

POTENTIAL BENEFITS OF INFORMATION TECHNOLOGY IN CONSTRUCTION IN FINLAND

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ABSTRACT

The paper presents an estimation of potential benefits of IT in construction. The estimation is based on a methodology which analyses a company's current IT capability. The methodology was adapted to industry level to analyse what is the current level of IT capability of the Finnish construction industry. The analysis resulted the potential direct cost savings though more efficient information processing if the current level would be upgraded and what would be the required investments, including hardware, software and education.

Keywords, Information Technology, Construction, Measure, Methodology, Benefits, Savings, Finland

INTRODUCTION

Investments in IT are often argued with the benefits it can bring with. Still few if any studies are reported which could justify these arguments or quantify the benefits. With this project we tried to estimate what the overall benefits could be. The problem is very challenging and requires plenty of research. Thus we accepted the fact that we cannot achieve any scientifically verified results, but the aim of the project was to produce well argued experts' estimate on the potential benefits. The study covers both the construction process and the facility management process.

This project is part of ongoing Finnish national technology programme Vera - Information Networking in the Construction Process (for more information, please visit at <http://www.tekes.fi/english/programm/prod/vera/index.html>). The aim of the study was also to help focus the research and development work in the Vera programme.

It was evident that to be able to quantify the possible benefits of information technology we need first a benchmark where to compare. Some kind of metrics where we can point current level and target level and then estimate what would be the benefits improving from a lower to a higher level and what would be the required cost to do that. So, the project resulted in a methodology to analyse the maturity of capability of the use of IT and respective benefits and cost. The methodology can be applied to any single company in construction industry. Furthermore, the methodology was applied to Finnish construction sector as a whole, and potential benefits of effective use of IT were estimated in the industry level.

IT MATURITY ANALYSIS -METHODOLOGY

IT maturity analysis methodology is based on a similar approach as is used in quality awards. There are six criteria that are assessed. Three of them – management commitment, processes,

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and IT skills – are required enablers which are needed to effective IT use. The other three are titled as technologies: information structures, infrastructure, and software. Each of these criteria have been given a weight according to the contribution we saw them to have on IT maturity. Maximum total score is 1000 points. For each criteria a general description was created to help give the score.

	Aspect	Max points	%	points
Enablers	Management commitment	200		
	Processes	150		
	IT skills	150		
Technologies	Inform. structures	250		
	Infrastructure	100		
	Software	150		
Total		1000		

Figure 1 Scoring table

Information structures	Weight 250
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Levels	Description	%
Level 1	Paper documents	0-10
Level 2	Digital data, no formal classification, paper based data exchange	10-30
Level 3	Formal classification, internal integration with main applications	30-60
Level 4	Formal classification, electronic data exchange	60-80
Level 5	Object based data exchange, interoperability	80-100

Figure 2 Simplified descriptions of the levels for “Information structures” criterion.

It is still impossible to analyse a company or industry as a single entity. Thus we first divided the construction industry into disciplines, and then a process model was made for each discipline. In each discipline, each process were given a weight according to the importance it was seen to have on the IT use. Then each process was analysed against the six criteria, and scores were given resulting in total score for each process, which then were summed up to get the score for the discipline (or a company), total maximum score is 1000.

The analysis of the Finnish construction industry was performed by disciplines, and for each discipline the six evaluation criteria were used to give the total score, resulting into maximum of 1000 points, which then would be multiplied with the weight factor of the discipline to get the total score for the industry. The weight factor (see Figure 3 and Figure 4) is each discipline’s share of the IT value of the whole industry. IT value describes the value of the

information work and it was derived using the total value of each discipline as a starting point, and then the share of the information work was estimated based on the work contents and the numbers of different types of employees each industry has. For example, in design the creative design work was considered 100% information work, while management of a business unit was considered only 30% information work, and industrial work 5%.

	Max points
Supporting processes	300
Company communications	75
Administration	25
Personnel management	25
IT and information services	75
Office services	25
Management system	75
Operative processes	700
Customer needs analysis	150
Project sales	50
Project management	100
Source information	100
Design work	100
Logistics	50
Documentation	50
Supervising	50
Project release	50
TOTAL	1000

Figure 3 Process model used for design and engineering

Two to three typical companies from each discipline were used as pilots and to represent the discipline. Additionally, experts' consideration was used to adjust score, which would represent the discipline in the whole industry IT, maturity analysis. Naturally, wider sample of companies would give better reliability, but in the methodology development phase, this was not seen reasonable.

	points	IT maturity level	weight	IT maturity
Project management	193	2	5.8%	11
Design & engineering	201	2	10.9%	22
Main contracting	154	2	16.6%	26
Subcontracting	96	1	6.1%	6
Building materials industry	437	3	1.6%	7
Building products industry	448	3	2.9%	13
HVAC contracting	196	2	5.0%	10
Electrical contracting	205	2	3.1%	6
Facility management	160	2	48.0%	77
Building Construction TOTAL				178
				Of 1000

Figure 4 Disciplines, and results of the analysis of the IT maturity of the Finnish construction industry.

The summary of the results is shown in Figure 4. As could have been expected the IT maturity was highest in building materials industry and building products industry, and lowest in subcontracting. The total score for Finnish Construction industry was 178, or level 2 in five level scale.

COST SAVINGS POTENTIAL IN FINNISH CONSTRUCTION INDUSTRY

IT maturity analysis was a foundation to quantify cost savings IT could provide to the construction industry. IT maturity is the scale against which the changes in IT use are measured and the cost saving potential is described as savings occurring when upgrading from a level to another.

There was no intention to get absolutely correct models how information technology could benefit a company, or what would be exact cost savings, since these would require intensive research on the subject. Instead we accepted to get only rough estimates what the cost benefits could be, and to get this estimate, best available expertise was used.

In the experts work four main mechanisms were identified, how IT can create savings:

1. through automation of information work,
2. through leaning processes, and reducing waste
3. through interoperability and transparency of information
4. through synergy impacts

Additionally, when the total cost saving potential was estimated, also the impact to other related processes or disciplines was considered. The most typical case would be design and engineering, where the total cost saving potential (if started from 0 level IT use), was estimated to be 128% of the IT value of design and engineering. This means that when the level of IT use in design is raised, a significant share of the cost savings will occur in main contracting and in other disciplines.

The estimated cost savings in Finnish construction industry are shown in Figure 5. The total cost saving potential (if starting from 0 level of IT use) would be 4.8 billion Finnish marks or 9.4% of the total output of the industry. The remaining cost savings potential (change from current level to top level, level 5 and 1000 points) in Finnish construction industry is 3.3 Billion Finnish marks annually or 6.5% of the industry's output.

	Total value, MFIM	IT value, MFIM	IT cost saving pot MFIM	Unused potential MFIM	Unused potential %
Project management	1,100	320	252	176	16
Design & engineering	1,200	601	772	541	45
Main contracting	4,500	914	783	548	12
Subcontracting	4,100	335	167	151	3.7
Building materials industry	2,800	90	101	40	1.4
Building products industry	3,400	157	196	79	2.3
HVAC contracting	5,000	275	153	107	2.1
Electrical contracting	2,600	168	113	79	3.0
Building Construction TOT.	24,700	2,860	2,537	1,721	7.0%
Facility management	26,400	2,672	2,290	1,603	6.1
Industry TOTAL	51,100	5,532	4,827	3,324	6.5%

MFIM/ year

Figure 5 Total cost saving potential (if starting from 0 level of IT use) and the remaining cost savings potential. One Finnish mark equals 0.19 USD or 0.17 Euros.

To realise the savings above, significant investments in hardware, software, and most of all in human resources are needed. These were estimated, based on experts' perception. To maintain a level, education and investment in infrastructure is needed continuously, and thus required investments are shown as annual investments. Obviously the investment would occur first, and savings would be realised after some period of time. Still, the interest rates were ignored in this study, but in a more detailed study this should be considered.

	Total cost savings MFIM	Investment MFIM	Net savings MFIM	Net savings %
Project management	176	42	134	12.2
Design & engineering	541	78	463	38.6
Main contracting	548	119	429	9.5
Subcontracting	151	43	108	2.6
Building materials industry	40	12	28	1.0
Building products industry	79	20	59	1.7
HVAC contracting	107	36	71	1.4
Electrical contracting	79	22	57	2.2
Building Construction TOT.	1,721	372	1,349	5.5
Facility management	1,603	347	1,256	4.8
Industry TOTAL	3,324	719	2,605	5.1

MFIM/ year

Figure 6 Remaining net savings potential for the Finnish construction industry, when the whole industry shifts from current level to level 5 and 1000 points in the IT maturity scale.

CONCLUSIONS

The project had two results:

- A methodology to analyse a companies IT maturity, and
- An estimate of the potential cost savings Finnish construction industry could achieve with better use of IT

The method helps a company to

- evaluate their present process and IT maturity
- benchmark with other, leading companies
- set goals for IT and process development
- plan and budget the IT, HR and operational development tasks and investments
- continuously evaluate the success of actions taken

The methodology also contributed to the estimation of potential cost savings. It was used to analyse current level of the industry in terms of the capability to exploit IT effectively. Reported cost savings are based on interviews and experts' perception on what could be achieved. Only the direct cost savings through more efficient information processing were reported. Obviously, there would be significant savings also through improved quality, reduced amount of mistakes, faster throughput times, etc. The authors' see that the benefits ignored in this study are remarkably more important to a company as the direct cost savings. Estimated cost savings should be verified (or disproved) scientifically by researchers.

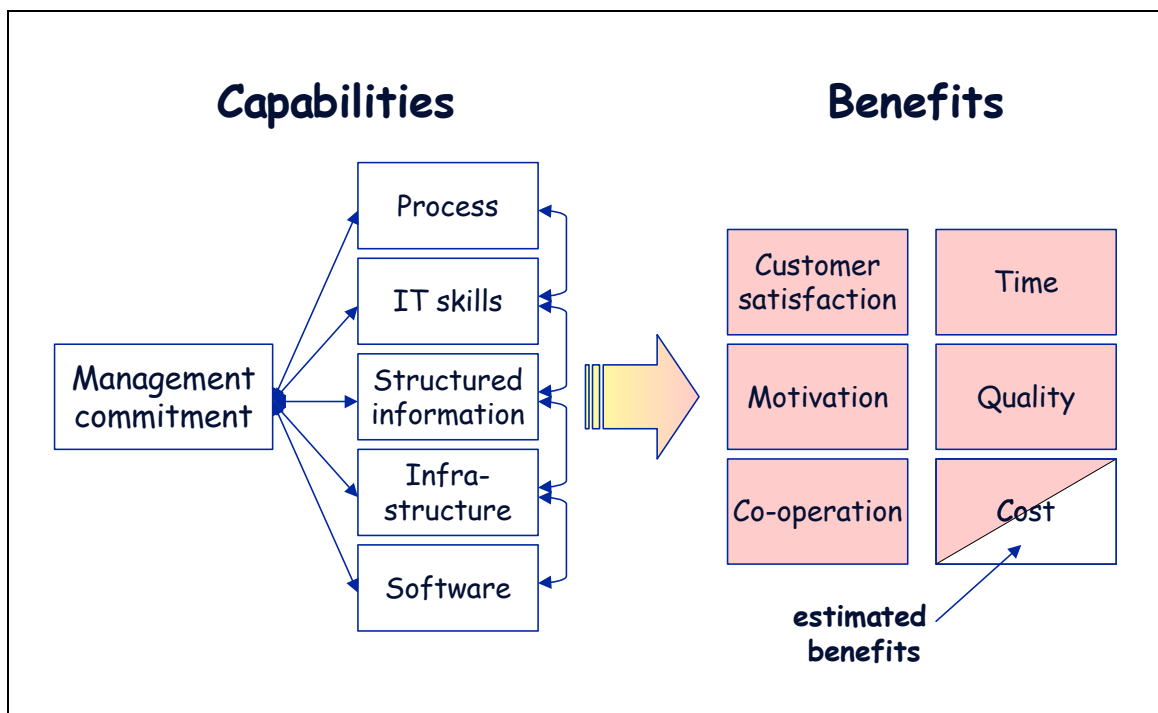


Figure 7 The reported benefits cover only the direct cost savings. Indirect cost savings, improved quality, reduced throughput time, improved customer satisfaction, improved employees motivation and improved co-operation with partners were intentionally ignored in this study.

This analysis reported potential net savings of 5.1% of the output of the industry. This would require long and intensive investments in education and development. Almost half of the absolute savings are expected in facilities management, but relatively design and engineering are the most fruitful area (39%) for investments in IT development (including human resources). In project management and main contracting significant savings can be expected both in relative (12%, 10%) and absolute figures.

Finally, we see that the main contribution of the project was to get an argued estimation what the benefits could be, to serve as a starting point for future and perhaps redirected R&D and better understanding how IT should be exploited within construction industry.