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The Benchmark Centre for the Danish Construction Sector (BEC)

*Applying and improving Key Performance Indicators (KPI) in the Danish construction sector
CREDIT Case DK02*

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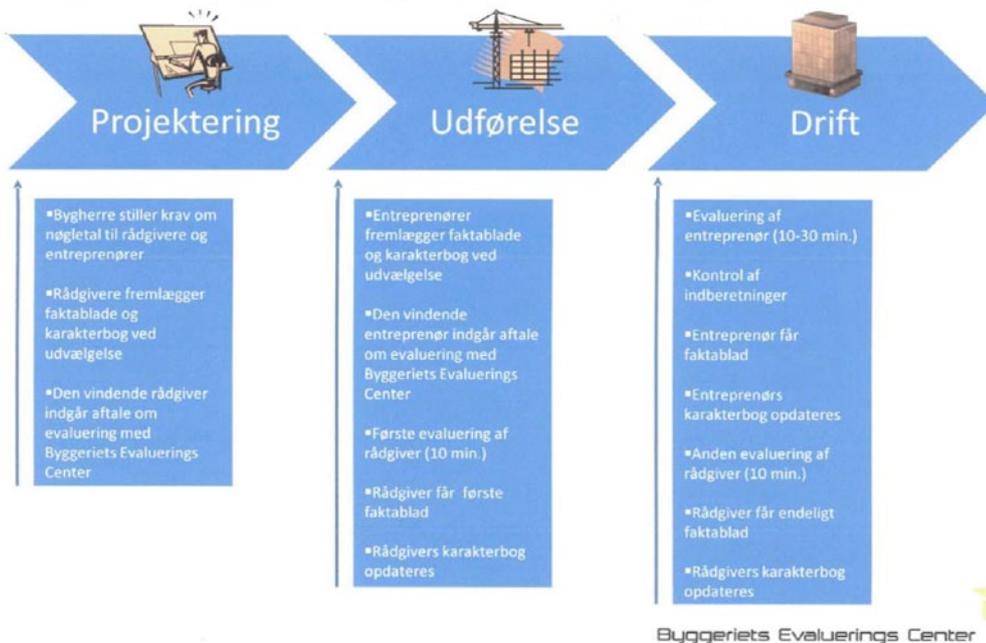
The Benchmark Centre for the Danish Construction Sector (BEC)

Applying and improving Key Performance Indicators (KPI) in the Danish construction sector

CREDIT Case DK02

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The Benchmark Centre for the Danish Construction Sector (BEC)

Applying and improving Key Performance Indicators (KPI) in the Danish
construction sector

CREDIT Case DK02

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Kim Haugbølle



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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).
- Pekka Huovila, VTT.
- Päivi Hietanen, Senate Properties
- 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

The actual building is situated in Frederikshavn in the northern part of Jutland/Denmark. It is a training centre ("Søværnets Taktikkursus") for employees in The Danish Navy and was designed and constructed in the years 2006 to 2008. The client is Forsvarets Bygnings- og Etablissementstjeneste.

During the construction phase the Benchmark Centre for the Danish Construction Sector (BEC) collected data to register how the construction work was executed. On the basis of the data the Centre subsequently established some key data in the form of Key Performance Indicators (KPI's) for the construction. They belong to level three in the CREDIT classification system.

The KPI's are for use in connection with prequalification for new projects and for use internal at client and company – and not for monitoring the concrete construction work. After three evaluations the company will get a grade book with the KPI's mentioned below for KPI's to the contractor.

The following Key Performance Indicators are based on the first established definitions in 2001 when the government decided to establish a benchmarking system. They have just been altered after an evaluation of the system. For example are data about costs and working hours left out due to efforts to reduce the work with collecting data.

Key Performance Indicators (KPIs) which were delivered to the client after execution:

- Actual construction time in relation to planned construction time
- Actual construction time incl. remediation of defects in relation to planned construction time
- Remediation of defects during the first year after handing over
- Number of defects recorded in the handing-over protocol, classified according to degree of severity
- Accident frequency per billion DKK
- Work intensity, man hours per m²
- Labor productivity
- Changes in project price during the construction phase
- Square meter price
- Customer satisfaction with the construction process.

KPIs which were delivered to the contractor:

- Actual construction time in relation to planned construction time
- Actual construction time incl. remediation of defects in relation to planned construction time
- Remediation of defects during the first year after handing over
- Number of defects recorded in the handing-over protocol, classified according to degree of severity
- Accident frequency per billion DKK
- Customer satisfaction with the construction process.

The Centre was established in 2002 by the organizations in the building sector with participation from the Danish Agency for Enterprise and Construction. Since January 1st 2004 it has been compulsory for clients responsible for state projects and later 1st March 2008 for clients for non profit housing projects to ask for KPIs when they are executing new buildings.

In this way the system and the indicators are used for different types of buildings – from offices and museums to all sorts of housing projects.

In practice the demand is part of the contract between the client and the construction company and it is up to the company to make an arrangement with an independent evaluator to make the registrations. In principle it can be other organizations than BEC.

Since 1st July 2005 construction companies also have had to present KPIs for previous projects if they wish to undertake new construction projects for state clients and from 1st October 2009 for non profit housing associations.

The Benchmark Centre issues as mentioned above so called grade books when a construction company has collected KPIs from at least three projects.

Up to now the Centre has executed 1460 evaluations and 115 companies have got a grade book. Further more 640 contractors have either got or are in the process of getting KPIs.

KPIs for the individual company will be made public from 2010 or when 100 projects have been evaluated in accordance with revised system.

The Centre has also in a collaboration with clients and the organizations in the building sector established a system of KPI's for the design work – done by private architects and civil engineers – and are working on a system for the client's work.

The system for design work consists of 13 indicators for different aspects of the work and 2 indicators for overall evaluation of the work. From 1st May 2008 it has been compulsory for state clients and for housing associations to require registration of data and establishing of indicators in new projects.

From 1st November 2009 it will be compulsory to use indicators in selection of potential companies for design work in connection with new projects.

State construction and non profit housing projects have acted as change agent in the use of KPI's. It has been difficult to implement this new form of evaluations and it has been necessary to adapt the KPI's and the registration of data. There is a growing interest in the private sector for use of KPI's but some users wish a more simple and cost effective system, which is an integrated part of the project and company management system.

1. Introduction and objectives

This chapter describes the objectives of the CREDIT project, the background, scope and purpose of the case study of search engines for private homes, and the research design of the study.

1.1 Objectives and work packages of CREDIT

Sir Winston Churchill once said, “We shape our buildings, afterwards our buildings shape us” (28th 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 case has been chosen to show how it is possible to carry out a systematic evaluation of the work on a construction site and thereby get an insight in the quality and productivity of the building process and how it is possible to use the results from evaluations in connection with prequalification of companies in a bidding procedure.

The case describes use of Key Performance Indicators (KPI's) for contractors work on building sites. It is obligatory for state client and non profit housing associations to use the described KPI's. Under the construction of a concrete building the necessary data for KPI's are collected and the companies have to deliver the obtained KPI's in connection with qualification for new building projects.

The resulting Key Performance Indicators are used by the client and the company/the companies to get information about the quality and effectiveness of the executed work. They also give new clients a possibility to evaluate qualifications of potential contractors looking for a new contract.

1.3 Research design and methods applied in the case study

The focal point is the calculation of KPI's based on the registration of data concerning a contractor's work on a building site.

The KPI's belongs to level three in CREDIT Indicator Classification.

Data for calculation of KPI's are collected of the client and companies and delivered to an independent organization, the Danish Benchmark Centre. They are used in a benchmark system, established by the Centre

The evaluation is based on written papers about the procedures – from the Ministry for Interior and Social Affairs, the Agency for Enterprise and Construction and the Danish Benchmark Centre (BEC) (www.ism.dk, www.ebst.dk and www.byggeevaluering.dk) - and interviews with Morten Skaarup Jensen (BEC).

The case has been conducted as an action research by researchers and members of the organization seeking to improve their situation (Greenwood and Levin, 1998)

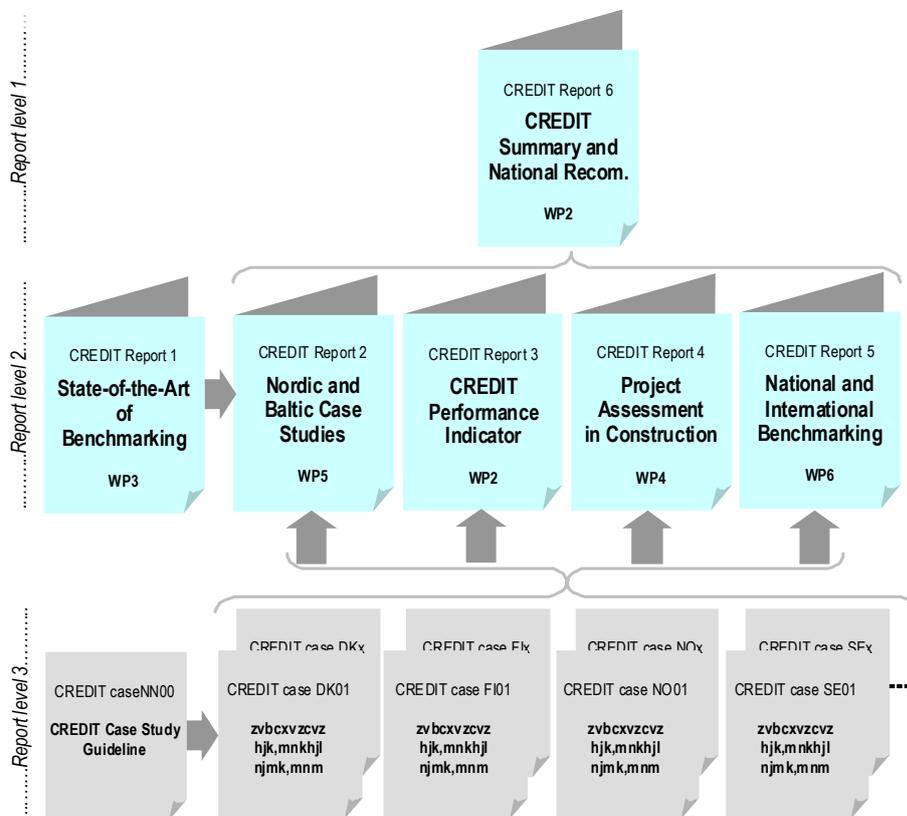
Data have been conducted from multiple sources to enhance reliability and trustworthiness of the results (Robson, 2002).

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

Based on a specific building case the assessments and indicators applied in the construction process is described.

Data is registered during the execution phase and forms the basis for a systematic calculation of Key Performance Indicators (KPIs) by an independent organization, the Benchmark Centre for the Danish Construction Sector (BEC).

2.1 The actual building, building parts and processes

The actual building is situated in Frederikshavn in the northern part of Jutland/Denmark. It is a training centre ("Søværnets Taktikkursus") for the employees in The Danish Navy and was designed and constructed in the years 2006 to 2008. The client is Forsvarets Bygnings- og Etablisementstjeneste.

The focus was on different aspects of the building process. They belong to level three.

The actual building has only been used as a starting point for a description of the bench mark system and the indicators.

2.2 The applied assessments and tools in the processes

The necessary data for calculation of the KPI's are collected by the client and the companies during construction. They are delivered to the Danish Benchmark Centre, an independent organization.

The indicators are mainly calculated after the construction phase and they are used for two purposes. One purpose is an evaluating of the work on the site. Another is to give information about the companies who have executed the building – and the likelihood that they will do a good job next time.

It has been decided that the practical registrations shall be executed by an independent organization. Up to now only the Danish Benchmark Centre, established by the main trade organizations in the building industry, has been active in the area.

In the individual concrete case the client has to answer some question about factual data in the project and about the execution. In new coming projects the client has to demand KPI results from potential contractors interested in the coming project.

Up to now only some of the companies use the indicators in their work with development of procedures and methods.

In the actual concrete case the Benchmark Centre for the Danish Construction Sector (BEC) collected data during the construction phase to register how the construction work was executed. On the basis of the data BEC subsequently established some key data in the form of Key Performance Indicators for the construction.

It is compulsory for clients responsible for state and non profit housing projects to ask for KPIs when they are executing new buildings. In practice the demand is part of the contract between the client and the construction company and it is up to the company to make an arrangement with an independent evaluator to make the registrations. In principle it can be other organizations than BEC.

The resulting Key Performance Indicators are used by the client and the company/the companies to get an impression of quality and effectiveness of the executed work in post analysis. They also give clients a possibility to evaluate qualifications at potential contractors looking for a new job

In this way the collected data and the calculated KPI's were primarily for the companies and for the client.

The basic philosophy is that a building process with a high effectiveness and quality will increase the possibility of getting a building which satisfies the users.

The costs for an evaluation depend on the size of the project. For a construction project above 12 million Danish kr. the prize is 0,75 per mille of the building costs. Under that limit – from 1 million to 12 million – 9.000 Danish kr. and under 1 million 5.000 Danish kr. For a consulting company the prize is 4.750 Danish kr.

2.3 Cost and performance indicators applied in the processes

The indicators address the building as a whole (for example construction time), the process on the site (for example accidents) and the different parts of the building (for example defects).

Key Performance Indicators (KPIs) which were delivered to the client after execution:

- Actual construction time in relation to planned construction time
- Actual construction time incl. remediation of defects in relation to planned construction time
- Remediation of defects during the first year after handing over
- Number of defects recorded in the handing-over protocol, classified according to degree of severity
- Accident frequency per billion DKK
- Work intensity, man hours per m²
- Labor productivity
- Changes in project price during the construction phase
- Square meter price
- Customer satisfaction with the construction process

KPIs which were delivered after construction to the contractor:

- Actual construction time in relation to planned construction time
- Actual construction time incl. remediation of defects in relation to planned construction time
- Remediation of defects during the first year after handing over

- Number of defects recorded in the handing-over protocol, classified according to degree of severity
- Accident frequency per billion DKK
- Customer satisfaction with the construction process.

The chosen indicators are the result of a thorough investigation into the criteria which can be used to evaluate the work on a building site. They are based on criteria normally used by contractor companies.

The concrete KPI's are for the moment anonymous and only for internal use at client and companies. But in accordance with the plan they will be published when there are more experiences in the form of a number of projects with KPI's.

2.4 Relation to different enterprises and national benchmarking

The indicators in this case show how it is possible to evaluate the process on the building site after the final delivery. They give the client and the companies an insight and information about the executed work. The results can be used for altering procedures within the contractor and a future client the possibility to evaluate potential contractors for new contracts

Furthermore the KPI's form the basis of a benchmark system.

The calculated Key Performance Indicators (KPI's) form the basis for a grade book for the individual company. These will be made public in 2010.

BEC will also inform the client and the company about how the obtained KPI's are ranked in comparison with an average for all companies which have been evaluated.

For the government, politicians and the building industry the KPI's give the possibility for a general overview of development in the building industry concerning the evaluated topics.

2.5 Visions and innovation for future improvements

In the new system it will be up to the client to send BEC the necessary data in efforts to simplify the work with collecting data and free the companies for the work.

Some KPI's have been changed.

3. Enterprises – assessments and indicators internally applied

Based on a specific contractor involved in the mentioned project in Frederikshavn the internal assessments and indicators applied in the company is described to illuminate the practical use of KPI's in the bench mark system.

Due to confidentiality the concrete results are not mentioned. For new projects the results will be published when a certain number of evaluations have been executed.

For the client the KPIs give an evaluation of the contractor, the work and the finished building (number of defects at handing over).

3.1 The actual enterprise, company and firm

The contractor in the mentioned project in Frederikshavn was Trigon A/S, contractor who has 50-99 employees. The company acted as main contractor

3.2 Applied assessments and tools in the enterprise

The contractor has to deliver data concerning the progress in the execution of the building to establish the basis for calculation of the KPIs.

The client will supplement with further data as for example data concerning customer satisfaction and factual data concerning the project.

All data is delivered digital. The resulting KPI's for the individual case and for companies are published on BEC's homepage – www.byggevaluering.dk. They are also together with grade books forwarded in paper. But until 2010 they are only accessible for the companies.

It has shown to be difficult to integrate the resulting KPI's in the company's system for project management

3.3 Costs and performance indicators applied in the enterprise

The collected KPI's are focused on the process. They are calculated after the process and in this way they give an evaluation of the (finished) process and KPI's for the contractor to deliver to new clients. When at least three evaluation of the contractor has been made, the contractor will be in a possession of a grade book to forward to any possible new clients

KPI's delivered after construction to the client:

- Actual construction time in relation to planned construction time
- Actual construction time incl. remediation of defects in relation to planned construction time
- Remediation of defects during the first year after handing over

- Number of defects recorded in the handing-over protocol, classified according to degree of severity
- Accident frequency per billion DKK.
- Work intensity, man hours per m²
- Labor productivity
- Changes in project price during the construction phase
- Square meter price
- Customer satisfaction with the construction process

KPIs which were delivered after construction to the contractor:

- Actual construction time in relation to planned construction time
- Actual construction time incl. remediation of defects in relation to planned construction time
- Remediation of defects during the first year after handing over
- Number of defects recorded in the handing-over protocol, classified according to degree of severity
- Accident frequency per billion DKK
- Customer satisfaction with the construction process.

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3.4 Relation to building cases and national benchmarking

The KPI's and the grade book give a possibility for the contractor to compare the company's work with similar work in other companies and between different projects executed by the same company. In this way the contractor gets an impression of strong and weak aspects of their work.

The company uses information from own experiences and from central databases concerning best practice. One example of another benchmarking system is the Building Defects Fund, see special description case DK08. From the Fund's homepage the company can get information about defects and more general experiences concerning different design solutions.

3.5 Visions and innovation for future improvements

The experiences have shown that the assessment methods and the KPI's give the client and the contractor an important contribution to their evaluation of the building process. Meanwhile the full usefulness will imply new procedures within the companies and the client.

From the companies there have been complaints about definitions of some KPIs and the work to reporting data. Therefore the system has been simplified and the work substantially reduced, see the following

4. National benchmarking – indicators and organisation

The chapter describes the idea and targets with the establishment of the Danish Benchmark centre. Furthermore it summarizes the procedures in the centre and the experiences up to now. (www.byggeevaluering.dk)

4.1 The actual benchmarking organisation and its purpose

BEC was established by the organizations in the building sector with participation from the Danish Ministry's Agency for Enterprise and Construction.

The establishment was a result of a task force report looking into the state of affair in the building sector. The report found that the Danish building industry was lacking behind other countries in productivity and quality in an international comparison.

It is compulsory for clients responsible for state projects and from 1st October 2009 for non profit housing projects to ask for KPIs when they are looking for potential contractors to execute new buildings and it also compulsory to get new building projects evaluated with the aim to calculate KPIs.

About 30 % of the evaluations executed of BEC are due to the demand from the state meanwhile 70 % are from private clients or local authorities.

The system and the indicators are used for different types of buildings – from offices and museums to all sorts of housing projects.

In practice the demand is part of the contract between the client and the construction company concerning a new project and it is up to the company to make an arrangement with an independent evaluator to make the registrations. In principle it can be other organizations than BEC.

Since 1st July 2005 construction companies have had to present KPIs for previous projects, if they wish to undertake new construction projects for the Danish state. BEC refers here also to the company's "grade book" when the construction company has collected KPIs from at least three projects.

From 1st October 2009 it is likewise compulsory for non profit housing clients with new projects to ask for KPI's from potential contractor interested in executing the project.

Up to now BEC has executed 1460 evaluations and 115 companies have got a grade book. Furthermore 640 contractors either have got or are in the process with getting KPIs

For the moment BEC covers about 3 % of the total market – buildings for private, regional, local authority, non profit housing and state clients

4.2 Assessment applied in the benchmarking organisation

In practice the demand is part of the contract between the client and the construction company concerning a new project and it is up to the company to make an arrangement with an independent evaluator to make the registrations. In principle it can be other organizations than BEC.

4.3 Cost and performance indicators applied in benchmarking

The contractor has to deliver data concerning the progress in the execution of the building to establish the basis for calculation of the following KPIs which are delivered to the client after the construction:

- Actual construction time in relation to planned construction time
- Actual construction time incl. remediation of defects in relation to planned construction time
- Remediation of defects during the first year after handing over
- Number of defects recorded in the handing-over protocol, classified according to degree of severity
- Accident frequency per billion DKK.
- Work intensity, man hours per m²
- Labor productivity
- Changes in project price during the construction phase
- Square meter price
- Customer satisfaction with the construction process

KPIs which are delivered after construction to the contractor:

- Actual construction time in relation to planned construction time
- Actual construction time incl. remediation of defects in relation to planned construction time
- Remediation of defects during the first year after handing over
- Number of defects recorded in the handing-over protocol, classified according to degree of severity
- Accident frequency per billion DKK
- Customer satisfaction with the construction process

The collection of data has been digitalized.

The system and the indicators are used for different types of buildings – from offices and museums to all sorts of housing projects.

4.4 Relation to enterprises, building projects and real estate

The KPIs are used at the company level and as a presentation of a company in connection with prequalification and the client's selection of companies to take part in a tendering procedure.

Furthermore they give clients information about the process at the building site in concrete projects when the building is finally delivered after one year.

4.5 Visions and innovations for future improvements

Since the system was introduced in 2004 it has been through some evaluations from clients and companies which have resulted in alterations. A main feature has been to simplify the system and especially reduce the scope of

work for the companies. Furthermore the collection of data has been digitalized.

From 1st May 2008 the system was simplified and digital reporting was introduced. The simplifications included costs and leaving out man hours from the contractors and subcontractors from reporting. This means that information about effectiveness; work intensity and labour productivity are not calculated in the new system.

From 1st May 2009 the system has been further simplified as the grouping of information about building defects at handing over has been changed and two groups combined. Possible defects will be evaluated in accordance with the costs for remediation and inconvenience for the users of the building. There are three now grades of seriousness of defects plus information about number of defects to be investigated further.

By using an average rate for costs per man hour it is possible to convert the new information to the former method and in this way to maintain continuity.

For the question concerning the clients satisfaction there were 11 questions to be answered. These have been reduced to 8. A new KPI is a question about client loyalty.

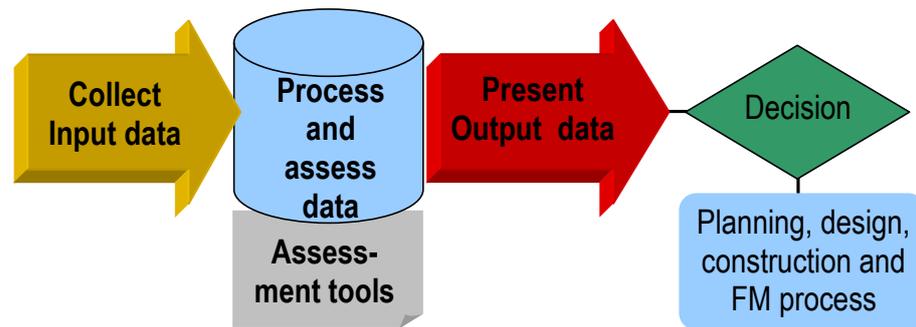
This simplification also implies that it will be up to the clients to report the necessary data for calculation of KPIs but the contractor still has to confirm the data.

5. Discussions and conclusions

The main focus in this case is a system of evaluating the building process. The evaluation is based on some defined key performance indicators and is executed by an independent organization.

In chapter five the system, the experiences and the revisions up to now are described and discussed with conclusions.

Figure 2. CREDIT information model in relation to decisions in the planning, design, construction and facility management processes.



5.1 Buildings – lessons learned and recommendations

The necessary data for establishing KPI's by an independent organization is collected during the work on the building site and at handing over. Until now it has been up to the contractor and subcontractor to report the main amount of data.

Meanwhile the findings in connection with evaluations of the system have shown that the companies had some complaints about the scope of the work and wanted a reduction. Further more it was noted that the client was already in possession of much of the necessary data.

Therefore the main part of the work with collecting data has been moved to the client and digitalization has been introduced.

5.2 Enterprises - lessons learned and recommendations

The experiences have shown that the assessment methods and the KPI's give the client and the contractor an important contribution to their evaluation of the building process. Meanwhile the full usefulness will imply new procedures within the contractor companies and the client.

From the companies there have been complaints about definitions of some KPIs and the work to reporting data. Therefore the system has been simplified and the work substantially reduced.

5.3 National benchmarking – lessons learned and recommendations

The government has decided that it is compulsory for clients working with state building projects and clients for non profit housing to use the system. The same clients have to demand key performance indicators from potential contractor interested in new projects.

Since the system was introduced in 2004 it has been through some evaluations from clients and companies which have resulted in alterations. A main feature has been to simplify the system and especially reduce the scope of work for the companies. Furthermore the collection of data has been digitalized.

Two of the main partners behind the system representing clients, the Agency of Enterprise and Construction and the Ministry of Interior and Social Affairs, have emphasized simplifications in order to secure the highest usefulness and the lowest use of resources in creating the KPIs. Therefore the efforts were concentrated about a reduction of indicators and the effectiveness of the system.

The target with alterations has been continuously to use objective as well as subjective KPIs and to maintain the continuity so it is possible to use KPIs already collected in a long time perspective.

From 1st May 2008 the system was simplified and digital reporting was introduced. The simplifications included costs and leaving out man hours from the contractors and subcontractors from reporting. This means that information about effectiveness; work intensity and labour productivity are not calculated in the new system.

From 1st May 2009 the system has been further simplified as the grouping of information about building defects at handing over has been changed and two groups combined. Possible defects will be evaluated in accordance with the costs for remediation and inconvenience for the users of the building. There are three now grades of seriousness of defects plus information about number of defects to be investigated further.

By using an average rate for costs per man hour it is possible to convert the new information to the former method and in this way to maintain continuity.

For the question concerning the clients satisfaction there were 11 questions to be answered. These have been reduced to 8. A new KPI is a question about client loyalty.

This simplification also implies that it will be up to the clients to report the necessary data for calculation of KPIs but the contractor still has to confirm the data.

It is the opinion that the simplification will not give the clients and the companies' poorer information than before but there is still some doubts about how KPI's will be included in the project and enterprise management systems and how the performance will be improved in the future.

References

Greenwood, D.J. and Levin, M. (1998) *Introduction to action research: social research for social change*, Thousand Oaks, CA: Sage Publications

Robson, C. (2002). *Real world research*, Oxford: Blackwell. 2nd Edition

Byggeriets Evaluerings Center. The Danish Benchmark centre. Located 20100616 at: www.byggeevaluering.dk

Indenrigs- og Socialministeriet. The Ministry of Social and Interior Affairs. Located 20100616 at: www.ism.dk

Erhvervs- og Byggestyrelsen. The Danish Agency for Enterprise and Construction. Located 20100616 at: www.ebst.dk



This report describes the results of a case study of the Benchmark Centre for the Danish Construction Sector (BEC). The study was undertaken as part of the Nordic and Baltic project CREDIT: Construction and Real Estate – Developing Indicators for Transparency.

The Benchmark Centre for the Danish Construction Sector was established in 2002 by the organizations in the building sector with participation from the Danish Agency for Enterprise and Construction. Since January 1st 2004 it has been compulsory for clients responsible for state projects and later March 1st 2008 for clients for non profit housing projects to require data for establishing Key Performance Indicators (KPI's) for the actual construction process.

The KPI's are for use in connection with prequalification for new projects and for use internal at client and company – and not for monitoring the concrete construction work. After three evaluations the company will get a grade book.

The actual building in the case is situated in Frederikshavn in the northern part of Jutland. It is a training centre for the Danish Navy and was designed and constructed in the years 2006 to 2008.

From January 1st 2010 it is compulsory for the mentioned clients to require KPI's for the main partners in a building project: Client, architect, consulting engineer and contractor.

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