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Needs versus technology—the challenge to design third-generation mobile applications

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Abstract

The development of third-generation mobile (3G) services and applications is shaped by fascination with technical feasibility. Useful applications and profitable business models can only be designed by focussing on the users' needs. Up to now, practical methods that take account of customer needs in the strategic product development are missing. In this paper, we outline the "system design" approach with the potential to analyze the possibilities and requirements for a system of mobile communication. The methods used in the early phase of the research and development process can lead innovative, need-oriented and therefore market-oriented product and service concepts for 3G.

Keywords: System design; Mobile business; Need orientation; Innovation; Maieutic; Telecommunication

1. Introduction

The total number of telephone calls will continue to rise sharply, stimulated in part by the success of mobile communication. A telephone call, however, is often a disturbance, an intrusion upon the self-determined day-to-day routine of the called (receiving) party. Since the invention of the telephone by Graham Bell in 1876, there has been only limited ability to send individual information about the caller while establishing the call. Only the static 'caller line identification' (caller ID) can be displayed on the mobile terminal of the receiver. With the increase in telephone calls, the decision to accept, reject or pass on a call (preselection of incoming calls) will become more and more important in the future. As a result, decision support by the mobile communication system is increasingly demanded to meet the need of the called party for information about the incoming calls.

The future third-generation mobile (3G) technology makes it possible to transmit individual information about the caller *within* the call-establishment process. The called person can prepare him/herself for the incoming call. The process of call establishment—the ringing of the cellular phone—opens up a short, but important period for transmitting individual information about and from the caller.

2. Scenario BusinessCall: future call establishment

Imagine you have an appointment with an important business partner—Mr. Con Carne. He is working for the Bank of Chilli and is travelling by airplane from Madrid to your office. The connecting flight is delayed. Mr. Con Carne will be late for the appointment. He will give you a call with his 3G cellular phone and inform you about his delay. Your PC telephone shows an incoming call while you are in a meeting. A quick look at the screen and you recognize Mr. Con Carne's "BusinessCallCard" and the short information about his delay. You pass the call on to your secretary, because you don't want to interrupt the running discussion.

This is an exemplary and rough sketch of the communication possibilities during call establishment. Sending and getting individual information during that period is the demonstrated need structure. A new kind of "communication space" is defined and opens up a wide range of need-oriented applications. Transmitting individual information during call establishment could become a new standard in future telecommunication systems.

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3. Need orientation in the strategic development of mobile business products

Up to now, technical feasibility has dominated the way to the "wireless information society including the exact application fields of the 3G Mobile." In today's technology-driven situation, customer usability and their future demands seem to be of only subordinate interest. However, the possibilities for profitable applications and services and for success in the competitive fight for the customer can only be secured with the knowledge of user needs.

Right now, development of 3G projects are resulting from coincidence or by the simple transmission of Internet and short message services (SMS). However, in the forthcoming "application evolution," customers cannot be persuaded to use the new services with a conglomeration of single ideas. Instead, integrated system concepts are necessary that do not treat users like "guinea pigs." The future task is to reduce the infinite technological possibilities logically and reasonably so that the users apply technology intuitively. Providers of the 3G system, therefore, will have to offer their future customers a flexible and integrated modular system. They also have to communicate this according to the user's needs. The development should aim at improving the customers' quality of life and work. This is the only thing a client will pay for.

The right thing, at the right time, at the right place— for the right customer is the goal for future planning. The customer is interested in his individual benefit. And here are the hurdles for the success of innovative 3G applications. Up to now, the complex possibilities of a "black box" technology like UMTS (the international standard for 3G mobile communication systems) are only little known to the future customer. This makes it difficult to define the customer's demands and needs. The development of need-oriented 3G applications and services is an anticipative planning task that belongs to the group of "wicked problems." According to Rittel and Webber (1972) wicked problems are characterized as follows:

- There is no definitive formulation. Information needed to understand the problem depends upon one's idea for solving: formulating a wicked problem *is* the problem.
- They allow neither immediate nor definite verification.
- They are mainly unique since they cannot be transferred from the past into the future.
- There is no detailed checklist for operational steps.
- The classification of right/wrong is not applicable.
- There are many explanations for one and the same question.

Therefore, the challenge to design 3G applications and services has a structure that cannot be penetrated by linear and analytic problem-solving approaches but only by an interpretative–creative approach (Lester et al., 1998). The distinctive features of system design are particularly suited to examine and solve the class of "wicked problems."

System designers

- have the user in mind;
- systematize complex social–technical aggregates;
- "produce novel, unexpected solutions;
- tolerate uncertainty, working with incomplete information;
- apply imagination and constructive forethought to practical problems;
- use drawings and other modeling media as means of problem solving (Cross, 1995).

The requirements for designing 3G services and applications are:

- an integrated comprehension of the "mobile communication" system;
- focussing on the user's needs;
- searching systematically for application fields;
- an elaboration of scenarios and designs that allows a valuation of ideas;
- combining various independent ideas to integrate service and application systems.

4. Understanding the system of mobile communication

A fundamental understanding of the system of mobile communication is required to design services and applications in this context. The system model is an abstraction and a simplification of reality. It shows the relevant aspects for a defined problem (Churchman et al., 1957). This system has to be defined by its subsystems, elements and their correlation (system unbundling). Conventional approaches focus on the technical elements. The system design approach, however, focuses on the usability for the client (Fig. 1).

The system of mobile communication can be divided into two main sections: possibilities and requirements. The complexity of possibilities can be reduced to a "manageable" degree using the 'possibility system' with its defined subsystems. Furthermore, a specific correlation of criteria allows a qualified positioning and description of rough application fields. In a further analytic step, the parameters of the system model are enlarged by the 'requirement system'. The requirements for the system of mobile communication result from the needs of different users. Fundamental principles for the enhancement and optimization of efficiency are considered as well as human ergonomic limits. The developed system parameters and criteria for the possibility and requirement systems provide the input for the 'systemic application identification.' The user groups, the relevant communication processes and the respective place and time aspects allow the configuration of concrete

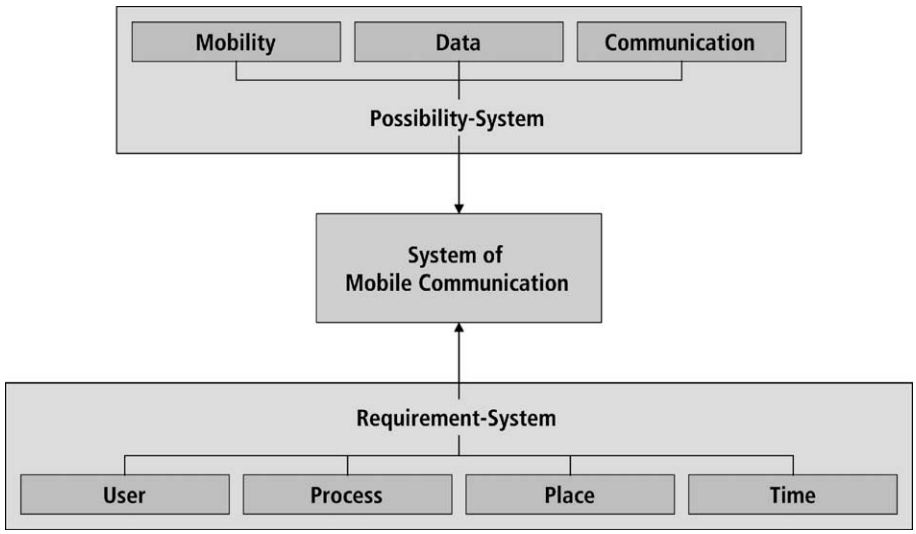

Fig. 1. Possibility and requirement system of mobile communication.

application scenarios. Thus the situation- and context-oriented needs of the user can be anticipated and converted into application designs (Mussel, 1992; Mallmann, 1980).

4.1. Possibility system of mobile communication

In the following, the technological potentials of the present and future mobile telecommunication technologies are always analyzed from the user point of view within the possibility system (Fig. 2). Working on a high level of abstraction leaves a broad range of possibilities and potentials. Within the systemic application identification, the knowledge of the possibility system is used to point out the customer benefits. In a first step, the possibility system can be subdivided into three subsystems.

4.1.1. Subsystem mobility

It describes the potentials resulting from the mobility of networks, users and terminals.

4.1.2. Subsystem data

Different types of data, security, integrity and the different transmission processes are described in this subsystem.

4.1.3. Subsystem communication

In the following, the subsystem communication and especially the communication processes are described as an example. A detailed analysis of the entire possibility system is necessary to illustrate the technologic potentials of mobile communication.

The subsystem is divided into 'participants,' 'relations' and 'processes.' It provides information about the possibilities, which result from different constellations of participants and the processes.

At least two *participants* are necessary for communication to take place. These do not have to be, inevitably, persons: Humans, machines and environment can interact in the different constellations. These compositions open up a field of new applications and services. Communication can also be described by the kind of *relation* between the different participants: Point (one participant), multipoint (a directly addressed group) or any point (an indefinite group). From these three basic elements, different communication connections can be generated. If defined participants (point or multipoint) are linked together, it is called individual communication. If an indefinite group is involved in the communication system, we speak of mass communication

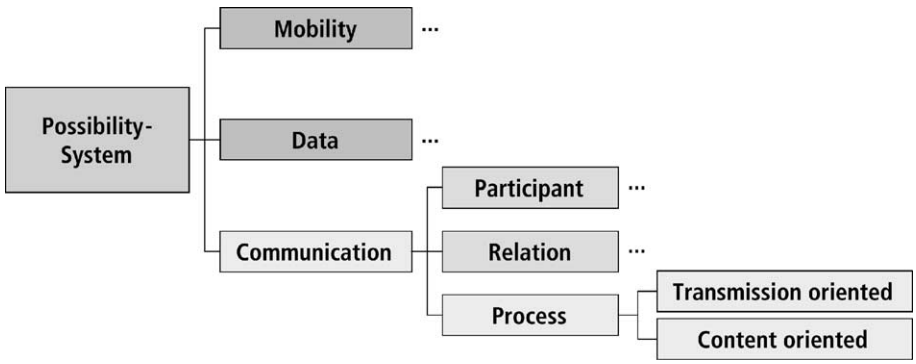

Fig. 2. Communication process within the possibility system.

(Kuehnapfel, 1995). The communication relations can be also characterized by the temporal presence of the different participants:

- *Asynchronous communication:* The transferred message is stored and held ready for the receiver (e.g., email, voice mail).
- *Synchronous communication:* The participants are acting at the same time and direct feedback is possible (e.g., telephone call, videoconference, and chat).

Different *processes* occur between the participants. Except for the pure speech transmission, these processes are often described as 'value added services' (VAS) (Kuehnapfel, 1995). They can be traced back to two groups of process archetypes: The transmission-oriented processes, in which the content of input and output is the same (e.g., telephone call, SMS, SMS to fax, text to speech). The second group is the content-oriented processes in which input and output of the process differ in content (e.g., controlling an intelligent home system, credit transfer, flight reservation).

4.1.4. Linking the subsystems

To recognize the potentials of future mobile communication systems, the described subsystems—'mobility,' 'data' and 'communication'—and their elements have to be related. It is used within the systemic application identification and is the work and knowledge basis for the design process. The result is a range of possibilities. As described, the system works at an abstract level in order to enable the system designer to generate new and innovative services and applications with these descriptions.

4.2. Requirement system of mobile communication

Referring to the system model of mobile communication, the requirement system is the opposite branch of the possibility system (Fig. 3). The development of generally accepted parameters is the aim of the requirement system. These parameters enable a systematic search process for user-adequate and need-oriented applications in the field of mobile communication. Technology is examined from a user point of view within the possibility system. The requirement system is focussing on the users themselves. The strategic planning process of new technological systems requires the position of an 'advocate for the user,' who anticipates the interests and needs of 'clients' concerning future products. The advocate offers alternatives and integrates the users in the product-definition process by designing innovative solutions.

Mobile communication will strongly influence future life and working sphere. The potential users of 3G applications include both end consumers as well as the business customers. The determination of needs and requirements in order to find meaningful 3G application fields must be examined with concrete reference to situation-oriented and social–spatial contexts. New services and applications can be evaluated and positioned. In contrast to the instrumental parameters of the possibility system, open parameters of 'user,' 'place,' 'process' and 'time' characterize the require-

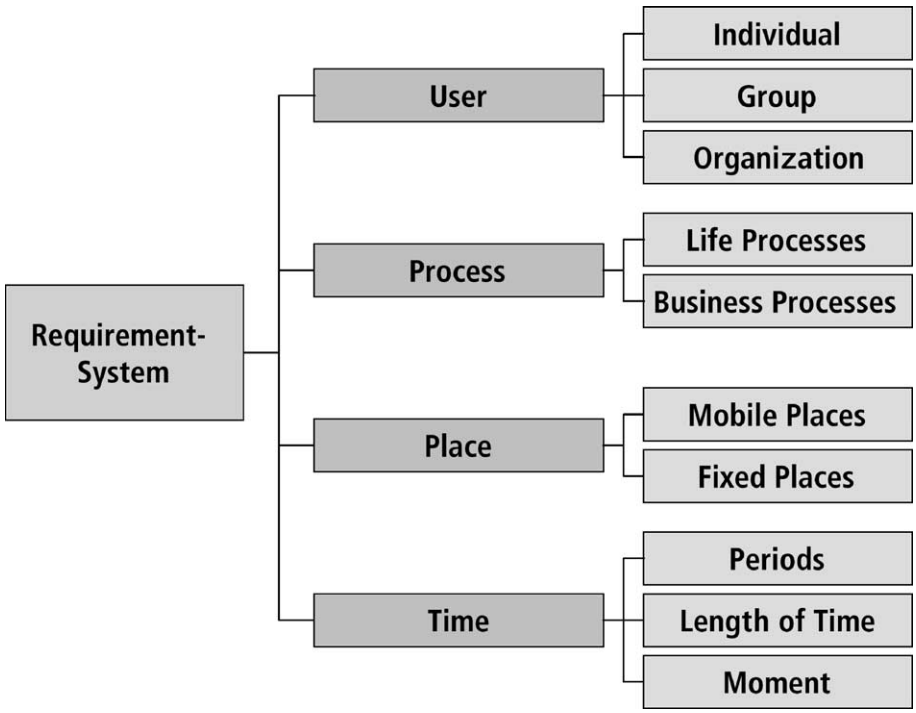

Fig. 3. Requirement system of mobile communication.

ment system. These basic parameters of the requirement system are further subdivided and differentiated and deposited with detailed criteria.

4.2.1. User

The requirement parameter 'user' is subdivided into the subsystems individual, group and organization. These are deposited in detailed user types, communities, as well as branches of enterprise and administrations. In addition, user-specific valuation criteria are determined.

4.2.2. Place

From the user point of view, mobile communication always takes place in a real place. These places are subdivided into fixed and mobile places. They can be private, semipublic or public. Each defined place is shaped by specific factors of influence and environment, which are registered in the system model as valuation criteria.

4.2.3. Process

Mobile communication is always an integral component of a process. The parameter 'process' is divided into two subsystems: life processes and business processes. Life processes represent day-by-day, leisure and operational sequences. These are defined by an analysis of macro and micro processes. In contrast, the determination of relevant business processes focuses on a different set of criteria optimization and efficiency. The analysis of process chains and the definition of interfaces allow a structured overview of the benefit potentials of mobile data communication.

4.2.4. Time

Periods, length of time and moments are differentiated within the parameter 'time.' This parameter of the requirement system contains deposited criteria, which illustrate temporal processes and time units. Cyclic and anticyclical procedures and behavior, actions and processes can be analyzed systematically.

Aspects and valuation criteria of the parameters—'users,' 'place,' 'process' and 'time'—have been developed in the context of the requirement system. These are now transferred into the methodical approach of the systemic application identification. The correlation of the different aspects allows the systematic examination of application fields. Furthermore, user-referred concepts of service applications can be designed.

5. Systemic application identification

The methodical approach of the systemic application identification is based on the system understanding of the possibility and requirement system. The advantage of this approach is a comprehensive and criteria-based correlation process, which transfers the possibilities of 3G technology into profitable and need-oriented applications and services. The approach is a systematic and creative process to identify application fields. A framework, the 'design field,' is formed to implement the correlation of the requirement parameters and is the platform for creativity, evaluations and decisions.

5.1. Step 1: Definition and detailing of an application field

The input criteria 'user,' 'place,' 'process' and 'time,' which have been determined in the requirement system, define an application field for examination. For example: A special user type (a) is selected from the parameter 'user.'

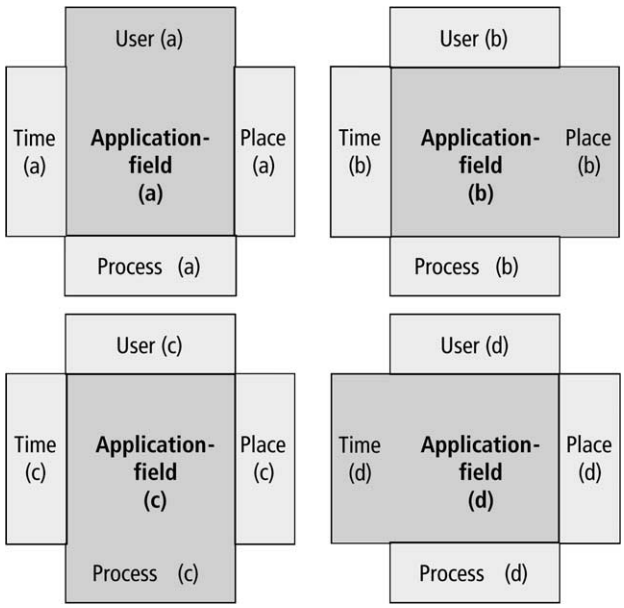

Fig. 4. Four possibilities of defining an application field.

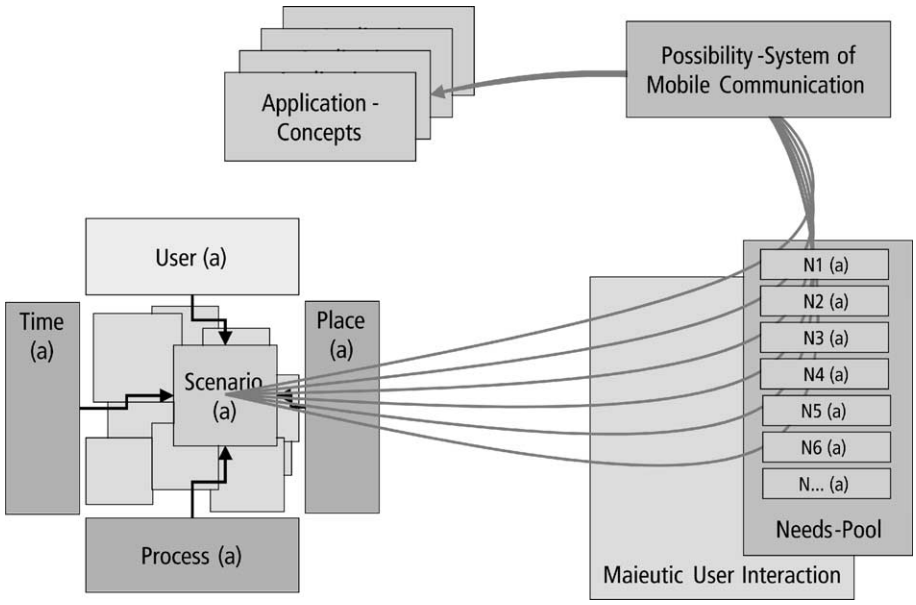

Fig. 5. Designing need-oriented application scenarios.

This selection defines the main focus. The remaining parameters 'process,' 'place' and 'time' become dependent on the selected user type (a) as illustrated in the following example (Fig. 4).

5.2. Step 2: Designing need-oriented application scenarios

The comprehensive understanding of the system and the acquired knowledge about the focused application field enables the design and configuration of relevant application scenarios (Fig. 5). With these detailed and positioned context-referred scenarios the determination of needs is possible. Potential users are integrated into the design process with a first 'maieutic user interaction.' Various application concepts are designed and visualized by considering the knowledge of the possibility system.

5.2.1. Step 3: Evaluating and defining application systems

The alternative application concepts can be examined, evaluated and further developed on the basis of a second maieutic user interaction (Fig. 6). Detailed information and navigation structures are defined in this step. Discovering the things in common of the different solutions leads to integrated application and service systems.

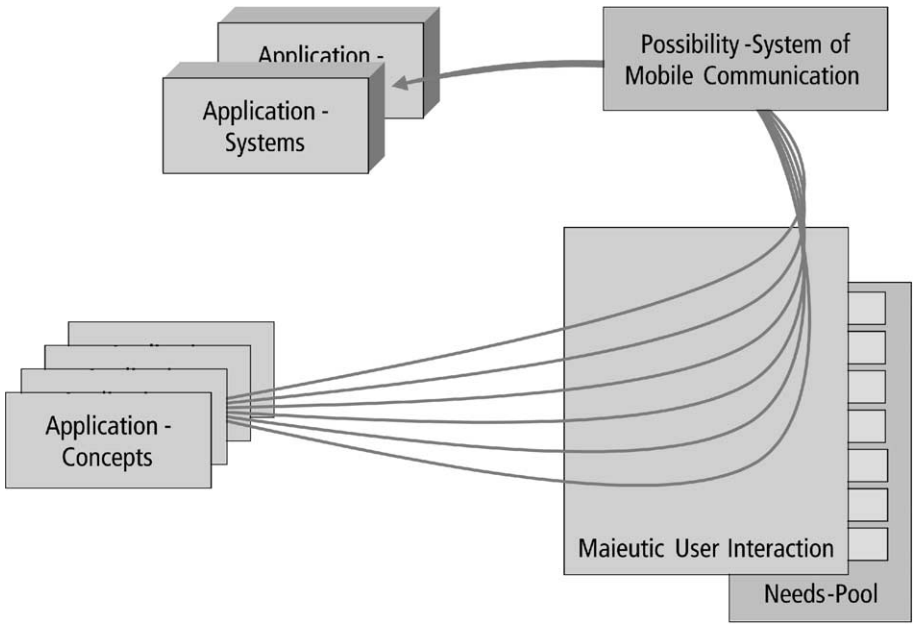

Fig. 6. Evaluating and defining application systems.

6. Inclusion of potential users–maieutic user interaction

The user acceptance is examined by the discursive inclusion of potential users. Initiated by Helmut Krauch (1972), the maieutic process is the methodological foundation that provides us with the hidden knowledge about the interrelations between needs and products in a comprehensive connection. The approach, which was developed in the field of system research, tries to detect needs and benefit potentials and to transfer them into a system of functions and applications and is not limited to the satisfaction of superficial requirements (cf. Sommerlatte, 1997). The maieutic interview is the basis of the methodical procedure. Originally developed by Socrates, maieutic (Greek: "maieutiké téchniké"—art of a midwife) is a method to lead the interlocutor to new realizations by asking skillful questions and making him believe that these realizations were developed by himself. Skillful questioning can activate the hidden knowledge and prepared insights. Two main instruments are provided for guiding discussions: decision and auxiliary questions. Decision questions only lead to true or false answers. By asking how, where, what, who and why the interview partner has to contribute content (Peters, 1966; Krauch, 1972). Hondrich (1983), one of the important representatives in the field of modern need research, sees substantial advantages for the determination of needs in the midwife function of the interview situation compared with standardized interviews or the opinion polls of the classical market study.

In the 1980s, Krauch and the Studiengruppe fuer Systemforschung Heidelberg applied the method of maieutic user interaction and the system design approach. They successfully defined the needs for a future information system at the German Patent Office and translated these needs into a digital information system with high acceptance and performance rates. Recently, Sommerlatte and his interdisciplinary team at the department of system design, Kassel University, Germany, successfully assessed the system design approach in several industry projects. The team of designers, economists, architects and engineers designed user-centered solutions in the fields of 'intelligent home technology' and 'orientation and communication at airport terminals and railway stations' (Sommerlatte, 2002).

The method was applied within the system model of "mobile communication" using four fields: 'Place: The Train,' 'Process: Individual Mobility, 'User: Senior Citizens' and 'Process: Calling.' Nine concepts, including the BusinessCall concept described in this paper, were designed in these fields with the need-based and user integrated method.

7. Conclusion

The presented approach is based on a generic system model of "mobile communication" from a user's point of view. It provides the social and technical knowledge base to design need-oriented service and application concepts for 3G. The method has been validated on the basis of four 3G service concepts. Mobile business experts of noted international consulting companies and research institutes assessed the designed mobile applications. The mobile business experts classified the 'BusinessCall' as a "potential killer application."

Detailed knowledge about human beings, about their life and working sphere, means knowledge about future market potentials. The method of system design integrates customer needs in the strategic research and development process. The well-structured search opens up a field for human-centered, innovative product and service developments, helps to minimize risks in the research and development process and leads to a faster time-to-market.

References

Churchman CW, Ackoff RL, Arnoff EL. Introduction to operations research. New York: Wiley; 1957.

Cross N. Discovering design ability. In: Buchanan RH, Margolino V, editors. Discovering design: explorations in design studies. Chicago: University of Chicago; 1995. p. 105-20.

Hondrich KO. Beduerfnisse im Wandel: Theorie, Zeitdiagnose, Forschungsergebnisse. Opladen: Westdeutscher Verlag; 1983. p. 205-9.

Krauch H. Systemanalyse in Regierung und Verwaltung. Freiburg: Rombach; 1972. p. 11.

Kuehnapfel JB. Telekommunikationsmarketing. Wiesbaden: Gabler; 1995.

Lester RK, Piore MJ, Malek KM. Interpretative management: what general managers can learn from design. Harv Bus Rev March–April/1998; 86–97.

Mallmann CA. Society, needs and rights: a systemic approach. In: Lederer K, editor. Human needs: a contribution to the current debate. Cambridge, MA: Oelgeschlager, Gunn & Hain; 1980.

Mussel C. Beduerfnisse in der Planung der Staedte: Zur Theorie und Methode eines diskursiven Beduerfnisbegriffs. Reihe Arbeitsberichte, Heft 106. Kassel: Fachbereich Stadtplanung und Landschaftsplanung; 1992.

Peters RS. Ethics and education. London: George Allen & Unwin; 1966. p. 59.

Rittel HW, Webber MM. Dilemmas in a general theory of planning. Working Paper No. 194. Berkeley, CA: Institute of Urban and Regional Development, University of California; 1972.

Sommerlatte T., editor. Angewandte Systemforschung: Ein intesdisziplinarer Ansatz. Wiesbaden: Gabler, 2002. pp. 7–20 (253–72).

Sommerlatte T. Zukuenftige Maerkte erfordern Systemdenken und Interaktion zwischen Gestaltern und Nutzern. In: Krauch H, Sommerlatte T, Arthur D, editors. Beduerfnisse Entdecken: Gestalten Zukuenftiger Maerkte und Produkte. Frankfurt: Campus; 1997. p. 14.