

Demand Development of Digital Cellular Communication

- The Concept of Simulation Model as a DSS -

Claudia Loebbecke

University of Cologne
Wilh.-Backhaus-Str. 23, 50931 Koeln, Germany
e-mail: afa03@rs3.rz.uni-koeln.de, Tel: ++49-221 444 900

Abstract

The paper covers work in progress concerning the concept of a dynamic simulation for the demand of digital mobile communication in Germany until the year 2005. The need for such a model and the value of a DSS in the form of a simulation model are briefly discussed. System goals and potential users - a for a DSS comparatively broad group - are presented. Furthermore, the paper outlines some background information regarding different kind of mobile communication, and provides some details on GSM.

The second part of the paper introduces the basic model principles and lists the main demand influencing factors selected for the simulation model. As an example, the overall model structure of one input factor is analysed in more detail demonstrating the importance of the feedback loops for the model. Finally several simulation possibilities are mentioned. The paper concludes with some critical questions regarding the usefulness of the 'soft' model concept and its relevance for the DSS field.

Introduction

Need for dynamic market development model from a demand perspective

Mobile communication is a demand driven business segment, different from other telecommunication technologies like BTX (in Germany), ISDN, satellite technology and fiber optics in the sense of "Fiber to the home".¹

Literatur² provides numerous estimates regarding the market growth of digital cellular communication in Europe as a whole or in a specific country. However, since most of the forecasts are executed by commercial market research institutes, they do not make explicit the analysis leading to the result. Furthermore, most of the estimates derive the numbers from the supply side.³

¹ See Bonek/ Technologie/ 59.

² See Commission of the European Community/ Introduction/ 94, OECD/ Communications Outlook/ 47; Cawthorne/ Transition/ 1; Eutelis/ Scenario Summary/ 5.

³ For example, the input factors taken into account by in the BIS are: "potential market size", "operators", "liberalization", "deregulation", "population", "penetration", "GDP", "Price (Service and Equipment)", "Coverage", and "Launch Plans".

The growing impact of mobile communication on our daily life is reflected in the rather popular slogan "Communication anytime and anywhere". An even stronger impact sees J.P. Ware during the joint Annual Conference of TMS / ORSA ("Institutes of Management Science" und der "Operations Research Society of America") 1994. He spoke about "Communication everytime and everywhere".

Interdependences between technological, professional and social factors on the demand side influence and characterize the market development patterns for mobile communication, but they are usually not integrated into the market forecasts.

DSS in the form of a simulation

"In the past, business computer models were thought of as technical tools for tightly structured problems of prediction, optimization, or financial planning. But increasingly models are seen to have a different and more subtle role as *instruments* to support strategic thinking, groups discussions and learning in management teams."⁴

The DSS to be introduced in this paper should serve as such an instrument. It is a "System Thinking" model to help single users or groups to understand the feedback loops and their dynamic consequences in the context of mobile communication demand, and to simulate various scenarios depending on either decisions of one or more players or on changes in the external environment. Thus the emphasis in the term "DSS" is clearly on the "Support".

The DSS, i.e. the model, aims at⁵

- clearly making the assumptions explicit underlying out mental models,
- demonstrating the - over time - changing consequences of the hypotheses,
- being easier to follow than verbal texts.

Its validity and usefulness should not be judged in comparison to an ideal perfection, but only in comparison with other mental and descriptive models to be used alternatively.⁶ Finally, the model should serve as an effective catalyst for inspiring enrichments to the current, shared mental model. The peculiarity / chance, but also the complexity of a System Thinking model as a DSS is expressed in one of the ground rules in the field summarized by Peter Senge:⁷

"In System thinking it is an axiom that every influence is both cause and effect. Nothing is ever influenced in just one direction."

Senge⁸ also lists the various intended contributions of simulation models of so-called "microworlds" to organizational learning and decision making:

- Integrating the microworld and the real world
- Speeding up and slowing down time
- Compressing Space
- Isolation of Variables
- Experimental Orientation
- Pauses for Reflection
- Theory-based Strategy
- Institutional Memory

⁴ Morecroft/ Knowledge/ 9.

⁵ See Forrester/ Grundzüge/ 77.

⁶ See Forrester/ Grundzüge/ 77.

⁷ Senge/ Discipline/ 75.

⁸ See Senge/ Discipline/ 335-336.

Specific System Goals

- Analytic forecast regarding the development of the GSM⁹ demand in Germany
 - Presentation of the demand factors and their interdependencies
 - Exclusion of factors not influenced by the demand side (e.g. regulatory aspects of GSM "supply")
- Development of a simulation model regarding the diffusion of GSM as an example of an innovative IT infrastructure.
 - Presentation of assumptions and the resulting behaviour patterns; precise numbers are less important than simulation results.
 - Transparency concerning actual or subjectively sensed dynamic GSM development patterns and thus providing the basis for further learning and better decisions for GSM suppliers and users.
- Development of a tool that will be adaptable to a changing environment and thus be transferable to different IT infrastructures.

Potential System Users

- GSM Providers (network providers, equipment producers, service provider, distributors)
 - The newly structured market forecast should help to improve the business strategy in the middle and long run, and contribute to finding decision parameters regarding service offers and product positioning.
 - Adjustment of the system to simulate the consequences of specific assumptions and strategic decisions (Organizational Learning).
- Current and potential GSM users
 - Transparency regarding the input factors of GSM-usage.
 - Chances and risks of GSM-usage.
 - Decision support regarding future usage.

System Context

Importance of digital cellular communication

- The telecommunication industry is becoming the most important industry in Germany and Europe

In 1993, the telecommunication industry accounted for 2% of the European GNP; its share is forecasted to increase to 7% by the year 2000. By the year 2000, more than 60% of the European employees will be dependent on the telecommunication industry.

With growth rates of more than 10 % p.a. the German telecommunication industry will reach a turnover of DM 300 billion by 1997, and thus be close to the automobile industry.¹⁰
- With an about 30% annual growth rate in Germany, mobile communication is the fastest growing segment within the telecommunication industry.¹¹

⁹ Due to the similarity from the users perspective, in the following the actual GSM licenses operating with 900 MHz (D1- and D2 in Germany) and the German version of PCN (E-Netz) operating with 1800 MHz are comprised under the abbreviation "GSM".

¹⁰ See Mellmer/ Unternehmen Zukunft/ 26.

¹¹ See Szenarius/ Markt/ 6.

- Digital cellular communication (GSM) is by far the largest segment within mobile communication and is expected to further increase its share until the year 2005.
 "GSM's share of the mobile communication market is expected to be 35%-60% up to the year 2000."¹²

Mobile Communications Overview

A word of caution: It is often stated that wireless communication increases people's mobility. This does not seem to be fully correct: While means of transportation have actually increased mobility, mobile communication only improves mobile reachability.¹³

- Mobile telecommunication - fixed vs. mobile access
- Different kinds of mobile communications (see Exhibit 1)
- Voice- and data communication

GSM Background Information

- GSM = 2Group Speciale Mobile" / "Global System of Mobile Communication"
- Basic GSM Features
 - Digital transmission of voice and data
 - High transmission / voice quality
 - Chip Card / PIN Number (=> person independent from telephone)
 - International roaming
 - Various value added services
 - ISDN compatible
 - Information security / data encryption
 - Cheap handsets due to economics of scale
 - Frequency 900 MHz
- Historic GSM Events
 - 1982 First idea by CEPT
 - 1987 Memorandum of Understanding
 - 1992 Introduction in Germany
- GSM Market Model (see Exhibit 2)
 - Network Operators: usually one or two per country, license needed
 - Service Providers: LOOK UP Definition (wholesaler, auf eigene Rechnung etc.)
 - Retailer / Distributor: cooperate with one or more Service Providers / Network Operators
- GSM within and outside Europe

In most european countries the GSM network should be capable to serve more than 90% of the population by 1994. In many countries (Denmark, Finland, Norway, Italy, Portugal, Greece, Spain, Germany and the Netherlands) competition regarding telecommunication infrastructures was introduced for the first time in the context of the GSM.

World-wide more than 60 countries world wide have decided to install a GSM infrastructure, and about 20 others are expected to join in 1994.

¹² Eutelis/ Scenario/ 25.

¹³ See Roos/ Yuppies/ 447.

Basic DSS / Model Concepts

Guiding Principles

- "Market segmentation" only according to the average telephone volume
- Total Volume = "Number of users" times "average number of minutes per user"
Experience in the US shows that new user groups use the wireless phone less than early adopters. Thus they reduce the average volume per user. (While there has been only little decline in airtime pricing, the average revenue per subscriber has declined from over US \$ 2.000 in 1985 to US \$ 812 in 1992. [EMCI, 1993].
- Consideration of professional and private users.
 - Marketing literature distinguishes between consumer and procurement behavior.
 - Demand is influenced by differently weighed input factors.
- Distinction between users and subscribers.
- Customer Potential
The model is based on total customer potential of 52.2 million users (82% private) stated in 1991 by Infratest, a German market research institute (for the computation see Exhibit 3).
- Consideration of GSM as an aggregate product offer by all network operators (exclusion of strategic actions by specific players).

Main Influencing Factors and Feedback Loops

Exhibit 4 provides an overview of the main input factors considered and lists the major sub-factors. Furthermore, exhibit 5 shows a simplified example of the feedback loops comprised in one input factor, namely "Private Life Impact". A detailed discussion of input factors and the interdependencies considered would go beyond the limits of this short paper.

Potential Scenarios

To accelerate the learning process and to support the decision making, each user (group) can - with or without facilitator - run their own scenarios. Distinctions are made between

- Scenarios based on different assumptions regarding interdependencies, feedback loops or parameter values, and
- Scenarios based on special externally driven events and / or service developments, such as
 - GSM Based "road fee collection"
 - Road Transport Information systems
 - Car theft protection
 - Prohibition to use the telephone while driving
 - No permission to build additional base stations

Concluding Remarks

This paper introduced 'work in progress' regarding a dynamic simulation model covering the demand for digital mobile communication. Due to the state of the work, the simulation outcomes as well as the detailed model structure have been left out. Nevertheless, some issues could be discussed in the context of DSS (- input is always appreciated):

- Does it make sense to build a system that lacks many "hard" input data?
- Have the main factors on the demand side been considered?
- Does the simulation model belong to group of "DSS" or "GDSS"?

References

- [Bonek/Technologie]; Bonek, E., Technologie und Dienste in der Mobilkommunikation. In: Fritz, Lorenz, Wolfsberger, Walter (eds.), *Trends in der Telekommunikation und ihre ökonomischen Auswirkungen*. Industriewissenschaftliches Institut, Technik und Wirtschaft. Band VII, Vienna 1992, p. 59-69.
- [Cawthorne/ Transition]; Cawthorne, N., The Transition from Analogue to GSM. In: *1992 Pan European Digital Cellular Radio Conference: GSM Markets & Technology - The Transition from Theory to Practice*. Berlin, 11./12. Februar 1992, organised by IBC Technical Services Ltd., 1992.
- [Cenarius/ Markt]; Cenarius, F., Mobilfunk - Großer Markt für viele Zwecke. In: *Diebold Management Report*, No. 8/9, 1993, p. 6-11.
- [Commission of the European Community/ Introduction]; Commission of the European Community: *A Study of the Analysis of the Introduction of GSM in the European Community*, October 1990
- [Eutelis/ Scenario]; Eutelis Consult, *Scenario Mobile Communications 2010: Study on the Forecast Development and Future Trends in technical Development and Commercial Provision up to the Year 2010 - Report to the Commission of the European Communities*, CEC Contract Number 48 166, Oktober 1993.
- [Eutelis/ Scenario Summary], Eutelis Consult, *Scenario Mobile Communications 2010: Study on the Forecast Development and Future Trends in technical Development and Commercial Provision up to the Year 2010 - Report to the Commission of the European Communities - Management Summary*, CEC Contract Number 48 166, Oktober 1993.
- [Forrester/ Grundzüge]; Forrester, J. W., *Grundzüge der Systemtheorie*, Wiesbaden, 1972.
- [Mellmer/ Unternehmen Zukunft/]; Mellmer, J., Unternehmen Zukunft - Start in das nächste Jahrtausend: Information wird ein globales Business. In: *Forbes*, 7/1993, p. 24-29.
- [Morecroft/ Knowledge]; Morecroft, J.D.W., Executive Knowledge, Models and Learning, *European Journal of Operational Research*, Vol. 59, 1992, p. 9-27.
- [OECD/ Communications Outlook]; OECD, *Communications Outlook 1990*, Paris, 1990.
- [Roos/ Yuppies]; Roos, J.P., 300 000 Yuppies? Mobile Telephones in Finland. In: *Telecommunications Policy*, Vol. 17, No. 4, August 1993, p. 446-458.
- [Senge/ Discipline]; Senge, P.M., *The Fifth Discipline. The Art and Practice of the Learning Organization*, New York, London, Toronto, Sidney, Auckland, 1990.

Exhibit 1: Market Segments of Mobile Communication

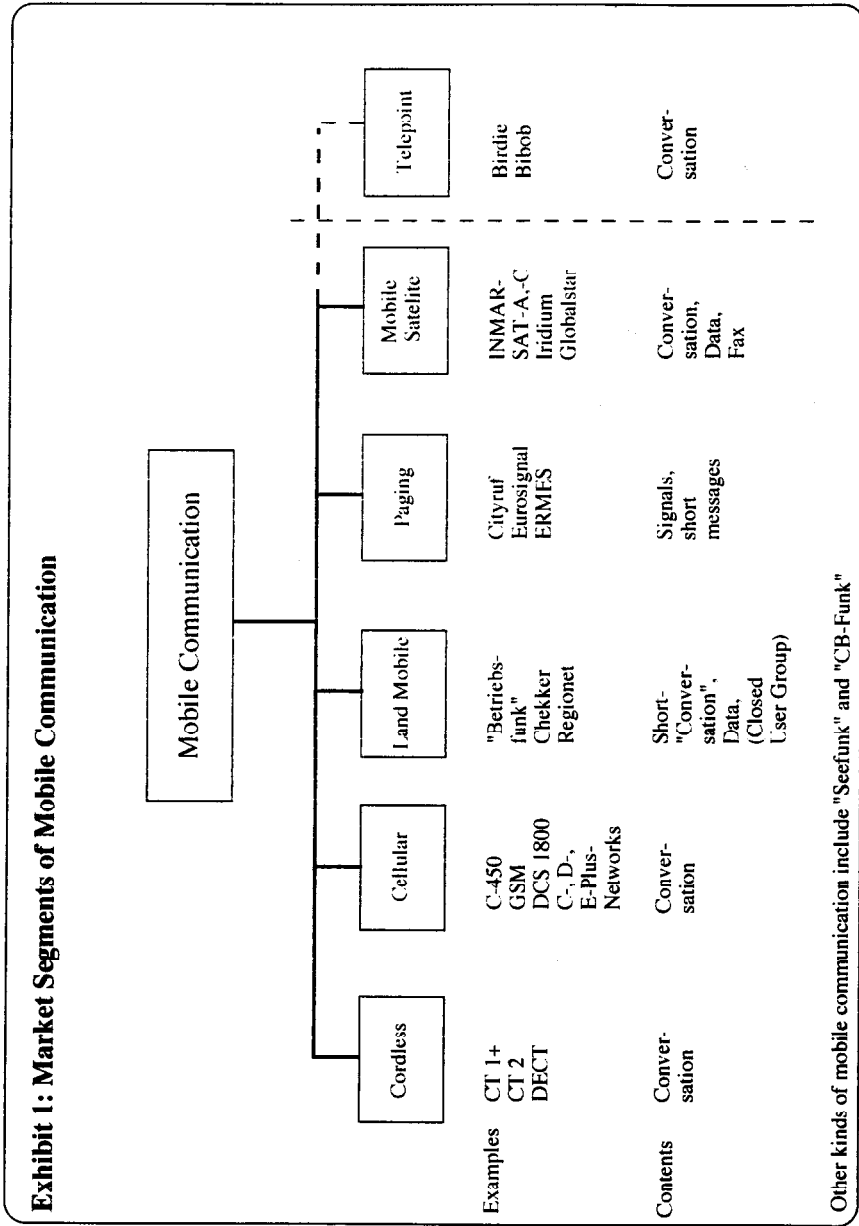


Exhibit 2: GSM-Market Model

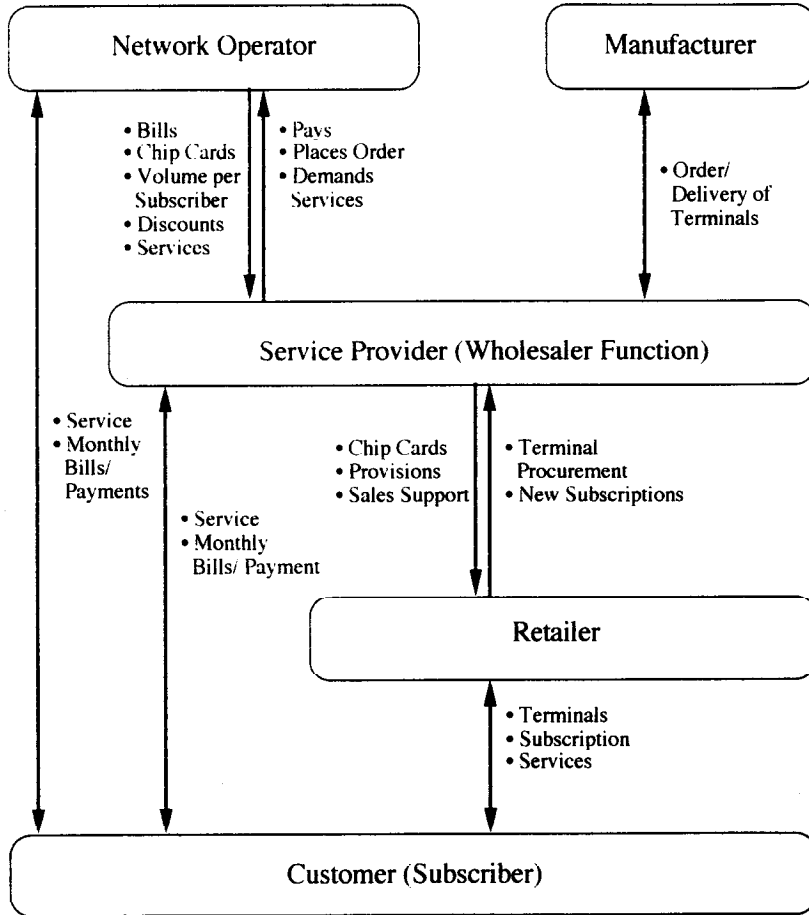
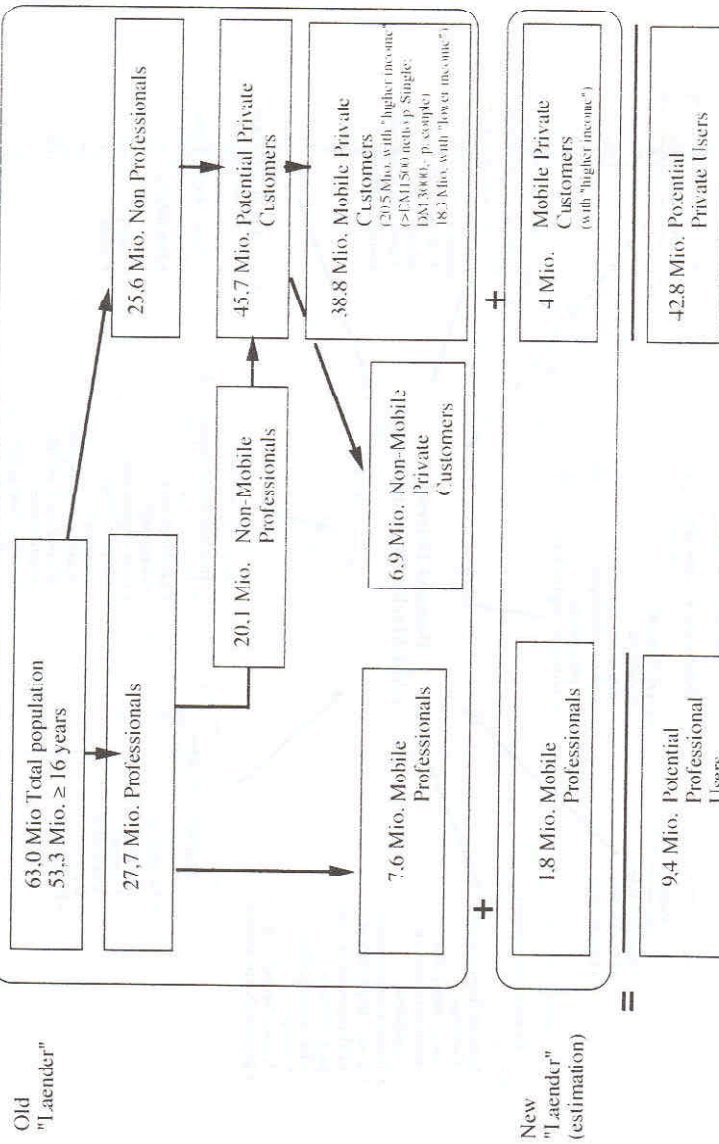


Exhibit 3: GSM Customer Potential



Source: Infratest Mobilfunkpotentialanalyse Dez.91.

Exhibit 4: Influencing Factors of GSM Demand

