Real Estate Development: A Customer Perspective

Doctoral Thesis in Real Estate Economics

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Stockholm 2009

Report 89
Building and Real Estate Economics
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Royal Institute of Technology
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An academic dissertation, with due permission of KTH Royal Institute of Technology, is submitted for public examination for the degree of Doctor of Technology in Real Estate Economics on the 15th of December 2009 (at 10.00) at L1, Drottning Kristinas väg 30, Stockholm.

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Abstract

This doctoral thesis ‘Real Estate Development: a Customer Perspective’, mainly concerns questions that are related to why consumers make a choice and what they are looking for. The first part of this thesis is the result of the research project ‘Models for the Construction Sector’ (MoPo) and the second part is the result of a collaborative project between KTH Royal Institute of Technology, the Construction Sector Innovation Centre (BIC), five private companies¹ and four municipalities in Stockholm County.

Since the Latham report (Latham, 1994), there has been considerable debate about the need for an increased focus on the end customer in the construction process. The housing sector in Sweden has a strong tradition in focusing on construction and project management issues and less on customer satisfaction. Similar findings have been reported in ‘Skärpning gubbar’ (Swedish Government Official Report, 2002) and recently, ‘Sega gubbar’ (Byggkommisionen, 2009), which show that attitudes and processes in the housing sector in Sweden have not really changed since the initial report in 2002. From the perspective of consumer-oriented research in residential development, this issue concerns the ability to understand why customers buy (cognition), what they want (the product) and how the message, relating the product to the consumer, should be formulated (marketing). Investment decisions could be improved if developers ask what kind of values have proved to be important for residents and buyers for a specific type of residential development, what the functional and psychological consequences they are looking for are, and then ask what kind of product attributes can be provided, given economic constraints.

Paper one shows the main activities in how to provide needed facilities and their relationship to the end users’ core business. Paper two shows how the laddering technique can be used to elicit buyers’ beliefs about the built environment, according to the means-end chain theory. The means-end chain theory postulates that buyers purchase a product because it satisfies personal values and desired consequences, which from their perspective are more important than product attributes. Paper three shows the development of a multi-item attitude scale. This scale identifies five key dimensions that are important for the customer when deciding to purchase an apartment in a residential development. The dimensions are: urban environment, architecture, safety, relaxation and liveliness. Paper four shows structural modelling evidence supporting the theoretical assumption that personal values have an impact upon expectations and perceived performance. The structural sub-models show that if perceived performance is increased, customers’ satisfaction will be positively affected. During our research, we have not found any current knowledge in the construction industry in Sweden on how to investigate and measure customers’ values and their beliefs, or how to model customers’ evaluation of product performance using structural equations.

Key words: Residential development, Customer satisfaction, means-end chain theory, laddering, Structural equation models.

¹ Besqab, JM, NCC, Stockholm municipality, Solna municipality, Sollentuna municipality, Swedbank, Upplands-Väsby municipality, Veidekkke.
Acknowledgements

There are many people who have contributed to this doctoral thesis and I am therefore in their debt and forever grateful for their support. First of all, my colleague at the Royal Institute of Technology for many years, Kurt Psilander, for his friendship and many constructive comments, especially on the lengthy second paper. I am also in debt to Stellan Lundström, my supervisor, for his faith and support in this research project.

I am also in debt to the advisory board with which I have had a truly fruitful collaboration during many meetings at the institute. My sincere thanks go to: Ulf Brandt, Per Anders Hedkvist, Billy Holmberg, Ola Karlsson, Ellinor Lindström, Brita Lindquist, Gösta Norén, Anna Persson, Gunnar Swartling, Erik Westling and Johan Westring. Special consideration goes also to the late Professor Emeritus Hans Rahm for his kind support and thanks to Magnus Carlsson, Fastighetsbyrå in Frösunda.

This research project would not have been possible without support from many colleagues at the Royal Institute of Technology, teaching on doctoral courses. My sincere thanks go to: Kent Eriksson at the Centre for Banking and Finance, Per Näsman at the Department of Security Research, Inga-Britt Werner at the Department of Urban and Regional Studies and fellow colleagues at the division of Building and Real Estate Economics.

Last but not least, no one has been as patient and considerate as my wife, Liselotte, who has supported and witnessed both the licentiate thesis and the doctoral thesis being a reality.

For financing this thesis, we acknowledge Formas (The Swedish Research Council for Environment, Agricultural, Sciences and Spatial Planning) and the Göran Collert Foundation and companies and municipalities participating for their economic support in the second research project.
Summary of thesis

Monograph


Paper 1

Lundgren, Berndt and Björk, Bo-Christer (2004) “A model integrating the facilities management process with the building end user’s business process (ProFacil)”, Nordic Journal of Surveying and Real Estate Research, 1 (2).

Paper 2


Paper 3


Paper 4

Lundgren, Berndt (2009) “Modelling antecedents to customers’ satisfaction in a residential development”.
Introduction

The first paper written is based on the empirical result of the monograph only. Papers two to four stem from a collaborative project established in 2005 by KTH Royal Institute of Technology, Sweden and the Construction Sector Innovation Centre (BIC) and five private companies¹ and four municipalities in Stockholm County. The mission declared by BIC is to support improvements in the construction sector through innovative processes that have staying power in a competitive market and target end-customer values, sustainable growth and profitability.

Research method

The monograph was a case study of the communication of generic process models made at Vattenfall AB, Stockholm. The collaboration between KTH and BIC resulted in an applied research project with a joint effort to find new working procedures that can improve how market analysis and studies of customers’ satisfaction are made in the residential sector. This case study was made in the residential development of Frösunda in Solna and was chosen due to its close location to the city of Stockholm. Another important reason was the relative isolation of Frösunda from other neighbourhoods, which gives it a clear identity.

A research project in applied research is characterised, according to Patton (1990) by an attempt to understand the nature and the sources of human problems existing within a social setting. The focus of the research is deemed by society itself to be of use and the key assumptions made by this type of research are that the problems motivating the research can be solved by the use of knowledge. The desired result is a contribution to theories that can be used as a means of formulating problem-solving programmes. The standard procedure for this type of research is to apply in-depth theoretical insights into the problem.

What we can conclude from Patton’s discussion is that applied research promotes both the use of theory and the need for practice. An applied research project aims both at practical benefits as well as a theoretical contribution. The empirical research was performed as case studies (Yin, 1994). Such a research approach is the one that I have chosen for my licentiate and doctoral thesis.

The working format for the second case study was an advisory board, having one representative from each organisation and myself as a researcher. Meetings were held every third month at KTH. In addition, several meetings took place with representatives at each organisation to inform them about theoretical aspects which otherwise could confuse the representatives in an advisory board meeting. These meetings turned out to be of high importance both for the researcher and the representatives. During the advisory board meetings theoretical findings were discussed to reach a common understanding of what they meant and whether these findings could be used to improve customer satisfaction in future residential projects.

¹ Besqab, JM, NCC, Stockholm municipality, Solna municipality, Sollentuna municipality, Swedbank, Upplands-Väsby municipality, Veidekkke.
For example, as a direct consequence, the research focused early on investigating existing residential projects instead of using models. The reason was the complexity of the built environment, which for our purposes, could not be evaluated by the respondents using a model. These decisions naturally had implications for how the case study was carried out and what residential development to choose. The fact that apartments were sold at market price at open sales was important, as well as meeting buyers who proved their attitudes towards the built environment by making a bid or not on an apartment on sale. We strived to make sure that the information we had from the laddering interviews and the survey came from people who critically evaluated what they paid for.
Presentation of the monograph

The monograph has the title “Model based Business Development” and was written during the research project Models for the Construction Process (MoPo). The MoPo project was a collaborative project involving the national technology programme in Sweden (IT Bygg och fastighet 2002), Finland (Vera - Networking in the construction process) and the University of Ljubljana, Slovenia.

Background
The aim of the MoPo project was to develop IT-based modelling tools for construction process analysis and planning as well as adaptable process models which could be reused in a modular way as part of company-specific process modelling efforts (Sanvido et al., 1990). The starting point for the project was the recognition of an increased need for methods and IT-based tools for construction process analysis and design (Björk et al., 1999). This need could partly be explained by the fact that the proliferation of IT use in construction (distributed CAD, document management and workflow systems, Internet etc) has lead to a need for companies to analyze and document their current work processes more precisely than previously (Svensson, 2000).

Formulation of the problem
The aim of this research project was to develop an adaptable and re-usable process model using the modelling method IDEF0 (NIST, 1993) for the facility management sector. However, this was not without problems. As soon as the process model was presented to participants in the MoPo project and to practitioners, questions were raised concerning how to support and manage interpretations of the model. The core theoretical problem concerned model communication. Thus, the problem formulation became a result of several empirical tests discussing the process model.

Theoretical assumption
The theory of situation semantics (Barwise and Perry, 1983; Cooper, 1996; Searle, 1969) was found to explain mechanisms that could provide guidance on how to achieve a successful communication of a process model. The theory of situation semantics is a linguistic theory founded in mathematics (Devlin, 1991). The idea behind the theory of situation semantics is that the meaning of a simple declarative sentence is a relationship between utterances and described situations. The interpretation of a statement on a specific occasion is the described situation. Process models can be seen as simple declarative sentences from which described situations should be clarified.

Empirical work
Interviews were made with a team of facilitators working with the implementation of a business process reengineering project. The purpose of the interviews was to investigate whether the theoretical constructs defined by the theory of situation semantics could be confirmed. Interviews and text analysis confirmed the research proposition.
Result
The facilitators were found to manage communication of generic process models using the following theoretical constructs: the discourse situation, connections, point of referent, resource situations, described situations in a modelling seminar. The contribution is thus an understanding of how the communication of complex models could be managed.
Overview of the research process for papers two, three and four

The four main activities in figure one provide an overview of the research process of paper two, paper three and paper four without detailing the research procedure.

Data from the activity, “Perform laddering interviews”, results in paper two. Laddering interviews were held with potential buyers and residents in the residential development of Frösunda to find the means-end chains that respondents formed about four different locations in Frösunda. Categorised means-end chains were used in the establishment of 24 hierarchical value maps and in the formulation of attitude statements.

The second activity, “Perform the design of a questionnaire”, resulted in a quantitative multi-item questionnaire. This activity includes the whole procedure of making an analysis of the laddering data as well as the formulation of attitude statements, the pre-testing of the items and finalising the multi-item attitude questionnaire.

The third activity, “Perform the survey in the residential development of Frösunda”, results in a complete quantitative survey which was used in statistical analysis. This activity includes contacts with respondents at open sales of tenant-owned apartments on sale as well as contacts with real-estate agents. The actual work with the survey included planning and quality controls as well as entering data into SPSS.

The fourth activity, “Perform analysis of data and the writing of papers” resulted in papers three and four and included analysis of data using SPSS and LISREL.
Figure 1  Overview of the research process for papers two, three and four
Presentation of the papers

Paper 1. A model integrating the facilities management process with the building end user’s business process (ProFacil), *Nordic Journal of Surveying and Real Estate Research*, 1 (2)

Since construction is a highly complex process involving many different stakeholders who interacts in a network depending on their role in the construction of a facility it can be beneficial to use a generic process model to understand the kind of activities that are part of the construction process.

The question which is addressed in the first paper is the definition of basic activities in the provision of a facility. The process model (ProFacil) can be used while defining company specialised process models where a specific process is described in detail. A company can save resources if generic process models are re-used in a modelling session (Davenport, 1993). The re-use of generic process models can also motivate and encourage team members (Rentzog, 1998). A key feature of the ProFacil model is the combination of both facility management and constructions activities in the same model.
Paper 2 Customer’s perspectives on a residential development using the laddering method”, *Journal of Housing and the Built Environment, 25 (1)*

**Background**

The research questions that we posed is whether it is possible, by understanding why some people buy in certain residential developments and others do not, to make future residential developments more attractive. By having knowledge about why some buyers prefers a specific development it can be possible to reduce the market risk in residential projects.

**Problem formulation**

According to the authors Bookout (1994) and Psilander (2004) residents have real difficulties in isolating the design features that they value highly at a specific place. The authors argue that a place cannot be divided into a series of parts that could individually be measured and rated. Instead residents almost universally perceive a residential development as a whole. In this article we investigate how it is possible to indirectly identify and capture buyers’ preferences of important product attributes and design features by understanding their values and what kind of consequences they are looking for.

**Theoretical assumptions**

It is important to know how to ask right questions to get relevant answers. The assumption that consumers make a purchase decision that will lead to an important personal outcome is the cornerstone in the means-end chain theory (Gutman, 1982; Olson and Reynolds, 1983). Consumers are assumed to favour experiences they gain from having the product before a specific set of concrete product attributes. We assume that values affect people’s behaviour, and beliefs potential buyers form about functional and psychological consequences are guided by their values (Gutman, ibid; Rokeach, 1973; Simon et al., ibid; Seth, ibid; Schwartz, 1994; Coolen and Hoekstra, 2001; Coolen, Boelhouwer and Van Driel, 2002). We have chosen the definitions made by Rokeach (ibid), where values are defined as being instrumental or terminal. We also adopted the traditional view of means-end chains as having hierarchical relationships. In this paper we do not specifically ask the respondents to isolate the product attributes they value most highly at a specific place. Instead we use a walk-through evaluation (Ambrose and Dyregaard, 1993; Ambrose and Paulsson, 1996; de Laval 1994) and ask the respondents to state some positive and negative remarks about a place. In the next step, beliefs about important values and consequences are identified using the laddering technique.

The following hypothesis was tested: “If a bid is made, then the beliefs of those individuals who bid will differ from those of those individuals who prefer not to make

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3 A functional consequence is defined as a direct and tangible outcome, positive or negative, as experienced by a person while he is using a product.

4 A psychological consequence is defined as a result of how a person feels using a product. Responses refer to usage, usage situations or conditions that have a hedonic or an expressive function.

5 An instrumental value is an enduring belief that a specific mode of conduct is personally preferable to an opposite mode of conduct.

6 A terminal value is an enduring belief that a specific end-state of existence is personally or social preferable to an opposite end-state of existence.
a bid, with respect to product attributes, functional and psychological consequences and personal values”.

Empirical work
The case study is made in the residential development of Frösunda, 3 kilometres north of Stockholm were four different locations is evaluated by 32 respondents. Laddering interviews were made with the respondents who accepted our request to participate in this research study.

Results
The data analysis resulted in 24 hierarchical value maps which were used to evaluate our hypothesis, which was confirmed at the level of functional and psychological consequences and instrumental values.
Paper 3  Measuring the perceived performance of a residential development
(Submitted to the Journal of Place Management and Development)

Background
The purpose of paper number three was to develop a new scale that measures factors that residential buyers evaluate when they are looking for an apartment to buy in a large scale real-estate development. This paper uses the results from paper two while defining the attitude statements.

Problem formulation
We use the same problem formulation as in paper two, where residents and tenants perceive a residential development as a whole, and not as a series of parts that can be measured and rated individually. The complexity of a whole real-estate development makes it difficult for real-estate developers and other decision makers to know ex ante the design of specific places that will appeal to specific segments of buyers.

Theoretical assumptions
In this paper we investigate the attractiveness of the built environment. The attractiveness of a specific place is measured by the strengths of respondents’ attitudes to abstract product attributes, functional and psychological consequences as well as instrumental and terminal values (Gutman, 1982; Olson and Reynolds, 1983). In order to measure the strengths of beliefs (Rosenberg, 1956, 1960; Zanna and Rempel, 1988) we assume that beliefs act as the forerunner to the development of attitudes (Ajzen, 1991; Ajzen and Fishbein, 1980, 2005). Moreover, we use a definition of attitudes which is widely recognised in attitude research: “an attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour” (Eagly and Chaiken, 1993). We further assume that attitudes can be measured using a five-point Likert scale (Likert, 1932).

However, where will we find differences in potential buyers’ attitudes and will these differences be significant? I therefore tested the null hypothesis at the 95 percent confidence level that there are no differences in the attitudes of bidders and non-bidders towards different places in Frösunda against the alternative hypothesis:

“Attitudes of those individuals who bid will significantly differ from those individuals who prefer not to bid with respect to factors that relate to abstract product attributes, functional and psychological consequences and personal values.”

Empirical work
The most frequent beliefs, found in our laddering study in paper two, were used in the creation of 41 attitude statements. Those beliefs with low frequency were discarded and remaining beliefs were pre-tested using staff members and students from the School of Architecture and the Built Environment, the Royal Institute of Technology, Stockholm. The questionnaire had 36 attitude statements and five separate sections. The ratings in the scale are based on a five-point Likert scale. The choice of a five-point scale (1 = strongly disagree to 5 = strongly agree) was a result of a compromise between comprehensibility of the grading and statistical performance. Respondents who rate highly on a sub-scale are assumed to perceive the built environment to be better than respondents who rate lower. In total, 174 questionnaires were handed out between October 2008 and March 2009 and 86 questionnaires were subsequently
returned, making a response rate of 52.3 percent. The number of respondents that became bidders was 57 and the number of non-bidders was 34.

First, an explorative factor analysis (principal component analysis) was made using 36 items. Six factors with an eigen value of one or greater were found. As a result of the overall analysis the dataset was forced into five sub-scales (maximum likelihood, varimax rotation) and specific items in a factor were compared with means-end chains from the initial laddering study. If an item did not have a conceptual good fit into a specific topic that item was shifted into another sub-scale if appropriate, or discarded. As a result of the explorative factor analysis and the evaluative process 27 items were selected into the final scale, consisting of 5 sub-scales.

Results
The differences in attitudes to the factors: urban environment, architecture, safety, relaxation, liveliness were tested in four different locations using a 95 percent confidence interval and an independent t-test. In Frösunda Entrée only one factor out of five turned out to have a significant difference in the mean values of bidders and non-bidders. On the contrary, in the street of Frögatan, all five factors proved a significant difference. In the inner courtyard a significant difference was found in four out of five factors. Lastly, in the town square only the factor relaxation proved a significant difference in attitudes. We rejected the null hypothesis since the alternative hypothesis was confirmed. The qualitative laddering data captured beliefs about the built environment that had an influence on buyers' decision-making when deciding whether to buy or not.
Paper 4 Modelling antecedents to customers’ satisfaction in a residential development

The fourth paper empirically tests the effects of values, expectations and perceived performance on customer satisfaction in a residential development, using a structural equation modelling approach. There are only a few recent research articles dealing with customers’ satisfaction in residential developments (Forsythe, 2007, 2008; Holm and Bröchner, 1999; Ozaki, 2003; Psilander 2004).

Problem formulation
Since residential housing is a high involvement product, it is reasonable to assume that personal values play an important role in buyers’ decision making. In a literature study of customer satisfaction research (Szymanski and Henard, 2001) no research studies have taken silent personal values (Rokeach, 1973) as antecedents to expectations and perceived performance and, according to Forsythe (2007), research in residential construction has yet to conceptualise customer satisfaction.

Theoretical assumptions
I follow the theoretical assumptions made by Grunert and Bech-Larsen (2005) on how consumers’ beliefs, derived by the laddering method, can explain choice option attractiveness. The authors found that beliefs linking the product to constructs of higher levels of abstraction, consequences and values, improve the explanation of choice option attractiveness rather than an explanation achieved by beliefs linking the product to product attributes only. I assume that that laddering data, as beliefs, are an important predictor of attitudes (Le Page et al., 2005). In this article, consequences and values are modelled as antecedents to customers’ expectations and perceived performance. In addition, research findings in customer satisfaction raise the question whether perceived performance of a residential development is directly related to customer satisfaction or if customer satisfaction is mediated by disconfirmation. Four hypotheses were tested to find out which of these approaches is more relevant than the others when measuring customer satisfaction in a residential development.

Empirical work
Data for this paper was collected using the multi-item attitude questionnaire in paper three. The number of residents in Frösunda that answered the questionnaire was 98 and the number of potential buyers giving a bid on a tenant-owned apartment on sale in the residential development of Frösunda was 57. In total 327 questionnaires were distributed, resulting in 155 valid questionnaires. To test the hypothesised relationship of a value construct as an antecedent to expectations and perceived performance in a customer satisfaction model a structural equation model is implemented in LISREL (Jöreskog and Sörbom, ibid).

Results
Five different models were tested, having a hypothesised probability level of 0.05 or higher. Only two sub-models: values–expectations–customer satisfaction and values–performance–customer satisfaction proved nomological validity as well as having significant relationships. For the values–performance–customer satisfaction chain, we confirmed that an increase in perceived performance will lead to an increase in customer satisfaction.
Concluding remarks

Articles two to four show how the means-end chain theory and the laddering technique have relevance for residential development. We have found reasonable theoretical support for the research question we had in front of us in the second research project, namely: to investigate how to make future residential developments more attractive using a customer-oriented theoretical framework. Since the built environment is a very complex product it is important for the producers to find efficient tools that enable them to understand what their customers are looking for. With such tools there is a higher probability for developers and planners to succeed in making the best of a new development. Judging by the results, it seems a reasonable suggestion to say that the methodology which we used in this thesis deserves further attention. One could ask oneself if the other alternative is better, namely to continue as before. If the focus on customer satisfaction is not just a temporary craze, the laddering method, attitude scales and structural equations can prove to be efficient tools to improve customer satisfaction in the construction industry.

Paper two shows how the laddering technique can elicit beliefs that capture both positive and negative aspects of the built environment in a specific place of a residential development.

Paper three shows that by using the five sub-factors of the RED scale, problematic places and dimensions can be identified. By focusing on places and dimensions which are problematic, it is possible to identify improvements which have empirical support. Thus, it is possible to suggest improvements, without making the built environment worse from the perspective of any other group.

Paper four shows empirical and structural modelling evidence which supports the theoretical assumption that values have an impact upon expectations and perceived performance. Further on, we have shown that if perceived performance is increased, then customers’ satisfaction will be positively affected. Strategic implications of the causal relationships found could be if the built environment in a residential development is according to values which are shared by residents, such a development receives higher customer satisfaction than an opposite.

Further research will make it possible to validate and improve the scale that been developed in this thesis and by using structural equations it can be possible to provide further empirical evidence for the hypothesis that values are antecedents to customer satisfaction.
References


The monograph

Model Based Business Development – a case study of the communication of generic process models

Berndt, A. Lundgren
1. Model Based Business Development

1.1 Moving towards a business oriented development of processes

The need to improve the organisation of the handling of tribute and taxes in the early Sumerian civilisation of 4,500 years BC led to the development and the use of simple written symbols on clay tablets. The possibility of documenting tribute and taxes by using written symbols was spread to other sectors such as the religious and the literary in Sumerian society. The act of writing and the task of organising agreements, debts and financial transactions were later spread to other civilisations by a time frame of several thousands years.

Merchants in Italy who were in need of a more elaborate way of keeping track of their businesses developed a new accounting system during the 15th century. The double-entry accounting provided a basis for calculating net profitability by balancing columns of income and expenditures.

The prevailing norm for how improvements in organisations are made takes its starting-point in transparent and well understood business processes. This norm is defended by a tradition from what is known as a pre-scientific stage starting with Adam Smith and his work “The wealth of Nations” in 1778. This pioneering work accelerated the industrial revolution and prescribed a specialisation of tasks. The industrial evolution is still continuing and we are all affected. This thesis concerns this evolution, a small part of it, but still a part.

Charles Babbage’s work “On the Economy of Machinery and Manufactures”, 1832, contributed to the analysis of manufacturing processes and the centralisation of work activities. Fredrik W Taylor coined the phrase “there exists a best way of doing things” and “the right man in the right place”, and through his book “The Principles of Scientific Management”, Taylor contributed to the development of early process thinking. Taylor is well known and referenced for his great interest in the analysis of sequential tasks. The pre-scientific norm is also influenced by Dr. Walter Shewart’s work in the field of variation and control systems. Dr. Shewart’s knowledge in logistics systems improved the understanding of manufacturing processes and he is regarded as the grandfather of what we know as Total Quality Management (TQM).

One of Shewart’s students, Dr. Edwards Deming, focused on the issue of quality in products and services and made a popular model for quality improvements, the Plan-Do-Study-Act cycle. Dr. Joseph Juran, author of “Managerial Breakthroughs”, had a profound impact on the Japanese quality revolution in the mid-sixties. He emphasised involvement of top management and worker empowerment through learning. Dr. Juran was the first to incorporate human aspects of quality management. The development of the quality paradigm is much the result of work done by Dr. Deming and Dr. Juran.

Dr. Armand Feigenbaum, the author of “Quality Control: Practices and Administration”, 1951 and originator of Total Quality Control (TQC). TQC is a method that provides the structure for managing quality and the method emphasises the importance of human relations and investments in modern technology for quality improvements. TQC, where rediscovered by companies in USA in the early 1980’s and the TQC concept, became
known as Total Quality Management (TQM). The emphasis is put upon customer focus, process improvement and total involvement of all employees.

Dr. K. Ishikawa, author of “What is Total Quality Control”, 1985, strove to take the evolution one step further and his notion of company-wide quality control called for a continued customer service and not merely a focus on the quality of a product.

A new direction which seems like a paradigm shift, though within the norm of what can be regarded as normal science, came by the best seller, “Re-engineering the Corporation – A Manifesto for Business Revolution”, 1993 by Michael Hammer & James Champy. They argued for a radical redesign of companies’ processes, organisation and culture to achieve a dramatic leap in company performance. "Don't automate — obliterate!", was the message sent to managers in industrialised companies.

Within this “new” paradigm of reengineering efforts, several authors are in favour for similar ideas as Dr. Thomas Davenport and his book “Re-engineering Work trough Information Technology”, 1993. Dr. Davenport argues that process innovation is a task for management and new process initiatives should be supported and not governed by the use of information technology.

Dr. Rummler & Dr. Brache introduced a new approach to improving organisational performance by their book, “Improving performance: How To Manage the White Space on the Organisational Chart”, 1995. It was one of the first attempts to bridge the gap between organisational strategy and the individual, concentrating on the flow of products or information between departments and not merely within departments.
1.2 Motives to this research project

The objective of this research is to investigate the process modelling approach and to contribute to a generic process model for the facility management area. How communication of process models can be managed in order to ensure that process models are re-used is another key objective.

The research design supporting such a research topic is a case study of a large implementation project re-designing business processes in Vattenfall AB in Stockholm. Vattenfall AB is the largest energy company in Sweden and an employer of nearly 24,000 persons within 30 companies in countries such as Sweden, Finland, Germany and Poland.

Process modelling is not a new concept for the building and the construction industry: there have been several large process modelling projects in this sector before this specific research project - Models for the Construction Process (MoPo). The Pennsylvania State model, The Process Protocol, and the Project Facilities Management Information 2002, all strive to provide process models capable of improving working procedures. The opinion exists that we still need to refine methods and tools for process modelling.

At the beginning of the MoPo project interviews were held with building industry representatives in Sweden and Finland in order to capture their needs. These interviews showed that the knowledge of how to use methods for process modelling only exists within a few companies. Enterprises working within the Facility Management area in Sweden have started to develop different types of quality systems but are lacking knowledge about the use of more elaborated methods for process modelling.

To bring information into my project on how knowledge about processes has advanced in companies outside the building and construction sector, interviews were held with company representatives from nine different companies by using semi-structured interviews. The first contact was usually established during a business seminar and was followed up by one or more interviews.

A general topic in these interviews was; Why does it exist, this growing base of knowledge about business processes in these companies? The most fruitful discussions are presented below together with insights made from these interviews.
ABB Management Consultants AB

Experiences at ABB started with the T50 project where about 6,000 – 10,000 activities were documented between 1991-1993. The T50 project included all companies in ABB and resulted in a general reduction of production lead time by 48 percent. The project was a breakthrough at ABB and generally improved the work performance and quality of their products. New process initiatives have been launched and succeed the T50 project as TOPS (Total Optimisation of Processes) and GP (Global Processes). A driving force for these initiatives was increasing competition in global markets.

Today, when a considerable amount of further "know-how" has been gained on how to perform process analysis, too much effort seems to have been invested into detailed analysis. A maximum of 150 activities are sufficient enough to describe a single present-state-process. A process that is described in further details will seldom contribute to the analysis of a process future-state. Further work with the present-state of a process will only strain personnel and reduce the motivation contributing to the project. To stay productive, it is important to focus energy on the description of a process future-state.

Would a generic process modelling methodology be of any use in ABB? At this moment, such a methodology is not in use within ABB Management Consultants, but yes, spontaneously, the reaction was such that a methodology providing generic models would be useful when facilitating interaction and communication in a modelling seminar.

An area of interest would be if generic process models could be used to support the integration of processes and information systems. The point made was that processes should not be viewed in isolation from information systems that support the flow of information. Another area of interest would be the retrieval of knowledge about processes where a set of generic process models could serve as a repository of enterprise knowledge.

Vattenfall AB

The project ELectrical Enterprise Knowledge for Transforming Applications (ELEKTRA) in Vattenfall AB started in March 1997 and finished in August 1999. The ELEKTRA project was a collaboration project, financed by the European Commision, with participants from Department of Computer and System Science at KTH and several international academic and industrial partners.

The European commission’s proposal for a deregulation of the European Electricity market was the driving force behind the ELEKTRA project. In Sweden the parliament decided on deregulation of the Swedish electricity market from January 1996. The senior management at Vattenfall AB decided that one of the means to stay competitive in a deregulated energy market was by developing a strategic and generic Human Resource Planning model. This model should be integrated in the overall business planning process at the Vattenfall Group.

Another key objective of the ELEKTRA project was to disseminate "Best Practice" knowledge from a deregulated enterprise in the energy sector by the use of generic patterns. The project team did not expect that these generic patterns could accommodate for all situations in the ESI sector, but patterns could create a framework assisting the Human Resource planning and also aiding the organisation in their learning process.
More information about the ELEKTRA Project and its successor, the UNO project is found in chapter 8.

Vattenfall AB was learning from the ELEKTRA project and the knowledge that emerged from the ELEKTRA project was refocused into a new process re-engineering project named the UNO project: this project aims to accomplish integrated processes and a uniform information system for the Vattenfall group of companies. The term used within Vattenfall to depict generic process models is "koncern mallar". These "koncern mallar" are implemented by the use of a method called "Process Development in Five Steps", PRO5, a method which is developed by Vattenfall AB together with a consultancy company, from the Rummler & Brache concept.

Accenture

Accenture (former Andersen Consulting AB) is a consultancy company working with process analysis and re-engineering companies. Accenture has long experience in how to analyse processes and systematically accumulate "Best Practise processes" from a wide variety of enterprises. Global centres for Process Excellence provide consultants with models of "Best Practise processes" world-wide.

The way Accenture utilises its business models makes it possible for it to re-use process knowledge for future business solutions. Accenture is a good example as a company knowing how to systematically benefit from the transfer of process knowledge in time and space.

The importance of understanding the nature of the problem at hand was pointed out by a company representative. The way a company performs and organises its activities will have a significant influence on the choice of process model. As an example, call centres are a group of companies that show highly formalised work procedures and information flows, a fact that makes it possible to standardise their work processes in much more depth. This will not be the case with a consultant company which usually operates with more unstructured work procedures and often with an entirely different management structure.
Aker Verdal AS

Aker Verdal AS is a company within the Aker Maritime group in Norway. The company manufactures technical products for gas and oil production. Customers are companies like Norsk Hydro and Statoil.

Aker Verdal have had difficulties while gaining their knowledge of a process oriented way of managing work. Most of their problems stem from how these new working procedures were introduced into their organisation. It seems that too much energy was put on merely technical mapping of the process instead of trying to solve cultural differences. The mapping of processes was performed using a commercial tool based on the IDEF0 methodology. However, the IDEF0 methodology proved to be too difficult to use for practical process mapping so the tool was exchanged to flow-chart modelling by use of Ms Powerpoint.

Ericsson Electronic Messaging AB

A company within Ericsson, Ericsson Electronic Messaging (EM), performed a process development project during 1999, called "Process- and Work Instructions Design at EM". The purpose was to identify and improve working processes for EM world-wide. The consultant team who performed the process analysis came from Frontec AB. The methodology used was based on the Integration Definition for Function Modelling, (IDEF0) methodology.

The consultants were asked to consider how much time could have been saved if a generic process model had been available and showing general activities performed within and by the EM organisation. The consultant team made a project revision and estimated that the amount of time that could have been saved was around 20 to 25 percent compared to the working procedures that the team used during their project. The estimation were subjectively made by the consultants.
Findings from the pre study

The following statements represent highlights made from the interviews and these insights have guided me in my elaborating of the research question by providing a frame of reference.

- Increased competition amongst companies stimulates management in a company to promote and implement process initiatives.

- Knowledge about the concept of processes and the ability to use process models is a key success factor in staying competitive.

- The *know-how* of how to describe and manage processes is still under growth in the industrialised sector.

- Generic process models support the implementation of improved processes.

- The use of abstract process models needs the support of a methodology that facilitates understanding of the information content in a process model.

- The importance of simplicity should not be underestimated since a process model made by the use of a less complex modelling language is easier to communicate and will increase the possibility of acceptance.

- The importance of managing cultural differences within an organisation during a process project should not be underestimated.

- Management philosophy and the various tasks to be performed determine the structure of a company and effect what processes are developed in an organisation.
1.3 Problem definition

To achieve the goals set by TQM or ISO 9000, to capitalise on the benefits from a more radical change of processes, we really need methods, tools and models capable of supporting the analysis and the description of business processes. These are key questions in order to strengthen the competitive edge within our sector.

The knowledge in how to use more advanced methods for process modelling is not very well provided for within the building and construction sector or within the emerging facility management sector. As the pre-study indicated, the body of knowledge within the industry sector is still growing, and the competence regarding processes is held within specialised departments and by key personnel. In order to gain the most benefit, the building and construction sector needs increased knowledge in how to manage the analysis of business processes and process management. They also need knowledge in how to act as skilled clients when purchasing such services from consultants.

The lack of knowledge could be a barrier making companies within the building and construction sector vulnerable to changed market conditions and also less adapted to using more advanced methods for process development. We need a better understanding of how we can use methods that have the strengths to support organisations in developing their own processes. The top-down process modelling approach using generic process models could be such a methodology where process knowledge is transferred in time and space to companies.

A generic process model is an abstract process model which is used as a reference when companies specify their own processes in further depth. An example of a generic process is a process showing how to sell a product, such as selling products by directs sales or by a retail store.

An example of a specific generic process within the facility management can be the process of letting facilities or the transaction process in selling a real estate. Using a generic process model, the collaboration between companies, one the service provider and the other the client organisation, are maybe processes that could be analysed and described to settle a contract for FM operations.

Processes in a building and construction project could also be analysed and described to increase their efficiency. Who is the decision maker and what are the interdependencies between decisions in a building and construction project? Who produces information needed and used in the decision process and what are the interdependencies between these activities? These questions can be analysed by using process models.
The development of the process model Provide Facilities (ProFacil) indicates a fundamental problem. Process models created by people tend not to be understood, nor to be re-used, even if we know that this can waste valuable time and effort.

Difficulties in communicating process models have been presented during the MoPo project, Kharu et al (2000) and as Matthew Bacon, Head of Processes at the British Airport Authorities, states at a seminar arranged by the MoPo team 1999. “There is a big difference between the tool we need for analysis and those that we need for communication”.

It is likely, in ensuring that the process modelling initiatives continue as an ongoing effort in organisations, that we also need knowledge to help us develop our skills in managing the interaction with modelling participants using process models. To achieve such a goal, we need knowledge concerning the mechanisms effecting communication of process models. One of the key factors for promoting the use of process models is the knowledge of how to support the modelling participant’s understanding of the information provided by these models. Such theoretical knowledge can even prove to be of importance, not only while investigating mechanisms for communication with process modelling participants, but also while constructing new tools for process modelling. A research question regarding theoretical knowledge of semantics in process models has not been formulated earlier in building- or construction research.
1.4 Objectives for the research

An objective for this licentiate thesis is to contribute with a generic process model for the facility management sector and to learn more about how to handle the problems occurring during the communication of generic process models. The research method chosen is a case study of a large implementation project at Vattenfall AB in Stockholm using the theory of situation semantics.

The focus of the research is based upon the following sub objectives.

_Empirical output_

- To stimulate discussions about process models, in particular the use of generic process models.
- To provide a generic process model for the Facility Management sector using a formal process modelling method.

_Theoretical output_

- To contribute to understanding how semantics is retained in generic process models by performing a case study using the theory of situation semantics.
- To provide a basis for other case studies to expand and generalise the theory of Situation Semantics.
1.5 Formulation of a research design

Is it so, that the reason for difficulties in using generic process models, is caused by these models being too generalised and abstract to provide for an understanding of a specific situation? Yes, this seems to be the case, since insights from the development of the ProFacil model and results in the pre-study confirm that the use of generalised and abstract process models needs some kind of method to facilitate understanding of the information content.

A facilitator using a generic process model seems to manage the interaction with modelling participants and somehow to explain the meaning of the model. The facilitators I met with during the pre-study had only a vague understanding of how meaning is given to verbs and nouns and how information later on is picked up by a modelling participant.

An understanding of the mechanisms that steer our understanding of verbs and nouns could clarify how to support the communication of generic process models. Such knowledge could aid the construction of new process modelling tools adapted to the interactive phase during a process modelling session.

My formulation of the research question is the following:

"How can semantics in generic process models be handled to ease the re-use of these models?"

The formulation of the research questions needs some elucidation to be better understood. By semantics we understand the meaning of a phrase used to convey some information, for example about an event, a particular person, or a feeling of some kind. By a generic model, we understand a generalised model that is successively elaborated and specialised for a given task within a particular domain.

A process is usually described by using nouns and verbs. We use verbs to describe what an activity is performing. Nouns are used to describe what an activity uses to produce output and to describe the output itself. The problem of using generic process models stems from the fact that abstract verbs and nouns can be given a number of different meanings depending on the situation where these key words are used. How meaning is created in a process model by the use of verbs and nouns will be attempted in this research project.
Design of a pattern-matching approach

The abduction phase of the research indicated that the semantic content of a model is a key factor to consider if we aim at facilitating re-use of models. The purpose of using a pattern-making logic in this study is to investigate how semantics is understood and handled by the facilitators using generic process models. The logic of a pattern-making approach is to test if certain theoretical constructs in the theory of situation semantics can be of importance in order to ease the modelling participant’s understanding of process models. If the result of the case study is positive a more elaborate test of the theory is recommended to further validate the results.

A definition for re-using enterprise models was made by P. Bernus, L. Nemes, R. Morris in 1993 using the theory of situation semantics. Their definition of efficiency and completeness of re-using enterprise models depends on the key elements “the intended meaning” and “the intended interpretation”. These definitions are being used during the design of a proposition for the case study at Vattenfall AB.

More about these theoretical constructs and the definitions for re-using enterprise models are found in chapter 2.

**The proposition made for the case study is:**

The re-use of a generic process model depends on the model conveying the intended meaning of all modelling elements in a model and, if the recipient can use the model for his purpose when the content of the model is understood.

Thus, the key elements, “the intended meaning” and “the intended interpretation”, are treated as independent variables and the re-use of generic process models is the dependent variable. The expected relationship between these variables is such that the re-use of generic process models is dependent on the existence of the intended meaning and the intended interpretation.

The “the intended meaning” and “the intended interpretation” are further broken down into their constituent parts, according to the theory of situation semantic. The purpose of using patterns is to predict the existence of theoretical constructs found in the theory of Situation Semantics, while facilitators are communicating generic process models in a modelling seminar.
Target group and stakeholders

The target group or potential users of a generic process modelling methodology or findings from the case study are personnel that take an active part in process orientation in all companies. People taking an active part have roles like process owners, process managers, process leaders and facilitators. Researchers will also be a group that can benefit from the theoretical results since the theory of situation semantics is now introduced to a new research domain.

My research is financed and supported by IT Bygg- och Fastighet 2002, a national research and development programme. They are, of course, natural stakeholders in this research as financiers. The development project Förvaltningsinformation 2002 (Facilities Management Information 2002), is another stakeholder, and one of their objectives is to provide a set of generic process models to companies working with facility management. Theoretical support, concerning the communication of these models, can be of use if they, or someone else, actively participate in a process modelling seminar.

Target group for a case study at Vattenfall AB

Interviews have been held with personnel who participated in the ELEKTRA and the UNO project. These persons work as process managers or facilitators in process modelling seminars. Interviews have also been held with persons from KTH responsible for the patterns developed during the ELEKTRA project.

Survey methods

The study at Vattenfall AB was done using open ended questions. The Theory of Situation Semantic has been used to guide a set of questions prepared in an interview guide. The study of the theory was performed as a plausibility probe that renders a weak test of the theory.

Tool for collecting data

Data was recorded using a tape recorder. The notes from each interview were documented in close connection with the session. The respondents were asked to confirm the documented interview and also encouraged to contribute with new information.

Tool for data analysis

The results come from six interviews and the collected data covers 70 pages of written text and a special tool for making data analysis was therefore not required.
1.6 Structure of the thesis

Chapters below provide the structure of the thesis which progresses from the basic of process modelling towards a depth of theoretical linguistics. A reader may choose parts of the thesis that meet with his or her preferences or needs.

1. **Overview on the Background of the Research** This chapter provides a brief background of how the process paradigm has developed through the quality oriented perspective towards a more business oriented perspective.

   **Motives For the Research** In this part important insights from the pre study are presented leading to the problem definition and the key objectives set for the research. The research question is discussed as well as the formulation of a case study research design.

2. **Research Methodology** Issues concerning the choice of methodology supporting the solving of research objectives are discussed in more depth in this chapter.

3. **Related Research and Development** Influential research and development projects are presented in this chapter.

4. **Business Development by the Modelling of Processes** The strategic motives to development of business processes are discussed as well as the key factors impacting on the success of change initiatives. In order to define the generic process modelling approach in more depth a model is presented for classifying the projects in chapter three.

5. **Processes and Modelling Methods** An example of the use of the functional modelling method is shown and several definitions are given to enhance the understanding of the concept of processes modelling.

6. **The ProFacil Model** The generic process model Provide Facilities is presented in this chapter.

7. **Theoretical Framework** The theory of situation semantics is discussed and a model showing the relationship between different elements in the theory is shown. As a result, semantic guidelines are provided using the situation theory.

8. **The Case Study** The background of the ELEKTRA and the UNO project is presented in this chapter. The proposition made for this research project is evaluated using the answers given by experts on process modelling.

9. **Conclusions** Finally, the findings of the research are discussed. Advice is given to the project Facilities Management Information 2002 and to the building and construction sector. A proposal is made for further research.
The purpose of the model in figure 1 is to show how different chapters in this thesis contributed to the final results. The viewpoint is that of someone reading this thesis.

As is shown by this process model, the input into the licentiate thesis is the interviews made during the pre study leading to a set of factors affecting the use of generic process models. The case study leads to knowledge of how to support the re-use of generic process models. The theoretical background is presented in chapter seven and the answers from the interviews are analysed in chapter eight. The knowledge from the reading of literature and the meeting with people is an important input contributing to the completion of this thesis.

As is seen the research method presented in chapter two, the findings from the related research and development projects within this domain presented in chapter three, and the funding for the MoPo project are the main determinants controlling this research process.

There have been several resources used in the transforming of inputs into the final results. The modelling method IDEF0 has been used as well as a tool supporting the drawing of the ProFacil model. Several PhD courses have contributed to the completion of the thesis as well as literature covering this research domain. The theory of situation semantics is a source crucial to the evaluation of the research question. Finally, the support given by my supervisors has had an affect upon the final design of the thesis and the effort being provided by myself.

The licentiate thesis provides the following results; a generic process model, an investigation and analysis of the generic process modelling approach, a case study as a scientific contribution and the writing and co-authoring of four conference papers and a scientific article summing up the work done in the MoPo project.
2 Research methodology

In research, we can choose between two main categories of research approaches - the quantitative research approach or the qualitative research approach. Often, a qualitative research approach is used during the initial start of the research project, because it gives the researcher a deeper understanding for the research problem at hand than would be possible if he used a quantitative approach, Borgbrant et al 1998.

The qualitative approach searches for meaning in a phenomenon using description techniques such as interviews, observations or document analysis while collecting empirical data. The analysis of the empirical evidence is performed by the researcher continuously interpreting and interacting data. The purpose of this process is to learn more about the evidence, thus to reveal its secrets. The strengths of a qualitative research approach are the possibility of reaching depth and detail in the analysis of a phenomenon. The weakness is, of course, the difficulty in making systematic comparisons of the result, though, if successful, this may prove both the strength and the charm of such a research approach.

Surveys or standardised observations protocols are used to collect data in a qualitative research approach. Empirical data are analysed using mathematical or statistical methods. Such a research method is not suitable for the type of research question that has been formulated in this stage of the research project.

2.1 Applied research

Different types of research

Michael Patton 1990, discussed “the basic research”, “the applied research”, “the summative research”, “the formative research” and “the action research” as a typology of five possible research purposes.

The purpose of applied research is, according to Patton, to understand the nature and the sources of human problems existing within a social setting. The focus of the research is deemed by society itself and the key assumptions made by this type of research are that the problems motivating the research can be solved by use of knowledge. The desired result is a contribution to theories that can be used as a means of formulating problem solving programmes. The standard procedure for this type of research is by applying in-depth theoretical insights into the problem.

Patton gives an example of an applied research project; “What is the divorce rate among different kinds of families in the United States and what explains different rates of divorce among different groups”.

What we can conclude from Patton’s discussion is that applied research promotes both the use of theory and the need of practice. An applied research project aims both at practical benefits as well as a theoretical contribution. Such a research approach is the one that I have chosen for my licentiate though we still have to clarify the requirements of such a research method. We also a need to explain some of the theoretical issues that ensue from this research design. An important issue is how to make generalisations of the research results from only one case study.
Robert Yin 1994, describes a possible solution by generalising from case studies to theory using analytic generalisation. The criteria for doing such a generalising is the researcher’s search for a quite unique case, a search described by Yin as a laboratory investigator’s selection of a topic for a new experiment. Under these circumstances a previously developed theory can be used as a template to compare the empirical results of the case study. If the same theory is supported by two or more case studies, a replication can then be claimed to exist and the results may be used to generalise theory. The notation here is, that there should not exist a rival theory known to explain the same phenomenon.

Before going into the details of the research design it is necessary to make a distinction between the aim of an applied research project and the aim of a development project that strives for practical benefits only. A development project focuses only on using theory and not on making any theoretical contribution.

This distinction is made because the first part of this thesis was done as a development project and resulted in the generic process model Provide Facilities – “ProFacil”. The objective in that part of the research was to provide a generic process model for the facility management sector using the integration definition for function modelling method (IDEF0). The ongoing theoretical discussion does not primarily concern that part of the research.

### 2.2 Basics requirements in theoretical research

Research can never be validated from absolute criteria, Alvesson & Sköldberg (1994). The authors are referring to the fact that theory is seeking an application within an area where it can contribute to an explanation of phenomena in our reality. The background to this standpoint is that a theory is developed for a certain specific area, and that it is the researcher responsibility and task to establish new application areas, and successively also to extend its domain. Investigation of new application areas regarding theory is conducted in tune with studies of the empiricism.

According to Patel and Tēbelius (1987), the principle of deduction involves the researcher who is working for substantiation by using a theory to deduce an answer for a specific question, see figure 2. Deduction conditions could be expressed as, if (a) then (b), where (a) is the theory, if assumed to be the truth, leading to the answer that (b) also will be true. If hypotheses are formulated, the research target would be to verify or to falsify the hypothesis deduced from the theory. Whether this verification or falsification is relevant or not is secured by in advance made criteria on how the research labour is carried out.

Deduction as a base for explanations derives explanations from a general rule explaining a certain case. Research results based entirely on deduction of a theory lead to conclusions only valid for the prerequisites the research is built upon. The risk with using the deduction method in the research design is, in regard to the authors, is however, less than for a research approach based on the principle of induction.
The principle of induction can be described as the opposite of the principle of deduction, signifying that the reality is described and analysed by studies of reality – the empirical evidence, see figure 2. Induction is based on the assumption that the reality delivers an answer possible to generalise as truths or theories. Induction could be illustrated when we state that \((a)\) is noticeable and uncontested facts for a certain type of generalised conclusions regarding the character of the reality, called \(P\). The induction is based on the assumption that this noticeable relation between \((a)\) and the general conclusion \(P\) is also valid for all other \((a)\). The conclusion is that \(P\) \((a)\) is valid for all \((a)\).

The danger of using the induction approach as an explanation base is that this method does not account for the variation in reality and takes it for granted that situation \(A\) is equal to situation \(B\). The critical understanding for research not leading to nonsense knowledge, constitutes, according to the authors, the insight that the empiricism not by itself – can explain our complicated existence.

The authors emphasise that abduction should be the research method to use in combination with a reflective and critical analysis of empiricism. This will, in the view of the authors, provide the necessary prerequisites to ensure that the research is able to avoid the main shortcomings of using a research approach founded on induction or deduction. Abduction is a qualitative research method and is often used in order to study a single case by use of a specific theory as an interpretation pattern.

The advantage with abduction, according to Alvesson & Sköldberg, is that it reflects the factual research process as to how this labour is carried on. Abduction combines analysis of the empirical evidence with theoretical studies and this provides the most important difference in regard to the principle of deduction. Research based on abduction is characterised by an interplay of empirical evidence and theory where the understanding of the studied increases by the reciprocal action created between the empiricism and theory.

Depending on the research tradition several different explanations of abduction is found in the literature, though all refer to the philosopher and logician Charles Sander Peirce (1839 – 1914). Abduction according to Pearce (1878) is to look for pattern in a phenomenon and suggest a hypothesis.

Another perspective on abduction is provided by Lundequist (1995), where he puts forward the role of abduction as that of defining new concepts or making new definitions for a particular subject.
Abduction, according to Itoh (1996), has a key role in stimulating creative thinking and triggers the development of new solutions to achieve a desired result which would not have been discovered using an inductive or a deductive research approach. The abduction approach stimulates an outward-looking search for new solutions by developing explanatory hypothesis, which are tested by a practical verification.

Josephson et al (1996) describes how abduction works by referring to an explanation made by Charniak and McDermott (1985). Which characterises abduction variously as “modus ponens turned backward; inferring the cause of something, and the generation of explanations for what we see around us, by making inference to the best explanation”.

The following is an example made by Itoh, on how to approach a research problem using an abduction strategy.

a. The phenomenon, X, is observed
b. Among hypothesis A, B, A seems to be capable of explaining X

Hence, there is a reason to pursue the evaluation of A

A fossil is found near the summit of a mountain. To explain this surprising fact, the following hypotheses are proposed:

A. The area had been an ocean in the remote past, before the mountain was created by the earth’s volcanic activity.
B. A bird carried the fish bones to the mountain top where they were later fossilized.

To establish which hypothesis is valid, a search is made for other types of fish and shellfish fossils. The first hypothesis is validated.

Abduction can thus be used to determine which hypotheses or proposition to test. I have used abduction in search for a plausible explanation that will give insight into the problems occurring during the development of the ProFacil model. The strategy of abduction was incorporated into the research design by formulating several equally hypothesis and thereafter selecting the most likely for a test using a case study. The research then continued by following the deduction strategy of research, see figure 2.
The theory dependency making interpretations

“Facts are always theory loaded”, according to Hansson (1958), but what does this statement mean? The author refers to the fact that we observe and interpret data by using a mental reference frame which determines our interpretation. Our individual reference frame is formed within a social coherence, as for example, a person’s ethnicity, education and social standing. Common expressions like “you see what you want to see”, “you hear what you want to hear”, can reflect the existence of such a reference frame.

Alvesson & Sköldberg are leading this discussion somewhat further by saying that “Behind a certain collection of data (already interpreted), a surface structure is not concealing as a rule, only one, but several additional explorative deep structures (theory), and surface structures are not unilateral linked or related to any of them. Then the theory will be – the creative recreation of the explorative deep structure – dependent on the used perspective, and the complexity of problems”.

Which theory to chose in order to interpret the pattern of the empirical evidence in figure 3 is dependent on the choice of perspective and the research question. The point is that a single theory can not fully explain a complex real life phenomenon. However, research that lacks a clear theoretical anchor will be incapable of either evaluating or interpreting the empiricism.

Figure 3. Interpretation of the surface structures and the patterns by use of theory.
2.2 The research design of a case study

Robert Yin makes an important remark by announcing "The research design is the logical sequence that connects the empirical data to the initial research question of a study and, ultimately, to its conclusions". The purpose of a research design is to help the researcher to avoid a situation where the empirical data does not support the evaluation of the research question.

A research question can be formulated by using a basic categorization schema that guides the researcher towards different types of research questions. This schema consists of a series of key words such as "why", "what", "how", "where", "who", and "when".

A case study can be the preferred research strategy when a "why" or a "how" research question is made, or if the researcher has limited chances to control the object of study, which usually happens if the research is conducted in a real life context. The "why" directed research question brings about a more explanatory oriented research than other types of research questions.

In my thesis, the research question is defined by the use of a "how" directed question with the purpose of providing for an understanding on how the interaction with modelling participants is carried out using generic process models. Mentioned above, such models were used by facilitators at Vattenfall AB as a support during the implementation of a new business process.

My research question is formulated as, "How can semantics in generic process models be handled to ease the re-use of these models?"

Robert Yin recalls the need for an analytical strategy during the case study design to prepare for the analysis of the case study evidence. A finger of warning is raised here, since no guidelines exist on how to conduct a case study analysis. Much of the design of how to analyse the case study evidence has to be made by the researcher.

A carefully planned research design will guide the researcher on how to design the analysis of the case study evidence. Yin recommends a choice between two general strategies. The first is to rely on a theoretical proposition or to develop a case study description. As mentioned by Yin in the first part of this chapter:

"The research design is the logical sequence that connects the empirical data to a study’s initial research questions and, ultimately, to its conclusions".
A pattern-matching approach

One of the most desirable strategies for case study analysis is the pattern-making approach that searches for a pattern in the case study evidence. The logic of this approach is that a proposition is made by the use of a theory and this proposition is tested against empirical data. The proposition is a claim on reality where the researcher states that this pattern will occur if the theory proves to be correct. The proposition is broken down into a theoretical pattern that is extracted from the theory. If these patterns coincide with the case study evidence there exists a support for the theory to explain the data collected during the case study.

One way to do such pattern-matching is by using multiple dependent variables. These dependent variables are the pattern that is derived from the theory. If these variables or “predicted values” are found in the case study evidence and alternative “predicted values” cannot be verified, then there exists a strong casual inference between the dependent variables and the case study evidence.

Yin provides an example of what such a pattern can be, starting with a proposition claiming that the effects from a newly installed decentralised office automation system will cause a certain pattern of organisational changes and stresses. The pattern occurring is that “employees will create new applications for office equipment, and these applications will be idiosyncratic to each employee”. The outcome of the predicted pattern represents a dependent variable that is assessed with different measures and instruments in the case study.

Collecting the evidence

The evidence from a case study can be collected using mainly six sources: documents, archival records, interviews, direct observations, participant-observations and physical artefacts.

An interview is the most important source of information in a case study. The most common type of interview is the open-ended interview, where a key respondent gives his or her experiences of a topic of interest for the researcher. Other types of interviews are the focused interview where a key respondent is interviewed for a short period of time. An hour can be sufficient depending on the character of the topic. The form of the interview can be more formal using some kind of interview guide to keep the interview on track. A third form of interview is the formal survey, where the questions consist of a more structured set of questions, giving the respondent much less freedom to express him- or herself in a specific topic.

The strength of using interviews is that there is the possibility of targeting the interview to focus directly on the case study topic. The weakness of an interview approach is the risk of poorly constructed questions that have no theoretical foundation and thereby reduce the possibility of making inferences between the answers and the propositions made in the research design. The respondent can give answers that are biased by leading questions or by echoing the same thoughts.

The procedure to record the interview can vary from notes taken down during the interview to tape recording. The choice of method to document an interview is more dependent on the individual preferences of the researcher.
2.4 The research design for the licentiate thesis – an abduction approach

With regard to the work done by Alvesson & Sköldberg, Itoh, Josephson et al, and Lundequist, an abduction approach can be used to guide the researcher in discovering a solution to a specific phenomenon. To be able to evaluate the formulated hypothesis and the indicated solution, we also need a specific theory as a pattern for analysis and interpretation. This is an approach also supporting the pattern-matching analysis, suggested by Yin.

Several initial hypotheses were formulated and reformulated in the search for a plausible explanation to the difficulties which occurred during the development of the ProFacil model:

“The resistance to using generic process models is affected by how semantic is retained in models.

“Are the resistance to using generic process models affected by the syntax of the model or by the structure”.

“The resistance to using generic process models is affected by the way the model is communicated”.

As a result of the abduction phase, I decided to test the following hypothesis:

“The resistance to using generic process models is affected by how semantic is retained in models”.

The reason for choosing this particular hypothesis was due to my study of research findings made by conference delegates participating in a systematic analysis of the “things that worked well” in a particular pattern1 at The Second Annual Conference on the Pattern Languages of Programs 1995, Monticello, Illinois. Their work resulted in a new method for making patterns “A pattern language for pattern writing”, Meszaros, G. and Doble, J, (1996).

The pattern approach is founded on the belief that we can understand a solution to a problem by making inference from a proposed solution. The use of a generic process model would be similar by making inference from a high level process model to a specific business process.

The frequency of design criteria while making a pattern language usable was studied to establish which of them are the most crucial. Twelve different criteria for evaluating enterprise models were studied in a survey, Lundgren (2000). The design criteria used in this survey were: scope, depth, precision, generality, competence, efficiency, perspicuity, transformability, extensibility, consistency, completeness and scalability, Vernadat (1996), Fox (1993).

1 A generally accepted definition of a pattern frequently referred to is made by Christopher Alexander, (1977) saying that “a pattern is a solution to a problem which occur over and over again in our environment and the pattern guides the reader towards a solution of his problem”. Thus, the solution of the problem can be reused over and over again.
The design criteria found was in order of frequency:

- Perspicuity
- Efficiency
- Completeness

The **perspicuity** criteria correspond to a process model that is easy to read and to follow. This criteria correspond to a user friendly model and another research project in the MoPo project is working with this issue, “*Making Process Models Usable*”, Berg von Linde, (2001).

The **efficiency** criteria correspond to the ability to efficiently support the problem solving and reasoning without the need for any transformation.

The **completeness** criteria correspond to a model being complete in the sense that all the information necessary to solve a problem is present in the model.

As will be shown below, the criteria of efficiency and completeness correspond to the principle of semantics, thus indicating that the semantics is potentially important when making a pattern or a generic process model usable.
Definitions for making enterprise models re-usable

The chosen hypothesis guided me to research by Bernus, Nemes, Morris (1993), who made a definition of efficiency and completeness of enterprise models. An enterprise model can be any model used by an enterprise as a database model or a process model. These definitions are defined in the context of the use of the models, and stem from the theory of situation semantics - a well-known theory in linguistics, Barwise and Perry (1983).

The purpose of using these definitions is to investigate the critical parts in supporting the communication and the re-use of generic process models. The proposition I make is based on these definitions. The reason for choosing such a research design is because it provides a strong theoretical support and the research will also be founded on findings being published by other researchers in this field. My case study also provides another step in the process of validating the use of the theory.

Efficiency of enterprise models

"An enterprise model is efficient if it conveys the intended meaning concisely between the parties who produce or use the model”.

According to the theory of situation semantics, by efficiency in language means the ability of a sentence to be re-used over and over again, with the same meaning, into different situations and locations. People who belong to a certain linguistic community will learn the meaning of a sentence or a word.

My interpretation of this definition is such that a model is efficient if the model conveys the meaning of the modelling elements from the creator to a user of the model. The intended meaning of a modelling element will only be understood within a specific language domain.

Completeness of enterprise models

"An enterprise model is complete, relative to the processes using the model, if the process can create and behave according to the intended interpretation of the model”.

According to the theory of situation semantics, all information from an utterance must come from the interpretation of a situation being described by an utterance. The intention of a speaker is to describe a particular situation and if he succeeds in conveying the described situation as he intended to the listener, the interpretation made by the listener will be the intended interpretation.

My interpretation of the definition is such that a model is complete if the recipient can use the model for his purpose when the content of the model is understood. If the model cannot be used when understood, the model will not be complete.
The proposition made for the case study is

The re-use of a generic process model depends on the model conveying the intended meaning of modelling elements to its users and if the users can use the model for their purpose when the content of the model is understood.

As is seen by this proposition, the use of a model is about the communication of the content of an enterprise model and reflects how the understanding of a model is made by first of all focusing on the facilitator of the model and then on the users of the model.

What I claim by making this proposition is that both the intended meaning and the intended interpretation of a model have to be fulfilled to transfer the semantics in a process model to a receiver of the model. This will increase the possibility of process models being re-used by the organisation.

This proposition is broken down into basic theoretical constructs or patterns defined by the theory of situation semantics concerning verbs and nouns. The theoretical constructs are used to define dependent variables linking the theory of situation semantics to the statements given by the modelling experts in the case study. Thus, the individual answers are linked to each of the dependent variables used in the case study and respond to a theoretical construct given by the theory.

The answers given by a facilitator will be interpreted using the theory of situation semantics and by following such an approach, the deep structure of the theory is leading to an interpretation of the answers made by the facilitators. At the same time, the case study provides a plausibility probe, e.g. a weak test of the theory, in deciding if the theory of situation semantics can contribute to explaining how semantics is gained in process models.

At this point in the research, another theoretical issue arose. How can we decide upon the validity of the results? That is, how can we know that the answers given by the experts are also the correct ones? My standpoint in this matter of internal validity is that the criteria for interpreting answers made by a modelling expert is whether a given answer fits the explanation of a theoretical construct or not. This is probably the best we can do.

The theoretically pattern used within the case study

An introduction is given in chapter 7 to the theory of situation semantics, providing a deeper understanding of the meaning of these definitions and the theoretically pattern formulated below.

“To re-use a generic process model, we have to make the discourse situation known to the recipients of a model”.

“To re-use a generic process model, we have to make connections and the point of referent known to the recipients of a model”.

“To re-use a generic process model, different resource situations are being used by the facilitators of a model”.

27
“To re-use a generic process model, the recipient interprets a process model as a collection of described situations”.

“To re-use a generic process model, constraints have to be shared and understood by both the facilitators and the recipients of a process model”.

Summing up the research design for the licentiate thesis

<table>
<thead>
<tr>
<th>The research disposition</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formulation of a research question</td>
<td>← Results from the modelling of the ProFacil process model and the pre-study</td>
</tr>
<tr>
<td>Formulation of a research proposition</td>
<td>← Definitions of efficiency and completeness of enterprise models</td>
</tr>
<tr>
<td>Formulation of a theoretical pattern</td>
<td>← The theory of situation semantics</td>
</tr>
<tr>
<td>Performance of a case study</td>
<td>← Interviews with process modelling experts, studies of research methodology</td>
</tr>
</tbody>
</table>

Figure 4. The structure and the resources being used during the licentiate thesis.

Figure 4 shows how different resources have been used to provide for the structure of this thesis. The interviews with modelling experts are evaluated using the theoretical pattern constructed from the theory of situation semantics. The research proposition has been formulated using the definitions of efficiency and completeness of enterprise models which are derived from the theory of situation semantics. The research question for this research was defined during the modelling of the ProFacil process model and the relevance in choosing this research topic was strengthened by the results of the pre-study.
3 Related research and development

This chapter describes six different research and development projects all involved in developing knowledge concerning process modelling to the benefit of the building and construction sector.

3.1 The integrated building process model

The Computer Integrated Construction (CIC) research program at Pennsylvania State University, USA contributed to The Integrated Building Process Model (IBPM), Sanvido et al (1990). The research team, consisting of up to 20 researchers, all participated in defining the scope of the model showing those activities required to provide a facility to an end user.

The project done by the research team was a seminal work and is often cited by research team within the building and construction sector, Björk et al, (1999). The process models were developed using the Integration Definition language 0 for Function Modelling (IDEFO) to five levels of detail. The Integrated Building Process Model (IBPM) is defined by using a generic context model showing the context where the IBPM is valid, see figure 5 and 6.

The benefits claimed by the research team is the support of various project participants in understanding which factors influence different tasks and their relationships and interdependencies. Other potential benefits claimed are the potential use of the IBPM model as a to-be model showing how a new and improved process could be carried out. The model could also be used to facilitate communication between team members and between the owner and other project participants.

The IBPM model could also provide a basis for requirement engineering when designing a facility information system. The IBPM model could also serve as a device to facilitate teaching and learning as the model shows the context of each activity and how different stakeholders influence the information flow in a project.

Besides these potential benefits the model can be used to determine which key decisions will be required to provide a facility, when these key decisions should be made and what information will be needed to support these decisions, Sanvido et al (1990).
Figure 5. The context model Conduct Business.

These functions provide the settings from where all other activities in the IBPM model are carried out:

- Develop Business Opportunity
- Provide Facility
- Conduct Business Operations
This model consists of five activities, as:

- Manage Facility,
- Plan for a Facility
- Design Facility
- Construct Facility
- Operate and Maintain Facility
3.2 The Process Protocol

Fundamentally, the vision of the Process Protocol stems from the idea of generic processes integrated around a generic product data technology. Such an approach would enable a free flow of information into the activities that make up the design, the construction and the management of a built facility. The purpose of the Process Protocol is to provide a framework where stakeholders in the building and construction process can co-ordinate their efforts in managing and controlling a building project. The result of such a framework is targeted at achieving fewer mistakes, less duplication of efforts and better products for the end users business needs.

The University of Salford and the University of Loughborough set forth the Process Protocol and their industrial partners in this project are Alfred McAlpine, BAA plc, B.T., Advanced Visual Technology Ltd., Capita, Waterman Partnership and Boulton & Paul.

The Process Protocol is based upon six key principles: The whole project view, progressive fixity, a generic process, stakeholders involvement and teamwork, co-ordination, feedback, (Kagioglou et al. 1998a), (Kagioglou et al. 1998b). The structure of the Generic Design & Construction Process Protocol, is founded on a design framework which was presented by Tighe and Kraemer, (1996).

By focusing on these six key principles the process of a construction project will cover the whole lifecycle from the inception of the business needs to the construction and the management of the built facility. These principles will also support a consistent planning and review phase of the project as well as measurement of performance and control of the whole project.

Effective co-ordination between the project team members is a key objective set for the Process Protocol. The structure provided by the process protocol will serve as the basis for process management. Finally, the review of different phases in a project can be recorded if the process is defined and when there is a free flow of information, thereby providing for future references to successful and less successful operations.
Figure 7. The Generic Design & Construction Process Protocol.

The Generic Design & Construction Process Protocol adopts a stakeholders view to engage project participants earlier in the process, striving to provide information to whom it concerns in the right time.
3.3 The British Airport Authority

The British Airport Authority (BAA) is the owner of seven United Kingdom (UK) airports and is responsible for the management of airport facilities in Britain such as Heathrow airport, Gatwick airport and Stansted airport. The BAA also has management contracts or stakes in eleven airports outside the UK. Within the UK, BAA has more than 1,000 construction projects in operation in a year. The goal is to improve the way construction projects are managed by applying lean principles drawn from manufacturing, to all of its activities.

To achieve consistent best practice BAA has established a broad framework model, the BAA process project model, to control all their projects and to enhance further process development. An explicit project process will be crucial in achieving an integration of processes and lean construction.

To establish a lean construction process, the aim is to design a system that shows how organisations and teams can work together. A key success factor in this approach is to manage technology and the information flows in the organization. The BAA process framework model is based upon identifying how different parts of the company work in relation to each other. The framework provides a reference for modelling sub-processes and identifies the major information flows throughout the enterprise.

As is stated by Matthew Bacon, Head of Process at BAA, “We need a common point of reference against which process development and process innovation can take place – otherwise how can we compare one way of working with another, indeed understand how one process adds value more than another?”

The BAA Reference Process Model challenges a set of key issues

- What important information is to be managed.
- What information is important to store so it is available to everyone who needs it.
- What processes both generate and use that information.
- Who the originator of that information is and who the process owner is.

BAA use their reference process model to co-ordinate the development of project processes. The horizontal bands, in figure 9, are essentially ‘core processes’ and the vertical bands are the enabling processes that are identified. An enabling process as the facility management process works across the business functions. Matthew Bacon describes this model as a tapestry and that the enabling processes are like the gold thread that runs through it. ”Where the process interfaces with the core processes, is like the knot that you might tie in that thread, at that interface”.

Further, at BAA the importance of process and process innovation is stressed to lead the debate within the organisation and the role of technology is to point the way to the future.
The BAA model shows the relationships between processes, product and the BAA organisation.

The process team at BAA strive to integrate the process around the product using teams as the co-ordinating factor. The model integrates processes to their major products and the organisation to their teams.
The figure shows part of the BAA reference process model as it was presented in 1999. The BAA Reference Process Model illustrates how the enabling processes support different business functions, and how people is supported working in core processes.
3.4 Facilities management information

Facilities management information 2002 (FI2002), set forth a set of generic process models based upon general system theory and a process oriented perspective. Their choice of modelling technique is the Integration Definition language 0 for Function Modelling (IDEF0), using a commercial tool for analysis and presentation, Svensson, Yngve, et al (2000).

The industry partners are UFOS, SABO, The Building Client Organisation, Swedish Real Estate Owners Association, ABB Facility Management AB, Akademiska hus, AP Fastigheter, Castellum AB, Lundberg fastigheter AB, Fastighet AB Tornet, Vasakronan AB.

The target group using results from the FI2002 project are people working within the facility management area such as IT-managers, process managers, business managers, suppliers of information systems, and others participating as knowledge- or information suppliers to the FM area. The following three core processes are targeted as vital for any FM business process: Letting of facilities, plan and conduct changes, provide FM service.

The FI2002 view of process models is directed towards their ability to support requirement engineering while developing information systems for the building and construction industry. The project is further set out to support the development of Industry Foundation Classes (IFC) and a forthcoming implementation of the product modelling technology in Sweden.
Using the Process-handbook by FI2002 the following objectives could be meet:

- Showing how and were resources are consumed.
- Showing what information is needed in different activities.
- Showing what support processes are needed in a business process.
3.5 The U Lipsanen process model

The U Lipsanen, is a construction company in Finland specialised in building hamburger restaurants. The U Lipsanen process model is made by the Finish participants in the MoPo project and consists of more than 20 diagrams and approximately 80 activities, Kharu et al (2002).

Figure 11. The set-up of a context process model and the main process model of modular construction project.
3.6 The Process Handbook Project

The Process Handbook Project at the Center for Coordination Science, Massachusetts Institute of Technology (MIT) has produced a repository containing both a set of generic business models and company specific process models, based on ideas from computer science and from co-ordination theory. The goal for the process handbook project is to create an electronic repository of re-usable organisational process models (e.g. sales, marketing or distribution processes) that supports companies in their effort to reshape their businesses.

The Process Handbook Project is a collaborative effort involving organisations such as the University of Hawaii, MIT, Syracuse University and the Michigan State University. The industrial partners include: Apple Computer, Boeing, Daimler-Benz (Germany), Dun & Bradstreet, GTE, Information Resources, Lotus, Matsushita (Japan), Statoil (Norway), Unilever (UK/Netherlands), Union Bank of Switzerland, US West, and Xerox.

The purpose of the MIT eBusiness Process Repository is to provide guidance on how to redesign existing organisational processes, invent new organisational processes and share ideas about organisational practices.

The MIT eBusiness process repository

The MIT eBusiness Process Repository is based upon a structure showing both different types of processes and different parts of a specific process. Examples of a type of process is “buy as a large business” or “produce as a small service provider”, an example of a process part is “identify own needs”, which is an activity that belongs to the process of buying a product.

Another feature of the process repository is the possibility of exploring interdependencies between different activities. The existence of interdependencies between each activity are described by the fact that, whenever there is an dependency between two production activities, coordination is required to manage their output, Malone et al 1999.
Examples of a set of process types that originate from the generic activity “Buy”:
- Buy a product
- Buy using credit card
- Buy as a large business
- Buy resources
- Buy using EDI
- Buy over internet
- Buy materials and suppliers

In figure 12 we can see the idea behind the eBusiness Process Repository. This project utilises a set of generic business models making it possible to derive a set of basic activities depending on a particular business area. The top-level model, “Produce as a business”, is the core model integrating all business models and their activities.

By using generic activities, the MIT project makes it possible to derive more specialised activities performed in a specific company. Examples of generic activities are “Buy”, “Make”, “Sell”, “Design”, and “Manage”. Most companies do all five of these activities as companies “Buy”, some input, “Make”, a product or service, and “Sell”, the product or service. They also “Design” the products and service they sell and their processes. The companies also “Manage” their organisation in some way.

Further down in figure 12, we find a set of activities which are defined by the generic activity “Buy”, as “Identify own needs”, “Identify potential sources”, “Select suppliers”, “Place orders”, “Receive”, “Pay” and “Manage suppliers”.

These activities can be found in process models connected to “Buy”, but as the decomposition and the specialisation of an activity as “Buy a product”, take place, further activities can be included and excluded from the list. This is an important property of the MIT eBusiness Process Repository and their concept in providing a reusable set of process models to different business areas.
Creator - A generic business model

The scope of a generic business model in the MIT eBusiness Process Repository is to describe “*What a company does and how they make money from doing it*”. There are six types of business models in the eBusiness Process repository, “Creator”, “Distributor”, “Broker”, “Extractor”, “Landlord” and “Service Provider”. Process models that are included into the repository will be classified to belong to one of these types.

In figure 13, we find the generic business models, "*Produce as a creator*". A creator buys raw materials or components from suppliers and transforms or assembles them to create a product (or service) sold to buyers. A business model such as the "*Produce as a creator*" is common to industries like manufacturing and construction and describes a supply-chain process.

![Diagram](image)

*Figure 13. "Produce as a creator", one of six generic business models in the process handbook.*
4 Business development by the modelling of processes

By presenting this chapter, an attempt is made to describe motives behind process modelling initiatives. An attempt is also made to classify the related research and development projects described in the previous chapter and the process model provided by this thesis. By classifying a certain process model as being a process model of this type, possessing these properties, we can use such an approach in clarifying the role of different types of process models in business development.

4.1 The modelling of processes supports business development

Processes affecting organisations and their personnel are a critical question for the future of an organisation. Companies need methods supporting the re-engineering of business processes, and it is my opinion that generic process models could be such a procedure supporting the intellectual task of identifying and designing processes.

It is fairly clear that it is strategic business objectives that lead to the process initiatives, and the design of new processes has to support these objectives to be useful. Undoubtedly, to fulfil business objectives we have to use information systems founded on the design of business processes. If these business processes are not fully understood by people responsible for developing, adapting and implementing information systems, there will be a risk that these systems will effect the way organisations work in a unintended way.

According to Davenport (1994), the design of new business processes should start with a high-level business model which engages both senior and middle management. The purpose is to avoid a too detailed description of processes in the initial creative stage because a detailed model will only lower the motivation of the management team. Rentzhog (1998) discusses a core process model as a tool to communicate a shared view of a company’s core processes on a high level of abstraction.

Davenport also points out that the information engineering approach, which includes phases like system planning, business area analysis, system design and construction, should not be a method used for process innovation. The innovation or modification of business processes should be done in the strategic context and together with the senior management in the company. Too strong a focus on tools and techniques can be contra productive and stand in the way of achieving the desired change of processes. Communication at each stage within the company is essential and a prerequisite to reach commitment of people to adoption of a new business process.

Österle (1997) makes a similar remark saying that process development brings about a renaissance in flow organisation; it links strategy with information system development. Though, he is not, as Davenport, reacting against a closer relation between the creation of new business processes and the development of information systems.

These remarks made by Davenport(ibid) and Rentzhog(ibid) are in my opinion true, but which are the motives supporting a process methodology and how can we describe this
rationality? To grasp the point of these questions, and how this approach for change works, we have to formulate some idea about the forces behind such an initiative.

Ken Blanchard and Terry Waghorn (1997) in their book ‘Mission Possible’, describe how organisations nowadays need not only to focus on the business processes of today but also on future processes to survive in a competitive environment. The rationality behind this point of view has its origins in the need to master constant change to prevent organisations from inevitable decline.

Figure 14. Decline of organisations illustrated by a S-shaped Sigmoid Curve.

All living systems face life cycles characterised by a phase of rapid and slow growth and an inevitable decline. The task for managers and decision makers is to manage complex and constant change for the benefit of the business of the organisation. Such an approach is presented by the authors, arguing for a second Sigmoid Curve which has to be established before the decline of the business is too obvious to stop.

Figure 15. A second Sigmoid Curve to initiate future innovations.

To act pro-actively, a second Sigmoid Curve has to be established starting from the point A, which represent the best time to launch a new initiative. By point B, the slide of the business has already begun and at point C, it is all too late.

The national postal service in Sweden is one example of an organisation facing a clear decline in business opportunities, and initiatives to implement a second Sigmoid Curve are still a very hazardous business.
Using high-level process models is one of the approaches that can be suitable for change initiatives. But, the use of process models is only one part of a bundle of key components needed to accomplish change management. Examples of such components would be the changes of attitudes, polices, and reward systems in organisations.

Beckard and Harris (1977) argue in their book ‘Organisational Transitions: Managing Complex Change’ that there are two essential conditions for any change effort to be effectively managed. The first condition stresses that the management must be aware of the need for change and the second condition implies the need for an explicitly expressed and comprehensible end state. Before any future state of the organisation can be assessed there is a need to understand the present state. An initiative to understand the present will reduce the risk for confusion, frustration, unexpected resistance and a failure to achieve the future state of the organisation.

Beckard and Harris refer to David Gleicher who developed an interesting model for determining the readiness and attitudes for implementing a change programme in an organisation.

\[ C = (ABD) > X \]

Where

- \( C \) = Change in an organisation,
- \( A \) = Level of dissatisfaction with the present state,
- \( B \) = Clear desired future state,
- \( D \) = Practical first steps towards the future state,
- \( X \) = Cost of change initiatives

To initiate and mobilise a change process (C) in the organisation there has to be sufficient dissatisfaction with the present state of order (A). If the goal or the future state (B) is not clear enough to be comprehensible by people in the organisation, they will feel that cost are too high to be engaged in the change process. How to move (D), from the present to the future state has to be shown by some practical first steps. If this guidance is incomplete there will be a resistance to accept the change initiatives.

There is a need for methodology that supports change initiatives and the implementation of new processes. There is no single “silver bullet” that solves these complex questions how to manage change. It is a question of getting the best out of several methods. The top-down process modelling approach seems to be one way of supporting and managing the refinement or re-engineering of processes. One of the major process initiatives, “the process handbook project”, made by the Massachusetts Institute of Technology provided us with a comprehensible reference in understanding this approach.
4.2 Principles used to classify process projects

The MIT eBusiness Process Repository covers up to 5 000 process models and a critical task is how to classify these models to enable users to navigate in a process library of such considerable proportions. The chosen solution for handling these problems is supported by a tool, the process compass, which is based upon two basic principles; the principle of decomposition and the principle of specialisation. This approach of how to manage a process library can be seen as a tool that empowers companies to achieve a second Sigmoid Curve, and the process library approach supports the initial requirements that establish change initiatives, as expressed by David Glicher.

The MIT eBusiness Process Repository is based upon a structure showing both different types of processes and different parts of a specific process. The solution chosen to navigate within this structure is the process compass having the shape of a compass. The navigating system for the process compass is based upon the principles of decomposition and the principle of specialisation, giving the directions for navigating in the process library.

The principle of decomposition: Processes are decomposed into activities which may in turn be further decomposed into their sub activities. Thus, an activity is first represented at a general level and, due to the principle of decomposition, the activity is later decomposed into sub activities to an increasingly detailed level. This principle is shown in figure 20, chapter 5.5.

The principle of specialisation: Activities belonging to a process are also specialised into a horizontal hierarchy where a certain composition of activities are derived from a previous process. This principle describes where a set of activities originates and other activities can be derived using the principle of specialisation. Thus, the principle provides an increasing specialisation of activities in order to perform different tasks. A specialisation represents an alternative set of sub activities accomplishing some activity in the outline, Malone et al (1999).

An example of a generalised process, e. g. a type of process, is the generic process “Buy” that can be specialised into the alternative processes “Buy a product” or “Buy using EDI”. By moving from a highly generalised process, which is shared by many companies, it is possible to describe a specific process for a single company.

Figure 16. The process compass founded on the principle of specialisation and the principle decomposition.
4.3 Classifying related research and development projects

A key objective in using generic business models is to facilitate the analysis of a particular business process in depth and to learn about the dependencies in the process. These models are used as references when making analysis of business processes, thus being used to describe existing processes or to formalise a description of a not yet existing business process. A way to describe this approach is shown in figure 17 were different types of process models depend on their relation to the principle of decomposition and to the principle of generalisation.

![Diagram showing generalisation and specialisation levels]

*Figure 17. A four dimensioned box using the principle of decomposition and the principle of generalisation showing different types of process models.*

A: A is a model being general and generic. The outmost degree of generalisation would be a process model that is valid for all business processes that exist. An example of a process model being highly general and showing a high degree of generalisation is the generic business model "produce as a creator" found in the process handbook project, see figure 13.

B: B is a model being detailed and generic. This type of process model can describe a generalised way of performing a certain process in more detail. The process of making hot beverages would be a detailed generic process if it is possible using such a model to describe the process of producing coffee, tea, chocolate, or a warm soup e. g. all the possible ways of producing hot beverages. The procedure making a detailed generic process model could be by using descriptions of specific processes showing how to make coffee, tea, chocolate or soup.

C: C is a model being general and specialised. This type of process model can describe a process on a high level but still related and close to a particular company. The point is that this model is not detailed enough to describe a particular business process but close enough to separate this model from being a model of type A. This type of model is used during a modelling session as a reference or a context model, see figure 11.

D: D is a model being detailed and specialised. This is a process model describing a particular business process in a company.
1. The Integrated Building Process Model

The reason for classifying The Integrated Building Process Model into this position is based upon the fact that the model was derived in collaboration with 22 companies and the model developed using three different phases, all with documented changes and reviews. The model is a process model showing fairly detailed activities and ICOMS of a high degree of generalisation close to the practice found in these companies.

2. The Process Protocol

The Generic Design & Construction Process Protocol is a model covering the pre-project phase, the pre-construction phases, the construction phase and the post-construction phase at a high level of abstraction. This model is highly general and highly generalised and is presented using only one level covering all four phases in construction. The model does not establish any connection to a sub-process or to a procedure showing a generic process in any detail.

3. British Airport Authorities BAA

The BAA reference process model is used as a reference that integrates the project-specific process of construction with the business processes at BAA. As such, the model will be a basic business model for BAA. As is shown in figure 10, the BAA reference process model is integrated around a conceptual model that explicitly puts the model in relation to the whole business process in BAA.

Further, there are process models showing how detailed construction processes are carried out in connection with an established reference process model. This would make the BAA approach both general/generic, general/specialised and detailed/specialised.
4. Facilities Management Information 2002

The models provided by the Facilities Management Information 2002 project are highly general and fairly generalised towards facility management processes, focusing on information needs only. There are no roles or resources shown in these models that would connect these models to the way a company is managed, though that was not the purpose in this project.

5. The U Lipsanen Process Model

This model is made with the purpose of establishing a context process model connected to a detailed/specific process model, describing the U Lipsanen process in making modular building constructions for hamburger restaurants.

6. The eBusiness Process Repository

The eBusiness Process Repository at MIT contains process models provided by companies participating in the project. Most of models in the library are process are models being close to company specific procedures. The set of generic business models are all highly general and highly generic and the library also contains process models being general/specialised.

7. The ProFacil process model

The ProFacil process model provided by this thesis is an example of a process model being general and fairly detailed. Details that concern this model are found in chapter seven.
4.4 A stipulative definition of the term generic

There may still exist different opinions to the approach to process modelling being presented in the previous chapters. In the following part we will look into a stipulative definition of the term general and generic, and a case study to come later, will also describe this framework by letting facilitators and modelling experts explain how they perceive the difference between a generic and a company specific process model.

What does the term “generic” mean? Has the term “generic” the same meaning as “general”? Is there a difference and does this difference really matter for the usage of process models or is it merely a shade of meaning with no practical importance?

The term “general”, adjective, denotes “generalis”, in the classical Latin, and depicts; involving or belonging to the whole of a body, group, class or type. (Webster’s, 3rd New International Dictionary).

The term “generalis”, is applicable or relevant to the whole rather than to a limited part, group, or section. The term “generalis involves or belongs to every member of a class, kind or group, applicable to every one in the unit referred to, not excluding anyone in that group. It is a term that is concerned with the universal rather than particular aspects.

The term “general” takes a wider perspective of the world and embraces, for example, aspects that are as common to mankind as the fact that humans are normally born with two arms, legs and eyes. The term general involves or belongs to members of a group, class, body or type and is applied to those characteristics that exist within a group.

In Webster’s, 3rd New International Dictionary, the term “generic”, adjective, denotes “gener-”, “genus”, originates from the classical Latin and we understand the terms “gener-”, “genus”, as the birth, race, class or kind. The term generic is relating, or applied to, or descriptive, of all members of a genus, species, class or group. A generic property is common to, or characteristic, of a whole group, or class, and it is not specific or individual.

The Cambridge International Dictionary of English, defines the term “generic”, adjective, as shared by, typical of or relating to a whole group of similar things, rather than to any particular thing.

What kind of different interpretations can we account for? The terms “general” and “generic” seem to be rather similar since both focus on the importance of the whole and concern all members of a group or a class.
An example of the use of generic is the term a “generic wine”. A generic wine is the name of a wine that comes from the district where it originated, as the California burgundy. Thus, the name of the wine relates to the particular district where it was produced and separates the California burgundy from other sorts of burgundy, Webster’s, 3rd New International Dictionary.

A similar example of the application of the term “generic” is provided by Henry Mintzberg in his book: “Inside our Strange World of Organisations”. Mintzberg (1989), define the structure of an organisation simply as the total of ways in which its labour is divided into distinct tasks and then its co-ordination achieved among these tasks. According to Mintzberg, specific activities or tasks that are co-ordinated in a company also define the structure of an organisation and separate one company from other types of companies.

Thus, specific activities that separate one company from other companies can be regarded as general activities for such a group when these activities are typical for those companies. Such general activities qualify those companies to belong to a certain generic group of companies. This point of view is focusing on the genus and the origin of an organisation.

By “generic”, we can understand that a certain group of companies, construction companies, constitute to a certain type of generic companies. The reason would be that they are part of all the companies that exist, but they do differ in some aspects from other companies.

Once again I refer to the application of the term “generic”, by using the process of making coffee. The process of making coffee is only one out of many other processes that produces a hot beverage. Thus, the process of making coffee can be generalised into a general process for how to make hot beverage. Such activities can describe all other types of process, leading to hot beverages being produced. This point of view focuses on the property of “generic”, not being specific.

By using the term “generic”, I refer to a term that describes the origin of business processes. The term relates to a whole group of companies performing similar activities, but also to the case where the term relates to a group of activities where a new set of activities can be derived producing products or services.

Thus, the term “general” and “generic”, are closely linked to each other, like a coin possessing two faces, different but still the same. The property of generic is to separate and to establish an origin, a common point of reference from where specialisation can take place. The term general points out a common property which is shared by many and becomes, on the whole, the opposite of something specific and detailed.
5 Processes and process modelling

This chapter attempts to explain what processes are, not only by providing definitions of the term. I will provide for an explanation of a method for process modelling and, furthermore, a concrete example of its use. The target group for this chapter is the reader, interested in understanding process modelling and the concept of generic process models introduced in chapter 3-4.

5.1 Motives of process modelling

A problem shared by many building and construction companies today is unclear processes providing products and services within their organisations and to their customers. Unclear processes and working procedures tend to propagate into highly individual ways of working and some organisations do benefit from an unstructured way of working, mostly this is not the case.

Unknown processes result in the uncertainty of what is being produced and delivered by the organisation at a specific time to its customers. From a strategically production viewpoint, process analysis supports the design of products, services or information systems by shortening the time frame of production and increases the likelihood of discovering eventual malfunctions in a prevailing process.

Companies could benefit from a top-down process modelling method while defining their own processes as part of their quality systems. By using process analysis, companies are able to document responsibilities, authorities and working procedures within their organisation. Such an analysis makes it easier to define a clear distribution of roles and the follow-up of production results. This effort is a first step towards being a certified organisation according to official quality standards such as the series of ISO 9000 certificates.

Different approaches to the measuring of the efficiency in processes are given by Andersson, (2000).
5.2 Definition of the term process

The term “process”, is a term that is in general use and depicts that something happens as a way of doing things. This term is understood with different meaning and needs a more elaborated explanation to be useful for practitioners.

A stipulative definition of the term ‘process’

The Latin term for process is “processus” and it is defined by Webster’s, 3rd New International Dictionary 1986, as follows:

A progressive forward movement from one point to another on the way to completion: the action of passing through continuing development from a beginning to a contemplated end: continued onward flow.

Natural progressively continuing operation, or development, marked by a series of gradual changes that succeed one another in a relatively fixed way and lead toward a particular result or end.

To sum up a stipulative definition of the term process

- Set of facts
- Gradual change
- Forward movement

A descriptive definition of the term process

Three different perspectives can easily be found using a descriptive definition of the term process:

- The business oriented
- The quality oriented
- The system oriented

Using a descriptive definition, see next page, the following key elements describes a process:

- Transformation
- Set of activities
- Input and output
- Series of actions
- Change of state
The business oriented perspective

"A process, is defined as a bounded group of interrelated work activities providing output of a greater value than the inputs by means of one or more transformations”

Eugene H. Melan, 1992

“A process is simply a structured, measured set of activities designed to produce a specified output for a particular customer or market. A process is thus a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs: a structure for action”

Thomas Davenport, 1993

The quality oriented perspective

"A process is a systematic series of actions directed to the achievement of goals”


The system oriented perspective

“A change of state in a system”

Mario Bunge, 1991
5.3 Making processes visible

A process is visible and at the same time invisible. We notice that changes happen during our everyday lives although we tend to do things in the same familiar way and as we are used to. We do not reflect upon the fact "now I am performing an activity" or "now I have done this or that task". The process is there but we do not see it because we are in the process. To see and to discuss a process we need a way to describe "what happens" and "how happens something".

The modelling of verbs and nouns

A model exists due to the existence of some kind of logic which humans are capable to recognise and understand. A model reduces the complexity by providing a simplified description of a real world phenomenon, such as a model of a building or a business process.

We use verbs, nouns and adjectives in order to explain a process. A verb is a word or a phrase that describes a course of events, conditions or experiences. A noun is a word that refers to a person, place, things, substance or quality. A noun can describe a car, a watch, a piece of information such as a protocol, raw material as steel or concrete, or a more abstract thing as energy or a human need. An adjective specifies an attribute to the noun as a red (car), or a round (building), or a great (need).

There is flow and relation between the noun, the verb and the adjective. Work is being done in this flow - a car is painted and the result is a painted car. This very simple principle describes the fundamentals of workflow. There is some input (the car) and there is an act (paint) which results in an output (a painted car), shown in the figure above.

5.4 Expectations put upon process modelling

An understanding of processes can be reached in many different ways. We can use a process modelling method to give us a picture of a typical everyday process and we can also learn by recognition or use some kind of categorisation of processes that relates to the way things are done in an organisation. We can use terms as core- or support processes or use references to well known methods such as the Perth method or to a GANT schema.

Before continuing this introduction to process modelling I would like to extend the understanding of what kind of answers a process model can provide by using a recipe as an example.

A recipe that provides an explanation of the purpose of different activities or how different ingredients contribute to the experience of the dish itself is normally not seen in a recipe. Such a recipe would provide us with the "know-how" of the design process itself.
For example, when preparing “lingonberry jam” and choosing two decilitres of sugar instead of 6 decilitres. There will, of course, be a much more bitter flavour due to the modification of the recipe and the knowledge of what change in the quantity of sugar means for the flavour is not shown in the recipe, but is known by the chef. A process model does not explicitly provide such an understanding.

The rationale of process modelling, using graphical models, is to show "what is done” and "how something is done”. It is not a method which in itself creates business benefits or explicitly shows the consequences of changes in a process design. A process model supports us in our understanding of the purpose of a particular activity or process. Such understanding can, for example, provide specialists in a domain with knowledge of how particular changes in the process affect the business.

I make a proposition by saying that the purpose of using a high-level process model, such as the ProFacil model, is to provide support for reaching a description of a process, but leaves the "know-how”, i.e. how to design a particular business process without an answer. However, this kind of support could anyway be of substantial use and value for companies and once again I make a reference to David Gleicher and his model for change initiatives. The creative leap from a high-level process model to the design of a particular process in a company is entirely a question to be solved by the company representatives themselves.
5.5 The functional modelling method

The functional modelling method presented in this part of the chapter is founded on the basic principles of linguistics. The Structured Analysis and Design Technique, SADT for short, is a modelling methodology that was originally developed to describe a system and its environment. For example, before making requirements of information systems, planning and co-ordinating large projects, describing shop-floor operations, designing telecommunication networks, or explaining how something is worked out by using a transformation perspective. The first sketches of the SADT method where made at MIT in the end of the 1950s by Douglas T. Ross, Marca & McGowan (1988).

The Integration Definition language 0 for Function Modelling (IDEF0) is a subset of this methodology and the IDEF0 modelling method is one out of a number of available process modelling languages for technical process descriptions. IDEF0 has been quite popular in construction process modelling efforts during the 1990’s and is regularly used in product modelling for describing the processes by which product data is defined and exchanged.

By using IDEF0 it is possible to the reveal the purpose of a particular activity. An IDEF0 model has boxes and arrows. The boxes represent activities that take place in a process and these boxes are interrelated and may be arranged in a hierarchical decomposition. Arrows connect boxes together and represent interfaces between boxes. An arrow represents a collection of things that can be plans, machines or information of any kind present in one and the same arrow and specified in a lower level diagram.

An activity uses some inputs and transforms these inputs into outputs by use of machines or people in the organisation. The resources that an activity needs to transform inputs into outputs are named mechanisms. Controls constrain these activities by specifying which conditions are actually regulating the performance of an activity.

An activity is described by using a verb phrase and an arrow is named by using a noun. We can use the following phrase to remind us of how the IDEF0 method works: “Under control, inputs are transformed into outputs by mechanisms”, Marca & McGowan (1988).

The IDEF0 methodology may seem complicated at first sight, due to the effect of controls and mechanisms. However, this is more of an educational problem in understanding how the method is used and what each arrow means in a process model.
IDEF0 uses a top down approach that encourages a holistic approach. A process can be analysed as a hierarchical set of interrelated activities where the diagrams at the top of the model are less detailed than those at the bottom. Figure 20 shows the decomposition structure of an IDEF0 model.

The general level in an IDEF0 model

The detailed levels in an IDEF0 model

This box is the parent of this child diagram.

Node numbers shown indicate that the box has been detailed.

Figure 20. The IDEF0 decomposition structure.

Purpose and viewpoint of an IDEF0 model

The purpose of a model will help to define the border of a model. The SADT methodology defines a model as: "M is a model of a system S, if M can be used to answer questions about S, with an accuracy of A".

The definition implies thereby, that the model will answer a set of predetermined questions. If the model does not answer all the questions that it is supposed to, then the model has not fulfilled its original purpose. This is an important aspect of how the purpose of a SADT model is obtained. It is by specifying a series of questions that the model is supposed to answer and the purpose is then derived from summing up those questions.

The viewpoint is equivalent to the perspective of a model. Often, only one viewpoint is permitted in a model and the chose of a particular viewpoint is guided by the questions the SADT model is supposed to answer. The viewpoint is supposed to provide answers to questions from a particular perspective, e. g. a particular role or roles in the organisation. The effect of more than one viewpoint in a model is that the reader will be unsure about how to interpret and understand the content of the model. The effect of not choosing a viewpoint will be the same.

Sequence and time in an IDEF0 process model
A Gantt or PERTH scheme represents both time and sequence but an IDEF0 model does not represent time at all. This fact may be rather confusing for people who are familiar with scheduling methods and have a picture of a project in terms of start and finish time, duration, temporal dependency or tasks decomposition.

Process models produced by the use of the IDEF0 method are constraint models and not flow models. The SADT technique represents a system of interrelated activities. These interrelated activities are placed according to their relative order of importance and depict the dominance one activity has upon another activity in the model. The most dominant activity could be the first in a sequence of activities or it can express an activity that has influence on all other activities. An example of such a sequence is shown in the model “Manage Facilities”, in figure 28.

Another example of the independence of sequence is shown in figure 21 where both the “Boil Pasta” activity and the “Taste Pasta” activity can be active simultaneously. The “Boil Pasta” activity can be active before or after the “Taste Pasta” activity has been performed. Thus, the functional modelling method does not express a strict sequence between activities.

The system that the model depicts can stop during a non-defined time frame and wait for some input or control information to be present before an activity starts in order to transform input into output. Control arrows are such an example, prescribing a strong sequencing relationship between two activities, where one activity is dependent on the output of another activity to start producing its own output.

The relation between a process activity and a task

An activity consists of tasks that are performed by humans and these tasks make up what actually is done in the process. Tasks are often analysed using a scheduling method where the starting and finishing time of a task are shown together with their dependences. The result of such a scheme is knowledge about the duration and critical parts in a workflow.

The relationship between activities and tasks is described by Karhu, (2000) as “A relationship between an activity and a task is essential. A task has a type attribute, i.e. a task type. Activities are defined as general descriptions of how to carry out some actions whereas tasks are specific descriptions with starting time, finishing time, duration and location”.
5.6 Process modelling in practice

To study the process of preparing pasta is perhaps a good way to learn more about process modelling methods and to understand how to make use of a top-down modelling approach to process modelling which is presented in chapter 6.

Preparing a meal is a typical everyday process in which we all have been involved in, whether we prefer being a chef or not. We will use a recipe as an introduction to how to read and understand a process model.

A recipe for preparing any pasta dish could be the following

---

**Fill a pasta pot with 3 quarts water, add 1 teaspoon of salt and cover with a saucepan lid. Put the saucepan content on the stove to boil for not more than eight minutes**

---

Add the 1/2 pound fresh pasta and cook until tender but still slightly resistant to the bite.

---

Drain the pasta in a colander and let the pasta have a quick rinse under cold water. Put the pasta into a large bowl. Serve the pasta.

---

Figure 19. Different steps and activities in the process of preparing a pasta dish.

What does a process model based on a textual description as the recipe above look like? The next part of this chapter will clarify these details.
A process model showing how to prepare pasta

The question from the previous chapter was, “what does the process of preparing a meal look like if we are using an IDEF0 model to show how to prepare a pasta dish”? To answer this question we simply describe the process “Prepare Pasta” seen in figure 22. This model shows input and resources needed to provide pasta. The controls will regulate when and under what conditions these inputs are transformed into pasta that is ready to eat.

The following items are used in figure 22.

- **Inputs**: Energy, water, salt, and pasta
- **Controls**: Temperature of water, recipe, preferences
- **Mechanisms**: Large bowl, colander, cutlery, pasta pot, stove, chef
- **Output**: Pasta ready to eat, waste

*Figure 22. The IDEF0 model, prepare pasta at level A-0.*

*Figure 23. The IDEF0 model, prepare pasta at level A0.*
Clearly, three activities are shown in figure 23, as boil, taste and drain – but these are not so easily noticed in the recipe or by observing the process. We can discover that the temperature is a crucial factor if the pasta is going to be boiled or not. The recipe for how to prepare pasta must also be known to prepare pasta. This is one of the constraints in the model and the logic of such a condition is that you have to know how to prepare the different ingredients in a pasta dish if you are going to succeed in making this dish. If you do not know the recipe, you may well put the pasta into cold water, instead of boiling the water before putting the pasta into the pan.

What are the resources needed in order to transform salt, pasta and water into pasta which is ready to be placed on a dinner plate? The model shows that a stove, a pasta pan, some cutlery and the chef are needed in this activity. These resources are also used in all activities in the model.

As this is a constraint model and not a flow model, the boil pasta activity will continue until the pasta has met the preferences of the chef and the instructions found in the recipe. The feed-back loop between the activities "taste pasta" and "boil pasta", containing the decision to continue to boil pasta or not, are visible in the model, as prescribed by the recipe.

The chef finishes this process by draining the pasta using a large bowl and a colander. Finally, the chef ends up with freshly cooked pasta which he is going to serve with beef tenderloin and broccoli but those activities are not shown in this example. As a result of the process of boiling pasta, some waste is also produced during the draining of the pasta.
6 The ProFacil process model

This chapter presents the Provide Facilities model (ProFacil model) developed during the start of this research project, the problems following by the chosen modelling approach, and the potential use of the model.

6.1 Introduction to the ProFacil model

1. What was the original purpose of the ProFacil model?

The ProFacil model was defined as a framework model showing the links between the facilities management process and the building end users business process to support more detailed process modelling.

2. What kind of experiences were gained during the development of the ProFacil model?

Three companies with experiences of FM activities participated during the development of the ProFacil model. These companies were the hospital, Karolinska sjukhuset in Stockholm, Electrolux Facility Management in Stockholm and ABB Facility Management in Västerås.

The company representatives participated by providing their experiences of the FM area. The concept of IDEF0 was not considered as an obstacle by the company representatives nor did they object to the presentation format. The diagrams were printed out and presented as single paper sheets or by using a paperboard showing several diagrams of the model.

The motive in using the ProFacil as a framework model seemed easy to comprehend by the representatives though when actually faced with the ProFacil model the communication about the model was indeed difficult. The company representatives did not disagree about the activities chosen to meet the purpose of the model; instead their confusion concerned the reality being described by the model. The information provided by the model itself seemed to be a problematic area to grasp, leading to the questions ‘what are really being described by the model and what is the model useful for?’ It is appropriate to point out that it is not possible for a single person to understand how to accomplish all the different tasks done by experts and their interdependencies in such a complex process as the one being described by the ProFacil model.

As will be shown in the chapter seven, several key concepts of semantics need to be understood in order to analyse how meaning is created by using verbs and nouns. Abstract verbs and nouns of the kind used in the ProFacil model needs an anchoring mechanism otherwise the communication of the process model will result in confusion and a considerably decreasing in the possibility of its re-use.
3 How is the generic approach to process modelling visible in the ProFacil model?

The ProFacil model describes business activities from the generalised point of view as management-, support-, and core processes \(^2\) and their relations. The model defines basic activities in the providing of a facility. Examples of these activities are “operate facilities”, “provide new facilities”, “provide re-build facilities”, “provide maintained facilities” and “perform dispose of facilities”. These are all generic activities able to establish an origin leading towards a specialisation of company specific FM activities and their tasks.

4 How can the ProFacil model be used?

The presented ProFacil model reflects, of course, the developers point of view of their current understanding. The ProFacil model would not be the initial tool for non-professionals carrying out analyses of their business processes. This is because a generic process model is a complex intellectual tool and requires careful handling by experienced professionals to be of any use.

The ProFacil model could be used while establishing a general/specialised process model, see figure 15, which may be used by facilitators engaged in a detailed and company specific process analysis. The ProFacil model could also be used as a learning device being aware of the complexity concerning the activities and the interdependencies that exist between the activities in providing a facility.

As being described in the previous chapters, companies enacting a top-down process modelling approach could save time, money if they are able to reuse information about their processes combined with a bottom-up approach that establish the details of tasks being done in their organization. In a top-down modelling approach process models possessing general/generic or detailed/generic properties are used in the detailed and company specific analysis of processes by using these models as references.

\(^2\) ‘Core processes’ means the processes that result in a product or service that is required by an organisation’s external customers, Rummier & Brache (1995).
5 How could a facilitator use the ProFacil model?

A bottom-up approach does not provide any pre-information about a process on a generalised level, because the facilitator is describing the process by sampling bits of pieces of information about the activities and their related tasks to a bundle describing an actual process. As been mentioned above the top-down modelling approach supports a facilitator by providing a reference concerning the main parts of a business process and by establishing consensus concerning the processes being described.

A facilitator can establish a general/ specialised process model by using the ProFacil model and interact with the modelling participants to describe their company specific processes. These modelling seminars or interviews will be done in an informal way, supported by a high-level process model as a reference.

Question that can be made about the process being analysed

- Can you tell me what activities you engage in?
- Can you tell me what activities make up this process?
- What deadlines do you have to meet?
- What paperwork do you encounter in your daily work?
- What control this process from being performed?
- What kind of recourses does this activity need?
- Who performs the activity, i.e. actors?
- What are the goals of this activity?
- What are you trying to accomplish?
- What are the goals of the various departments or individuals engaged in this activity?
- What forms, reports, or other paperwork must you complete or have available to complete this activity?
- What forms or reports does this activity produce?
- What else does this activity produce?
- What contextual factors are of critical importance in completing this activity as issues, problems, exceptions, key performance measures, incentives, or interdependencies between activities or tasks.
6.2 The provide facility model

The provide facility model (ProFacil) shows links between the facilities management process and the building end users business process from the viewpoint of people working in the organisation. The model was presented in an earlier version at the conference “Customer Satisfaction: A Focus for Research & Practice in Construction”, CIB W55, Cape Town, South Africa, Björk, Lundgren, Nilsson (1999).

To understand notation in an IDEF0 model and how the decomposition of a model is made, see chapter 5.5.

It is assumed that the purpose of the organisation is to produce products, services or information, which has value to some external customer. This diagram combine to any organisation whether non-profit or a maximum profit organisation. On the next levels to come, the relation to Facility Management process will appear.

By ‘business management’, we understand to mean the planning activities in a company which studies both long-term market conditions of the company as well as the opportunities offered by technology development and the funding of investments, which results in a strategic business plan for the business. ‘Business activities’ include budgeting
and long-term plans involving such key issues as the development of new production systems or strategies to improve the working situation for personnel or of a new strategic plan to highlight the need for special competence in a business function. By business operations is meant the operations made by the core- and the support processes on a daily basis, see diagram 26.

![Diagram A3. Perform business operations.]

Examples of core business activities could be
- In a university, teaching undergraduates and carrying out research.
- In a hospital, examining and treating patients.
- In a telecommunicating company, to develop and manufacturing mobile telephones.

Examples of support activities are
- Paying salaries to the employees
- Supplying the personnel with IT-equipment
- The supply of facilities or services to the core business
- Buying in stocks and materials needed in the core business
These support activities can be further broken down into the following sub-activities, see figure 27.

- Provision of Machinery services
- Provision of Financial services
- Provision of Material services
- Provision of Personnel services
- Provision of Facility Management services

![Diagram A32. Perform support business processes.](image)

From the organisation’s point of view, well-functioning spaces and buildings are only one of a number of resources needed as input to the core process. In larger organisations we often find specialised departments set up to manage these different categories of support activities.
The link between the business management of the core business and strategic FM planning is important to note. Signals to start planning for changes in stock of building and spaces responds to a predicted need for these resources, though an unforeseen change in the business environment can also rapidly change these plans.

Whenever, such changes occur, these have to be carried out using a set of basic activities.

- Provision of a new or existing facility
- Rebuilding of existing facilities
- Maintenance of existing facilities
- Operation of existing facilities
- Disposal of existing facilities

![Diagram](https://via.placeholder.com/150)

**Figure 28. Diagram325. Manage Facilities.**

As is seen by figure 28, the business and budget plans, a facility plan from the business management, affect these activities by controlling when to start transforming inputs into operational facilities used for the core business processes. External constraints are, for example, public regulations or legal agreements with stakeholders connected to the business process.

Information from different sources in the core process is used by the FM activity in providing facilities to core processes, and information produced by FM activities becomes an input to each of the activities in the process of changing the continuing use of facilities. Resources used by this process are IT tools and equipment needed in the daily operations and the facilities are also a resource used in the process.
The provision of a new facility can be accomplished in two separate ways by acquiring an existing facility or by acquiring a new facility. An existing facility may be acquired through buying a built facility on the real estate market or renting facilities on the property market, see figure 30.
By acquiring land and constructing a building or rebuilding a building already owned, new facilities may be supplied but only after a long period of time. It is only by breaking up this level, that we can find the familiar categories design and construction, which are so often found as central to many construction process models.

The information in the facility plan provides for decisions involved in the activity of providing a site and these decisions are forwarded into the conceptual design, detailed design and to the construction of the building itself. Data and information about sites, such as their location, their surrounding and amenities are inputs to the activity of acquiring a site. Structured and unstructured information given by facility managers are used by all the activities involved in an acquisition of a facility.

As can be seen, the project team is involved as one among several resources in the provision of new facilities. The information flow being produced as a result of the activities above is used in the decision making process and to describe the artefact itself – the facility.

A remark to figure 31, in this model the traditional activity of system design or main design is an integrated part of the activity of conceptual design.

The generic property of the ProFacil model provides for an origin from where specialisation of detailed process models can take place. Several perspectives can be made in the process of acquiring a facility by using the diagram in figure 31, be it the information technology perspective, the decision making perspective or the material flow perspective.
At this level, the decomposition of the model is taken one step further and the details of the activities in the previous diagram are visible. What is seen in figure 32 are the activities of making analyses of client needs that lead to an architectural programme. Building and tendering documents are produced in the architectural program and by the activities during the design of a building. The project team, IT tools and equipment are used as resources while performing these activities.

Figure 32. Diagram A225122. Perform conceptual design.

The information flowing into the architectural program and the architectural design are building specifications and engineering design information. Information is also provided by the facility management function.

Figure 33 shows the detailed design by establishing five basic activities describing this process.

Figure 33. Diagram A225123. Perform detailed design.

The design of ground and foundation produces basic information formalised into the building specification as one of the several inputs to the spatial design activity which provides information about the design of walls and roofs into the structural design.
Figure 33. Diagram A225124. Perform construction.
7  Theoretical framework

The aim of this chapter is to describe the theory of situation semantics in sufficient depth to be able to evaluate the proposition made for this research. Thus, the purpose is not to fully analyse and describe the theory in depth: such an effort would be out of scope in this research project. What is needed is a description of the theoretical constructs and their relationship in order to establish a theoretical framework from where an analysis can take place of the answers made by facilitators in the case study. The evaluation of the case study is based on the seminal work done by Barwise & Perry, Situation and Attitudes (1983).

7.1  Situation semantics – a theory in linguistics

Jon Barwise has made a considerable contribution to mathematical logic and philosophy. His work has contributed in enlarging the theoretical understanding of how the information content is expressed in language, computers or graphical representations and how information is transferred from one form of representation to another. Barwise is the author or co-author of several books such as “Admissible Sets and Structures”, 1975, “Situation and Attitudes”, 1983, “The Liar: An Essay on Truth and Circularity”, 1987, “Vicious Circles: On the mathematics of Circular Phenomena”, 1997. He has authored and co-authored nearly 100 articles within his field of science.

John Perry has made a considerable contribution to mathematical logic and philosophy. His work has contributed in enlarging the theoretical understanding of how the information content is expressed in language, computers or graphical representations and how information is transferred from one form of representation to another. Perry is the author or co-author of several books such as “Dialogue on Personal Identity and Immortality” 1984, “The Problem of the Essential Indexical and Other Essays”, 1993, “Dialogue on Good, Evil and the Existence of God”, 1999. John has authored and co-authored nearly 75 articles within his field of science.
7.2 An introduction to the theory of situation semantics

During the start of this research a comparison was made of IDEF0 and Action workflow, Turk & Lundgren (1999), which is a process modelling method based upon the theory of speech acts, Searle (1969). In the speech act theory, Austin (1962), Searle (1969), a commitment between a ‘speaker’ and a ‘listener’ is the mechanism in natural language that explains why people are willing to do such a thing as perform a task in a process. In contrast, the SADT methodology and the IDEF0 modelling language do not take any account of commitments between ‘speaker’ and ‘listener’. This fact makes the speech act theory less adequate as a theoretical pattern in support of the research proposition set out in this research.

According to Barwise and Perry, language is used to carry information about the world but language per se is not information - it is a tool that we use to communicate information with. Semantics is the study of linguistic meaning, of a relationship that is held between expressions of language and things in the world. We uses models for the same purpose, namely to convey information about phenomena in our world.

The leading idea of situation semantics is that the meaning of a simple declarative sentence is a relation between utterances and described situations. The interpretation of a statement made with such a sentence on a specific occasion is the described situation.

When a sentence or phrase is uttered on a specific occasion, our sentence constrains the described situation to be a certain way, to be like one of the situations in the interpretation. Or, as Barwise and Perry say, it constrains the described situation to be one of the interpretations.

Now what do the parts of a sentence do? Basically, they help build up this constraint, either by contributing subject matter, that is, the individuals, properties, and locations that appear in the described situation, or by showing how the contributed subject matter fits together. Thus the meaning of a simple noun phrase will typically be a relation between an utterance and an individual, and the meaning of a verb, a relation between an utterance and a property.

In the theory of situation semantics, efficiency and information is handled through the relation theory of meaning. An expression can be used over and over again with the same meaning, a meaning that is learned once and for all by the members of the linguistic community. But the interpretation of a sentence may be new each time, determined by the unchanging meaning and the varying circumstances of utterances. According to Barwise and Perry, all information in an utterance must come from its interpretation.

One example of how information exists independently of language is the x-ray of a broken leg. A doctor interprets the signs of a broken leg by a x-ray photograph and conveys the information to you by the use of the sentence, “you have a broken leg”. Another example is the sign of fire, which you interpreted by seeing smoke coming out of a house. You have learned by experience that smoke is a sign of fire and you know, without saying, that there might be a fire in the house.
The meaning “My wife”, has a certain linguistic meaning and allow speakers of English to convey many different kinds of information by utterances containing the phrase. What kind of information conveyed by the utterance “My wife”, is determined by the interpretation of the utterance. The interpretation of an utterance is affected by the very situation in which it is uttered. The natural language also exploits many features to direct to a correct interpretation of an utterance, like intonation, gestures, eye-movement or social settings.

The efficiency of language in the theory of situation semantics is about the speaker and the listeners place in the world. Expressions used by different people, in different space-time location, with different connections to the world around them, can have different connections, even though they retain the same linguistic meaning. An example is provided by Barwise and Perry when you say, “I am right, you are wrong”, talking to me, and I use the same words talking to you. We disagree. We make different claims about the world. What you said will be true if you are right and I am wrong, while what I said will be true if you are wrong and I am right. These different claims are the different interpretations our utterance has. But the meaning of the sentence we both used did not change. It is the same; the interpretation is different. That is efficiency.

Expressions, whether simple or complex, can be recycled, can be used over and over again in different ways, places, and times and by different people, to say different things. This is what the theory of situation semantics mean by efficiency of language. Efficiency lies at the very heart of meaning. The interpretation of language is a product of linguistic meaning of the expression, and its context of use. The context of use is broken down into what Barwise and Perry call the ‘discourse situation’, ‘connections’ and ‘resource situations’.
Compositionally and the meaning of phrases

Verb and noun phrases and determiners are those parts that make up a sentence, but uttering such expressions in isolation does not describe a situation, according to Barwise and Perry. However, uttering a verb or a noun phrase do provide with a situation element that contributes to the description of a situation. To describe the making of a tensed verb phrase, another situational element is needed.

What is common to a meaningful utterance is that the speaker is describing or exploiting a situation in which an individual is doing something. The meaning of a tensed verb phrase is a relation between discourse situations, connections, individuals and a course of events.

How do we get a unique interpretation out of an ambiguous expression?

Barwise and Perry refer to ambiguity as another aspect of the efficiency of language. Expressions are seen as uniformities across certain kinds of situations, utterances. That an expression can be used in more than one way is just another feature of the expression. As an example, if someone says, "Melanie believes she dropped a book", what is said depends on how someone used the expression, and this is a fact about the utterance, not about the expression.

The factors that contribute to determine meaning of an utterance are factors such as to whom is being referred to by the use of a pronoun, what resource situation the speaker is exploiting and the contextual facts which go toward getting a unique interpretation out of an ambiguous expression? The answer is obvious. There are an enormous number of features about language use - features like intonation patterns, gestures, eye-movement - that help us interpret an utterance.

The relation theory of meaning

An utterance situation consists of a speaker who addresses an utterance to a recipient. The interpretation of such an utterance and the information that is picked up by someone making the interpretation greatly depends on the linguistic meaning of an expression.

The linguistic meaning of an utterance is formally denoted by the relation $d, c \parallel \varphi \parallel e$ and the interpretation is a collection of described situations ($e$), such that the discourse situation ($d$), the connections ($c$), and the utterance ($\varphi$), are related to the described situation ($e$). The interpretation of an utterance is fulfilled if the recipient is able to recreate a collection of described situation ($e$) to understand the meaning of the utterance ($\varphi$).
The discourse situation

The discourse situation is said to be the public part of an utterance by involving who is speaking, when and where, what words are being uttered and to whom. By referring to an individual, an object, and to a location, we are able to establish a referring situation and such a situation where there is a unique way to anchor these roles, is called a discourse situation.

As mentioned above, the interpretation of a statement (u) is determined by decomposing (u) into its constituent expression (p), a discourse situation (d) and connections (c). The first step in understanding the situation described by the utterance is by finding the individuals referred to by their names, thus start the establishing of a discourse situation. When established, the speaker makes use of different connections being the referent of an utterance. Resource situations are used by the speaker in passing information about a particular event to the receiver. There is an interplay between the speaker and the receiver, where the speaker can modify the information content in an utterance by adding, or modifying the connections or the resource situations which are being used during the conversation.

The speaker connections and the point of referent

To connect an utterance with the situation it describes, the theory of situation semantics uses a set of linguistic elements referred to as the speaker connections and the point of referent. A speaker exploits past and present perceptual experiences, connections to objects, properties, places and times by referring to them. The information content in a sentence is modified depending on how the speaker uses these connections and on the particular relation held by the speaker being the referent. The ability to refer to something in connection to the world we live in is gained by the individual experiences made by a person.

Examples of past or present perceptual experiences can be a person having first hand experiences of performing research or teaching in a particular subject, or experiences in any particular business event. Present experience, can be somebody performing an activity at a specific location and time.

Examples of objects are a person named Peter, an artefact as a building, a car, or a tree. A connection to an object can be you referring to that person named Peter, or a connection can be about what you have seen, read or heard. Properties are held by objects such as Peter being a tall person or the building having a brick wall that is red.

We can modify the information content by referring to and exploiting a certain property of an object by referring to an object being larger or smaller.

A connection used to describe a situation can also be re-used as a part in a resource situation if the connection has succeeded in establishing a described situation. How this happens will be presented in the next part of this chapter.
Resource situations

The theory of situation semantics defines a third form of efficiency in natural language called resource situations. This form of efficiency stems from a speaker’s ability to exploit any situation which is available to a dialogue participant in order to convey information about another situation Cooper (1996). A resource situation is based upon a fact about a particular situation involving a particular person at a particular location doing something. By identifying a particular object, such as a person, in a situation, this person can be used to describe another situation.

Resource situations includes the following

- By being perceived by the speaker
- By being the object of some common knowledge about some part of the world.
- By being the way the world is.
- By being built up by previous discourse
- By being the way the speaker or listener or both mistakenly take some situation to be, or even just mutually pretend it to be.

If a speaker makes the utterance:

(1) \textit{Sam is drinking beer}

He informs someone that a specific person known to the speaker as “Sam” is drinking beer. This is about the speaker’s connection and reference in the world. We refer to this particular situation and by referring to (1) as a fact we can exploit this situation by someone saying

(2) \textit{That man driving that car has just been drinking beer}

The situation (2) is established by exploiting the situation (1) as a resource situation. It is by referring specifically to Sam that a resource situation is created. For all we know, the situations (1) and (2) could be re-used to describe another situation, (3) for example, if someone is saying

(3) \textit{That man falling down that tree has just been driving a car and drinking beer}

As shown by these examples, a resource situation is an established fact about a situation which is re-used by the speaker to pass on information about another situation.
Another example of a resource situation, made by Barwise and Perry, is how the expression “My wife” can be reused to convey different information to a person, depending on the situation in which it is used. The expression “My wife” has a fixed meaning, learned by a linguistic community because the meaning in being a wife is sustained by law. The interpretation of the utterance depicts what information is passed by the expression.

<table>
<thead>
<tr>
<th>The discourse situation (d)</th>
<th>Speakers connections (c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Who is speaking</td>
<td>e. Past and present experiences</td>
</tr>
<tr>
<td>b. To whom am I speaking</td>
<td>f. Connection to an object</td>
</tr>
<tr>
<td>c. Where and when</td>
<td>g. Place and time</td>
</tr>
</tbody>
</table>

The expression d. The sentence (φ) The resource situation h. “My wife”

Case 1

The discourse situation
a. I am  
b. A stranger at the party  
c. At the entrance to a party  
d. “My wife will be late”

Speakers connections and point of referent
e. The stranger does not know me or my wife  
f. There does not exist any relation to the stranger  
g. I am visiting a costume ball during the evening of 12th August 2001.  
i. My utterance conveys the information that I am a married man and that my unknown wife will be late for the party.

Case 2

The discourse situation
a. I am  
b. A friend met at the party  
c. A dining room at the party  
d. “That is my wife”

Speakers connections and referent
e. The person has not yet revealed my disguise  
f. The person knows my wife and me quite well  
g. I am visiting a costume ball during the evening of 12th August 2001.  
i. If my wife enters the dining room and recognises me standing and talking to the person, then my utterance will convey some entirely different information – namely who I am.
Constraints

According to Barwise and Perry, the meaning of an expression is reached through a systematic relation of constraints existing between different situations. These constraints are what allow one situation to contain information about another. In the theory of situation semantics, it is the attunement to constraints that makes life possible and we systematically act according to our understanding of how a constraint effects the world around us, providing the basis for flow of information, Devlin (1991). These constraints can be unconditional and exists under all circumstances as facts, and others are conditional and apply only to a specific environment. There are four different types of constraints defined by the situation theory.

**Necessary constraints**; meaning that there exists a basic set of constraints that must hold true, such as a woman being a human, every kiss is a touch, or a dog is a mammal. There are also relations that must hold as true. An example given by the authors is that if someone is eating, that individual is eating something. Mathematics provides another example of a necessary constraint, as $2 + 2$ will equal 4 and not 3.

**Nomic constraints** respond to constraints or patterns known to us as natural laws, such as the laws of physics, as the law of thermodynamics, or laws of chemistry, and of elements. To be successful, an individual must be attuned to the most important nomic constraints, either explicitly or implicitly. An example would be a girl playing basketball - she knows explicitly that the basketball will come down if thrown in the air, and to be successful she has to attune to other implicitly nomic constraints that will effect her performance on the court. Another example given by Barwise and Perry is the fact that only open doors can be closed and only closed doors can be locked. We learn that if a door is closed and locked, no humans can move through it without being hurt. We become attuned to these nomic constraints and use the knowledge about them while acting and talking about situations in our everyday life.

**Conventional constraints**; these constraints stem from explicit and implicit conventions existing within a community of living beings. An example is the relation between the ringing bell and the end of a class, or someone giving a cookie to someone, saying “here is a cookie”! However, such constraints are neither necessary nor nomic, since they can be violated. Both the ringing bell and the expression “here is a cookie” can have an entirely different meaning in another language community.

**Conditional constraints**; these are constraints that hold only within certain conditions and apply to both the necessary, nomic and conventional constraints. An example of a conditional nomic constraint would be if the girl playing basketball would do so on the moon. Initially she would fail to do so, being attuned to the nomic constraints on earth.

Barwise and Perry claim that most of the constraints we are attuned to actually take this conditional form and as long as we stay within a community attuned to these constraints, we can exploit these constraints to get information about one situation from another.
The described situation and truth values

Facts from reality determine whether the utterance will be interpreted as true or false. According to Barwise and Perry; “The interpretation of an utterance depends on the meaning of the expressions used and on various additional facts about the utterance”. The truth of an utterance depends on whether its interpretation fits the facts and facts about the world come in twice: once to determine the truth-value, given the meaning, and again to determine the truth value, given the interpretation.

Using a hypothetical example, we can try to understand how constraints are used to support the evaluation of the truth of an utterance. According to the theory of situation semantics, we use facts from reality twice, once to interpret the meaning of an utterance, given d, c and \( \varphi \) and once again to interpret the collections of described situations (e). The interpretation made by a person is a collection of described situations (e), such that the discourse situation (d), the connections (c) and the expression (\( \varphi \)) are related to a collection of described situations (e). Figure 35, illustrates these relations.

Consider the utterance (\( \varphi \))

\[(4) \quad \text{This is a blue pen} \]

Expressed by Folke to Kurt. The fact about this utterance is, the blue pen being a red pencil, making this utterance a false one.

The discourse situation is targeted at Folke, the speaker and Kurt, the receiver of the utterance. The location is in the office at KTH and the statement was uttered at 09.32 on 14th of July 2001. Folke is only showing the pencil to Kurt, and does not make any use of any connections or resource situations at all, just passing the utterance to Kurt.

The receiver Kurt is, however, attuned to the ‘nomic’ constraint that is the law of physics and knows how to distinguish a blue colour from a red one. Kurt is also familiar with the ‘conventional’ constraints, that one making the colour code system and Kurt also understand the meaning of the word “pen”, as he has been brought up in the same linguistic domain as Folke. The interpretation Kurt makes of this utterance and what Kurt sees using his own eyes is put in relation to these constraints and the discourse situation. In this situation Folke did not use any connections at all making his utterance “This is a blue pen”.

Obviously, the truth value, given the meaning of the utterance made by Folke, is false, also the truth value, given the interpretation, is false, making the whole utterance a false one. Observe the dynamic nature of this process. If this is not clear, the reader is encouraged to read the introduction of the chapter once more.
Figure 35. The theoretical elements of the theory of Situation Semantics.
7.3 Relating the theory of situation semantics to process modelling and the ProFacil process model

Before relating the theory of situation semantics to the modelling of processes and the ProFacil process model. I would like to make clear that the ProFacil model has primarily been used to highlight problems that are general by nature, such as the difficulty of managing communication of generic process models. The research question, which is of primarily concern in academic research, focuses on this problem. The objective is to provide us with the theoretical knowledge that will make us more capable of handling these problems. The results from the case study at Vattenfall is used as an attempt to verify whether or not the facilitators used the theoretical elements found in the theory of Situation Semantics when managing the communication of generic process models. In such a case, the theory could contribute to increasing our understanding of how to manage the interaction when generic process models are used.

From what has been said about theory of Situation Semantics, I believe that a process model containing generalised modelling elements is like a huge conversation taking place between the creator of the model and its receivers - the ones about to interpret the model. A generic process model consists of generalised activities that are common to a certain business process. Such modelling constructs will always be prone to different interpretations whether the model is studied alone or communicated during a modelling seminar and need support in order to be properly understood.

A modelling participant trying to understand a generic process model will interpret a modelling construct as a claim on his or her business process. He or she will respond to that claim by reflecting if this claim is true or false. What kind of information the modelling participant is going to pick up will be determined by the individual interpretation of a modelling construct, see figure 35.

As being discussed, the interpretation of the intended meaning is a product of the meaning of a modelling construct and its context of use. The context of use is described by a discourse situation, connections and the point of referent, resource situations. To support the individual interpretation of a particular modelling construct, there is a need to handle these theoretical constructs described by the theory of situation semantics. Thus, a person could support a modelling participant in their effort to try to understand a process model by anchoring their interpretations of a modelling construct by making use of these theoretical constructs.

According to the theory of situation semantics, we interpret utterances made by the natural language in terms of described situations. In order to understand the meaning of an utterance we have to anchor each of the elements; the discourse situation, and the speaker connections and the point of the referent, to direct our understanding of a described situation. A resource situation can contribute to the decomposition of activities in a process, which will be shown later on.

The meaning of a particular activity, the inputs, and the outputs, and the controls or the mechanisms, (ICOM;s) is learned by the business community. Any modelling construct will be a claim on reality, i.e. a claim on how business processes are performed using resources or information. Such a claim is the intended meaning of a modelling construct and this meaning is not changed during the use of the model. A modelling construct is the verbs and nouns we are using to describe a process, the activities and the ICOM;s that...
represent the flow of information and materials. I will try to relate the theoretic elements provided by the situation theory to process modelling by constructing some examples, giving us a feeling for how modelling element in an IDEF0 process model can be analysed by use of the situation theory.

First, we have the discourse situation which describes; who performs the activity, what is done by the activity, when is the activity performed and where, to whom is the result passed. There is a need to anchor the discourse situation in order to start to understand what the intended meaning is of a modelling construct. Most of these constructs are found in the simple flow modelling method, and maybe this is a reason why this process modelling method is found to be one of the more user friendly.

The connections and the point of referent: A facilitator exploits past and present perceptual experiences, connections to objects, properties, places and times by referring to them. When a facilitator succeeds in establishing a connection to a modelling construct, he is linking the verb and the nouns in the modelling construct to become a particular claim on reality. That is, that the verb used really refers to an activity or the noun to the information or the material flow in the business process. In this case, it is important that the modelling construct really is what the modelling participants are also is referring to otherwise there will be different claims on reality and there will be no mutual understanding of what the modelling construct represents. The facilitator can use connections and resource situations to modify the information content that a modelling participant picks up from a modelling construct.

A resource situation: A resource situation stems from the ability of a person to exploit one state of affair in order to convey information about another. By exploiting one fact about reality, we reach another fact. The functionality that is provided by a resource situation can be used in supporting the interpretation of a process model by referring to what is done by a particular person in another activity.

The constraints: The discourse situation, the connections, and the point of referent guides to those constraints that are active to form our understanding of a certain modelling construct. Constraints make up our understanding of cause and effects of a real event and, be it a true or false picture, it will steer our perception of reality. Our understanding of the intended meaning of a modelling construct stems from these constraints. The information that modelling participants gain from a modelling construct is thus dependent on the individual understanding of the constraints that are found behind an activity or an ICOM. If we systematically spell out these constraints we can gain a better overview of why people misunderstand each other while talking about a particular business process.

The theory of situation semantics also accounts for what is described as additional facts: Additional facts support the interpretation of a modelling construct but it is not semantics per se. When an utterance is made to a receiver, we are able to direct the interpretation of an utterance by making gestures and thus what information is going to be picked up. If we use the possibility to highlight certain features in a model, we could reach a similar effect. This could be by changing the colours in a critical part of a process model or by making some modelling construct visible or not in the model.

From what has been presented and discussed in the preceding chapters, we still lack a connection to the process model ProFacil developed during this research project. However, relating the theory of situation semantics to practice is probably on of the more difficult parts in this thesis. Let us suppose that we make this utterance at a modelling seminar using the process model “Manage Facilities” in figure 25.
Such an utterance (φ) seems to be a complete, according to the syntax used in the IDEF0 modelling language but, as will be shown this utterance does not fully describe a situation. The effect of an incomplete interpretation will be a too randomised understanding of the meaning of the utterance, leading to both low efficiency and completeness in the use of the model.

The discourse situation (d), in this utterance is unclear, providing little support in deciding to whom the utterance is directed and who the sender was. Information about budget and business plans are in most cases produced by the management process and usually there is someone in the management responsible for this task. By using a model of a high level of abstraction, neither does it seem possible to anchor the utterance to a person providing this information nor does it seem possible to anchor this utterance to a person receiving the information.

To provide an anchor to the business management activity, we need an utterance explaining who provides the business and budget plan. For example;

(2)  *Arthur Peterson is the person who provides the business plan controlling the activity provide new facilities*

But we also need someone who is the receiver of the business plan and if we add a specific person as the receiver to the utterance, it will be complete in this sense.

Still, there are more elements needed to anchor the discourse situation. We need information about when the utterance was made and we also need information about the location of this utterance e.g. where it take place?

As can be seen from this example, we really lack an anchor for each of these elements in the ProFacil model. These facts are important in order to start unreeling the meaning of the modelling elements and in order to make sure that the interpretation of the utterance made at a modelling seminar is not randomised. If someone takes the ProFacil model and reflects in solitude about the modelling elements, that person will surely encounter problems in establishing a described situation.

How are connections (c), used in the utterance (1): “Business and budget plans controls the activity provide new facilities”? The answer is that there are no connections used in the utterance itself. Since connections are used to steer the interpretation to be the intended one, the missing connections will result in difficulties in creating the intended interpretation, that is, there will be difficulties in establishing a described situation.

During a modelling seminar there is a need to use past or present perceptual experiences to steer the interpretation of the users to be the intended one. In the utterance (1) the knowledge about a business plan can be used to support the interpretation such as a deliberate change towards an increased market share of the office premises held in the suburbs of Stockholm.

A connection can be made to the utterance (1) by referring to a business plan, giving the modelling participants support in their interpretation of meaning of the utterance. Another connection can be made using the fact that there is a budget constraint made in
investments for premises, since no investments made on premises in the suburbs should exceed 15 000 SEK/Sqm. This fact is also passed to the participants.

To further support the interpretation of the meaning of the utterance “Business and budget plans controls the activity provide new facilities”. A connection is made to facilities in the suburb, referring to the standard of the premises not being higher than the condition of the properties “Snödroppen 16”, or “Vitsvansen 21”. By passing these connections, the meaning, of the IDEF0 constraint controlling the activity “Provide new facilities”, can be steered to be the one which is targeted by the person making this utterance.

Another example of the use of connections is if the speaker is referring to an object such as The World Trade Centre, and the well known major disaster in New York. The speaker is using such a connection by uttering,

(3)  The strategy is to avoid all investments in properties having a business risk like the one of the World Trade Centre

By using the connection, ‘The World Trade Centre’, the meaning of an IDEF0 control as “the business and budget plans”, is being unreeled for the users of the model. Such an understanding is not provided in the model but needs to be facilitated to ensure that the intended interpretation of the model is properly understood.

What about the use of resource situations? There are no resource situations available in the model itself since resource situations are created by a person using past situations as a fact in order to describe a new situation, or by using an expression with a fixed meaning passing on information to a person. An example of a resource situation is the following;

(4)  The property which Sara bought yesterday, is for sale today

By making this utterance, a resource situation is used to identify a particular property, namely the property which Sara bought yesterday. The situation described is the activity of buying and selling a specific property at the real estate market, see figure 30.

An example of the use of a resource situation at a modelling seminar could be the facilitator referring to a particular business activity such as the buying of a property or the activity of providing design solutions. What other activities are related to the individual in the resource situation above? As described, a resource situation can be used to describe another situation and the ones we are interested in are the situations describing the activities performed by this individual.

Let us use the utterance in (4) as a resource situation and try to find other activities related to this utterance.

(5)  Sara bought the property yesterday but what activities and tasks did she perform in buying the property?

By establishing a referent to the described situation in (5) we might continue to unreeel other activities performed by this individual. The key needed to unreeel these activities is guided by questions based upon resource situations. Resource situations can provide a structured set of situations where the activities of an individual come in focus and systematically unwind a high level process model into a detailed process model for a specific company.
If we turn to the described situation: what kind of described situations can be gained using the ProFacil model? I do not have an answer to that question and I am not supposed to have one either since the interpretations of a model are highly individual. The interpretation of a modelling element is guided by the constraints possessed by the individual.

However, we can try to do our best and turn to the purpose of the model for some guidance of the situation being described by the model. The purpose of the ProFacil model is defined as to describe situations that relate to; “The buildings end users business process and the activities needed to constantly support this process with operational facilities”.

A potential conflict arises immediately here since the definition of the purpose and viewpoint of a model, according to Marca & McGowan (1983), requires that all questions a model should be able to answer are determined in advance. According to the theory of situation semantics, such a claim is in conflict with the efficiency of natural language and the ability of an utterance to provide for new information, depending on the situation where an expression is used.

However, it should be pointed out that the definition of the purpose and viewpoint in an IDEF0 model is founded on system theory. System theory is not developed at all to account for the efficiency of natural language and how the semantics in a process model is understood while communicated during a modelling seminar. Little seems to be known about this issue, which is surprising, since a lot of money and time is spent upon the modelling of business processes.

In our effort to understand the problems associated with the communication of process models, I believe that there is much to be learned using the theory of situation semantics - making it easier to understand how to handle the flow of information using process models in the context of a communication act.

An IDEF0 model, such as the ProFacil model, has well defined roles for how the modelling language should be used but it does not provide any guidance at all for how the model is understood when communicated using the natural language. As already shown, humans do not understand an utterance, by a singular noun phrase classified as an input, an output, a control or a mechanism connected to a verb phrase such as “Perform or Do any activity”. The act of speaking conveying information is much more complicated and needs in some way to be handled.
8  Case study

A presentation is made in this chapter of the business process re-engineering project UNO at Vattenfall AB in Stockholm. Experiences from Vattenfall AB show that analyses of business processes using generic process models cannot be performed without an active support of facilitators. Most of the modelling experts expressed a keen interest in an explanation and guidelines on how semantics could be understood. They lack a formal explanation today and are managing the interaction with the users informally.

8.1  Vattenfall AB

Specific use of generic process models as an advanced method for supporting the design of new processes was only found in one industrial company in Sweden – Vattenfall AB. The reason for choosing the generic process modelling approach in the UNO project stems from a learning process of enterprise modelling methods used when participating in the Electrical Enterprise Knowledge for Transforming Applications project (ELEKTRA). An evaluation of the ELEKTRA project is presented by Rolland et al (2000). More general information about the ELEKTRA project is found in chapter 1.

The key drive for the ELEKTRA project came when the European commission’s proposed a deregulation of the European energy market. The Swedish energy market was deregulated during 1996. Energy production and sales were opened for competition and all the Swedish utilities had to break up their organisations and form separate companies for energy sales and network operation. The way to succeed with such a transformation is through a process renewal focusing on customer needs, to increase environmental awareness and to develop alternative, renewable power resources.

One of the key success factors in such a challenge is to integrate the human resource (HR) planning process with the business planning process. The development of the work force strategy must relate to the overall business strategy to ensure that at any time, the necessary knowledge, expertise, their mix, and the number of employees are available. This is important in order to fulfil short as well as long term goals decided by the company and described in the business plan. This business strategy is now leading to the development of the HR processes in the UNO project.

The UNO Project

The target set for the ongoing UNO project is to integrate IT support into new business processes at Vattenfall AB. The chosen IT platform is the SAP Enterprise System. The UNO process modelling project involves nearly 30 companies within the Vattenfall Business Group. This project is aiming towards the redesign of the core process plant construction and support processes as the finance, the human resource and the procurement processes. This is the first step towards new business processes within all the Vattenfall group of companies.
During the UNO project only process models are used as separate goal models or ontology’s have not been developed during this project. In the UNO project, the simple flow modelling method, Melan (1992), was found to be sufficient enough to implement the change initiative. The new business processes at Vattenfall are implemented by support of the method “Process development in five steps”, PRO 5 that ensures that the process models are understood and accepted by people in the companies.

8.2 Selection of test persons

During the pre study only Vattenfall AB was found to have the necessary experience of working with generic process models making Vattenfall AB the only company suitable to contribute to the evaluation of the research question. A reason for the scarcity of experiences of these models is probably due to the fact that industry practice has not yet discovered this way of handling large scale change programmes such as the one accomplished in Vattenfall AB. A pauses here, as is shown by the state of art study, companies working with this type of methodology are not small or medium sized companies since the level of competence required is high and costly though the potential benefits seems to be in the same scale.

This case study was performed within the Human Resource Department (HR) in Stockholm during two weeks in June 2001 within the Human Resource Process organisation of the UNO project. The reason for choosing the HR organisation for this case study was due to a key person, working as the process manager at Vattenfall group, who accepted my proposition for a case study on the communication of generic process models. The support from Vattenfall AB has been a crucial factor impacting the succeeding of this research project.

The selections of test persons from Vattenfall AB were not randomly chosen since they were selected from a small team of facilitators. I particularly asked for persons with different backgrounds and if possible a different position as a facilitator. These requests were meet by Vattenfall AB. The facilitators who took an active part in the work with the change programme are also responsible for the implementation of the generic process models discussed in this case study. One person held the position of Process Manager and was responsible for the generic process models being developed and implemented in the HR organisation.

Two of the interviewees have only been involved in the ELEKTRA project producing models and performing facilitation of models during this project. The background and job positions of these two interviewees are as academics, working as researchers at the Department of Computer and System Science at KTH. They provided a balancing standpoint to the answers given by the facilitators at Vattenfall. They are not formally connected to the UNO project but, in my opinion, owning enough knowledge about the facilitation of abstract models through their experiences of the development of generic patterns in the ELEKTRA project.

The group of facilitators consisted of three woman and three men, all having at least a university degree. Two persons had academic backgrounds in economics. Four persons have their background as computer and systems engineers and one of those had a PhD degree in computer and system science. One more person in this last group is working on his PhD degree.
To meet the requirements regarding high competence and skill, people who took part in the change programme had to undergo a trainee programme to become certified facilitators. The facilitators working experiences, managing the change initiatives and the implementation of process models, were of a high standard. Naturally, the academics do not have such a certificate due to their job positions.

8.3 The questionnaire

I did the interviews myself, using open-ended questions supported by an interview guide and I recorded the interviews on tape. The interview guide was formulated to support free discussion and gave the facilitators a feeling of not being steered at all. This was, in my opinion, also the result of the discussion. I could navigate around the essential questions given by the theoretical pattern and ask probing questions in order to be sure that the respondent had enough time to reflect upon the central theme.

Reformulation of a question and putting it forward from another angle was crucial in capturing their understanding. I made sure each person was unaware of my standpoint and what I expected as a valid answer. I did not provide any written questions during the interview but each person received a written transcript and was also asked to read through, comment and to approve the interview and also if possible, to provide more information about the subject matter. The analysis of the proposition is, of course, entirely founded on the recorded material.

The given answers during the interviews were put together to make the facilitators point of view on a particular question as clear as possible and interpreted by me. To make it possible to follow the answers given by a particular person I chosen a simple quantitative approach giving each quotation a letter and a number. The scale I used is “few”, corresponding from one to two persons expressing that view, “most”, corresponding from three to four persons and finally “many”, corresponding from five to six persons.

8.4 Generic versus specific process models

General questions I was interested to learn more about were: how did the facilitators define a generic process model?: was there an explicit and comprehensible definition existing of this abstract term?: How did they themselves reflect upon this term? I was searching for an explanation and an understanding of the properties a process model has when the model is generic. If these properties cannot be spelled out, how can we then make sure that generic process models are going to be understood and used by organisations?

In my own preconception, my belief was that the facilitators should have a clear understanding of the properties held by such a model. At least, this was what I was hoping for, since my own understanding about the issue was growing and the case study at Vattenfall was selected very carefully and represents what I consider as a unique case. In general, people I met with and interviewed had difficulties explaining what a generic process model was, and also in talking about the properties held by a generic process model - these matters often brought the conversation to an end. I expected the answers to be about a generic process model making the transfer of information possible between companies. In my opinion, the property a generic model had was that the abstraction level was higher than a company specific model, which leads to the generic model being
separated from a company specific model. That was how I looked at that the term ‘generic’ while performing the interviews. Today, I know more about these properties by understanding that a generic activity establishes an origin from where a specialisation of related activities can take place.

To investigate the understanding of what kind of properties a model has when the model is generic and to avoid any misunderstanding of the purpose of the interview, I asked the facilitators to make a definition of the term generic. The question was formulated as: “How would you define the term a generic process model?” The answers given during the interviews were as the following:

“I think generic models are – the most obvious answer will be something more generic than specific models. ...it has another abstraction level, in order to exclude all the specific little details that are particular to each application case or to each company. I think generic models are more abstract than the specific application models”. (A1)

“I look upon a generic model as a model which is abstract enough to be used in different settings”. (B1)

“I understand these models as a general frame which can be used as a start during the mapping of a company specific process”. (C1)

“They are more abstract, they are abstract and they have been created because there are something more specific in a particular company”. (D1)

“It is a general, basic thing, the generic. Without any special deviations, basic models. A very basic model or something similar. A generic model is not specific in any way and can be used in many different areas, many different configurations. Very basic, the standard model for a car. The lowest common denominator. (E1).

“A model which is generic is described in such way that it can be understood and used in more than one company, for Swedish circumstances a more broad and general description”. (F1).
Comments

Most interviewees agreed upon a generic model having a high level of abstraction and being useful during a company specific and detailed process mapping. This seem to be broadly in line with what is presented in chapter four and how a generic process model is representing a model being generalised and general, used for the purpose of taking the process modelling session into another state, the detailed and the specialised.

Though there is no clear understanding of the differences between an activity being generalised and an activity being general. This is unsurprising, because there exists a confusion about the meaning of the term generic clearly shown by the people I met during the research.

In general, many facilitators from Vattenfall AB showed a more precise understanding of the term ‘generic’ than the academic parties. This was a surprise to me since the term is frequently used by academics. The last answer points to the property of a generic model being understood and re-used in more than one company, that is, making the transfer of process information possible to more than one company.

As a follow up to the previous question, I asked the facilitators to describe “The difference between a company specific model and a generic model”. This question relates to the previous answers of the properties specific to a generic model. The purpose of my question was to give room for a more specific description of differences existing between these different types of models. The answers were the following;

“A company specific model concerns, for example, the specific staffing of a company” (F2).

“As I see it, the difference between these models is in the abstraction level, a company specific model provides an exact view of how this company works using different flows and steps”. (B2).

“A specific model, gives an adapted, tailor-made model for the company, with names, notation, different ways of doing things, making the process model specific for a company. The language used becomes adapted to a specific company. There is a difference in the abstraction level, often but not always, a model specific for a company can be abstract as well. It has to do with the use of the terms, the symbols which is connected to a particular company. But, of course, it tends to become more specific when we approach the company level”. (E2).

“A company specific model would include probably more information about maybe, I really do not know, ...others probably have a lot of very specific models with some kind of very specific indicators for process performance. Or they have put names for responsible persons who are assigning the process or for certain activity”. (A2)

“In the case of a company specific model, you are using the organizational terms and what need to be changed”. (C2)
Comments

The answers indicated a different function and use for a generic process model. A company specific model seems to include information about activities which are close to an organization by their use of terms which are connected to different roles in the company. Activities described by a company specific model are the activities that are broken down into a workflow, e.g. the tasks being performed by a particular person.

This separation into these different types of models is shown in figure 15. The quotation made by E2 is interesting and important because the facilitator refers to a company specific model being both “general and specialised”, a property which is expressed by the remark; ‘There is a difference in the abstraction level, often but not always, a model specific for a company can be abstract as well’. This is what the model in figure 15 shows and what the facilitator is indicating by her referring to a company specific model as, “a model specific for a company can be abstract as well”.

What is shown in figure 15 is the presence of four different types of process models though the answers made by the facilitators address only three of these. The state-of-the-art study contains process models corresponding to these three types referred to by the facilitators and these type of models are perhaps the ones we deliberately can use during a systematic approach to process modelling. The type not mentioned by the facilitators corresponds to a model which can be derived by studies of detailed process models and such a type of process model is likely to require a considerable effort in extracting a generic process model by using a bundle of specific and detailed process models.

Another question given to the facilitators was: “Do you believe that information about processes could be transferred using generic process models”. This question is relevant because if they do not believe themselves that this modelling approach is worth its salt, why should anyone else care? The answers given by the facilitators were;

“Yes I do think so! But the transformation process is not easy … and you have to put a lot of effort into it. So, absolutely, generic models can be of a great help, but they need to be supported by specific models. You should be able to see where the generic model is coming from, what its the background is, why it is generic in this way, who made it, why did they do it this way, and so on. That kind of information is needed, otherwise I feel they are a little bit, kind of naked, on the sense they are, maybe not very explanatory. You have to provide for supporting information”. (A3)

“Unfortunately not I am afraid, I believe they are a good support, but it requires people who can transfer these pictures I have been talking about, taking these pictures down to a level where people understand them, that is what this concept is resting on”. (B3).

“Yes, that is the easiest way to transfer information. The models should not be too specific because in that case you will not recognise yourself in the model”. (E3)

“Yes, I do believe that is a good way to do it. Pictures, even complex ones, illustrate better than text. Text, which is used to transfer the information found in
a picture, will require a larger effort to assemble and tends to be incomprehensible”. (F3)

“Yes I do, if the models we used are what you refer to as ‘generic’”. (C3).

Comments

There seems to exist consensus about generic process models being useful when transferring information concerning processes, though a problem clearly expressed is the information transfer which is not very easily established. The facilitators are talking about the difficulties in succeeding with the transfer of process information using generic process models to people. This was also our own experience during the development of the ProFacil model leading to the formulation of this research question.

Another question given to the facilitators was “What happens when a generic process model is presented at a modelling seminar”? Interesting to know more about was the reaction from people when they were working with a generic process model. We had experienced problems when showing the generic process models ProFacil to people met within the companies and during PhD modelling seminars. What insights could these facilitators contribute with? The following are the answers given by the facilitators;

“It is not easy to interpret what happens. We have really put in a lot of effort into the work with explaining the models. We have put the models on a wall, and gone through the models step by step, since guidance is required because the models are rather theoretic. I would not leave people alone with a file of models and believe that they could understand the models on their own”. (F4).

“This is the largest shortcoming in this approach. It is not enough to hand over the models and say – ‘please, go and do some modelling’ and it is not enough saying – ‘This is how you are supposed to use the model’. That will not work, what is missing is a method.” (D2)

“I do not think you can do it. Because in a modeling session you have to steer the creative process. And if you frame them with a certain solution then they may refuse this solution, and then you are stuck with this solution. I would be very reluctant to do so, put up an existing solution to a problem and say – “OK guys – here it is, let us try to do something about it.” It would be quite difficult. If you want to re-use something in a modeling session, I think you will have to go through some kind of a walk through, going into the background of the model and so on. So I do not really think, that it is good reusing existing models which are not their own models. For example, you can probably reuse Vattenfall models in Vattenfall, not now because it is quite a long time past and people do not feel that they own the models any more. But you can not bring a strange model into a modeling session and say “here is a model, let us use it”. One of the main problems is that the modelling group must feel that they own the model. And they would not feel about a model that comes from a book, a CD, or a website.
They would not feel that way about that kind of model. I think that if they are experienced they would probably try to reject it. If they are inexperienced, they would try to accept it but they would feel uncomfortable about it. There are two ways then, they would probably somehow get out of it, or they would, sort of, accept it and then the result would not be very good. Then you will have problem of implementing it because the group would not feel responsibility for it. They will say “Oh, that guy brought in this model, and we do not feel about it, but well he brought it up so we accepted it. I think the acceptance is the main problem”.

(A4).

“At first sight people feel faint when they study a map being 3.5 times 1.5 metres. I believe that you need to go through the model step by step guided by someone who can explain the model, by doing so you will understand the idea and why the model is made as it is and how all the symbols relate to each other and the meaning of the symbols. By doing so you gain a connection to your own business, and get a feeling ahaa, that is the meaning of that little box where I am working doing whatever I do. (E4).

“‘What usually happens when I go to a company where people have participated in the modelling of processes is that those people are readily enthusiastic about this way of working with organisational change’. People who did not take part in the modelling sessions are normally suspicious and believe that these models really do not cover everything and they are naturally critical to something not seen before. People who participated in the modelling of generic process models accept these models much faster compared with people who did not participate during the development”. (C4)

“If the model is put forward to a group of five people without being facilitated, I do not think there will be very much activity, unless these people are very enthusiastic about this field. If they are enthusiastic they maybe start to redraw the model and try to understand what it means and then they redraw it. It is easy to get consensus on the model, because people do not go very deeply into it. One of the reason for people not being very enthusiastic is the feeling of not having an influence on the model, if the model is open for discussion, then there will be a long discussion about every box and their relations and the reasons behind the model”. (B4).

When given a probe about the modelling participants’ reaction to a generic model, the answer above was extended to the following: “If the facilitator is very enthusiastic about the model and stimulates a discussion and triggers thoughts, you can have a discussion about the model, but if you merely put the model on the table, ...then it will be more fun to drink a cup of coffee”. (B5).

Comments

Many of the facilitators feel that people should not be left alone with a generic process model without providing an explanation made by a person having knowledge in the background of the model. Most of the facilitators seem to agree directly and indirectly that the acceptance of a generic model is the critical part in re-using such a model. If these
models are not accepted by the organisation as models being made by the organisation this will only lower the motivation during the implementation phases. To succeed with the implementation, some kind of method is needed to ensure that the model is accepted and understood.

Fairly clear is the danger of the lack of motivation and enthusiasm if these models are forced upon the organisation as a solution or as a suggestion to new business processes. There do not seem to be any short cuts to a successful implementation and re-use of process models - people have to be engaged in the development and feel responsible for the models. An open atmosphere and a method guiding the use of the models seem to be key success factors for companies. Although the models used in the UNO project have not really been open for a discussion, they have been accepted by the companies within the Vattenfall group. The acceptance is probably due to the fact that these models have been developed by Vattenfall AB and are not brought to Vattenfall AB by any external company.

What can be questioned by these results is the belief that we can create a library of generic process models free for use by companies which are granted access to such a library instead of directly engaging with people in the organisation in developing their own models. Is this really the case?

No, I do not believe there is a problem in using such a library; instead the problem is how to make people engaged in the change process. I believe that if everyone is knowledgeable in the procedure of using these models and what separates a company specific process model from being a generic process model, we can use these models. But, the facilitation of the understanding of these models is of crucial importance in succeeding with the re-use and the implementation of new business processes.

If I refer to the problems I met during the development of the ProFacil model, these can be partly addressed by the lack of engagement and enthusiasm of the people in the organisations I met with. The development of the ProFacil model started as part of the research work done in the MoPo project, and continued with meetings with companies engaged in the verification of the model. These companies had no ongoing process modelling schedules within their organisation, leaving little room for people to feel engaged in the development of the model.
8.5 Interaction with empirical data

The purpose of the case study is both to render a plausibility probe, e.g. a weak test of the theory of Situation Semantics, and to learn more about how generic process models were handled by facilitators at Vattenfall AB working with reengineering of business processes.

The interviews were done by using open-ended questions, gave each respondent the freedom to express and reflect upon his or her answers to a question. The consequence of using an open-ended interview technique lead to each of the patterns being unconfirmed by all of the facilitators. Taken together, the answers given by the facilitators still confirmed the research proposition.

8.5.1 Introduction

As an answer to the question if knowledge about the semantics is important for the organisation, using generic process models, one of the facilitators in the case study replied;

“Yes, because our purpose is to describe generic processes which are going to be re-used and these processes will effect the way people are working in this organisation. It is important to know how people can assimilate the models that are produced. If it is shown that this approach is not very easy to comprehend, we have to consider that. Otherwise we will engage in an effort which produce information of limited value”. (F 5)

The facilitators at Vattenfall AB, using generic process models, seem to manage the interaction with modelling participants, and somehow explaining the meaning of the model. So, what do the facilitators know when they know how to facilitate a generic process model? Can an explicit understanding of the semantics ease the interaction with modelling participants? Clearly, the semantics seems to be of importance in succeeding with re-engineering business processes using generic process models. However, the problem is that little is known about the semantics in these models, specially concerning the communication during a modelling session.

As has been shown by the answers above, the facilitation of a generic process model is troublesome. A question was given to a facilitator seeking his knowledge about this matter;
Do you have any idea about how modelling participants gain their understanding of the meaning of a generic process model?

“I do not know. The question of the meaning of the model may not be in the model itself. Somebody has to write that meaning down somewhere, if it is not written down it may be lost – and the model will be useless”. (A 5).

This answer can illustrate the complexity of this task. Though, so far we do not know if the theory of situation semantics provides any understanding of how a modelling participant gains an understanding and what the facilitators do when they manage in explaining a generic process model.

According to the answer of the facilitator, he has experienced that the information may not be in the model itself. This statement is in accordance with the theory of situation semantics, since information from verb and nouns is gained by making an interpretation of a described situation.

Asking a question, as to whether the semantics in generic models was also of a research interest during the ELEKTRA project, one of the two academics replied;

“No, nothing was done. The problem was the schedule, we could not do it due to the closing of the project and us running out money. It could have been the most interesting to do, but we never reached so far”. (D 3)

Asking a probe, I gave the facilitator room to expand his statement; Why do you think it would have been more interesting?

“Because that is what really matters. I do not think that it is the creation of models, instead it is what you said, the understanding of the models that matters…often we spend too much time making the model symmetric and looking nice”. (D 4)

Another probe was made, giving the facilitator the possibility of changing his statement by saying; But do you think that this is an important aspect, understanding how people comprehend the content of a model?

“Yes, but in the same time this is the most difficult part, and there is probably an answer to why most time is spent upon structure and symmetry, because it is the easiest part”. (D 5)

What I believe can be learned from these answers is the importance of the semantics, when we engage in process modelling. The research question and the research proposition set up to investigate how semantics is retained in process models is shown below:

My formulation of the research question was the following

How can semantics in generic process models be handled to ease the re-use of these models?
Making the following proposition

The re-use of a generic process model depends on the model conveying the intended meaning of modelling elements to its users and if the users can use the model for their purpose when the content of the model is understood.

In the next part, the answers given by the facilitators, are presented and evaluated by linking these answers to the theoretical pattern formulated to evaluate the proposition made for the research.

8.5.2 Relating the interviews to the theory of situation semantics

In this chapter, the theoretical patterns set up for the research proposition are analysed using the results from the interviews. Before the answers are presented, a short summing-up is made of the theoretical element, being evaluated by using the answers from the facilitators.

(1) “To re-use a generic process model, we have to make the discourse situation known to the recipients of a model”.

The discourse situation is said to be the public part of an utterance by involving, those who perform the activity, what is done by the activity, when the activity is performed and where and to whom the result are passed. The public part of an utterance is established by referring to an individual, an object, and to a location, we are able to establish a referring situation and such a situation where there is a unique way of anchoring these roles to an individual, is called a discourse situation. There is a need to anchor the discourse situation in order to understand what is the intended meaning of a modelling element.

Do the facilitators refer to a discourse situation while they are making the modelling participants understand the content of a generic process model? The following answers were given by some of the facilitators:

“When we are describing a generic process model we are describing roles as human resource specialists, competence specialists, and so on, it is roles which can be used within each company. When we are entering a company and facilitate a generic model to become a specific process model for a particular company, we will put a name instead of the role, this individual is doing these specific tasks. By using a generic model we are able to describe what is done on the company level and what is done at a division level. We are using the company specific model to describe what is done by a division or by a specific company. Furthermore, a specific activity can be decomposed into details to describe what is really done in a particular company”: (F6)

In order to try to find out more about the importance of roles in a discourse situation, a probe was made by asking: Do the roles contribute in clarifying the content of the model?

“Yes and no! The roles helps to relate to what is important or less important, how often something is done, how I am connected to this activity and so on. In our education material we have decided not to bring the roles into the models
because we are starting the description on an easy level. “This is done and the next to be done is this”. This might be contradictory, but you need to do it step by step”. (F7)

A new probe was made to discover what would happen if the role was removed from the discourse situation; “If we increase the abstraction level in the model and move away from the description of a company specific process. How will the interpretation of the model be affected if we remove the roles”?

“As I described earlier, one of the main changes in the way of working is the managers become more active in the work. If you remove the role by making the model abstract, the model will be so generic that it will make people say “what is the new with this”, or “what is specific about this”? (F8).

To give the facilitator the possibility of modifying her statements, a summary was made about them and a claim was made about the effect of a discourse situation; ‘If you take away the roles and make the model abstract, the understanding of the model decreases, making it difficult to understand the meaning of the model. Would you say that you anchor the meaning of the model when you decrease the abstraction level and make the individual visible in the model’.

“Yes that’s true, because it makes it possible for you to ask counter questions in another way. The details make it possible for you to feel if this is something I would like to be a part of or not”. (F9)

Is the discourse situation important and does the facilitator talk about these elements? Yes, these answers reflect each of the elements in a discourse situation by talking about roles “as human resource specialists, competence specialists, and so on”. What is done and where the activity is performed are referred to by saying, “what is done at company level and what is done at division level”. When the activity is done it is referred to by “how often something is done”; and to whom the result is passed is referred to by saying “how am I connected to this activity and so on”.

Another answer given by a facilitator reflects the importance of the role in starting a discussion about what is going on in a business process. The question asked was how a modelling participant gains an understanding of a generic process model.

“When abstract models are shown to the participants in a modelling seminar, their reaction will in principle be; is that so, you don’t say, lets move on! The models do not provide a solid background for people asking questions about what is being described by the model. It is only when you enter the specific level, presenting the roles and connecting each individual to a specific role, that a discussion takes place”. (C 5)

The answer made by the facilitator shows the importance of settling a described situation. A generic process model is made understandable by establishing a discourse situation, reflected at a company specific level. If these elements are missing in the model, the facilitators have to provide these elements in order for people to start unwinding the meaning of the model.
“To re-use a generic process model, we have to make connections and the point of referent known to the recipients of a model”.

The situation theory uses connections and the point of the referent as a mechanism to modify the information being picked up by the receiver of an utterance. In general, a speaker exploits past and present perceptual experiences, connections to objects, properties, places and times by referring to them. The information content in a sentence can be modified depending on how the speaker uses these connections and on the particular relation held by the speaker to the referents.

Do the facilitators refer to connections and the point of the referent while they are helping the modelling participants to understand a generic process model? The following answers were given by some of the facilitators:

“We have produced information material using PowerPoint slides, showing what is done in different processes. As an example, in the competence planning process, were we say “translate business plan”, and provide information about who is doing this, as the manager for competence planning and the steering group. We have made a picture using a group of people standing and writing on a board – providing a clearer understanding of what is done in this process”. (F10)

The facilitator is talking about establishing a connection by using a slide showing people in action doing a business plan. She is aware that by doing so, the understanding of what is done in this particular process is being made clear to the receivers. She provides information about who is doing this activity as “the manager for competence planning and the steering group”, making a connection to these objects, e.g. the people in this particular business function.

One of the facilitators gave another view of a connection during the interview as a response to his talking about the importance of using mental pictures while gaining an understanding of a whole situation.

“You are telling a story describing a situation, and putting this story into some sort of perspective. By doing so, you are gaining an understanding, making sure that the model is not some kind of theoretical product hanging on a wall. You can discover that this is done and this is the context; that this is my part and that, this will be done by someone else. To reach an understanding of a whole situation, you need to create a picture in the head of the modelling participants. They will not do that by themselves, by using the model and I believe that somebody has to convey an idea of how everything fits together”.

“I believe that this is needed in order to find out your part of the whole situation; often, when you discover how you become a part of a situation, you can start to relate and understand how all the other pieces hang together. This is just my spontaneous belief, if I turn to myself, if someone is about to change my way of working and introduce a new information system and new working procedures. I would like to know what I will have to do and this will be done at the economics department, and they are doing this at the HR department and this is the responsibility of my chief. This will be done at the start and this is done later on. This is a glimpse of how I look at the way it could work but it will also depend on the target group, the different kinds of
By telling a story, the facilitator is the referent, explaining something being experienced by the facilitator himself. He is helping the recipients to understand what is done by these activities and their particular role in the process by referring to another situation.
“To re-use a generic process model, different resource situations are being used by the facilitators”.

A third form of efficiency is called a resource situation and stems from a speaker’s ability to exploit one state of affairs in order to convey information about another. A resource situation is based upon a fact about a particular situation involving a particular object, such as a person, in a particular location doing something. By identifying a particular person in a situation, this object can be used to describe another situation.

Do the facilitators refer to resource situations while they are facilitating a generic process model? The following answers were given by one of the facilitators:

“How do we interpret a model? By going through the processes, a walk through, and relating to what you are doing in your daily work, then you reach an understanding of the process step by step. For example, what is modelled here, does what happens when Kalle enters my room in the morning, throwing a sheaf of paper on my desk, lead me do these tasks”. (E5).

In this case, the facilitators use an example to describe what happens in a particular process. The statement describes what happens when Kalle enters the facilitator’s room in the morning. The facilitator is provided with the results of Kalle’s efforts, which happens when he throws a sheaf of paper on her desk, which leads to the start of a new activity. This is a use of a resource situation, since Kalle is used to describe another situation, the situation were the facilitator is performing a new activity in the process.

The facilitator continues to describe what modelling participants are doing when they start to understand the content of a generic process model, by saying;

“It is, in fact, fun to see how people working in these activities we are talking about become very active when they come further down in the model. This activates people very much, the cross-fertilization between people who are working further down in the process and those who work in the beginning of the process. They say for example, “If you had done that in time, there would not have been any problems for me”. These discoveries create a stimulating discussion among people”. (E6)

By providing this example, the facilitator is describing how modelling participants discuss the model by using a particular person in a particular activity doing something and relates this fact as a resource situation to describe what happens in another part of the process, the one where the speaker is working.

Resource situations seem to play an important part while describing what happens in a process. They activate people and trigger participation, due to their ability to re-use facts about something being done.
“To re-use a generic process model, the recipient interprets a process model as a collection of described situations”.

As already described above, the linguistic meaning of an utterance is formally denoted by the relation \( d, c \ V \| \varphi \| e \) and the interpretation is a collection of described situations (e), such that the discourse situation (d), the connections (c), and the utterance (\( \varphi \)), are related to the described situation (e). The interpretation of an utterance or a modelling element is fulfilled if the recipient is able to re-create a collection of described situation (e) to understand the meaning of the utterance (\( \varphi \)).

Do the facilitators refer to described situations while they are talking about how modelling participants are interpreting a generic process model? The following answers were given by some of the facilitators:

“I believe you relate the model to the reality you know about”.

A probe was given to expand the utterance given by the facilitator; in your opinion, what would the reason be for doing so?

“It will be easier for you to put a picture in your own head, to have a hook to hang it to. If you are familiar with how a process is performed you will have something to relate to. If this is not the case, it will be insufficient to have only a written text to explain what should be done and how. You need to experience it as well. You are using several senses as a human, and if you haven’t done this before, than you will only have the text. You need to know, to be able to think – is this OK or not. How will this affect me? Somehow you need to find out, what are you doing with this, what do you really do when this happens in reality? In this case you need to explain it in different ways”. (F11).

As the verbs in a process model are courses of events, describing what is done in a particular activity, the facilitator is referring to what is taking place in a process. According to the theory of situation semantics, we pick up the meaning of an utterance, or in this case the verb and the noun depicting the activity and ICOMs, by making an interpretation of a described situation. To be able to recognize a situation, we need the experience of it as well. Barwise and Perry give the example of smoke coming out from a house as a sign of fire. If we have not experienced fire and do not recognize smoke as a sign of fire, we would be unable to pick up the information that a house might be on fire. The facilitator is referring to a described situation by saying that she believes that the modelling participants interpret the model by having different pictures created in their heads.

While talking about models and the need to support the interpretation, one of the facilitators said:

“Absolutely, you need to have some kind of background information, some kind of anchoring. Of course, another thing that we found in the ELEKTRA project was – if you have a model on its own, then the value of the model is less than if you have a model related to other models. So, the more you see them in perspective, the better value you can get out of it. If you have a small model or even a big model which are standing alone, then it is difficult to
appreciate it. If you have a number of them somehow linked and you see, OK, this is linked to that, and that is part of this, and they are all part of that, and all these are because of that and that. And you can see a larger picture of them, then you can try to reason about each of them and you see the bigger picture. Then you can understand each of them much better rather than just seeing a certain piece. You always need to have a bigger picture around them” (A6).

By making this statement, the facilitator is referring to different models being able to create a bigger picture of the reality being described by the models. A described situation is our knowledge about how the world is made up and we refer to these situations while making an analysis of what is being described by the utterance. If I relate the answer made by the facilitator to the theory of situation semantics, I would say that he is referring to a set of described situations provided to the interpreter by a set of models. These different models makes it easier for him to pick up information about the reality being described by these models.
Constraints are what allow one situation to contain information about another. The interpretations a modelling participant or a facilitator make out of a modelling constructs will be effected by his understanding of a set of constraints. In the theory of situation semantics, it is the attunement to constraints that makes life possible and we systematically act according to our understanding of how a constraint affects the world around us, providing the basis for flow of information, Devlin (1991).

Do the facilitators refer to constraints while they are talking about how modelling participants are interpreting a generic process model? The following answers were given by some of the facilitators:

“During the ELEKTRA project we had a focus on producing models. We did not pay so much attention on implementing the models. What really needs to be considered, while focusing on understanding, becomes clear when entering the implementation of models, and meeting with the people who did not themselves participate in the creation of models. What we discovered in the ELEKTRA project was that the models were not easy to comprehend even if you had participated in their creation. We made the models in groups and only some of us did the documentation. The ones responsible for the finishing of the models presented the result for the whole group. I wouldn’t say that it always was easy to comprehend the resulting models, even if you participated in the actual modelling work. We discovered an important lesson. It is very important when you document a model, that you stand close to the formulations and thoughts made by the modelling participants”. (F12).

A facilitator was asked to reflect upon the problems created by people interpreting a model. The answer was the following:

“What are the main problems in interpreting models? One is, misunderstanding. You do not have the same background, and then you are not able to understand the methods and the kind of semantics and notations and everything. If you are not experienced in models, your eye is not trained to understand them. For example, if people are trained in different flows they always think that bold arrows are some kind of flows. So if you look at goal model the arrows are not really flows, they are just indicating which goals are supporting others and which are contradicting with others. Inexperienced people would think that these are flows and they will understand something completely different. If you look at concept models, then, object oriented person would see all the concepts as classes. Business concepts are basically
anything that can be; it is not necessarily class or something that you store in your database. So I think these kind of misunderstanding usually go wrong. If you look at the model which is not your own, you may say “Oh, yeah, it look good”. But if you have to use it, then you may not feel responsible for it, you may not feel that it is yours and therefore you may feel that it is somehow pushing something else on you. I think these are the main misunderstandings”. (A7).

Asking a probe, the facilitator replied;

“...That is one of the problems with this pattern movement that we have just proven to be useful in object orientation. We try to do use some of these principles in business patterns, but we tend to forget the community is different. The people who use and the people who made the patterns are different. It is not exactly the same...”. (A8).

The facilitator is referring to background and experiences as the main source for misunderstanding a model. He has experienced how different communities have their own constraints guiding to a specific interpretation of a modelling construct, as the shape of an arrow or the flows depicted between objects. These different shapes are given a certain interpretation depending on their specific function in a model. It is fairly clear, however, that there are some factors which make these different interpretations possible. The theory of situation semantics provides a system of constraints making up these interpretations. From the answers given by these facilitators, the existence of such constraints as theoretic elements may have caused these misunderstandings.
9. Conclusions and recommendations

9.1 Final conclusions

This licentiate thesis is about generic process models. Generic process models are models of a business process at a high level of abstraction that are used to support the analysis of processes. These models have a special property, namely to establish the base for a specialisation of a particular process into business activities and their tasks by establishing the origin of an activity. During the research, this property was defined as the ability to separate and to establish an origin, a common point of reference from where specialisation can take place.

As the pre study indicates, a driving force behind process initiatives is increased competition among companies. To stay competitive there is a need to manage how to document and improve processes and work flows. A generic process model is such a tool as it allows companies to increase their ability to compete. The establishment of generic processes and the creation of generic models are costly ventures and also time consuming and were definite factors in motivating my research into these problems.

The development of the generic process model, ProFacil, indicated clear difficulties in the communication of these models. A recurring phenomenon seems to be the problem of recognising the simplified reality being described by the model. This resulted in difficulties in having the model understood and accepted in achieving a desired re-use of the model. My research question was formulated to investigate and contribute with an idea of how semantics could be handled in generic process models to ease the re-use of these models. The ProFacil model has primarily been used to investigate problems that are general by nature, such as the difficulty of managing the communication of generic process models.

The case study at Vattenfall had two purposes: first, to clarify experiences in using generic process models and secondly, to make a plausibility probe using the theory of situation semantics. The reason for choosing Vattenfall AB was their considerable experiences of using generic process models to achieve a re-engineering of their business processes. The objective of making a plausibility probe using the theory of situation semantics was to render insights into how generic process models could be handled by facilitators. The theory of situation semantics had not been used before in providing an understanding of how to support the communication of generic process models.

The case study shows that generic process models are useful and that those participating also believe that this approach to change is useful. However, there exist drawbacks in this approach. The results do not come easily since the effort in managing the communication of generic process models is not at all a simple task. The case study strongly indicates that these models have to be actively facilitated in order to become re-used. The understanding of the content of these models needs to be transferred from one person to another, otherwise the desired re-use tends to be seriously negatively effected.
Another problem to overcome is how to motivate personnel to accept a model not made by them.

In evaluating the results from the theoretical part of the case study, I have considered them as a whole, and, taken together, the answers given by the facilitators confirmed the research proposition. The interviews with the facilitators were done by using open-ended questions so that each respondent had the freedom to express and reflect upon his or her answers of a question. As a consequence of using an open-ended interview technique, it was found that each of the patterns was not in fact confirmed by all of the facilitators. This was a surprise to me but this fact is probably what can be expected in view of this research approach.

In my opinion, the case study evidence confirmed the research proposition and this is a fair conclusion since the team of facilitators can be viewed as a totality due to their similar working experiences. Even though those participating in this study are not identical, they share approximately the same knowledge and experiences of facilitating models. It is probably that, had the group been extended, the result would probably be the same.

The consequence of confirming both the case study evidence, and the proposition is the confirmation also of the definitions made for efficiency and completeness in enterprise models. These definitions are quite difficult for practitioners to understand and apply. However, this case study makes it possible to appreciate better the mechanisms behind these definitions, and it also endeavours to introduce the knowledge gained from the theory of situation semantics which supports the interaction with modelling participants.

Through this research, a new set of theoretical elements has been introduced into process modelling: the discourse situation, connections, resource situations, the described situation and constraints. This research has provided us with new knowledge in how facilitators can improve the communication of generic process models using these theoretical elements.
9.1 Recommendations to the implementation project FI2002

During the interview, one of the facilitators summarised why Vattenfall AB put much effort in training people in how to facilitate process models.

“The reason why we have chosen this approach is because some persons responsible for the development of the models, will in time leave the organisation. We will educate the people succeeding us, making sure that they have an understanding close to ours. They will then be prepared to facilitate these models in different companies. If we had sent these models, and someone doing the facilitating who have not been trained by us, it could have ended in any way. I believe if you do so, you are capable to interpret the models in any way, and in that case there is no meaning in using such an approach. You will not be able to send your message. People will only wonder why the model look as it does. But choosing this approach there is someone who can explain the content of these models”. (B7).

I recommend the project FI2002 and companies working in the FM sector ask for people trained in these process models, produced by the project FI2002. Considerable efforts and resources have been invested in producing these models and there exists one company in Sweden that has succeeded in implementing a change approach using this concept of change. If there are difficulties in knowing how to facilitate these models, there are some useful insights provided by this licentiate thesis.
9.2 Future research

It would be beneficial for the industry to direct its interest towards what been accomplished by British Airport Authorities (BAA). BAA has collaborated with the University of Salford, UK and has developed an impressing body of knowledge on the implementation of reference process models into their business operations. I strongly recommend that such a research project be conducted in Sweden to support a transfer of knowledge between the construction industry in UK and the Swedish building and construction industry. Such findings would be useful for companies, because the development of processes and process management involves all functions in a company and not only the procurement of the product itself.

To benefit from the findings in this research project I recommend research by developing a prototype that implement the theoretical constructs from the theory of situation semantics. This research has provided support to motivate such a research project. Soon IT tool makers will implement various generic process models into their tool kits, though they will still face the same problems which has been discussed at length in this thesis. To avoid failures and increase the likelihood that analysis of business processes is a successful venture we could benefit from supporting the communication of generic process models by using the insights given by theory of situation semantics.

An interesting academic aspect is that computer linguistics as a specific topic has existed for many years, but what about process related semantics? It seems appropriate and tempting to extend this domain and include such a subject as business related information logic, in the research area of mathematical linguistics. Research concerning situation semantics and how constraints effects the flow of information has been made by Devlin (1998). This research was done within the research project “Business Applications of Situation Theory” (BAST) at the CSLI Research Institute at Stanford. One of the leading experts is Robin Cooper, who has the chair as professor in computational linguistics, at the department of Linguistics, Göteborg University, Sweden. Future research in this subject could be carried out in Sweden.
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Paper one

Model Based Business Development – A case study of the communication of generic process models

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Published in Nordic Journal of Surveying and Real Estate Research
1 (2), 2004, 190-204
A model integrating the facilities management process with the building end user’s business process (ProFacil)

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Abstract. The ProFacil model is a generic process model defined as a framework model showing the links between the facilities management process and the building end user’s business process. The purpose of using the model is to support more detailed process modelling. The model has been developed using the IDEF0 modelling method.

The ProFacil model describes business activities from the generalized point of view as management-, support-, and core processes and their relations. The model defines basic activities in the provision of a facility. Examples of these activities are “operate facilities”, “provide new facilities”, “provide re-build facilities”, “provide maintained facilities” and “perform dispose of facilities”. These are all generic activities providing a basis for a further specialisation of company specific FM activities and their tasks.

A facilitator can establish a specialized process model using the ProFacil model and interacting with company experts to describe their company’s specific processes. These modelling seminars or interviews will be done in an informal way, supported by the high-level process model as a common reference.

Key words: Process model, Facilities Management, Construction

1 Introduction

Although process modelling using computer-supported tools is a relatively new phenomenon in the facilities management and construction industry, companies and trade associations have made definitions of the construction process or its parts for many decades using less formalised methods. These definitions have for instance served the internal needs of companies for rationalising their working methods, the needs of the construction industry for standardised principles for setting fees as well as the needs of society or the clients for quality control. Often such models have taken the form of checklists of activities published by trade associations.
An important conclusion from studying earlier efforts is that construction process modelling can be done on many different levels, ranging from the overall life-cycle of a building, thus spanning decades, down to the technical details of how to install different types of building components. The motives and views of the models differ considerably from one level to the other. On certain levels the central motive for modelling may be establishing the borders between the activities of the different companies that take part in the construction process, as well as defining the flows of products, materials, information and money that occur at the interfaces. On other, more detailed levels, the exact sequence of activities needed for some technical task may be modelled, in order to increase job safety, minimise the risk of defects or even to provide information support for the development of automation and robotisation equipment.

2 Earlier work

During the last couple of decades the need for more formalised models as well as better (in practice computer-aided) modelling methods has steadily increased. The proliferation of integrated CAD, document management systems and the Internet make it difficult for the different participants in construction projects to co-operate efficiently unless the data creation and exchange process is well known and agreed to. At the same time there is increasing commercial pressure as well as legislation which force companies to define their processes as a part of defining quality systems. Many companies striving for competitive edge, for instance in utilising the possibilities offered by IT, have launched business process reengineering efforts where process modelling has a prominent role.

Important earlier attempts to define formalised construction process models include the IBPM from Pennsylvania State University (Sanvido et al. 1990), VTT’s model of the Finnish Construction Process (Karhu and Lahdenperä 1999), and the Generic Process Protocol (Aouad et al. 1994). Each of these efforts has had a slightly different focus. Both the IBPM and the Process Protocol work have tried to define normative models which try to illustrate to industry how it should work in order to become more efficient. VTT’s model is closer to current practice and tries to define it more precisely using formal modelling tools, in order to facilitate communication about the process.

In the multinational MoPo (Models for the construction process) project the aims were not so much to build a comprehensive normative model of how the researchers think the process should work, as to create new computer-aided tools and modelling methods that would allow companies to build models for themselves, both describing their current way of working and possible reengineered processes. The project has resulted in one doctoral [Karhu 2000] and two licentiate theses (Berg von Linde 2001; Lundgren 2002), looking at different aspects of process modelling in the FM and construction setting.

The different process modelling methods and/or resulting models can be categorized as follows (Karstila et al. 2000):
Generic process description methods, which typically are generic and not specifically developed for construction process modelling. Examples of this category are the IDEF0-method (NIST 1993), PetriNets, various kinds of flow charting or data flow methods. These methods are often based on a very limited set of concepts that have corresponding graphical symbols for developing models, which are represented and presented as graphical diagrams.

Construction process activity or functional models. These models have been typically developed for a specific purpose with a specific viewpoint, using e.g. one of the above mentioned generic process modelling methods, such as the IDEF0 modelling method.

Construction process information models, for instance formalised using the EXPRESS data specification language, which describe and represent various objects, their attributes and relationships.

Simulation models for construction tasks, which describe the dynamic aspects of some construction subprocesses (i.e. mechanical engineering), or tasks of construction work, like earth moving of crane lifting. The goal of the simulation is to analyse the performance of the process as well as the impacts of process disturbances on the queuing and performance.

3 The need for generic framework models
According to Davenport (1993), the design of new business processes should start with a high-level business model, which engages both the senior and the middle management. The purpose is to avoid a too detailed description of processes in the initial creative stage, because a detailed model will only lower the motivation of the management team. Rentzhog [1998], discuss a core process model as a tool to communicate a shared view of a company’s core processes on a high level of abstraction.

Davenport also points out that the information engineering approach which includes phases like system planning, business area analysis, system design and construction, should not be a method used for process innovation. The innovation or modification of business processes should be done in the strategic context and together with the senior management in the company. Too strong focus on tools and techniques can be counterproductive and stand in the way of achieving the desired change of processes. Communication at each stage within the company is essential and a prerequisite to reach commitment of people to adopt a new business process.

A key object in using generic process models is to facilitate the analysis of a particular business process in depth and to learn about the dependencies in the process. These models are used as references when making analysis of business processes, thus being used to describe existing processes or to formalise a description of a not yet existing business process. In order to establish a modular set of partial re-usable sub-models a framework model on a high level of abstraction is needed.
In the following a proposed generic model of the facilities management
process (ProFacil) is presented. The focus of the model is to define the relationships
between the building end user’s business process and the activities needed to
constantly supply this process with operational facilities. The model in particular
sees FM as only one of a number of supporting activities that all businesses
need (in line with the primary value chain and supporting activities proposed by
Porter (1980)). The model is generic in the sense that it models activities which
are always present, although they may be performed by different parties under
different contractual arrangements, and although the degree of formalisation may
vary. Large public FM and building organisation often have quite formalised
procedures for the processes depicted in this model, whereas one-off construction
clients often lack such procedures.

4 The functional modelling method
The Structured Analysis and Design Technique, SADT for short, is a modelling
methodology that was originally developed to describe a system and its
environment, for example before making specifications for information systems,
planning and coordinating large projects, describing shop-floor operations,
designing telecommunication networks, or explaining how something is worked
out by using a transformation perspective.

The Integration Definition language 0 for Function Modelling (IDEF0)
is a subset of this methodology and one out of a number of available process
modelling languages for technical process descriptions (NIST 1993). IDEF0
has recently been quite popular in construction process modelling efforts and is
regularly used in product modelling for describing the processes in which product
data is defined and exchanged.

By using IDEF0 it is possible to the reveal the purpose of a particular
activity. An IDEF0 model has boxes and arrows. The boxes represent activities
that take place in a process and these boxes are interrelated and may be arranged
in a hierarchical decomposition. Arrows connect boxes together and represent
interfaces between boxes. An arrow represents a collection of things, which can
be plans, machines or information of any kind, which can be present in one and
the same arrow and specified in a lower level diagram.

An activity uses some input and transforms these inputs into outputs by use
of machines or people in the organisation. The resources that an activity needs to
transform inputs into outputs are named mechanisms. Controls constrain these
activities by specifying which conditions actually are regulating the performance
of an activity. (Figure 1.)

An activity is described by using a verb phrase and an arrow is named by
using a noun. We can use the following phrase to remind us of about how the
IDEF0 method works: “Under control, inputs are transformed into outputs by
mechanisms” (Marca and McGowan 1988).
The IDEF0 methodology may seem complicated at the first glimpse, due to the effect of controls and mechanisms. However, this is more of an educational problem to understand how the method is used and what each arrow means in a process model.

IDEF0 uses a top down approach that encourages a holistic approach. A process can be analysed as a hierarchical set of interrelated activities, where the diagrams at the top of the model are less detailed than those at the bottom. Figure 2 shows the decomposition structure of an IDEF0 model.

Figure 1. The basic concepts of the IDEF0 syntax

Figure 2. The IDEF0 decomposition structure
5 The modelling and validation process

The first version of the model was developed by the authors of this paper based on their own domain knowledge and by incorporating feedback from other members of the research team. This version was presented in two scientific conferences (Björk, Nilsson and Lundgren 1999), (Björk, Lundgren and Nilsson 1999) and encouraging feedback was received.

The ProFacil process model was further developed and refined in close co-operation with the participants of the MoPo project, domain experts and company representatives from three companies all working in the FM industry. The companies were the Karolinska hospital in Stockholm, Electrolux Facility Management in Stockholm and ABB Facility Management in Västerås.

The objective for the validation activity was to find out whether or not the model represented a generic process in providing a facility or not. Representatives of the three companies participated in meetings and provided their knowledge of the FM area. The procedure of a meeting was the following; an IDEF0 diagram was presented to a company representative who reflected whether the activities in the diagrams were generic or not. The purpose of the ICOMs in the diagram was carefully explained and sufficient time was given to provide an answer. Each remark was written down in connection to the interview and was later sent for confirmation together with a new version of model.

The process of validating the model began at the Karolinska hospital in Stockholm. Two managers at the Karolinska Hospital facility management department participated in semi structured meetings during the development of the process model. The process model was discussed in three meetings and verified in one final workshop. One result of the interviews was for example the decision not to detail the conceptual design in further levels because further detailed activities would not be generic.

The model was further developed and refined together with the Electrolux Facility Management department in Stockholm. During the refinement one senior manager participated in three meetings based on semi-structured interviews. The refinement of the model continued by a dialog of the representativeness of each of the activities in a diagram. The final version of the model was verified at a workshop.

Finally the ABB Facility Management department in Västerås verified the generic properties of the ProFacil process model. One senior manager from the FM department participated in two meeting based on semi structured interviews. The latest version of the ProFacil model was presented and was approved as a generic model representing the FM process.

A final workshop was held at two of the companies to verify the latest version of the model and to test the validity of the model. During these workshops the diagrams of the complete model where printed out and presented using a paperboard showing all of the diagrams at the same time.
6 The ProFacil model
The provide facility model (ProFacil) shows links between the facilities management process and the building end user’s business process. Figure 3, which depicts the overall business process of any organisation, is the starting point for the modelling.

![Figure 3. Perform the business of any organisation](image)

It is assumed that the purpose of the organisation is to produce products, services or information, which has value to some external customer. This diagram applies to any organisation whether commercial or non-profit. On the next levels, going down in the model hierarchy, the relation to the Facilities Management process will gradually appear. (Figure 4.)

![Figure 4. Perform the business of any organisation](image)
By business management we understand the planning activities in a company, which include studying both long-term market conditions of the company as well as the opportunities offered by technology development and the funding possibilities for investments. Such activities result in a strategic business plan for the business. Business activities include budgeting and long terms planning involving key issues such as the choice of new production systems or personnel and competence strategies. By business operations we mean the operations made by the core- and the support processes on a daily basis. (Figure 5.)

Examples of core business activities could be:  
- In a university, teaching undergraduates and carrying out research, in a hospital, examining and treating patients, in a telecommunicating company, to develop and manufacturing mobile telephones.

Examples of support activities are:  
- Paying salaries to the employees, supplying the personnel with IT-equipment, the supply of facilities or services to the core business, buying in the inventory and materials needed in the core business.

These support activities can be further broken down into the following sub-activities:  
- Provision of Machinery services, Provision of Financial services, Provision of Material services, Provision of Personnel services, Provision of Facility Management services. (Figure 6.)
From the organisation's point of view, well-functioning spaces and buildings are only one of a number of resources needed as input to the core process. In larger organisations we often find specialised departments set up to manage these different categories of support activities.

The link between the business management of the core business and strategic FM planning is important to note. Signals to start planning for changes in stock of building and spaces respond to a predicted need for these resources, though an unforeseen change in the business environment can also rapidly change these plans.

Whenever such changes occur, these have to be carried out using a set of basic activities.
- provision of a new or existing facility,
- rebuilding of existing facilities,
- maintenance of existing facilities,
- operation of existing facilities,
- disposal of existing facilities.

As is seen in Figure 7, the business and budget plans and the facility plan stemming from the business management activities control when to start transforming inputs into operational facilities used for the core business processes. External constraints are for example public regulations or legal agreements with stakeholders connected to the business process.
Figure 7. Manage Facilities

Information from different sources in the core process are used by the FM activity in providing facilities to core processes, and information produced by FM activities becomes an input to each of the activities in the process of changing the continuing use of facilities. Resources used by this process are facilities, IT tools and equipment needed in the daily operations. (Figure 8.)

Figure 8. Provide new facility

The provision of a new facility can be accomplished in two separate ways. By acquiring an existing facility or by acquiring a new facility. An existing facility
may be acquired through buying a built facility on the real estate market or renting facilities on the property market (Figure 9).

**Figure 9. Acquire existing facilities**

By acquiring land and constructing a building or rebuilding a building already owned, new facilities may be supplied, but only after a long period of time. It is only by breaking up this level, that we can find the familiar categories design and construction, which so often are found as central in construction process models (Figure 10).

**Figure 10. Acquire new facility**
The information in the facility plan provides for decisions involved in the activity of providing a site and these decisions are forwarded into the conceptual design, detailed design and to the construction of the building itself. Data and information about sites, such as their location, their surrounding and amenities are inputs to the activity of acquiring a site. Structured and unstructured information given by facility managers are used in all the activities involved in the acquisition of a facility. (Figure 11.)

As can be seen the project team is involved as one among several resources in the provision of new facilities. The information flow being produced as a result of the activities above are used in the decision making process and to describe the artefact itself – the facility.

The generic property of the ProFacil model provides for an origin from where specialisation of detailed process models can take place. Several perspectives can be adopted in the process of acquiring a facility by using the diagram in Figure 10, be it the information technology perspective, the decision making perspective or the material flow perspective.

At this level, the decomposition of the model is taken one step further and the details of the activities in the previous diagram are visible. What is seen in Figure 11 are the activities of making an analysis of the client’s needs providing input into the architectural programme, the activity of making the architectural program, and the actual building design.

The information flows into the architectural program and the architectural design are building specifications and engineering design information. Information is also provided by the facilities management function.

Figure 11. Conceptual design
Figure 12 shows the detailed design including five basic activities describing this process.

![Diagram](image)

**Figure 12. Perform detailed design**

The design of ground and foundation produces basic information formalised into the building specification as one of the several inputs to the spatial design activity which provides information about the design of walls and roofs into the structural design.

The final diagram in the model (Figure 13) shows the stages of the actual construction process, finally resulting in the building ready for use.

![Diagram](image)

**Figure 13. Perform construction**
7 Conclusions
A problem shared by many building and construction companies today is unclear processes in the provision of products and services within their organisations and to their customers. Unclear processes and working procedures tend to propagate into highly individual ways of working, and although some organisations do benefit from an unstructured way of working, mostly this is not the case.

Unknown processes result in the uncertainty of what is being produced and delivered by the organisation at a specific time to their customers. Process analysis supports the design of products, services or information systems, by shortening the time frame of production and increases the likelihood of discovering eventual malfunctions in a prevailing process.

In the project presented a generic process model for the FM and construction process was developed and validated with industry practitioners. A key feature of the model is that it puts the FM and construction processes in a wider perspective of core and supporting activities in any business enterprise, rather than view them as isolated processes in their own right (which has been the case for most earlier process modelling efforts in the construction sector). The idea is that companies, through a process of specialization, could use the Profacil model as a basis for their company specific modelling work.

The feedback received during the validation of the model was encouraging and the researchers hope that these types of methods would become more commonplace in the facility management and construction sector.

Acknowledgements
The financial support of the ITBygg2002 program in Sweden and the National Technology Agency of Finland (TEKES) for carrying out this work is gratefully acknowledged.

References


Paper two

Customer’s perspectives on a residential development using the laddering method

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Accepted for publishing in the Journal of Housing and the Built Environment 25 (19), 2010
Abstract

Residential development is closely related to the question why some people buy in certain residential developments and others do not. The reason is obvious: if the product is not appreciated by consumers they will search for another alternative which will decrease the estimated market share for a specific residential project. The main idea in this study is to increase our understanding of how to design and build more attractive residential developments by evaluating buyers’ needs and preferences. Research concerning the means-end chain theory and the laddering technique has been quite extensive in the food industry but examples in residential development are rare. Laddering interviews were made with respondents who visited open house sales of a tenant-owned apartment on sale. We hypothesize that there exists a difference between bidders and non-bidders regarding their beliefs of functional and psychological consequences and abstract personal values. In our study we did not find any major difference in terminal values, but instrumental values do differ. This is true also for abstract product attributes and functional and psychological consequences. Professional developers and planners were able to use the beliefs of bidders and non-bidders to decide on a re-design of specific locations in the residential development of Frösunda, north of Stockholm, Sweden.

Keywords: Conceptual design, Residential development, Means-end chains theory, Laddering.
1 Introduction

Why do some people buy in certain residential developments and others do not? Can we reduce the risk in real estate development by evaluating the choices buyers make? Certainly, if buyers could specify their needs, their preferences and willingness to pay, residential development would be a fairly risk-free business. However, that is not the case. The uncertainty of whether the developer has succeeded in capturing the preferences of a target group is greatest during the early conceptual stage. The answer comes during the selling or leasing phase, but usually too late. Since real estate development is a very risky business, developers should be interested in a theoretically grounded method that provides information about the benefits and disadvantages people believe to exist in a residential development.

1.1 Problem formulation

A delicate problem is the question of how to link potential buyers’ beliefs to the design of a housing project that does not yet exist. A housing project is a truly multidimensional product and difficulties in acquiring usable information from buyers as input to the conceptual design phase are well known. Bookout et al. (1994) provides an example of the difficulties developers are facing by saying, “One of the most interesting and consistent findings is the inability of tenants and residents to isolate the design feature they value highly”. Residents and tenants almost universally perceive a project as a whole, not as a series of parts that could individually be measured and rated. A similar idea has been presented by Psilander (2004), who refers to consumers’ inability to separate the characteristics of a housing project into its different parts; instead they interpret the project as a complete whole.

The developers participating in this research project acquire knowledge of the factual purchase process by sending an evaluative survey two years after households move in. To investigate consumer preferences for a residential development project that is still in the conceptual design phase, inferred analysis or focus groups are frequently used methods, covering different aspects of consumer expectations. In-depth interviews are also used to investigate specific issues, such as the layout of a residential development plan or pricing. Despite these methods there have been some notable failures in Sweden in foreseeing the preferences and needs of different target groups. We believe that there might be a method that can help reduce these shortcomings.

1.2 The study object

The residential development in our study, Frösunda, is located 3 kilometres north of Stockholm, Sweden (see plate 1 in the appendix). The first residential units were built in 1999 and the project will be completed during 2010, by then consisting of approximately 2,500 tenant-owned apartments with “bostadsrätt”1. The building styles represent a modern town environment, combining offices and commerce with multi-family buildings. Within Frösunda there are public services such as day care centres, primary and secondary schools and private services such as cafés,

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1 According to Swedish law “bostadsrätt” is tenant-owned housing/housing association. A housing association is a co-operative association normally consisting of between 20 and 100 apartments (tenant-owner apartments) built together or as detached units in a defined geographical area. The members (the residents in the tenant-owned housing) own a share of the housing association which in turn owns the housing. The members are free to sell their share and thus their tenantship rights on the open market.
restaurants and banks as well as residential brokers. The four locations that we used in our study were chosen after discussions with the advisory board\textsuperscript{2} who found the locations to be representative of Frösunda (see plates 2-5 in the appendix).

1.3 The structure of the article
Firstly, in chapter two we present our research design and the means-end chain theory as well as the ladderling method as a general approach to understanding residential buyers and their decision-making. In chapter three we show how the ladderling technique has been used to investigate residential buyers’ decision-making in an open house sale of tenant-owned apartments in Frösunda. In chapter four we present findings from our study and show two hierarchical value maps and dominating means-end chains that we found in one of the four locations in our study. In chapter five we discuss our findings and relate them to recent research and argue how the evaluation of a residential development can be used to provide clues for making future residential developments more attractive.

2 Research design

2.1 Research proposition
We believe that if real estate developers and planners know more about the differences between the bidders’ and the non-bidders’ beliefs about existing residential projects, they can use this information to improve their understanding of the buyers’ and non-buyers’ motives for purchasing a home or not. By using bidders’ and non-bidders’ beliefs we might gain more information about how they perceive product attributes in a residential development. If developers decide on a conceptual design that reinforces the positive benefits perceived by bidders and reduces the disadvantages perceived by bidders and non-bidders, the risk in real estate development may be reduced by making future residential developments more attractive from specific target groups’ point of view.

2.2 Research method
In this study we adopted the traditional view of means-end chains having hierarchical relationships. We use the theoretical standpoint made by various authors (Gutman, 1982, 1991; Rokeach, 1973; Simon et al., ibid; Seth, 1987; Shert, Newman and Gross, 1991; Schwartz, 1994; Coolen and Hoekstra, 2001; Coolen, Boelhouwer and Van Driel, 2002) that values affect people’s behaviour and we assumed that the beliefs potential buyers form about functional\textsuperscript{3} and psychological\textsuperscript{4} consequences are guided by their values. We chose the definitions made by Rokeach (ibid), where values are defined as being instrumental\textsuperscript{5} or terminal\textsuperscript{6}. To capture residents’ experience of a housing development we use a walk-through evaluation (Ambrose and Dyregaard, 1993; Ambrose and Paulsson, 1996; de Laval 1994). During a walk-through evaluation the respondents are asked to observe and sense

\textsuperscript{2} Besqab, JM, NCC, Stockholm municipality, Solna municipality, Sollentuna municipality, Swedbank, Upplands-Väsbys municipality, Veidekke.

\textsuperscript{3} A functional consequence is defined as a direct and tangible outcome, positive or negative, as experienced by a person while he is using a product. Responses refer to usage, usage situations or conditions that have a hedonic or an expressive function.

\textsuperscript{4} An instrumental value is an enduring belief that a specific mode of conduct is personally preferable to an opposite mode of conduct.

\textsuperscript{5} A terminal value is an enduring belief that a specific end-state of existence is personally or socially preferable to an opposite end-state of existence.
the built environment in a specific location of a residential development and write down their observations as positive and negative remarks. In this sense, a walk-through evaluation is a method to identify positive and negative product attributes. In de Laval (ibid) the author refers to the evaluation of a walk-through as often taking place at a joint meeting with the developer, planners and architects as well as the residents to identify potential improvements in the physical structure. By using a walk-through evaluation in our study we focused the respondent on specific locations in Frösunda in turn.

Each respondent visited the selected locations in Frösunda, one by one, and was asked to come up with three positive and three negative aspects and indicate their relative importance on a scale from one to three (see appendix, plate 1). These aspects were later taken as starting points for an interview to elicit means-end chains and were not discussed at a joint meeting, as would be the case with a traditional walk-through evaluation.

2.3 Research hypothesis

We hypothesize that bidders and non-bidders for apartments on sale hold different beliefs (Hypothesis 1): “If a bid is made, then the beliefs of those individuals who bid will differ from those of those individuals who prefer not to make a bid, with respect to product attributes, functional and psychological consequences and personal values”. If this hypothesis holds, we expect to find different and more positive functional and psychological consequences and fewer negative ones within the group of bidders than within the group of non-bidders. We also expect to find different personal values. In addition, we hypothesize that developers and planners are able to use knowledge of potential buyers’ beliefs about product attributes, functional and psychological consequences and values to suggest a re-design in the locations that we have chosen for our laddering study in Frösunda (Hypothesis 2).

2.4 Means-end chains theory

The means-end chain theory provides an explanation of how consumers’ knowledge of products is stored and organized in human memory as means-end chains. The theory is based on the belief that consumers make a purchase decision that will lead to an important personal outcome (Gutman, 1982; Olson and Reynolds, 1983; Peter and Olson, 1996). Consumers are not primarily interested in product attributes; instead they are interested in the experiences they can gain from having the product. These experiences are defined as consequences, the importance of which is directed by personal or social values that the person holds. In everyday life values act as a compass directing a person to different choices without him being aware since those choice criteria that represent values are silent. We have no reason to believe that residential buyers are any different from consumers in general. A product will be a means towards a desired end and in this sense a means-end chain will represent a hierarchical relationship between attributes, consequences and values (see figure 1).

Figure 1. Hierarchical levels of product and self-knowledge in a means-end chain.
The means-end chain model, consisting of six levels: Concrete and Abstract Attributes\(^1\); Functional and Psychological Consequences and Instrumental and Terminal Values, is commonly used in means-end chain research (Le Page et al., 2005). In Coolen and Hoekstra (ibid) the authors discuss the means-end chain theory as a more fruitful approach to consumer behaviour than, for example, the compositional approach, the conjoint preference model and decision plan nets. Their argument in favour of the means-end chain model over these models is based on the existence of consequences, which is a relationship between the attributes of a product and the silent personal life values that a person holds.

2.5 The laddering method

The laddering method was developed as an in-depth one-to-one technique to elicit means-end chains from a respondent. Data that is stored as means-end chains can be retrieved as excerpts from a respondent’s cognitive structure by the laddering technique (Reynolds and Gutman, 1988). Laddering data is visualized as categorized meta-data by hierarchical value maps (Reynolds, Dethloff and Westberg, 2001). Different laddering probes have been developed to elicit positive and negative functional, psychological, social consequences and values. The classical laddering probe which forces the respondent up to a higher abstraction level is: Why is that important to you? However, other probes can be used at different levels of abstraction, such as: How does that help you out? What do you get from that? Why do you want that? What’s wrong with that? Why do you want to avoid that? The probing on a specific ladder continues until the respondent can no longer answer the probe and the ladder is thus saturated. Software is commercial available to analyse and visualize laddering data.

2.6 Literature review

Why do some people buy in certain residential developments and others do not? Not many research papers have addressed this question using the laddering technique. Only one study is found that specifically addresses the means-end chain approach and the laddering technique in housing (Coolen and Hoekstra, ibid); these authors studied the means-end chain approach as determinants of preferences for housing attributes. However, they did not empirically evaluate an existing residential development, nor did they address the question of differences in bidders’ and non-bidders’ choice criteria. As other authors (Schoormans et al., 1991; Claeyss et al., 1995; Snelders and Schoormans, 2004) argue, abstract product attributes are mostly linked to emotional feelings and related to psycho-social consequences. This might be an explanation for the inability sensed by residents and tenants when asked to separate important design features in a housing project. The inability of tenants and residents to isolate the design feature they value highly might be due to the existence of abstract attributes and consequences which are silent to the consumer. In Snelders and Schoormans (ibid), the authors found that concrete product attributes are mainly directed towards functional consequences of product use and refer to ergonomic arguments such as the practicality and usefulness of features in the product. Our selection of four specific locations, as described above, is supported by Bech-Larsen et al. (1996), who found that situational aspects are important in order to reach a higher level of semantic precision on constructs that are mentioned by respondents during a laddering interview.

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\(^1\) Concrete attributes are tangible and physical characteristics that have a distinct material form that can be observed by an individual. Abstract attributes are subjective, intangible characteristics that cannot be represented as a distinct material form and communicate more hedonic and emotional motives for product acquisition.
In the context of food-related product development, several studies using the means-end chain approach have been carried out (Sondergaard, 2005; Sondergaard and Harmsen, 2007). In the latter study product developers found consumers’ experience of negative consequences more useful than positive consequences as clues to the design of new and improved products. Similar results are reported by Sorensen, Grunert and Nielsen (1996), who found that the perception of negative consequences and the inhibition of value attainment were major distinctions between those who buy more fresh fish and those who buy less.

Recent research on consumers and their decision-making using the laddering technique was carried out by Urala (2005) and Urala and Lähteenmäki (2003), who investigated consumers’ decisions to either choose or not choose functional foods. Ter Hofstede et al. (1998) have developed a method known as the association pattern technique, which reduces the amount of information that is required in a laddering study. An in-depth overview of the laddering technique is found in Grunert and Bech-Larsen (2005) and in Veludo-de-Oliveira et al. (2006). The laddering technique is not without criticism, however, and, as Silverman and Grover (1995) argue, many consumers do not follow this approach when they assess product quality.

The assumption that laddering data follow a hierarchical order (Kelly 1955; Gutman 1982; Grunert and Bech-Larsen, ibid) has recently been challenged by Van Rekom and Wierenga (2007) who suggest that means-end relationships are network oriented. Reviewing the literature, we have not found any publication that empirically investigates how to evaluate an existing residential development using the means-end chain theory and the laddering method.
3 Data collection

There are some potential threats to the predictive validity of laddering results (Grunert and Grunert, 1995). Firstly, to reduce the potential risk of grouping respondents with highly different beliefs about appreciated product attributes and desired consequences into the same group of consumers, we have separated respondents by their decision to make a bid or not, assuming that their values have guided them in their decision whether to bid or not. To reduce the potential risk that the information given by respondents is different from what they use in their decision-making, we provide a situation that is as close as possible to a real-life situation, using a walk-through evaluation. We believe that most of the respondents that visited the open sales of tenant-owned apartments found the location of Frösunda suitable to their needs and the price levels affordable.

To make sure that the raw data is as much as possible a result of the respondents’ cognitive structures and processes, we decided to use the hard-laddering approach (Reynolds, Dethloff and Westberg, ibid). To reduce the risk of respondents giving a far-fetched answer as a response to a probe, we decided not to force the respondent to produce an answer if they had difficulties in finding one. To collect data from the respondents we conducted semi-structured telephone interviews. The design of our research was based on a trial study undertaken in May and June 2007. In the trial study five respondents completed a walk-through survey consisting of seven different locations within Frösunda and participated in a laddering interview. The selection of each of the locations was based on a previous walk-through study undertaken by the Nordic Construction Company (NCC).

During the laddering interviews several probes used in laddering studies were tested to see how easy and efficient they were in stimulating answers that made sense to the respondent and the author. Most of the respondents kept on talking for a period of three up to five hours, providing a very detailed view of functional and psychological consequences and life values. This procedure became tedious for both the respondent and the author. Based on the results from the trial study we decided to reduce the number of locations to four. The number of probes to be used was also restricted to the ones proven to provide relevant and accurate information. We decided not to perform face-to-face interviews; instead we decided that telephone interviews were likely to be sufficient. Those who participated in the final study were not truly a random sample since they represent a group of people who decided to visit an open sale in this particular development.

The respondents were selected from open sales of tenant-owned apartments. The respondents were asked about their interest in participating in the walk-through survey as they left the apartment on sale. We collected data during a period of 9 weeks from mid-August to mid-October 2007. The data collection was made at eight open sales of privately owned two- to four-bedroom apartments in Frösunda. Each sale was visited by between 9 and 25 people. As they left the apartment, 86 of them were asked about their interest in participating in the study. A total of 65 specially designed walk-through surveys were handed out and subsequently 35 were returned in a prepaid envelope, making a response rate of 55 per cent.
The respondents who returned the walk-through survey received a letter inquiring about their interest in participating in a telephone interview to follow up their answers to the walk-through survey. Ultimately, 32 of the respondents accepted our request and took part in the subsequent laddering interviews. The laddering data from these respondents provided us with 1,913 chunks of responses and 531 ladders. A chunk is a response regarding a specific type of attribute, a consequence or a value. The telephone interview followed a semi-structured form and lasted between 18 and 70 minutes, with an average of 36 minutes. During the telephone interview the respondents were asked if they had made a bid on the apartments on sale or if they had any intention of making a bid.

The group of bidders consisted of 10 respondents aged 32-82 years; the non-bidders consisted of 9 respondents aged 37-65 years and the group of residents already living in Frösunda, making a bid or not, consisted of 13 respondents aged 28-56 years.

<table>
<thead>
<tr>
<th></th>
<th>Respondents</th>
<th>Age</th>
<th>Bidder</th>
<th>Non-bidder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>17</td>
<td>30-82</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
<td>28-65</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>28-82</td>
<td>14</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 1. Distribution of respondents in the laddering study.

3.1 Data analysis

Each of the answers from a laddering interview was categorized as one of the following: concrete product attribute, abstract attribute, functional consequence, psychosocial consequence, instrumental value or terminal value.

The data reduction procedure was undertaken by two people: firstly, the interviewer and, secondly, another researcher acting as a judge. The process of establishing relevant categories continued until a final decision was made. The actual task of placing answers in a specific category was not perceived as problematic since the laddering data were sufficient to indicate categories. The categories for bidders and non-bidders were the result of the same categorization procedure. The process resulted in 117 categories. Laddering data from the first location, Frösunda Entrée, were coded into 57 categories; the second, Frögatan, resulted in 52 categories; the third location was the inner courtyard and the responses were coded into 51 categories; and finally the responses from Frösunda square were coded into 52 categories. Since some categories are the same in all of the locations, such as ‘feel fine’ or ‘safety’, the number of categories was reduced from 212 to 117.

Separate hierarchical value maps (HVMs) were made to capture both positive and negative aspects in four locations in Frösunda. For bidders and non-bidders, not living in Frösunda, the data analysis resulted in 16 hierarchical value maps, eight HVMs showing positive beliefs and eight showing negative beliefs. For residents living in Frösunda eight additional HVMs were used as a reference for bidders and non-bidders. The laddering data were analysed with MECanalyst software, version 1.0.14.
4 Analysis of hierarchical value maps

The category in a hierarchical value map shows firstly the name of the category, for example *safety* and then the number of chunks it represents and the percentage of respondents that made a direct or indirect connection (see figures 3 and 4). A hierarchical value map is based on an implication matrix (Reynolds, Dethloff and Westerberg, ibid) that displays the number of times each category leads to another category. Two types of relationships are created, direct and indirect, whereby a direct relationship is a response that is directly related to a category. An indirect relationship is established if there is another category between them. To investigate the hypothesized differences between bidders and non-bidders we have used hierarchical value maps at a cut-off level of two. This means that a link is drawn between two categories if at least two respondents are included in that chain, directly or indirectly. In this article, we present a positive hierarchical value map from bidders and non-bidders in one of four locations: Frösunda Entrée. Since a complete set of 24 hierarchical value maps would require too much space in this paper, we will gladly provide those missing maps by e-mail upon request to the author.

4.1 Results from Frösunda Entrée

In the interpretation of the aggregated laddering data (figures 3 and 4) we paid special attention to means-end chains that showed a complete relationship and reached the value level. We recognize that means-end chains that form networks are likely to have a higher impact on the potential buyers’ decisions to bid or not. We are interested in finding out what kind of categories are part of such chains since these categories are likely to express buyers’ choice criteria. If some means-end chains are present in both positive and negative responses, these categories are of special interest, since these means-end chains can indicate that a particular attribute or consequence is not provided to a sufficient degree. What information did we obtain from the laddering study in Frösunda? Figure 3 shows the positive beliefs that were formed by ten bidders in Frösunda Entrée. The main product attribute perceived by bidders in Frösunda Entrée is *restaurants and shops*, which bidders associate with *liveliness* and directly with the preferred behaviour of *being amongst people*. Bidders seem to believe that being amongst people is a behaviour that is supported in Frösunda Entrée. Bidders also experienced Frösunda Entrée as a *town environment* that they relate to a *homely feeling* and the terminal value *safety*.

This is in contrast to nine non-bidders, who mainly associate *restaurants and shops* as being *practical and convenient*, supporting their preferred behaviour of *saving time*. This highlights a main difference between bidders and non-bidders. Non-bidders relate *restaurants and shops* to the psychological consequence of *feeling at ease* and the terminal value *safety*. As is seen in figure 4, the product attribute, *the buildings*, generates a similar means-end chain for bidders’ and non-bidders’. The terminal value in both groups is *safety*, which is related to the psychological consequences *feeling at ease* and a *homely feeling*. This means-end chain indicates that bidders and non-bidders share these two beliefs with each other.

Non-bidders associate Frösunda Entrée with *open space* and a *fresh appearance* that they link to the psychological consequences of *feeling comfortable* and *feeling fine*; the terminal value *feel fine* is only linked to *feeling comfortable*. Non-bidders also have a direct link from *Frösunda Entrée* to the terminal value *well-being*, indicating that Frösunda Entrée has a direct impact on non-bidders’ well-being.
Figure 3. Frösunda Entrée, bidders, positive beliefs, not living in Frösunda.

Figure 4. Frösunda Entrée, non-bidders, positive beliefs, not living in Frösunda.
From the HVMs in Frösunda Entrée it seems that bidders’ need for safety can be met by a nice town environment that gives them a homely feeling and by shops and restaurants that promote liveliness and a sense of being amongst people. Non-bidders, on the contrary, satisfy their need for safety by having shops and restaurants close to home and maybe easy access to Stockholm that saves them time.

5 Results

In this study a set of 24 hierarchical value maps were derived for four locations in the residential development Frösunda, Sweden. These HVMs contain the main results, and two of these are shown in figures 3 and 4. Our first aim was to investigate whether information from a laddering technique provides a plausible explanation of why some people buy in a certain development and others do not. Our second aim was to investigate if developers and planners can use information about bidders’ and non-bidders’ beliefs (expressed as product attributes, consequences and values) to suggest changes in an existing residential development. If so, we proposed that knowledge from a laddering study can be used to make future residential developments more attractive.

The question of why some people buy in a certain development was investigated by Hypothesis 1: “If a bid is made, then the beliefs of those individuals who bid will differ from those of those individuals who prefer not to make a bid with respect to product attributes, functional and psychological consequences and personal values”. Nine professionals who participated in our advisory board were asked to evaluate 16 hierarchical value maps of bidders and non-bidders. In evaluating the hypothesis the advisory board also used eight hierarchical value maps of residents living in Frösunda as a reference for the group of bidders and non-bidders. It is reasonable to assume that the beliefs of bidders resemble those of respondents who currently own an apartment in Frösunda. In preparation for the evaluative meeting, all members of the advisory board received copies of the hierarchical value maps several weeks in advance. The principle behind the HVMs was well understood. If this hypothesis holds, we expected to find different and more positive abstract product attributes, functional and psychological consequences and fewer negative ones within the group of bidders than among the group of non-bidders. We also expected to find different personal values. Hypothesis 1: In 16 hierarchical value maps representing beliefs of bidders and non-bidders the advisory board found, in the evaluative meeting, a larger number of positive abstract attributes and functional and psychological consequences than within HVMs for non-bidders. Within the group of bidders the advisory board found fewer negative abstract attributes and fewer negative functional and psychological consequences than within non-bidders. Negative beliefs showed less variation between bidders and non-bidders, although negative beliefs were more frequent in the group of non-bidders. These findings are in accordance with our first hypothesis. However, we expected to find different terminal and instrumental values. The hierarchical value maps show that safety, well-being and feel fine were terminal values irrespective of the group. This means that the hypothesis was not confirmed at the level of terminal values. The hierarchical value maps show different instrumental values and functional and psychological consequences in the group of bidders and non-bidders. This was also the case for abstract product attributes. The members of the advisory board concluded that a difference exists between the cognitive profiles of bidders and non-bidders. The advisory board also concluded
that the cognitive profile of bidders and respondents owning an apartment in Frösunda is similar, although not identical, but clearly different from that of non-bidders. Insofar as it is possible to judge by hierarchical value maps, the hypothesis was confirmed at the level of abstract product attributes, functional and psychological consequences and instrumental values.

Hypothesis 2: To evaluate the second hypothesis the advisory board was asked to suggest a re-design of the residential development Frösunda by reinforcing the positive benefits perceived by bidders and reducing the disadvantages perceived by both bidders and non-bidders. This task resulted in drawings and text documents that altered the design in three out of four locations (see appendix, plates 2, 3 and 5). In brief, the advisory board came to the conclusion that the experience of a small town environment in Frösunda Entrée (plate 2) could be improved if restaurants and cafés were moved from Frösunda Square (plate 5). This change is justified because bidders and non-bidders perceive Frösunda Square as dull and boring, dead and bare and the square supports neither the instrumental value meeting people nor the terminal value social contact.

Most members of the advisory board agreed that Frösunda should not have been built with two small centres in a limited area. Another insight is the inappropriate design of the area close to the street Frögatan (plate 3) which has eight buildings oriented towards an open green area. The advisory board concluded that this area should have been given a design similar to the appreciated inner courtyard (plate 4). As a result we found reasonable support for our second hypothesis: information from a laddering study can be used to suggest improvements to the physical design of specific locations in an existing residential development. From a developer’s and a planner’s point of view, a belief that is linked to lower level means-end chains was more actionable for them since those levels are closely connected to concrete product attributes that make up the physical built environment of a residential development.

5.1 Discussion
According to (Rokeach, 1973), values and goals play an important part in people’s lives, and values will affect their choice behaviour in particular. We hypothesized that if a group of individuals make a bid, then their decisions will be guided by a set of instrumental and terminal values which is different from those held by individuals who decide not to make a bid. However, that hypothesis failed to materialize fully. We did not find any major difference between those groups regarding their terminal values but we did find different instrumental values. In this study we did not specifically test the predictive strengths of different levels in a means-end chain.

It is interesting to compare our findings to recent research, however; for example Le Page et. al. (ibid) assessed the predictive value of the means-end chain theory in the context of choice of meat products. Their findings indicate that the least abstract levels of means-end chains appear to be most predictive. They suggest that abstract levels, as terminal values, take the respondent beyond their own awareness of their behaviour. Conversely, in Grunert and Bech-Larsen (ibid), the authors found consequences and values to be a better predictor of choice option attractiveness than beliefs that link the product to product attributes only. Our study does indicate the importance of consequences and instrumental values for the choice of whether to make a bid on an apartment on sale in Frösunda or not.
An important aspect of hierarchical value maps is the fact that the information we gain concerns the frequency of how often a direct or an indirect relationship is established between different categories in a means-end chain. In our study we have not investigated which part of a means-end chain has the highest correlation to the bidder’s and non-bidder’s decision to make a bid or not. Since a hierarchical value map does not provide such information we cannot verify that values are more important than product attributes, as for example has been asserted in the study by Grunert and Bech-Larsen (ibid). Nor did we test that the hierarchy assumption holds (Van Rekom and Wierenga, ibid). However, that was not our intention either. The relative strength of important values, such as safety and well-being, could be investigated using latent constructs (Jöreskog and Sörbom, 1993) that represent these values.

In Le Page et al. (ibid) it was found that laddering data proved to be an important predictor of attitudes. If we use attitude items that represent different values found in a laddering study, it would be possible to measure the relative strength of impact on the decision to make a bid or not. The reason for doing this is to identify how belief structure impacts people’s experiences of specific parts of a residential development and in turn their decision. In our study categories that express bidders’ beliefs concerning abstract product attributes, functional and psychological consequences and instrumental values tend to be more numerous compared to categories for non-bidders.

Within this set of means-end chains bidders, as a group, generated 46 positive categories and 20 negative categories, compared to 31 positive categories and 28 negative categories for non-bidders. Why bidders as a group have a larger number of positive categories than non-bidders, and vice versa for negative categories, might be a result of an increased/decreased spreading activation amongst a set of cognitive categories (Grunert and Grunert, ibid; Anderson, 1983a; Anderson, 1983b; Anderson and Pirrelli, 1984; Collins and Loftus, 1975). Bidders may, according to the spreading activation theory, have generated a more complex network of associations which results in a larger number of positive categories compared to the non-bidders.

Thus, an individual who has a positive experience of a residential development will be able to express a larger number of positive abstract product attributes, consequences and instrumental values than an individual that does not appreciate what he/she experiences. The opposite seems to be true for a negative experience. As a result of this study, the laddering technique provides reasonable insight into why some people buy in certain residential developments and others do not.

An interesting observation from our study regarding the practical usefulness of the laddering technique concerns the complexity of residential housing. As been discussed by Bookout (ibid) and Psilander (ibid) respondents have a tendency to refer to a location as a whole. The respondent has difficulties in identifying specific concrete attributes that affect their overall judgement. Even if we use a probe the respondent might have problems in separating one attribute from the whole set of attributes or he or she simply might not know the answer. Extensive probing will only increase the risk of bias since the respondent will try to come up with an answer whether this is relevant or not.
However, taking these problems into consideration, the means-end chains that are elicited by the laddering probes still provide insight into those abstract attributes, functional and psychological consequences that are experienced by a respondent at a specific location. This may be the best we can hope for. The interpretation of product attributes that have an effect upon the respondent’s beliefs has to start from some point. Moreover, the contribution of the means-end chain theory and the laddering method compared to an attribute assessment method such as a walk-through evaluation is the understanding of values and desired consequences which do stem from the respondents themselves.

A walk-through evaluation faces the same kind of problem as has been discussed above, imposed by the complexity of the built environment. The HVMs were perceived by developers on the advisory board as an improvement, especially when discussing the HVMs within a project group compared to textual data from a traditional in-depth interview or a focus group discussion. The reason lies in the highly structured data from a laddering study which provides an advantage over these methods.

A member of the advisory board, who lives in Frösunda, made a walk-through evaluation himself using hierarchical value maps and thereby gained new and relevant insight into the disadvantages perceived by non-bidders. We believe that the results of this study show that the laddering technique can enhance the understanding of the benefits and disadvantages that go beyond attribute assessment. Members of the advisory board were able to suggest improvements in a residential development and we believe that these findings are worthwhile to investigate further.

It should be noted, from a developer’s perspective, that the decision on a particular design solution for a new development should be made by the developer. The market analyst, who may perform the laddering interviews, should act as a facilitator of the laddering data, together with an architect who provides an improved residential design using 3D drawings and site plans or, if appropriate, advanced computer animations. The knowledge gained from a laddering study and the evaluation of an existing residential development could well reduce the risk in real estate development by providing clues to the developer on how to improve the future design of residential developments for specific target groups.
6 Appendix

See Figs. 4, 5, 6, 7 and 8.

Fig. 4. Part of Frösunda, Solna. Paths that were chosen in the walk-through evaluation.

Fig. 5 No:1 Frösunda Entree
Fig. 6  No:2 The street Frögatan

Fig. 7  No:3 Inner courtyard

Fig. 8  No:4 Frösunda Square
7 References


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Paper three

Measuring the perceived performance of a residential development

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Submitted to Journal of Place Management and Development
Measuring the perceived performance of a residential development

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Abstract
This research paper investigates whether residential buyers’ beliefs about the built environment in a specific place influence their willingness to buy in a large-scale real-estate development by developing and testing a new attitude scale. The empirical study was carried out in two phases. The first phase was a qualitative laddering study to capture the beliefs of potential buyers visiting open sales of apartments on sale in the real-estate development of Frösunda, Sweden. In the second phase, a multivariate analysis was carried out to identify and measure factors that have an influence on their willingness to buy. Five factors were found that describe buyers’ beliefs about the built environment: urban environment, architecture, relaxation, safety and liveliness. Buyers’ and non-buyers’ attitudes towards these factors vary depending on the characteristics of the built environment. The means-end chain model and laddering technique proved useful in eliciting beliefs that describe how a particular place is perceived by potential buyers. These findings stem from one case study and a retest should be made using an independent sample to assess the generalisation of the scale. This paper demonstrates novel research using the laddering technique, how real-estate buyers’ attitudes and their evaluation of performance of the built environment vary depending on location. Practitioners will have a new tool for real-estate development if the RED scale proves to be broadly applicable to access real-estate buyers’ evaluation of the performance of a residential development.

Keywords
Residential development, means-end chain, laddering, beliefs, attitudes
Introduction

The purpose of this article is to present and discuss a new scale that measures factors that residential buyers evaluate when they are looking for an apartment to buy in a large scale real-estate development. This scale is founded on the concept of the walk-through method but also on the means-end chain theory and the laddering technique. The means-end chain theory and the laddering technique have been developed by marketing researcher (Gutman, 1982; Olson and Reynolds, 1983) and, recently, been used in understanding consumer choice of food related products (Grunert and Bech-Larsen, 2005; Le Page, et. al 2005; Urala, 2005). Research that applies the laddering technique is almost non-existing within the field of residential development. Only three previous research studies is found (Coolen and Hoekstra, 2001; Coolen, Boelhouwer and Van Driel 2002; Lundgren, 2009). Measuring buyers experience and the actual performance of a product is important, for example, in understanding customers’ satisfaction (Churchill and Surprenant, 1982; Day, 1977; Oliver, 1977, Tse and Wilton 1988).

According to Bookout (1994) and Psilander (2004), residents and tenants almost universally perceive a residential development as a whole, not as a series of parts that can be measured and rated individually. The complexity of a whole real-estate development also makes it difficult for real-estate developers and other decision makers to know ex ante the design of specific places that will appeal to specific segments of buyers. From a developer’s perspective it would be an achievement to be able to unravel what product attributes to provide and how to configure those to satisfy the preferences and needs of a specific group of households. In this article the complexity of a real-estate development is evaluated by measuring the strengths of beliefs the individuals form about desired abstract product attributes, functional and psychological consequences and their personal values.

The means-end chain theory provides an explanation of how consumers’ knowledge of products is stored and organised in human memory as means-end chains. The theory is based on the belief that consumers make a purchase decision that will lead to an important personal outcome (Gutman, 1982; Olson and Reynolds, 1983). Consumers are not primarily interested in product attributes, instead they are interested in the experiences they can gain from having the product. These experiences are defined as consequences, the importance of which is directed by the personal or social values that the person holds. The means-end chain model, consisting of six levels: Concrete and Abstract Attributes 1; Functional and Psychological Consequences and Instrumental and Terminal Values is commonly used in means-end chain research (Le Page et al., 2005). The laddering technique is developed as an in-depth one-to-one technique to elicit means-end chains from a respondent. Data that is stored as means-end chains can be retrieved as excerpts from a respondent’s cognitive structure by the laddering technique (Reynolds and Gutman, 1988; Grunert, K.G. and Grunert, S.C. 1995; Grunert and Bech-Larsen, 2005) and is visualised as categorised meta-data by hierarchical value maps (Reynolds, Dethloff and Westberg, 2001).

Attitudes and beliefs (Rosenberg, 1956, 1960; Zanna and Rempel, 1988) and their effect upon behaviour have been an extensive research area in social science (Ajzen and Fishbein, 1980; Ajzen, 1991). Beliefs acts the forerunner to the development of attitudes (Ajzen, ibid). A definition of attitudes widely used in research is “a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour” (Engly and Chaiken, 1993). According to Zanna and Rempel (ibid) attitudes are defined as “the capitalization of a stimulus object along an evaluative dimension”. This means that attitudes are evaluative judgements of an object in terms of its “goodness” or “badness”. Means-end chain research has shown (Le Page et al., ibid) that laddering data, as beliefs, are an important predictor of attitudes. It has also been shown that laddering
data may increase the explanatory power of choice option attractiveness (Grunnert and Bech-Larsen, ibid) beyond beliefs about a product that was derived by the expectancy value model (Ajzen and Fishbein, ibid).

**Research hypothesis**

The research question is as follows: will there be differences in buyers’ and non-buyers’ attitudes when they evaluate different locations within the residential development of Frösunda? If so, where will we find such differences and will there be significant differences in the strength of their beliefs? To investigate this research question, I will test the null hypothesis at the 95% confidence level that there are no differences in attitudes of bidders and non-bidders towards different places in Frösunda against the alternative hypothesis:

\[ H_1: \text{Attitudes of those individuals who bid will significantly differ from those individuals who prefer not to bid with respect to factors that relate to abstract product attributes, functional and psychological consequences and personal values.} \]

**Research method**

The theoretical standpoint made by (Gutman, ibid; Rokeach, 1973; Simon et al., 1987; Seth, 1991; Schwartz, 1994; Coolen and Hoekstra, ibid; Coolen, Boelhouwer and Van Driel, ibid) that values affect people’s behaviour is adopted in this study to understand buyers’ evaluation and their experience of the built environment in Frösunda. Following this research tradition, beliefs which potential buyers form about functional and psychological consequences is guided by their values. The definitions made by Rokeach (ibid), is chosen where values are defined as being instrumental or terminal. In order to determine which factors buyers evaluate we use beliefs found in a previous laddering study (Lundgren, ibid). In this study the potential buyers’ own experience of the real estate development of Frösunda was captured using the walk-through evaluation method (Ambrose and Dyregaard, 1993; Ambrose and Paulsson, 1996; de Laval 1994). Using a walk-through respondents were asked to visit each of the four locations in turn (see plates 2-5), writing down three positive and the negative observations and indicating their importance. This procedure makes sure that the scale, which is used to measure product performance, contains statements that are relevant from the perspective of a buyer (see the appendix plate 1, table 1).

**The study object**

The large-scale urban development in our study, Frösunda, is located 3 kilometres to the north of Stockholm, Sweden (see plate 1 in the appendix). This real estate development is based on the New Urbanism principle. The first residential units were built during 1999 and the project will be completed during 2010, then consisting of approximately 2,500 tenant-owned apartments with “bostadsrätt”. The building styles represent a modern urban design, combining offices and commerce with multi-family buildings. Within Frösunda there are public services such as day care centres, primary and secondary schools and private services such as cafés, restaurants and banks, as well as residential brokers. The four locations were chosen after discussions with the advisory board who found the locations to be representative of Frösunda. The main entrance in Frösunda is by the E4 and the main road, Gustav III Boulevard, passes through the place. The main buildings have a circular form and represent a modern building style, having white plaster facades (see plate 2, no.1 in the appendix). The street Frögatan is a side road off Gustav III Boulevard and the buildings on both sides of the road have balconies oriented towards the street and sidewalks that lead towards an open car parking and a large green area (see plate 3, no.2). The inner courtyard has buildings that surround trees, shrubberies and a small playground for children. In the inner courtyard there are benches for people to rest on placed at strategic
intervals along several footpaths (see plate 4, no.3). The town square is surrounded by office buildings and multi-family units and has amenities such as a kiosk, a café, a sculpture, benches and trees (see plate 5, no.4).

Scale development

Laddering study
According to Grunnert and Bech-Larsen (ibid) an important criterion to ensure predictive validity, using the means-end chain model and the laddering technique, is a homogeneous group of customers which share some common frame of mind with respect to an object of interest. The theoretical motivation is the spreading activation theory (Anderson, 1983a, 1983b). I have fulfilled this condition by selecting potential buyers who are as close to their purchase decision as possible and the respondents have the purchase of an apartment in the real-estate development of Frösunda as a common interest. The data collection for the laddering study was made during a period of 9 weeks from mid-August to mid-October 2007 (Lundgren, ibid). The data collection was made at eight open sales of privately owned two- to four-bedroom apartments in Frösunda. Each sale was visited by between 9 and 25 people. 86 of them were asked about their interest in participating in the study as they left the apartment. A total of 65 specially designed walk-through surveys were handed out and subsequently 35 were returned in a prepaid envelope, making a response rate of 55 percent. The respondents were asked to perform a walk-through evaluation and visit each of the four locations in turn (see plates 2–5), write down three positive and three negative observations and indicate their importance. These observations were later used as the starting point in the laddering interviews, which were held during a telephone interview. The answers from the respondents were classified into a certain type (concrete or abstract attribute, functional or psychological consequence, instrumental or terminal value) and then categorised into a certain belief. The laddering study resulted in 163 ladders by bidders and 165 ladders by non-bidders. In total 16 hierarchical value maps covering the means-end chains of bidders and non-bidders found in Frösunda were made using MECanalyst software, version 1.0.14. The group of bidders consisted of 10 respondents aged 32–82 years; non-bidders consisted of 9 respondents aged 37–65 years.

The most frequent beliefs found in our laddering study were used in the creation of 41 attitude statements. Those beliefs with low frequency were discarded. The statements were pre-tested using 18 staff members and students (10 male and 8 female) from The School of Architecture and the Built Environment, The Royal Institute of Technology, Stockholm. 36 attitude statements were included in the questionnaire; six statements were discarded because of a high correlation with other statements. The questionnaire had five separate sections: four consisting of street maps and photos for each of the locations in Frösunda, containing 36 statements in each and, lastly, a final section with questions to capture whether they had made a bid or not, as well as questions providing contact information, socio-economic and socio-demographic information.

The questionnaire and data collection
The date and time for the open sale were advertised by residential brokers in local newspapers and on the internet. The respondents participating in the quantitative study were recruited by the author when they left the apartment on sale. The socioeconomic profiles of the respondents that participated in our study accorded with those of Frösunda residents. The potential buyers were told that the research study aimed at investigating how future residential developments can be made more attractive. When the potential buyers indicated their interest, a short presentation was made of how to perform the walk-through. The respondents were, as in the laddering study, asked to visit each of the four locations in turn (see plates 2–5) and answer the questionnaire. They were also instructed
to return the questionnaire within three weeks in a prepaid envelope and received a lottery ticket as soon as their survey had been returned. 38 males and 53 females decided to participate (mean = 45.5 years, std = 13.5 years). In total, 174 questionnaires were handed out between October 2008 and March 2009 and 86 questionnaires were subsequently returned; after a reminder was sent out the number of questionnaires increased to 94. Three questionnaires were discarded as incomplete thus making a response rate of 52.3 percent. In June 2009 a telephone call was made to non-bidders to confirm whether they had made a bid or not, or whether they had any intention to buy an apartment in Frösunda since they filled in the questionnaire. 34 respondents answered that they had not made a bid on an apartment on sale, nor were they interested in buying one. The number of respondents that became bidders was 57 and the number of non-bidders was 34.

Scale testing

The strength of the respondents' beliefs was measured using both positively and negatively formulated statements on a five-point scale Likert scale (1 = strongly disagree to 5 = strongly agree). In order to evaluate our hypothesis and compare differences in the strength of buyers' and non-buyers' beliefs one scale (Real-estate Development, RED) was developed (see table 1, plates 2–5). Analysis was made using SPSS Statistics 17.0. 36 items were entered into explorative factor analysis. Five items with a highly skewed distribution were discarded from further analysis. To investigate the number of factors that explain most of the variability in the laddering data the items were grouped into independent dimensions (principal component analysis). Six factors with an eigen value of one or greater were found. Items with factor loadings of 0.30 or more and the content of the items were screened to gain a first insight into the dimensionality. As a result of the overall analysis the dataset was forced into five sub-scales (maximum likelihood, varimax rotation). To finally decide which items should belong to a specific sub-scale the items in a factor were compared with means-end chains that I found in the initial laddering study. If an item did not have a conceptual good fit into a specific topic that item was shifted into another sub-scale if appropriate, or discarded. As a result of the explorative factor analysis and the evaluative process 27 items were selected into the final scale, consisting of 5 sub-scales (see table 1 and table 2).

Each factor was analysed to verify that the items formed one dimension only. The Kaiser-Mayer-Olkin and Bartlett's test of the suitability of the correlation matrix for factor analysis showed that the data set was factorable (> 0.85, p <.000). A test-retest of reliability was made using one of the statements twice in the questionnaire. The correlation (Pearson correlation) in four locations was 0.73. The internal-consistency reliability of the sub-scales from the current sample was investigated using Cronbach’s Alpha. The cumulative variation (maximum likelihood, varimax rotation) by five sub-factors was Frösunda entrée: 58.0%, the street Frögatan: 63.7%, the inner courtyard: 67.5%, the town square: 64.5%. These factors can be thought of as representing: urban environment, architecture, safety, relaxation, liveliness.
Results

Sub-scales

First, a short note that describes the content of the five sub-factors. The first factor was termed urban environment and consists of six statements that capture the attitude a respondent has towards the urban environment. This sub-scale has two statements which are abstract product attributes and five statements that are psychological consequences. An abstract product attribute is an intrinsic feature of concrete product attributes and is perceived by the respondents. A psychological consequence tells how the respondent feels being in the location, for example afraid or uncomfortable. In this sub-scale abstract attributes are as follows: positive overall impression and nice urban environment. The psychological consequences are: at ease, feel at home, feel good and comfortable. Respondents who score highly on this sub-scale have a positive experience of the place and believe that it represents an attractive urban environment.

The second factor was termed architecture and consists of six statements that capture the attitude of the respondents towards the architecture in a specific location in Frösunda. All six statements are abstract product attributes which have been categorised as a result of the laddering interviews by potential buyers in Frösunda. In this sub-scale the abstract attributes are: attractive, uninteresting, varied, pleasing, boring, the buildings are all the same. There are no statements about liking, such as “Do you like this architecture?” since that item would not capture any intrinsic feature of concrete product attributes. Respondents who score highly on this sub-scale believe that the architecture appeals to them.

The third factor was named safety and consists of four statements that capture attitudes towards safety. In this factor two items are statements regarding functional consequences, one statement is a psychological consequence and lastly one statement is a terminal value. The statements contain beliefs such as: play and be safe, safe playgrounds, traffic noise and, lastly, a safe urban environment. Respondents who score highly on this sub-scale feel that the place is a safe one.

The fourth factor is termed relaxation and consists of statements that capture the capacity of the place to support personal activities and whether the place supports people in relaxing on their own terms. This factor has seven attitude statements based on beliefs about psychological consequences and instrumental values as follows: relax, feel at home, feel uncomfortable, stop and rest, perform activities, interest me. An instrumental value is a belief about whether the place is supporting a personally preferable mode of conduct, such as, for example, being able to go out jogging. The items in this sub-scale are negatively formulated to capture aspects that are preventing the respondent from relaxing in a home environment. Respondents who score highly on this sub-scale believe that they can feel free and relax in a specific place in Frösunda.

The fifth factor is termed liveliness and consists of statements that capture the attitude towards the place as being lively or not. This sub-scale contains four statements which are based on abstract product attributes and one statement that is a functional consequence. The abstract product attributes are: dead, full of life and deserted. The functional consequence is: a good place to meet people. Respondents who score highly on this sub-scale experience the place as lively and not as a dull place.
Measuring performance using the RED scale

The ratings in the RED scale are based on a five-point Likert scale and respondents who rate highly on a sub-scale perceive the built environment to be better than respondents who rate lower. The differences in attitudes are tested using a 95 percent confidence interval and an independent t-test (see table 3).

The factor *urban environment* has six positively worded statements explaining 17.3–21.5% of the variance in four locations (maximum likelihood, varimax rotation (see table 1). The internal consistency reliability of this sub-scale, measured by Cronbach’s Alpha, varies between 0.9–0.94. There is a significant difference in attitudes towards the urban environment in three out of four places. Bidders had the highest attitude score at the inner courtyard (mean = 4.1). The largest difference in the potential buyers’ ratings is found at the street of Frögatan (mean = 4.0 bidders, mean = 3.3 non-bidders). An independent t-test showed that the differences in attitudes towards the street of Frögatan were significant (t = 4.05, df = 80, p = .000, two-tailed).

The factor *architecture*: This factor consists of six positive and negative formulated statements explaining 14.8–17.9% of the variance. The internal consistency reliability of this sub-scale was measured using Cronbach’s Alpha and varies between 0.81–0.92. An independent t-test confirms that differences in attitudes is significant in two out of four places, for example at the inner courtyard (mean = 3.9 bidders, mean = 3.2 non-bidders t = 3.994, df = 75, p = .000, two-tailed). The street of Frögatan received the lowest attitude score on the factor architecture (mean = 3.8, bidders, mean = 3.1, non-bidders, t = 3.49, df = 79, p = .001, two-tailed).

The third factor *safety* consists of four positive and negative formulated statements explaining 7.7–14.0% of the variance. The internal consistency reliability of this sub-scale varies between 0.71–0.77. There is no significant difference in attitudes towards safety in three out four locations. A difference in attitudes is only confirmed in the street of Frögatan (see table 3).

The fourth factor *relaxation* consists of seven positive and negative formulated statements explaining 7.7–10.8% of the variance and the internal consistency reliability of this sub-scale varies between 0.87–0.91. A difference in buyers’ and non-buyers’ attitudes in the sub-scale relax are confirmed in three out of four locations.

The fifth factor *liveliness* consists of four positive and negative attitude statements explaining between 6.3–9.2% of the variance. The variance and the internal consistency reliability of this sub-scale varies between 0.75–0.84. A difference in attitudes towards this factor is confirmed in the street of Frögatan and in the inner courtyard.

Evaluating the hypothesis

In evaluating the hypothesis, the mean values by bidders (n = 57) and non-bidders (n = 34) was compared using an independent t-test (95% confidence interval) and five sub-scales in four different locations (see table 3). In Frösunda Entrée only one factor out of five turned out to have a significant difference in the mean values of bidders and non-bidders. This means that the difference in mean values might be the result of chance in four out of five factors. Thus, there is not a significant difference in attitudes between those who make a bid and those who do not. Such a particular factor is equally “good” or “bad” from the perspective of the bidders and the non-bidders. On the contrary, in the street of Frögatan, all five factors proved a significant difference. In the inner courtyard a significant difference was found in four out of five factors. Lastly, in the town square only the factor relaxation proved a significant difference in attitudes. We have to reject the null hypothesis.
since the alternative hypothesis was confirmed. The means-end chain theory and qualitative data from this laddering study do capture beliefs about the built environment that have an influence on buyers’ decision-making when deciding whether to buy or not.
Conclusions

In the introduction chapter there is a description of how the complexity of the built environment imposes a restriction on the possibility for real-estate developers in knowing *ex ante* the design that will appeal to specific segments in a specific location. I proposed that the means-end chain theory and the laddering technique can assist developers in capturing beliefs in the attribute–consequence–value chain that are important to people in their purchase decision. This turned out to be true. The beliefs in my laddering study were an important predictor of attitudes which also been found by (Le Page et. al., ibid). The scale which is developed in this study does capture buyers’ evaluation of the performance of the residential development of Frösunda in four locations. Thus, there is reasonable evidence to believe that residential developers and planners can find this scale useful, if a customer perspective matters, while planning the design of new developments.

There is a limitation to the generalisation of these results since this scale has not been re-tested using an independent sample to assess the generalisation of the factors found in this study. However, when a larger sample is used in a re-test there is also the opportunity of investigating whether we can find any significant differences in attitudes towards the built environment related to age and income or other socio-economic variables of interest.

Reviewing the results, the factor safety seems to be the most problematic one in Frösunda entrée and the town square. The structure of Frösunda entrée that has had an effect on the factor safety needs re-thinking if re-used in other projects. The street Frögatan proved to be extraordinary, since both bidders and non-bidders had significantly different mean values on all five sub-factors. The design of the inner courtyard should also have been given a different design due to the same reason as the street of Frögatan, even if this inner courtyard is regarded as one of the best in Frösunda. This is a signal to planners and developers in trying to understand the reasons for the reaction of the buyers and the non-buyers. Such an understanding is achieved by investigating the physical structure of the place.

Looking ahead, what other questions could be of interest in empirical research using the attribute–consequence–value approach in finding other factors than these five? One option could be to select potential customers according to a specific position in the life cycle, assuming that their needs will be equal as a group. A research question could be: Are there new factors along the attribute–consequence–value chain that have an effect on the choice of a residential development, when the group of interest is families with small children? Will we find significant correlation with these new factors to variables such as age or disposable income, or is taste uncorrelated with such variables? Another research question could be to evaluate specific places in an existing old town centre to find out factors along the attribute–consequence–value chain that are related to a particular urban structure. This makes sense since the principle of new urbanism has old European town structures as a key model. Such an investigation could equally well be addressed using a life-cycle approach. The benefits of using attitude scales would be to avoid mistakes while planning the design of new real-estate developments, a strategy which could equally well increase the marketability and profits in new projects.
Table 1. Multivariate analysis: factor loadings (maximum likelihood, varimax rotation), internal-consistency and total variance explained by five factors in the RED scale.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Cronbachs Alpha</th>
<th>Variance explained %</th>
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<tbody>
<tr>
<td></td>
<td>FE  FG  IC FS</td>
<td>FE  FG  IC FS</td>
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</table>

1. RED Urban
- This is a really nice urban environment: 0.69 0.73 0.78 0.77 0.91 0.93 0.94 0.93 21.5 17.2 19.3 17.3
- I feel at ease here: 0.54 0.89 0.87 0.81
- This is a place where I feel at home: 0.58 0.73 0.83 0.78
- This is a comfortable living environment: 0.77 0.83 0.82 0.79
- This place provides a really positive overall impression: 0.61 0.73 0.82 0.77
- This place makes me feel good: 0.68 0.72 0.71 0.59

2. RED Architecture
- The architecture is attractive: 0.57 0.80 0.70 0.72 0.81 0.92 0.90 0.91 14.8 16.3 17.9 16.6
- The architecture of the buildings is uninteresting: 0.42 0.63 0.72 0.54
- The housing environment is really varied: 0.35 0.75 0.65 0.65
- The relative placing of the buildings makes a pleasing impression: 0.42 0.76 0.68 0.94
- The buildings are boring: 0.59 0.85 0.83 0.69
- The buildings are all the same: 0.47 0.68 0.72 0.60

3. RED Safety
- This is a place where children can play and be safe: 0.54 0.60 0.76 0.62 0.73 0.71 0.72 0.77 7.7 14.0 10.6 11.6
- This is a safe urban environment: 0.61 0.39 0.73 0.71
- The traffic does not disturb me: 0.40 0.31 0.42 0.48
- There are no safe playgrounds for children: 0.18 0.41 0.73 0.36

4. RED Relaxation
- I cannot relax here: 0.60 0.55 0.66 0.71 0.87 0.88 0.88 0.91 7.7 9.0 10.5 10.8
- I do not feel at home here: 0.71 0.78 0.77 0.87
- There's nowhere you can stop and rest for a while: 0.71 0.70 0.58 0.63
- This place makes me feel uncomfortable: 0.93 0.46 0.57 0.66
- There is nothing that interests me here: 0.76 0.75 0.76 0.68
- There is nowhere for me to do any activities: 0.63 0.52 0.56 0.53
- This place makes me feel insecure: 0.81 0.60 0.68 0.73

5. RED Liveliness
- This is a dead place: 0.99 0.66 0.73 0.71 0.76 0.82 0.75 0.84 6.3 7.2 9.2 8.2
- This is a full place of life: 0.40 0.41 0.64 0.36
- This is a good place to meet people: 0.51 0.35 0.43 0.61
- This place is really deserted: 0.34 0.73 0.65 0.75

R = Negative statements. FE = Frösunda Entrée, FG = the street of Frögatan, IC = inner courtyard, FS = Frösunda square.
Table 2. Multivariate analysis: (maximum likelihood, varimax rotation), mean values and standard deviation of five factors in the RED scale.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Factor</th>
<th>FE Mean</th>
<th>FE St.dev</th>
<th>FG Mean</th>
<th>FG St.dev</th>
<th>IC Mean</th>
<th>IC St.dev</th>
<th>FS Mean</th>
<th>FS St.dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RED Urban</td>
<td>This is a really nice urban environment</td>
<td>3.7</td>
<td>0.85</td>
<td>3.8</td>
<td>0.81</td>
<td>4.2</td>
<td>0.70</td>
<td>3.8</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>I feel at ease here</td>
<td>3.8</td>
<td>0.62</td>
<td>3.8</td>
<td>0.84</td>
<td>4.0</td>
<td>0.76</td>
<td>3.8</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>This is a place where I feel at home</td>
<td>3.3</td>
<td>0.97</td>
<td>3.6</td>
<td>0.93</td>
<td>3.9</td>
<td>0.94</td>
<td>3.5</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>This is a comfortable living environment</td>
<td>3.5</td>
<td>0.97</td>
<td>3.8</td>
<td>0.91</td>
<td>4.1</td>
<td>0.78</td>
<td>3.8</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>This places provides a really positive overall impression</td>
<td>3.9</td>
<td>0.80</td>
<td>3.9</td>
<td>0.83</td>
<td>4.1</td>
<td>0.72</td>
<td>3.9</td>
<td>0.93</td>
</tr>
<tr>
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<td>This place makes me feel good</td>
<td>3.6</td>
<td>0.91</td>
<td>3.6</td>
<td>0.97</td>
<td>3.6</td>
<td>0.88</td>
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<td>3.7</td>
<td>0.9</td>
<td>4.0</td>
<td>0.8</td>
<td>3.7</td>
<td>0.9</td>
</tr>
<tr>
<td>2. RED Architecture</td>
<td>The architecture is attractive</td>
<td>4.0</td>
<td>0.64</td>
<td>3.7</td>
<td>0.98</td>
<td>3.9</td>
<td>0.74</td>
<td>3.8</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>The architecture of the buildings is uninteresting</td>
<td>3.8</td>
<td>0.99</td>
<td>3.6</td>
<td>1.07</td>
<td>3.7</td>
<td>1.02</td>
<td>3.7</td>
<td>1.03</td>
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<tr>
<td></td>
<td>The housing environment is really varied</td>
<td>3.3</td>
<td>0.82</td>
<td>3.5</td>
<td>0.93</td>
<td>3.3</td>
<td>0.82</td>
<td>3.5</td>
<td>0.88</td>
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<tr>
<td></td>
<td>The relative placing of the buildings makes a pleasing impression</td>
<td>3.6</td>
<td>0.97</td>
<td>3.4</td>
<td>0.97</td>
<td>3.5</td>
<td>0.89</td>
<td>3.6</td>
<td>0.85</td>
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<tr>
<td></td>
<td>The buildings are all the same</td>
<td>3.9</td>
<td>0.86</td>
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<td>3.9</td>
<td>0.96</td>
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<td>1.0</td>
<td>3.6</td>
<td>1.10</td>
<td>3.6</td>
<td>1.02</td>
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<tr>
<td>3. RED Safety</td>
<td>This is a place where children can play and be safe</td>
<td>2.3</td>
<td>1.24</td>
<td>3.4</td>
<td>0.94</td>
<td>4.3</td>
<td>0.72</td>
<td>2.7</td>
<td>1.08</td>
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<tr>
<td></td>
<td>This is a safe urban environment</td>
<td>2.9</td>
<td>1.11</td>
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<td>0.95</td>
<td>4.1</td>
<td>0.88</td>
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<td>The traffic does not disturb me</td>
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<td>0.99</td>
<td>3.3</td>
<td>0.99</td>
<td>3.8</td>
<td>1.06</td>
<td>2.5</td>
<td>0.89</td>
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<td>1.2</td>
<td>3.4</td>
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<td>0.9</td>
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<td>4. RED Relaxation</td>
<td>I cannot relax here</td>
<td>3.5</td>
<td>1.21</td>
<td>3.9</td>
<td>0.98</td>
<td>4.1</td>
<td>0.76</td>
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<td>1.07</td>
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<tr>
<td></td>
<td>I do not feel at home here</td>
<td>3.8</td>
<td>1.17</td>
<td>3.9</td>
<td>0.97</td>
<td>4.1</td>
<td>0.96</td>
<td>3.9</td>
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<td></td>
<td>There is nowhere you can stop and rest for a while</td>
<td>3.7</td>
<td>1.23</td>
<td>3.9</td>
<td>0.99</td>
<td>4.3</td>
<td>0.72</td>
<td>4.2</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>There’s nowhere for me to do any activities</td>
<td>4.1</td>
<td>0.97</td>
<td>3.4</td>
<td>1.06</td>
<td>4.0</td>
<td>0.87</td>
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<td>This place makes me feel uncomfortable</td>
<td>3.9</td>
<td>0.94</td>
<td>4.0</td>
<td>0.99</td>
<td>4.1</td>
<td>0.97</td>
<td>4.2</td>
<td>0.92</td>
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<td>This place makes me feel insecure</td>
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<td>0.96</td>
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<td>0.71</td>
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<td>3.7</td>
<td>0.95</td>
<td>3.7</td>
<td>1.10</td>
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<tr>
<td>5. RED Livelihood</td>
<td>This is a dead place</td>
<td>4.1</td>
<td>0.97</td>
<td>3.9</td>
<td>0.97</td>
<td>4.0</td>
<td>1.02</td>
<td>4.1</td>
<td>0.99</td>
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<tr>
<td></td>
<td>This is a place full of life</td>
<td>3.9</td>
<td>0.85</td>
<td>3.3</td>
<td>0.75</td>
<td>3.2</td>
<td>0.89</td>
<td>3.8</td>
<td>0.90</td>
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<td>This is a good place to meet people</td>
<td>3.6</td>
<td>0.90</td>
<td>3.4</td>
<td>0.96</td>
<td>3.9</td>
<td>0.73</td>
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<td>3.6</td>
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<td>3.8</td>
<td>0.9</td>
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<td>0.9</td>
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</table>

R = Negative statements, FE = Frösunda Entrée, FG = the street of Frögatan, IC = inner courtyard, FS = Frösunda square.
Table 3. Mean values, independent t-test (95% significance levels), of respondents in the real-estate development of Frösunda.

<table>
<thead>
<tr>
<th>Factor RED Urban</th>
<th>Buyers</th>
<th>scale mean</th>
<th>st. dev</th>
<th>t-test</th>
<th>df</th>
<th>sign. (2-tailed)</th>
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<tbody>
<tr>
<td>Yes</td>
<td>3.9</td>
<td>0.672</td>
<td>2.39</td>
<td>79</td>
<td>0.020</td>
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<td>3.4</td>
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<table>
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<tr>
<th>Factor RED Architecture</th>
<th>Buyers</th>
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<th>t-test</th>
<th>df</th>
<th>sign. (2-tailed)</th>
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<tbody>
<tr>
<td>Yes</td>
<td>3.8</td>
<td>0.528</td>
<td>1.92</td>
<td>79</td>
<td>0.059</td>
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<td>3.5</td>
<td>0.737</td>
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<th>Buyers</th>
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<th>t-test</th>
<th>df</th>
<th>sign. (2-tailed)</th>
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<tbody>
<tr>
<td>Yes</td>
<td>2.7</td>
<td>0.842</td>
<td>0.733</td>
<td>78</td>
<td>0.467</td>
<td></td>
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<td>0.887</td>
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<tr>
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<th>Buyers</th>
<th>scale mean</th>
<th>t-test</th>
<th>df</th>
<th>sign. (2-tailed)</th>
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<td>78</td>
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<th>st. dev</th>
<th>t-test</th>
<th>df</th>
<th>sign. (2-tailed)</th>
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<tbody>
<tr>
<td>Yes</td>
<td>4.0</td>
<td>0.599</td>
<td>1.464</td>
<td>78</td>
<td>0.147</td>
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<th>st. dev</th>
<th>t-test</th>
<th>df</th>
<th>sign. (2-tailed)</th>
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<td>Yes</td>
<td>4.0</td>
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<td>80</td>
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<th>sign. (2-tailed)</th>
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<th>sign. (2-tailed)</th>
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Appendix

Plate 1. Part of Frösunda, Solna. Paths that were chosen in the walk-through evaluation.

Plate 2: no.1 Frösunda Entrecé
Plate 3: no.2 The street Frögatan
Plate 4: no.3 Inner courtyard
Plate 5: no.4 Frösunda Square
References


Bookout, L.W., et al. (1994) Value by Design – Landscape, Site Planning and Amenities. The Urban Land Institute, Washington.


Gutman, J. (1991) Exploring the Nature of Linkages Between Consequences and


MECanalyst software, v. 1.0.14, SkyMax_DG, Milano, Italy.


Concrete attributes are tangible and physical characteristics that have a distinct material form that can be observed by an individual. Abstract attributes are subjective, intangible characteristics that cannot be represented as a distinct material form and communicate more hedonic and emotional motives for product acquisition.

A functional consequence is defined as a direct and tangible outcome, positive or negative, as experienced by a person while he is using a product.

A psychological consequence is defined as a result of how a person feels using a product. Responses refer to usage, usage situations or conditions that have a hedonic or an expressive function.

An instrumental value is an enduring belief that a specific mode of conduct is personally preferable to an opposite mode of conduct.

A terminal value is an enduring belief that a specific end-state of existence is personally or social preferable to an opposite end-state of existence.

According to Swedish law “bostadsrätt” is a tenant-owned housing/housing association. A housing association is a co-operative association normally consisting of between 20 and 100 apartments (tenant-owner apartments) built together or as detached units in a defined geographical area. The members (the residents in the tenant-owned housing) own a share of the housing association which in turn owns the housing. The members are free to sell their share and thus their tenantship rights on the open market.

Besqab, JM, NCC, Stockholm municipality, Solna municipality, Sollentuna municipality, Swedbank, Upplands-Väsby municipality, Veidekke.
Paper four

Modeling antecedents to customers' satisfaction in a residential development

Berndt, A. Lundgren
Modeling antecedents to customers' satisfaction in a residential development

Berndt, A. Lundgren

Royal Institute of Technology, Department of Building and Construction Management, Division of Building and Real Estate Economics

Abstract

This research paper empirically tests the effects of values, expectations and perceived performance on customer satisfaction in a residential development, using a structural equation modeling approach. The empirical study in this article was carried out in two phases. The first phase was a qualitative laddering study to capture buyers’ beliefs about benefits and disadvantages in the real-estate development of Frösunda, Sweden. In the second phase a confirmatory factor analysis was made to investigate antecedents to customer satisfaction. A positive and causal relationship was found between values, expectations, perceived performance and customer satisfaction. A sub-model using instrumental and terminal values as an antecedent to perceived performance provided the best explanation of customer satisfaction. These findings stem from one study with a fairly limited number of respondents (n = 155). Retests should be done also using group analysis to investigate the effects of differences of socioeconomic and sociodemographic characteristics on customer satisfaction. This paper demonstrates how the laddering technique and structural equation modeling can improve how market studies of customers’ satisfaction are carried out in the residential sector. The academic work contributes to research in customer satisfaction as well as in real estate economics.

Keywords
Residential development, Consumer satisfaction, Structural equation models, Means-end chain theory, Laddering
Introduction

Customer satisfaction is an important theoretical concept and practical instrument for companies to better understand how to make their customers satisfied. How to measure customer satisfaction using different approaches to stay competitive in the market place has been described by Szymanski and Henard (2001). There are only a few recent research articles dealing with customer satisfaction with a focus on residential development (Forsythe, 2007, 2008; Holm and Bröchner, 1999; Lundgren, 2009b; Ozaki, 2003; Psilander, 2004).

One important reason for the sparse research focus on consumer satisfaction is the tradition of governments in supporting research directed to the supply side of real-estate construction. Moreover, various kinds of subsidies to stimulate demand for housing have also contributed in reducing a focus on customer satisfaction. There seems to be an ongoing shift in focus in the housing sector, from a production-oriented one towards an increased interest in customer satisfaction in Sweden; see for example: ‘Skärpning gubbar’ (Swedish Government Official Report 2002:115) and, recently, the report ‘Sega gubbar’ (Byggkommissionen, 2009). State agencies funding research in Sweden, construction companies and planning offices now take a more active part in customer-oriented research in the residential sector.

How to develop the research area in customer satisfaction for residential development is not a simple task. In order to understand what performance is and how quality is evaluated it is necessary to identify what buyers really are looking for (Grönroos, 2007). At the moment we do not know much about how to conceptualize customer satisfaction in residential construction (Forsythe, ibid). Nor do we have a profound knowledge of how to measure perceived performance of a residential development and how performance is related to customer satisfaction as described by Churchill and Surprenant (1982), Cronin and Taylor, (1992) and Tse and Wilton (1988).

Reviewing customer satisfaction literature (Szymanski and Henard, ibid), little is written about the antecedents to expectations and perceived performance reflecting silent values from a theoretical standpoint. Johnson (1998) refers to value ladders and the laddering technique as an under-utilized tool in marketing research. Laddering is an interview technique to elicit attribute–consequence–value chains, defined by the means-end chain theory. Preceding this article, a case study was made studying residential buyers’ and residents’ attribute–consequences–value ladders in four different locations in the residential development of Frösunda, Sweden (Lundgren, 2009a). As a result of this research study, a multi-attribute scale was developed to measure performance using five dimensions in each of the locations (Lundgren, ibid).

The means-end chain theory provides an explanation of how consumers’ knowledge of products is stored and organized in human memory as means-end chains (Gutman, 1982; 1991; Olson and Reynolds, 1983). An attribute–consequence–value ladder often consists of concrete and abstract product attributes, psychological and functional consequences (Olson and Reynolds, ibid) and terminal and instrumental values (Rokeach, 1973). How consumers’ beliefs, derived by the laddering method, can explain choice option attractiveness has been further discussed by Grunert and Bech-Larsen (2005). The authors found that beliefs linking the product to constructs of higher levels of abstraction, consequences and values improve the explanation of choice option attractiveness beyond the explanation achieved by beliefs linking the product to product attributes only. Means-end chain research has also shown (Le Page et al., 2005) that laddering data, as beliefs, were an important predictor of attitudes. In this article, values are modeled according to the means-end chain theory, as antecedents to customers’ expectations and perceived performance. This approach may prove fruitful to further enhance our understanding of customers’ satisfaction.
The study object; the residential development of Frösunda

The residential development of Frösunda, which is used in this research study, is located 3 kilometers to the north of Stockholm, Sweden (see plate 1 in the appendix). The first residential units were built during 1999 and the project will be completed during 2010, then consisting of approximately 2,500 tenant-owned apartments with “bostadsrätt”. The building styles represent a modern, new urban design, combining offices and commerce with multi-family buildings. Within Frösunda there are public services such as day-care centers, primary and secondary schools and private services such as cafés, restaurants and banks as well as real-estate agents. The main entrance to Frösunda is by Frösunda Entrée, which is close by the E4 and the main road, Gustav III Boulevard, passes through the development (see no.1 in the appendix). The street of Frögatan, which is used in this study, is a side road off Gustav III Boulevard and the buildings on both sides of the road have balconies oriented towards the street and pavements that lead towards an open car park and a large green area (see appendix, plate 2; no.1 and no.2).

The customer satisfaction model

Customer satisfaction is an individualistic experience that captures customers’ feeling of being satisfied with their purchase and their use of a product or the service given by a service provider. There are six broad directions in customer satisfaction research: the first one is “the perception based”, which is about customers making their evaluation of satisfaction based on the performance of the product only (Churchill and Surprenant, ibid; Tse and Wilton, ibid).

The second school is the “disconfirmation based”, in which satisfaction is the result of a relative comparison between pre-purchase expectations and the evaluative judgment of the performance (Oliver, 1977, 1980a). In measuring service quality, Parasuraman, Zeithaml and Berry (1988) developed the service quality instrument, SERVQUAL, which is based on disconfirmation and, as a follow up, Cronin, Steven and Taylor (1992, 1994) and Cronin and Brady (2001) presented their service performance model, SERVPERF. The latter model makes use of a direct comparison or “the perception based” approach, as advocated by Churchill and Surprenant (ibid).

The third school originates from seminal work done by Grönroos (1984), who defines service quality as having two dimensions: a technical (what is delivered) and a functional or process-related dimension (how service is delivered) affecting the perception of service quality. The fourth direction is represented by the development of the Swedish customer satisfaction index, which measures customer satisfaction in different sectors, such as banks, insurance companies and construction companies at a national level, for example (Fornell, 1992).

Other approaches to customer satisfaction which found support in the marketing literature are ‘affect’, which is grounded in affective-processing mechanisms and attribution theory (Westbrook and Oliver, 1991) and ‘equity’, which is an approach based on judgment about fairness, rightness, and deservingness (Oliver, 1997). There is no absolute consensus as to which of these models is right or wrong, however, when comparing research by the first two scholars, the disconfirmation model seems to play a more dominant role in satisfaction assessment (Szymanski and Henard, ibid). None of these approaches relate directly to values as defined by Rokeach (ibid), which we investigate as the antecedents to the formation of expectations and performance in this article.
The disconfirmation model (figure 1) has four constructs: expectations, performance, disconfirmation and satisfaction. A customer’s expectations are confirmed when a product performs as expected, or negatively disconfirmed when the product does not perform according to prior expectations, or positively disconfirmed when the product performs better than expected (Oliver, ibid). In an experimental study (Churchill and Surprenant, ibid) the authors used a video disc player to investigate the relation between disconfirmation and perceived performance. The performance of the video disc player, that is sound and picture quality, was manipulated by using a special device. The authors found that neither disconfirmation nor the respondents’ initial expectations had any significant effect on satisfaction. Customer satisfaction was determined solely by the performance of the video disc player. When the perceived performance was high the respondents were satisfied, otherwise not. The direct effect of perceived performance did not vary depending on the respondents’ expectations.

Similar findings have been reported by Tse and Wilton (ibid), who argue that their findings from laboratory research with record players provide strong theoretical and empirical support for extending the disconfirmation model to include direct influences from perceived performance.

**Should we measure disconfirmation or not?**

Research findings in customer satisfaction raise the question of whether perceived performance of a residential development is directly related to customer satisfaction or if customer satisfaction is mediated by disconfirmation. The relationship between product performance and satisfaction should be separately measured according to Churchill and Surprenant (ibid), Cronin, Steven and Taylor (ibid) and Tse and Wilton (ibid). On the other hand, according to Oliver (ibid) and Parasuraman, Zeithaml and Berry (ibid), customer satisfaction should be measured using the disconfirmation approach. We do not know which of these approaches is more relevant when measuring customer satisfaction in a residential development.
Are values antecedents to expectations and perceived performance?

From a theoretical standpoint, it would be rewarding to find out more about the antecedents to expectations and perceived performance using, for example, values as defined by Rokeach (ibid). In a study by Bloemer and Dekker (2007), the authors found values as an antecedent to customer satisfaction. Values were defined in line with Rokeach (ibid), but operationalized using Kahle’s list of values (Kahle et al., 1986).

Development of the customer satisfaction value model

*Figure 2* The customer satisfaction value model

Test of nomological validity

In figure two, values are modeled as an antecedent to expectations and perceived performance. We do not know if the customer satisfaction value model in figure two is nomologically valid or if nomological validity concerns certain sub-models only. To investigate this question I will evaluate a null hypothesis against two alternative hypotheses. The following structure of hypotheses is used to evaluate the value model and the disconfirmation model against the sub-models of direct measurement of expectations and performance. The goal of using these hypotheses is to find structural equation models that withstand the strict statistical test of nomological validity. If some models are ruled out, the best ones will remain (see table 1).

H0: There is no significant difference in nomological validity of the disconfirmation model (see figure 1) compared to the proposed customer satisfaction value model (see figure 2), at a probability level of 0.05 or higher. They are equally good. This null hypothesis is tested against the following two alternative hypothesis concerning potential sub-models:

H1: Structural sub-model one (see figure 3 and model three in table 1) consists of the following latent variables: *terminal and instrumental values, expectations* and *satisfaction* and is nomologically valid at a probability level of 0.05 or higher.

H2: Structural sub-model two (see figure 3 and model four in table 1) consists of the following latent variables: *terminal and instrumental values, performance* and *satisfaction* and is nomologically valid at a probability level of 0.05 or higher.
Test of structural relationships

We have not yet investigated how values as defined by (Rokeach, ibid) affect customer satisfaction and how perceived performance effect customer satisfaction. In order make such an investigation the following three hypothesis are formulated using the model in figure three.

H3: There will be a positive and significant relationship between the terminal and the instrumental value and expectations.

H4: There will be a positive significant relationship between the terminal and the instrumental value and perceived performance.

H5: An increase in perceived performance will lead to an increase in customer satisfaction.

How do we interpret the structural relationships in figure three?

An interpretation of the causal relationships is the following: A respondent’s evaluation of the performance of a place is influenced by the strengths of his beliefs. If product attributes and perceived consequences are according to his silent instrumental and terminal values we expect a positive and significant relationship between terminal and instrumental values and the perceived performance of a place. The theoretical justification is the spreading activation theory (Anderson, 1983a, 1983b; Anderson and Pirolli, 1984; Collins and Loftus, 1975), which postulates that the strength of a belief depends on the total loss of activation occurring in one or several cognitive categories. If buyers’ beliefs are firm, there exists a chain of beliefs, with varying strengths, which are activated by the statement about a specific place. When a resident or a bidder evaluates a specific place it is reasonable to expect a significant and positive correlation in the relationship of perceived performance and customer satisfaction. In hypotheses three to five, the existence of a positive relationship between values: expectations and perceived performance is tested as well as a positive relationship between perceived performance and customer satisfaction.
Data and research method

The data for this research study was collected by a multi-item attitude questionnaire. Respondents answering the questionnaire were residents and potential buyers visiting open sales of apartments in the residential development of Frösunda. The potential buyers acted in their own self-interest and could decide to make a bid if the performance of the apartment and the built environment was up to their preferences and expectations and if the selling price was acceptable in relation to their personal financial position. The built environment in Frösunda could be observed by the respondents before making a decision. If the trade-off between price, expectations and performance (the disconfirmation process) was not met, the potential buyers would most probably not participate in a bidding procedure. The asking price had been public on internet sites and in local newspapers several weeks before the open sale took place. The price per square meter for the apartment on sale in Frösunda could be compared with sales in other residential areas. In the bidding procedure, which was managed by the local sales agent, the asking price may not be the final one and thus could be lower or exceed the top price that a potential buyer is willing to pay.

The potential buyers were randomly recruited when they left the apartment on sale in Frösunda since asking one buyer another could pass by. The date and time for the open sale were advertised by residential brokers in local newspapers and on the internet. Since the location of Frösunda was known to the respondents before visiting the sales it is reasonable to assume that the respondents had found the location to be acceptable. The potential buyers and the residents were told that the research study aimed at investigating how future residential developments can be made more attractive and the actual purpose was not discovered. When the potential buyers indicated their interest, a short presentation was made of how to perform the walk-through. The respondents were, as in the laddering study, asked to visit the street of Frögatan and three other places (see plate 1) and answer the questionnaire. The number of questionnaires handed out at the open sales was 174 and 91 were finally approved as complete, making a response rate of 52.3 percent. In June 2009 a telephone call was made to potential non-bidders to confirm whether they had made a bid or not, or whether they had any intention of buying an apartment in Frösunda since they had filled in the questionnaire. The number of potential buyers that became bidders was finally 57. As an addition to this sample, 153 questionnaires were sent to residents in Frösunda in December 2008. Data about residents in the residential development of Frösunda were distributed by Bolagsverket (the Swedish Companies Registration Office) and respondents to the survey were randomly chosen. The socioeconomic profiles of the bidders that participated in our study accorded with those of Frösunda residents however, having a slightly higher income before tax per household (see table 3). The number of complete questionnaires was 98, making a response rate of 64 percent. In total 327 questionnaires were distributed to the respondents, resulting in 155 valid questionnaires.

The attitude statements that define the constructs were formulated by the author and a second person acting as a judge: Firstly, respondents were asked to perform a walk-through and make three positive and three negative remarks about a specific place in the residential development of Frösunda. In the next step, laddering interviews were conducted by the author to elicit their beliefs about positive and negative concrete and abstract product attributes and classified into a certain type (concrete or abstract attribute, functional or psychological consequence, instrumental or terminal value). In the third and final step respondents’ beliefs were categorized into a certain attitude statement and then pre-tested before entering into the questionnaire (Lundgren, ibid).
LISREL
An established theory can a priori define latent variables having causal relationships and a hypothesis can be tested by specifying causal relationships in a structural equation model using empirical data (Bollen, 1989; Hayduk, 1987; Jöreskog and Sörbom, 1993). The structural equation model in figure 3 is implemented in LISREL (LInear Structural RELations) by Jöreskog and Sörbom (ibid) and used to test a hypothesized relationship of a value construct as antecedent to expectations and perceived performance in a customer satisfaction model. The structural model equation is represented by indicators, relationships and latent variables. The indicators are numerical expressions that capture a measurement of an attitude or a number which represent, for example, a profit margin, or a sales figure. Indicators are part of a latent variable or constructs that represent the latent, common properties of the indicators. A latent variable is thus an abstract entity that, defined by its indicators, represents a specific phenomenon in the real world. In the study of customer satisfaction, perceived performance is an example of a construct, representing how well a product is performing from the perspective of a customer. Lastly, relationships between constructs represent a causal consequence between two latent variables. LISREL derives causal structures by analyzing both regular correlation and error covariances. By using LISREL it is possible to analyze both direct and indirect causal relations simultaneously (Bollen, ibid; Hayduk, ibid; Jöreskog and Sörbom, ibid).

Assessment of the homogeneity of indicators and their construct is made to validate that the constructs relate only to the chosen indicators. Convergent validity is assessed by investigating coefficients which measure the strength of relationships between two variables, t-values which measure statistical significance and $R^2$ values that estimate the strength of linearity of a relationship (Jöreskog and Sörbom, ibid).

Assessment of the separateness of constructs is made to determine discriminant validity between constructs. Discriminant validity is assessed by measuring the correlation between two constructs using a confidence interval and the standard error of the constructs. An alternative control can be made using the modification index that suggests changes to the model in LISREL.

The nomological validity is an assessment that is made to ensure that the model as a whole is a valid measure. Nomological validity is assessed by measuring the distance between the model and the data that represents constructs using Chi-Square, degrees of freedom ($\chi^2$, df) and a probability estimate (p-value). A valid measure of nomological validity for a structural model is when the relationship between ($\chi^2$, df) is close to 1 and the (p-value) is higher than 0.05.

Analysis of the structural equations using LISREL in this article was made by first of all analyzing the convergent validity of the indicators and then assessing the discriminant validity of the constructs. In the second step, the causal relationships between the constructs were analyzed to determine nomological validity. Missing values was treated using listwise deletion, since an asymptotic covariance matrix of estimated coefficients can only be estimated under this condition.
Nomological validity
The validity of a structural equation model is determined by measuring the nomological validity (Bollen, ibid; Hayduk, ibid; Jöreskog and Sörbom, ibid). The customer satisfaction model (model one), the hypothesized customer satisfaction value model (model two) and sub-model one (model three), sub-model two (model four) are empirically tested in a LISREL model using empirical data before proceeding to analysis of construct and discriminant validity.

Table 1. Test of nomological validity

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<td>0.77718</td>
<td>0.000</td>
<td>0.90</td>
</tr>
<tr>
<td>Model four</td>
<td>47.17</td>
<td>51</td>
<td>0.62637</td>
<td>0.000</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Construct and discriminant validity should only be tested for models three, and four since nomological validity is not empirically confirmed for model one and model two.
## Construct validity

### Table 2a. Construct analysis sub-model one (Expectation)

<table>
<thead>
<tr>
<th>Constructs and factor loadings</th>
<th>Abbreviation</th>
<th>Factor loading</th>
<th>t-value</th>
<th>Mean</th>
<th>Std dev</th>
<th>R2 value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Satisfaction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How satisfied or dissatisfied are you with this residential development</td>
<td>SATISF</td>
<td>0.93</td>
<td>na</td>
<td>8.36</td>
<td>1.27</td>
<td>0.86</td>
</tr>
<tr>
<td>To what extent does this residential development confirm your expectations</td>
<td>EXPECT</td>
<td>0.94</td>
<td>14.06</td>
<td>8.29</td>
<td>1.21</td>
<td>0.89</td>
</tr>
<tr>
<td>Imagine an ideal residential development, how far or close to this ideal would you rate Frösunda</td>
<td>IDEAL</td>
<td>0.73</td>
<td>12.44</td>
<td>7.43</td>
<td>1.51</td>
<td>0.54</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The urban environment should always be safe</td>
<td>ED02</td>
<td>0.19</td>
<td>1.55</td>
<td>2.66</td>
<td>1.17</td>
<td>0.04</td>
</tr>
<tr>
<td>You shouldn’t feel uncomfortable in a modern housing development</td>
<td>ED03</td>
<td>0.59</td>
<td>4.27</td>
<td>4.37</td>
<td>0.65</td>
<td>0.34</td>
</tr>
<tr>
<td>You should feel secure in a housing development</td>
<td>ED04</td>
<td>0.73</td>
<td>5.59</td>
<td>4.54</td>
<td>0.75</td>
<td>0.53</td>
</tr>
<tr>
<td><strong>Relaxation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A place is needed in a residential development where one can stop and rest for a while</td>
<td>EA07</td>
<td>0.69</td>
<td>Na</td>
<td>4.24</td>
<td>0.76</td>
<td>0.47</td>
</tr>
<tr>
<td>There needs to be space and amenities for personal activities in a residential area</td>
<td>EA09</td>
<td>0.72</td>
<td>7.40</td>
<td>4.22</td>
<td>0.71</td>
<td>0.52</td>
</tr>
<tr>
<td>It’s important that a housing development contains natural meeting places</td>
<td>EE03</td>
<td>0.83</td>
<td>8.80</td>
<td>4.18</td>
<td>0.76</td>
<td>0.28</td>
</tr>
<tr>
<td><strong>Expected performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Towns provide the best urban environment</td>
<td>EA01</td>
<td>0.33</td>
<td>Na</td>
<td>3.13</td>
<td>0.95</td>
<td>0.11</td>
</tr>
<tr>
<td>It is important that a residential development has a nice overall impression</td>
<td>EB01</td>
<td>0.91</td>
<td>3.16</td>
<td>4.73</td>
<td>0.47</td>
<td>0.82</td>
</tr>
<tr>
<td>The relative placing of buildings in a development should be placed to provide a lively impression</td>
<td>EB02</td>
<td>0.57</td>
<td>3.24</td>
<td>3.72</td>
<td>0.96</td>
<td>0.33</td>
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</tbody>
</table>
Construct validity

Table 2b. Construct analysis sub-model two (Performance)

<table>
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<tr>
<th>Constructs and factor loadings</th>
<th>Abbreviation</th>
<th>Factor loading</th>
<th>t-value</th>
<th>Mean</th>
<th>Std dev</th>
<th>R2 value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Satisfaction</strong></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How satisfied or dissatisfied are you with this residential development</td>
<td>SATISF</td>
<td>0.96</td>
<td>na</td>
<td>8.36</td>
<td>1.27</td>
<td>0.92</td>
</tr>
<tr>
<td>To what extent does this residential development confirm your expectations</td>
<td>EXPECT</td>
<td>0.91</td>
<td>15.68</td>
<td>8.29</td>
<td>1.21</td>
<td>0.83</td>
</tr>
<tr>
<td>Imagine an ideal residential development, how far or close to this ideal would you rate Frösunda</td>
<td>IDEAL</td>
<td>0.73</td>
<td>11.78</td>
<td>7.43</td>
<td>1.51</td>
<td>0.53</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This is a safe urban environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This place makes me feel uncomfortable (R)</td>
<td>PD02</td>
<td>0.61</td>
<td>8.23</td>
<td>3.69</td>
<td>0.85</td>
<td>0.37</td>
</tr>
<tr>
<td>This place makes me feel insecure (R)</td>
<td>PD03</td>
<td>0.72</td>
<td>8.35</td>
<td>4.13</td>
<td>0.86</td>
<td>0.52</td>
</tr>
<tr>
<td>PD04</td>
<td>0.97</td>
<td>15.32</td>
<td>4.17</td>
<td>0.80</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td><strong>Relaxation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is nowhere you can stop and rest for a while (R)</td>
<td>PA07</td>
<td>0.88</td>
<td>na</td>
<td>4.05</td>
<td>0.95</td>
<td>0.77</td>
</tr>
<tr>
<td>There’s nowhere for me to do any activities (R)</td>
<td>PA09</td>
<td>0.60</td>
<td>5.71</td>
<td>3.57</td>
<td>1.11</td>
<td>0.36</td>
</tr>
<tr>
<td>This is a good place to meet people</td>
<td>PE03</td>
<td>0.55</td>
<td>6.31</td>
<td>3.48</td>
<td>0.97</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>Perceived performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This is a really nice urban environment</td>
<td>PA01</td>
<td>0.76</td>
<td>na</td>
<td>3.97</td>
<td>0.74</td>
<td>0.58</td>
</tr>
<tr>
<td>This places provides a really positive overall impression</td>
<td>PB01</td>
<td>0.94</td>
<td>8.32</td>
<td>4.00</td>
<td>0.79</td>
<td>0.89</td>
</tr>
<tr>
<td>The relative placing of the buildings makes a pleasing impression</td>
<td>PB02</td>
<td>0.70</td>
<td>5.79</td>
<td>3.41</td>
<td>1.00</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Note. R = reversed negative statements. The wording of indicators is the same as in the questionnaire.
Dependent construct

Customer satisfaction

Customer satisfaction is defined and operationalized by a function of three indicators on a ten-point graded scale. The customer satisfaction construct measures an overall post-purchase attitude. One of the advantages with this scale over other measures is that the causes of satisfaction are not confounded with the phenomenon itself and it allows fallibility (Fornell, 1992).

(a) How satisfied or dissatisfied are respondents with the residential development of Frösunda. The item end-points are “very dissatisfied” and “very satisfied”.
(b) To what extent does the residential development of Frösunda confirm their expectations. The item end-points are “not at all” and “completely”.
(c) How far or close to an ideal residential development is the residential development of Frösunda. The item end-points are “very far from” and “completely”.

These indicators are valid representations of customer satisfaction:
In sub-model one, t-values are above 12.43, factor loadings are above 0.72 and $R^2$ is above 0.53. In sub-model two, t-values are above 11.77, factor loadings are above 0.72 and $R^2$ is above 0.52.

Independent constructs

Statements are defined by a function of three indicators measuring an overall attitude to the independent construct, using a five-point Likert scale. The item end-points are “completely agree” and “completely disagree”. It is difficult to pinpoint exactly what product attributes establish an evaluative judgment. The respondent observes what is provided at the place in terms of buildings' structures and density, quality of building materials, the architecture and landscaping. The respondent’s evaluation of independent constructs and his standpoint in relation to an item activate a chain of beliefs that triggers an attitude and results in a score on the attitude scale.

Perceived performance

The indicators representing perceived performance are abstract product attributes that capture respondents’ beliefs about intrinsic features in the built environment at a specific place. The performance construct in sub-model three consists of the following indicators: the first and second statements relate to the place being nice and providing a positive impression. The third statement is about the relative placing of the buildings.

The indicators are valid representations of perceived performance:
In sub-model one, t-values are above 3.16, factor loadings are above 0.33 and $R^2$ is above 0.10. In sub-model two, t-values are above 5.78, factor loadings are above 0.69 and $R^2$ is above 0.48.

Safety

The first indicator measures general safety. The second and third indicators measure the psychological feeling of being insecure or uncomfortable. These beliefs capture an overall attitude towards the safety of the place. Safety is a terminal value in the means-end chain terminology. A terminal value is an enduring belief that a specific end-state of existence is personally or social preferable to an opposite end-state of existence (Rokeach, ibid).
These indicators are valid representations of safety:
In sub-model one, t-values are above 1.55, factor loadings are above 0.19 and $R^2$ is above 0.04 (indicator ED02 was not significant at the 95 percent level). In sub-model two, t-values are above 8.22, factor loadings are above 0.60 and $R^2$ is above 0.36.

Relaxation
The first and second indicators reflect the instrumental values of the buyers and capture the belief that a place should provide for opportunities to stop and rest for a short while. Breathing space could be an open green space area with wooden tables and benches or a café. Laddering interviews highlighted the belief that a place should support personal activities, which is reflected in the second statement. The third statement captures buyers’ belief that a place should provide some facilities for socializing in restaurants, pubs or at an open piazza. Since an instrumental value is an enduring belief that a specific mode of conduct is personally or socially preferable (Rokeach, ibid), they are important to identify.

These indicators are valid representations of relaxation:
In sub-model one, t-values are above 7.39, factor loadings are above 0.68 and $R^2$ is above 0.27. In sub-model two: t-values are above 5.70, factor loadings are above 0.54 and $R^2$ is above 0.29.

Discriminant validity
Discriminant validity between constructs has also been tested, using the correlation matrix of independent variables (see appendix, measurement model). An estimation of a confidence interval was made by multiplying the observed standard errors for each construct by two. The constructs in sub-model one and two (models three and four) were found to be discriminant valid and the statistics support the separation of the constructs as loading on one construct only and, thus, measuring one dimension.

Evaluation of hypothesis
H0: There is no significant difference in nomological validity of the disconfirmation model (model one) compared to the customer satisfaction value model (model two), at a probability level of 0.05 or higher. The disconfirmation model failed to show a significant relationship to customer satisfaction ($t=-1.24$, two-tailed, and the modification indices suggested no changes to this model).

Result: The null hypothesis failed, since none of the models showed nomological validity: p-value was 0.000 for both models, RMSEA was 0.201 and 0.114 respectively, which is far above the recommended level of 0.08 or less (Jöreskog and Sörbom, ibid).

H1: Structural sub-model one consists of the following latent variables: values, expectations and satisfaction and is nomologically valid at a probability level of 0.05 or higher.
Result: This alternative hypothesis was confirmed ($\chi^2=43.07$, df=51, p-value=0.77718, RMSEA=0.000).

H2: Structural sub-model two consists of the following latent variables: values, performance and satisfaction and is nomologically valid at a probability level of 0.05 or higher.
Result: This alternative hypothesis was confirmed ($\chi^2=47.17$, df=51, p-value=0.62637, RMSEA=0.000).

H3: There will be a positive and significant relationship between the terminal and the instrumental value and expectations.
Result: This hypothesis was confirmed by empirical data (coefficient=0.81, t-value=3.04).
H4: There will be a positive significant relationship between the terminal and the instrumental value and perceived performance.
Result: This hypothesis was confirmed by empirical data (coefficient=0.74, t-value=6.47).

H5: An increase in perceived performance will lead to an increase in customer satisfaction.
Result: This hypothesis was confirmed by empirical data (coefficient=0.38, t-value=3.25).
Figure 4  Structural equation sub-model one

Note: Model Chi-square is 43.07 with 51 degrees of freedom at a probability of 0.77718, RMSEA is 0.000, GFI is 0.90, CFI is 1.0 and NNFI is 1.0

Sub-models one and two have not been ruled out by the statistical tests of nomological validity or by the test of construct validity. The result from the structural equation sub-model one is shown in figure four. Key statistical data such as GFI, CFI and NNFI are satisfactory for this model, having a p-value higher than 0.05 and a RMSEA lower than 0.08, which is within recommended levels (Jöreskog and Sörbom, ibid).

Interpretation of structural sub-model one

What can be learned from sub-model one in figure four? Firstly, this model has a high factor loading from the safety construct on relaxation (0.62). A change of one step in the 5-point Likert scale will lead to a change of 0.62 in relaxation.

A specific score on the five-point Likert scale is a respondent’s attitude to safety and relaxation, given the meaning of the indicators. The direct effect of the instrumental value on the expected performance is (0.81), which is high correlation, and the direct effect on satisfaction is (0.34). Values have a high significant effect on expectations. This hierarchical effect of the terminal value safety on the instrumental value relaxation which we found is postulated by the means-end chain theory.
Figure 5  Structural equation sub-model two

The results from sub-model two are shown in figure five. Key statistical data are satisfactory for this model. This sub-model has a similar good fit between the data and the structural model as is seen in sub-model one.

Interpretation of structural sub-model two
The direct effect of values on expectations in sub-model one was high and significant. What about the effect of values on perceived performance in sub-model two? This model also shows a high factor loading on relaxation from the safety construct (0.70) as well as a high direct effect of relaxation on performance (0.74) and a moderate effect on satisfaction (0.38). The instrumental value relaxation has a high direct effect on both expected performance as well as perceived performance and an indirect effect on customer satisfaction, which has not been shown by housing research before.
Discussion

It is interesting to find empirical support and confirm the relationship between expectations and perceived performance and the relationship to customer satisfaction. This specific relationship has been discussed by Churchill and Surprenant (ibid) and Tse and Wilton (ibid) as an advantage over the disconfirmation procedure for durable products. However, in what way are our findings different? Our contribution in this article is the investigation of the relationship of the value construct as defined by Rokeach (ibid) and its relationship to customer satisfaction.

Do values affect customer satisfaction? From structural modeling evidence, it is likely that satisfaction is affected in a positive direction if the built environment is according to buyers’ values. This conclusion has empirical support in this study. Why? Values play an important role in the satisfaction of a high involvement product such as a private home. For example, in the experiment with a video disc player Churchill and Surprenant (ibid) argue that in the case of a durable product performance is a major determinant of satisfaction. A customer who purchases a costly durable product can be expected to be highly involved in the selection of the product. That is probably true also for residential housing, since the amount of debt and private funding is very high compared to other durable products. Analysis of the relationship between perceived performance and customer satisfaction showed a higher $R^2$ value for residents than for buyers (buyers = 0.14; residents = 0.20). The increased strength in linear relationship indicates a higher involvement over time, which has a positive effect on customer satisfaction.

Is disconfirmation biased by expectations? As discussed by Grönroos (ibid), a non-trivial problem is the measuring of expectations at any specific point in time when service is provided and consumed. The disconfirmation procedure inherits the problem of a time effect since expectations are part of the measurement of the disconfirmation construct. Moreover, another non-trivial problem is the formulation of actual statements about expectations and the difficulty in making sure that the semantics are equivalent with those statements being formulated about performance. These obstacles can contribute in explaining why we did not reach nomological validity in structural models one and two.

An important reason for modeling values as antecedents to perceived performance, is a growing need for residential developers and planners to understand their customers and know more specifically; what specific values and desired consequences have had an impact on buyers’ expectations and their evaluation of perceived performance in a residential development. Since we found empirical support for the hypothesized causal relationship between expected and perceived performance and customer satisfaction it is interesting to draw conclusions about its implications for residential development. Safety has for long been regarded as one of the most important aspects in housing. However, the structural sub-models also showed the importance of relaxation. Factor scores indicate that relaxation has a higher impact on perceived performance than safety. The structural model evidence in this study supports the argument that developers and planners can gain the most out of one US dollar invested by focusing on safety and relaxation if they strive to increase customer satisfaction in residential developments. An obvious interpretation of the strategic implications of the causal relationships found is that if the built environment in a residential development is according to values which are shared by residents, such a development receives higher customer satisfaction than a development where the opposite situation pertains.
Appendix  Construct validity sub-models one and two

Correlation matrix of independent variables: sub-model one

<table>
<thead>
<tr>
<th></th>
<th>Satisfaction</th>
<th>Relaxation</th>
<th>Safety</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfaction</td>
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<td></td>
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</tr>
<tr>
<td>Relaxation</td>
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<tr>
<td>(0.11)</td>
<td>(0.11)</td>
<td>(0.11)</td>
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</tr>
<tr>
<td>1.80</td>
<td>1.80</td>
<td>1.80</td>
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<tr>
<td>Safety</td>
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<td>1.0</td>
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<td>(0.12)</td>
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<td>(0.12)</td>
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<td>1.98</td>
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</tr>
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<td>Performance</td>
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<td>(0.10)</td>
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Correlation matrix of independent variables: sub-model two

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<td>Relaxation</td>
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<td>(0.10)</td>
<td>(0.10)</td>
<td>(0.10)</td>
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<tr>
<td>2.94</td>
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<td>2.94</td>
<td>2.94</td>
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<tr>
<td>Safety</td>
<td>0.39</td>
<td>0.67</td>
<td>1.0</td>
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<td>(0.09)</td>
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<td>(0.09)</td>
<td>(0.09)</td>
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<tr>
<td>4.25</td>
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<td>4.25</td>
<td>4.25</td>
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<tr>
<td>Performance</td>
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<td>0.61</td>
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<td>(0.10)</td>
<td>(0.10)</td>
<td>(0.10)</td>
<td>(0.10)</td>
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<tr>
<td>3.53</td>
<td>3.53</td>
<td>3.53</td>
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<td>3.53</td>
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</table>
Covariance matrix of latent variables: Sub-model one

<table>
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<th>Relaxation</th>
<th>Safety</th>
<th>Performance</th>
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<td></td>
</tr>
<tr>
<td>Relaxation</td>
<td>0.27</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>0.34</td>
<td>0.81</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Performance</td>
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<td>0.50</td>
<td>1.00</td>
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</tbody>
</table>

Covariance matrix of latent variables: Sub-model two

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<th>Safety</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relaxation</td>
<td>0.28</td>
<td>1.00</td>
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<td></td>
</tr>
<tr>
<td>Safety</td>
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<td>0.74</td>
<td>1.00</td>
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<tr>
<td>Performance</td>
<td>0.19</td>
<td>0.70</td>
<td>0.52</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Table 3. Socio-economic profile of respondents and households in Frösunda. Statistics Sweden, Solna Stad.

<table>
<thead>
<tr>
<th>Age</th>
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The residential development of Frösunda

Plate 1. Part of Frösunda, Solna.

Plate 2: no.1 the street of Frögatan

Plate 2: no.2 the street of Frögatan
References


1 According to Swedish law “bostadsrätt” is a tenant-owned housing/housing association and normally consists of between 20 and 100 apartments (tenant-owned apartments) built together or as detached units in a defined geographical area. The members (the residents in the tenant-owned housing) own a share of the housing association, which in turn owns the housing. The members are free to sell their share and thus their tenancy rights on the open market.