"Things are talking"

An estimation of innovative change for RFID based services

Anke A.P. Hagemeijer MSc.
School of Management and Governance

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Thesis supervisor	Prof. Dr. Hans E. Roosendaal
2nd thesis supervisor	Dr. Peter A.T.M. Geurts
Internship Supervisor	Dr. Jan Kroon

University of Twente
Enschede - The Netherlands

‘πάντα ρει και ουδέν μένει’

‘Everything flows, nothing remains’

(Heracleitos, 540 - 480 BC)

Management summary

Introduction

First off, this study will search for a valid method to forecast future demand for innovative strategic processes. Secondly it will test the selected method in the innovative market of RFID based real-time services.

Being able to forecast market demand is of great interest in business context, because planning a new business requires a large number of decisions to be made in advance of the actual launch of that service. Common market research typically collects information from an existing market. For innovative products and services however, such historical data and past experience does not exist. Forecasting future demand for innovative products can therefore only be done by estimation. Commonly accepted methods for this kind of estimation are the Delphi method (Jolson and Rossow, 1971), scenario planning, conjoint analysis and the lead user method (von Hippel, 1986). These methods are less adequate when forecasting for radically innovative products, because of functional fixedness, an effect that causes subjects to experience great difficulty in generating novel product concepts that deviate from the familiar.

Current study

To overcome this problem, the method for estimating innovative change (Geurts and Roosendaal, 2001) was selected to be applied onto the RFID market. This particular method uses Talcott Parsons' AGIL scheme to describe the market that is being investigated. The four subsystems are captured in a four-function model, which serves as a framework from which provocative statements are generated. These statements are then introduced by a textual sketch of an imaginary future on which one should react. Probing generates additional qualitative information. This qualitative information is quantified and interpreted into the four- function framework.

This model is tested at Royal KPN N.V., a Dutch, north-western Europe oriented telecommunication company that seriously considers the option of providing RFID enabled services. KPN is currently focusing on two kinds of RFID services: Asset Management services, that focus on real-time, location based assets and personnel tracking. And 'Value Chain Visibility services', which focus on providing timely information for control in logistic chains.

KPN searches for an answer to the questions: '*What are the expectations of business customers for RFID based real-time services that KPN should provide in the future?'* and *'Can these expectations and KPN's strategy be linked?*' The most interesting competitors were contacted with the philosophy that a successful service, provided by direct competition, might be successful for KPN as well. However, BT as well as T-systems was not prepared to cooperate for strategic and legal reasons. Therefore this part of the research was abandoned. After applying the method for estimating innovative change, it will be evaluated for more generic use in KPN's department Business Strategy & Innovation.

In order to find answers to the questions, the four-function framework for the market for RFID enabled services is constructed. The four functions that were identified are Adequate Information, User Interface, Real-time Response and System Reliability. Two separate questionnaires where established for Asset Management and Value Chain Visibility. Twelve individuals were interviewed, being business customers regarding RFID and contacts with solid experience in the field. Seven individuals were interviewed for Value Chain Visibility and five were interviewed for Asset Management.

Results and implications

The results show that expectations of business customers differ per client. This is deducted from the variation in answers to the provocative statements, the many referents made to Adequate Information and the little convergence in the composition of referents made in reaction to the statements. These results imply that the services should be tailor-made. This interferes with the strategy of the KPN department Business Strategy & Innovation, which is to create high-growth business with a repeatable business model, and hence standardized products. Providing tailor-made services will only be interesting in two cases; for large corporate clients -in which case it will be a matter for the KPN department Corporate Solutions, which is equipped for providing tailor-made services and handling major corporate clients- and when only those parts that can be standardized, are offered as a semi-finished product.

Furthermore, the results show that the form of the user interface is not a requirement by itself. It is important that the information that is being communicated to the user is relevant, reliable and on time. This means that it will be situation-specific which interface will

be most suitable. A product containing a standardized interface will therefore be unsuccessful. In addition, the reliability of the technique used, is important in selecting an interface.

With regard to the degree in which an information system must be able to take real-time action on collected data, it is indicated that the technology that is used, should be extremely reliable. The interviewees appear to differ in opinion whether the reliability will be sufficient enough or not. Delivering reliable products as well as being able to choose how information is communicated, are values that are explicitly stated in KPN's mission statement and are therefore strategically interesting to KPN.

Application of the method of estimating innovative change has proven the method to be able to deliver both interesting and useful results. However application needs education of the innovation-managers and outsourcing of the interviews as well as labour-intensive data processing parts. Application of the method for every innovation subject will be too costly and time-consuming. Application can therefore only be justified when strategic, high investment decisions are to be made.

With regard to the backward processing promoted by a textual introduction, not all interviewees were able to think freely about their needs. Interviewees referred to the current possibilities as an argument for their choices in needs. To help them to consider their needs more freely, it is recommended that backward processing entails a textual introduction accompanied by a short movie.

Conclusion and recommendations

Because of customer-specific wishes, a tailor-made product is needed. It is advised to only provide tailor-made services to major corporate clients and transfer this responsibility to KPN Corporate Solutions. KPN Business Strategy & Innovation should concentrate on small and medium sized companies. To decrease the 'tailor-made factor', it is well-advised to provide a semi-finished product, containing an accurate database and a reliable network. The more customer-specific user interface should be transferred to partners or value-added resellers.

Because of the customers' hesitation towards allowing a system to make real-time decisions without human intervention, KPN is advised to focus on doing a pilot that shows all technological abilities. This pilot should be actively used for visits by potential customers.

In regard to using the method for ***estimating innovative change*** (Geurts & Roosendaal, 2001), KPN is well-advised to use a two-tier approach. Its current market research method

Klant InZicht (Customer InSight) should be used for scanning purposes. When this indicates strategic, big investment decisions; more accurate research should be done by applying the method for estimating innovative change.

A scan has identified the four-function model used in this research, to also represent the innovations within Business Strategy & Innovation that involve information systems. For innovations that serve as a tool or as entertainment, the goal and latency function should be rethought.

Preface

This report is the result of my graduation project for the Master of Science degree in Innovation Management. The graduation project was performed at Royal KPN N.V. and was supervised by the School of Management and Governance of the University of Twente.

While a preface is the beginning for you reading this Master Thesis, for me it marks an ending. Getting this far would not have been possible without the help of several people. I would like to use this preface to thank them for their support. First of all I would like to thank all that have contributed to this research by making time for interviews. Furthermore, thanks to all of my colleagues at KPN Business Strategy & Innovation for their hospitality and all their suggestions. You made my stay at KPN a very valuable learning experience and a nice conclusion to my years as a student.
Specifically, my gratitude goes out to Jan Kroon, my internship supervisor for this project. Jan was always available for all my questions and his feedback usually provided me with coffee and some metaphors to understand KPN, RFID and life.

Furthermore I would like to express my gratitude to Hans Roosendaal en Peter Geurts, my supervisors at the University of Twente. I would like to thank them for their useful feedback during the project and their critical review of this report.

Certainly, I would also like to take this opportunity to thank my parents and brothers for their never-ending support and interest. Not only during this project, but during both of my studies, my rowing career and in everything I undertake. And Joris, thank for being my second corrector!
Of course, also a special ‘thank you’ to all my friends for both their useful and their less useful suggestions. And last, but certainly not least: ‘Timo, thank you for just being there.. ‘

Anke Hagemeijer
Den Haag, April 2008

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1. Introduction

The desire to be able to predict the future has been one of all times. Astrology, crystal balls, tarot cards, the techniques are endless! Predicting the future has, in some instances, even become a common daily practice. A prediction for the next day or even a week is done daily for the weather. The meaning of some predictions can be vital. In case of earthquakes, hurricanes or tornados, it can save the lives of entire populations.

Predicting the future is also interesting in a more commercial context. It can have tremendous significance for businesses to be able to predict the future. What if you could predict what product a market will be waiting for in a few years from now? Then you could start the research and development program in time, you would be able to start the production and marketing efforts before the market even realizes it needs a product or service. You would have a great advantage over your competitors.

It is obvious that being able to forecast market demand is of great interest in business context. McBurney, Parsons & Green (2002) describe in their discussion about demand forecasting, that planning a new business requires a large number of decisions to be made in advance of the launch of the service. Many of these decisions depend upon knowing the likely number of customers. In the absence of live, operating data, these decisions can only be made on basis of forecasting the number of customers and frequency of usage.

The difficulty of forecasting is that the available information is always derived from present-day measurements, through for example business analysis or interviews, but must give information for the future. So somehow, these present conditions are the fundament for the future. A forecasting model determines what kind of present-day measurements lead to what kind of future. This is based on experiences from the past and the assumption that the same conditions always lead to the same future. To illustrate this, it is useful to draw the comparison with weather predictions. Present-day measurements for temperature, humidity, atmospheric pressure and knowledge of the location of anti-cyclones and depressions are converted by a forecasting model. Based on assumptions about the impact of these conditions on the weather, a forecasting model converts the information into a prediction for next week (see figure 1).

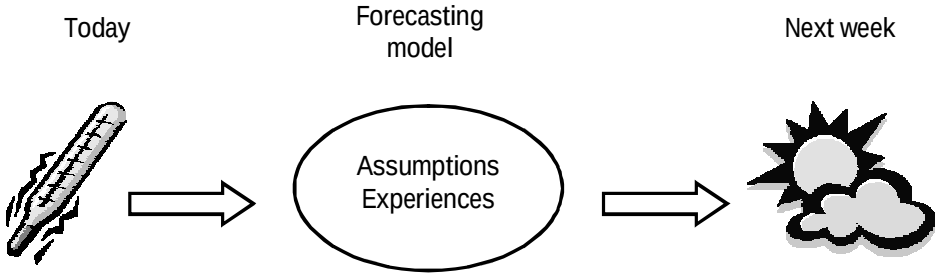


Figure 1. The forecasting model.

However, unlike the weather, for very innovative products and services, the conditions for a forecast cannot be determined on past experience and can only be determined by making assumptions. That is what makes forecasting for innovative products a challenging task. Even when data from similar markets are available, a turbulent market environment may make historic data less useful (Gruszecki and Andries, 1990).

This research will therefore discuss and compare several market research methods for innovative products. The selected model of Geurts and Roosendaal (2001) for estimating innovative change will be tested in the innovative RFID market (Radio Frequency Identification). The research will be done at KPN, a Dutch telecom provider involved in this technique. The following paragraph will discuss the relevant background for this research.

2. Forecasting future demand for new products and services

The need for a dependable forecast is a significant one. An estimation of what the market will be like, will support go or no-go decisions in time and effort supported to the development, manufacturing and commercialization of the product or service. An inaccurate forecasting could mean company wide consequences (Kahn, 2000). However, doing accurate forecasting for innovative products is a 'frustrating, perhaps futile, effort because of minimal data, limited analysis time and a general uncertainty surrounding a new product and the marketplace' (Kahn, 2000).

What makes forecasting complicated is the fact that a product or service, that makes use of a new, innovative technology, is usually yet to be launched. In the innovation literature these products are known as *radical* or *discontinuous* innovations. Innovations can be thought of as falling in a continuum from *continuous* or *incremental* innovation to *discontinuous* or *radical* innovation (Veryzer, 1998). Continuous or incremental innovation refers to improvements, upgrades and line extensions while radical or discontinuous innovations refer to radically new products or services that involve dramatic leaps in terms of customer familiarity and use (Veryzer, 1998). RFID enabled services are such radical innovations. Instead of the currently needed human action to identify a product -by scanning a barcode- the product now is sending out its identity by itself, and thus radically changing the arrangement of the business process.

Precisely the necessary leap in what the customer is used to, makes common market research, like the Delphi method (Jolson and Rossow, 1971), scenario planning, conjoint analysis and the lead user method (von Hippel, 1986), typically not very useful to determine which radical innovation will be most interesting in the future. This is due to the fact that new information is always interpreted in the light of one's own knowledge (Trott, 2001). Therefore these approaches are commonly more useful to predict incremental innovations (von Hippel, 1986; Trott, 2001).

The general problem statement for this research is formulated in terms of this discussion. Many companies can benefit business-wise from a prediction of customers' future demands and wishes for innovative products.

The problem statement for this research will therefore be:

> "What is a valid method for future demand forecast for innovative strategic processes?"

The problem described above will be researched in depth in terms of a radically innovative product. As a case study Radio Frequency Identification (RFID) is chosen. RFID is a tracking, tracing and identification technology that has received a great amount of attention in the last few years. The technology will be further described in the next section.

2.1 RFID Technology and research

Tracking, tracing and identification systems are innovative technologies in information systems. Tracking refers to the ability to localize a product in a supply chain; tracing is the ability to find the origin and characteristics of a product (Doukidis & Pramatari, 2005) and identification refers to the recognition of a unique entity. Unique identification enables tracking and tracing. For obtaining detailed information about a specific object and its whereabouts an identification system is essential. A system that is able to accomplish this very specific identification is a system that makes use of radio frequency to broadcast its identity by sending out a unique code. *Radio Frequency Identification*, or *RFID*, is a wireless tracking technology that allows a reader to activate a transponder on a radio frequency tag. This tag can be attached to or imbedded in an item and allows the reader to remotely read the tag, or write data onto it (Curtin, Kauffman & Rigggins, 2007). The information gathered is translated by some kind of middleware into valuable information for the organisation (see figure 2).

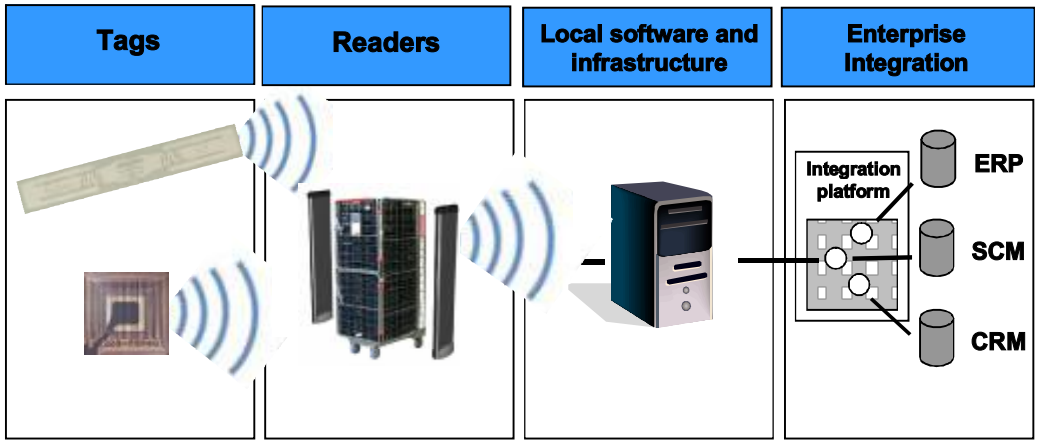


Figure 2. The RFID architecture.

By coupling an RFID system to some kind of communication device any tagged entity can become a mobile, intelligent, communicating component of the organization's overall information infrastructure (Curtin et al., 2007). Because of the electronic identity that a physical object obtains from the unique code it broadcasts, it is able to identify itself while communicating with other objects. This turns physical objects in an internet of things (Glover

& Bhatt, 2006). It can dramatically change the capabilities of an organisation to acquire a vast array of data about the location and properties of a tagged entity (Curtin et al., 2007).

Especially the real-time information that can be gathered through RFID systems will be interesting for companies that operate within a forecast driven process chain. These companies often suffer from a phenomenon called the *Bullwhip effect.* The information flow within the chain is distorted as the demand information passes along the chain. Because demand is hardly ever stable, every party in a chain will carry an inventory buffer, a safety stock. This results in a distortion of demand information and implies that the manufacturer, who only observes its immediate order data, will be misled by amplified demand (Lee, Padmanabhan & Whang, 1997). RFID can help to prevent this effect by providing real-time data about the actual demand of the several links of a value chain, without the information having to pass trough the whole chain.

Early application areas involve tagging books for bookstores (Selexyz), tagging consumer electronics for proof of delivery (Sony), tagging airplane parts for administration of maintenance (Airbus), tagging luggage to avoid errors in baggage handling (Schiphol), tagging equipment and medicine in hospitals (AMC), tagging waste containers to bill after kilograms of waste offered (Rova), tagging assets and ID-cards in office buildings (Samskip) and tagging crates for monitoring the supply chain of fresh vegetables (Schuitema). In spite of these early applications RFID is not yet broadly utilized. The next paragraph will discuss the adoption issues.

2.1.1 Adoption issues

In the last few years many companies have become aware of the possibilities of RFID. The technology is fairly developed and the applications seem endless. Nevertheless, the technology has yet to become standard. However obvious the advantages of this innovation seem, innovative IT-systems are complex to introduce. The description Utterback (1991) gives of the several stages in the introduction of a new technology into an industry, which he calls *waves of change,* is useful to describe these difficulties.

In these waves a parallel to an existing form is usually first created, and a dominant design emerges. The existing form in case of RFID is the barcode. A passive technology that requires line of sight for reading information. Barcoding still seems to be the standard at this point. In a wave of change outsiders often seem to be the real innovators, resulting in established firms being reluctant to adopt the radical technology. In the case of RFID the

adoption of this technology means that all products, now containing barcodes, must be provided with a RFID tag. And all barcode scanners must be replaced with RFID readers. This transition will be costly and will take time. Therefore companies might be reluctant to make this transition. At this point in the wave the innovation shifts from product to process innovation as it affects the whole process it is embedded in. RFID affects the process by giving exact information. This way, entities can always be backtracked. And because of the real-time information, problems can be intervened even before they occur.

Utterback (1994) continues that there is a dual focus on cost and quality in a wave of change. Because of the high cost of introducing process innovation, the costs must be as low as possible but with a high level of quality. Costs in case of RFID consist, among other things, of the tag itself, the applying of tags, purchasing and installing the readers, system integration costs, training and reorganisation and the costs of implementing application solutions (Smith & Konsynski, 2003). With regard to the costs of the tags, Sheffi (2004) states that a widespread adoption of RFID will only happen when a tag becomes cheaper than five dollar cents. It is needless to say that the quality cannot suffer.

Utterback (1994) lastly stresses the importance of innovation in the whole system. All elements should be altered as to support the innovation. The introduction of RFID in a value chain means that the whole chain should adopt this technology to be able to track entities the entire chain trough. Because of the expenses involved, many companies wait for early adopters to take on the costs (Clemons & Row, 1991). This way the copying firm learns from the innovator and can use the same technology, at a lower cost.

This illustration of the wave of change clearly illustrates the difficulty of the adoption of RFID. To lower the threshold for adopting RFID more research should be done. As the technology behind RFID is becoming more and more mature, the focus of attention turns to managerial and organizational issues (Curtin et al., 2007). Curtin et al. (2007) recently made a research agenda for RFID in which three topics are proposed to especially receive research attention. The topics are: the ***adoption dimension*** -how RFID is adopted and implemented by organisations to solve business problems- the ***usage dimension*** –the way RFID is used within processes, organizations and alliances- and the ***impact dimension*** –the way RFID impacts individuals, business processes, organizations and markets.

The ***adoption dimension*** for innovations in general received a fair amount of attention in the literature. Rogers and Scott (1997) state that rate of adoption of any innovation amongst

a social system is determined by the following characteristics: the *relative advantage* should be obvious in economic terms, social prestige, convenience, and satisfaction. The technology should be *compatible* with the existing values, past experiences and needs of prospective adopters. The *complexity* is important. It should be perceived as not difficult to comprehend, implement and maintain. An innovation that is "trial-able" represents fewer uncertainties to the individual who is considering it for adoption. Lastly, the observability is important. The results of the innovation must be visible to others (Rogers & Scott, 1997). In summary, innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations (Rogers & Scott, 1997).

The adoption dimension for RFID and specifically for RFID services, is what is of interest to this research. Before the usage and impact dimension (Curtin et al., 2007) can be established it is important to find out which RFID services are perceived to satisfy the description of Rogers and Scott (1997) for a trial-able product.

2.2 Telecommunication and RFID

Communication via RFID would mean an exceptionally high growth of business for Telecommunication Companies (TelCo's), who exploit networks necessary for the transmission of sound, images and other data. In case of RFID not only we, as humans, make contact with the network, but also "things" will do so, to communicate with other "things". These "talking things" will especially be beneficial when the corporate market gets interested. When stocks can be kept up-to-date and business processes can be regulated from one central point, were all information comes together. The adoption of RFID is therefore evidently of great interest to TelCo's.

KPN, a Dutch based, north-western Europe oriented Telecommunication Company, has also taken a keen interest in the possibilities. KPN has thus commissioned this research into the market demand for RFID.

The next paragraph will further discuss KPN as a company.

2.2.1 Royal KPN N.V.

What is nowadays Royal KPN N.V. was founded as a state company for Post, Telegraphy and Telephony (PTT) in the mid 19th century. The company name was changed into Koninklijke PTT Nederland (KPN) when the company was privatised in 1989. In 1998 the post services were split off to become an independent company, the TPG, and later TNT.

Nowadays KPN is the leading multimedia company in the Netherlands. KPN has been a traditional telecommunication company focused on technology and products in the past, but is now transforming into an independent commercial undertaking with a great variety of multimedia services for consumers and fully managed ICT services for companies. The mobile services cover the Netherlands, Germany and Belgium for corporate customers as well as personal customers (Royal KPN N.V., 2006).

As a mission KPN describes *"to deliver high-quality and reliable services to enable its customers to reach their personal and business aims, both during work and in free time."* (Royal KPN N.V., 2006).

As of December 31st 2007 KPN has over 35 million customers in the Netherlands, Belgium and Germany, of which 27 million in wireless services, 5.4 million wire-line voice, 2.4 million in broadband internet and 0.5 million in television. At this moment KPN employs over 25.500 individuals (Royal KPN N.V., 2007). KPN reports revenues of €12.6 billion and an operating profit of €2.5 billion for the year 2007.

Figure 3 on the next page depicts the KPN organizations chart as of January 2007.

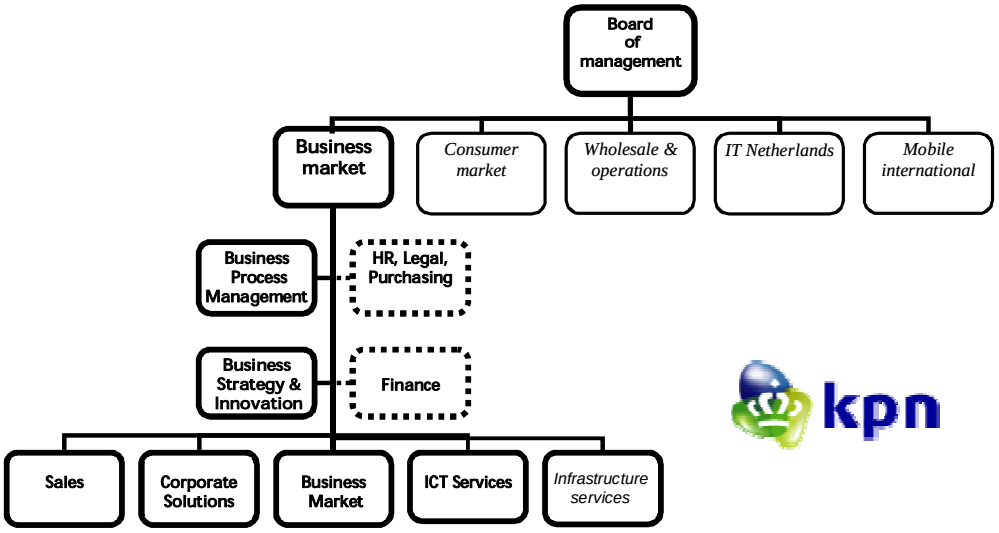


Figure 3. KPN Organization Chart.

The department that is concerned with the development of Tracking, Tracing & Identification services is *Business Strategy & Innovation (BS&I)*. This is a staff department of the *Business Market* division. The department develops new products and businesses to support KPN's growth ambitions. Within the department several venture teams work within a given subject. The Tracking, Tracing & Identification venture team is one of these teams. The next section will describe the strategy supporting the growth ambitions in detail.

2.2.2 KPN and strategy

KPN has been a traditional telecom provider for as long as it exists. However, the traditional telecom market is under severe pressure due to price erosions as well as the gradual disappearance of traditional voice traffic and data traffic, like fax. New IP based technologies can eventually make the old wire-line network obsolete. The traditional voice and data traffic services through the physical network make up 70% of the current business. Therefore new services must be developed to replace the traditional business. For the coming years KPN will, for that reason, focus on online managed work stations, online applications and managed services. Managed services are end-to-end services in which everything, from reselling of advice, installation of hardware and the connectivity of the system to monitoring and maintenance services.

These managed services also involve tracking, tracing and identification services. Besides GPS, GSM and Wi-Fi, KPN is currently also looking into RFID.

2.2.3 KPN and RFID

RFID includes many applications which make this technology interesting for businesses, for internal operations as well as business to business logistics and business to consumer marketing. At this moment KPN has developed real-time tracking and tracing services that make use of RFID in mainly two areas. These services are focused on real-time, location based assets and personnel tracking and on providing timely information for control in logistic chains. The services have the working names *Asset Management* and *Value Chain Visibility*. Both services will be explained and illustrated with pilot studies below.

2.2.3.1 Value Chain Visibility

A promising service is what KPN calls *Value Chain Visibility (VCV).* Within this service all products -or crates which hold products- are tagged with an RFID chip which sends information back to a central database at given steps of a process. This way the process can be controlled from one location. In addition, problems can be intervened before they actually occur. Problems like decay of fresh food or financial damage due to loss of high value goods can be prevented with VCV services. The promising part of such a service for a TelCo is that 'things are talking'. Not only humans make contact with a network, but also 'things' make use of the network to communicate with other 'things'. Also Curtin et al. (2007) have stated that transportation, logistics and shipping are among the most interesting and potentially most valuable application areas for RFID technology.

In the past two years KPN did two pilot studies for VCV services. In 2006 the *Telitrace Study* started; a pilot study at TNT. Mobile phones and boxes were tagged and readers and antennas were installed throughout the warehouse. The study learned that Value Chain Visibility Services provide an improved efficiency and better and real-time insight in stock levels in the warehouse, during transport and in the shops.

A recently completed study is the collaboration between Schuitema N.V., the distribution centre of C1000, W. Heemskerk B.V., a supplier of fresh vegetables and KPN. In this project RFID chips were attached to some thousands of crates, in which bundles fresh cut vegetables of Heemskerk B.V. are transported. These crates were monitored throughout the

chain. At a number of locations in the production company and the lorries of Heemskerk B.V., the distribution centre of Schuitema N.V. and a C1000 supermarket RFID readers were placed. By means of the combination of RFID and temperature tracking it was possible to make use of the philosophy *First Expired, First Out*. The information gathered by the RFID tag, was sent back by means of the fixed and mobile networks of KPN to a central database in KPN's CyberCenter. All parties concerned in the chain were able to consult this data (Schuitema, 2006). This study is currently being evaluated.

2.2.3.2 Asset Management

Secondly KPN is involved in a project called Intelligent Building (I-building), an asset management system that makes use of RFID.

A pilot study for I-building is currently taking place at Samskip B.V., a transport and logistics company in Rotterdam. At Samskip B.V. every employee will receive a company card containing an RFID chip. This chip refers to his information in a database. This can, for example, be about the areas a specific employee is, or is not authorized to enter. After an automatic check in the database some doors open automatically, and others stay closed. Besides the company cards, also assets, like laptops and beamers, can be tagged. When an employee leaves the building with a laptop that is not linked to his company card, a security camera will automatically capture his leaving.

2.2.4 KPN and market research

For idea to product development, KPN uses a process divided in five phases. After every phase a go or no-go decision is made. Successively the process contains the following phases: Concept phase, marketing plan phase, launch preparation, launch and monitoring & evaluation. Before starting this process, a team consisting of individuals from several disciplines is assembled to investigate a development, of which the strategic department observes that it fits the core competences of KPN –like the tracking, tracing & identification team for RFID-. Such a team examines the chances for the specific development in telecommunication.

At this moment determining whether a technology is a market chance for KPN, is done based on primary market research, or what KPN calls *'Klant inZicht' ('Customer inSight')*. These insights are gained from observations and customer visits. The visits are

combined with conversations based on a questionnaire, which consists roughly out of three parts; the first part discusses the company, the second part is about the currently used ICT and the last part discusses some kind of innovative development, for instance RFID. The questions serve as a guiding principle and are not fixed. The purpose of this questionnaire is to identify possible drivers and barriers. The different comments are grouped afterwards into common subjects, which serve as insights for developing new propositions and marketing strategies.

This method does not lead to an actual forecast, but merely determines the situation as it is. The problem of this method is that customer insights can only flow from their own real world experience. This method, as a result, is likely to help innovate incrementally; however radical innovation will be hard to accomplish.

KPN is interested in the future market demand for the innovative RFID enabled services. This research will therefore focus on the selection of an appropriate method for predicting future demand for these innovative services. In testing the selected model, an estimation of this demand will be done as well. The next section will formulate the research objectives.

2.3 Research objectives

The method KPN currently uses, *'Klant inZicht' ('Customer inSight'),* is less useful for supporting radical innovation. In order to forecast demand for an innovative product like RFID another forecasting method will be needed. The first research objective will therefore be:

1	*"What forecasting method is valid for KPN to use in this particular case?"*
1.1	*"Is the selected method appropriate for generic use within KPN Business Strategy and Innovation?"*

The selected forecasting method will be applied to the field for RFID based real-time services. A first indication for the possible success of an RFID product is the group of customers that partnered in a trial with KPN involving an RFID service. The availability of all details of the projects they partnered in, and the already established relationships with these customers, makes this an interesting group for this research. However, this group of early adopters alone will not represent the whole market. Therefore, contacts that have solid experience with RFID will also be involved in this research.

The second question and sub question therefore are:

2.	*"What are the expectations of business customers for RFID based real-time services that KPN should provide in the future?"*
2.1	*"Can these expectations and KPN's strategy be linked?"*

A second indication for the potential of a service would be the activities of other parties involved in the RFID service business, i.e. the competitors. The philosophy is that a successful service, provided by direct competition, might be successful for KPN as well. However, through several ways it was attempted to get in contact with representatives of the most interesting competitors, BT as well as with T-systems. These companies were

unfortunately not prepared to cooperate for strategic and legal reasons. Therefore this part of the research was abandoned.

The next section will focus on choosing the right model to do a forecast for RFID-based real-time services for KPN. In order to do so it will firstly discuss several issues in forecasting future demand. Hereafter some accepted models are considered and compared. In conclusion, the chosen model will be explained in detail.

2.4 Forecasting in context

There are several methods available for the estimation of market demand for innovative products. The methods used for such market research can be roughly divided into two categories: *exploratory methods* and *primary market research techniques* (McBurney et al, 2002). *Exploratory methods* (or qualitative methods) do not collect the primary data from prospect customers. Usually the participants are drawn from the management or a group of experts. *Primary market research techniques* collect data through interviews with prospect customers, like KPN does with its *'Klant inZicht' ('Customer Insight').*

Table 1 displays the characteristics of *exploratory methods* and *primary market research techniques.* The selection of a technique always depends on the situation in which it will be applied. Current market research methods are typically not reliable at all, in case of radically innovative products or product categories characterized by rapid change, such as high technology products (von Hippel, 1986; Trott, 2001). In this instance no real markets exist yet, because of the launch of new generations of technology. With *primary market research techniques* the interviewed potential customers seem unable to understand the product and to articulate their needs. *Exploratory methods* on the other hand are generally perceived to be less persuasive then forecasts based on primary market research, because of the subjective views of the marketplace (Mc.Burney et al., 2002).

Table 1. *Characteristics of exploratory and primary market models (deducted from McBurney et al.)*

Exploratory models	**Primary market research techniques**
Experts, management	Prospect customers
Less forceful because of subjective view	Problem of sparse (meagre) target populations
Inexpensive, fast	Costly, time-consuming (amount of data)
Roughly true for bigger population	True for tested population

However, the main problem with current research methods seems to be that the users and experts, selected to provide input, are constrained by their own real world experience. New information is always interpreted in the light of one's own knowledge (Trott, 2001). These users or experts will have great difficulty to generate novel product concepts which

conflict with the familiar (von Hippel, 1986). When the function of an object is primed, subjects become 'fixed' on the design function of the object (German & Barret, 2005); an effect that Dunker (1945) has called *functional fixedness*. Because of this fixedness only *incremental* innovations seem possible through market research. It can help fine-tuning an existing concept, but it seldom is the source for an entirely new product concept (Hamel & Prahalad, 1994). For many markets, like the food market, this is not a real problem. However incremental innovation can be helpful for the more fast-moving technology and ICT market. Sometimes the innovation will need to be more radical to stay on top of the market. The next paragraph discusses some accepted methods in reference to the discussion above.

2.4.1 Accepted methods

The discussion of the models will be divided in exploratory models and primary market research models. Out of both categories two frequently used models will be discussed.

2.4.1.1 Exploratory models

The first method to be discussed is the ***Delphi method*** (Jolson and Rossow, 1971). This is a widely used exploratory, pure qualitative research method. Within this method the researcher asks a group of experts individually about their opinions for the future of a product. After this opinion is expressed, feedback is given about the answers of the other experts. In the light of this new information the experts are allowed to adjust their opinion. The process is then repeated until some kind of consensus is reached. Despite of Delphi being a widely adopted method, it has been criticised for its artificial consensus due to the pressure for it and for personal and situation specific biases (Woudenberg, 1991).

Another widely used exploratory method is ***scenario planning***. This method has experts consider possible futures and then explore the consequences of those futures. However for market categories in turbulent environments, there may be a large number of influences and a consensus of the possible future will be difficult to reach (McBurney et al., 2002). Furthermore it is difficult to really take innovations into consideration, when one starts from the current situation. The problem with scenario planning is that it is based on a technique called *forward processing*. Not the current situation as it should be, but the situation as it is, is the starting point in this technique. A method based on *backward processing* should

fix this problem. Within such a technique a notion of an imaginary future is constructed and the decision to be made is backtracked from this point (Saaty, 1980).

Both the Delphi method and scenario planning seem unsuitable for forecasting radical innovation because of the *consensus creation* in both methods. Secondly, both methods only use qualitative data and are not supported by *quantitative data* in any way. Additional quantitative data could help interpret the qualitative data. Greene, Caracelli and Graham (1989) identified this as one of five reasons to use a mixed method approach. Greene et al. (1989) also point out that a mixed method increases the validity, meaningfulness, breadth, depth and scope of the results.

2.4.1.2 Primary market research techniques

Primary market research techniques are less sensitive for the subjective market views that exploratory methods cope with. **C*onjoint analysis*** is a quantitative example of such a technique. For new services a key marketing task is to decide what features are to be included in a service package. Conjoint analysis is frequently used to this end. Within this technique, customers are typically asked to rank hypothetical products, which sometimes only differ in one feature, order of preference. The extent to which one product is preferred over another can be calculated afterwards (McBurney et al., 2002). This technique is more persuasive than exploratory techniques, however far more *time-consuming*. This is due to the intensive interviews needed and the enormous amount of data to be evaluated afterwards.

Conjoint analysis, being a quantitative measurement tool, produces a less subjective result. The results however lack an *interpretation frame*. Questions like 'why does the consumer like product x better than product y?' and 'Has the personal situation been of influence in making this choice?' typically will not be answered. Also the *functional fixedness* can be expected to play a role within this technique. Products that do not match a customer's real world perspective may be discarded because of that (Trott, 2001). When this is taken into consideration, conjoint studies seem mainly suitable for incremental innovation.

Von Hippel (1986) developed a currently widely used primary market research technique, that deals with functional fixedness; the ***lead users method***. Lead users are users whose present needs will become general in the market place months or years into the future. Because these users are familiar with conditions which are in the future for most others, they can serve as a 'need forecasting laboratory' (Von Hippel (1986). 3M Company is one of the

examples of major companies that successfully adopted this strategy to do their market forecasts (Lilien, Morrison, Searls Sonnack & von Hippel, 2002),

However, the lead users concept is not without difficulties. Diffusion literature, i.e. literature about the way innovations spread out, suggests that *early adopters might differ from the main users*, so there might be some kind of translation needed (Von Hippel, 1986). Furthermore, though lead users will be able to deal with innovative concept much better; it is probable that they will suffer from *functional fixedness* to some degree as well. In addition, because of the use of *forward processing*, the result will not be very innovative, but somewhat conservative.

Geurts and Roosendaal (2001) propose a technique for ***estimating innovative change***, which can be used as a *primary market research technique* as well as an *exploratory model*. It draws on a four-function framework from which interviews are established and in which the results can be interpreted afterwards. The method uses the discussed interview technique *backward processing* combined with provocative statements. This should encourage a reaction based on invariant needs and bypass the problem of functional fixedness. The data processing involves converting the qualitative data into quantitative data, making the interpretation afterwards straightforward.

The method of Geurts and Roosendaal (2001) seems to overcome the mentioned limitations of the discussed models for forecasting demand. This method is therefore selected for application in this research. The next paragraph will explain the method in detail.

2.4.2 Forces and functions (Geurts and Roosendaal, 2001)

According to Geurts and Roosendaal (2001) the base for an estimation of a direction of innovative change should be twofold. Firstly, the validity of the measurement is essential. This, because of the functional fixedness, can be a challenging task. Secondly, it is important to recognize that there is a balance between all parties or stakeholders. This balance is similar to one in an ecosystem. The balance serves as the starting point for the interviews and as an interpretation frame for the results afterwards. The balance may change with the introduction of an innovation.

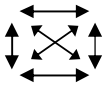
Geurts and Roosendaal (2001) developed a multilevel model in which the core activities and the forces governing a system should be rethought. This way a more general system can be created instead of just taking the direct interest of the current stakeholders as a starting point for the model. On the highest level of the model the *forces of the market* are represented and inspired by this, on a somewhat lower level it illustrates the *functions of the product*.

The method is based on the assumption that there are several forces present within a market. Each of these forces pulls the market into a certain direction. On a lower level the functions are influenced by this. These functions are invariant; however, the balance between the functions can change. By mapping the balance between these functions, the direction of innovative change can be estimated, according to Geurts and Roosendaal (2001). When all forces and functions are taken into consideration, the model can serve as a general framework. This way, a potential product can be related to the deeper level of the forces of the market and the functions of the product.

The function part of this method for capturing the functional demands of a system is based on a theory proposed by Parsons (1967) named AGIL. This theory assumes that a social system is an *action system*; a system of relationships of an actor to a situation (Parsons, 1967). The system can be divided by two dimensions into four subsystems (see table 2). The first dimension is the *internal* versus the *external* characteristics of a system. The second dimension captures the *instrumental* versus the *consummatory* characteristics of a system. In which consummatory characteristics point to the need of an actor for a relationship to an object; instrumental characteristics on the other hand involve the need of an actor *for help* to establish a relationship to an object (Parsons, 1967). The four subsystems that result from this division, *Adaptation, Goal Attainment, Integration* and *Latency,* are depicted in table 2. Each

of these functions is a system on its own. In order for a system to be stable and have a successful and continuing existence, there must be a balance between the functions (Parsons, 1967).

Table 2. *Parsons' AGIL scheme (1967)*

	Instrumental		Consummatory
External	Adaptation		Goal attainment
Internal	Latency		Integration

Parsons' scheme can be understood as a social system that functions in an environment. The extent to which the system can control the environment as to provide for its members is represented by *Adaptation*. *Goal attainment* refers to a systems need for collective goals, to which activities can be devoted. The extent, to which the system is able to coordinate the subsystems when conflicts between these subsystems occur, is the ability for *Integration* of the system. *Latency* refers to the ability of a system to maintain the value pattern of a system (Parsons, 1967).

The subsystems influence each other mutually -as depicted in table 2 by the arrows-; the character of the whole system is determined by the way in which the subsystems influence each other (Parsons, 1967).

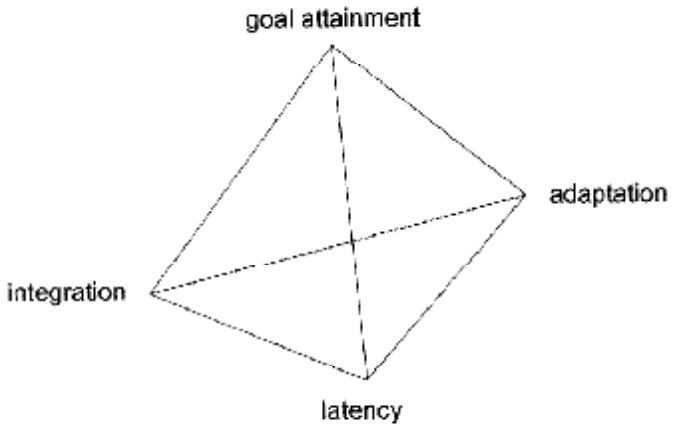
The description of a social system is useful for estimating innovative change for a certain product category. It captures the dynamics of a system and the reaction to external influences. These influences can shift the balance between the functions, but never change the functions itself.

This concept is illustrated by the following *example* in scientific communication (Roosendaal and Geurts, 1998). The functions in scientific communication are identified as *registration*, *archiving, awareness,* and *certification*. Scientific information used to be communicated in a linear fashion, through books or magazines. The need for awareness and archiving at this point in time was low. The internet caused a shift in the way scientific information could be retrieved. The need for archiving and awareness of the information became more apparent. As a result a more interactive network arose. This example shows that

however the balance between these functions has changed in the past decennia, the composition is still the same!

Following the Geurts and Roosendaal method (2001), a model of functions is used as a framework to establish interviews that can help determining the balance between the functions. In addition, the model will serve as an interpretation frame afterwards. The determined balance helps foreseeing the direction of innovative change. Subsequently it will help foreseeing which products have a better probability of being successful.

As interpretation frame Geurts and Roosendaal propose a model based on AGIL but depicted in a three-dimensional figure, like in figure 4. Doing so, it is not necessary to represent the functions in a specific order, because each order will result in the same figure, be it turned. More over, each point within the three dimensional space can represent an interaction between two, three or four functions. This way every balance between the functions can be represented in the same model.



Figuur 4: The four functions in a three-dimensional model
(Roosendaal and Geurts, 1998)

2.4.2.1 The interview method

To determine the balance between the functions, and thereby the character of the system, several topics are to be established. The introduction of a topic places the issue at hand in the future ("in ten years from now…"). This introduction is followed by a *provocative statement* concerning the interaction between two or more of the four functions. This introduction combined with the statement should encourage the interviewee not to answer with a general affirmative remark, but based on (latent) needs. The interviewee is then asked to react to the statement on a quantitative five point scale (running from strongly disagree to strongly agree). Agreeing in this case means that the interviewee expects the proposed shift in balance, a neutral answer means that there is no perceived balance between the functions; disagreeing means that there will be a shift, but in an opposite direction. This way the sketch of a possible future gives information about the direction of the change.

In order to obtain information regarding the way the *initial reaction* should be interpreted, (qualitative) probing questions like 'Why do you think that?' and 'In what time frame do you expect that..?' can be posed. This should give information about the way the proposed interaction between the functions is potentially influenced by the other functions. The introduction, the provocative statement and the probing together should avoid *functional fixedness.* To illustrate, this assume that the functions for retrieval of information are *timeliness*, *completeness*, *reliability* and *relevance.* A possible statement on the interaction between reliability and completeness is: *In ten years from now timely information will only be interesting when it's complete*. When the reaction of an interviewee is "I agree partially" and his answer to the probing why-question is "I'm only interested in timely, complete information when I know I can trust it", then there is a three-way interaction; namely for *timeliness*, *completeness*, *reliability.*

After some probing questions the interviewee is given the chance to revise the initial reaction to the statement and to give a *final reaction* to the statement. The final reaction will be used in the data-processing.

In the next chapter this model will be applied to the IT real-time service market in which KPN operates.

3. Theory and methods

In order to answer both research questions 1 and 2 the method developed by Geurts and Roosendaal (2001) will be used. It is important to keep in mind that predicting the success of an innovative product or service, just like predicting the weather, isn't an exact science. There are routes that lead to an informed estimation or an educated guess, but these estimations will still be based on assumptions.

This chapter will develop the model of the functions by the method of Geurts and Roosendaal (2001) for estimating innovative change. For the purpose of this study only the somewhat lower and less abstract level of the of the product functions is interesting. Therefore only the future functional demands of the stakeholders for a product will be plotted. The establishment of the questionnaire will also be commented.

3.1 The functions

The model will be applied to the system for RFID enabled real-time IT-services. To be able to create the model of the functions, first of the goal of the system must by be determined. All three of the other functions serve that goal. In case of the system of real-time IT services offering *adequate information* is its goal. Therefore, this will serve as the function for the subsystem 'goal attainment'. Adequate information will refer to the degree in which the information will be real-time, on time or afterwards, as well as to the degree to which the information is relevant for the receiving end of the information. Adequate information is an external function, meaning that 'adequate information' cannot be influenced by the system itself, but is, in this case provided via a telecom provider, or more specifically KPN.

User interface is identified to represent the adaptation subsystem. By user interface is meant: the way the information is presented to the user. This can be done in a personal way, for example by e-mail or text message on a mobile phone, or through some kind of more generally accessible management dashboard. Making the user aware of important information and subsequently enable him to act on it, is the only means by which a real-time system can control its environment. Just like *adequate information*, this function is an external one, which is provided by the service provider.

The third function in this model is *System Reliability*, as function for the subsystem integration. Shekhar and Ramachandra (2006) have developed a reference model for an RFID enabled enterprise in which they named this specific function *real-time sense* and in their definition it 'comprises hardware for detecting or sensing physical events of business significance'. This 'sensing' enables the system to integrate other systems and coordinate between the subsystems. However, the technical part of this 'sensing' is not important for the customers to understand. It is to be filled in by KPN afterwards. The only thing the customer has to know is that the technology is reliable. As an illustration; it is not important for a driver to know how his car works, to be able to use it. The driver only has to be able to use its interface, being the steering wheel and the gas-, brake- and clutch pedal.

Lastly *real-time response* is identified as representing the latency part. This term too, is chosen following the example of Shekhar and Ramachandra (2006). In their definition this function is involved in interpreting and responding to the physical environment. In the current research it also includes the degree to which the system can act independently on information in predetermined scenarios. The system must, on basis of the provided data, independently determine whether the situation is desirable and no action should be taken or whether the situation is undesirable and action should be taken. In the latter the data should be acted upon by the system itself in simple cases (for example grant or deny access) or communicated to a human in more complex cases. This system-intelligence is what makes the difference between the current situation, in which information can only become available after the fact, and the new system, in which the information will be made available as it happens. The three-dimensional model of the discussed functions is represented in figure 5.

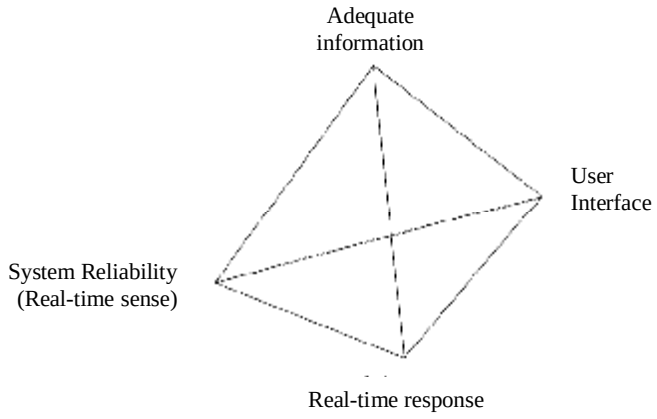


Figure 5: The representation of the functions for real-time IT services

The three-dimensional model as depicted on the previous page is very useful when every combination between the functions is meaningful. However, in this case, some of the combinations are void. Firstly, the combination *System Reliability – real-time response* is not of value, because it is either without goal or connection with the end-user. In other words, this combination doesn't contribute to the goal, nor does it reach the user.

Secondly, the combination *System Reliability - user interface* is meaningless. However the reliability of the user interface is interesting, the function *System Reliability* refers to the accurateness with which the information is collected. The reliability of the user interface is captured in the function *user interface* itself.

Lastly, the combination *adequate information – real-time response* is void. The real-time response can only serve the goal by providing adequate information via a user interface. More concrete, when it is decided through predetermined rules that the information is important enough to be communicated to the users, but there are no means of communication, this real-time response is of no value.

With the discussed combinations being void, a two-dimensional model as depicted in figure 6 will be sufficient to depict all meaningful interaction axes.

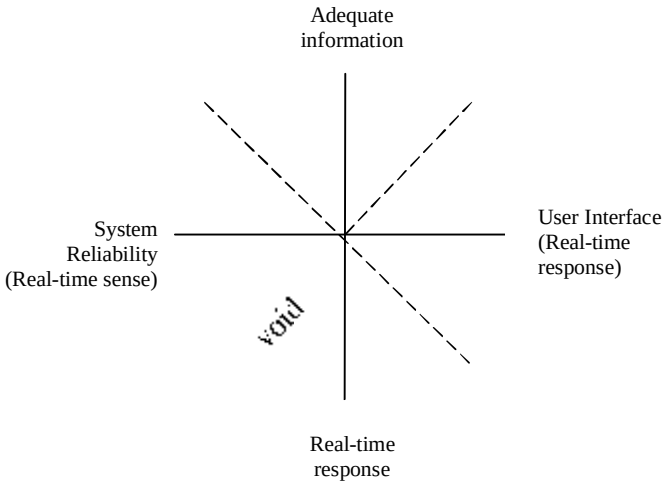


Figure 6. The two-dimensional representation of the functions for real-time IT services

Now that the model of functions is established, the framework for the development of the questionnaire and the interpretation of the results afterwards, is ready for use.

3.2 The business customers

3.2.1 The interview

The discussed interview method proposed by Geurts & Roosendaal (2001) was used. For the interviews, two questionnaires were developed. One questionnaire for RFID services concerning Asset Management and one for RFID services concerning Value Chain Visibility. For the questionnaire 'Asset Management' twelve provocative statements were developed to which the interviewees could react to. For the questionnaire 'Value Chain Visibility' thirteen similar statements were established. The topics that were used in the interviews can be found in appendix A.

Because the (potential) tracking and tracing customers of the KPN department Business Strategy and Innovation formed the group of interviewees, no statements regarding technology were incorporated. The technology, represented in the *system reliability* function, is regarded to be external to the customer's demands and internal to the service provider's process. In other words, it is not necessary for the customers to know how the technology works, to be able to express their needs regarding it. This technology that is to be used to make these wishes happen is to be filled in afterwards by the service provider. Statements regarding the technology will therefore be of no interest.

3.2.2 Data collection

Table 3 shows the division of interviews per area. The data was collected from twelve individuals. Five of the individuals had a business relation with KPN concerning Asset Management. Three value chains, in which KPN was or still is involved for the development of an RFID solution, were subject for the Value Chain Visibility interviews. Four of the interviewees represented the links in 'Vers Schakel', the project where crates of fresh vegetables were followed throughout the chain, mentioned earlier. Two of the interviewees represented links in a case that followed books from the distribution centre until the shop

floor. One of the interviewees represented a link in the garbage disposal chain. Together this resulted in seven interviews for Value Chain Visibility.

Table 3.

Interviews per area

RFID area	**market segment**	**Interviews held**
Asset Management		5
Value chain Visibility	Vegetables	4
	Books	2
	Garbage	1
Total		12

All interviewees were approached by email or phone and an interview was scheduled. The interviews were face-to-face, on location and always individually in a separate room as to minimize the possibility of interruption. All interviews were held in Dutch because of the absence of non-Dutch speaking customers. For the purpose of accurate data processing, all interviews were recorded and then transcribed. All interviews were held and transcribed by the same researcher.

The transcriptions were used to accurately identify assertions that referred to one or more of the seven vectors. These sentences were collected and ordered by vector in a codebook to provide an overview. To increase the reliability, two coders have coded one interview independently. In an iterative process all dissimilarities between the two coders were discussed as to create convergence.

To convert this qualitative data in more workable quantitative data, the statements were scored on a five point scale, running from *totally agree* to *totally disagree*. The additional comments stemming from the probing question were scored on a five point scale as well, representing the magnitude of the assertion expressed by the interviewee.

3.2.2.1 Data presentation

Geurts and Roosendaal (2001) propose a vector model to present the results. This *vector model* is to be established in the same two-dimensional model, by drawing an arrow (topic vector) with a corresponding length on the specific axe. In figure 7 a (hypothetical) reaction for the interaction vector *adequate information – interface* is shown. Disagreeing results in an arrow ending close to the origin, for example [1,1]; strongly agreeing, on the other hand, results in a score of [5,5] and thus a longer arrow. The additional comments resulting from the probing questions stem from the end of the final reaction arrow; the direction of the arrow represents the function it is referring to. In the model, this is represented by drawing an arrow that corresponds in length with the appointed magnitude, (see *comment vector* in figure 7). This way also three-way balances for example between *adequate information – real-time response – interface*, as in the example of figure 7, can emerge from the referents based on two-way statements.

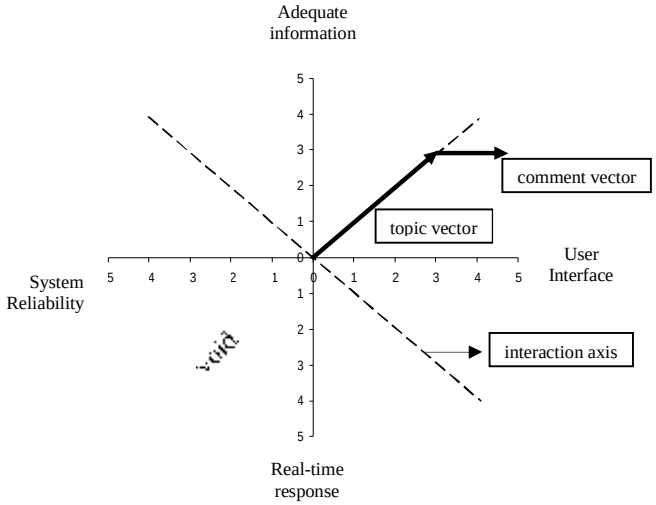


Figure 7: Example for vector model

For this research all interviews will be plotted in individual schemes, were after the plots will be analyzed to discover trends. Because of the low number of interviewees, no statistical analysis will be done. The results will therefore be statistically irrelevant, but merely point in a certain direction.

3.2.3 The procedure

Before the start of the actual interview the interviewee received an introduction (see appendix A) to read for himself. In the introduction the interviewees were first thanked for their participation. Then the purpose of the research was explained. Furthermore the estimated duration of the interview and the way to react to the statements were commented. Subsequently the interviewee was made aware of the fact that the interview would be recorded and that the research findings would be reported to KPN and the University of Twente. Finally the interviewee was given the opportunity to ask questions. After responding to potential questions the recorder was started en the actual interview began.

The interview began with an introduction that placed the following statements in the future. For the interviews concerning Asset Management this was (translated from Dutch):

"In five years from now every company and every company area were we work will be fully equipped with sensors. All employees, but also all valuable company assets, like laptops or returnable transport items, are provided with sensors. This makes it possible to always and real-time track your personnel and your valuables company assets."

The introduction for the RFID services concerning Value Chain Visibility was as follows (again translated from Dutch):

"In five years a whole product or service is no longer produced within one company but together with other companies. Every party has its own part in the process. The technique for data exchange will be at such a high level that not only the information of your own company, but also the information of the other parties is accessible"

After this introduction the provocative statements followed. The interviewee indicated his level of agreement by choosing one of the following options: 'totally disagree – disagree – neutral – agree – totally agree'. As to get an indication of how to interpret the initial reaction, the interviewer continued with probing questions. Finally the interviewee was given the opportunity to revise his initial opinion. Hereafter the interview continued with the next question. After all questions were discussed in this way, the interviewee was thanked for his time and was promised a copy of the final report.

4. Results

This chapter will discuss the results from the interviews. As pointed out earlier, these results are not statistically valid but merely propose a direction.

The results will be discussed on function level as opposed to statement level, because KPN's interest is in an overall balance between the functions and not in the specific answers to the questions.

The discussion of the results for the interviews with the business customers is divided into two paragraphs. The first paragraph will denote the results for the provocative statements and paragraph 4.2 will discuss the results for the probing questions.

4.1 Results for the provocative statements

Table 5 shows the results for the statements. For the larger part, the statements received positive responses. The result for *User Interface* stands out because of the neutral reaction for both VCV (M = 3.0, SD = 1.00) and AM (M = 3.0, SD = 0.71). The results for *System Reliability* show for both VCV (M = 4.6, SD = 0.34) and AM (M = 4.6, SD = 0.42) an extremely positive reaction. Lastly, the result for the interaction vector *System Reliability – Adequate Information* shows a positive result for VCV (M = 3.7, SD = 1.03), but a neutral result for AM (M = 3.0, SD = 0.61)

Table 5.
Results for the provocative statements (continued on next page)

Area	Vector	Statements	Mean	Modus	Standard Deviation
Value Chain Visibility	Adequate Information	6	3.4	3	0.53
	Adequate Information – User Interface	1, 5 & 8	3.4	3	0.21
	User Interface	9	3	3	1.00
	User Interface – Real-time Response	2, 3 & 4	3.6	4	0.37
	Real-time Response	11 & 12	3.5	4	0.57
	System Reliability	10 & 13	4.6	5	0.34
	System Reliability – Adequate Information	7	3.7	4	1.03

Area	Vector	Statements	Mean	Modus	Standard Deviation
Asset Management	Adequate Information	6	3.8	3 & 4	0.84
	Adequate Information – User Interface	1 & 2	3.3	2 & 3	1.10
	User Interface	7	3	3	0.71
	User Interface – Real-time Response	4	3.8	4	1.26
	Real-time Response	9, 10 & 11	3.7	4	0.34
	System Reliability	8 & 12	4.6	5	0.42
	System Reliability – Adequate Information	3 & 5	3.0	2	0.61

4.2 Results for the probing questions

This paragraph will discuss the results for the probing questions. In answering a probing question, the interviewee can refer to one or more of the vectors. The vectors that are referred to, support the reaction to the provocative statement.

There are only a few similarities in the responses to the probing question. This is true overall, but also within the groups *Asset Management* and *Value Chain Visibility*. The results seem to be specific for the particular individual that was interviewed. The discussion below will highlight the results per function.

4.2.1 Adequate Information

The results for *Adequate Information* -the function representing goal attainment- show that the reactions to statements on this vector are seldom substantiated with referents to other vectors. *Adequate Information* is only substantiated with referents to itself. This results in figure 8.

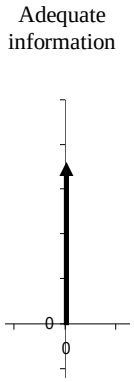


Figure 8. Result for Adequate Information

However, reactions to statements on all other vectors are substantiated with referents to *Adequate Information.*

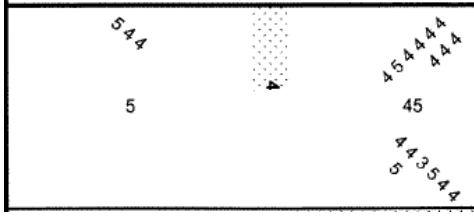
Table 6 on the next page displays the weight of all referents made to *Adequate Information* in one interview. This specific result can be considered typical for *Adequate Information.* The weight of each referent is placed onto the vector for which the provocative

statement was made. It clearly shows that *Adequate Information* is referred to from all possible positions in the framework. The term 'possible' is used because *Adequate Information* cannot be used as referent for statements on the vector *Real-time Response*. As discussed in the methodology section, the relation between *Real-time Response* and *Adequate Information* is void.

Interviewees use *Adequate Information* most often as support for statements on the interaction vectors *Adequate Information – User Interface* and *User Interface – Real-time Response*.

Table 6.

Referents made to Adequate Information

referent score positioned on original vector	Number of refferents	mean of referents
	22 (51%)	4.2

In addition, it applies to all interviews that, of all referents made in a specific interview, the largest part of these referents refer to *Adequate Information*. The percentages range from 47 to 68%. These referents largely consider three main subjects. Firstly, the *relevancy* of the provided information:

> *"Je zult moeten nadenken welke informatie mensen in een proces echt nodig hebben om het proces te verbeteren"*
> *(*"You will have to think about what information people really need in a process to be able to improve the process*")*

Secondly, the *reliability of the information*:

> *"Het moet de werkelijkheid meten; als het dat niet doet, introduceer je een dermate grote foutkans, dat de toegevoegde waarde ten opzichte van de huidige situatie hard afneemt"*

("It must measure the reality; if it does not do this, you introduce such a large possibility for errors that the added value in regard to the current situation decreases fast")

And lastly, the *timeliness* of the information:

"Als ik het real-time kan meten, dan kan ik daar direct actie op ondernemen. Corrective acties"
("If I can measure real-time, I can take immediate action. Amendatory action")

4.2.2 Adequate Information – User Interface

Reactions to statements on *Adequate Information – Interface* are in all cases substantiated in a relatively strong fashion with referents to *Adequate Information* (M = 3.9). In addition, in most cases quite firm referents are made to *System Reliability* (M = 4.1). Figure 9 depicts the described balance.

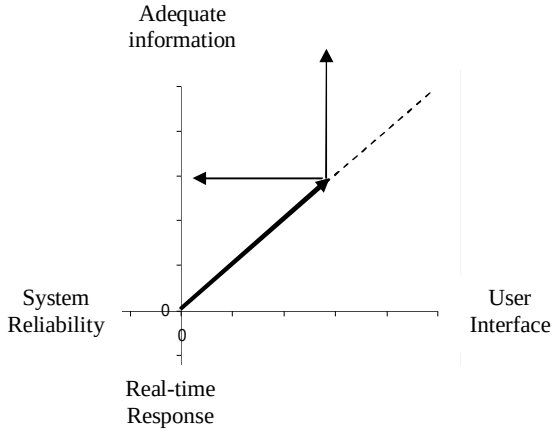


Figure 9. Result for interaction vector *Adequate Information – User Interface*

4.2.3 User Interface

Reactions regarding *User Interface* are always explained with referents towards *Adequate Information* (M = 3.9) and in many cases also referents to the interaction vector *Adequate Information – User Interface* (M = 3.9) are made. This is illustrated by figure 10 on the next page.

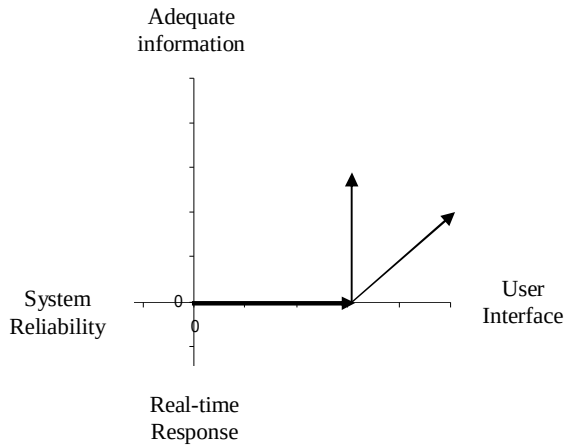


Figure 10. Result for User Interface

What is striking for the vector *User Interface* is that it is scarcely used as a referent to support reactions to the provocative statements. For VCV it is least referred to, in 6 out of 7 interviews, ranging from 0 to 3% out of all referents made in that interview. The interviewees for AM used *User Interface* more often as support; they referred to it in 4 to 15% of all referents made.

4.2.4 User Interface – Real-time Response

The results from the probing questions for this interaction vector differ per interview. It is only constant in the relatively strong referents made to *Adequate Information* (M = 3.9). Because of the absent convergence, no visualization is shown.

4.2.5 Real-time Response

For statements on *Real-time Response* the composition of the referents, resulting from probing, is once more interview-specific.

However, a constant factor is the referents made to interaction between *System Reliability* and *Adequate Information* (M = 3.2). Figure 11 on the next page depicts the common balance for *Real-time Response.*

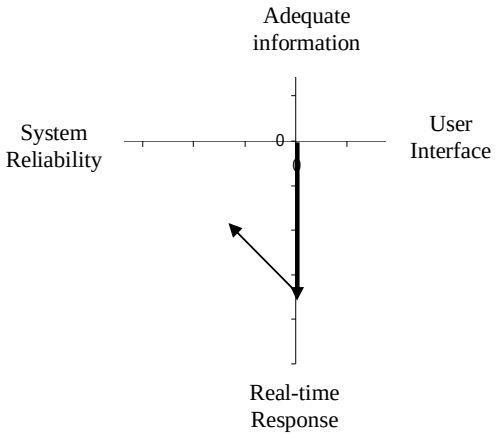


Figure 11. Result for Real-time Response

In addition, ***Real-time Response*** is not much referred in support of a reaction on a provocative statement, but when it is referred to, this is done with quite firm terms (M = 4.0) as illustrated with the following quotes:

"Als het systeem kan ingrijpen, moet het systeem ingrijpen"
("If the system can intervene, it should do so too")

"Dat is super, je krijgt zelfdenkende systemen"
("That is magnificent, systems that think on their own")

4.2.6 System Reliability

No real direction can be found for the referents made to support statements on ***System Reliability***. The single constant factor is that ***Adequate Information*** is used as substantiation. Striking is that these referents are made quite strongly (M = 4.2). The visualization is not shown because of the absent direction.

4.2.7 System Reliability – Adequate Information

Statements on the interaction vector *System Reliability – Adequate Information* are mainly supported with referents to *Adequate Information* (M = 4.0). However, the interviewees in the *Asset Management* group also refer to *System Reliability* (M = 4.0), whereas none of the interviewees in the *Value Chain Visibility* group make this connection. This is due to the difference in provocative statements between the areas. Again, a general visualization cannot be shown.

5. Discussion and conclusion

This chapter is divided into two parts. The first part will discuss the results from the interviews and answers research question 2 and 2.1. The second part will discuss the value of the method for *estimating innovative change* (Geurts and Roosendaal, 2001) for KPN's purposes and will thereby answer research question 1.

5.1 The results from application of the model

First of all, it should be noted that the relatively low number of respondents does not support any statistically valid conclusions. A higher number of customers would be ideal. However, this relatively low number does not mean that the conclusions are not relevant at all. The market for this innovative product has not yet been developed. The number of respondents can, as a result, be considered a significant part of the market known to KPN. This is why the results should be interpreted as being an indication of the direction the market is headed for.

5.1.1 Customer specific reactions

The results of the interviews in general indicate a striking outcome. The wishes and demands of the customers prove to be customer-specific for a considerable part. This is mainly indicated by three observations.

The first observation stems from the *provocative statements*. These responses are mostly positive, meaning that the interviewees agree that shifts in balance will happen for almost every vector. However, it could also indicate that the statements were not provocative enough and left the interviewee with no other option than agreeing to it. This could be plausible for the statements on *System Reliability*. Almost every interviewee reacted extremely positive to statements on this vector. A positive response in this case seems to be obvious to the interviewees. However the remaining statements are regarded to be provocative enough. The positive mean in these cases is the result of negative answers being evened out by extremely positive ones. The great variation indicates that interviewees do not share opinions. The results are customer-specific and should, in case of high standard deviation, be interpreted with caution to be more generally valid.

The second observation that supports the customer specific nature of the answers is found in the *referents made to Adequate Information*. This function is the most referred to in substantiating reactions to all statements. This seems quite obvious, with provision of adequate information being the goal of the system. However, adequate means that it should equal a clients needs and can therefore hold very different implications for different clients. For instance, information that can be consulted afterwards, during invoicing, will be adequate for a garbage disposal centre. A distribution centre for fresh vegetables however will need information more instantly to avoid decay of the vegatables. The referents to *Adequate Information*, once more, indicate client specific wishes regarding the service.

The final observation that indicates the customer-specificity is *the variation that is found in the referents* made in reaction to the statements. In spite of vectors with recurring referents to a specific function being present, the general composition of all referents for one statement varies.

Due to these observations no common denominator for the market for RFID enabled services can be indicated. This means that a generic product for the entire market will not be successful.

5.1.2 User Interface

The reactions to the statements concerning the *User Interface* came out neutral, but with rather big variation between various answers. This indicates that the feature of the interface is important for some clients, but not for all of them. To clarify their reaction all interviewees refer to *Adequate Information* and most of them to the interaction between *Adequate Information* and *User Interface*. Apparently it is important that the information that is communicated to the user is relevant, on time and reliable, which means that it will be situation specific what interface is most suitable.

That the form of the interface is not a requirement on its own, can also be inferred from the little referents made to it. SMS, a management dashboard, alarm sounds, rotating lights: it is all possible, as long as it adequately provides the information.

What is striking as well is that reactions to statements on the interaction vector *Adequate Information - User Interface* -or the way in which information and mode of communication influence each other- are substantiated with referents to *System Reliability*. This means that beside of the fact that the information that is communicated must be relevant;

the reliability of the technique that is used is also important in the choice for an interface. This means that when, for example, the information is private, it must be communicated only to the relevant person and with a reliable technique.

5.1.3 Real-time Response and System Reliability

The results show that the degree to which an information system must be able to take real-time action on collected data, depends on the reliability of the technique to adequately collect information. The interviewees, though, appear to differ in opinion whether the reliability will be sufficient enough or not. This reliability however seems to be extremely important, inferred from the quite strong referents made to it.

This has two central implications. One is, naturally, that the provided system should be extremely reliable. But the second implication is in the *perception* of what the technique can do. It seems from the interviews that businesses are hesitant to trust a system with important decisions. This can be explained in some degree by *functional fixedness*, which makes it hard to imagine that a system could act reliably on its own based on the current situation. In addition, a self-acting and self-thinking system would make humans, and therefore the interviewees' job obsolete. Hesitation towards real-time response should therefore also be interpreted in the light of this wishful thinking.

5.1.4 The expectation of the customers and the fit with KPN's strategy

With respect to research question 2, there does not seem to be a result that is valid for every customer. Although convergence in the results of the interviews would have been a very useful outcome, the diversity in responses is also a very meaningful result. Apparently the balance between the functions is very customer-specific. This is a significant result for KPN Business Strategy and Innovation. This department strategically concentrates on developing high-growth business with products that are able to have a revenue of at least €10.000.000 in 3 years time. Therefore products with a repeatable business model, which will usually are standardized products, are strategically most interesting. If a more tailor-made approach for RFID-based services is necessary, this could implicate that providing these services is not strategically interesting for this department.

However, there are two cases in which providing RFID enabled services can be strategically interesting for KPN. The first case concerns providing tailor-made products to corporate clients. The second one regards providing only those parts that can be standardized, to small or medium sized clients.

In case of the corporate clients, consider that revenue is price times quantity. So with the quantity being lower in case of tailor-made services, the issued price must be higher. This, for instance, is true with large corporate clients. In these cases providing a tailor-made service can be attractive for KPN. This, however, is not a matter for KPN Business Strategy & Innovation, but for the KPN department Corporate Solutions, which is more equipped for providing tailor-made services and handling major corporate clients.

However, KPN can also consider providing a semi-finished product to small or medium sized clients. In this case the elements that make the product customer-specific should be transferred to partners or value added resellers.

Besides the customer-specific results, a salient constant result is that for communicating the information to the customer, as well as for independently acting upon it by the system, the client will demand an extremely reliable technique. This perfectly fits KPN mission statement, which is formulated as follows:

"Our customers trust us to provide them with high-quality, reliable services to help them achieve their business and personal goals, and enrich their work and leisure time. […]" (Royal KPN, 2007)

For the *User Interface* it is evident that the form will depend on the situation and customer. A general interface for this service will not be successful; this fits the second part of KPN's mission statement remarkably well:

"[…] We offer them a range of innovative products which enable them to access information and entertainment, anytime, anywhere, and let them choose how to do that, […]"(Royal KPN, 2007)

5.2 The value of the method for KPN's purposes

The application of the method for estimating innovative change has proven it to be able to deliver interesting and useful results. For evaluation purposes, the discussion of the method will be divided into four main subjects. The first subject will concern the establishing and use of the framework. The second matter regards the interview techniques. This will include the use of provocative statements, the probing questions and the *backward processing*. The third part will consider the data processing. Lastly the link between the complete method for estimating innovative change (Geurts and Roosendaal, 2001) and KPN Business Strategy & Innovation is discussed; this paragraph will answer research question 1.1.

5.2.1 The framework

The framework has proven to offer a structured and balanced approach for setting up the topics and statements. It serves as a solid backbone for the interviews and offers visual support for comprehending the dynamics of the system under investigation. The establishment itself as well as the interpretation of the remarks from the interviewees afterwards, demands a thorough understanding of the market for which the framework is established. This means that the framework should preferably be established by the innovation manager who is responsible for the subject under evaluation and cannot be outsourced.

The framework that was set up in context of this research worked well. The functions that were identified to cover the area for RFID-based tracking, tracing and identification services did so to a great extent. However, it also means that the chosen functions are quite general and convey a wider range of subjects. This caused some difficulties in the establishment of the interviews, but mainly in the interpretation of results afterwards. Two high scores on, for instance, *Adequate Information* can be essentially different; among others things it could imply that the information must be fast, or relevant or maybe extremely reliable. The strongly generalized results are therefore difficult to compare mutually.

5.2.2 The interview

The statements that are generated from the framework must be provocative enough to encourage the interviewee not to respond with a general affirmative remark, but based on needs. This means that every question must be thought through and be tested in order to determine whether it is provocative enough or not. Because this appraisal can only be done by the responsible innovation manager, he or she should generate the questions as is the case for establishing the framework.

The degree to which the interview will deliver interesting data depends on the provocative statements, but also for a considerable part on the interviewer's skills. Probing at the right moment and with the right issue has proven to be a skill that must be developed by exercise. When the statements are established by the innovation manager, the actual interview can be outsourced to a more experienced interviewer. This interviewer should, in that case, be thoroughly instructed about the market and the meaning of the questions.

The method was applied to collect information about the future needs of customers for RFID enabled services. To be able to collect information about both latent and active needs, provocative statements on function level combined with probing questions were used. This combination has proven to be able to collect information about these needs. However, needs that are unrealistic, because of current technological possibilities, have a tendency to be left implicit. For instance, a need to get from one point in the world to another in a fraction of a second can be a real one, but on the basis of current transportation possibilities will not be made explicit. To help interviewees forget about current limitation of technology or their organisation and let them think freely about their real needs, *backward processing* is promoted. This was done with use of some introductory lines sketching an imaginary future. In practice not all interviewees were able to think freely. Often the interviewee's referred to the current possibilities as an argument for their choices in needs. This may have the effect that the expressed needs are too limited by the current situation, and therefore not valid for the future situation. Examples are:

"De andere kant die je moet bepalen is: wat kunnen we?"
("The other side of the story is that you will have to decide: what can we do?") and

"Dat maakt het systeem wel erg complex".
("That will make the system extremely complex".).

Possibly, a textual introduction is not strong enough to accomplish the needed mind shift, or has an only temporary effect. To really lose the constraints the interviewees must envisage the situation. To lower the threshold to do so, a more multi-medial approach will be useful. Picturing the future more vividly might have a stronger, more lasting effect. Imagine the textual introduction accompanied by a short movie. Using more media to express a message is more effective as can be explained by the dual coding theory (Clark & Pavio, 1991). The theory assumes that there are two cognitive subsystems, one for the processing of nonverbal objects and the other for language. Clark & Pavio (1986) demonstrate that recall and recognition is enhanced by presenting information in both visual and verbal form.

The movie should not explicitly show the technological possibilities and constraints. Like the introductory lines it should concern imaginary anecdotic situations, leaving the exact application possibilities to imagination.

5.2.3 Data processing

The transcribing, coding and quantifying of the interviews has proven to be an extremely time-consuming task. Since the department BS&I merely employs managers with academic background, it will be too time-consuming and therefore too costly to keep this task within the department. However, the data-processing can easily be outsourced when the codebook is of sufficient quality.

5.2.4 KPN and estimating innovative change

The application of the model has proven to deliver very useful results. From the discussion above, it has become apparent that analyzing a market with use of the model for ***estimating innovative change*** cannot be entirely done by the department itself. Education and outsourcing will be necessary to apply this method.

The innovation managers will have to be educated to be able to thoroughly understand the dynamics of the AGIL-scheme. This will enable them to establish a framework that describes their market to a great extent and generate provocative statements from it. Subsequently the interviews itself should be outsourced; however the interviewers should be

instructed in detail by the innovation manager. Lastly the data processing should be outsourced and the data processors will need instruction about the market to be able to interpret and code the results.

Currently, KPN *BS&I* employs nine innovation managers, who, at this moment, carry twelve innovation topics. An innovation subject tends to have a duration of one to one and half year until it is handed over to a business unit. This would mean that when this method is used throughout the whole department, it would have to be applied twelve times a year. The schooling, outsourcing and hours devoted by the innovation managers would mean an extremely sizeable investment. However, because the model has proven to deliver valuable results, application of the model will be justified for important strategic decisions, which need a sizable investment.

The *CustomerInsight* approach, which is currently used for gathering market information and which has proven to be less costly, can be used as a scanning method. When this method indicates a sizable investment, this should be further investigated using of the method for estimating innovative change.

5.2.4.1 Using the constructed four-function model

In order to asses whether the four-function model, constructed for RFID enabled services, is applicable for other innovations within Business Strategy & Innovation, a quick-scan is done for nine of the innovations. The scan assesses the applicability of each function of an innovation (see table 7).

Table 7.

Quick-scan for broader applicability of the four-function model for RFID enabled services

Subject	Adequate Information	User Interface	Real-time Response	System Reliability
Software Online	x	✓	x	✓
Remote Care Services	✓	✓	✓	✓
Security, e-camera	✓	✓	✓	✓
Retail, Point of Sale Services	✓	✓	✓	✓
Smart Metering	✓	✓	✓	✓
Mobile Payments	x	✓	x	✓
Connected Car (road pricing)	✓	~	✓	✓
3D World Services (virtual worlds)	x	✓	x	~
Personal Movie System	x	✓	✓	~

Table 7 shows that the model will represent innovations that involve information systems, like *Remote Care Services,* which provides personalized care information at home to patients with a chronic illness, and *Smart Metering,* which entails gas- and electricity meters providing up-to-date meter range information to the energy company. For innovations that are merely tools like *Software Online* and *Mobile Payments,* the functions *System Reliability* and *User Interface* are applicable. However these tools will not provide adequate information or react in a real-time fashion to events. For the 'tool-innovations', these functions should therefore be rethought.

Furthermore, the constructed model does not apply for innovations in leisure or entertainment; *3D World Services,* services in virtual worlds like Second life, and *Personal Movie Service*, which provides personalized videos of participants in events, like runners in marathons. The goal of these services is not providing adequate information, but merely providing entertainment. In addition, for these services the system reliability seems of lesser concern. The integration function should however entail in some way hardware for detecting or sensing physical events.

The above discussion shows that that the derived model is only partly applicable to all innovations at BS&I. The unchanged model only represents those innovations that concern an information system. To represent those innovations that merely serve as a tool or as entertainment, changes should be made to the latency and goal function.

6. Recommendations

This concluding chapter will discuss the recommendations for KPN based on the discussed research. This research brings forth two kinds of recommendations; the ones that flow from the results of the application of the model, and the ones concerning the generic use of the model at KPN. These subjects will be discussed in that order.

6.1 Recommendations for Business Strategy & Innovation

The results show that -when providing end-to-end- RFID based real-time services, this will involve tailor-made features. Given the strategy of KPN BS&I, to develop high-growth business with a repeatable business model, providing tailor-made RFID solutions will not be strategically interesting for this department. However, because reasonable revenue can be generated from this, it is advisable to provide these custom-made services to major corporate clients and transfer this responsibility to the department KPN Corporate Solutions.

KPN BS&I then, is advised to concentrate only on small and medium sized clients. Because of the specific wishes of these clients, the idea of providing an end-to-end service should be abandoned. KPN Business Strategy & Innovation is advised to only provide that part of the service that can be standardized. Providing the customer-specific parts should be transferred to partners or value-added resellers.

The form of the user interface is a main source for the customer-specific wishes. The results show that a service containing a standardized interface will not be successful, as the situation will determine the needed interface. The market has no specific wishes for the interface either, as long as it adequately provides the information. This implies that the development of a user interface should not be the focal point of interest for KPN Business Strategy & Innovation. Developing a ***semi-finished*** product, containing an ***accurate generic database*** and providing a ***reliable network***, will help creating a more standardized product. This way, the required interface –for instance SMS, email, or an alarm sound- can be coupled to the generic product by partners or value added resellers. This is illustrated by figure 12 on the next page.

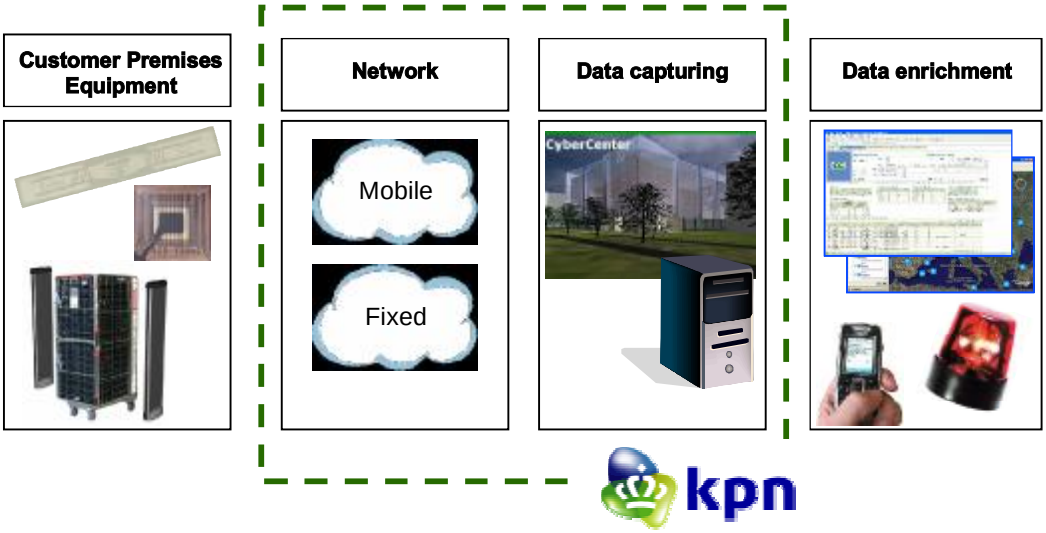


Figure 12. The focus for KPN Business Strategy and Innovation for RFID enabled services

However, it should be noted that development in *customer premises equipment* as well as in *data enrichment*, should be closely monitored to be able to support standards that may arise in these areas.

Furthermore, the results have indicated that customers are hesitant to allow a system to make real-time decisions without human intervention. In addition, the customers demand an extremely reliable technology to do so. This implies that there is a role for KPN in getting the market acquainted with the technology and assuring its reliability.

A pilot test can serve as a model setting for customers that consider installing an RFID enabled system and provides proof for KPN's abilities to develop such a system. Additionally, a system that is up and running will provide some reassurance in regard to transferring responsibilities from a human to a system. KPN should therefore focus on doing a pilot that shows all technological abilities. This pilot should be actively used for visits by potential customers.

6.2 Recommendations for using 'estimating innovative change'

The tested method for *estimating innovative change* (Geurts & Roosendaal, 2001) has proven to deliver valuable results for forecasting demand in changing markets. Using the provocative questions in combination with the probing questions produces a great amount of qualitative data. The quantifying of the data and interpreting it in the four-function model offers a visual aid for understanding the future dynamics in the market. This understanding is necessary for making strategic decisions. The method has proven to lend itself to explore markets that can be expressed in invariable functions.

Application of backward processing in the form of a textual introduction is not at all times sufficient to let the interviewees think freely about their real needs and forget about current limitation of technology or their organisation. To help them to do so it is recommended that backward processing entails a textual introduction accompanied by a short movie.

KPN Business Strategy and Innovation is advised to use the method for strategic decisions. In order to do so, a number of criteria should be met. First of all, every innovation manager should receive *instruction* on how to identify the invariable functions and on generating provocative statements. Because of the need for outsourcing of labour-intensive parts of the method, generic application of this method will be too costly. A two-tier approach is therefore advised; only if the current market research method *Klant InZicht (Customer InSight)* brings forth *strategic issues which need sizable investments* –the second criterion-, further investigation with use of *estimating innovative change* (Geurts & Roosendaal, 2001) is justified and recommended.

A quick-scan has shown that the specific four-function model that was used in this research does also represent the innovations within BS&I that concern information systems, being the innovations *Connected Car (road pricing), Remote Care Services, e-camera, Point of Sale Services* and *Smart Metering.* For the innovations that serve as a tool or as entertainment, the goal and latency function should be rethought.

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Appendix A

Interviews

Introductie

Allereerst wil ik u hartelijk bedanken voor uw tijd.

Dit interview wordt gedaan in opdracht van KPN en de Universiteit Twente en heeft als doel *'het maken van een inschatting van de marktkansen rondom Radio Frequency Identification (RFID)'*. Het onderzoek zal niet leiden tot statistisch relevante gegevens, maar tot een beoordeling van de richting voor toekomstige diensten die van RFID gebruik maken. Omdat RFID vele toepassingen kent, is het belangrijk te bepalen aan welke van deze toepassingen de markt op korte termijn behoefte zal hebben. U bent gevraagd om uw mening te geven omdat u samen met KPN betrokken bent (geweest) bij een project waarvoor RFID is toegepast.

Het interview zal ongeveer een half uur in beslag nemen. U wordt gevraagd te reageren op een aantal stellingen. Deze stellingen beweren iedere keer iets over een toekomstsituatie. Probeert u zich in te leven in deze toekomstsituatie en uw reacties vanuit dat scenario te geven. Probeer daarbij dan ook niet uit te gaan van de huidige mogelijkheden.

U kunt reageren op de stellingen door aan te geven welke van de volgende opties het beste bij uw mening past:

'zeer mee oneens - mee oneens – neutraal – mee eens – zeer mee eens'

Hierna krijgt u telkens de mogelijkheid om uw reactie toe te lichten.

Om dit gesprek zo zorgvuldig mogelijk te verwerken, zal er een geluidsopname van worden gemaakt. De opname is alleen toegankelijk voor de onderzoeker. Het onderzoek wordt gerapporteerd aan KPN en de Universiteit Twente in de vorm van een onderzoeksverslag. In het verslag zal niet met naam verwezen worden naar uitspraken. KPN zal het onderzoek gebruiken om te bepalen welke RFID services de komende jaren aangeboden dienen te worden.

Als u vragen heeft, kunt u die nu stellen. Zo niet, dan starten we nu met het interview.

Value Chain Management

Stelt u zich eens voor:
Over 5 jaar zal er niet meer binnen een bedrijf maar samen met andere partijen een totaal product of service worden geproduceerd. Iedere partij neemt dan een deel van het proces voor zijn rekening. De techniek voor informatie-uitwisseling is dan zo ver dat je niet alleen toegang hebt tot je eigen systemen, maar ook de informatie van andere partijen kunt inzien.

1. Het delen van informatie is alleen zinvol als voor alle partijen de informatie van alle partijen te bekijken is.

2. In deze situatie, moet het systeem direct kunnen waarschuwen op basis van de informatie van alle partijen (denk aan voorraadtekorten, dreigende bederving van houdbare producten, volle containers etc).

3. Wanneer er samengewerkt wordt over de gehele keten, moeten de meldingen van relevante dreigende fouten in het eigen proces en dat van partners (zoals voorraad tekorten, niet betaalde rekeningen) doormiddel van een algemeen alarm of zwaailicht worden gemaakt.

4. Wanneer er samen wordt gewerkt in keten, zal mens alleen waarschuwingen willen ontvangen - over bijvoorbeeld voorraadstanden van andere partijen - wanneer er met zekerheid vanuit kan worden gegaan dat het systeem de informatie juist interpreteert.

5. Zo'n systeem moet bij meldingen een inschatting geven van de correctheid van de waarschuwing (bijvoorbeeld voorraad van leverancier X is onder het minimum peil niveau → 80% zeker)

6. In een dergelijke situatie is informatie delen alléén zinvol wanneer alle keteninformatie real-time vrijkomt.

7. Managers zijn in een dergelijke situatie alleen geïnteresseerd in real-time informatie wanneer de metingen van het systeem uiterst betrouwbaar zijn.

8. In een waardeketen moeten de partijen ook de vertrouwelijke informatie delen.

9. Meldingen van het systeem moeten persoonlijk zijn, per mail, sms, of pop-up op de eigen werkplek, in plaats van meer algemeen door een alarm of zwaailicht.

10. De stabiliteit van de netwerken die mijn IT provider biedt, wordt in de toekomst uiterst belangrijk.

11. Om de keten optimaal te laten functioneren moet zoveel mogelijk kennis in de toekomst in systemen zitten, in plaats van in mensen.

12. Bedrijven zullen van een real-time systeem verwachten dat het in eenvoudige gevallen zelf actie kan ondernemen (in plaats van de actie doorspelen naar een mens).

13. De IT partijen die de systemen ontwikkelen en netwerken beheren moeten uiterst integer en betrouwbaar zijn.

Tot slot

Graag wil ik u hartelijk bedanken voor uw tijd. Als u dat graag wilt, kan het uiteindelijke onderzoeksverslag met uw bedrage en de bijdragen van andere bedrijven naar u opgestuurd worden.

Tot slot wil ik nu vragen of u nog bereikbaar bent voor eventuele vragen achteraf?

Asset Management

Stelt u zich eens voor:
Over 5 jaar is ieder bedrijf en ieder bedrijventerrein waar we werken, volledig uitgerust met een infrastructuur van sensoren. Alle werknemers, maar ook alle waardevolle bedrijfsmiddelen zoals laptops of rolcontainers, zijn voorzien van sensoren. Hierdoor is het mogelijk om altijd en op real-time wijze te zien waar het personeel is en waar de waardevolle bedrijfsmiddelen zijn. Het systeem geeft actief waarschuwingen af wanneer er fouten op dreigen te treden. Bijvoorbeeld wanneer beamers het gebouw uitgaan of containers niet op de juiste plek zijn. De nu volgende stellingen worden vanuit dit beeld gedaan.

1. Zo'n systeem moet, wanneer het meldingen doet van gebeurtenissen, een inschatting geven van de betrouwbaarheid van de waarschuwing
   → Bijvoorbeeld: de rolcontainer is in loods X, dit is voor 80% zeker

2. De informatie moet niet persoonlijk maar via een voor iedereen toegankelijk dashboard worden aangeboden, zodat ik het kan bekijken wanneer het mij schikt.

3. Als een bedrijf gebruik kan maken van real-time systemen om te weten waar waardevolle bedrijfsmiddelen zijn, moet de informatie niet via een service-provider komen, maar direct uit het eigen systeem.

4. Wanneer een systeem bijhoudt waar mensen en spullen zijn, moet het persoonlijke meldingen maken van dreigende fouten (zoals onbevoegden in het gebouw, of containers in de verkeerde loods); bijvoorbeeld per sms, mail of een knipperend lampje op een handcomputer.

5. Managers zijn alleen geïnteresseerd in snelle informatie wanneer de metingen van het systeem heel betrouwbaar zijn.

6. Een systeem zoals net is beschreven, is alleen zinvol wanneer de informatie real-time vrijkomt.

7. Meldingen van het systeem moeten persoonlijk zijn, per mail, sms, of pop-up op de eigen werkplek, in plaats van meer algemeen door bijvoorbeeld een alarmgeluid of zwaailicht.

8. De stabiliteit van de netwerken die mijn IT provider biedt, is in deze toekomst uiterst belangrijk.

9. Voor locatiebepaling van waardevolle bedrijfsmiddelen en beveiliging van gebouwen moet zoveel mogelijk kennis in systemen zitten, in plaats van in mensen.

10. Bedrijven zullen van een real-time systeem verwachten dat het in eenvoudige gevallen zelf, en dus niet via een mens, actie kan ondernemen
    → Deuren openen of sluiten, video opnames maken etc.

11. De sensoreninfrastructuren waar bedrijven over 5 jaar mee uitgerust zijn moeten zoveel mogelijk zonder menselijke tussenkomst kunnen werken, in plaats van via notificaties naar verantwoordelijke personen.

12. De IT partijen die de systemen ontwikkelen en netwerken beheren, zullen in dit scenario uiterst integer en betrouwbaar moeten zijn.

Tot slot

Graag wil ik u hartelijk bedanken voor uw tijd. Als u dat graag wilt, kan het uiteindelijke onderzoeksverslag met uw bedrage en de bijdragen van andere bedrijven naar u opgestuurd worden.

Tot slot wil ik nu vragen of u nog bereikbaar bent voor eventuele vragen achteraf?