Measuring the Benefits of CE-Environment in Multi-partner Projects

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Summary

This paper deals with the measuring the impact of the usage of concurrent engineering environment in the multi-partner project. The paper is grounded in the research project *ProCE: Project Management and Organization in the CE-environment*. The project is attempting to determine the benefits derived from using the concurrent engineering environment in construction design and project management routines. In this context, the concurrent engineering environment is defined as a conceptual arena created by any or all technologies enabling collaborative efforts in the building process.

This paper presents the main findings of the state of the art study, where the existing approaches to evaluate information technology IT within multi-partner projects where reviewed from the viewpoint of project management and organization in the construction industry. It also presents the framework for measuring the benefits of using the CE-environment.

Keywords: e-collaboration, groupware, measuring, benefit, Internet, construction, concurrent engineering

1. Introduction

The concurrent engineering (CE) environment for construction has been developed and implemented. There are already several commercial tools and CE environment solutions for the construction industry. The main elements of the environment are tools for document management that is supported by e-mail.

There has been several approaches to the implementation of these technologies, each having different strengths and weaknesses according to the party's viewpoint from which implementation is considered. The main approaches are:

1. Document management for design phase

2. Project management in the production phase

3. Document management for property management

The primary challenges in the multi-partner project environment are the following: (1) to identify the construction industry requirements, (2) to configure and combine existing systems to achieve the required functionality, (3) to deploy the tools into practice and establish new communication procedures between companies.

To be able to respond to the challenges above, the construction project needs to be handled as one process, which should be optimized as a whole, not only one party's sub-process. In addition, the benefits gained by using the CE environment in the construction project need to be determined.

This paper is grounded in the research project called ProCE: Project Management and Organization in the CE-environment. The project was attempting to determine the benefits gained by using the concurrent engineering environment in construction design and project management routines. ProCE is a Finnish-American cooperative research project being carried out from September 2000 - December 2001. In this context, the concurrent engineering environment is defined as a conceptual arena created by any or all technologies enabling collaborative efforts in the building process [1].

In this paper, a description of the main findings of the state of the art study is presented, where the existing approaches to evaluate information technology IT within multi-partner projects where reviewed from the viewpoint of project management and organization in the construction industry. A framework for measuring the benefits of using the CE-environment that was created for ProCE project to evaluate benefits in case-projects is also presented.

The framework consists of the tools for measuring and of the application. The first one is the part that is common to benefit measurement in any project, and to which a project specific application is based on.

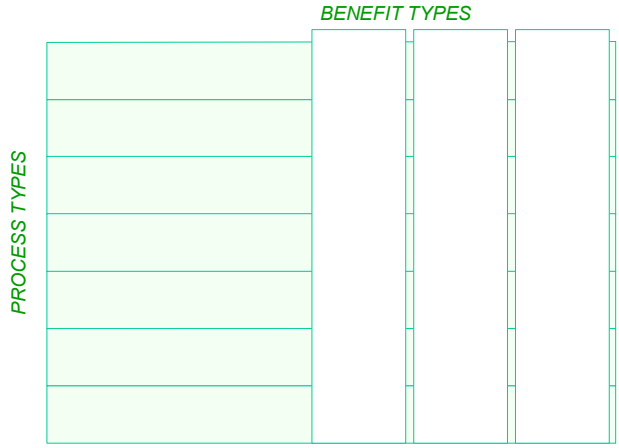
2. Framework Development

2.1 Evaluating the Benefits of IT Investments

Previous research shows that most construction organizations have no formal methodology to evaluate the benefits of IT investments and formal cost-benefit analyses are not widely used in the construction sector. Meanwhile, a majority of organizations in other sectors evaluate IT investments. However, in resent years the construction sector has also recognized the need for effective benefits assessment [2].

Some suitable methods for assessing the benefits of information technology in the construction sector have been developed. Construct IT [4] created a framework to be used within one company to support IT investment decisions and compare competing investments, or show the relative impacts of a proposed investment. One of the basic principles of the framework is a matrix classifying benefits according to type and business process stage (Figure 1).

Figure 1. Benefit classification matrix



Applicable parts of that approach have been advantaged in this research and developed further to better suit the evaluation of benefits of using the CE-environment in multi-partner construction projects.

2.2 Benefit Types

Literature shows that benefits can be typified in different ways. The most general typification distinguishes between quantifiable and non-quantifiable benefits. Simmons [3] developed a more detailed framework identifying five benefit types occurring within an organization. The framework classified benefits that increased efficiency, increased effectiveness, added value, contributed to a marketable product, or developed corporate IT infrastructure. Additionally, Simmons acknowledged that within each type both quantifiable and non-quantifiable benefits exist.

Construct IT [4] presented another framework having three benefit types within an organization and identified them as efficiency, effectiveness, and performance. In less technical terms these benefits were described as doing things right, doing the right things, and doing better things, respectively. Efficiency benefits, or doing things right, grouped those benefits associated with the rate of converting input into output. Effectiveness benefits, or doing the right things, grouped benefits

associated with the comparison of output and planned output. Performance benefits, doing better things, grouped benefits associated with new, unplanned output. Again, it was recognized that many times within these types both quantifiable and non-quantifiable benefits would exist.

For the purpose of this research, a suitable classification framework was developed and used to classify benefits of utilizing the CE environment in the building process.

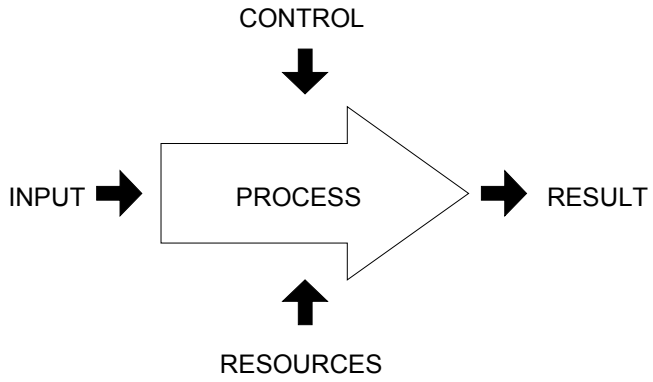
2.3 Process Types

In addition to different methods for typifying benefits, previous research showed that different building process models exist. The underlying basis for the models establishes the differences between them. *Construct IT* [4] utilized a business process view in their measuring framework to model the building process from the enterprise perspective. The business process consisted of business planning, marketing, information management, procurement, finance, client management, design, construction, operation and maintenance, and human resources.

A different underlying basis for modeling is the building process. Back and Moreau [6] developed a measuring framework based on the engineer / procure / construct (EPC) process. This research emphasized using the building process approach as the measuring basis in order to accurately determine the significance of the realized benefit with respect to the entire process, in contrast to within one organization. Extending this idea, the *Quality Management System* [7] model was developed based on the building life-cycle process that included facility management.

The process function can often be measured directly. But if the process is very complicated, like the sub-processes of the building life cycle process, it can be hard to find suitable measures. In that case, relationships to the process can be measured, like *input*, *control*, *resources* and *result* of the *process*, and these relationships form the underlying basis for the model. The form of these relationships varies depending on characteristics of the process. Input can be basic information of the process or some result of the previous process. Control can be different types of efforts that are needed for planning and follow-up of the process. Resources can be work, material and equipment, and result is that what the process produces (Figure 2).

Figure 2. General process model [7]



Based on these ideas, a model was developed that accommodated the building project process, using both the life-cycle process and project management as the underlying concepts.

3. The Measuring Framework

The resulting measuring framework consists of two parts. The first part is the development of a general measuring framework, applicable to all ProCE case studies. The second part of the framework is the project specific application of the measuring framework.

3.1 Measuring Framework Description

The benefit measuring framework consists of three tools. The first tool is a categorized checklist of benefits intended to identify all the possible benefits of implementing the CE environment in a multi-partner project. The checklist helps identify perceived or expected benefits, and can be used

when setting targets for using the CE-environment in a project. The second tool is an evaluation sheet for each benefit type that records selected indicators, collected data, and defined measured results. The third tool is a summary table, where results from each evaluation sheet are entered to evaluate benefits and make final conclusions. These tables are intended to organize measuring and record results, and to group them according to benefit type.

Because the process approach to benefit measurement is used, the foundational benefit classification system utilized was modified from those found in literature. The checklist organizes potential benefits both in terms of type and related activities of building project. This was done in an attempt to consider all the benefits possible from implementation of the CE environment, in contrast to assessing benefits from the viewpoint of one organization.

Benefit classification was based on the principles of quantifiable and non-quantifiable benefits. Benefits were classified into three types and identified as monetary (quantifiable in monetary terms), other quantifiable (quantifiable but not in monetary terms), and qualitative (non-quantifiable, expressed qualitatively). This classification framework better suited the project process approach to benefit measurement.

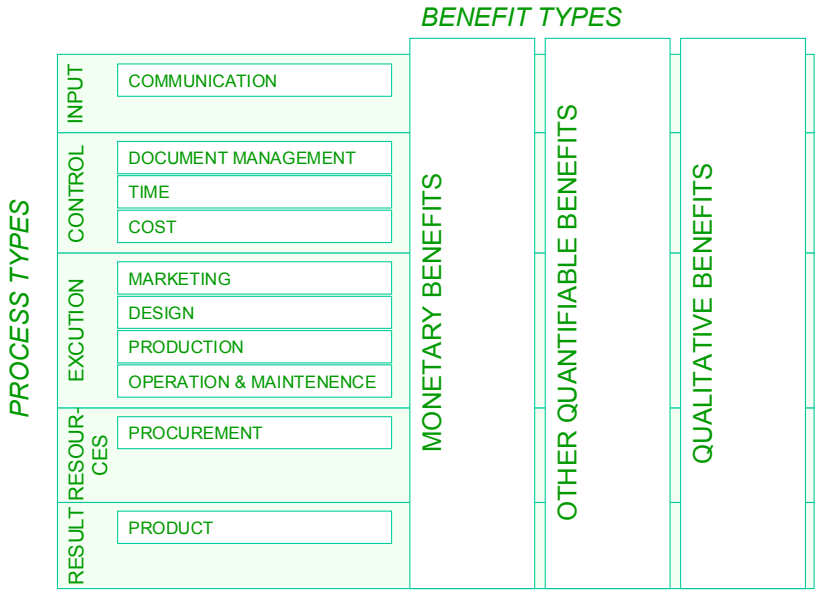


Figure 3. Benefit classification matrix for project process

3.2 Project Specific Application

To perform the actual benefit measurement, the measurement framework is applied to each case study in four phases, identification of expected / perceived benefits, preparation for measurement, benefit measurement, and evaluation of benefits (Figure 4).

The identification of expected / perceived benefits is the initial phase. Expected benefits are applicable to those cases where the building project is starting or still in progress. Perceived benefits are identified in the cases where the project is complete. This phase utilizes the framework's benefit checklist and interviews, and the result is identification of benefits to be assessed.

In preparation for measurement, performance indicators are identified for each benefit that is selected to be measured, data collection methods are planned, and expected benefits estimated or a target set for utilizing the CE-environment. If the project has been completed without target setting, maximum possible benefits have probably not been achieved, therefore necesitating an estimate of what benefits would have been available, a comparison to what was gained, and analysis of the gained benefit's significance.

Measuring of benefits is done through analysis of the collaboration solution data and documents, and by interviews/questionnaires, resulting in measured results for each benefit type.

Final benefit evaluation is done after summarizing data in the summary sheet. Intended results of the last phase are conclusions concerning benefits and cost-benefit comparison.

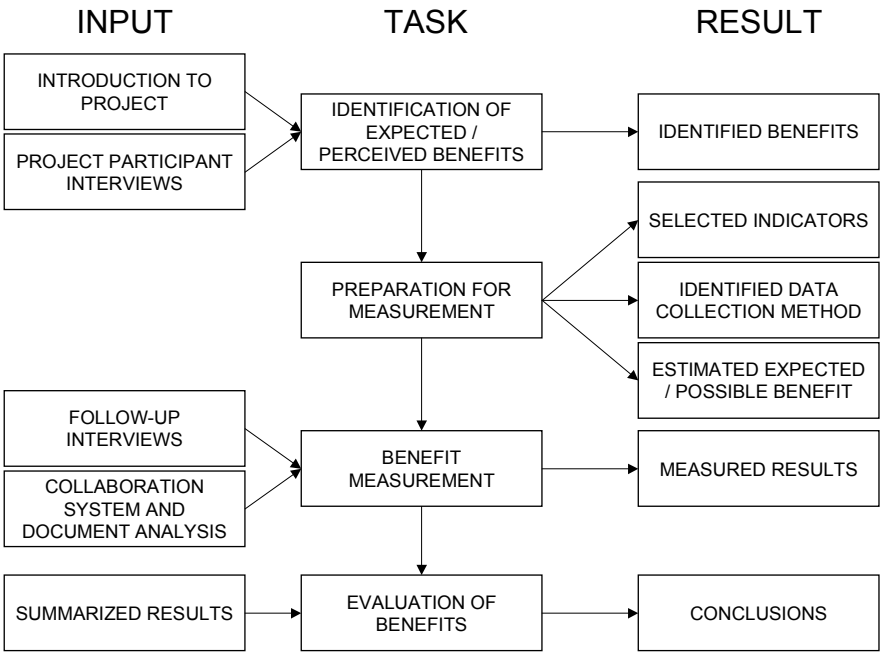


Figure 4: Project Specific Application of Measuring Framework

4. Conclusions

A framework for assessing the benefits of using the CE-environment in multi-partner projects was presented in this paper. More research is needed to develop the measuring indicators and methods for quantifying and evaluating benefits. The framework has been tested and further developed while conducting several case projects in Europe and the USA.

A project process approach was selected in this benefit assessment framework because benefits are usually distributed across several organizations; from the viewpoint of one company, benefits for team and the project as a whole cannot be seen. Also the costs of using the CE-environment are mainly related to a specific project, especially when using application service provider (ASP) services, and the project process approach supports comparison of both costs and benefits.

The framework described in this paper can be used to assess the benefits of using of the CE-environment in a single multi-partner project. To evaluate longer-term benefits, the underlying basis for the process model should be modified from the project process. In addition, long-term benefit analysis should consider additional issues such as the evaluation of changes in construction industry- and project management routines, or the implications of not implementing an innovation [4].

Any developed framework must be modifiable to fit the unique attributes of the specific construction project. The framework presented in this paper is applicable to evaluate benefits in concluded projects but can also be used when setting targets for and evaluating results of using the CE environment in projects.

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