes it most economical to choose the same operator as other family members or close friends. Also calls from mobile to fixed phone are more expensive than the calls from mobile to same network's mobile. For the consumers, the best alternative is a subscription that has a well-defined and transparent pricing system. It is said that subscriptions like Tandem Aina and dna Vakio (Korva 2003), will be good competitive weapons for the operators in the future, because these subscriptions have transparent pricing system and users know all the time the price they have to pay. Users have lately become very price sensitive and critical.

For some customers the price is a crucial selection criterion when choosing a subscription type. But in fact, operators are not that interested in those customers, because they are normally the ones who most likely change the operator whenever another operator offers "bonuses", such as free airtime. If the price was the most important factor for most of the customers, Telia should be the market leader. However, for the operators the free airtime offers are almost inconsequential, because these offers do not bind customers to use the services permanently. In addition, for the new operators opening offers are difficult to make. Some new operators have got new customers that do not have any purpose to take their new subscription into active use. As operators come up with a new even more complicated offers to bind up their customers, consumers find new ways to "earn" some money out of their offers, for example if an operator gives "bonuses" to a customer who remains an active user for a set of period (often six months or a year), consumer counts that it is worthwhile to greet the offer, open the subscription and not the use the subscription or only use the free airtime.

### 7.4.1 The Price Level of Telecommunications Charges

Important price reductions have taken place in mobile services. Between 1993 and 2001 the price index fell by about 40 percent (see Fig. 7-3). It is estimated that the competition has decreased price level about 20 percent if comparing the price level of 2002 with 1993, which is the year before competition started. Consumer prices

have increased in the same time approximately 13 percent. Thus, the prices of mobile communications have actually decreased about 29 percent. (Ministry of Transport and Communications 2002)

As markets were liberalized the range of tariff plans increased enormously. In many cases the tariff plans did not greatly reduce the price of mobile calls but they did reduce the costs of user. This was because they were better suited to different types of usage patterns. (OECD 2000b, p. 22) The tariffs schemes were increasingly tailored to meet user's needs.

It is not possible to achieve the information how the amount of users is distributed among the different subscription types, and therefore, the price index is difficult to calculate. Thus, the price index acquired from Ministry of Transport and Communications (2002) is used. This index is calculated from Sonera's and Radiolinja's call prices. The price index is calculated from all their subscription types. The average prices take into account the different tariffs (whether you call during the day or night, do you call same operator's network etc.). Prices exclude monthly access fees and only minute prices are included. These prices are weighted with operators' market shares. The price index of mobile phone calls, which depicts the average price development of GSM calls, is presented in Figure 7-3. This is adjusted price seem to have declining trend. After the year 1995 prices have declined quite smoothly. Between 2001 and 2002 the prices declined only 2,9 percent. It is worth pointing out that the prices of smaller mobile operators have declined more than the prices of bigger operators. However, their market shares are so small that their prices do not affect the index considerably. Thus, it has been possible to leave them out from the index.

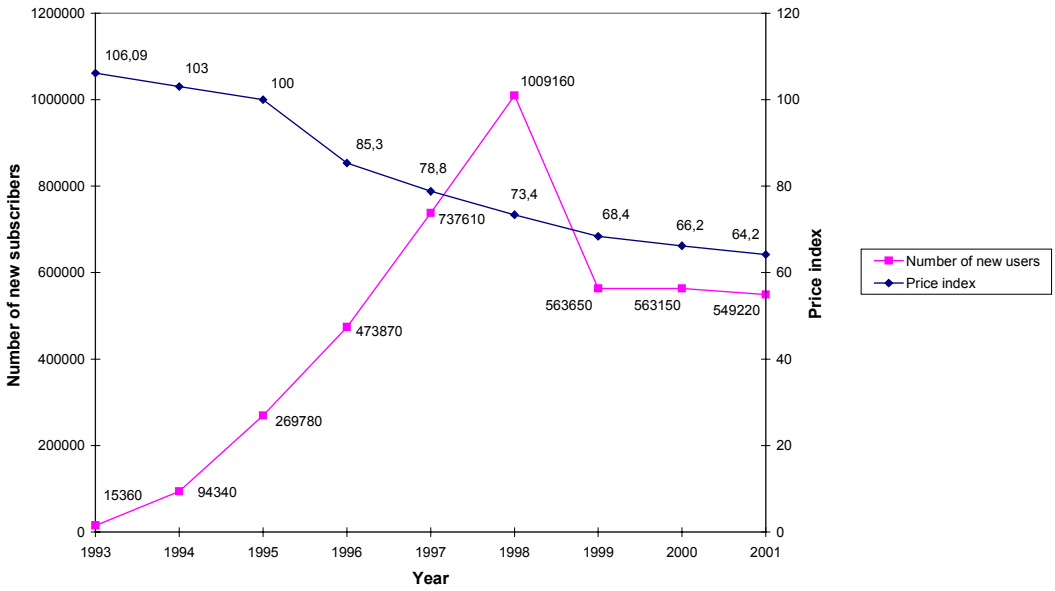


**Figure 7-3 Number of New Subscribers and Price Index of Mobile Phone Calls**

In general, prices went down quite much after the GSM technique was adopted. New digital technique affected the costs loweringly. Also the fact that competition started impacted prices. In the first three years of GSM era prices decreased slowly, but still the amount of new subscribers increased fairly much. After 1995, prices have declined faster. It is not obvious have the lowering prices affected the amount of users or has the growing number of new subscribers made possible the price reductions. However, price reductions have had impacts on call durations, because people talk more on the phone when the prices are low.

The network effects may have also affected the general price level. It was easier to charge more from early adopters for the entrance to the network. Nowadays, late adopters are not as willing to pay for the entrance as the first adopters were.

In 1998, the sales peak of new subscriptions occurred, although the charges of traditional calls of mobile communications remained almost unchanged. Newer, less expensive GSM 1800 services became available from more several telecommunications operators. New GSM services also had better coverage. GSM 1800 prices were much lower than GSM 900 prices. Dual band services offered customers savings of up to 35 percent on the normal GSM tariffs. (Ministry of

Transport and Communications 2002)

During 1999, GSM charge costs decreased about two percent as the users increasingly changed to dual band mobile phones. Moreover, less expensive GSM 1800 services became available from several communications. Instead, the call prices of conventional GSM subscriptions remained almost unchanged. The pricing of basic services, such as pricing of calls, has become easier, e.g. Radiolinja took Aina-subscription into use. Aina-subscription decreased the expenses of calling to another operators' subscription. Although a new technique became available for the users diffusion started to decelerate.

Price competition intensified in 2002. Small operators declined their prices more than bigger operators. Small operators, like DNA, decreased the prices of the calls that were made to numbers in competing operators' networks. DNA decreased these prices about 10 percent during the year 2002. The prices of Radiolinja and Sonera have declined less. Telia has the cheapest fees for the calls that are made to another operators' subscription. Although the price level in Finland is lowest in the whole Europe, it seems that the price level of the telecommunications sector is lowering even more. Also the penetration seems to be close to maturity. Now operators need to maintain their old customers and one way to do that is to compete with prices.

To sum up, most of the price reduction are due to more developed technology. In other words, the prices charged vary by the stage of the product life cycle. In the beginning when the technology is new, the prices are naturally higher. Also when the product is new for the consumers it is easier to charge higher prices. Technology enables operators to offer cheaper calls. Also competition has affected pricing schemes. Especially in the beginning of 21$^{st}$ century competition has appreciably had effects on pricing. For example after DNA launched its services other operators have almost been forced to decrease their prices to keep up in competition. Like stated in the chapter 4.1.1 operators may have no choice but to respond to price competition, because otherwise the competitor who is focusing on price can threat others' position in the market, in this case DNA could threat Sonera's and Radiolinja's positions. It is worthwhile to notice that the prices of different operators' calls have not declined

systematically all the time. There have been both declines and increases of prices in operator level. However, on the whole the price trend has been downward.

### 7.4.2 The Price Level of Mobile Phones

The average prices of mobile phones have declined enormously over the last ten years. This is due to both developed techniques and the growth of new users. Average prices of mobiles are presented in Figure 7-4. Average price includes both the prices of NMT and GSM mobile phones. NMT phones were more expensive than GSM phones, but the prices of NMT phones have affected considerably the average price only in the beginning of GSM era, because by then most of the phones sold were NMT's. Situation changed quite fast after GSM technique was taken into use and sold GSM phones exceeded the NMT phones.

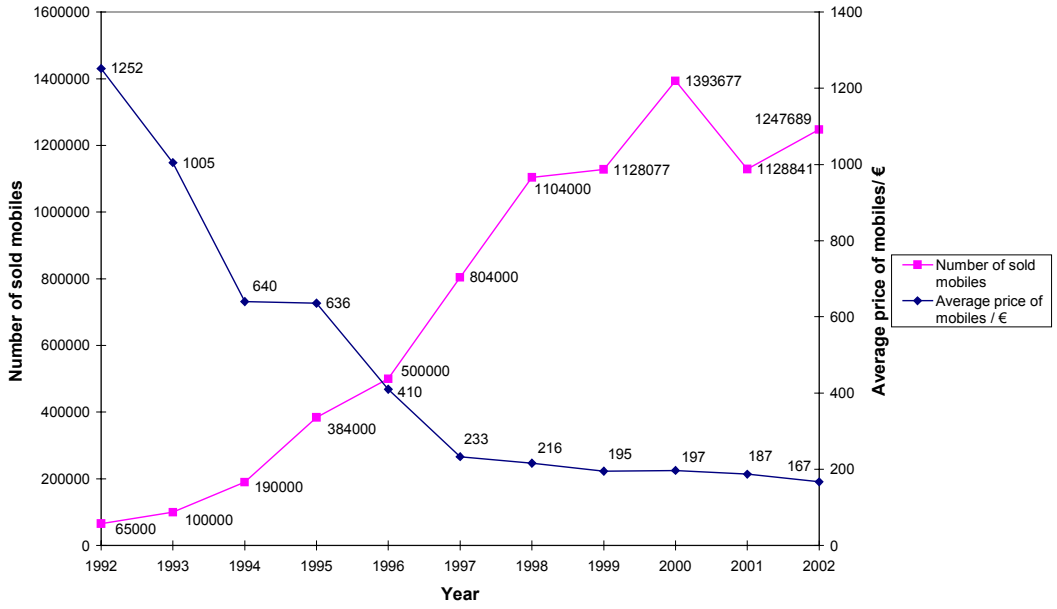


**Figure 7-4 Number of New Subscribers and Average Price of Mobile Phones**

The increased demand of mobiles has also affected prices: while the demand has increased the prices have come down. Finnish mobile phone sellers have also chosen to sell the phones at a realistic price, which may have affected the diffusion positively.

In the beginning of 1990s, a cellular was some kind of luxury good and the prices were quite high. Only few people, innovators and early adopters, had a mobile. Mobiles were not as popular as at the moment also because calling prices were higher and the coverage of mobiles was weak. In the end of 1990s, anyhow, cellular became more or less a necessity good for people and majority of people bought a mobile. Even younger and younger age groups became mobile users. Mobiles are more than just phones for the consumers and mobiles are needed in every day life. Currently, in the beginning of 2000s, the one who finally decides to buy a mobile is called a laggard. Most of the people who do not yet have a cellular are either children or elderly.

Although, the penetration level of subscriptions seems to be close to maturity, it does not mean that the sales of mobiles end. New attributes of mobiles attract people to achieve new and even more improved phones. In 2000, mobiles were sold more than ever. This may be due to the new dual band technology. To be able to make cheaper calls one has to have a mobile that enables to make dual band calls. The sales figures of 2000 show that people change their phones quite often. Decreases in prices of mobiles may motivate consumers to replace the old mobile before the termination of its useful life. According to Raivio (2000) in the middle of 1990s consumers changed their mobile phones once every five years. However, in 2002 the change interval had shrunk to 16 months (Viitasaari 2002).

The price of a mobile and the diffusion of mobiles are also affected by quality factors. Mobiles have not stayed the same during the diffusion period; mobiles are not physically same today than in 1993. Mobiles have become smaller and their using possibilities have increased. Technique has enabled price reductions, but on the other hand some new functions have increased the prices. In 2002, the prices have started to increase again. Although prices were higher in the beginning of 1990's it did not mean that those mobiles had more attributes. Today consumers get more for the money.

# 8 IMPACT OF PRICE AND COMPETITIVE SITUATION ON DIFFUSION CELLULAR SUBSCRIPTIONS

The purpose of this chapter is to find out how the price and competitive situation affect the diffusion of cellular subscriptions. In the analysis of the effects of competitive situation on diffusion only the fact how competition has affected prices is analyzed. The main interest of the chapter lies in the effects of price on the diffusion rate and potential. A regression analysis is conducted and the effects of price on the diffusion of cellular subscriptions are discussed based on the regression results. Moreover, methods applied are presented.

## *8.1 Selecting the Method*

In evaluating forecasting methods accepted scientific procedures should be followed (see Figure 8-1).

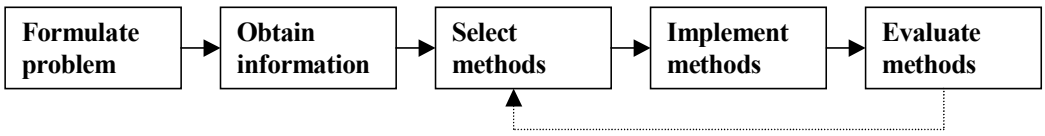


**Figure 8-1 How to Choose a Research Method (Armstrong 2001, p. 441)**

The quality of analyses greatly depends on the proper selection of appropriate techniques. The problem of the present study is how to assess the effects of price and competitive situation on diffusion and how to find a suitable model to assess these effects. Because there is no unified framework how to integrate price and competition into diffusion models this estimation is difficult.

Data requirements to explore the effects of price and competition are high. It is well known that the diffusion parameters become unstable when only a few observations are used for model estimation (Bass 1969; Heeler and Hustad 1980). This instability often causes problems and uncertainty in interpreting the parameter values, thereby

preventing clear insights into the diffusion process (Kamakura and Balasubramanian 1988, p. 2). In this study, annual level data is used in the analyses. However, a comprehensive study would require monthly data of prices. On the other hand, monthly data would be difficult to collect and very difficult to analyze due to the complex pricing system, and therefore the available annual pricing information is used.

There are also many different methods available for analyzing the data. In this thesis, exploratory analyzing methodology is used. Exploratory methods utilize the historic data to project future developments. They start with a set of events that have taken place up to the time forecast, an attempt to identify the patterns present in that history, and project these patterns into the future. (Fowles 1978, p. 373)

Among the many analyzing methods i.e. time series analysis and regression analysis, regression analysis is chosen, because it is best suited for the available data. Regression analysis estimates the object's dependence on other objects and generates a forecast of the independent variables' development with another time-series technique. The forecast is obtained by substituting the predicted values of the independent variables into the dependency equation. (Pitkänen 2001, p. 6) In addition, it is often possible to consider different formulations of the same growth curve, for example, a non-linear curve, a linearised version or an autoregressive version. Here the choice of formulation is constrained to non-linear curve, because the functions are non-linear and the non-linear estimation method is required.

To make a non-linear regression analysis the logistic curve is chosen because of its advantages. One of its advantages is that the shape and the location can be controlled independently. Changes in the coefficient *a* affect the location only and the coefficient *b* affect the shape only. This makes the curve useful in diffusion of innovations. (Martino 1983, p. 61) Also because the diffusion of cellular subscriptions was slow in the beginning, the logistic function is better suited for modeling diffusion than for example Gompertz or Bass model. Gompertz is more suitable for the products, which diffuse fast in the beginning. The logistic model is fitted into cumulative diffusion curve of total subscribers using the SPSS nonlinear

regression estimation procedure.

The choice of an error measure is also somewhat difficult. The choice of the method depends on the type of data and the expertise available. At one extreme, like in this study, there is a single series to forecast, an appropriate probability model is fitted and optimal forecasts are then made. Mean Absolute Percentage Error (MAPE) is the most widely used accuracy measure, but it is only relevant for ratio-scaled data. For a single series it is perfectly reasonable to evaluate forecasts from different models by Mean Squared Error (MSE), Mean Error, or RMS (Root-Mean Square) of the forecasts. (Armstrong and Collopy 1992, p. 69)

### *8.2 Diffusion of Subscriptions*

The diffusion of subscriptions of different operators is illustrated in Figure 8-2. Based on this Figure it can be said that the diffusion of digital mobile subscriptions follows the S-shape curve, and therefore the shape of a curve can be explained with the theory of diffusion of innovations. There are a lot of factors that explain the diffusion of cellular subscriptions, such as the prices of mobiles and mobile phone calls, increased competition and different attributes of innovations. These factors are discussed further in the present chapter.

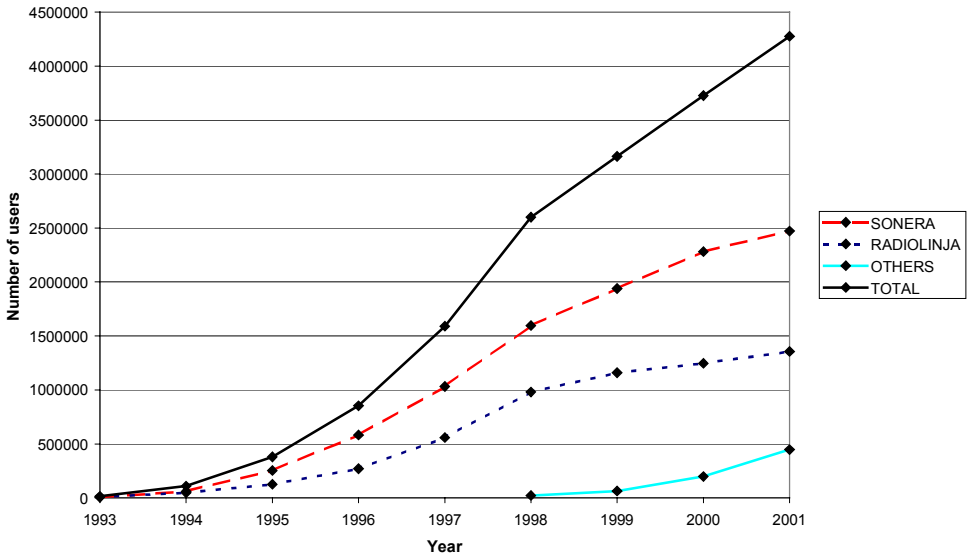


**Figure 8-2 Cumulative Number of Adopters by Operators**

High mobile growth rates continue to strongly correlate with the stimulation provided by market liberalization. After markets were liberalized for fully competition, the growth of users has been faster than it was in whole NMT era. GSM subscriptions achieved the same amount of users in less than four years as NMT did in almost 13 years. In general, the mobile phone penetration in Finland has grown rapidly, and passed the 50 % milestone already in 1998, the same year when it surpassed the number of fixed telephone connections. By the end of 1996 the number of GSM subscribers exceeded the number of NMT users in Finland. At the end of the year 2002, the penetration rate was 86,7 %. (EMC) After the year 1995, the growth of GSM users has been rapid. In the three-year period (1995-1998) the amount of users grew from 380,000 users into approximately 2,600,000 subscribers.

The sales peak occurred in 1998 when operators managed to achieve over one million new subscribers. However, after the year 1998, the growth has slowed down. Already in the first part of 1999 growth rates in Finland were considerably slower than in 1998. In 1999, only half a million new subscribers were achieved. Between the 1998 and 2001 the growth was slow, but after DNA launched their services in the beginning of 2001 sales started to increase again.

### *8.3 Innovation Attributes and Diffusion of Subscriptions*

According to Rogers (1995, p. 206) the perceived attributes (see Chapter 3.3) of an innovation are important explanations of the rate of adoption, and most of the variance in the rate of adoption is explained by these five attributes: relative advantage, compatibility, complexity, trialability and observability.

Relative advantage is the degree to which an innovation is perceived as being better than the idea supersedes. The economic advantage is often expressed as economic profitability, social prestige, or other benefits (Rogers 1995, p. 212). Mobile phone can be used almost everywhere unlike fixed phone. The portable nature of cellular phones frees users from being in any fixed place. This attribute increases considerably reachability, which in turn brings many benefits for the user. The relative advantage of telecommunications compared with fixed line has grown in

time. One motivation for many individuals to adopt an innovation is the desire to gain social status (Rogers 1995, p. 213). Cellular phone have been an important status symbol right from the beginning, but the status motivations for adoption seem to be more important for innovators, early adopters, and early majority, and less important for the late majority and laggards.

Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters (Rogers 1995, p. 224). A cellular phone connects into the existing telephone system, and allows the user to talk with anyone who has a regular telephone. Compatibility with fixed line network may have fasten the diffusion of telecommunications and affected to its successful diffusion.

Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use. The complexity of an innovation is negatively related to its rate of adoption. (Rogers 1995, p. 242) From the user's perspective, a cellular telephone operates exactly the same as a regular phone, and so it was unnecessary to learn any new skills. This may have eased the diffusion of telecommunications.

Trialability is the degree to which an innovation may be experimented with on a limited basis. Trialability is positively related to its rate of adoption. (Rogers 1995, p. 243) Probably, most of the mobile phone buyers have borrowed someone's cellular for trial use before buying decision.

Observability is the degree to which the results of an innovation are visible to others. The observability is positively related to its rate of adoption. (Rogers 1995, p. 244) The mobile phone as an innovation was highly observable; mobiles are every day life.

### *8.4 Effects of Competition on Diffusion*

In the present study, not any model is used to estimate the effects of competition on diffusion. The effects of competition are analyzed through prices, because normally

competition impacts price level, because the pressure of competition affects pricing strategies of the firms.

Price trend of both subscriptions and mobiles are presented in chapter seven. Both of these prices have a declining trend, but still no significant correlation between price and the number of competitors exists. Of course the prices are lower now when there are more competitors in the market, but there is no evidence that lower prices are only due to the competition. Also other reasons have affected the price declines besides competition. However, the competition has stimulated price reductions. Under the NMT technology there were no competition and prices were high. When GSM technique was taken into use introducing a competition between operators had a significant effect both on the number of mobile phone users and prices. Prices started slowly to decline, because competition as well as the development of technology created additional incentives to reduce prices.

Gruben and Verboven (2001) state that a sequential entry has a stronger impact than a simultaneous entry on diffusion and competition is found to lower prices. Also the number of competitors on the market is expected to influence demand via prices. Radiolinja and Sonera launched they services almost simultaneously, and that may be the reason why during the first years of GSM era the prices declined only smoothly and not dramatically. On the other hand, in 1998 when new operator, Telia, started its services it did not affect prices loweringly either. Actually in 1998, Radiolinja increased its prices from fixed phone to mobile network. Competition with afore mentioned players has been quite soft. It has not affected much prices, but however competition has accelerated the diffusion, because it offers consumers more alternatives. The entry time of Telia may not have been the best possible, because it launched its services in a year when the sales peak occurred. Mobile had become a popular among people and they wanted a phone, because everyone else had it too. Operators were not obligated to lower their prices, because sales were good anyway. Competition shows more in the amount of new services than in the price level.

Although the competition has not had much effect on average price level, competition is still shown in operators' pricing strategies, e.g. the prices of Sonera

and Radiolinja have followed each other. When the other has either declined or increased its prices the other has adjusted to new price rapidly. Operators need to be aware of others pricing strategies, so that they can respond quickly competitors' price changes.

Price competition intensified in 2001 when DNA became into market. Now operators are lowering the prices and price competition is one means to achieve new customers and keep up the old ones. The greater and more aggressive the competition becomes the more operators need to compete with price. Now even the bigger operators have been forced to decrease prices to maintain their customers, because new and smaller operators have very aggressive pricing strategies. If the growth of mobile communications slows even more down and operators start competing more against each other for existing customers, more rapid price declines can be expected.

### *8.5 Effects of Price on Diffusion*

In the present thesis, because of the complexity of pricing, price index is used in the analyses. The index shows the approximate decline in the tariffs of mobile phone calls. The price index is presented in chapter seven.

The prices of mobile phones are also used in the analysis, because buying a subscription depends on the fact, whether a consumer has a mobile or not. The average price of mobiles is used, because there are plenty of different kinds of mobiles and it is not easy to evaluate which phone has been the most common in certain time. The average price of mobiles gives some kind of picture how the prices have developed. The prices have declined enormously during the last decade and today mobiles have more attributes than in the early 1990s because of the development of technology. A few studies suggest that a monotonically declining price is optimal only if the discount rate is very high (Krihnan et al. 1999, p. 1651). The discount rates of mobiles have been quite vast and therefore one could assume that the price would affect the diffusion positively.

According to the previous studies of the effects of price on the diffusion (see Chapter

5) price is assumed to affect either the number of potential adopters or the diffusion rate. In the present study both kind of models are tested and evaluated. The model, which is used in estimating the effect of price on the diffusion rate, is selected among the models presented in chapter five. To evaluate the impact of price on the number of potential adopters, the market potential is believed to be a function of price. The market potential variable of the logistic function is replaced with this new function. Because price and time variables correlate with each other they cannot be used simultaneously but they need to be combined to as one variable.

The effects of both mobile phone call and mobile phone price on market potential and diffusion rate are systematically tested and evaluated. First, the logistic model is fitted into the cumulative diffusion curve of subscriptions and mobiles sold over time using the SPSS non-linear programming procedure. Second, the price variable is incorporated into the logistic diffusion model. The models are tested both by using mobile tariffs and mobile phone prices. Then, the accuracy of the forecasts is measured by different error terms and the results are compared with each other. In order to make the estimations comparable with each other both the effects of price on the diffusion rate and the market potential are estimated by using the logistic function.

### 8.5.1 Effect of Price on the Diffusion Rate of Cellular Subscriptions

In the following analysis, diffusion modelling of the effects of price on the diffusion rate of cellular subscriptions is proceeded in two steps.

*Step one: Estimating how the data fits to the logistic diffusion model.*
In first step, the data is tested and the logistic model is applied on the annual total subscriptions data. The used data ranges from the year 1993 until year 2001. The parameter estimates and error fit statistics are depicted in Table 8-1. The error terms are achieved by comparing the logistic function to the actual growth of subscribers.

**Table 8-1 Parameter Estimates and Error Fit Statistics for Subscriptions**

| | **TOTAL** | | **SONERA** | | **RADIOLINJA** | |
|---|---|---|---|---|---|---|
| $R^2$ | 0,99682 | | 0,99822 | | 0,99794 | |
| Mean error | -0,0167 | | -0,0096 | | 0,0015 | |
| Mean Abs Error | 0,0794 | | 0,0352 | | 0,0215 | |
| Mean Pct Error | -60,4 | | -88,7 | | -1,5 | |
| Mean Abs Pct Error | 62,5 | | 90,9 | | 11,1 | |
| MSE | 0,0085 | | 0,0017 | | 0,0006 | |
| RMS | 0,0921 | | 0,0407 | | 0,0252 | |
| | | Std. error | | Std. error | | Std. error |
| a | -5,5813 | 0,3578 | -5,5985 | 0,2733 | -6,8256 | 0,4007 |
| b | 0,8306 | 0,0634 | 0,86518 | 0,0489 | 1,09439 | 0,0693 |
| $y^*$ | 4,42127 | 0,1566 | 2,54749 | 0,0598 | 1,34025 | 0,0263 |

The overall fit ($R^2$ = 0.99682) of the total data is very good as well as the fits of Sonera and Radiolinja. Also the parameter estimates seem realistic (see standard errors in Table 8-1). The market potential estimates (total 4.42 million, Sonera 2.55, and Radiolinja 1.34) are close to the actual saturation level of the year 2002 (total 4.48 million, Sonera 2.52, and Radiolinja 1.30). Therefore, the logistic function can be used in the present study. However, the mean absolute percentage errors of the variables total and Sonera are unrealistic and they cannot be used in the analysis. This is due to the fact that the logistic function starts to grow faster than the actual growth. Later, the logistic diffusion curve mimics better the actual growth. Other error terms of data: Mean Absolute Error (MAE), Mean Error (ME), and both MSE and RMS are though good, e.g. the MAE for total data is 79,400 subscribers. These error measures can be used for measuring the accuracy of the single series.

The logistic model is applied on the annual total mobile phone data as well. Table 8-2 reviews the estimation results.

**Table 8-2 Parameter Estimates and Error Fit Statistics for Mobile Phones**

| | TOTAL | |
|---|---|---|
| $R^2$ | 0,99950 | |
| MAE | 0,0406 | |
| MPE | -5,6687 | |
| MAPE | 7,3164 | |
| | | Std. error |
| a | -4,8197 | 0,09047 |
| b | 0,5971 | 0,01879 |
| $y^*$ | 8,9223 | 0,28404 |

The parameter estimates show that the fit of the mobile phone data is also very good ($R^2 = 0{,}9995$). The mobile phone data fits better to the model than the subscriptions data. The Mean Absolute Percentage Error is good, only 7,3 %. The biggest error comes again from the beginning, although the error is not as big as the error of subscriptions data. Also the estimate for the future sales is good (8.92 million). The actual number of sold mobiles at the end of 2002 was 8.04 million.

*Step two: Estimating the effect of price on the diffusion rate*.

Because logistic function gives good estimates for *a*, *b*, and $y^*$, the price parameter is included to logistic function. Krishnan et al. (1999) included price variable to the Bass model. In the present study, the same is done using the logistic model. Time variable is replaced with another variable ($t+\beta\left[\ln\frac{\Pr(t)}{\Pr(0)}\right]$), where *Pr(t)* is price at time *t* and *Pr(0)* is the introductory price of the new product. $\beta$ is the diffusion price parameter since it controls the effect of price in accelerating or decelerating the diffusion process. The modified logistic function can be presented as follows:

$$y(t) = \frac{y^*}{1 + e^{-(a+b*(t+\beta*\left[\ln\frac{\Pr(t)}{P(0)}\right]))}}. \qquad (9)$$

First, the mobile phone call price is included in the model. Although the overall fit ($R^2 = 0.99666$) of the model, where mobile tariff is included, is good, and the parameter *a* is significant, and the estimated market potential seems realistic (4.57

million) and more accurate than with the simple logistic function, the model yields insignificant estimates for the parameters *b*, which estimates diffusion rate, and $\beta$, which estimates price. Due to the values of *b* and $\beta$ the model, where the price is included, does not explain the diffusion rate better in overall than the simple logistic model. Only market potential estimate is closer to the actual value than the value of the basic model. The error terms are, however, better in the model with price variable in it (MAE = 75,300 subscribers).

The results show that time affects already significantly the diffusion and more accurate results are not achieved with the model where price is included. The statement, that the logistic model provides a good fit to adoption data as such, gives an explanation of why the logistic function fits without any decision variables. This can been seen also from Figure 8-3. Incorporating price in the logistic model does not lead to notably better forecasts than the basic logistic model. The curves of the logistic model, the logistic model with price variable and the actual amount of users are presented in Figure 8-3.

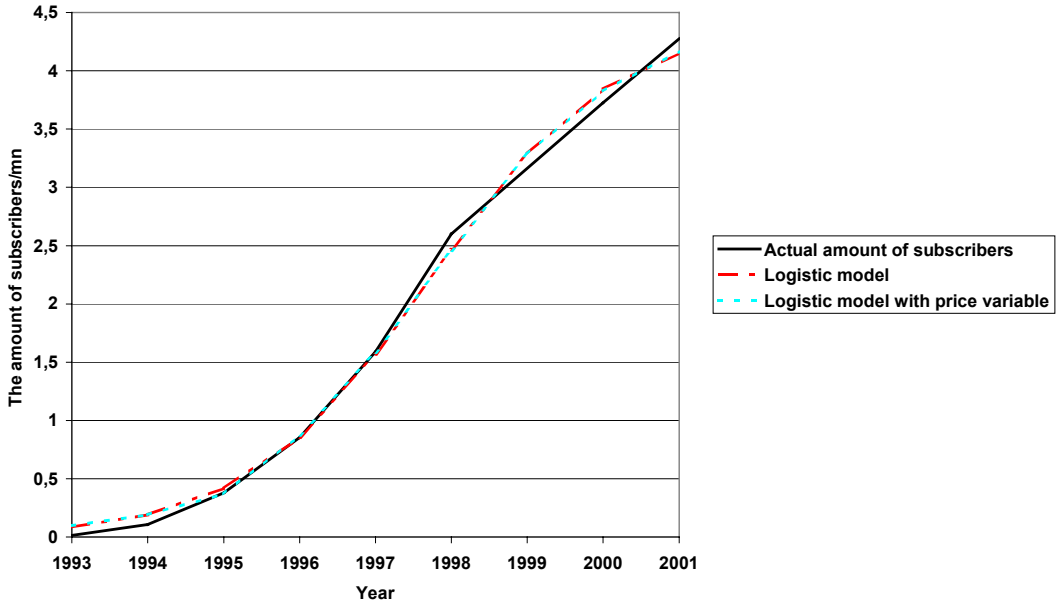


**Figure 8-3 Diffusion Curves of Subscriptions**

The curve with price variable in it is almost identical with the logistic curve and the

price does not seem to have increasing or decreasing effect on the diffusion process. However, one cannot make conclusion that the price of mobile phone calls does not affect diffusion rate at all. It is not obvious that the way price is modelled to impact the rate of adoption is appropriate, and therefore the achieved results may be due to incomplete model: the model is not suitable for testing the effects of call prices. Most likely the price affects diffusion, but however the effects are not significant, because the price of mobile phone calls declines monotonically.

In the second step, also the effects of mobile phone prices on diffusion are tested. Both the effects of price on the diffusion of mobile phones and GSM subscriptions are evaluated, because the price of mobiles is also assumed to affect the diffusion of subscriptions. If having a mobile it is almost a necessity to have a subscription, because a subscription requires a mobile.

The fit ($R^2$ = 0,99954) of the model where price is included is better than the fit of the logistic model for sold mobiles without price variable. The model gives good estimates for the parameters $y^*$, $a$, and $b$ as well. On the other hand, the estimates for the parameter $a$ and $b$ are not as good as the values what the basic logistic function yields. In overall the smaller the value $a$ is and bigger the $b$, the better estimates are achieved. In addition, the variable $\beta$ gets insignificant value. The estimation for $y^*$ (number of potential adopters) is clearly higher (9.20 million) compared to the estimated variable of the simple logistic function. This seems more realistic result, because the sales of mobiles keep growing, because of the new mobile phone models. People are willing to change their mobiles quite often, approximately in every 16 months (Viitasaari 2002). The higher estimate for future sales may be due to the fact that the models give normally better estimates and the accuracy of the model is increased if some variable, like price or advertising is added to the model. The curves of actual amount of sold of mobiles and the both logistic curve and the curve with price variable are illustrated in Figure 8-3.

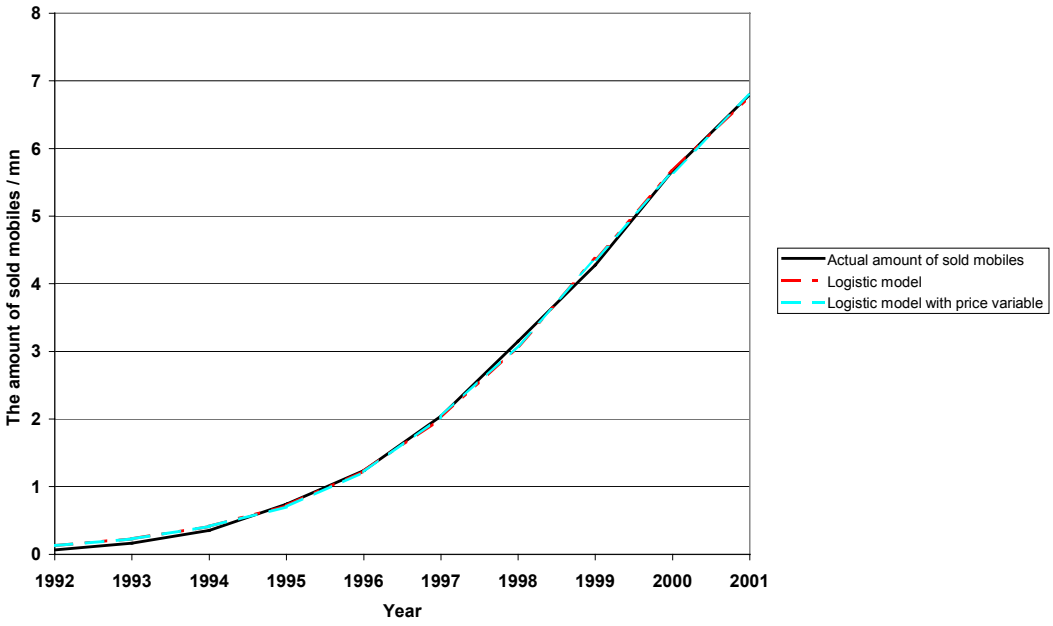


**Figure 8-4 Diffusion Curves of Mobile Phones**

Price variable decreases the error of logistic function. The MAPE of the logistic function is 7,32 % as the MAPE of the logistic function with price variable is 7,20 %.

If the total subscriptions data is used and the price of the mobiles is included in the logistic function higher estimates for market potential (4.71 million) and better estimate for the parameter *b* are achieved than if the phone call price is used instead of mobile phone price. However, the parameter, which estimates price, gets once again insignificant value. It should be noted that the parameter estimates and fits of the models are quite similar regardless of the type of the model. The differences of the estimates are marginal, and therefore the following conclusion can be drawn: price has no considerable effects on the diffusion rate of cellular subscriptions.

Normally, price is assumed to influence the rate of adoption only for relatively expensive durable goods (e.g. Balasubramanian and Kamakura 1988; Jain and Rao 1990). A mobile is not considered to be as an expensive durable good as for example PC. This may cause that the price does not have considerable effects on the diffusion rate. One could assume, as the mobiles have become more common in a society that

the price is not the number one reason for achieving a cellular and the price has not affected the buying decision remarkable. In other words, some other reasons have affected diffusion more than prices. The prices of mobiles have declined monotonically as well as the mobile phone call prices and no price peaks have occurred, except in the beginning, and therefore the prices have not accelerated diffusion significantly.

### 8.5.2 Effect of Price on Market Potential of Cellular Subscriptions

The growth of the potential adopter population is controlled normally by price. Therefore, the effect of price on the market potential is important to research as well. The market potential has to be defined as a function of price if the effect of price wants to be evaluated. In the present analysis, price and market potential are assumed to have either linear or non-linear correlation and the market potential is not constant but a function of price. Linear means that when price decreases the number of potential adopters increases equivalently. Non-linear correlation refers to the situation where in the beginning price may decrease linearly as well as the number of potential adopters but soon after the price reductions do not affect as much market potential than earlier. In other words, price level may fall, but it does not necessarily mean that the number of potential adopters grows. This is the 'normal' situation because markets cannot be saturated linearly even at low prices. The linear and non-linear correlations are illustrated in Figure 8-5.

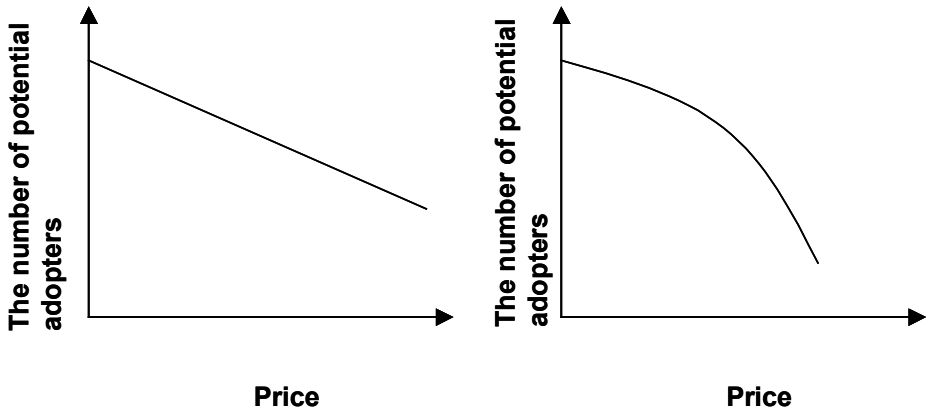


**Figure 8-5 Linear and Non-linear Correlation of Price and Market Potential**

The analysis of the effect of price on market potential is also proceeded in two steps.

*Step one: Estimating the effect of price on the market potential (the number of potential adopters) when the correlation between price and market potential is linear.*

To estimate the effect of price on the market potential the variable $y^*$ (market potential) of the logistic function needs to be replaced with another variable, which includes price. $y^*$ is substituted with linear function $y^* + \beta * \Pr(t)$. $\beta$ is the parameter, which estimates price and *Pr(t)* refers to the price at time *t*. This function measures the effect of price on market potential.

$$y(t) = \frac{y^* + \beta * \Pr(t)}{1 + e^{-(a+bt)}}. \qquad (10)$$

First, the effect of mobile phone call prices on the market potential is evaluated. Model fails to provide better values for the estimates *a* and *b* than the basic logistic function, although the model gives better fit for the data ($R^2$ = 0,99723) and errors of the model are smaller, e.g. MAE is 72,000. Also, the estimated eventual market potential (3.99 million) is clearly lower than the actual saturation level in the end of year 2002. However, the value of estimated market potential is statistically significant. The variable, which estimates price, gets a negative value. This value indicates that when the price declines a certain amount the market potential grows instead. However, the model provides statistically insignificant estimate for the variable $\beta$, and therefore it can be stated that mobile tariffs do not affect the market potential of cellular subscriptions. Different diffusion functions are illustrated in Figure 8-2.

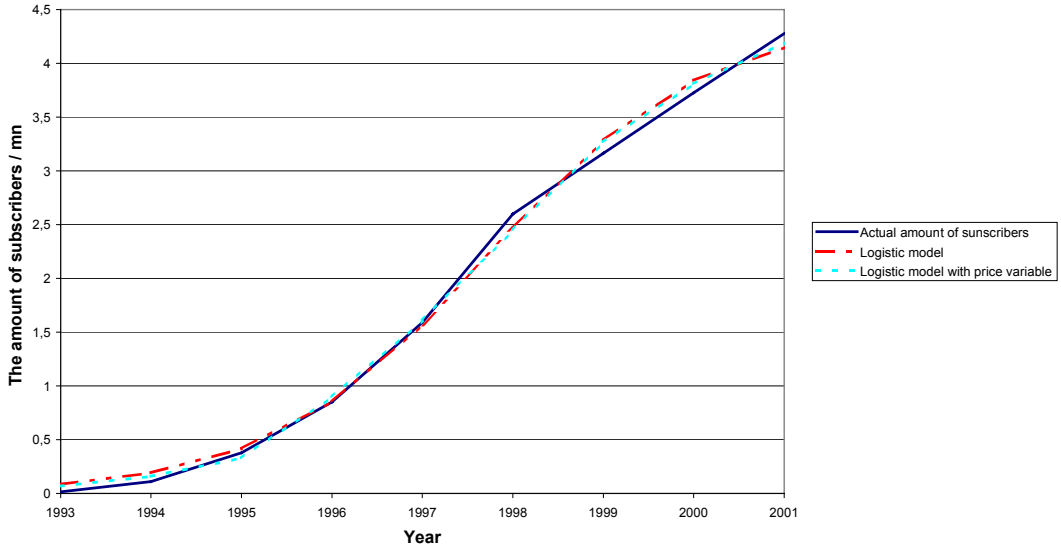


**Figure 8-6 Diffusion Patterns of Cellular Subscriptions.**

Although the model with price provides poor estimates for the parameters, still the function with price imitates better the actual growth of subscribers than the simple logistic function (see Fig. 8-6).

The modified logistic function did not work at all in estimating the effects of mobile phone price on the market potential. It gives implausible parameter estimates for the variables. This result indicates that the correlation between market potential and mobile phone price is not linear at all and $y^*$ cannot be replaced with linear function.

*Step two: Estimating the effect of price when the correlation between price and market potential is non-linear.*

The diffusion pattern is described by the parameters estimated with the extended logistic model. Now, the market potential variable, $y^*$, is replaced with a non-linear function ( $y^* * \Pr(t)^{\beta}$ ). The function then becomes as follows:

$$y(t) = \frac{y^* * \Pr(t)^{\beta}}{1 + e^{-(a+bt)}}. \qquad (11)$$

The non-linear model fails in estimating the effect of the mobile tariffs on market potential. The model reaches the iteration limit even if the iteration limit is high. Thus, the model leads to insignificant estimates for the parameters of the diffusion process, the market potential, and the decision variables. Therefore, the non-linear model is not appropriate for testing the effect of cellular call prices, although one could assume that non-linear correlation between price and market potential would be more probable than linear.

If estimating the impact of mobile prices on market potential of the mobiles the price parameter $\beta$ obtains a negative value, which is in addition insignificant. The model does not either provide a good estimate for future market potential (6.8 million). It underestimates the sales. However, the fit of the model ($R^2 = 0{,}99952$) is better than the simple logistic model has. Standard errors are, e.g. MAPE 7,35 %, almost as goods as the errors of the simple logistic function.

The results obtained from the tests are as expected: the prices do not notably affect market potential. Though, it cannot be concluded that market potential is not affected by price at all. The simple logistic mobile provides good results as such, and therefore the model with price variable does not make forecasts more accurate. The extended logistic model may as well be invalid for testing the effects and that may cause the estimation process to fail.

The effect of prices on the market potential was also tested with the Bass model. However, the results were not better than the results obtained with the logistic pattern. The Bass model failed to provide significant value for the price parameter as well.

The correlation of mobile phone call price and the residuals of the logistic function was tested as well. No correlation existed between these variables. This result affirms the fact that the function with price variable does not explain better the diffusion rate and potential than the simple logistic function. No correlation between mobile phone prices and the residuals was found either.

### 8.5.3 Conclusions of the Effects of Price on Diffusion of Subscriptions

Generally, the incorporation of prices into the model of innovation diffusion failed to significantly enhance the exploratory power of the model compared to the simple time-dependent variant, logistic model. The results are most likely due to the small number of observations and the poor fit of the model for testing the effects of price.

The results show that most likely the monotonically declining prices do not have significant effects on the diffusion rate or potential number of mobile phone subscriptions. Although discount rates of both the prices of calls and mobiles have been vast prices have not had major effects on diffusion, because prices have declined monotonically. Of course, the declining price trend causes automatically the market potential to grow over time. It is natural that consumers adopt an innovation earlier if the prices are low enough already in the beginning. More dramatic price peaks or fluctuation of prices would most likely have more effects on the buying behaviour of the consumers than the monotonically declining prices. Thus, on the basis of the achieved results of the effects of price on diffusion rate and market potential, it can be assumed that the price has not a large impact on the first time purchase. However, price may affect the timing of early replacements of the mobiles and if the annual subscription cost of some operator is higher than the others have, a customer may renew his subscription type and favour some other operator.

Because it is not possible to achieve monthly statistics of different subscriptions, sold mobiles, and price changes we do not know how for example price campaigns and price reductions in certain month affect the sales. One could assume that different price campaigns, like free airtime offerings affect the diffusion of subscriptions in monthly level. For example at Christmas time when operators offer free airtime more than normally the sales of subscriptions increase temporarily. However, this does not affect the diffusion remarkable annually, because the average sales of Christmas time bring down the sales of January or some other month. The price offerings most likely encourage people to achieve a new subscription, but they have no intentions to change their subscriptions permanently. Only the free airtime offers are used. High churn rates are partly due to these aggressive price campaigns.

Because the prices do not have much impact on diffusion of cellular subscriptions, one could assume that prices would instead affect more call durations. People speak more on the phone if the prices are low. Operators' revenues grow if the prices are lower, but it does not explain the diffusion.

# 9 CONCLUSIONS

This chapter discusses the main implications of the present study. First, the conclusions are made. Also the limitations of the study are reviewed. Finally, some proposals for further research are given.

## *9.1 Summary and Major Findings*

In this study the main object was to examine the effects of price and competitive situation on the diffusion of mobile communications. In the theoretical part, the purpose was to define the concept of diffusion, to explain the diffusion patterns in telecommunications field as well as to review the theories of competition and pricing in the highly turbulent telecommunications markets. Also the relations between competition, price and diffusion were clarified. Furthermore, the objective of the empirical part was twofold: First, the aim was to clarify the competitive situation of Finnish mobile communications market, and secondly, the effect of competition on price was explained and the effect of price on diffusion was studied empirically. Due to the limitations of the data, the analyses were limited to concern only the whole diffusion of GSM subscriptions in Finland, and no operator level results were achieved.

The end results show the effects of price of cellular subscriptions on the diffusion rate and potential and how the competition has affected price level. Theories of pricing and diffusion suggest that price affects either the rate of diffusion or the market potential of the different consumer durables, but the present study found no effects of monotonically declining mobile tariffs and mobile phone prices on the diffusion of cellular subscriptions. In fact, one could assume that if the prices do not affect diffusion prices may instead have effects on call durations, because lower prices encourage people to use their mobiles more. Theories also suggest that competition accelerates diffusion and lowers prices. In Finnish mobile communication market competition may have speeded up diffusion, but it has not

had much impact on prices, at least not before DNA, the third biggest operator in the market, launched its services. It was not until recently when price competition started in wider scale.

In Finland, the diffusion of cellular subscriptions seems to follow the S-shape pattern and the penetration is close to maturity. One interesting question derived from the competitive analysis of the study is how high penetration of the cellular subscriptions may go over the next several years when there is no more new adopter potential in the market? One can only try to guess the answer. The current price competition is distorted already and operators are trying to achieve new customers with all possible means. In addition, new operators are coming to market and their pricing strategy is to charge less than the already existing operators charge. This causes price wars between operators. Setting a price is already difficult for operators and the competition may lead to the situation where all operators have a subscription that has the same price for all the calls, even to competitors' network. The price wars may also lead to a situation where in the future the bigger operators will loose their customers to smaller operators or perhaps the smaller will disappear. However, most likely the power balance will change if not the whole structure of the Finnish mobile communications market.

Given the managerial implications of this study, it appears reasonable to conclude that low price adjustments do not affect diffusion of cellular subscriptions. Based on the results, it could be assumed that the price adjustments actuate more on the duration of calls than the diffusion of subscriptions. Diffusion rate is likely to accelerate when operators take up considerable price reductions. These price declines also contribute to growing number of churn rates.

### *9.2 Limitations and Further Research*

The number of limitations of this study should be noted. First, one problem with considering competition and the effect it has on diffusion is that we do not have an appropriate diffusion model to use. In this study, the main problem was not to study competition and diffusion but price and diffusion. However, future research should

focus on developing an appropriated diffusion model that includes both the effect of competition and pricing, because also competition has large impact on diffusion rate and potential.

Second, the models used in the analyses are made for expensive durable goods, not for the services. Thus, these models are not satisfactory in estimating the effects of price of fast changing high technology products or services on diffusion. The basic models also assume that the nature of the innovations remain constant. However, the nature of mobiles has dramatically changed during the diffusion. The validity of the diffusion models where price is incorporated has been satisfactory for consumer durables. Still, can it be argued that these models have enough validity if incorporating the prices improves the predictive performance of diffusion models only marginally? Because these models rarely add the forecasting capacity of the simple diffusion models, there is in the future a strong demand for diffusion models that estimate better the effects of both call and service prices as well as the prices of durables. It also has to be noted that price is not the only marketing variable affecting the diffusion process. Other variables, such as advertising, play also an important role in product diffusion. Therefore, further studies should concentrate on developing a model where all the marketing mix variables are included.

Third, the used data also caused some limitations. First, the price data was inadequate. Another problem, which is not merely a problem of the present study but also the problem of all the studies concerning the sales of subscriptions, was that today, when the churn rates are high, the reliability of the diffusion data should be carefully checked. The number of subscriptions sold in a certain time period is no longer a valid indicator, and as a consequence the numbers presented in this study are not exact for estimating the diffusion.

In addition, the exploratory character of this study needs to be stressed: only GSM mobile phone calls were analysed. It will be useful to investigate whether this pattern holds across the diffusion of NMT and fixed phones as well. Also, further research to examine the generalizability of these results to each telecom operators separately would be valuable. Additional empirical studies will lead to an enhanced

understanding of the essential issue of the effects of price on the demand for high technology, fast changing, products.

To estimate the effects of price on diffusion process is somewhat difficult by using only the generalized diffusion models. Therefore, other techniques and tools would be valuable to take into use along side the diffusion models in further research. For example, cointegration analysis could be used in analyzing the effects of mobile phone and mobile call prices on diffusion, and especially the relations between prices and sales, because cointegration analysis seeks to identify and quantify the associations between two sets of variables. In addition, the user level analysis could be a valuable tool in further research.

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**APPENDIX 1**

## Price Table of the Mobile Phone Call Prices in Europe (OECD 2000b).

| | **Calls from a fixed phone to mobile (USD PPP)** | | **Calls from a mobile to a fixed phone (USD PPP)** | |
|---|---|---|---|---|
| Time of day | 11:00 | 20:00 | 11:00 | 20:00 |
| Austria | 0,30 | 0,16 | 0,37 | 0,23 |
| Belgium | 0,38 | 0,17 | 0,32 | 0,13 |
| Czech. Rep. | 0,49 | 0,49 | 0,44 | 0,27 |
| Denmark | 0,19 | 0,10 | 0,22 | 0,11 |
| **Finland** | **0,24** | **0,15** | **0,24** | **0,12** |
| France | 0,43 | 0,22 | 0,22 | 0,22 |
| Germany | 0,47 | 0,24 | 0,68 | 0,27 |
| Greece | 0,47 | 0,47 | 0,38 | 0,38 |
| Hungary | 0,53 | 0,35 | 0,63 | 0,46 |
| Iceland | 0,20 | 0,16 | 0,18 | 0,13 |
| Ireland | 0,26 | 0,17 | 0,28 | 0,14 |
| Italy | 0,40 | 0,15 | 0,27 | 0,15 |
| Luxembourg | 0,35 | 0,21 | 0,10 | 0,10 |
| Netherlands | 0,42 | 0,24 | 0,34 | 0,14 |
| Norway | 0,18 | 0,18 | 0,16 | 0,15 |
| Poland | 0,69 | 0,69 | 0,53 | 0,29 |
| Portugal | 0,50 | 0,50 | 0,34 | 0,34 |
| Spain | 0,34 | 0,34 | 0,62 | 0,28 |
| Sweden | 0,35 | 0,23 | 0,49 | 0,17 |
| Switzerland | 0,38 | 0,26 | 0,36 | 0,24 |

**LAPPEENRANTA UNIVERSITY OF TECHNOLOGY**

**Department of Industrial Engineering and Management**

Section of International Operations and Marketing

# EFFECT OF COMPETITIVE SITUATION AND PRICE ON DIFFUSION OF MOBILE COMMUNICATIONS

The subject of this thesis was approved by the council of the department of industrial engineering and management in the meeting of 9 April 2003 in Lappeenranta University of Technology.

| | |
|---|---|
| Supervisor of the thesis | Professor Seppo Pitkänen |
| Instructor and supervisor | Professor and Project manager Sanna Sundqvist |

In Lappeenranta, 19 May 2003

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Additionally, I want to express my gratitude to my family giving me all the support needed during my studies. Last but not least, I want to thank Kalle for his encouragements.

**ABSTRACT**


| | |
|---|---|
| Author: | Eeva-Mari Karine |
| Title: | Effect of competitive situation and price on diffusion of mobile communications |
| Department of Industrial Engineering and Management | |
| Year: | 2003 Place: Lappeenranta |
| Master's Thesis: | Lappeenranta University of Technology, 110 Pages, 20 figures, 6 tables, and 1 appendix. |
| Supervisors: | Professor Seppo Pitkänen and Professor and Project manager Sanna Sundqvist |
| Keywords: | Diffusion, innovation, price, competition, cellular subscription, mobile phone, mobile communications |

The main object of the thesis was to study the effects of price and competitive situation on diffusion of mobile communications. The empirical part of the study concentrated on explaining the effects of the price of cellular subscriptions and mobile phones on the diffusion and how the competitive situation has affected the price level of mobile communications. The competitive situation of Finnish mobile communications was also analysed. The data of the study was collected from the secondary sources, e.g. from EMC- database. The research approach was quantitative.

The models used in the empirical analyses were formed based on previous studies. A regression analysis was applied to estimate the effects of price on diffusion rate and market potential. The method applied for this was non-linear regression analysis.

The end results show that the monotonically declining prices of subscriptions and mobile phones have not had any considerable effects on the diffusion of mobile communications. Additionally, it was found that competitive situation has not affected much general price level. Based on the results of the study, few aspects were given for further research.

**TIIVISTELMÄ**


| | |
|---|---|
| Tekijä: | Eeva-Mari Karine |


| | |
|---|---|
| Nimi: | Effect of competitive situation and price on diffusion of mobile communications |
| Osasto: | Tuotantotalouden osasto |
| Vuosi: | 2003 Paikka: Lappeenranta |
| Diplomityö: | Lappeenrannan teknillinen yliopisto, 110 sivua, 20 kuvaa, 6 taulukkoa ja 1 liite. |
| Tarkastajat: | Professori Seppo Pitkänen, Professori ja projektipäällikkö Sanna Sundqvist |
| Hakusanat: | Diffuusio, innovaatio, hinta, kilpailu, matkapuhelinliittymä, matkapuhelin, matkaviestintä |
| Keywords: | Diffusion, innovation, price, competition, cellular subscription, mobile phone, mobile communications |


Työn päätavoitteena oli selvittää hinnan ja kilpailutilanteen vaikutusta matkaviestinnän leviämiseen eli diffuusioon. Työn empiirinen osuus tarkasteli matkapuhelujen sekä matkapuhelimien hinnan vaikutusta liittymien diffuusioon sekä sitä, miten alan kilpailu on vaikuttanut matkaviestinnän hintatasoon. Työssä analysoitiin myös matkaviestinnän kilpailutilannetta Suomen markkinoilla. Tutkimuksen empiirinen aineisto kerättiin toissijaisista lähteistä, esimerkiksi EMC-tietokannasta. Tutkimus oli luonteeltaan kvantitatiivinen.

Empiirisessä osassa käytetyt mallit oli muodostettu aikaisempien tutkimuksien perusteella. Regressioanalyysia käytettiin arvioitaessa hinnan vaikutusta diffuusionopeuteen ja mahdollisten omaksujien määrään. Regressioanalyysissa sovellettiin ei-lineaarista mallia.

Tutkimustulokset osoittivat, että tasaisesti laskevilla matkapuhelinliittymien sekä matkapuhelimien hinnoilla ei ole merkittävää vaikutusta matkaviestinnän diffuusioon. Myöskään kilpailutilanne ei ole vaikuttanut paljon matkaviestinnän yleiseen hintatasoon. Työn tulosten perusteella voitiin antaa myös muutamia toimenpide-ehdotuksia jatkotutkimuksia varten.

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*Chapter 7*



*Chapter 8*



## LIST OF FIGURES

*Chapter 1*



*Chapter 2*



*Chapter 3*

**ABBREVIATIONS**

| | |
|---|---|
| a | Timing of the diffusion process |
| APE | Absolute Percentage Error |
| b | Diffusion rate of information |
| $\beta$ | Parameter that estimates price |
| GPRS | General Packet Radio Services |
| GSM | Global System for Mobile Communications |
| EDGE | Enhanced Data Rates for Global Evolution |
| EMC | World Cellular Database |
| MAE | Mean Absolute Error |
| ME | Mean Error |
| MAPE | Mean Absolute Percentage Error |
| MPE | Mean Percentage Error |
| MSE | Mean Squared Error |
| MTC | Ministry of Transport and Communications |
| NMT | Nordic Mobile Telephone System |
| PTO | Public Telephone Operator |
| $R^2$ | R-Square |
| RMS | Root-Mean Square |
| RL | Radiolinja |
| SMS | Short Message Service |
| SPSS | Statistical Analysis Program |
| Std. Error | Asymptotic Standard Error |
| TAI | Technology Advancement Index |
| UMTS | Universal Mobile Telecommunications System |
| $y^*$ | Potential number of adopters |