

# VALUE CHAIN MANAGEMENT IN CONSTRUCTION: MODELLING THE PROCESS OF HOUSE BUILDING

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*ABSTRACT: Construction companies today find it hard to handle the complexity of the housebuilding process, in terms of differentiating between value and non-value adding activities. The research project 'Value chain management in construction' includes an investigation of time, cost and quality improvements within one such company. Project success is believed to be linked to the extent to which companies are able to manipulate their supply chain to add value for the customer, whilst at the same time improving their own internal management. In order to be in a position to understand the true extent and complexity of the process, extensive functional models have been created using a computer-based tool. This first pass through the organisational infrastructure has produced detailed 'as-is' IDEF0 models. The next steps are to transform these into 'to-be' IDEF0 models and then to decompose them into workflow models using the IDEF3 standard. Other tools and techniques were used during this first mapping of the process: analysis and audit of company specific documentation including the quality assurance system and interviews with key personnel. The preliminary results of this two and a half year project show that already there is considerable scope for improvement, specifically the research has pinpointed areas where little added value is derived from the process 'as-is'. Other areas are under examination.*

*KEYWORDS: Value chain management, process modelling, process thinking, housebuilding, information flows, total commitments*

## 1. INTRODUCTION

Clients and customers (the market) today demand a reduction of time and cost when speaking of construction of housing, while at the same time increasing the demands concerning quality and environmental issues. As a consequence of this, information and communication flows have become more important to control, when attempting to reduce development times. Right information at the right place and time throughout the entire process of house building will help to eliminate a lot of non-value adding activities. These new demands necessitate a more transparent house building process, competent personnel (education and training), and the ability to perform changes necessary to survive in a competitive market. To be able to carry out such a large change, which this will bring about, we should start with minimising non-value-adding activities in the project process.

Large construction companies today all too often suffer from inadequate communication inside and between divisions and divergent procedures of handling the project process. A focus on processes, or collections of tasks and activities that together transform inputs to outputs, allows organisations to view and manage materials, information, and people in a more integrated way (Gavin, 1998). To be able to perform any dramatic improvements to the house building process, it is important to have a clear understanding of the process. This could be achieved by the use of process models. In order to develop new processes, we must better understand the present processes, which are in place (Abeyasinghe and Urand, 1999).



In order to understand and describe their processes by process models, companies need techniques to help them. There are a number of methods available for process modelling, which helps modellers to structure their information. The IDEF0 and DSM methods only will be mentioned in this paper. What is actually needed to fulfil the above mentioned demands is an organisation that has the ability to survive and prosper in a competitive environment of continuous and unpredictable change. This makes the time ripe for a thorough re-evaluation of the entire house building project process from business idea to occupation. This paper aims to show how the modelling of the project process of a Swedish house building company was performed. The second and third sections of this paper will explain of the research project 'Value chain management in construction' and outline the process modelling procedure of a house building company. In the penultimate section the use of process models and implementation areas are discussed. The final section presents the conclusions and the preliminary results of this two and a half year research project.

## **2. VALUE CHAIN MANAGEMENT IN CONSTRUCTION**

The expression "value chain management" is defined as "the manner of managing, controlling, handling, and directing a sequence of activities a company carries out to create products/services that increase profit for the company and generates profit/value for the customer (Lindfors, 2000)." By using the term value chain management, it is implied that value has to be added at all points in the supply chain.

The research project 'Value chain management in construction' intends to examine and re-evaluate today's house building process and together with industry produce and establish a single, coherent process model. The project plan for the project starts with the creation of a detailed 'as-is' process model, from business idea to occupation. This is then followed by the creation of a 'to-be' model, which will be created by the interpretation of company specific goals and strategies, and the use of existing management innovations and manufacturing philosophies. This implies that the model will be used as a platform for further research in the area of value chain management. The 'to-be' model will then be used to show how management innovations can help to optimise costs in the value chain and reduce time consumption in the house building process. This will finally result in a practitioner's guide for time and cost effective house building.

The project started with a mapping of the house building process from a management perspective, having NCC Housing's Total Commitment<sup>1</sup> stand as a model of how it is performed today. The mapping makes it easier to manage the complexity of the process. As a side product of the main purpose of the project, this first phase has already proved useful in terms of quality control. The next phase intends to eliminate non-value-adding activities in the process and develop the process to cover the whole value chain. Thoughts about how improvements of the process can be made are directed in the direction of control, management systems, and improvements from a Quality Function Deployment (QFD) process perspective. This paper contains a real-life case study of the project process of a house building company. In the research project 'value chain management in construction' the Total Commitment project process was modelled and analysed.

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<sup>1</sup> The Total Commitment is NCC Housing's name for development / construction 'promises' covering the process from the business idea to customer support. The Total Commitment is a concept where the same company controls the process from early stages to occupation, making it possible to manage the project in the best possible way.

The process model was built using IDEF0 and relationship matrix methods and interviews with relevant practitioners. The initial process model was developed using the input obtained by the analysis of existing company specific documentation and by interviews carried out with process actors. The model was later modified according to the information gathered from an extensive case study of the actual 'as-is' scenario.

One way of accomplishing and implementing a value chain management approach is most likely to combine the best from existing management innovations, management philosophies, and customer oriented approaches. Organisational management innovations are used for the purpose to enhance companies' abilities to control and manage their value chains. The hard part is to combine them to minimise waste and increase the value throughout the process.

Project success is believed to be linked to the extent to which companies are able to manipulate their supply chain to add value for the customer, whilst at the same time improving their own internal management. Managerial processes of construction companies depend on rich communication and information, so by increasing their ability to control and handle these entities, the ability to cut cost and time should increase. In value chain management, the name of the game is communication and information. The ability to control and handle information has increased over the years by the rapid improvements in information technology. So, the necessity to adapt emerging technologies and increase efficiency is vital for future company survival. To stay at the forefront, construction companies must understand their own organisations and customers, and deliver the latest technology and communications capabilities. Being clear about how the organisation achieves its objectives and aims is crucial. Those who figure this out will be the winners.

In manufacturing industry, organisational management innovations are very much a reality. The construction industry in Sweden has a lot to learn by studying what has been done in manufacturing. Construction companies have tried and are trying to implement management innovations and management philosophies, but rarely wholeheartedly. Implementation often stops when no immediate results in terms of cost reductions are noticed. What has to be understood is that management innovations do not generate profit overnight, more likely over a number of years. What has been the biggest obstacle so far for the construction industry is the time horizon for investment payoffs. Until today, the return on investment has been measured in terms of up to a year. When looking at manufacturing industry, it often has an investment horizon of up to five years. The strengthening economy in Sweden can probably lead to a larger commitment in the development of management systems and the house building process. The construction industry has begun to realise this.

### **3. PROCESS MODELLING PROCEDURES**

The first phase of the research project 'Value chain management in construction' was the creation of a process model describing the house building process as it appears today. In order to be in a position to understand the true extent and complexity of the house building process, an 'as-is' process model describing the project process of a Total Commitment for house building was created using a computer-based tool. Due to the knowledge that visual models can better achieve process understanding, the use of a graphical approach was decided upon. Modelling can be defined as the process of developing and providing an abstraction of reality, i.e., a model. Therefore, the model "should be easy to understand, easy to change, and easy to correct and above all should represent the process correctly (Abeysinghe and Urand, 1999)."

The chosen tools and techniques for the modelling approach were decided upon, by the availability of a computerised tool, which supported the IDEF0 method. The need for a complementary technique made the matrix approach decided upon, by its capacity to structure and handle information in a formalised manner.

The modelling started with a need to list the activities that forms the process of a Total Commitment of housebuilding. To satisfy this need a document study was performed. At this stage company specific documentation, i.e. the organisation system (quality and environment system), Total Commitment documentation, and the company's construction control system were studied. As a result an activity list with over 350 main activities was produced. To be able to transform this information into an IDEF0 process model, both ICOMs (input-control-output-mechanism) and dependencies had to be clarified and specified. The inputs and outputs would explain changes in the information exchange. The controls would cover company specific control and support documentation and the mechanisms the company's process actors.

To map the ICOMs for each single activity two different matrices were created and ICOMs were derived from company specific documentation. One matrix was created to capture the participation of process actors in the activities and another to map dependencies between activities. These were then distributed to relevant key personnel directly engaged in the project process, who were asked to fill out the matrices. These have been given a free scope to describe how they carry on their jobs associated to the Total Commitment. The first matrix mapped the relationship between personnel and activities, generating a clear picture of personnel participation in activities. The second matrix, a so-called dependency structures matrix, generated a full understanding of the relationships between activities. By compiling the results mapped by the matrices, the 'as-is' model was created, reflecting a good abstraction of reality. As a side product an activity-task list was derived from the results captured by the activity-personnel matrix. This list will serve as a platform when creating role activity diagrams and workflows for end activities. The procedure is shown in figure 1.

The decision to use more than one method when modelling the project process proved successful. The advantages of using more than one modelling method (the IDEF0 method, the dependency structure matrix, and the activity-personnel matrix) are that:

- existing computer-based tools can be used for the modelling as well as for the visualisation. [Platinum BPWin and MS Excel spreadsheets]
- they provide a structured and formalised procedure when modelling the project process of Total Commitment.
- the different methods provide different possibilities to gather information about the 'as-is' process model.
- relations between objects can be represented in relationship matrices, which enables an easy interpretable representation of relations between objects (Malmström et al., 1998).
- it provides a good platform for discussions on process development and a future reference model.
- the combined result gives a very accurate picture of how the project process of Total Commitment actually is carried out today.
- it is possible to reach a workable result reasonably fast by using DSM on a rougher level of detail of the activities.

The end product of this mapping is an IDEF0 process model displaying over 350 main activities connected to the project process of a Total Commitment (see figure 2). The mapping stopped at this decomposition level of detail, because the modelling objectives were reached.

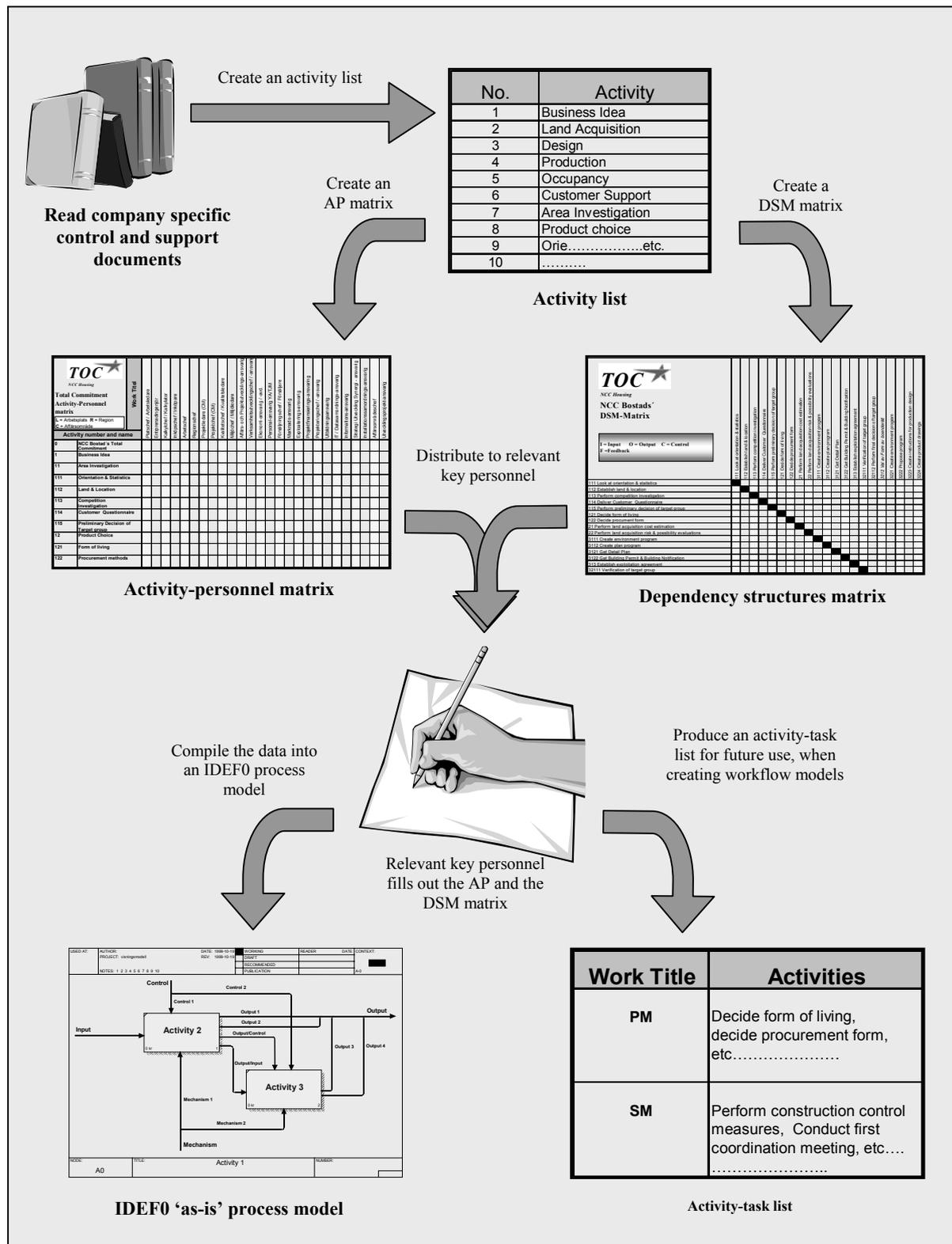


Figure 1. The procedure of creating an 'as-is' process model

The DSM and IDEF0 techniques support each other. Depending on the objectives with the modelling work, both techniques can be used. Useful insights can be reached with little additional work by using both techniques. Both serve the purpose of modelling information flows (Malmström et al., 1998). An ‘as-is’ process model also helps to engage personnel, who start to realise how poorly their company specific control and support documentation covers their need for information to manage the value chain.

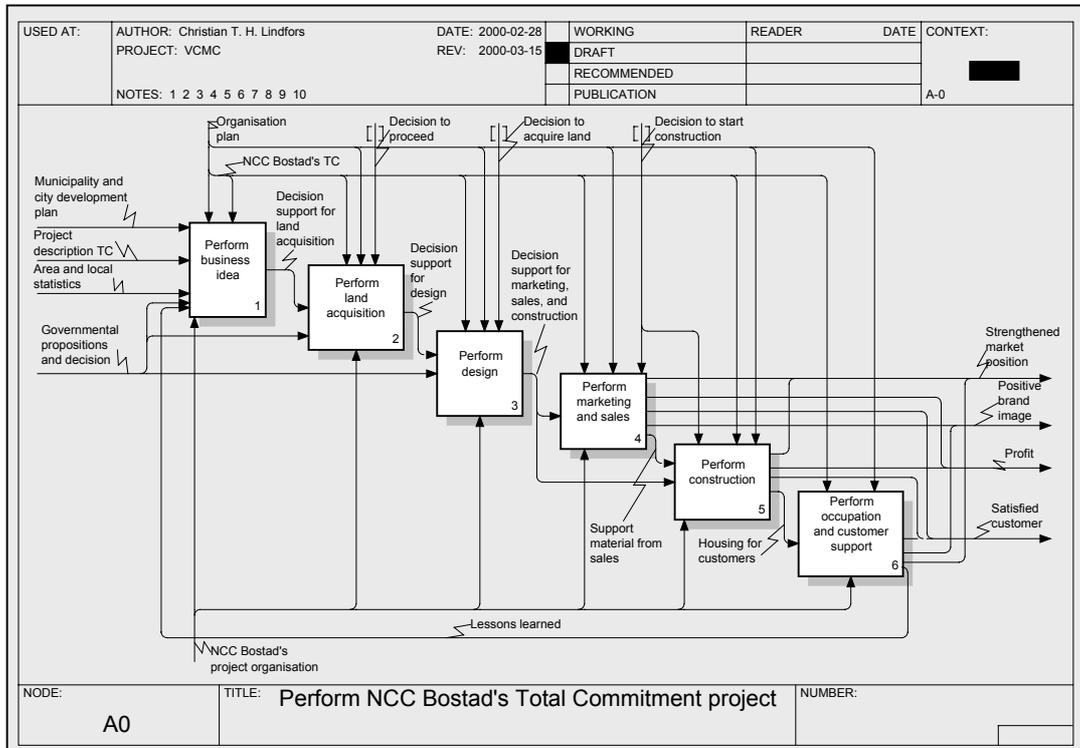


Figure 2. The second tier process diagram view of the Total Commitment project plan

#### 4. IMPLEMENTATION AREAS

The modelling work has provided NCC Housing with a greater understanding of their present process, e.g. their different document systems have shown to be insufficiently integrated and work tasks are not adequately described throughout the organisation. Additionally, the model has and will help to find a shared view of the details in the process and serve as a foundation for further development of the process. A standardised process can increase organisational flexibility. “When all business units are performing a process the same way, a company can easily reassign people from one unit to another to respond to shifts in demands. Its organisational structure becomes much more plastic (Hammer and Stanton, 1999).”

The process model will be used as a foundation for further research in the value chain management field. Implementation areas where the use of an ‘as-is’ process model will serve useful are:

- minimising non-value-adding activities and to maximise value-adding activities in the housebuilding process. The modelling procedure gives a clear picture of where little value is added to the process and points out areas where value-adding activities may be introduced.

- introducing the concept of process thinking into the organisation. With this new understanding of processes, teams of people drawn from estimating, construction, sales, marketing, and other departments could team up to perform a project with full responsibility from business idea to occupation. The responsibility could include such highly specialised activities as generating documentation, producing advertising and developing training materials for facility managers. “A new management role would be created to oversee the process, the process owner (Hammer and Stanton, 1999).” An increased focus on process thinking facilitates the possibilities for a customer focused industrialised construction. This is made with the advantage of a flexible, company specific, building concept, with a high degree of prefabrication and an increased use of standardised modules. The arrangement ought to be flexible to the extent that the customer may get a house that is unique, with the help of various additions and extras.
- forming a basis for the work related to the development of the housebuilding process. The model provides a good platform for discussions of process development and a common viewpoint of how the process is carried out.
- developing the organisational system, i.e. tying together the quality system, the environmental system, the construction control system, and other company specific systems.
- developing management systems, i.e. a company specific Balanced Scorecard (see figure 3), and key business indicators for the internal processes perspective. Companies have lately shifted the focus of their measurement systems from unit goals to process goals, and they have based compensation and advancement directly on process performance (Hammer and Stanton, 1999). Being able to measure the internal processes would increase the usefulness of Balanced Scorecards dramatically.

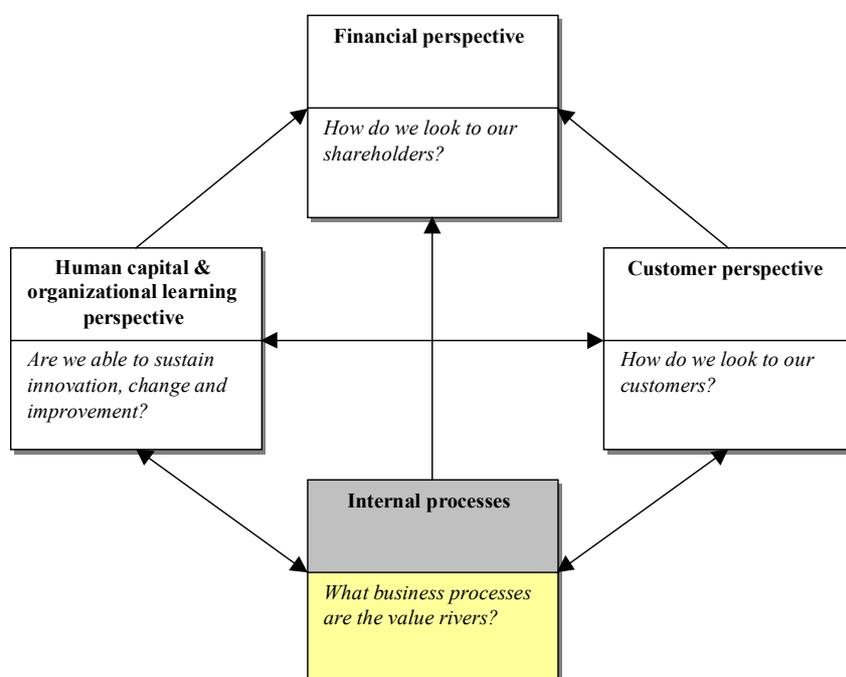


Figure 3. The four perspectives in the balanced scorecard approach (Kaplan and Norton, 1996)

## **5. CONCLUSIONS**

This paper's content gives an indication that the use of an accurate representation of the house building process, with the help of an 'as-is' process model, would help a construction company improve significantly its value chain. The preliminary results of this two and a half-year project show that already there is considerable scope for improvement. Further conclusions that can be made today from the creation of an 'as-is' process model of the Total Commitment process are that the house building process is complex. It is beyond human capability to understand fully the entire process without creating a representation of it. In this case study, the representation of the project process was visualised as an IDEF0 process model created using a computer-based tool. The roles inside the organisation are very diffuse concerning work tasks, e.g. at one division an activity can be associated to the division manager, whereas at another division the same activity is associated with the value engineer.

The organisation system lacks a comprehensive representation / description of the process, i.e. the different control and support systems need a unified platform, and instead they run parallel without any vital integration. A unified picture among the employees of how the Total Commitment process is supposed to run is missing. Differentiation in organisation arrangements inside the same company makes work related to development fairly complicated. A clear allocation of work tasks in an organisation facilitates or is a condition for development work to be carried through in an effective manner.

The house building industry can learn from manufacturing industry, regarding process thinking and the implementation of a process-oriented organisation. The introduction of management innovations (VCM, Business Process Reengineering, Project Process Reengineering, SCM, Balanced Scorecards, QFD, partnering the supply chain, virtual organisations, lean and agile production) are easier to accomplish today when technology makes it possible to structure, make follow ups, control and handle the information flow. That is why it is important to investigate the different supporting technologies available on the market today. Construction companies have a tendency to focus on quantity instead of quality when the workload is turning up. What companies must focus on is re-evaluating their house building process to determine if it is competitive enough to survive in this information era.

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