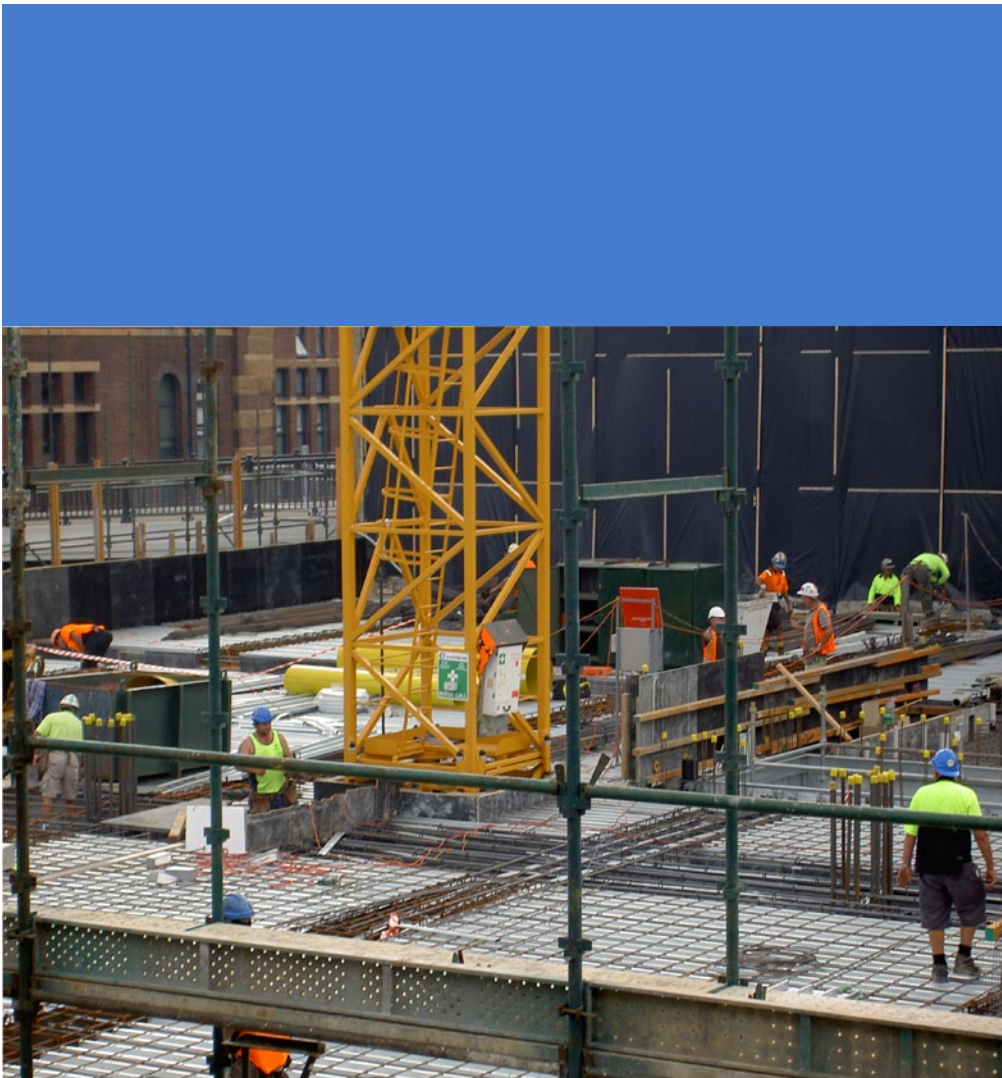


SBi 2010:40

# System for Evaluating the Construction Process

CREDIT Case SE03



Danish Building Research Institute  
AALBORG UNIVERSITY



**CREDIT**<sup>©</sup>

Construction and Real Estate -  
Developing Indicators for Transparency



# System for Evaluating the Construction Process

CREDIT Case SE03

Sofia Pemsel

Title System for Evaluating the Construction Process  
Subtitle CREDIT Case SE03  
Serial title SBi 2010:40  
Edition 1 edition  
Year 2010  
Authors Sofia Pemsel  
Language English  
Pages 17  
Key words Process, efficiency, evaluation

ISBN 978-87-563-1452-7

Cover Division of Construction Management, Lund University

Publisher Statens Byggeforskningsinstitut  
Danish Building Research Institute  
Dr. Neergaards Vej 15, DK-2970 Hørsholm  
E-mail [sbi@sbi.dk](mailto:sbi@sbi.dk)  
[www.sbi.dk](http://www.sbi.dk)

Extracts may be reproduced but only with reference to source: *Pemsel, S. (2010). System for Evaluating the Construction Process. CREDIT Case SE03 (SBi 2010:40). Hørsholm: Danish Building Research Institute, Aalborg University.*

# Contents

Contents .....	3
Preface .....	4
Summary .....	5
1. Introduction and objectives.....	6
1.1 Objectives and work packages of CREDIT .....	6
1.2 Background, purpose and focus of the case study .....	7
1.3 Research design and methods applied in the case study .....	7
1.4 Reading instruction .....	8
2. Buildings – assessments in construction or real estate processes.....	9
2.1 The actual building, building parts and processes .....	9
2.2 The applied assessments and tools in the processes.....	9
2.3 Cost and performance indicators applied in the processes.....	11
2.4 Relation to different enterprises and national benchmarking .....	11
2.5 Visions and innovation for future improvements.....	12
3. Enterprises – assessments and indicators internally applied .....	13
3.1 The actual enterprise, company and firm .....	13
3.2 Applied assessments and tools in the enterprise .....	13
3.3 Costs and performance indicators applied in the enterprise .....	13
3.4 Relation to building cases and national benchmarking .....	14
3.5 Visions and innovation for future improvements.....	14
4. National benchmarking – indicators and organisation .....	15
4.1 The national benchmarking and purpose of the organisation .....	15
4.2 Applied assessments and tools in national benchmarking.....	15
4.3 Cost and performance indicators applied in benchmarking .....	15
4.4 Relation to enterprises, building projects and real estate.....	15
4.5 Visions and innovations for future improvements.....	16
5. Discussions and conclusions .....	17

# Preface

This report describes the results of a case study undertaken as part of the Nordic/Baltic project *CREDIT: Construction and Real Estate – Developing Indicators for Transparency*. The case study is part of the work in work package 4-6 with respect to project assessment tools, application in firms and national benchmarking systems.

CREDIT includes the most prominent research institutes within benchmarking and performance indicators in construction and real estate, namely SBI/AAU (Denmark), VTT (Finland), Lund University (Sweden) and SINTEF (Norway). Further, three associated partners have joined CREDIT. The three associated partners are the Icelandic Center for Innovation (Iceland), Tallinn University of Technology (Estonia) and Vilnius Gediminas Technical University (Lithuania).

The project has been managed by a steering committee consisting of the following persons:

- Kim Haugbølle, SBI/AAU (project owner).
- Niels Haldor Bertelsen, SBI/AAU (project coordinator).
- Päivi Hietanen, Senate Properties (chair of Finnish steering committee).
- Pekka Huovila, VTT.
- Ole Jørgen Karud, SINTEF.
- Magnus Hvam, SKANSKA.
- Bengt Hansson, Lund University.
- Kristian Widén, Lund University.

The project group wishes to thank our industrial partners and all the contributors to the case studies. In particular, the project group wishes to thank the four Nordic funding agencies that sponsored the project as part of the ERABUILD collaborative research funding scheme: The Nordic Innovation Centre (NICe), TEKES in Finland, FORMAS in Sweden and the Danish Enterprise and Construction Authority (Erhvervs- og Byggestyrelsen) in Denmark.

Danish Building Research Institute, Aalborg University  
Department of Construction and Health  
August 2010

*Niels-Jørgen Aagaard*  
Research director

# Summary

This case study describes a tool for managing projects in the construction sector (buildings, road and rail ways) in a more efficient way. The tool is a system for measuring, steering and developing within a project and between projects. Data and information is collected in a software program connected to a database provided by a company specialised on reviews. Feedback on how the project is proceeding is obtained in two ways; a report from a licentiate taker and graphs from the software database. The system focus on two perspective; how and what. The “how” perspective focus on leadership, co-workers, organisation and processes. The “what” perspective on effect/operation goals and project goals. The system offer a number of different evaluations both between the four main phases; programming/briefing, design, construction and occupancy as well as within every phase. The main focus is though on the construction phase from the leadership perspective. First is the different leadership organs are evaluating their pre conditions to manage the phase from a number of aspects, and then the participant are evaluating their experiences of the leadership. The leadership then have to come up with actions for improvements.

The system is built on a voluntary basis and is striving towards continuous improvements of the project. The focus is not on whether the product is right or wrong but to reach the set goals in the most effective way. The benefit of the system is that people are reflecting over their work and goal setting continuously so that the process can be continuously corrected during the project. The system is not in use today but it will be interesting to see how the usability of it and the commitment to it among different participants. The tool is offering an evaluation of the previous phase but not feedback to the participants in the early phases from the participants in the later.

The system will start measuring in April 2009.

# 1. Introduction and objectives

This case study presents a system for measuring the building process with the purpose to make it more effective. The system is founded in research made in one university in Sweden in collaboration with the institute for quality improvement and the council of building quality. The system is then further commercialised by a company specialized on reviews. The system has two main perspective; how and what.

## 1.1 Objectives and work packages of CREDIT

Sir Winston Churchill once said, “We shape our buildings, afterwards our buildings shape us” (28<sup>th</sup> Oct 1943). This quotation underlines how strong a building can influence an occupier or a user. Providing complex public facilities for example hospitals, schools, universities and libraries that are able to meet both the internal and external stakeholders’ needs and requirements is not without complications. The aims and demands of different stakeholders within a project can sometimes create conflict with each other’s interest. Understanding the needs and requirements of these stakeholders are essential to remain competitive in today’s market. A client that pays attention to the needs of the end-users will be rewarded with a high-performance property. Simultaneously, this shift seeks to solve many ills associated with inadequate building conditions and resulting in poor building function.

Due to the amount of both public and private money being invested in delivering public and private facilities, strong actions must be adopted. Collaboration with the relevant stakeholders will help building owners in identifying the required performance indicators to create high-performance facilities. The project aims to define a model for the implementation of performance requirements, which ensure the fulfilment of the various types of users’ and stakeholders’ needs and demands. The model shall also allow for the continuous measuring of the effectiveness of the used requirements and the model as such so that it may be improved as more knowledge and experience of it is achieved.

Following the themes of the ERABUILD call closely, the aim of CREDIT is to improve transparency on value creation in real estate and construction.

Thus, the objectives of CREDIT are:

- To capture end user needs and requirements in order to identify and quantify – where possible – value creation in real estate and construction.
- To develop compliance assessment and verification methods.
- To define and develop benchmarking methods and building performance indicators in real estate and construction.
- To set out recommendations for benchmarking internationally key building performance indicators.

Consequently, the deliverables of CREDIT are:

- 1. The establishment of a network of Nordic and Baltic researchers for benchmarking and performance indicators through frequent interactions in workshops across the Nordic and Baltic countries.
- 2. A State-of-the-Art report, that will identify and critically examine a number of existing tools, databases, mandatory reporting, approaches and benchmarking schemes to capture and measure end-user needs, client and public requirements on performance and value creation.

- 3. A strategic management and decision making tool to guide the definition and development of benchmarking methods and building performance indicators in different business cases.
- 4. A comprehensive performance assessment and management tool with associated key performance indicators to capture end-user requirements and to continuously measure and verify the compliance of performance throughout the lifecycle of an actual building project and linked to building information models.
- 5. Recommendations as to how sectoral and/or national indexes for performance indicators can be designed in order to allow for international benchmarking of construction and real estate.
- 6. Dissemination of the lessons learned and tools developed through news articles, press releases, workshops with actors in the real estate and construction cluster etc.

## 1.2 Background, purpose and focus of the case study

The project was initiated in September of 2003 of the council of building quality and a pre-study started in the beginning of 2004. The pre study showed the need for the kind of system and later in 2004 was money conceded and the project manned. The project lasted during 2005 and 2006 and the participants consisted of representatives from a university in Sweden, the institute for quality improvement and the council of building quality and two enterprises. The system was piloted in ten projects during 2007, but the research based tool has then been further commercialised by a company specialized on reviews (a letter of intent was signed in March 2008), so these studies are not representing to the system of today that will start measuring projects in April of 2009. The researchers looked inter al at experiences from similar initiatives/programmes in England and in Denmark. But this system is working in other circumstances though the use of the tool is made on free basis, the participation is made on the participants own expenses. The systems in Denmark and England presuppose public capital or public directives.

The system is built on the thought of continuous improvement during the project and between projects and is thereby measuring both before starting and ending a new phase as well as during that particular phase. The system develops the building process in four main phases; program/briefing, design, construction and occupancy. The system is directed to all kinds of company in the society construction sector (housing, roads, railways, hospitals etc.). The customer benefits of the tool is that it makes the process measurable, it enables feedback of experience and steering information, it makes different parameters comparable, creates a dialogue and is a support when choosing suppliers to the project.

The system is of interest for CREDIT though it focusing on measuring to improving the effectively of the building process on three levels, project, enterprise and national. The purpose of the study is:

- To map out how this system is attempt to work and the purpose behind it and further development strategies.
- To understand how users are involved and what benefits they get from it

## 1.3 Research design and methods applied in the case study

The case study is based on documents and one interview with two involved persons in the project (the supplier of the system and a person from a real

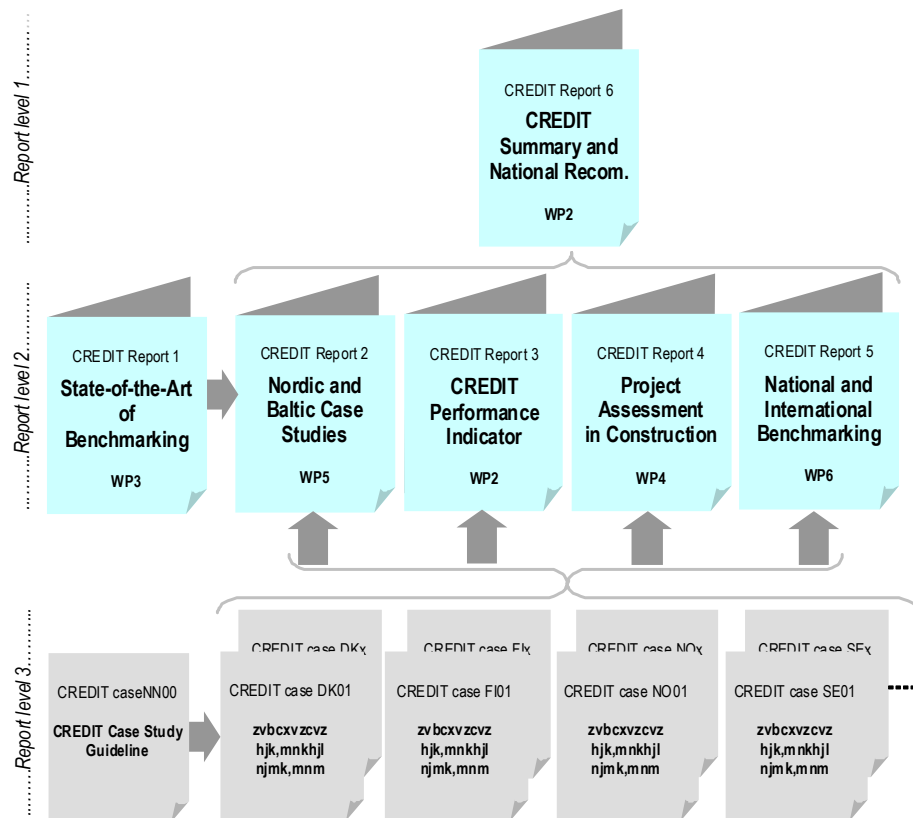
estate company that have been actively involved in the project since 2007). The system will work on a building level, an enterprise level and a national benchmarking level.

## 1.4 Reading instruction

Chapter 2 in this report addresses issues relevant to WP4 on assessments at project level. Chapter 3 addresses issues relevant to WP5 on the application of assessments in firms. Chapter 4 addresses issues relevant to WP6 on sectoral, national or international benchmarking systems. Chapter 5 discusses and concludes on the lessons learned with respect to the three levels of projects, firms and systems.

The work of each work package (WP) is documented in various other reports, articles etc. Below, a graphical illustration of the hierarchy and linkages between the individual reports is given.

Figure 1. Graphical illustration of the hierarchy of the CREDIT reports.



## 2. Buildings – assessments in construction or real estate processes

The tool is a system for measuring, steering and developing within a project and between projects. Data and information is collected in a software program connected to a database provided by a company specialised on reviews. Feedback on how the project is proceeding is obtained in two ways; a report from a licentiate taker and graphs from the software database. The system focus on two perspective; how and what. The “how” perspective focus on leadership, co-workers, organisation and processes. The “what” perspective on effect/operation goals and project goals.

### 2.1 The actual building, building parts and processes

The system is supposed to work in all kinds of construction projects (houses, roads, railways, hospitals etc.) and work both in new built, renovation and conversion projects.

### 2.2 The applied assessments and tools in the processes

The main idea on a project level is to receive continues improvements by a learning spiral existing of: preparations, data collection, results from the questionnaire, feedback, dialogue and interventions. When using the software tool you start with creating a new project and fills in background variables, performers, client (byggherre), project leader and main milestones. The software then creates a Gantt chart that views a plan for data collections, evaluations and interventions. The thought with the Gantt chart is to offer a structured support for planning the measurement and knowledge exchange. The project is divided in four main phases: briefing, designing, construction and occupancy. The system provides a volunteer pre-study (strategic briefing phase) this is chosen though different enterprises are working differently; some include the pre-study in the program some do not. Measuring/following up is made before starting and ending a new phase as well as during that particular phase. Persons responsible for the different activities are assigned and if an activity is not performed in time a reminder is sent out to the responsible person. The system as well informs the client about the missed activity. The system focus on two perspective; how and what. The “how” perspective focus on leadership, co-workers, organisation and processes. These factors are founded in the research and are called critical success factors by the providers of the system for achieving efficiency, high productivity and good quality. The construction phase is the main focus in these measuring. The leadership is focusing different aspects of the leadership such as personal, administrative leadership and communication skills. The tool advocates the use of a SWOT (strength, weakness, opportunities and threats) analysis and risk analysis as well as evaluations systematically during the project. The co-workers aspect is focusing on influence, well being, opportunity to develop, proud, loyalty, engagement and work load (arbetsbelastning). The work load is the only stress measure; all the other aspects are focusing on positive aspects. The organisation aspect focuses on delegating responsibilities, authorities, ensure back-up competence and choosing the right suppliers. The process aspect is planning cooperation, the

advance of the project, steering of time, costs and steering towards the goals. The “what” perspective on effect/operation goals and project goals and brings value both to the client and the user. The effect goals for them are often different but both should be fulfilled. When the effect goals are set, is the thought that, they should result in project goals (more technical related goals). The two perspectives are working in parallel but are to be considered individual. To manage these perspectives the system uses different kinds of measuring/following ups;

- time and cost follow-up,
- goal fulfilment
  - project
  - effect
- different kinds of evaluation processes
  - self-evaluation
  - temp – measuring
  - performance evaluation
- feedback and meetings
  - experience from the temp- measuring
  - workshops (when starting up a new phase)
- interventions
  - activities

The project process for each phase is:

1. Self-evaluation: The leadership of the current phase is evaluating the pre-requests for each phase and then if any intervention is needed.
  - Self-evaluation exist inter al of questions like; are we equipped for a leadership, have we a plan and a strategy to feedback experience? The leadership is rating their presumptions to manage the process optimal.
  - A workshop is held when starting up a new phase and should evaluate the result from the earlier phases and the pre-request of the up coming phase. The leading committee of every participant in that phase should be present in the workshop.
2. Temp-measuring: Every active participants are evaluating their experience of how the work is going, if anything needs to be improved immediate and if so what?
  - Answering around 20 questions.
  - This is repeated three times / phase.
  - After every temp-measuring is a standard report immediately produced with feedback to the project organisation
3. Performance and self-evaluations: The leadership is then evaluating what contributed to the result and analysis whether interventions are needed to manage the next project better.
  - The leadership is then creating time set activities with correcting interventions.
  - The evaluation of the goals is made after every phase.

The main thought with all these evaluations are to force the project members to evaluate and analysis how the result of the phase is supporting to reach the goals. Every kind of evaluation consist of around 20 questions that the respondent have to rate their experience on a scale with the possibility to make a remark. The evaluations provide the project organisation to correct both during the phase and before sending it to the next. The project goals are first measured by the final inspection and the effect goals at the guarantee inspection. But the work is evaluated in the end of each phase to see if the project is leading towards the set goals. These goals are not involved in the process of continues improvement within the project, but it is possible to improve them to the next but that on an enterprise level. The suppliers are planning to maybe assist the client with their view of what kinds of goals are possible to set as an effect and project goal. But in the beginning the client

starts with a blank sheet when formulating the “what” perspective and a structured form when dealing with the “how”. This leads to that the tool is not correcting the project goals. The tool is doing the process effective; not considering the relevance of the goals or ensuring that the right product is produced.

Those users that are involved in a working group in respective phase are involved when setting effect goals and temp measuring and evaluating the effect goals in the end. The clients will be forced to set effect goals for a user organisation even if there does not exist one (for example when building to a segment of possible customer/users).

The great benefit with the tool is that the tool confirms that you understand the prerequisites, to create an awareness of the conditions and force people to take one’s stand.

The cost for using the tool is estimated to be around 0.2-1% of the total project cost. For bigger projects the cost will be a smaller share and for smaller projects a bigger.

The tool enables a systematic evaluation of the process. Every new actor that is participating gets the chance to evaluate the previous work and their experience of the work. The system is though not offering a feedback loop from the persons in a later phase back to the people in an early phase. Hypothetically the persons in the early phase can thereby make the same mistake over and over again without being conscious about it.

## 2.3 Cost and performance indicators applied in the processes

The cost and time aspects are lifted out as independent evaluation parameters though they are so important for project success. The performance of the project collaboration measuring is done in the end of every phase. The appropriateness of the goals in the end of the project (final and guarantee inspection). A report is produced after every evaluation and shows the result, the average, the standard deviation etc. for time, cost and goal fulfilment so far. It is the leadership of respective phase that are rating the fulfilment of the goals. This requires that the persons evaluating are capable of doing it otherwise it is quite meaningless states the supplier of the system. The performance evaluation is validated by the fact that first is the leadership rating their performance and then is the participants rating their experience of the performance and then is the leading evaluating way it may differ and proposing interventions. The interventions are time and person assigned to ensure that something will be happening. The supplier of the system concludes that “it is measuring a lot in the market, but very little is done”.

## 2.4 Relation to different enterprises and national benchmarking

All information collected during the evaluations is stored in a database. Both within the enterprise as well as between enterprises are different “best practices” possible to compare. The information is made visible to other enterprises by the creation of a “client-index” in the software for every specific project. The information shared is though made anonymous but provides information about project kind, size, collaboration form etc. The parameters that will be compared are leadership, self-evaluation, temp-measuring, how the way we manage our projects experienced and cost registration.

## 2.5 Visions and innovation for future improvements

During the interview came the question of changing goals and needs during the process up to discussion. One of the interviewed persons was reasoning about doing temp-measuring with the users. To check if the draft document was implemented to a brief document in the way the users was hoping for. A check could be done with the users be done after procurement, and before the digging starts.

The supplier of the system concludes that the ambitions with the tool, in this early phase, have been to offer an open tool that does not lock aspects too much; just to start measuring. The instrument shall be working in project with so different conditions (rail ways and housing) and requests of the instrument. When starting measuring the tool will be evaluating to identify possible over motilities (överörligheter) in the system and then correct them.

The interviews are though reasoning as well about building in a structure to change the goal picture if the users' needs are changing or if the users did not have the ability to express their goals in an early phase. If changes are made during the project the instrument should though in the "how" process ensures that every involved participant is aware of the changes.

The tool is delimited to focus on internal relations not how the project is performing towards external stakeholders. The tool is focusing on the client perspective (byggherre) from a project and construction efficiency perspective. But the enterprise representative remarks that "we have been working in five years trying to make the project managers understand that they are clients. To make them understand that they need to have a wider perspective. The coming versions of the tool should maybe consider other aspects as well."

### 3. Enterprises – assessments and indicators internally applied

The system provides to make a collected analyse of every performed project and supplies an intervention plan for interventions to develop the enterprise. The tool is as well to be seen as an opportunity for project leaders to develop and improve their work. Besides the statically reports and feedback from the system the system will provide a licentiate taker that will provide the enterprises help with consultancy. The consultancy will raise questions like “how are you going to measuring this and how are you going to use the result.” In other words; the licentiate taker will support the enterprises in their organisation development. Though the system has not stated measuring yet the main focus has been on making the processes measurable. There is a need for further research and thereby are not the indicators for benchmarking set yet.

#### 3.1 The actual enterprise, company and firm

The tool is directed to every company within the building sector. The tool is managing by monitoring and evaluating. The main focus is on the construction phase but the whole construction process is covered.

#### 3.2 Applied assessments and tools in the enterprise

The tool is collecting/documenting all information in a database by questionnaires.

#### 3.3 Costs and performance indicators applied in the enterprise

The main focus is on the how and what perspective with the purpose of improving the efficiency of the process (leadership, co-workers, organisation and processes) and to enhance the ability of setting relevant project and effect-goals for the project. The cost and time aspects are though lifted out as separate aspects to follow-up during the process.

The indicators used are “soft” (e.g. leadership, co-workers, organisation and processes). These are the same questions for every kind of project.

The project and the effect goals are adapted and adjusted after the nature of the project and the needs of the customers. The proposed indicators in the CREDIT project e.g. cost and performance indicators could be used but which ones depends on the interest and needs of the customer. The customer is setting the units which make them incomparable between projects.

The thought of the softer indicators are to be collected in a national bank but not the project and effect goals measurement depending on their nature as aforementioned.

The use of the indicators is to evaluate if set goals are achieved.

### 3.4 Relation to building cases and national benchmarking

The system is not in use today but will soon be (April 2009).

### 3.5 Visions and innovation for future improvements

The supplier of the system told that after talks with involved enterprises to the project, it appeared a need for sharing knowledge of experiences among project leaders. That gave birth to a thought of a system that would work as a subscribe procedure. The project leaders can classify information on different levels so that information that the leader likes to share is raised up one level. The subscribers to that kind of information would be addressed information, on a monthly basis, within the same enterprise and with other enterprises that are not competing. The other interviewed person did not agree with the first that this system would work in reality.

## 4. National benchmarking – indicators and organisation

Every measuring an enterprise is doing is generating data to an index data base. In the index data base it is possible to compare for example the efficiency to similar projects. The thought is to be able to compare to best practices in the sector. The suppliers of the system are planning to premiere the best results or having some kind of competition. The benchmarking can give a base to some kind of standardization. The suppliers consider the possibility to comparing by measuring in a similar way, to be one value of the system. Another value is the increased capacity of goal setting at all.

### 4.1 The national benchmarking and purpose of the organisation

The background of the tool is to improve the efficiency of the construction process by improving the leadership, co-workers, organisation and processes and the ability of setting relevant project and effect goals. The purpose is to create a spiral of continuously improvement. The improvement will mainly be on learning, communication skills and management in construction process. The tool is monitoring between the four main phases; programming/briefing, designing, construction and occupancy as well as within every single phase. The tool is directed to the whole construction sectors (buildings, roads, railways). The tool will be taken in action in April 2009. The collection of the information is made on a voluntary basis.

### 4.2 Applied assessments and tools in national benchmarking

The project members and the enterprises are addressing the information to the system. Data is collected by questionnaires and raw data inserted by the different leading units.

### 4.3 Cost and performance indicators applied in benchmarking

Exactly what indicators that will be inserted are not clearly set at the moment. The first challenge was to make the system measurable. The supplier of the system would like to research more before setting every indicator.

The thought of the softer indicators are to be collected in a national bank but not the project and effect goals measurement depending on their nature as aforementioned.

### 4.4 Relation to enterprises, building projects and real estate

The main thought is that the participant in the project can learn and correct their ways of working during the process by a number of different kinds of evaluations (see chapter 2).

## 4.5 Visions and innovations for future improvements

See visions and innovations in chapter 2 and 3

## 5. Discussions and conclusions

The purpose of the study was to:

- To map out how this system is attempt to work and the purpose behind it and further development strategies.
- To understand how users are involved and what benefits they get from it

Though the system is no in use it is hard to evaluate the benefits of it in use. The system is very ambitious and it will be interesting to see how/if the participants in every phase will embrace it. The end user are involved in the system of they are participating in workshops, meetings in the different phases. They should be involved when setting the effect goals the end users organisation wants to achieve in the beginning and be able to express their opinions about the goal fulfilment in the end.

The thought of the softer indicators are to be collected in a national bank but not the project and effect goals measurement depending on their flexible nature.







This case study describes a tool for managing projects in the construction sector (buildings, road and rail ways) in a more efficient way. The tool is a system for measuring, steering and developing within a project and between projects. The system was not in use when the case study was carried out (started during the late spring of 2009). Therefore it is impossible to evaluate the benefits of it in use. The system is, though, very ambitious and it will be interesting to see how/if the participants in every phase will embrace it. The end user are involved in the system of they are participating in workshops, meetings in the different phases.

1<sup>st</sup> edition, 2010  
ISBN 978-87-563-1452-7