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Shaping the Construction/Society Nexus: Volume 3

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Volume 3: Construction in Society

Danish Building Research Institute
AALBORG UNIVERSITY

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Organising Committee’s declaration:
All the papers in these proceedings were double-blind refereed at abstract and full paper stage by members of the scientific committee. This process involved, detailed reading of the abstracts and papers, reporting of comments to authors, modifications of papers by authors and re-evaluation of re-submitted papers to ensure quality of content.

FOREWORD

On behalf of the Organising Committee, it is my pleasure to welcome you to Copenhagen and the Conference Centre of the Danish Association of Engineers for the 6th Nordic Conference on Construction Economics and Organisation.

When we commenced with the planning of the this year's conference, we had great hopes and expectations to be able to invite you to the largest Nordic Conference on Construction Economics and Organisation yet, along with a number of associated events, and with papers of high scientific rigour and quality – and we are pleased to announce that our expectations have been fulfilled.

Focusing on the nexus between construction and the built environment, we invited papers that would explore the various ways in which construction and the use of constructions are interlinked and mutually constituting and transforming each other. We received more than 150 abstracts, which through a double-blind peer review process resulted in 56 papers being published here in these proceedings under the theme: "Shaping the construction/society nexus." The published papers are of a high quality and display a growing tendency with our field of research: namely the application of theoretically informed approaches to raise the quality of the analyses and the generalisation of conclusions.

The road to the conference has, however, been long and arduous, which has presented organisers, committee members, reviewers and authors with a series of minor and major technical and organisational issues. We apologise and are at the same time confident that these sorts of problems will be a thing of the past when the 7th Nordic Conference on Construction Economics and Organisation will be held in 2013.

Thus, in the two years until the next conference, we will work hard to establish a more professional or at least a more permanent, organisation behind the conference series by forming a network for Construction Researchers on Economics and Organisation in the Nordic region. We have already taken the first step by signing a Memorandum of Understanding with our friends in both ARCOM and CIB who have cordially helped us promote this year's conference. It is our hope that we in the years to come will be able to return the favour and help develop the field of construction management for the benefit of all of us.

An event like this is only possible with the help of many individuals and organisations. First and foremost, I wish to thank the members of the Organising Committee and in particular Stefan Christoffer Gottlieb and Göran Lindahl. Further, I would like to thank all members of the Scientific Committee, who have helped us maintain a high standard and quality of papers. Finally, I would like to thank our partners and sponsors for their collaborative contributions and financial support.

I wish you a pleasant and profitable conference.

Kim Haugbølle
6th Nordic Conference Chair
Danish Building Research Institute, Aalborg University

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UNETHICAL BUSINESS PRACTICES AND CORRUPTION IN INTERNATIONAL CONSTRUCTION: A SURVEY OF AMERICAN CONTRACTORS WORKING OVERSEAS

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Transparency International has identified public works and construction to be the most corrupt industry sector in the world. It is estimated that up to 10 percent of the global spending on construction is lost to all forms of corruption. Unethical business practices and corruption in international construction has resulted in notable human and financial losses; and destruction of the environment. The purpose of this study is to analyse perceptions of American construction companies about unethical business practices and corruption in international construction. Necessary data was collected via a questionnaire survey. The results indicated that bid shopping, procurement of substandard/defective materials, bribery, and employment of illegal workers are the most prevalent ethics issues in international construction. Cultural practices, political systems, and social norms were found to be the biggest contributors behind these problems. About half of the survey participants were of the opinion that unethical business practices and corruption have slightly decreased during the last five years due to following of strict codes of ethics by many large international contractors.

KEYWORDS: Ethics, Corruption, Professional practice, International construction

INTRODUCTION

The public works and construction sector has been identified as the most corrupt in the world (Transparency International, 2008). The global construction industry is worth around US$4 trillion per year. This represents 5-7% of the GDP in developed countries, and around 2-3% of the GDP in developing countries (Rodriguez et al., 2005). It is estimated that up to 10 percent of the global spending on construction is lost to all forms of corruption. This estimate puts the total cost of global corruption and unethical conduct to about US$400 billion per year (Usmen et al., 2009).

Unethical conduct and corruption in the construction sector across the world has taken a high toll including lost lives, financial resources, diverted resources, and destruction of the environment (Krishnan, 2009). Following are some of the examples:

- In Hong Kong, a geotechnical subcontractor at the Northern Basement site of the Airport Railway Hong Kong Station used substandard bored piles to make extra profit. Investigations revealed that 83 out of the 87 piles had not been constructed to specifications, leaving the foundations seriously defective and resulted in remedial work worth many millions of Hong Kong dollars (Hong Kong Institute of Engineers, 2000).

- In India, a young civil engineer, *Mr. Satyendra Dubey*, was murdered after he courageously blew the whistle on corruption in the construction of a major highway project in Gaya, Bihar in 2003 (Krishnan, 2009).

- In Philippines, bribery was alleged in the construction of the US$2 billion Bataan nuclear power plant. The reactor was built on an active fault line and never produced any electricity (Transparency International, 2005).

- In Turkey, a research study into the 1999 Kocaeli earthquake revealed organizational deviance in the pursuit of risk laden policies. Corruption tolerated or tactically encouraged such as forcing land settlements in hazardous zones, post-disaster cover-up and concealment of evidence, and promotion of policies directly contributing to corrupt practices in the construction industry (Krishnan, 2009).

The scale of unethical business practices and corruption in the construction industry is typically magnified by the size of projects and their associated high costs (Stansbury, 2005). Such projects, as mentioned above, involve numerous players, a large number of contractual links, complicated approval and permit procedures, and a complexity of work not found in most other industries (Cavill and Sohail, 2007). Because construction projects usually involve a large number of entities and individuals working together, the detection of unethical practices often becomes quite difficult (Usmen et al., 2009).

PURPOSE AND SCOPE OF STUDY

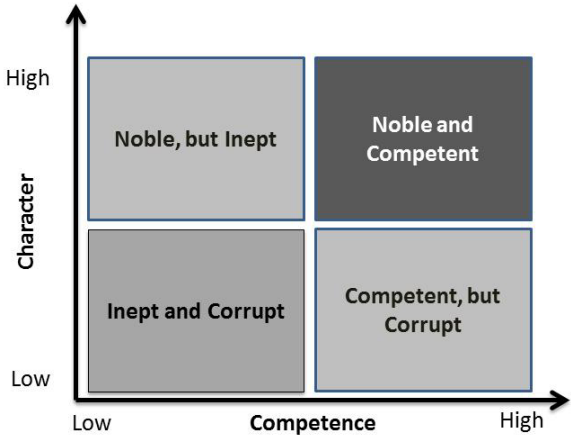
The purpose of this study is to analyse perceptions of American construction companies about unethical business practices and corruption in international construction. The research objectives are: (1) to determine different forms of unethical and corrupt practices in international construction; (2) to subjectively explore magnitude of unethical and corrupt practices; and (3) to identify possible measures and remedies to combat corruption. The research scope was limited to large U.S. general contractors working/worked on several mega projects in different regions of the World.

LITERATURE REVIEW

Defining Unethical and Corrupt Practices

Ethics refers to a code or set of principles by which human conduct is guided and may be appraised. Law and ethics are closely related but they are not identical. Law is actually based on many ethical principles set up in order to keep justice and fairness in society (Fan and Fox, 2009). The FMI's Leadership Group in USA has defined ethics in terms of *character* and *competence* in leadership as shown in Figure 1 (Fails Management Institute, 2004).

Figure 1: The Character-Competence Grid. Source: Fails Management Institute (2004)



Corruption can be defined as the abuse of entrusted power for private gain (Stansbury, 2005). It can occur in any country or locality, during any phase of a construction project, at any level in the contractual hierarchy, and may be committed by any project participant (Stansbury and Stansbury, 2007). The unethical and corrupt practices in the construction industry can take many forms but the most common ones are as follows:

- *Bribery*: A cash or a non-cash favour to get something in return (e.g. promise of a future contract without following standard procedures, promotion, or a vacation).
- *Fraud*: Deception in order to get financial or other advantages (e.g. procurement of substandard or defective materials, underpayments to workers, etc).
- *Extortion*: A form of blackmail where one party makes threats against another party of adverse consequences unless demands are met by the other party.
- *Embezzlement*: The misappropriation of corporate or public funds.
- *Kickbacks*: Sweeteners or rewards for favourable decisions.
- *Bid Rigging*: Illegal conspiracy in which competitors join to artificially increase the prices of a bid.
- *Overbilling*: Inflating unit prices for activities that are scheduled to happen earlier in the project to increase the cash flow.
- *Change Order Games*: Submitting a low bid to win the project and later on recover the profit by submitting change orders.
- *Claim Games*: Making extra profit by submitting false claims.
- *Money Laundering*: Moving cash or assets obtained by criminal activity from one location to another, often to conceal the source of funds.
- *Employment of Illegal Workers*: Workers who are not authorized to work in a country or at a specific jobsite.

As indicated earlier, these practices can occur during all phases of a construction project. Table 1 provides an example:

Table 1: Examples of Unethical and Corrupt Practices in a Project Life Cycle (Cavill & Sohail, 2007)

Project Stage	Examples
Planning Stage	• Bribing a local official to obtain approval of a project
Design	• Corrupt selection of consultants for feasibility studies, preparation of specifications/bid document
Bid and Contract Signing stage	• Leaking information such as the bid assessment procedure • Collusion between bidders/suppliers to keep prices high • Kickbacks for construction and supply contracts
Construction	• Changing subcontract party after receiving bribes • Misuse of vehicles and funds • Cutting corners, ignoring rules, by-passing procedures • Payment for equipment, materials or services which were not supplied • Concealing substandard work • Bribe and relevant official to certify that the work was done according to specification
Inspection Stages	• Bribe inspectors for approval of substandard work
Service Delivery	• Ghost/absent Workers • Siphoning of supplies to market • Favoritism in hiring or promotions
Maintenance and Management stage	• Corruption in procurement of equipment and spare parts • Withholding needed approval/signatures for gifts/favours • Bribes to win O&M contracts/personal appointments
Billing System	• Opaque system of billing • Irregularities on ledgers of paid bills

Unethical and Corrupt Practices in International Construction

Published literature has indicated presence of unethical conduct and corruption in the construction sector of both developed and developing countries. Here are some examples:

- Fails Management Institute (FMI) conducted a study for the Construction Management Association of America (CMAA) entitled "Survey of Construction Industry Ethical Practices" (Fails Management Institute, 2004). The study focused on the activities of construction project owners, architects, engineers, construction managers, general contractors, and subcontractors. The results were quite alarming. For instance, when respondents were asked whether they had personally experienced, encountered, or observed industry-related acts or transactions that they would consider unethical in the last 12 months, an overwhelming 84 percent said "yes". In addition, 34 percent indicated that they had encountered such acts "many times". A majority (63 percent) of survey respondents felt that the construction industry was tainted by the prevalence of unethical acts. Similarly, 61 percent of the respondents thought unethical behavior was affecting the cost of completing the projects.

- The Chartered Institute of Building (2006) conducted a survey to gather views on corruption within the UK construction industry. It was found that there was a great

deal of variation in the way that respondents perceived the nature and extent of corruption. It was acknowledged, however, that 41% of those surveyed had been offered a bribe on at least one occasion.

- Hartley (2009) reported that within the Australian construction industry, anti-competitive practices especially related to workplace practices are common. These practices have included collusive bidding, lack of honesty and fairness in business relationships, and poor or non-existent occupational health and safety practices.

- A study by Ling and Hoang (2010) indicated widespread corruption in foreign funded public projects in Vietnam. They indicated enforcement of new anticorruption laws by the government to combat corruption in Vietnam.

METHODOLOGY

A questionnaire was developed to collect the necessary data. A few preliminary interviews were conducted with the construction professionals to collect feedback about the questionnaire design. The final questionnaire was made up of 14 questions and was divided into the following four sections.

- Section 1: General information about the respondent and the organization

- Section 2: International construction experience of the respondent

- Section 3: Perceptions about unethical business practices and corruption in international construction

- Section 4: Recommendations on how to best overcome unethical business practices and corruption

A list of top 225 international contractors was obtained from the Engineering New Record (ENR) magazine (Engineering New Record, 2009). There were 40 American companies in this list which were selected for the survey. The questionnaire was compiled and distributed via a web-based service *Zoomerang*® (http://www.zoomerang.com). The data was collected between April 23, 2010 to July 6, 2010. There were 30 complete and 7 partial responses. Partial responses were excluded to maintain consistency in the reported results. Hence the final response rate was 75%. In the following sections, the brief results are reported along with necessary discussion whereas more details can be found in Selph (2010).

RESULTS AND DISCUSSION

Sections 1 and 2: General Information and International Construction Experience

The questionnaire was mainly responded by Vice Presidents (22%), Project Managers (26%), Procurement Managers (22%) and Overseas Operations Managers (11%). All of them had over 15 years of international construction experience. Due to their position and related experience, it can be inferred that they had sufficient knowledge on this topic.

Out of 30 responding companies, 13 (44%) have worked on more than 10 international mega construction projects whereas 8 companies (26%) have completed 5 or more mega projects. The remaining companies (30%) have worked on less than 5 mega projects. The projects were located in Europe (35%), Asia (31%), South America (16%), Africa (10%) and Australia (8%). The projects categories were Infrastructure (36%), Commercial (28%), Oil and Gas (17%), Industrial (7%), Residential (5%), Power (5%) and other miscellaneous projects (2%). The cost of these projects ranged from US$500 Million (38%) to over US$1 billion (62%). This information indicates that the responding companies had worked on different types and sizes of projects in different regions of the world. Hence the information collected is diverse and can lead to meaningful conclusions.

Section 3: Perceptions about Unethical Business Practices and Corruption in International Construction

In this section, participants were asked about their perceptions of various unethical and corrupt business practices in international construction. A brief overview of different forms of unethical business practices and corruption was also provided to the respondents.

First, participants were asked how common they believe unethical business practices and corruption are in the current international construction market with a rating scale of 1-5 (1: Non-existent; 3: Fairly Common; 5: Very Common). Results showed a mean of 3.22 with a standard deviation of 1.02 which would infer that unethical practices and corruption are fairly-to-moderately common in international construction.

Next, participants were asked to rate various unethical and corrupt practices based on their experience, observations and gut feelings. The results are summarized in Table 2. As evident from the table, most respondents indicated *Bid shopping* as the most prevalent unethical practice followed by *Procurement of substandard/defective materials, Employment of illegal workers* and *bribery*. Interestingly, the respondents felt that Collusion and Overbilling are not very common in international construction. In a follow-up interview, some respondents mentioned that this is probably due to strict laws against these conducts in most countries.

Table 2: Rating of Unethical and Corrupt Business Practices in International Construction

Unethical/Corrupt Business Practices	Mean	Standard Deviation
Bid Shopping	3.41	0.97
Procurement of Substandard/defective Materials	3.38	1.08
Employment of Illegal Workers	3.04	1.07
Bribery	3.04	1.15
Change Order Games	2.83	0.90
Payment Games	2.83	1.05
Under Employment of Workers	2.73	1.10
Fraud	2.70	0.86
Collusion	2.40	0.91
Overbilling	2.25	1.28
Other	1.95	1.14

1 = Non Existent, 2 = Not Very Common, 3 = Fairly Common, 4 = Moderately Common, 5 = Very Common

The respondents were asked to indicate the project phase/sub-phase in which they believe most unethical and corrupt conducts happen. The results are shown in Table 3. The *Awarding of contracts*, *Hiring of subcontractors*, *Bidding process* and *Construction* were found to be the stained phases/sub-phases. A comparison of Table 2 and 3 indicates that the presented data is consistent as the top four unethical and corrupt conducts typically happen in these four phases.

Table 3: Unethical and Corrupt Business Practices v. Project Phases

Project Phase/Sub-phase	Mean	Standard Deviation
Awarding of Contracts	3.45	0.88
Hiring of Subcontractors	3.33	0.92
Bidding Process	3.12	0.95
Construction	3.00	0.98
Operations and Maintenance	1.95	0.86
Design	1.95	0.93
Project Planning	1.79	0.84

1 = Non Existent, 2 = Not Very Common, 3 = Fairly Common, 4 = Moderately Common, 5 = Very Common

In the next question, respondents were asked to indicate the biggest contributors to unethical business practices and corruption in international construction. Their responses are depicted in Table 4 which shows that *Cultural practices*; *Political systems;* and *Social norms* are the three biggest contributors. This indicates that the society and culture of different countries push construction industry personnel to conduct unethical acts to improve their social status in the society. To control corruption in the construction industry, there is a need to respond to these fundamental issues.

Table 4: Contributors to Unethical Conducts and Corruption in International Construction

Reason	Mean	Standard Deviation
Cultural Practices	7.50	1.64
Political Systems	7.17	2.30
Social Norms	7.04	1.71
Government Involvement	6.04	2.10
Size of Project	4.58	2.22
Number of Contractual Links	4.17	1.58
Culture of Secrecy within the Industry	3.71	2.33
Project Complexity	3.63	1.44
Other	1.58	1.38

1 = Very Low Contribution; 5= Moderate Contribution; 10 = Very High Contribution

After that, survey respondents were asked if they believe unethical business practices and corruption result in a significant cost to their company. The overwhelming majority (over 75%) said “Yes”. Respondents were then asked approximately how much they believed these practices cost their companies every year as a percent of annual revenues. The responses were 1-3% (22%); 3-5% (33%); 5-7% (28%); and 8-10% (17%). On average, it is 5 percent of annual revenues. Since the annual revenue of the majority of companies was over $1

Billion, it points a loss of approximately US$50 million per year per company. These approximate figures indicate that the construction industry is losing a significant portion of its revenues due to unethical and corrupt business practices. Had this leakage of money stopped, it could result in better profitability and productivity.

At the end of section 3, survey respondents were asked to indicate their perceptions about the magnitude/trend of unethical business practices and corruption over the past 5 years. The overwhelming majority of respondents believed that there was either no change (48%) or a minor decrease (44%), which is a positive sign. This indicates that the efforts to curb corruption are either keeping it at bay or starting to have an impact on its levels slowly. This is encouraging from the aspect that what is being done to stop corruption is effective to some extent and efforts are heading in the right direction. Continued research and conscience efforts to stop unethical business practices and corruption in the international construction industry should continue its suppression.

Section 4: Recommendations on How to Best Overcome Unethical business practices and corruption

In this section, respondents were asked an open-end question to give suggestions about how to best overcome unethical business practices and corruption. The top responses are as follows:

- Adopt zero tolerance policy against corruption
- Make consistent international laws to fight against corruption
- Strictly monitor construction projects funded by international donors in corrupt countries
- Give award and possible protection to whistle blowers
- Educate young engineers and constructors about ethics
- Conduct necessary training within construction companies to teach employees about code of conduct

It is important to note that recently many countries and anti-corruption organizations have taken strong measures to fight against corruption. A description of some of these measures is as follows:

- *The Global Infrastructure Anticorruption Centre*: The Global Infrastructure Anticorruption Centre (GIACC) was found in May 2008. It is an independent non-profit organization that is based in England, but operates internationally. The objective of GIACC is to promote the implementation of anticorruption measures as an integral part of government, corporate, and project management. GIACC provides resources and services for use by all stakeholders for the purpose of preventing corruption in the infrastructure, construction and engineering sectors (Stansbury, 2009a).

- *The Partnering Against Corruption Initiative*: The Partnering Against Corruption Initiative (PACI) was launched in 2005 as an outcome of discussion on anticorruption measures at the 2004 World Economic Forum's annual meeting. The sole focus of PACI is to establish multi-industry principles and practices that create a competitive, level playing field based on integrity, fairness, and ethical conduct. More than 140 large companies from 39 countries have signed this initiative (Tashjian, 2009).

- *The Global Anticorruption Education and Training Project*: The Global Anticorruption Education and Training Project (ACET) was developed in 2006 in USA in collaboration with the American Society of Civil Engineers (ASCE). The ACET project involves designing, developing, and distributing a comprehensive education and training program devoted to the importance of *individual integrity* among all participants in the performance of engineering/construction projects (Smith, 2009).

- *United Kingdom Anticorruption Forum*: The United Kingdom Anticorruption Forum was formed in 2004 to create a business environment that is free from corruption, giving rise to fair competition. The forum has published an Anticorruption Action Statement; holds quarterly meetings; and publishes a quarterly newsletter (Stansbury, 2009b).

- *The ASCE Committee of Global Principles for Professional Conduct*: The ASCE Committee of Global Principles for Professional Conduct was formed to address corruption in the global engineering/construction industry. Among its many activities, the committee has brought anticorruption topics to ASCE annual meeting programs, developed policy statement 510 entitled "Combating Corruption", worked with other committees and groups to develop anticorruption education and training materials, and in general brought the topic of corruption in the engineering/construction industry to the forefront of discussions (Crist, 2009).

CONCLUDING REMAKRS

It is apparent that the unethical conducts and corruption is one of the most significant challenge currently faced by the construction industry. Approximately US$400 billion per year is lost globally due to unethical business practices and corruption in the construction sector. A survey of top American contractors working on international projects revealed that the efforts to stop corruption are making headway but still there is a long way ahead. As shown in the survey results, the three biggest contributors to corruption are *cultural practices*, *social norms*, and *political systems*. Cultural and social norms vary from region to region and country to country. What might be considered unethical or dishonest at one place might be a standard business practice in a different locale. When these different beliefs and practices collide, each party views each transaction from their own system of beliefs and standard practices. If one could get all parties to agree on a standard set of rules, it might help to level the playing field. Unethical business practices and corruption will continue to be an issue for years to come, but if owners and contractors will continue to commit to an ethical code of conduct, there would be a significant decrease in their level.

IMPLICATIONS FOR FUTURE RESEARCH

The research results indicated that cultural and social norms have a great impact on the scale and form of unethical conducts and corruption in different countries. It is suggested to further research this issue to identify how a standard code of ethics could be developed and successfully implemented worldwide.

REFERENCES

Cavill, S. & Sohail, M. (2007). *Accountability arrangements to combat corruption*, WEDC, Loughborough University, Leicestershire.

Crist, R.A. (2009). The ASCE committee of global principles for professional conduct. *Journal of Leadership and Management in Engineering*, **9**(3), 144-146.

Engineering New Record. (2009). The top international contractors, **261** (19).

Fails Management Institute (FMI). (2004). *Survey of construction industry ethical practices*. Webpage accessed 24-11-2010 at: http://www.fminet.com/dotAsset/4344.pdf

Fan, L.C.N. & Fox, P. W. (2009). Exploring factors for ethical decision making: Views from construction professionals. *Journal of Professional Issues in Engineering Education and Practice*, **135**(2), 60-68.

Hartley, R. (2009). Fighting corruption in the Australian construction industry: The national code of practice. *Journal of Leadership and Management in Engineering*, **9**(3), 131-135.

Hong Kong Institute of Engineers. (2000). *Ethics in practice: A practical guide for professional engineers*. Hong Kong: HKIE Press.

Krishnan, C. (2009). Combating corruption in the construction and engineering sector: The role of transparency international. *Journal of Leadership and Management in Engineering*, **9**(3), 112-114.

Ling., F.Y.Y. & Hoang, V.T.P. (2010). Political, economic, and legal risks faced in international projects: Case study of Vietnam. *Journal of Professional Issues in Engineering Education and Practice*, **136**(3), 156-164.

Rodriguez, D., Waite, G., & Wolfe, T. (Editors). (2005). *The global corruption report* Webpage accessed 20-07-2010 at: http://www.globalcorruptionreport.org

Selph, J. (2010). *Unethical and illegal business practices in international construction*, unpublished thesis, Auburn University, Alabama.

Smith, J.H. (2009). The global anticorruption education and training project. *Journal of Leadership and Management in Engineering*, **9**(3), 139-143.

Stansbury, N. (2005). *Preventing corruption on construction projects – Risk assessment and proposed actions for project owners.* Berlin: Transparency International.

Stansbury, C. (2009a). The global infrastructure anticorruption centre. *Journal of Leadership and Management in Engineering*, **9**(3), 119-122.

Stansbury, N. (2009b). United Kingdom anticorruption forum. *Journal of Leadership and Management in Engineering*, **9**(3), 115-118.

Stansbury, C., & Stansbury, N. (2007). *Anticorruption training manual*. Webpage accessed 24-11-2010 at: http:// www.transparency.org.uk/TI_TRAINING_MANUAL.doc

Tashjian, L. (2009). Partnering against corruption initiative leads industry battle against corruption. *Journal of Leadership and Management in Engineering*, **9**(3), 123-124.

The Charted Institute of Building. (2006). *Corruption in the UK construction industry: Survey 2006*. Berkshire: The Chartered Institute of Building (CIOB).

Transparency International. (2005). *Global corruption report*. London: Pluto Press.

Transparency International. (2008). *Bribe Payers Index*. Webpage accessed 24-11-2010 at: http://www.transparency.org/policy_research/surveys_indices/bpi

Usmen, M.A., Mamman D., Kazan, E., & Singh, K. (2009). A critical review of ethics issues and corrupt practices in the global construction industry. *Proceedings of the 5th International Conference on Construction in the 21st Century*, Istanbul, Turkey, May 20-22, 975-983.

ENERGY ISSUES IN PUBLIC PRIVATE PARTNERSHIP

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During the last ten years, there has been a growing tendency in most European countries to develop new procurement methods in the construction of assets needed to deliver public services. Public private partnership (PPP) is one of these new methods. In France, PPP was formalised with a law enacted in 2004. PPP is supposed to bring better value for money for the public authority. To appreciate this value most researchers have tried to evaluate PPP on criteria such as time and cost performance, innovation and service quality. PPP is also supposed to be a way to promote whole life costing and the development of solutions saving energy consumptions. However this issue has been rarely examined. The presentation highlights how PPP were assessed regarding time and cost performance, innovation and service quality. Then it examines how energy performance is taken into account and why stakeholders have not proposed innovative solutions to save energy in this kind of contractual agreement. The results indicate that energy issues are actually taken into account in French PPP projects mainly under the influence of building regulations.

KEYWORDS: Public private partnership, energy saving performance contract, innovation, energy, procurement process

INTRODUCTION

For the last ten years, there has been a growing tendency in most European countries to develop new procurement methods in the construction of assets needed to deliver public services. Public private partnership (PPP) is one of these new methods and it has broadening the range of procurement approaches.

PPP is a shift from conventional procurement process. Under this new scheme, design, build, finance and operation are transferred to private sector partners. Public authorities do not own anymore the facility. They become the tenants. Consequently their role during the project delivery and the contract life-time is altered. Fees are paid by the public authority to cover finance, construction and operating costs. Payments are made according to the quality of the service delivery which is judged on performance indicators.

Among European countries the United Kingdom has the main experience in the private finance of assets for the delivery of public services. Between 1992 (date of the introduction of the Private Finance Initiative - PFI) and 2007, over 625 PFI projects were signed with a total capital value of £58.7 billion (HM Treasury, 2008). 510 of them were in operation. Despite this surge of PFI projects, the vast majority of investment in the UK's public service is still procured through conventional means. Between 2005 and 2006, PPP only represented 10% of public investments.

France has a long experience in private finance procurement. It concerns mainly infrastructure projects where an asset (such as a road) is provided for which users pay directly. Only a

limited number of assets such as buildings (hospitals, schools, prisons, stadiums…) were delivered under this form of procurement. However in June 2004 a new law was enacted to spur PPP projects: "*A partnership contract is an administrative contract under which the State or a State-run entity entrusts to a third party, for a period set according to investment amortization or agreed financing terms, a comprehensive project related to the construction or conversion, upkeep, maintenance, operation or management of works, equipment or intangible assets necessary to public service as well as to the total or partial financing of the latter, with the exception of any form of equity financing*" (Ministère de l'économie, des finances et de l'industrie, 2008),

Table 1: Contracts signed at the end of September 2010

Type of projects	Local authorities	State	Total
Building	3	6	9
Energy / waste	5	4	9
Urban facilities	24	0	24
Information and communication technologies*	11	2	13
Sport and cultural facilities	5	2	7
Transport	1	1	2
Training	0	1	1
Total	49	16	65

Source : MAPPP (2010) - http://www.ppp.bercy.gouv.fr/

Despite this law the development of PPP projects remains limited in public investments. According to MAPPP, a government unit in charge of assisting public authorities, proposing methodological standard-setting and validating preliminary assessment, these investments would be around 5 to 6 billion euros per year for the next ten years (Grall, 2010). Knowing that the level of public investments is 90 billion per year, it would represent a maximum of 6% per year. Thus PPP has just broadening the range of procurement approaches.

Public procurement is an instrument for the State to promote innovation (Edler and Georghiou, 2007) but also environmental goals. In France as in most industrialised countries the building industry accounts for the largest share of greenhouse gas emissions in terms of

energy end usage. With 120 million tons of CO_2 emissions, it represents 25% of France's national emissions. Its share in the total energy consumption is also the highest with 43%. This represents 1.1 tons of oil equivalent consumed every year by every French citizen. To deal with this environmental challenge, various policies have been launched by the French government. Lots of standards have been set up since the oil crisis and the mid 70's to reduce energy consumption in buildings. But France was late to implement the 2002 European Energy Performance of Buildings Directive. It was only in 2008 after the "Grenelle de l'Environnement" that the national energy policy was modified. The "Grenelle de l'Environnement" was a French multi-party debate on the environment involving several bodies: the government, local authorities, employers, unions and environmental associations. The aim of these negotiations was to take decisions to fight against climate change, to restore biodiversity and to limit environmental and health risks. Several laws were enacted after these debates. Mainly three sectors were at the core of the discussion and have been affected by the law enacted in 2010: transport, construction and energy.

After the "Grenelle de l'Environnement" both laws concerning public and private finance procurements were modified to integrate environmental issues.

Before choosing the public private partnership tender proposal, public authorities have to prove that it offers value for money. Moreover a comparison with the public procurement option is necessary. A life cycle cost approach is used to compare both projects. With PPP the responsibility to design, build, finance and operate a facility is integrated into a long-term contract. The company in charge of the contract is supposed to have an interest in minimizing the whole life cost. In theory it should accept to invest more at the design and construction stages to reduce operating costs. Conversely under traditional procurement the lack of integration between different stages of design, production and operation limits the opportunity to minimize whole life cost. Moreover fragmented procurement creates organisational barriers between designers, contractor and operators (Rintala, 2005). Finally it has been showed that public authorities who face budgetary constraints tend to cut maintenance and operating expenditures when they are not bound to operational service contracts (Bougrain and al., 2005). Thus PPP project should be more economically and environmentally efficient. By taking appropriate decision at the design stage to minimize energy consumption the private consortium in charge of the project, should also contribute to increase its profit over the life of the contract. However so far almost no studies examined whether the way to handle energy and environmental issues in PPP projects, is better than under traditional procurement. The goal of this study is to bring a partial answer to this question by analysing how energy performance was taken into account in PPP projects.

The paper first presents a brief overview of the studies which tried to evaluate PPP on criteria such as respect of time and costs, innovation and service quality. Then it examines how the energy issues were taken into account in PPP projects.

PPP AS PERFORMANCE BASED PROJECT

Performance-based building is perceived as a shift from traditional prescriptive approaches. "In the prescriptive approach, the building parts are described, specified and procured, resulting in a building with an implicit set of attributes. In the performance approach, the criteria that define the level of performance required of the building attributes are defined, described or specified, and many combinations of different building parts can be innovatively created and/or procured for which it can be demonstrated that the specified attributes will satisfy the required level of performance" (Sexton and Barrett, 2005: 143).

As performance-based project PPP is a shift from conventional procurement process. The advocates of PPP argue that it offers better value for money thanks to a better respect of contracted timetable and contracted price, a better ability to propose innovative solutions and better service quality. Leiringer and Schweber (2010) called this consensus around the benefits of PPP, the "*PFI ideology*". However a literature review indicates that the consensus is not total.

Respect of timetable and contracted price

The respect of time and the respect of costs are probably the issues the most examined. In the UK, the National Audit Office (2003) surveyed 37 construction projects. 76% of them were available for use on time or early. 8% were delayed more than two months. 70% of the cases had no increase in costs. When it was the case it was due to new user requirements. The result of a similar study carried out in 2008 (NAO, 2009) were not statistically different. It was based on 114 projects and showed that 69% of projects were delivered to timetable and 65% to contracted price.

A French study (MAINH, 2007) based on 10 hospitals drew similar conclusions. The delivery time was respected. Compare with traditional procurement the advantage was stronger for large projects. An Australian study based on 15 hospitals considered that the motivation was stronger for all private stakeholders in PPP projects because "time is money" becomes their "raison d'être" (Dowdeswell and Heasman, 2004). Yuan and al. (2009) had similar arguments. Under PPP, design, build, finance and operation are transferred to private sector partners. Payments are made according to the quality of the service delivery which is judged on performance indicators. Penalties are paid to the client when the expected delivery time is not respected. Moreover the consortium in charge of running the project does not receive any payment before the delivery of the project. In addition banks strongly monitor the project team (designers, contractors and facility managers) during the course of the project and particularly in the early stages.

Raisbeck and al. (2010) compared 33 traditional projects with 21 PPP projects to analyse project time and cost outcomes. Their results indicated that cost overruns were more pronounced for traditional procurements. The traditional project costs increased by 35% in average versus 11.6% for PPP projects. The advantage was particularly strong for large PPP projects which displayed better cost discipline. The time analysis was not conclusive. The difference between projects was no statistically significant. Since PPP projects cover design, construction and operation, they rendered the contracting more complex. Similarly the financing of the projects was more time consuming in PPP projects than for traditional projects financed by governments.

However these results have to be mitigated by a study made by the Association of Chartered Certified Accountants which indicated that cost overruns were limited but that PPP projects in hospitals were on average more expensive than traditional projects (ACCA, 2004). Public authorities would accept to pay a premium of 30% to limit the risks of time overruns.

Innovation in PPP

PPP projects are also frequently portrayed as more innovative. However Leiringer (2006) supports the opposite. He examines four arguments:

1. Design freedom refers to the ability of the private sector actors to be more innovative and to propose solutions that better serve the client's needs. This is due to the use of output specifications and service level agreements. However the regulatory framework is so strong in construction that it affects innovation. Specific design and requirements are a barrier to innovative behaviour. Thus the link between output specifications and innovation seems limited. The key element appears to be the communication between the public sector client, the project company and the contractors.

2. Collaborative working refers to the capacity of the designers, contractors and operators to work together for the mutual benefits of the projects. However the contracts are written in such a way that it becomes difficult to make changes as the project develops. Trust among partners is usually better to facilitate innovation.

3. Risk transfer: there is no evident relation between risk transfer and innovation. In fact it appears that private partners are sometimes forced to take risks that they cannot handle. In this situation innovation is not stimulated.

4. Long-term commitment: PPP projects are long-term contract in which the company in charge of the contract is supposed to have an interest in investing and innovating at the design stage to reduce its future operating costs. However in many case the construction companies prefer to sell their shares in the projects a long time before the end of the contract. This behaviour tends to favour tested and tried solutions in order to limit the risk exposure.

Barlow and Köberle-Gaiser (2008) drew similar conclusions after undertaking case studies of six hospitals in the UK. Design is carried out at concurrently with the tendering phase. This inhibits innovation. The public client also tends to refuse solutions which are "*untested or required derogation from current guidance (the official 'health building notes' and 'health technical memoranda'). This tends to be highly prescriptive and does not provide much scope for creative solutions*" (Barlow and Köberle-Gaiser, 2008: 1397).

Most public authorities do not realise that PPP is a shift from conventional procurement process. To promote innovation and to be less prescriptive they have to behave as building occupants and not anymore as the owner of the facility during design and construction phases.

Moreover the long-term contractual agreement does not favour innovation since none of the private sector actors wants to support the risk associated with the severe penalties for any non-availability of hospital facilities. Similarly investors and financiers are risk averse. Rintala (2005) shows that financiers have an incentive to discourage the implementation of innovative solutions since they support the risks associated to these solutions but not the benefits.

Quality of service delivery in PPP

In PPP projects Performance Measurement System (PMS) with Key Performance Indicators (KPI) is established according to the expectations of the public authorities. The level of achievement for each KPI is monthly reported. In case of poor performance or buildings unavailability the payments to the private partners can be reduced. To be efficient measurement procedures have to go along with the quality of the service. Then the issue is to focus on objectives with measurable targets (Barlow and Gaiser, 2008).

Measurement requires two conditions to be effective: observability and verifiability. “The first is the possibility for the principal to observe the performance of the agent. The second is the capacity of the principal to verify observations and supply evidence by measures" (Aubert and al., 1996: 59).

Studies focusing on the quality of services show that contracts are often too vague. Robinson and Scott (2009) pinpoint the lack of sufficient precision to cover all service delivery contingencies. This leads to disputes over interpretations of contracts. This was the case with the Hereford Hospitals NHS Trust (Bougrain and al, 2005). The Trust was dissatisfied with the service provided by the private partner who was in charge of the sterilisation of medical equipment. His partner was not able to deliver a rapid turnaround in equipment to be sterilised. He argued that the hospital did not buy enough sterilisation equipment.

Penalties are also not motivating. Sometimes they do not compensate for the service disruption. There is also a lack of flexibility in these contracts. In most cases it is also difficult to judge the quality of services delivery since subjectivity and incompleteness of contracts are frequent in this project. Moreover the renegotiation of contractual details to get better services after the signature of the contract is difficult because it requires the approval of many actors (for example the investors). Once the contract is signed the bargaining position of the public user is limited.

ENERGY PERFORMANCE AND PPP PROJECTS

The link between PPP projects and energy performance is not straightforward. However since these projects are long-term contract they should favour the introductions of solutions minimising energy consumptions over the life of the contract. The aim of the following part is to examine how this issue has been raised by private sector actors.

The energy issue in two PFI projects (UK)

A literature review on PPP projects indicates how much the energy question was neglected. Only Rintala (2005) in its doctoral work tackled the subject by analysing two case studies in the UK. He analysed the transfer of the “energy risk” to the private actors. Two risks were identified: the first concerned the evolution of the energy price and the second related to the evolution of energy consumption.

The energy price was always fully retained by the public actor since no private actor was able to control the market price of energy.

In the first case (“King's College London”) the public actor also retained the energy consumption risks because the private partner would have been unable to control the volume of the activity of the public actor (a research community doing laboratory experiments). By retaining this risk, the public actor was able

"*to reduce the price of the design and build component of the project further in order to make the project affordable*" (Rintala, 2005, p.129). The private partner had just "*an obligation to follow a good housekeeping policy in relation to energy usage*" (idem).

In the second case (the "University College London Hospitals NHS Trust"), the energy consumption risk was shared. The private actor was responsible for energy consumption above a certain standard. The standard was defined after examining the design of the building and different guidance documents on energy consumption for this type of building (a hospital). Within the consortium, some energy consumption risks were transferred to the companies in charge of design and construction solutions. Moreover it appeared that the partners had conflicting interests in implementing whole life cost driven design solutions. But they had an incentive to reduce energy consumption by receiving 10% of the saving arising from below standard. However this incentive was too small. Indeed the expenditures required for the implementation of energy saving design solution, were too important and they would have offset the gain obtain from energy savings. The private actor also agreed to pay for energy consumption above the standard only if it resulted from the design, construction and operation of the building. As a result of this negotiation the private partner accepted to upgrade the design to improve the energy efficiency of the building. It incorporated features such as energy efficient lighting, heat recovery on major HV plant, variable speed motors on major drives, free cooling and night purging. However the baseline for energy consumption was not very ambitious because both parties were not able to rely on historical data they could trust.

In both cases, the operator had less influence on the service provision solution than the contractor. Consequently operational solutions were not optimised.

The energy issue in French PPP projects

According to MAPPP, 376 PPP projects were published in the BOAMP (Bulletin Officiel des Annonces des Marchés Publics) between December 2004 and July 2010. BOAMP is an official bulletin concerning French public markets. Publication in the BOAMP is done once a public call for expressions of interest is advertised in the press. Thus projects contained in the BOAMP can be still in procurement. MAPPP publishes on its website a document containing the names of the projects published in the BOAMP. The document indicates that energy issues were at the core of 121 projects at the end of July 2010. These projects can be classified in five categories:

1. Public lighting: most of the 60 projects which are supposed to lead to substantial savings (around 30%) are run by municipalities. The dominant place of these projects (24 were signed and 36 are still under negotiations) shows that the PPP procurement approach is well adapted to this type of market.

2. Energy supply and waste treatment: 9 projects were signed and 8 are still under negotiations. Many of these projects concern energy heating and cooling in hospitals.

3. 14 projects concern the refurbishment of buildings and integrate strong incentives to reduce energy consumptions;

4. Building certified as "High Environmental Quality" (French Green Building evaluation standard): 10 projects are under negotiations;

5. 19 energy saving performance contracts: 4 were signed and the rest is being negotiated.

Thus a total of 61 projects over 376 (about 16%) could be classified in the category “building and energy”.

This way to classify projects suffers from a bias since some contractual elements concerning energy consumptions may be included in the remaining 255 projects. For example in the project concerning the refurbishment of the National Sport Centre, the private partner has an incentive to reduce energy consumption (Catarina and al., 2009). A baseline was established. If the energy consumption is above or below the baseline but within a limit of 10%, no penalty / bonus applies. The project company has to pay all energy consumption above this ceiling of 10% if it results from the design and the refurbishment of the building. However environmental and energy issues are not at the core of this project. Thus even if a bias exists in the aforementioned classification it is limited.

The energy issue was seldom raised in the first PPP projects. Between December 2004 and the end of 2007, 114 projects were published in the BOAMP. Only 7 could be classified in the category “building and energy” (6%). After 2007 and the “Grenelle de l'Environnement” things started to change. Between 2008 and July 2010, 20% of the projects which were published, belonged to this category. Thus the logic of PPP (minimisation of whole life cost thanks to the integration in one contract of design, build, finance and operation) has less influence on the strategy of private consortia and on the requirements of public authorities than a stringent regulation.

Among the projects focusing on energy issues, energy saving performance contract (ESPC) deserves a special attention. ESPC is defined as: “*A contractual arrangement between the beneficiary and the provider (normally an ESCO) of an energy efficiency improvement measure, where investments in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement*.” (European Parliament, 2006)

Energy saving performance contract concerns all financial instruments “that are made available to the market place by public or private bodies in order to cover partly or totally the initial project cost for implementing energy efficiency improvement measures”

Finally an Energy Service Company (ESCO) is defined as “a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria”

The Ministry of the Environment considers that this type of contracts offers the best opportunities to reduce energy consumption of the existing stock.

Several municipalities were the first to “jump” on these contracts and to launch a call for proposals. Several reasons can explain this development:

1. Municipalities already had contracts for the operation of their buildings and they knew how to monitor operators;

2. They already had a department working on the energy issue which gathered reliable data on energy consumption of municipal buildings and on the usages.

3. The building assets are located in one city while in the case of the State or a Region assets are widespread.

However despite this growth of ESPC, France is still far behind countries such as Belgium or Germany for the development of energy saving performance contracts. For example many German municipalities set up these contracts in the early nineties. Between 1993 and 2003, more than 200 “Energiespar-Contracting” concerning about 1500 public buildings were signed (Ghisgant and al., 2008). Contracts were signed for a period varying from 7 to 15 years Most of the investments carried out by the private actors focused on the systems and the equipments of the building (such as heating and cooling). But they did not concern the envelop of the building which offers longer return on investment. The reduction of energy consumption associated to these projects was around 10 to 25%. The private operators benefited from 70 to 90% of the savings. The remainder was allotted to the public person. The share allocated to the private actors was stronger when the contract was signed for a short period.

In France the lack of projects focusing on energy from 2004 to 2007 was due to several factors (Bougrain, 2010):

1. The law concerning PPP, enacted in 2004, did not mention that sustainable development was an issue. The modifications of the law enacted in July 2008 introduced several changes by referring to concepts such as sustainable development and whole life costing. Thus before 2008 most public actors were not aware of the environmental issues and energy consumption risks were not included in the output specification.

2. The energy issue is just one issue among many other. For example in PPP projects concerning hospital, the health issue and the service quality delivered to the patients are the key points of the contract. Energy is not a strategic matter for hospital managers.

3. Most public authorities do not know the level of energy consumptions of their buildings in operation. Without data it is difficult to negotiate with a private partner. This lack of reliable information also increases the risk of the projects and the duration of the negotiations.

4. Most of the issues dealing with energy are new. For example to establish the baseline for energy consumption, the International Performance Measurement and Verification Protocol is recommended (Catarina and al., 2010). But its use is rather complex and training would be necessary to raise the competences of the public servants.

5. One of the first steps of ESPC is to define a list of facilities and indicate the bounds of potential projects. Public authorities need to have implemented strategic asset management principles in order to accomplish this task. Most of the time it is not the case.

6. The general framework concerning the use of ESPC is still rather unknown. Similarly performance based contracts are not widespread in traditional public procurement. However guiding materials are under development to reduce the gap.

7. Most public actors wanted to integrate work on the building envelop in ESPC. But this tendency makes the contracts more complex and lengthens the return on investment. Thus contract needs to be signed for a longer period. It increases transaction costs and projects risks.

8. Almost no private company has competences to propose works that integrates the envelop and the systems. ESCOs work mainly on energy systems but do not integrate the works on the envelop of the building.

9. The lack of data on whole life cost does not allow environmental comparison of buildings and tend to discourage the implementation of energy efficient solutions.

10. In private consortia, facility managers and contractors do not really cooperate. Even if they have the same shareholders, they belong to different business units whose aim is to increase their yearly profit. Thus the incentives to implement win-win solutions are too often limited.

CONCLUSION

This paper examines how energy issues were taken into account in French PPP projects concerning buildings. It indicates that this subject was regularly ignored in the first wave of projects. Both private sector partners and public authorities are responsible for such a situation. Because of a lack of awareness and competences on these questions, public actors did not seek to impose energy efficiency measures in their functional program. This absence of request was seldom compensated by offers emanating from the private consortia. Nevertheless, this issue was gradually integrated in contracts in progress after the “Grenelle de l'Environnement”. After the national debates on environmental issues, several decisions concerning both existing and new buildings were taken and a new stringent regulation was enacted. For example after December 2012 any new building will have to consume less than 50kwh/m²/year. These changes raised the awareness of PPP stakeholders (both the private sector partners and public authorities) and prompt them to tackle the energy issue in PPP projects concerning buildings. Thus the implementation of a new regulation has a stronger impact on the project delivery than the transfer of design, build, finance and operation to private actors.

It would be interesting to examine whether this trend to increasingly include an energy ambition in PPP project is similar in construction projects following traditional procurement models.

PPP projects have also to be judged on the long run. The integration of energy issues in the contract is one thing but its implementation is a different matter. The performance of PPP in operation has rarely been treated. Thus it should be examined whether they succeed in implementing energy efficient solutions and record lower energy consumptions than traditional projects. The role of the users of the buildings would also deserve further empirical investigations since human behaviour has a strong impact on energy consumptions of buildings.

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REFERENCES

ACCA, 2004, Evaluating the operation of PFI in roads and hospitals, Research report n°84, London.

Aubert B.A., S. Rivard and M. Patry, 1996, "A transaction cost approach to outsourcing behaviour: Some empirical evidence", *Information and Management*, vol.30, 51-64.

Barlow J. et M. Köberle-Gaiser, 2008, « The private finance initiative, project form and design innovation », *Research Policy*, vol.37, 1392-1402.

Bougrain F., 2010, L'énergie dans les contrats de partenariat, CSTB-LSPI, DHUP.

Bougrain F., Carassus J. et M. Colombard-Prout, 2005, *Partenariat public privé et bâtiment en Europe – Quels enseignements pour la France ?*, Presses des Ponts et Chaussées, 271 p., Paris.

Catarina O., Grillon D., Bougrain F., Colombard-Prout M. et L. Markl, 2010, *Guide pour le montage et le suivi des contrats de performance énergétique dans les collèges et les lycées*, CSTB, Ecocampus, ADEME, Webpage accessed 06-06-2010 at: http://www.cstb.fr/fileadmin/documents/telechargements/Guide_CPE_V1_15_02_10.pdf

Catarina O., Joumni H. et D. Liffran, 2009, Mesures et incitations à la qualité de service dans les contrats de partenariat, CSTB-LSPI, DHUP.

Dowdeswell B. and M. Heasman, 2004, *Public Private Partnerships in Health: a comparative study*, Report prepared for the Netherlands Board for Hospital Facilities, University of Durham.

Edler J. et L. Georghiou, 2007, "Public procurement and innovation – Resurrecting the demand side", *Research Policy*, 36, 949-963.

European Parliament, 2006, « Directive 2006/32/CE of the European parliament and of the council of 5 april 2006 on energy end-use efficiency and energy services and repealing council directive 93/76/EEC", *Official Journal of the European Union*, 27 April 2006

Ghisgant J., Bougrain F., Catarina O., Colombard-Prout M. and L. Markl, 2008, Accompagnement méthodologique pour des expérimentations de contrat de performance énergétique pour des bâtiments publics, CSTB, EIfER, ADEME.

Grall M., 2010, « Le rôle des contrats de partenariat dans l'investissement public », *Management Immobilier*, n°10, Avril – May 2010, p.14.

HM Treasury, 2008, Infrastructure procurement: delivering long-term value, London, March 2008.

Leiringer R. and L. Schweber, 2010, "Managing multiple markets: big firms and PFI", *Building Research and Information*, 38(2), 131 – 143.

Leiringer R., 2006, "Technological innovation in PPPs: incentives, opportunities and actions", *Construction Management and Economics*, 24, 301-308.

Ministère de l'économie, des finances et de l'industrie, 2008, *LOI n° 2008-735 du 28 juillet 2008 relative aux contrats de partenariat*, Webpage accessed 10-10-2009 at: http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000019261845&dateTexte=vig

NAO, 2009, *Performance of PFI construction*, National Audit office, A review by the private finance practice, October 2009.

NAO, 2003, *PFI: Construction performance*, Report by the comptroller and auditor general, HC 371 Session 2002-2003: 5 February 2003.

Raisbeck P., Duffields C. et M. Xu, 2010, "Comparative performance of PPPs and traditional procurement in Australia", *Construction Management and Economics*, 28, 345-359.

Rintala K., 2005, The economic efficiency of accommodation service PFI projects, VTT Publications 555, Espoo.

Robinson H. S. et J. Scott, 2009, « Service delivery and performance monitoring in PFI/PPP projects », *Construction Management and Economics*, 27, 181-197.

Sexton M., Barrett P. (2005), "Performance-based building and innovation: balancing client and industry needs", *Building Research and Information*, 33 (2), 142-148.

Yuan J., Zeng A. Y., Skibniewski M. J. et Q. Li, 2009, « Selection of performance objectives and key performance indicators in public-private partnership projects to achieve value for money », *Construction Management and Economics*, 27, 253-270.

CRAFTING COMPETENCES – THE FUTURE OF THE SKILLED WORKER IN DENMARK

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The Danish and Global construction industry undergo continual change in use of materials, equipment and methods. The aim is to demonstrate how these new tendencies in material and immaterial demands impose change in production and work processes in the construction industry, hence calling for new and different definitions of competences compared to traditional bounded skills. The study also intends to illustrate the appearance of new patterns in professional interaction amongst construction workers and interaction between construction workers and customers. Drawing on recent concepts of competence such as OECDs the paper distinguishes between non-production-related process skills and production dependent component skills. Case studies shows how new market and political demands inflicts on the organization of work and challenge the competencies embedded in and associated with traditional crafts. The methods used are explorative interviews and field observations. It is concluded that specific processes of change concerning material and immaterial demands, requires a rethinking of necessary skills and competences to succeed as a construction worker in a field undergoing rapid change. Given the Danish occupational training structure, there are political options for response with further educational development to the industrial trends.

KEYWORDS: Construction industry, development of competences, material/immaterial demands

INTRODUCTION

The construction industry is currently characterised by complexity and diversity. The construction workers are faced with new and shifting demands and are operating in contexts undergoing change. The development of competences of the construction workers often has the respective crafts as a starting point. The purpose of this paper is to investigate how the competences of the construction workers are challenged by changes in material and immaterial demands and wishes. Furthermore it is the aim to discuss a rethinking and definition of the construction workers necessary competences. What are the challenges facing the construction workers when it comes to competency? Is core professionalism challenged? Are the cores of the crafts challenged or irrelevant or does different crafts need rethinking, redefinition and supplements? Does professionalism has to be redefined? The purpose of the paper is to present different cases and scenarios and discuss different aspects of competence thinking in the construction industry. The aim is to show, that there is a need for an expanded concept of competence to comprehend the needs for development of the crafts, skills and needed qualifications.

The paper draws on empirical knowledge of construction work and the resulting current and future skills needs. Based on an analysis of building production and competence, using OECD competence concepts it will be possible to strengthen the construction workers

competences through a targeted and appropriate training strategy. In addition we consider a more relational and contextual concept of competence based on Brammings approach (Bramming, 2001)). Further studies could create a well-documented and useful tool for use in the development of the vocational training both basic and further education.

The paper will deal with corporate and construction workers competence relationships of two areas which we will define as the *process competence* and *component competence*.

METHOD

This paper is partly drawing empirically on two studies initiated by Byggeriets Uddannelser (Byggeriets Uddannelser is a secretariat housing the trade committees of building and construction (except the area of installations) and The Vocational Training Committee for Building, Construction and Industry) and carried out by Byggeriets Uddannelser and Byggeriets Uddannelser and The Danish Technological Institute 2009. The studies have had different purposes but are in different ways preoccupied by development of competences in the construction industry. The studies are:

- Future Construction Programs and Educations - The construction workers competence needs (Bro & de Place, 2009)
- Slippage of Crafts and Cooperation on the Construction Site - Study of the occurrences of slippage of Crafts and interdisciplinary cooperation in the Danish construction sites (Holsbo & Thrane, 2009)

For the empirical work, the pilot study has chosen 12 companies, covering five areas; Implementation of construction projects, -construction of building projects, - demolition, Carpenters and Bricklayers. These represent total contractors, prime contractors and sub contractors in construction, renovation, restoration, reconstruction, additions, maintenance and demolition. Some companies are dealing with specific product areas. Others are large general contractors. The empirical material covers both companies which can be described as traditional construction companies and firms that have a more marked development approach.

The study has selected a range of companies, all working with a high degree of complexity whether in work processes and / or organization of work. However, we also encountered companies who have taken a different path, and are working with very limited products where production is routine, for example, companies that specialize in plaster fairing, sealing, joints and casting of the floors.

We have conducted semi structured interviews with key people in companies, asking them to describe their activities and business development and the tasks they have dealt with previously and what they are dealing with currently. Thereby we have obtained different characterizations of the changes the individual companies themselves find essential when it comes to customer needs and demands, and how they act in relation to these changes in terms of production and work processes. The key persons in this study are small craftsmen, project managers, environmental and quality managers and directors.

The pilot study aims to provide empirical knowledge of the construction workers actual performances, the modes of production and the resulting current and future skills needs.

The survey Slippage of Crafts and Cooperation on the Construction Site aims to identify whether there are slippage of crafts taking place which should influence the vocational training in building and construction area. The term slippage of crafts refers to that builders with construction training perform tasks that traditionally and educationally belong in other professions.

The study conducted interview on a total of 31 building projects, 14 of which were supplemented with building site observations. In the majority of the companies both employees and leaders were interviewed. Three of the 31 building projects have been related to concept companies, i.e. companies which specialize in certain well defined products. The survey covers two major categories; Building and Renovation

The paper at hand adopts an interpretive sociological approach, using elements of competence analysis (Bramming & Larsen, 2000; Hermann, 2003) and ethnographic approaches (Hammersley & Atkinson, 1995). Our ambition of mapping technological development is here approached in an empirical manner, through interviewing and collecting data on technological trends

It is a limitation that we in the present study rely mostly on key individuals and statements about the characteristics of their businesses because we are preoccupied with identifying trends affecting the performing field in production and work organization. In further studies it is necessary to interview more construction workers and additionally to observe actual construction processes.

DEFINITION OF COMPETENCES

Competence Concepts, Formation and Educational Thinking

The original use of competence refers to an authorization, meaning that a person has a formal authority to perform certain tasks, make certain decisions, etc. It is an authorization which comes from above, a competence granted by a system or authority. Has been awarded this certification you are by definition competent. In this general sense of the term competence is detached and independent of context and use.

In the second meaning of the term is not linked to the formal, but rather the contextual, situational and relational issues. This means that competence is present in concrete actions, situations and especially where persons interact with others on specific tasks (reference).

This second meaning which is used in many contexts today, defines competence as skill, knowledge, attributes and experience, i.e. what it takes to master various situations in working life, education, privately and society in general. Competences are something potentially and substantially. Competences are skills specifically needed to master a situation or solve a problem. The formal authorization is less important and becomes perhaps even irrelevant (Hermann, 2003).

In 1997, the OECD set the concept of competence at the forefront of DeSeCo program. DeSeCo (Definition and Selection of Competencies) focuses on *key competencies, meta-competencies,e*tc. In its effort to create a basis for measuring competences DeSeCo take a starting point based on an objective understanding of competence, which focus on measurability. The Danish NKR (National Competence Account), with the support of the theoretical background of DeSeCo, defines competence as "the ability to meet demands of a

high degree of complexity, including both knowledge, skills, strategies and routines as appropriate feelings and attitudes and effective self-management of these components, which is possible to learn " (Jensen et al., 2002). Complexities as a condition and prerequisite must therefore not only be met with the knowledge and skills but also appropriate feelings and attitudes, and effective self-governance.

Hence there are a number of factors that can be thematized in a discussion of education and competence thinking. Is competence merely an analytical concept and value-neutral? Is there anything that points to a special educational ideal of competence reflection? Who and what defines what is or should be not only relevant and useful knowledge, skills, strategies, but also appropriate feelings, attitudes and virtues? What relations of power play a role in the definition, selection and assessment of competencies? What ideals lies behind and what means are applied to develop competence (Keating, 2002)?

The discourse of competences is not just reserved for purely instrumental skills, but also values, attitudes, social competence and self-management. Thus, the discourse of competence and the way the concept is applied in some contexts is about ideals and not objective categories. Discussions attached to the concept of competence, show that competence is not in itself a neutral analytical concept to grasp a new reality, but a process that can help to define a new educational ideal, and how the related learning and knowledge processes have to be or should be. These issues suggest perspectives on the relationship between the concept of competences rooted in economic utilitarianism opposite the concept of formations/educations holistic thinking

Bramming (2001) has the assumption, that there always is competence present in every performance. In this sense it is pointless to demand competence and skill. All activities require an actual unfolding of competence. Competence, in this perspective, is not understood as an input to an activity. Competence is not something in itself, competence is an assessment conducted in and by a concrete practice. A human is ascribed competent if the activity is assessed competent in the context, it is included in. Competence is not something an individual has within itself, but an assessment of what man does in different contexts. "Best practice" is pivotal, and therefore Bramming speaks of competence-in-practice, where it is relevant to observe what the local practices comprehend as the good practices and that the word competence should be reserved to be used in this context. Competence is a basic condition for all trade and activity, and therefore it is not competence which should be at the center, but how you in organizational and management terms relate to what is done in practice.

Our position is thus drawing on the Bramming´s and OECD understanding of competences, knowing that further investigation should deal with educational thinking and possible changes and therefore must address questions about education as formation processes towards the purely instrumental utilitarianism which may - but not necessarily – be embedded in competence thinking.

Our starting point is therefore not a certain perspective of education which we try to get the survey to coincide with.

We obviously cannot ignore the fact that the instrumental utilitarianism will have its place in the analysis given that the survey examines the relations of production in the construction sector. This will stipulate skills and competences which alone are necessary to perform in building processes.

The definitions of competencies by OECD and Bramming contribute to the understanding and discussion of the competences of the construction workers as both approaches to understanding competence challenge an understanding of development of competences based on core skills, i.e. a position which perceives development of competences as starting from the respective crafts and professions. In our view this theoretical starting point allows a more dynamic approach to the understanding of competencies and their development.

If companies and employees should be able to create and deliver the building and construction products, they obviously have to possess a range of competences. The following describes the common competence needs which we assume are likely to be present across disciplines and industries regardless of the building products and services in question. It is the non-production-related competences, often called interdisciplinary skills. Next, we try to identify and frame the production-dependent competence. Competence requirements in both areas will vary depending on the task at hand, i.e. that the range of capabilities must be present to varying degrees, but never absent. Instead of interdisciplinary and professional skills, this study defines the two fields of competences respectively as *process competence* and *component competence*.To what extent those two open and broad fields of competence play a role is context dependent.

CONSTRUCTION PROCESSES IN SHORT

We know that the works are carried out independently by individuals or in gangs and that gangs predominantly are formed by skilled or unskilled workers from the same trade. Construction involves a range of gangs with different skills, but nevertheless the various gangs (or individuals) have many common competences.

The construction worker will understand the overall scope of the work, complexity and in what context their work is included. They must have knowledge and understand the overall product to be delivered to the customer/client. They must be able to read and understand the premises for the sub-process they perform, so that they are in a position to plan and manage the tasks they are responsible for performing. This means that the construction workers also must have skills that enable them to plan and manage the efforts of the gang and mastering relationships with customers.

Finally, it is a necessary competence to be able to relate analytically to the operations and processes, because it is essential to improve and develop processes and products, i.e. contribute in innovative processes (Vogelius, 2008).

The competences we have mentioned above cover both material and non-material skills, but all skills must be present through the different steps in the building processes. Whether and to what extent the competences are present, shapes how the workers involved can participate in the construction processes.

Competence in building processes are here described objectively, but should be related to contexts as building processes will be different and constantly changing.

MATERIALS, COMPONENT COMPETENCES AND AREAS OF UNIQUENESS

The building and construction trades are associated with a material professionalism. Masonry professionalism is often linked to brick, carpentry professionalism associated with wood, unskilled construction workers with concrete, etc. It is obviously a very simplified picture, but also points at a significant factor in production-related competence issues. Instead of using the concepts of material or professional proficiency, we will use the term component competence, since it can accommodate traditional materials, new materials, prefabricated elements, etc. Component competence is related to the actual work of restoring, molding, assembly, bricklaying and casting concrete which is a part of components in buildings and constructions. It is production-related skills. The concept of component competence is open to new subjects and is therefore of a more changing and dynamic nature. Firstly, new materials emerge; secondly, new elements in buildings and constructions appear. With this conceptual definition the construction workers perform primarily in relation with components composed of materials, without the material being defining professionalism.

We would however stress, that a professionalism that is closely tied to the individual materials are absolutely necessary, as respective areas by their nature require specialization. It is however the necessary common volume within the areas of process competence and component competence that is the starting point, knowing that professional differences, uniqueness and disciplines also have to be examined. Obviously material competence requirements cannot be regarded as a static field (Vogelius, 2008).

Both non-production-related process and production dependent component competences should be present during construction and none of the fields must be detached. By examining these issues empirically, it is possible to identify which direction the products, construction processes and component competences moves, the current trends and what educational impact it should have. The right competences and especially the right interaction between competences is crucial to developing quality in construction, optimization of construction processes and the construction workers implementation of flexibility regarding work tasks.

CASES

Products Delivered – Diversity and Complexity

Construction companies may be organizational structured from the simple to quite complex. Some of the businesses operate predominantly "traditional". Other is organizational complex companies. These two categories are discussed below.

Below we also present some products the companies provide in a perspective that includes the expectations, demands and requests from customers in the broadest sense, showing several aspects of the needs and demands.

We find in some of the companies surveyed, clear indications of three important factors which both affect the relations of production, but also contribute to the complexity of the building product and production, namely:

- The complexity of the material used; prefabricated components, new products and the interaction with "traditional" building
- The immaterial demands and values relating to production and building products

- Management and organizational models and management tools, primarily associated with and derived from industrial production

Very briefly formulated: The quality of a building and construction product depends on many factors, not just that it is done professionally correct.

Traditional companies focus on daily operations, dealing with the tasks that might be provided, which can be solved with the knowledge and professional competence which the company holds.

One example (Bro & de Place, 2009): Recruitment of staff is based on trust, tasks are performed and the quality is ensured through the experience of the manager and the employees. The manager himself is a guarantor of quality. Thus, one company appears in this way: The company has tasks because they are trusted in the industry. One job often leads to the next; public housing, semi-large co-ops, maintenance and renovation. They are subcontractors in plumbing when buildings have experienced water damage due to collapse in the plumbing. The company has also built a few holyday cottages. The insurance jobs provide the day to day needed income, but it is the building of homes the director mostly prefers and wants to deliver. The company defines quality in the sense that the work is professionally correct and that the work is delivered on time. When building the holiday cottages they have used prefabricated rafters which have been industrially manufactured. This affects the ways that the construction workers previously worked. Furthermore the company has built some unfinished buildings. The manager rather hire people who are good all-round, but not necessarily quick in any job function. If an employee works enough in a certain area, he is fast to do the job anyway. The manager has largely recruited experienced people who can solve problems. But in his opinion the employees must be able to acquire new knowledge.

New materials and products affect the relations of production. A lot of products that previously were exclusively crafted at the workshop in or on site in connection to the contract are today part of the building process as a whole or semi-finished component.

The pilot study (Bro & de Place, 2009) affirm that the interaction between suppliers of prefabricated building components and architects/ consulting engineers, designers and contractors play a major role. The handling and installation may require new special knowledge and competences that differ from traditional areas of skills and knowledge. Moreover, the new building components may need to tap into traditional building elements. The issues are both on the interaction between materials and that the measurements/scales must be adjusted.

Finally, with finished components from abroad there might be a "translation problem". There are certain standards of technical drawings which make use of an international language, but despite this there may be areas where there are differences.

Immaterial Requirements and Values Relation to Construction Products and Production

Beside the material product the construction workers are involved with realizing the delivery also includes other more immaterial elements. Construction products are also consulting, environmental management, energy correctness; political correctness, quality assurance and the business may be associated with lifestyle trends (outdoor kitchen, wellness-rooms in private homes, etc.). There have probably always been these immaterial demands and

requests associated with building products, but there are currently a tendency for some building products that they must be and are a part of the formation of identities. Constructions (eg. from a new bathroom in the villa to new premises on the waterfront) are markers of a particular identity. Architects and consultants play obviously a role in this context but also for businesses and the construction workers, the challenge is to translate the client's wishes into something constructible and to be able to formulate and articulate the customer´s more or less clear images of the finished product (Bro & de Place, 2009).

A part of the industry emphasizes customer contact and customer focus as an area which they work actively and systematically to improve, because it is essential to getting contracts. Companies stresses that these new requirements, i.e. to offer products that are differentiated and customized solutions. Consumers have more knowledge, or think they have more knowledge. A company are supplying a carefully customized product, namely to create balconies in existing apartment buildings, where the employees must provide balconies after carefully specified standards for production (Holsbo & Thrane, 2009).

That the customer has certain demands regarding quality, price and timeliness, but also to service and advice, is not surprising or a new finding. But, for the customer to be assured there is a tendency that they demand documentation from construction companies that show they can meet the requirements. Within the larger and public buildings it is a requirement. Therefore there are examples of companies making systematic assessments of construction projects. This provides proof to the customer that delivery is in order, but is also used for pre-qualifications, tenders and marketing (Bro & de Place).

Below we discuss some examples of how immaterial factors associated with the products emerge in different ways and how it directly or indirectly has consequences for the construction worker.

Standards, monitoring, evaluation and management

At the prequalification and engagements in larger enterprises, it is increasingly necessary to apply the standards and quality management systems which are normally associated with industrial production. Leadership, management and documentation of prior projects are also in focus, and increasingly a requirement. Companies are also measured in relation to the environment, e.g. waste management, energy use and working environment. Therefore, there are requirements for construction companies to act, so that it supports client values (Bro & de Place).

Environmental certifications are another example that companies are concerned about environment, health etc. and profile the company on certifications. Methods there must be documented in the prequalification.

ISO certification demands commitment, and training of employees help and support in this context, one company emphasize. In some systems of certification employee involvement is a requirement and that its magnitude is documented. As a player in this market the building and construction products become more complex as the requirements go far beyond the proper professional manufacturing of the product.

Given the many different requirements for building products, changed production conditions for the construction worker, businesses in some contexts will have to be differently occupied with work processes and work organization. Broadly, one can say that The Craft as the

guarantor of correct performance, quality, and practical production faces a more industrial thinking and the various methods and tools found here (Bro & de Place).

Industrialization trends are evident in some companies, but certainly not everywhere. In those companies they are systematically preoccupied by optimizing use of resources and systematically ensure and document quality, using a variety of parameters. They seek uniformity in products; cf. the logic in ISO International Organization for Standardization. Even within a "soft" area such as ethics and environment standards are developed. Corporate CSR work (Corporate Social Responsibility) may be an indirect requirement and provide loyal customers who want products that deliver a clear conscience, as they are produced under decent conditions for construction workers.

In contrast to time studies, retail management and planning, lean concepts, a company mentions that production in some contexts is a “black box” (Bro & de Place, 2009).

One example: A company has recently become aware of this fact as they found that there is ample opportunity to optimize resources by studying the work processes and formulate a best practice. Best practice is in this context to accumulating and applying knowledge in different situations and contexts. It is both gathering of experience and a continuous process that includes learning, feedback, reflection and analysis in relation to what works, how and why etc.

This resource thinking is concrete and instrumental in relation to what extent there must be resources present, namely labor and materials. These are the two things that create products. Optimization is in this context a question of streamlining the different steps and be in control of logistics.

Organizational and management models, management and quality management systems are primarily used in companies of a certain size, which has larger clients and public clients. To deliver the products, some businesses are increasingly interested in avoiding piece-rate pay. Their experience shows that it helps to retain employees and to ensure the company's development of quality work over time.

In these companies there are also a focus on relationships within the company and each employee at work. This management approach - human resource management - can have far reaching implications for the construction workers organization and production. Coaching and mentoring are introduced in the workplace, communication and collaboration internally and externally will become a development issue to ensure quality of work, etc. Teams of construction workers are formed and team development will be an issue and subject to measurements. Systematic evaluations of construction and building ratios are parameters from which construction companies is judged.

The construction workers influence and involvement is not only an opportunity but also a requirement.

In the planning and performance of the work there is a focus on resources, and the maximum use of them, c.f. black box. But this perspective on the organization cannot stand alone without process competence.

DISCUSSION

As stated above there are several tendencies working on the same time. It makes little sense in this paper to draw a clear picture of exactly how the building and construction industry is moving. The question is not *if*, but *how* different factors affect production and organization of work. The construction workers production is subject, influenced and defined by factors that go far beyond the construction site.

This understanding can be founded on the "traditional" professional skills or on a new comprehension of skills. A major part of building and construction can be described as assembly work. But there is an enormous variety of materials and the materials traditionally associated with the workers respective trades and crafts along with new materials and components, constantly growing into each other. There are new materials and components that provide new and additional design and modes of outfitting. It creates both new opportunities but also challenges related to proper fitting, material interaction, joints, etc.

As indicated, not all but many buildings and constructions have become increasingly complex. This applies to the design, construction, use of materials, installations, insulation, outfitting etc. But even for the individual sub-process the complexity of some situations is increasing. Diversity is also ever-increasing. That private homes are the framework for much more "construction projects" than earlier is just one indicator, companies that specialize in sealing etc. is another. In this context, one must not forget the second image of the construction industry, which exist at the same time, namely smaller businesses working from day to day basis and are organized more traditionally within more traditional building craft businesses. This suggests two directions: each specialized workflow is handled by specialists or the individual construction worker must embrace more, have a greater comprehensiveness of the craft.

There is a tendency that the building and construction business, beyond the legal requirements, is being tied to political aspirations and must act in a political field. The crafts and a skilled worker is in this context, does not suffice as proof of quality of work in marketing and pre-qualifications. Businesses must continuously work on the development and documentation of quality, health, safety, accountability, etc. and not least to demonstrate to customers and prospective customers.

In addition there are also the more immaterial qualities of the building product, which the customers emphasize, building products as identity and identity markers. This is not just something architects and designers should be concerned about, but also the construction workers, because they in several contexts are expected to be able to advise clients and translate their more or less articulated and conscious wishes for concrete constructions.

Construction is covered by an enormous complex of laws and regulations. Fire safety, construction requirements, density requirements, isolation, environmental management are just some of them.

The competencies and contexts described must be related to the OECD´s conceptual thought; competence is the ability two act and the complementary approach by Bramming who stresses competences as being relational and contextual (Bramming 2000, 2001; Jensen 2002; Keating, 2002; Hermann, 2003).

As stated above the construction industry is characterized by complexity and diversity. This complexity and diversity derives from new, shifting and different organizational, political, material and immaterial demands of building and construction products. The construction workers are thus operating in contexts undergoing change. The current core of the construction workers professionalism is often The Craft. We argue that the challenges facing the construction workers when it comes to competency comprises of more than the development of The Craft. We do not intent to affirm a certain approach to the development of competences. We simply argue that a rethinking and definition of the construction workers necessary competences carefully must consider in which changing contexts construction workers act. Hence we suggest an expanded concept of competence to be able to comprehend the needs for development of the crafts, skills and the professionalism. We find this approach necessary in any efforts to rethink or redefine professionalism and supplements to the crafts.

We have mentioned assembly as common in certain areas in contrast to crafting competences. This could be perceived as a development of de-qualification of the construction worker. On the contrary we argue that the necessary fields of process and component competences are expanding. This suggests that the crafts, skills and different professions must develop accordingly. As shown there are several new and different markers of competence in almost every context. Competences are redefined and created in the shifting contexts.

CONCLUSION

We have considered a rethinking the development of competences by using a broader concept of competence which can handle and relate to changing contexts. We argue that this is not a question of de-qualification, but that there could be a need for another perspective on competence than the respective crafts and professions as a starting point. As shown process and element competence is both developing fields that are constantly challenged and changed in various ways. Development of competences has to be regarded as more dynamic and able to accommodate rapid change and different requirements.

Market and policy requirements are affecting the organization of work and challenge the competences embedded in and associated with the crafts. The premise is that both process and component competences are being and must be constantly evaluated and that targeted and appropriate training strategy should be based on the competences related to practice. Returning to the definition of competences by OECD we argue that the identification of key competences and making them subject to individual development must be coupled with a more dynamic approach where competence is seen as relational in a given context, work situation and practice (Bramming, 2001).

REFERENCES

Bramming, P. & H. Holt Larsen (2000), Making Sense of the Drive for Competence. *Human Resource Management in Northern Europe. Trends, Dilemmas and Strategy*, *Blackwell Business.*

Bramming, Pia (2001), *Kompetence-i-praksis*, Ph.d. series, nr. 2001-8, Samfundslitteratur, Copenhagen.

Bro, Rasmus Zier, de Place, Bill (2009). Future Construction Programs and Educations - The construction workers competence needs. *Byggeriets Uddannelser*.

Hammersley, Martyn og Paul Atkinson (1995) *Ethnography. Principles in practice.* London, Routledge.

Hermann, Stefan (2003), *Et diagnostisk landkort over kompetenceudvikling og læring.* Learning Lab Denmark.

Holsbo, Annemarie, Thrane, Lone (2009). Slippage of Crafts and Cooperation on the Construction Site - Study of the occurrences of slippage of Crafts and interdisciplinary cooperation in the Danish construction sites. *The Danish Technological Institute, Byggeriets Uddannelser*.

Jensen, Bente et al. (2002). *Nøglekompetencer - forskerbidrag til Det Nationale Kompetenceregnskab.* Undervisningsministeriet 2002

Keating, Daniel P. (2002). Definition and Selection of Competencies from a Human Development Perspective. *Contributions to the Second DeSeCo Symposium Geneva, Switzerland.*

Vogelius, Peter (2008), *Fremtidens kompetencer i byggeriet.* R-178 BYG-DTU, Lyngby.

QUANTITY CHOICE IN UNIT PRICE CONTRACT PROCUREMENTS

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A common approach for procuring large construction projects is through Unit Price Contracts. By the means of a simple model, we study the optimal quantity to procure under uncertainty regarding the actual required quantity given that the procurer strives to minimize expected total costs. The model shows that the quantity to procure in optimum follows from a trade-off between the risk of having to pay for more units than actually necessary and of having to conduct costly renegotiations. The optimal quantity increases in costs associated with possible renegotiations, decreases in expected per unit price, and, if a renegotiation does not increase per unit price too much, decreases in the uncertainty surrounding the actual quantity required.

Keywords: Unit price contracts; procurement; construction

INTRODUCTION

Large constructions, e.g., infrastructure projects, may be procured in a series of different ways. In many countries, the prevailing approach in practice seems to be through Unit Price Contracts (UPC)1. In a UPC, the procurer, e.g. a national road administrator, specifies the amounts of each activity, e.g., the amount of gravel to be removed, and lets the agents bid on unit prices. Typically, the agent with the lowest total bid – summing over all amounts times the bidding prices – wins the procurement.

This paper addresses the optimal behavior of the procurer, henceforth the principal, in UPC procurements. In particular, it addresses what amount of an activity to procure in a setting where the actual amount required is uncertain. Previous work dealing with UPC more or less implicitly assumes that the principal will procure the estimated amount of each activity. For instance, Ewerhart and Fiesler (2003) states that in a UPC "*the buyer estimates the quantities of the respective input factors that will be needed to accomplish the task. Then the buyer publicly announces her estimates* [...]". We will, by the means of a simple model, show that this notion is not correct. Rather, there are cases in which the principal should – in order to minimize her expected total costs – procure a quantity exceeding the estimated or expected

[1]UPC can be viewed as a subgroup of Design-Bid-Build. Love (2002) notes that "traditional lump sum" procurements (to which UPC belongs) dominate in many commonwealth countries. In Sweden, ~ 90% of the road investments between 2000 and 2009 were procured under UPC, Mandell and Nilsson (2010).

one and other cases in which the procured quantity should be lower. More importantly, the model will provide us with an intuitive understanding for the mechanisms at work.

This paper is akin to a literature focusing on optimal behavior among bidders in UPC procurement. In particular, that literature addresses strategic bidding behavior under which the bidding agents have superior information. The agent may exploit their information advantage by skewing their bids. This behavior is often referred to as unbalanced bidding. The underlying information asymmetry may be that the agent is better informed about the actual, *ex post*, amounts of individual tasks. This case is investigated by Atey and Levin (2001) and Bajari et.al. (2007). A similar situation may occur when the agent is better informed about her own type, e.g., skill, as studied in the aforementioned Ewerhart and Fieseler (2003). These papers model the bidding agents' behavior in UPC auctions while the present paper models the procurer's behavior. Thus, the present paper is a step towards a unified model which allows for strategic behavior of both procurer and bidders.

As noted, a central outcome of our model is that the quantity to procure may deviate, upwards or downwards, from the expected quantity actually required. Consequently, our model adds to the literature on cost overruns. That cost overruns are frequently occurring in infrastructure projects seems to be an established fact in the literature, Flyvbjerg et.al. (2003) and Odeck (2004). According to Priemus et al (2008), cost overruns for large infrastructure projects of between 50 and 100 per cent are common. Furthermore, the forecasts of costs have not improved over the last 70 years.

Priemus et.al. also provide a couple of plausible explanations for systematic miscalculation of costs leading to cost underestimation; bad forecasting due to technical problems and calculation problem, that the project change shape during the construction phase, and that planners, instead of getting the forecast right, perform a forecast to support an already decided project. Our model suggests one additional reason. Namely that the procurer, in some situations, contracts on a low quantity knowing that the required quantity with a large probability will be larger than the contracted one and, thus, that total costs *ex post* most probably will exceed the contracted sum. The interesting – and perhaps somewhat paradoxical – result is that this behaviour is optimal since it keeps the *expected* total costs at a minimum.

Ganuza (2007) and Gaspar and Leite (1989/90) are related to the present paper as both develop models on procurement in which cost-overruns are likely to occur in optimum. These studies focus on different aspects of procurement than our model. The former shows that the procurer, in optimum, should underinvest in design specification. The reason is that an exact design will decrease competition among bidders, which results in that a large share of the rents will be captured by the winning bidder. The latter provides a model in which each bidder has an imperfect signal about the cost of finalizing the project. As the lowest bid will win, a selection bias problem emerges. This results in a high risk for cost-overruns.

It should be noted that there are different definitions of the concept cost-overrun. The definition here, as in Ganuza (2007) and, to some extent, Gaspar and Leite (1989/90), would be actual total costs minus contracted sum. Priemus et al. (2008, page 125) states the definition as "*Actual cost minus forecasted cost*" where forecasted cost is defined as "*the estimate made at the time of decision to build, or as close to this as possible if no estimate was available for the decision to build*". The contract sum is probably not a good approximation of the latter.

The remaining paper is structured as follows: The next section introduces the model and leads up to a first-order condition. The characteristics of this condition is analysed in section 3. The model relies on a series of assumption. Possible consequences of relaxing some of the more restrictive assumptions are discussed in section 4. Section 5 concludes.

THE MODEL

We will not model the bidding procedures. Rather, we assume that the winning bid covers the agent's marginal cost associated with each activity with some margin. Consequently, the agent always gains from conducting one extra unit of the activity and the agent has no incentive to carry out less of an activity than what is specified in the contract. Given this, the amounts specified in the contract serve as a lower threshold[2].

For the sake of this presentation it suffices to focus on one activity. Let us denote the amount of this activity required to complete the project by Q. It is easy to expand the model to include several activities, but it will not add to the understanding of the problem. In the procurement stage, i.e., *ex ante*, Q is not fully known[3]. However, it seems reasonable that the principal, i.e. the procurer, has a prior but uncertain estimate of Q. For simplicity, let us assume that $Q \sim U(Q_{low}, Q_{high})$ .This assumption of a uniform distribution is not very realistic, but it greatly simplifies the presentation.

Given this information, the principal specifies an amount in the UPC. Let us denote this amount q, which is the central variable in the model as it is the only variable the principal controls. The bidding process yields a winning per unit price for q, which we denote p. Clearly, when deciding what amount to procure the resulting price is not known. Intuitively, and as will be shown subsequently, the principal's belief about the emerging per unit price will influence his choice of q. To capture this, we assume that the principal knows that the emerging price will be in the uniform[4] interval (p_{low}, p_{high}). Again, the uniform distribution is probably not very realistic but a simple way to capture uncertainty.

Due to the uncertainty regarding required quantity, it may be the case that q is not sufficient to produce the project, *i.e.*, it may be the case that $q < Q$. Whether or not this situation occurs is not known at the procurement stage, but becomes evident to the agent during the construction phase. It is of minor concern exactly when (after the procurement) the information about the true Q is revealed. Here, we assume that it is revealed once q has been conducted.

If it turns out to be the case that $q < Q$ the principal and the agent must renegotiate the contract in order to finalize the project. This may be associated with a renegotiation cost,

[2] For this to be true there must be nothing else to gain from conducting less of an activity than the contract states. In particular, there may be no reputational effects. That is, the agent's behaviour in this contractual relationship must not influence the probability of winning future contracts.

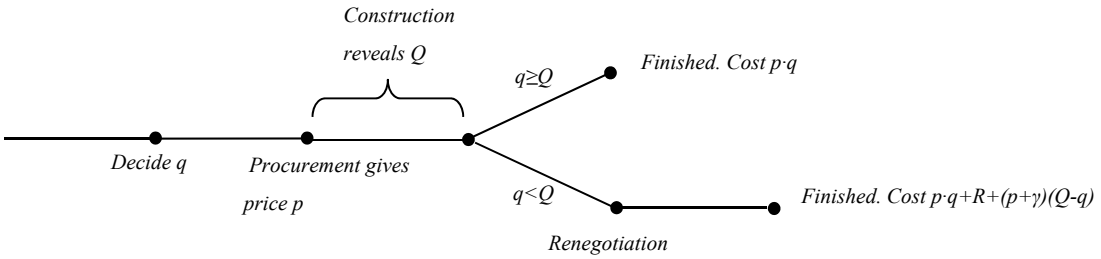
[3] This may, for instance, be due the exact characteristics of the rock may be unobservable prior to the project has started.

[4] The crucial assumption is that the distribution is symmetric around its expected value. The use of a uniform distribution is motivated by it being used for the quantity (where the exact distribution, as will be discussed in section 4, will influence the outcome).

denoted R. We restrict our attention to $R \geq 0$ and $R \leq (Q_{high}\text{-}Q_{low})\ p$. The former limit is uncontroversial. If the latter limit is not fulfilled, the cost of renegotiating the contract will exceed the entire possible gain from renegotiating[5]. The result of the renegotiation is a price per unit for the remaining amount of the activity required to finalize the project, $p_R. \geq p$.[6] Let p_R be equal to $p+\gamma$. For simplicity, we assume that at the renegotiation stage the true Q is observable for both parties. That is, there will only be one renegotiation as it is then known (with certainty) that the remaining amount is $Q\text{-}q$.

Figure 1 summarizes the timing of the model as described above. In the first stage, the principal decides on how many units to procure, q. This is followed by the procurement, which will establish the winning per unit price. The next step is the construction phase under which the true Q will be revealed to the agent. If q is sufficient, i.e., $q \geq Q$, payments are made according to the contract and the game ends. If not, renegotiations are needed.

Figure 1. The sequence of the game.



Using the assumptions above, the principal's total cost, TC, will be

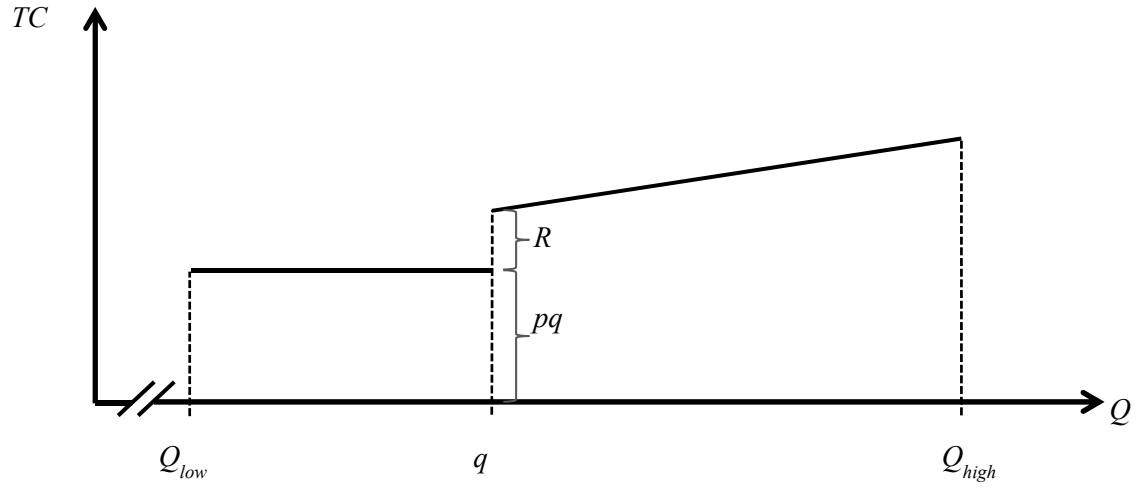
$$TC = \begin{cases} p \cdot q & when\, q \geq Q \\ (p \cdot q) + R + (p+\gamma)(Q-q) & when\, q < Q \end{cases}$$

Figure 2 shows TC for different realizations of Q. One key factor is that for realizations below q; TC always equals $p \cdot q$. The principal thus, most likely, pays for q units even though the project could have been carried through using only $Q < q$ units. Note that for these realizations; the principal only knows that Q is weakly less than q as he may not observe Q. The other key factor is the cost of renegotiations. In figure 2 these costs show up in two different ways; first through a shift in the TC-curve at q, due to the renegotiation cost, and, second, through the slope of the TC-curve above q. If there is a mark-up in per unit price due to the renegotiation, this will result in a steeper TC-curve.

[5] Then, it is obviously better to procure the maximal amount of the activity, i.e., $q=Q_{high}$, and thereby setting the probability of having to renegotiate to zero.

[6] That is, we disregard the case where the renegotiated price is less than the initial one. The rational for this is that it seems unlikely that the principal would receive a better deal once locked into an agreement with a given agent.

Figure 2.Total cost over realization of Q.



Neither party knows the actual TC prior to the construction phase. Rather, the principal strives to minimize the *expected* total cost, which may be written as

$$E\{TC\} = \frac{1}{p_{high} - p_{low}} \int_{p_{low}}^{p_{high}} \left(\frac{1}{Q_{high} - Q_{low}} \left(\int_{Q_{low}}^{q} pq \, dq + \int_{q}^{Q_{high}} \left(pq + R + (p + \gamma)(Q - q) \right) dq \right) \right) dp$$

The first integral is due to the uncertainty in emerging price prior to conducting the procurement. The first integral inside the brackets captures realizations under which q is sufficient and the second integral captures those where additional activity is required. The expression may be rewritten as

$$E\{TC\} = \frac{(p_{high}+p_{low})(q^2-2qQ_{low}+{Q_{high}}^2)+2(q-Q_{high})(\gamma(q-Q_{high})-2R)}{4(Q_{high}-Q_{low})} \quad (1)$$

The principal's optimization problem amounts to choosing q to minimize $E\{TC\}$. From (1) we may derive the following first order condition

$$q^* = \frac{Q_{low}(p_{high}+p_{low})+2(Q_{high}\gamma+R)}{p_{high}+p_{low}+2\gamma} \quad (2)$$

Taking account for that the symmetry we have assumed regarding the distribution around the expected price implies that $p_{low} + p_{high} = 2\bar{p}$, where $\bar{p}$ denotes the expected price, we reach

$$q^* = \frac{\bar{p}Q_{low}+\gamma Q_{high}+R}{\bar{p}+\gamma} \quad (3)$$

The next section contains a closer analysis of the characteristics of this optimal quantity to procure. For now, we only note that the uncertainty surrounding the price does not enter into the expression as long as it, as is assumed here, is symmetrically distributed around the expected value.

Analysis

From (3) it is evident that the optimal quantity to procure is influenced by several variables; the expected price, the renegotiation cost, the possible mark-up in price following a renegotiation and the range of the uncertainty in required quantity. The aim of this section is to analyze how these variables affect the optimal quantity as well as to provide an intuitive understanding of these dependencies.

We start with the influence from the renegotiation cost. Differentiating (3) with respect to R yields:

$$\frac{\partial q^*}{\partial R} = \frac{1}{\bar{p}+\gamma} > 0 \tag{4}$$

The denominator of (4) is the expected price after the renegotiation. Even if we would allow for a negative price mark-up, we do not allow for this price to be negative. Thus, (4) is positive and the optimal quantity increases (linearly) in the renegotiation cost, see Figure 3a. This makes intuitive sense. By increasing the procured quantity, the risk of ending up in a situation where this quantity is insufficient, i.e., $q < Q$, becomes smaller. On the other hand, by increasing q, the cost incurred when q turns out to be sufficient, i.e., $q \geq Q$, becomes larger. This illustrates the fundamental trade-off faced by the principal; a larger q reduces the risk for costly renegotiations, but also increases the costs for outcomes where renegotiations are not needed. What (4) shows is that if the renegotiation costs are higher, then the principal is willing to increase the costs incurred when $q \geq Q$ to reduce the risk of renegotiations.

Applying the same logic on the price mark-up, γ, would suggest that the optimal procured quantity should increase if the mark-up is increased. To see this, we differentiate (3) with respect to γ, which yields

$$\frac{\partial q^*}{\partial \gamma} = \frac{\bar{p}(Q_{high}-Q_{low})-R}{(\bar{p}+\gamma)^2} > 0 \tag{5}$$

Equation (7) is indeed positive[7]. Thus, if the price mark-up increases, the principal increases the contracted quantity and thereby reduces the risk of having to pay the higher renegotiated price, see Figure 3b.

If the expected per unit price increases, the principal will reduce the procured quantity, as seen from differentiating (3) with respect to $\bar{p}$ which yields

$$\frac{\partial q^*}{\partial \bar{p}} = -\frac{R+\left(Q_{high}-Q_{low}\right)\gamma}{(\bar{p}+\gamma)^2} < 0 \tag{6}$$

This too makes intuitive sense in the light of the fundamental trade-off described above. The principal may reduce the risk of a costly renegotiation by increasing the procured quantity, but that increases the probability of having to pay $p \cdot q$ for a job that actually required less than q units of input. The higher the p, the higher the cost in these outcomes. Consequently, if the expected per unit price increases, the principal will reduce the procured quantity as a renegotiation has become relatively (but not absolutely) less costly, see Figure 3d.

[7]This is true as long as $R \leq (Q_{high}\text{-}Q_{low})\,\bar{p}$ which must be the case otherwise the contractor will put $q = Q_{High}$ and thereby ruling out any risk for renegotiation

The optimal quantity to procure depends, in addition to the variables discussed above, on the lower and upper limit of the distribution of Q, i.e., the minimum and maximum amount of the input required respectively. Differentiating (3) with respect to Q_{low} and Q_{high} respectively yields

$$\frac{\partial q^*}{\partial Q_{low}} = \frac{\bar{p}}{(\bar{p}+\gamma)} > 0 \tag{7}$$

$$\frac{\partial q^*}{\partial Q_{high}} = \frac{\gamma}{(\bar{p}+\gamma)} > 0 \tag{8}$$

From (7) we see that if the lowest possible quantity required increases, the optimal quantity to procure must increase. As seen from (8), the same applies for the highest possible required amount. Neither of these is surprising in the light of our previous discussion. Increasing the upper boundary increases the probability of having to conduct costly renegotiations. The same applies for the lower boundary as increasing this will shift some probability mass to outcomes where $q < Q$ and a renegotiation is required.

Equations (7) and (8) also say something about the optimal response from a change in uncertainty. For the uncertainty surrounding a given expected Q to increase it must be the case that Q_{low} decreases at the same time as Q_{high} increases at the same rate. From (7) we know that the former implies a decrease in q^*, while, from (8), the latter implies an increase in q^*. The outcome is determined by the relative strength between (7) and (8), which depends on the relation between the expected price (being in the numerator of (7)) and the price mark-up (the numerator of (8)). We have no theoretical prediction of this. However, as long as the mark-up is less than the expected price, (7) will outweigh (8) implying that the optimal quantity to procure decreases when the uncertainty increases (also see Figure 3c).

The results above are summarized in Figure 3, which illustrates – by the means of a numerical example – the optimal quantity and resulting expected total cost as a function of the renegotiation cost, R, the price mark-up, γ, the quantity range, Q_{high}-Q_{low}, and the expected price, $\bar{p}$. Note that the quantity is measured on the left axis and expected cost on the right and that the scale for the expected cost is different in the expected price graph.

Figure 3. Optimal quantity to procure (left axis) and resulting expected total cost (right axis) as a function of R, γ, Qhigh-Qlow and $\bar{p}$, respectively. The base case of this numerical example is plow=2, phigh=4, Qlow=10, Qhigh=20, R=4, and γ =1.

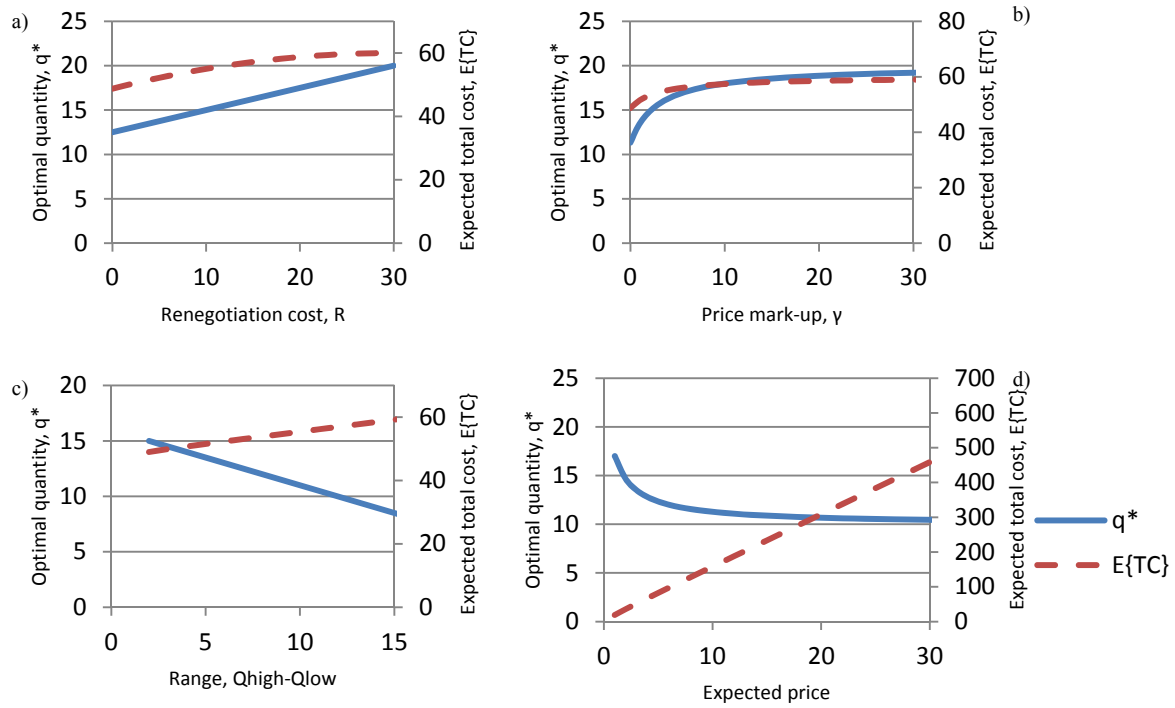


Figure 3 hints towards some other findings, in addition to those discussed above. For instance it seems as q^* asymptotically approaches Q_{high} when the price mark-up increases, and Q_{low} when the expected price increases. That these observations are not artifacts of this particular numerical example is easily verified by studying (3). There is also an intuitive explanation. As the price mark-up becomes very high, risking a renegotiation becomes prohibitively costly. Hence, to avoid renegotiations the principal procures an amount equal (or, in the limit, very close to) to Q_{high}. A similar logic applies for the expected price. When this is very large (relative to R and γ), the principal faces great incentives to avoid paying for more units than are actually required. This is achieved by procuring an amount close to Q_{low}. The principal knows that this implies a large risk for a renegotiation, but the cost this incurs is relatively small.

Also note that when the range of the uncertainty surrounding Q decreases, q tends to the expected value of Q (15 in the numerical example)[8]. This must be the case as in a setting without uncertainty; the principal clearly should procure the certain amount.

Finally, as seen from Figure 3a, when R tends to zero the amount to procure is close to Q_{low}. This provides a good illustration of the fundamental trade-off the principal faces. The reason for a $q > Q_{low}$ when $R = 0$ in Figure 3a is that there is a positive mark-up in price in the base case of the numerical example. From (3) it is easily seen that if both R and γ equal zero, the optimal quantity to procure is exactly Q_{low}. In the light of the discussion above, this is expected. In this setting there are no costs associated with a renegotiation and, thus, the trade-off breaks down to the corner solution of procuring Q_{low}, conducting the (costless)

[8]The range in Figure 3C starts at 2. A lower value on the range would violate the upper limit of R, $((Q_{high}-Q_{low})\bar{p})$.

renegotiation at which the true Q becomes known to both the agent and the principal. By this the principal will only have to pay for units actually required.

Discussion regarding relaxing assumptions

The model and analysis above build on a series of assumptions. To a large extent these are chosen as to facilitate the presentation, rather than because they are realistic. This section contains a brief discussion about likely consequences of relaxing these assumptions. We pay particular attention to the assumptions regarding q operating as a lower limit, and the use of uniform distributions. We also briefly address the assumptions stating that both the mark-up in price after a renegotiation and the renegotiation cost itself are known with certainty prior to the renegotiation.

That q operates as a lower limit follows from an assumption of that the price will cover marginal cost with some margin together with the assumption that only the agent may observe Q prior to a renegotiation. The former implies that it is always profitable for the agent to conduct one extra unit of the activity. By allowing for an increasing marginal cost function there may be situations when the agent does not conduct q units, if these are not necessary for finalizing the project. However, even in this case it may, depending on the marginal cost structure, be that more than amount actually required is conducted. Thus, the basic problem still remains.

Another question is whether the agent may conduct less than q units even though the price exceeds the marginal cost. For this to be the case there must be something else to gain for the agent. A plausible explanation would be reputation. By delivering the project at a lower cost than contracted upon may result in it being easier to win future procurements. For this to be the case it seems that the winner in the (future) procurement process must be elected not only on lowest total price, but also on past records.

Related to this discussion is the issue about the principal's ability to observe the actual quantities prior to a renegotiation. In the model it is assumed that only the agent may observe these. It seems plausible that the principal could adopt some kind of (potentially costly) monitoring that would relax this assumption. If the quantities were perfectly observable for the principal, the problem addressed would disappear. In that case the principal would procure the maximum possible quantity, but only pay for units actually required. This points towards another problem that entails a trade-off between the problem we address here and the cost of monitoring. This question is left for future research. More interesting from the present paper's perspective is if the principal may observe actual quantities, but that the observation is imperfect, i.e., it contains noise. To really capture the outcome of such a situation would require a different model.

However, the model in its current form hints towards a possible outcome. Partial observability should result in that the total cost at low realizations is lower than at higher ones (still less or equal than q). Even if the total cost is lower for low realization, it is – due to imperfect monitoring – larger than the cost under perfect observability. Graphically, this would imply that the horizontal section of Figure 2 is sloping upward at a rate lower than the unit price. Consequently, the basic mechanism in the current model is still present in that the principal for low realizations risks paying more than would have been necessary under perfect monitoring. This is still weighed towards the risk of a costly renegotiation. However, as the cost of the former is less under partial observability, the optimal quantity to procure must be higher than predicted by our model since the renegotiation is now *relatively* more costly.

Regarding the uniform distribution surrounding the expected price, this assumption is easily relaxed. As seen from (2), what matters for the principal's choice of q is that the distribution is symmetric around the expected value. As long as this is the case, it would seem to have no impact on q^* which distribution is chosen. Thus, this assumption is not very restrictive.

The assumption of a uniform distribution around the expected required quantity has a larger impact on the outcome. Without data it is difficult to say much about the shape of a realistic assumption. A starting point would be a more bell-shaped distribution having the same upper and lower bound as the uniform distribution currently used. As this puts more probability on outcomes close to $E\{Q\}$ it will have a similar impact on the result as decreasing the range of the uniform distribution. As shown above this would typically (when the price mark-up is less than the expected price) call for a higher q in optimum.

Flyvbjerg et.al. (2002) examine the difference between *ex post* total cost and planned budget for 258 transportation infrastructure projects. They find a distribution that is skewed towards cost overruns. A similar pattern is reported by Berechman and Chen (2011) for 163 highway investments in Vancouver Island. Both these studies differ from ours in that we compare *ex post* outcomes with what is contracted (not planned). Even so, they point towards that a likely distribution of Q should be skewed to the right. Still keeping the same upper and lower bound, this would shift probability mass towards lower outcomes and thus, using the same logic as above, would call for a lower q^* than under the assumptions of a uniform distribution.

Given that there is no risk-aversion involved, there is little reason to suspect that uncertainty in renegotiation cost and price mark-up at the procurement stage will have any impact on the optimal q. The principal would simply have to base his decision on the expected values. Of course, this may change if, for instance, the variables are correlated with Q.

CONCLUSIONS

In this paper we have, by the means of a simple model, studied the optimal quantity to procure when unit price contracts are used and there is uncertainty around what the actual required quantity will be. The model shows that the optimal quantity to procure, i.e., the one that minimizes the procurer's expected total cost, is determined by a fundamental trade-off between (1) the risk of having to pay for more units than actually necessary and (2) the risk of having to conduct costly renegotiations. In optimum, the procured quantity will increase in costs associated with a possible renegotiation. It will decrease in the expected per unit price. Typically, if the renegotiation does not result in too large mark-up in per unit price, the procured quantity decreases in the uncertainty surrounding the actual quantity required. These results have all been shown mathematically and the intuition behind them is discussed in the main text.

When the procured quantity is low compared to the expected amount required the risk that the final amount exceeds the procured one is obviously large. This implies that the actual total cost, with high probability, will exceed the total sum agreed upon in the contract. If we allow ourselves to define this as being a measure of cost-overrun, this leads to an interesting conclusion. Namely that not only is it rational and optimal to allow for cost-overruns. It is actually more likely, in optimum, to see cost-overruns in projects that are expected to run smoothly in the sense that the costs of renegotiations are expected to be low. That is, if one observes cost-overruns defined as actual costs minus contract sum, this does not necessarily

be an indication of any miscalculation or other error – intentional or not – on behalf of the procurer. Rather, it may serve as an indicator that the relationship between principal and agent was expected to run smoothly with low costs associated with any possible renegotiation of the initial contract.

Let us conclude this paper by pointing at an area for future research. The literature on unbalanced bidding predicts that a rational informed agent will exploit her superior information in the bidding process. In particular, she will post high per unit bids on activities that she believes are underspecified by the procurer. That is, the optimal procurement strategy described above, may invoke strategic responses from the bidding agents. Understanding the implications of such strategic responses requires a unified model capable of handling both procurer and agent behavior.

REFERENCES

Athey, S. and J. Levin (2001). Information and Competition in U.S. Forest Service Timber Auctions, *The Journal of Political Economy*, Vol. 109, No. 2 (April 2001), pp. 375-417

Bajari, P., S. Houghton, and S. Tadelis (2007). Bidding for Incomplete Contracts: An Empirical Analysis of Adaptation Costs. Working Paper, *faculty.haas.berkeley.edu/stadelis/incomplete.pdf*

Berechman, J. and L. Chen (2011). Incorporating Risk of Cost Overruns into Transportation Capital Projects Decision-Making, *Journal of Transport Economics and Policy*, Vol. 45, pp. 83-104

Ewerhart, C. and K. Fieseler (2003). Procurement auctions and unit-price contracts. *Rand Journal of Economics*, Vol. 34, No. 3, Autumn, pp. 569-581

Flyvbjerg B., M. K. S. Holm and S. L. Buhl (2002) Underestimating Costs in Public Works Projects, Error of Lie?, *Journal of the American Planning Association*, Vol. 68, No. 3, pp. 279-295

Flyvbjerg B., M. K. S. Holm and S. L. Buhl (2003) How common and how large are cost overruns in transport infrastructure projects? *Transport Reviews*, Vol. 23, No. 1, pp. 71-88

Ganuza, J.-J. (2007) Competition and cost overruns in procurement, *The Journal of Industrial Economics*, Vol. LV, No. 4, pp. 633-660

Gaspar, V. and A. P. N. Leite (1989/90) Selection bias induced cost overruns, *Information Economics and Policy*, 4, pp. 175-187

Love P. E. D. (2002) Influence of project type and procurement method on rework costs in building construction projects, *Journal of Construction Engineering and Management*, Jan/Feb, pp. 18-28

Mandell S. and Nilsson J.-E. (2010). A Comparison of Unit Price and Fixed Price Contracts for Infrastructure Construction Projects, vti WP 2010:14, *swopec.hhs.se/vtiwps/abs/vtiwps2010_013.htm*

Odeck J. (2004) Cost overruns in road construction--what are their sizes and determinants?, *Transport Policy*, Vol 11, Issue 1, pp. 43-53

Priemus H., B. Flyvbjer, and B. Van Wee (Editors) (2008) *Decision-making on Mega-projects: Cost-benefit Analysis, Planning and Innovation*, Edward Elgar Publishing, Cheltenham, UK

DOES CONSTRUCTION PARTNERING RESEARCH REFLECT CHANGES IN SOCIETY?

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Studies of partnering hold a strong position among researchers in construction management and exemplify a variety of scientific approaches. The purpose here is to analyse how leading contributions to construction partnering research have related the phenomenon to broader changes in society. Ten highly cited articles are selected, of which eight are clearly focused on partnering. Background societal themes or forces that can be identified in these articles are international competitiveness, the business cycle and information technologies, but these themes are hardly reflected in the research questions or the research design of these articles, which take a broad view of the field or collect practitioners' opinions. The explosion of interest in partnering after 1990 appears to have taken the researcher community by surprise. Chinese and Japanese influences, not from the construction sector, and partly transmitted through American publications, have been overlooked or underestimated, as well as the development of New Public Management. Thus those who have investigated construction partnering emerge as reactive and therefore unlikely to resolve tensions, ambiguities and paradoxes felt by leading practitioners in the construction sector. A conclusion is that new understanding, leading to new industry practice, should be based on approaches from disciplines that support prediction.

KEYWORDS: partnering, competitiveness, China, Japan, New Public Management

INTRODUCTION

Since the early 1990s, many researchers in the field of construction management have studied how partnering practices have been developed and how these have spread in the industry. Work on partnering is central to the field and dominates citation patterns for scientific articles in construction management. However, it is seldom that the partnering phenomenon itself has been seen in a broader societal perspective, although there are attempts (Winch, 2000, to mention one). Construction management researchers may evoke growing international competition and other forces for change but in most cases without deeper analysis of the causal mechanisms and actual effects on styles of collaboration in construction. The partnering phenomenon offers an opportunity for closer study of the relation between construction management research and changes in society.

Without attempting here to define construction partnering more precisely, there appears to be a broad consensus that it is a set of collaborative practices intended at least to mitigate adversarial relations. The relational problem is not a new discovery; considering only the UK, government reviews in the early 1960s, the early Tavistock study by Higgin and Jessop (1965) together with Bowley's overview of British construction were all concerned with the adversarial relations in a fragmented industry. What needs explaining is why it took more than twenty years before this led construction management researchers to explore alternative

practices. One possible explanation is that the research community simply went on pursuing the path outlined by Higgin and Jessop, who recommended operational research in order to improve communication and coordination in projects. The typical 1960s rationalist way to overcome lack of communication in a project setting was to refine and optimize the documents exchanged between contractual parties.

Against this background, the purpose here is to analyse how leading contributions to construction partnering research have related the phenomenon to broader changes in society.

This paper is organized as follows. There is a description of how ten articles were identified and there is an analysis of their contents. This leads to a review of how the authors refer to societal change in their articles, and a discussion of the complex influences from Japan and China, not least through policies of New Public Management which appear to be clearly relevant for understanding the spread of practices associated with construction partnering. Before drawing more general conclusions, there is a discussion of the role of construction management researchers.

THE TEN ARTICLES

'Leading contributions' to construction partnering research are interpreted here as being frequently cited articles in international scientific journals, although this is an interpretation that can be questioned. Ten articles have been selected as being the most frequently cited according to Google Scholar and Scopus in late 2010, containing the two words 'construction' and 'partnering' in the full text of the articles. No time limit was imposed for publication dates. This selection procedure reduces the need for establishing a general definition of 'construction partnering'. When the same author recurs among the top ranked, only the most cited article has been included. One article obviously falling outside the construction management field was eliminated initially. The outcome is found in Table 1.

However, two of these ten articles mention partnering although their main focus is elsewhere (Sarkar et al., 2001; Winch, 1998). Thus Sarkar et al. (2001) studied alliances, understood as nonequity collaborative ventures with other contractors – thus not in the Australian sense of a construction alliance – and their article is "not about relationships involving contractors and project owners". Winch (1998) mostly discussed innovation.

The resulting set of articles does not necessarily reflect the current status of partnering research, given that they were published at least eight years ago. The field of construction management is not one of those where breakthrough articles rapidly generate numerous citations. Turning to articles with 'construction' together with 'partnering' and published in 2010, we now find a much greater spread geographically, including author countries that do not share Anglo-American legal traditions: China, France, the Netherlands, Norway, Poland, South Korea and Sweden.

The introduction and the conclusions of each article were analysed for their indications of background phenomena that the author(s) regarded as important. However, when authors formulate their conclusions, they will remember the stated purpose of their articles, but it is seldom that they return to features of the grand introductory scene that they have used for capturing their readers. The articles represent a variety of empirical approaches. Unlike Sarkar et al. (2001), who studied construction alliances, nine of the articles lack a small set of hypotheses deduced from theory and tested against a large body of data. It is obvious that the

heavily cited articles are those that approach partnering in a broad manner, relying on widely ranging questionnaires or reviews of other studies, rather than contributing precise elements of new knowledge.

Table 1: Ten highly cited Construction Partnering articles.

Scientific article, author country	Construction industry and society
Larson (1995) (US)	Erosion of profit margins; litigation; quality of work; administrative overhead; deterioration of competitive advantage overseas
Thompson & Sanders (1998) (US)	International competitiveness; legal concerns; speed of introduction of new technologies; flexibility; response time
Winch (1998) (UK)	Lagging rate of (process) innovation to be remedied by gainsharing contracts; little sharing of learning between principal and trade contractors
Barlow (2000) (UK)	Poor industry performance, lack of innovation; highly complex projects, client image, business cycle
Black et al. (2000) (UK)	Conflict, adversarial relationships; success of Japanese industry (ref. to Fellows, 1997); Japanese continuous improvement, TQM
Bresnen & Marshall (2000) (UK)	Fragmentation, lack of integration; information technology as support; a buyer's market
Cheng et al. (2000) (Hong Kong, Australia)	Performance improvement; competitive advantage; productivity improvement; alliances between organizations a contemporary management strategy
Dainty et al. (2001) (UK)	Cost overruns; programme delays; poor productivity; tendency to vertically differentiate the construction process; use of labour-only subcontracting
Sarkar et al. (2001) (US)	Partner choice; discontinuities created by a volatile, interdependent and information-intensive global economy
Naoum (2003) (UK)	Inefficiency caused by fragmented industry, unique products, divorce design/construction, role of consultants, procurement methods; increasing project size and complexity; Japanese kaizen, TQM

More cited than any other construction partnering article, the one by Bresnen and Marshall (2000) can be read as questioning government policy rhetoric, which is set against the knowledge accumulated in the organizational studies literature. That so many later authors have chosen to cite their contribution indicates that the concern with partnering practices has to be seen in the context of how cultural change became part of the governmental and industry agenda, an issue that we shall return to.

THE CONTEXTUAL THEMES

Reading the introductory parts of the articles in Table 1, several contextual themes with elements of change can be seen to recur. First, authors refer to themes that are internal to the construction industry and where authors do not stress that contextual change is a reason for engaging in partnering research; the main themes here are industry fragmentation, litigation, poor performance in terms of productivity or quality and also little or slow innovation. Then there are just a few themes characterized by dynamics and larger perspectives: one is growing

international competition and another is increased project size and complexity, together with advances in information technology. A strongly dynamic theme, although seldom mentioned, is that of the business cycle and fluctuations in construction demand.

International competition: Japan

Competitiveness was a key concept in 1980s management thinking. Soon, the concept was adopted and transferred to a government policy level in the US, as with the President's Commission for Industrial Competitiveness, set up by Reagan in 1983, delivering its final report in 1985 and lying behind Michael Porter's *Competitive Advantage of Nations* five years later. While the main background change may have been the lowering of trade barriers combined with the astonishing international success of Japanese manufacturers, the international competitiveness of the construction industries in the US and UK was what the authors brought up in their articles. Japan worried the US, and in the UK, the prospects of a 1992 European Single Market appear to have vexed leading construction firms. Why these concerns are reflected in several of the partnering articles in Table 1 is a complicated issue, where perceptions of Japanese industry figure prominently. Still today, government policies for science and technology research in Western countries, where the manufacturing base is subject to fierce international competition, have a spillover effect on construction management researchers. This not just a British phenomenon where support for research in CM has been treated almost as an appendix to efforts for promoting innovative manufacturing (see Brandon, 2009), rather than recognizing and developing the business services aspect of construction.

Nevertheless, if the large Japanese contractors were a competitive force during the 1980s, how did this affect the development of an interest in construction partnering and an argument for engaging in closer relations in projects? In their report on the Japanese construction industry, Bennett et al. (1987: 33) acknowledged less adversarial relations in projects, but as receding into the past: "Predictably, though, as the larger contractors have become more international in their dealings, some of the gentlemanly principles have started to disappear." Also, the gentlemanly principles and a partnering mentality are less than conspicuous in *Built by Japan*, the most influential contemporaneous book on the Japanese construction industry, published in the US (Hasegawa & Shimizu Group FS, 1988).

At the same time, competition rather than quasi-integration between firms was on the UK policy agenda; words such as 'consensus' were no favourites of the Thatcher government confrontational style (Vinen, 2009: 294). If we turn to the ministerial prefaces of the report by Bennett et al. (1987) and of two other 1988-89 reports from the Centre for Strategic Studies in Construction at the University of Reading, they had nothing to say that even foreshadowed partnering or public-private partnerships, but were keen on competition (for the policy context, see also Anderson & Pollington, 2006). The 1989 report had its preface signed by the prime minister herself. At the first CIB Workshop on Procurement Systems held the same year in Liverpool, the problem of adversarial relations was only hinted at; only one contribution mentioned that there might be Eastern alternatives to learn from (Fellows, 1989). (This dissenting theme was developed later as a CIB W92 conference paper, Fellows, 1997, cited by Black et al., 2000, and expanded in an article by Liu & Fellows, 2001, bringing in the Confucian Analects, but also emphasizing Japanese reliance on ownership patterns in supply chain *keiretsu* structures.)

Instead, the development of partnering practices in the UK appears to have owed more to Japanese methods of Total Quality Management (cf. among our authors: Black et al., 2000; Naoum, 2003). One of the obvious formative publications was *The Machine that Changed*

the World, the MIT study by Womack, Jones and Roos; note that the second author was invited to join Egan's Task Force later in the 1990s (Adamson & Pollington, 2006: 85). But when Koskela (1992) compiled his *Application of the New Production Philosophy to Construction*, among all the Japanese practices listed, 'partnering' was mentioned as an American phenomenon with reference to a study by the Construction Industry Institute.

In retrospect, the 1980s expansion of foreign activities of Japanese contractors and their rapid shifts between regions can be understood as reflecting variations in foreign policy, notably the rivalry between bureaucracy and politicians (Rimmer, 1990). After 1989, the relative position of Japanese contractors began declining. Today, the ENR 2010 ranking of international contractors based on contracting revenue from projects outside their home countries is led by non-UK European firms. In this list, the top exporting UK contractor is ranked 16th and the top exporting Japanese contractor 33rd. Perhaps partnering has little to do with the international position of contractors.

Business cycles

It is recognized by economists that tendencies to vertical integration of firms or disintegration are influenced by demand shocks (Kranton & Minehart, 2000): when demand is low, the tendency to integration is weak. Nevertheless, Barlow (2000) mentions that the UK construction recession in the early 1990s was thought to have made it possible for clients to impose tough performance improvement targets. Also, the sharp decline in construction output increased the fears of foreign ownership (Adamson & Pollington, 2006: 6). Industry spokesmen wished government to increase construction demand, relying on this argument, but with little success. They were not to be protected from international competition, the same message as the prime minister had given them before 1987/88 (Adamson & Pollington, 2006: 10).

While partnering is one type of vertical quasi-integration of firms, the 1992 UK Exchange Rate Mechanism crisis led the government to rely heavily on concessions through the Private Finance Initiative, a different type of vertical quasi-integration (Winch, 2000). However, concessions remain sensitive to financial and political crises, as the experiences since 2008 have shown (Kappeler & Nemoz, 2010). Looser types of networks, such as in partnering projects, may be more robust.

Information technology and project complexity

Roughly half of the selected articles refer to information technology, flexibility, project complexity or discontinuities from volatility. There is a cause-and-effect problem here. Although writers on the need for better information technology support of construction often ascribe this need to increasing complexity of projects, it is tempting to argue that advances in information technology are an important cause of growing complexity and also of demands for more flexibility, as well as lying behind the increasing volatility in markets. The reality is probably an intricate combination of demand pull and technology push. In the context of construction partnering, it is clear that better support of communication in projects is evident in the diffusion of incentive (gainshare) contracts with open books and joint monitoring simplified by commonly accessible software used in project networks.

NEGLECTED INFLUENCES? MAO AND NPM

In this section, the possibility that construction management researchers happened to neglect two sources of influences that reinforced the case for partnering in the US and the UK. Construction partnering has its origins in the private sector and as a set of practices, it preceded the US Construction Industry Institute (CII) Task Force that was active between 1987 and 1991 (cf. Barlow, 2000, for UK antecedents). However, beginning with the US Army Corps of Engineers in 1988, partnering soon migrated into construction projects with public clients, although only on a project partnering basis in order to conform to regulatory requirements for public agencies (Weston & Gibson, 1993).

Here we encounter a nexus between Chinese influences and American business writing, ultimately contributing to major changes in governmental policies in Western countries in general. The final report in 1991 from the US Construction Industry Institute was published as *In Search of Partnering Excellence*, a title that in itself declares its link to the Peters and Waterman 1982 bestseller, *In Search of Excellence.* As revealed by Chan and Clegg (2007), there is a Chinese influence operating here, but not from the Confucian tradition. Instead, they show by considering textual parallels that there are echoes of the Cultural Revolution: the emphasis on self-criticism (Hawes, 2008), and somehow, 'the masses' found in *Quotations of Chairman Mao* resurface as 'the customers'.

The shift of public clients into partnering is best explained as a feature of New Public Management, NPM, which has its roots in several countries in the late 1970s and should be thought of as a case of major societal change. There has been almost no construction researcher interest in the links between NPM and partnering, although the claim can be made that partnering is an obvious outcome of NPM thinking – although not without a reinterpretation of fundamental concepts. The exception among researchers is a review of benchmarking and performance measurement activities related to NPM, where Hall et al. (2003) interviewed twelve UK project sponsors for public sector construction, and partnering emerged from the interviews as one of nine themes.

A convenient framework for understanding the links to partnering has been provided by Hood (1991) who has listed a number of doctrinal components of NPM: (1) hands-on professional management in the public sector, (2) explicit standards and measures of performance, (3) greater emphasis on output controls, (4) shift to disaggregation of units in the public sector, (5) shift to greater competition in the public sector, (6) stress on private-sector styles of management practice, and (7) stress on greater discipline and parsimony in resource use. Some of these components of NPM are conspicuous elements of partnering practices, whereas other elements can be thought of as compensating for peculiarities of construction and of being a public client under NPM. The total effect as it emerged for partnering could be interpreted as a move towards corporatism in society with reminiscences of Mussolini (Green, 1999), although the Chinese connection seems stronger.

The Latham 1992-94 review was the first time that clients were formally involved in construction policy reform, and the "consumer movement had spread to construction", as Adamson and Pollington express it (1996: 11). After the Latham Review, the UK Treasury's then Central Unit of Procurement was eager to improve public client practices (Adamson & Pollington: 29), while private sector clients were more reluctant to engage. As mentioned, the customer theme (Du Gay & Salaman, 1992) in NPM has an important root in the concept of 'the masses' in Mao's Little Red Book. But in the UK, the 'sovereign' customer became

literally that in the guise of the public client. There was a fusion of customer-orientated thinking with government client power. One of the private industry trends, that of customer survey technologies, surveys 'made to exert control over employees' (Du Gay & Salaman, 1992), was also introduced or at least reinforced in construction by government action, along the lines of components (2) and (6) above, although the employees to be controlled were now seen as the contractors working for government clients. The process of reinterpretation went on with a logic of its own. Thus the key performance indicators for construction launched in 1998 were a British adaptation of an American system designed by J.D. Power and Associates for measuring customer satisfaction with new homes (Adamson & Pollington, 1996: 129). The UK introduction of the KPI system, which originated in the automotive industry, was thus replacing household customers with public and commercial clients.

However, except for the dismantling of municipal direct labour organizations, the principle of introducing a 'market relation' was hardly the recipe for improving construction projects, which might already suffer from an excess of market disputes and instead would benefit from more elements of hierarchical relations. Thus it was irrelevant to introduce another NPM principle, to 'replace hierarchical control with simulated market control'. While an increasing differentiation of demand on organizations had affected much of the private sector in general and now also influenced the public sector (Du Gay & Salomon, 1992), the issue of product market variability was far from new to the construction industry with its tradition of uniqueness of projects.

The NPM doctrine of disaggregating public sector units had materialized fully in the 1992/93 privatization of the Property Services Agency (Burnes & Coram, 1999), already since 1988 no longer having a monopoly of being the central government client. Therefore, implementing components (1) – (3) and (7) in construction projects for the public sector through unitary practices could not be done through following long-established command routes. Nevertheless, there was actually an element of legislation, as when compulsory adjudication was introduced through the 1996 Housing Grants and Regeneration Act.

ROLE OF CONSTRUCTION MANAGEMENT RESEARCHERS

Studies of partnering hold a strong position among researchers in construction management and exemplify a variety of scientific approaches. Partnering research served as an illustration during the 1995-97 theory debate in *Construction Management and Economics.* Raftery et al. (1997) proposed that what was then recent experiences of construction partnering would be suitable for a case study of how the 'rationalist paradigm' "is capable of producing cultural change", whereas Seymour et al. (1997), arguing for interpretist approaches, had complained about researchers in construction management glossing over and hiding the "analysis that goes into the identification of problems, the formulation of questions, [...]". Still today, this complaint about hidden analysis might be a valid observation for many studies of construction partnering.

In a recent special issue of the *Journal of Construction Engineering and Management,* devoted to research methodologies, 'partnering' remains as a topic when Azhar et al. (2010) make a plea for action research and in the same issue, it is mentioned also by Green et al. (2010), as an observation when applying a grounded theory approach to the study of lean construction. Here, Green and his coauthors argue for contextualist research that takes into account historical dynamics when studying companies. Certainly, context is a fundamental

issue, and in the present paper, construction partnering in the larger context of dynamics on a national or even the global level is addressed.

Taking construction management researchers to be the community of those who habitually publish in construction management journals, why is it that they seem to have failed to anticipate the emergence of practices intended to transform adversarial relations in construction projects? The explosion of interest in partnering after 1990 appears to have taken the researcher community by surprise. One explanation based on the articles analysed here is that they spent too little effort on wider societal changes. Although they may have invoked these changes initially in their articles, it is difficult to see how these insights are reflected in the design of their investigations, and the big picture is almost forgotten when authors reach their conclusions, not revisiting the issues they obviously were aware of.

Educational background could be an explanatory factor. A useful analysis of the reform movement in construction (Adamson & Pollington, 2006) has been authored by two skilled practitioners and not by members of the research community; one also notes that Michael Latham holds a degree in history. While senior researchers in construction management might be able to keep track of major changes and relate to the development in more fundamental disciplines, PhD candidates in a highly applied subject where they lack the practical experience that high-level practitioners in the field possess run the risk of missing the relevant contexts and theories.

From partnering research to research partnering

Research into partnering began around 1990, and twenty years later, one may well argue that there is a phenomenon of 'research partnering', including practices such as those advocated by Azhar et al. (2010) and Green et al. (2010). Decades ago, at least some of the contributions by construction researchers were intended as part of a basis for government decisions related to the construction industry. However, political dirigiste initiatives have been made largely obsolete with the shift to New Public Management, and consequently, a university dialogue function for larger, leading firms in the industry has evolved, sometimes combined with a researcher expert and teacher role with regard to smaller firms in the construction sector.

Strong engagement with practitioners has its advantages and disadvantages. Perhaps only marginal changes to the existing order of things will emerge from grounded approaches, which may be felt comfortable in dealing with industry people, but then run the risk of conserving their professional roles and associated views (see Winch, 2000). This is only what is to be expected when many companies and roles are involved, as in typical construction projects. Action research with iterative experimentation has its limits; it is less attractive to firms when huge, irreversible investments are involved; it appears to work best with internal change in organizations and experiments with information systems and other support services. The challenge is much greater when non-marginal issues implying simultaneous change in several firms are on the research agenda. Partnering constitutes a change of this kind.

There is thus a need for researchers to equip themselves with approaches that allow them to deal directly with what explains the vagaries and boundary changes that are thought to result in "tensions, ambiguities and paradoxes with which practitioners in the industry constantly have to grapple" (Chan & Johnson, 2010: 185). This has to be taken seriously. Is the emergence of e.g. partnering just capricious and irrational, or could the boundary changes

have been interpreted by researchers and systematically related to a few background forces and mechanisms?

The analysis of societal themes behind partnering, here identified as international competition, business cycles as well as information technology and project complexity, could have proceeded with more reliance on economic theory, as with other modern applications of construction economics (De Valence, 2011) that may be helpful also for practitioners who wish to foresee boundary changes. The paradox that follows from this is that it may actually be in the medium and long term interest of leading firms that there is more of independent analytical research with less of a continuous industry dialogue. However, given the path taken in the field of construction management, such studies can be pursued alternatively within more broadly defined fields of economics and management research with an empirical engagement in other activities typical of modern highly developed economies, thus primarily with the business services industry.

CONCLUSIONS

From the ten articles analysed here, construction partnering research certainly appears as reflecting changes in society, but only indirectly, not because most researchers in the field have made an explicit connection based on mainstream theories from economics or political science. Background societal themes or forces that can be identified in these articles are international competitiveness, the business cycle and information technologies, but these themes are hardly reflected in the research questions or the research design of these articles, which take a broad view of the field or collect practitioners' opinions. Chinese and Japanese influences, not from the construction sector, and partly transmitted through American publications, have been overlooked or underestimated, as well as the development of New Public Management.

But this may not be typical of articles that have attracted fewer citations or are of more recent origin. All our ten highly cited articles have emanated from the Anglo-American legal sphere: from the US, the UK and Hong Kong with Australia, thus written by authors from policy-shaping regions. Industry, government and academic interest in partnering followed later in countries outside the common law tradition, including the Nordic region.

The influences on the policy encouragement and development of partnering practices can be seen to come from a small set of widely read books that had almost nothing to say about the construction sector. The connection with a potential for construction industry reform was not made by the specialized research community. Are there any publications of a similar nature out in the market now, or imminent? Will construction management researchers be quicker this time, then?

Ultimately, those who have investigated construction partnering emerge as reactive and therefore unlikely to resolve the tensions, ambiguities and paradoxes felt by leading practitioners in the construction sector. What should then be on the agenda for construction management researchers who wish to predict future changes in the industry and support practitioners who look for deeper insights into the forces and mechanisms that produce change? New understanding, leading to new industry practice, could well be based on approaches from disciplines with theories that support prediction, such as economics. And if it is argued that construction management research should forsake predicting the future, a case could be made for greater awareness of what political scientists do.

REFERENCES

Adamson, D. M. & Pollington, P. (2006). *Change in the Construction Industry: An account of the UK Construction Industry Reform Movement 1993-2003*. London: Taylor & Francis.

Azhar, S., Ahmad, I. & Sein, M. K. (2010). Action research as a proactive research method for construction engineering and management. *Journal of Construction Engineering and Management*, **136**(1), 87-98.

Barlow, J. (2000). Innovation and learning in complex offshore construction projects. *Research Policy*, **29**(7-8), 973-989.

Bennett, J., Flanagan, R. & Norman, G. (1987). *Capital & Countries Report: Japanese Construction Industry*. Reading: Centre for Strategic Studies in Construction, University of Reading.

Black, C., Akintoye, A. & Fitzgerald, E. (2000). An analysis of success factors and benefits of partnering in construction. *International Journal of Project Management*, **18**(6), 423-434.

Brandon, P. (2009). United Kingdom. In *Building a Discipline: The Story of Construction Management*, Langford, D. & Hughes, W. (eds), Reading: ARCOM, pp. 134-137.

Bresnen, M. & Marshall, N. (2000). Partnering in construction: a critical review of issues, problems and dilemmas. *Construction Management and Economics*, **18**(2), 229-237.

Burnes, B. & Coram, R. (1999). Barriers to partnerships in the public sector: the case of the UK construction industry. *Supply Chain Management*, **4**(1), 43-50.

Chan, A. & Clegg, S. (2007). Cultural Revolution's peculiar echoes in Organization Theory. University of Sydney, School of Management Working Paper No. 2007/8.

Chan, P. & Cooper, R. (2010). *Constructing Futures: Industry Leaders and Futures Thinking in Construction.* Chichester: Wiley-Blackwell.

Cheng, E. W. L., Li, H. & Love, P. E. D. (2000). Establishment of critical success factors for construction partnering. *Journal of Management in Engineering*, **16**(2), 84-92.

Dainty, A. R. J., Briscoe, J. H. & Millett, S. J. (2001). Subcontractor perspectives on supply chain alliances. *Construction Management and Economics*, **19**(8), 841-848.

De Valence, G. (2011). Theory and construction economics. In *Modern Construction Economics: Theory and Application*, De Valence, G. (ed.), London: Spon, pp. 1-13.

Du Gay, P. & Salaman, G. (1992). The cult[ure] of the customer. *Journal of Management Studies*, **29**(5), 615-633.

Fellows, R. (1989). Development of standard forms of building contract in Britain. In *Proc. CIB International Workshop Contractual Procedures, Liverpool, 6-7 April 1989*, Liverpool: CIB, University of Liverpool & Liverpool Polytechnic, pp. 13-21.

Fellows, R. (1997). The culture of partnering. In *Proc. CIB W92 Procurement: a key to innovation, Montreal, 20-23 May 1997,* CIB Publication 203, Montréal: Société de recherche IF, pp. 193-202.

Green, S. D. (1999). Partnering: the propaganda of corporatism. In *Profitable Partnering in the Construction Industry,* Ogunlana, S. O. (ed.), London: E & FN Spon, pp. 3-14.

Green, S. D., Kao, C.-C. & Larsen, G. D. (2010). Contextualist research: iterating between methods while following an empirically grounded approach. *Journal of Construction Engineering and Management,* **136**(1), 117-126.

Hall, M., Holt, R. & Purchase, D. (2003). Project sponsors under New Public Management: lessons from the frontline. *International Journal of Project Management,* **21**(7), 495-502.

Hasegawa, F. & Shimizu Group FS (1988). *Built by Japan: Competitive Strategies of the Japanese Construction Industry.* New York: Wiley.

Hawes, C. (2008). Representing corporate culture in China: official, academic and corporate perspectives. *The China Journal,* **59**, 33-66.

Higgin, G. & Jessop, W. N. (1965). *Communications in the building industry: The report of a pilot study.* London: Tavistock.

Hood, C. (1991). A public management for all seasons? *Public Administration,* **69**(1), 3-19.

Kappeler, A. & Nemoz, M. (2010). Public-Private Partnerships in Europe: Before and during the recent financial crisis. Economic and Financial Report 2010/04, European Investment Bank.

Koskela, L. (1992). Application of the New Production Philosophy to Construction. CIFE Technical Report #72. Stanford University. September.

Kranton, R. E. & Minehart, D. F. (2000). Networks versus vertical integration. *The RAND Journal of Economics,* **31**(3), 570-601.

Larson, E. W. (1995). Project partnering: results of study of 280 construction projects. *Journal of Management in Engineering,* **11**(2), 30-35.

Liu, A. M. M. & Fellows, R. (2001). An Eastern perspective on partnering. *Engineering, Construction and Architectural Management,* **8**(1), 9-19.

Naoum, S. (2003). An overview into the concept of partnering. *International Journal of Project Management,* **21**(1), 71-76.

Raftery, J., McGeorge, D. & Walters, M. (1997). Breaking up methodological monopolies: a multi-paradigm approach to construction management research. *Construction Management and Economics,* **15**(3), 291-297.

Rimmer, P. J. (1990). The internationalisation of the Japanese construction industry: the rise and rise of Kumagai Gumi. *Environment and Planning A,* **22**(3), 345-368.

Sarkar, M. B., Echambadi, R., Tamer Cavusgil, S. & Aulakh, P. S. (2001). The influence of complementarity, compatibility, and relationship capital on alliance performance. *Journal of the Academy of Marketing Science,* **29**(4), 358-373.

Seymour, D., Crook, D. & Rooke, J. (1997). The role of theory in construction management: a call for debate. *Construction Management and Economics*, **15**(1), 117-119.

Thompson, P. J. & Sanders, S. R. (1998). Partnering continuum. *Journal of Management in Engineering*, **14**(5), 73-78.

Vinen, R. (2009). *Thatcher's Britain: The Politics and Social Upheaval of the Thatcher Era*. London: Simon & Schuster.

Weston, D. C. & Gibson, G. E. (1993). Partnering-project performance in U.S. Army Corps of Engineers. *Journal of Management in Engineering*, **9**(4), 410-425.

Winch, G. (1998). Zephyrs of creative destruction: understanding the management of innovation in construction. *Building Research & Information*, **26**(5), 268-279.

Winch, G. M. (2000). Institutional reform in British construction: partnering and private finance. *Building Research & Information*, **28**(1), 141-155.

LEVERAGING R&D INVESTMENT FOR THE AUSTRALIAN BUILT ENVIRONMENT

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This paper discusses a current research project building new understandings and knowledge relevant to R&D funding strategies in Australia. Building on a retrospective analysis of R&D trends and industry outcomes, an industry roadmap will be developed to inform R&D policies more attuned to future industry needs to improve research investment effectiveness. The project will also include analysis of research team formation and management (involving end users from public and private sectors together with research and knowledge institutions), and dissemination of outcomes and uptake in the Australian building and construction industry. The project will build on previous research extending open innovation system theory and network analysis and procurement, focused on R&D. Through the application of dynamic capabilities and strategic foresighting theory, an industry roadmap for future research investment will be developed, providing a stronger foundation for more targeted policy recommendations. This research will contribute to more effective construction processes in the future through more targeted research funding and more effective research partnerships between industry and researchers.

KEYWORDS: R&D policy; R&D diffusion; innovation systems; strategic foresighting; industry roadmapping

BACKGROUND

This paper describes research currently underway evaluating impacts, diffusion mechanisms and uptake of R&D in the Australian building and construction industry. Starting with a retrospective analysis of R&D trends and industry outcomes, a future-focussed industry roadmap will be developed to inform R&D policies more attuned to future industry needs, to improve research investment effectiveness. This collaborative project brings together academic (Australia and Finland); Australian government agencies at state and national levels; and private sector players to address this critical issue. The project aligns with the recently released Organisation for Economic Co-operation and Development *Innovation Strategy* (2010) which highlights the need for a whole-of-government approach to innovation policy, and 'stable platform(s) for coordinating actions, policies with a medium- and long-term perspective' (OECD 2010:23). This project uniquely addresses this focus in the context of the Australian building and construction industry.

To this end, this research will develop new theory for interactive innovation, built on open innovation, dynamic capabilities and absorptive capacity theories, in the context of strategic

foresighting and industry roadmapping. This is based on the hypothesis that each of these theories can be brought together to address the specific characteristics and tensions which impact R&D in this industry. Conditions specific to this and like industries, requiring this unique investigation include its disaggregated nature, intense competition and limited R&D investment.

The building and construction industry in Australia accounts for between 14%-20% of GDP (Furneaux et al. 2010). In 2008, the cumulative value of site-based residential, non-residential and engineering construction was A$160 billion (Newton et al. 2009). The industry employs around 950,000 people through 250,000 firms, the vast majority of which are small to medium-sized enterprises. The Australian Bureau of Statistics estimates that from an initial A$1 million of extra output in construction, A$2.9 million in additional output could be generated in the economy as a whole. This would create nine jobs in the construction industry and 37 jobs in the rest of the economy (ACIF 2002).

However, the productivity of this industry continues to lag behind that of the rest of the economy (Property Council of Australia 2009). To address this, the Australian Procurement and Construction Council (APCC) and the Australian Construction Industry Forum (ACIF) identified a set of national KPIs to track industry productivity performance. These indicators were further developed by the Australian Cooperative Research Centre for Construction Innovation (CRC CI) (Furneaux et al. 2010). These KPIs relate to safety; productivity and competitiveness; economic security; workplace capability; and environmental sustainability/eco-efficiency. Examples of poor performance in these areas which illustrate the extent of the problem include:

1) Deaths in construction increased from 3.14 deaths per 100,000 workers in 2004 to 4.27 in 2008 (CFMEU 2010). This compares to an overall fatality rate of 2.7 deaths per 100,000 workers across all industries.

2) ‘Productivity growth in the building and construction industry was less than the average for the market sector over the past five years. Were productivity growth to match that of the market sector, economic modelling shows that the accumulated gain in real gross domestic product between 2003 and 2010 would approximate $12 billion’ (Royal Commission 2002:3).

3) Kajewski et al. (2001) identify a key driver for ICT uptake as improved productivity, however the level of uptake remains less than optimal (Gallaher et al. 2004).

4) Engineers Australia (2005) report that poor documentation is ‘contributing an additional 10 to 15% or more to project costs in Australia’ (EA 2005:3) with ‘substandard project documentation’ equating to an estimated financial loss of $12 billion nationwide annually (EA 2005:4).

These examples highlight the need for those participating in the innovation agenda in this industry to establish a more focused industry R&D roadmap for addressing these complex challenges.

SIGNIFICANCE OF THIS RESEARCH

The Australian Department of Innovation, Industry, Science and Research (DIISR 2010) identifies an overall decline in spend on science and innovation as a percentage of GDP in Australia since 1993-94 of 22% (DIISR 2010:2). Australia's spend on R&D as a percentage of GDP is 2%, compared to that of Denmark, Germany and the United States of 2.5%; and Finland, Sweden and Japan of more than 3% (DIISR 2010:3). To address this, the Australian Government has identified a number of key initiatives including a target of a 25% for increased business engagement in innovation in the next 10 years; doubling the tax incentive for small-business (a critical component of the building and construction industry in Australia); supporting targeted responses to climate change; improving innovation skills and capabilities in the workplace; and maintaining a focus on business innovation through government sponsored industry innovation council's such as the Built Environment Industry Innovation Council (BEIIC) (DIISR 2010:6). Informing this project is the Australian Government commitment to an increased 'use of metrics, analysis and evaluation to inform policy development and decision-making (DIISR 2010:9).

More specifically, Hampson and Manley (2001) report on the relatively poor innovation record of the building and construction sector in Australia with an R&D expenditure of 1.4% compared to the share of site-based construction activity in total output of 6.5-7% of GDP. Recent findings by the Department of Innovation, Industry, Science and Research reveal that trend performance of this sector in terms of Gross Value Added outcomes (i.e. a measure of the value of goods and services produced in a sector) remains well below that of the manufacturing sector, despite a considerable drop in that sector's performance in the past three decades (DIISR 2009:24).

DIISR (2010) also highlights seven *National Innovation Priorities* being: (i) public research funding supports high-quality research that addresses national challenges and opens up new opportunities; (ii) Australia has a strong base of skilled researchers to support the national research effort in both the public and private sectors; (iii) the innovation system fosters industries of the future, securing value from the commercialisation of Australian research and development; (iv) more effective dissemination of new technologies, processes and ideas increases innovation across the economy, with a particular focus on small and medium-sized enterprises; (v) the innovation system encourages a culture of collaboration within the research sector and between researchers and industry; (vi) Australian researchers and businesses are involved in more international collaborations on research and development; and (vii) the public and community sectors work with others in the innovation system to improve policy development and service delivery (DIISR 2010:4). This current research addresses each of these priorities.

NEED FOR THIS RESEARCH

Current methods to understand and improve the process of R&D investment in the Australian building and construction industry are not currently well linked to important environmental, social and economic drivers such as technological and market developments. There is a lack of compelling case studies, and only limited innovation frameworks of relevance to this industry. As such there is an urgent need to study the dynamics, constraints and future vision for the industry using a structured methodology to gain this understanding. This is an essential precursor to new strategic policy responses that explicitly respond to the key

emerging industry drivers and place the industry in the optimum position to leverage R&D to improve its performance.

Recent research has identified macro approaches to industry policy on the one hand, and detailed evaluation of product and process innovations on the other. Many researchers have also stressed the importance of the role of key individuals. These approaches neglect the role of dynamic network interactions between multiple players and the temporary organisational structure in an industry where innovations at the individual project level determine the success or robustness of R&D uptake for the industry more broadly.

The need for this research is further reinforced by the strong recent focus on innovation beyond the now traditional realms of R&D and 'business innovation', to that of broader influences and factors associated with learning and interaction (Kraemer-Mbula and Wamae 2010 and OECD 2010).

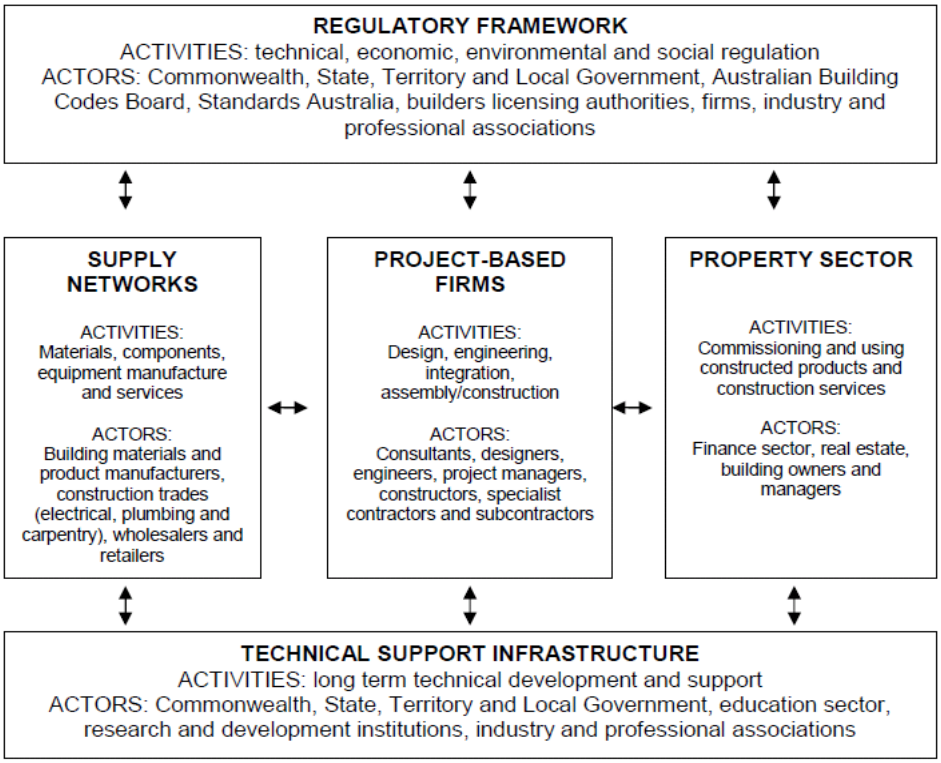
RESEARCH AIM AND INTENT

Aim of this research

The key aim of this project is to build new understanding and knowledge of R&D dissemination and uptake in the Australian building and construction industry, and thereby develop robust, sustainable pathways to increase the safety, productivity and competitiveness, economic security, workplace capability and environmental sustainability of the industry. The context for this aim is the national industry KPIs by the APCC and ACIF to track industry productivity performance (Furneaux et al. 2010). The development of strategies to maximise R&D's impact for improving industry performance becomes even more critical as the industry strives to respond to increasing public expectations in environmental protection and enhancement, increasing demand for packaged construction services and moves towards private-sector funding of public infrastructure.

Effectively leveraging R&D is a major challenge for the building and construction industry due to its disaggregated nature (Figure 1), intense competition and limited investment in R&D and new technologies including IT advancements.

Figure 1 - Building and construction industry cluster map (Department of Industry Science and Resources 1999:10)



Performance is further constrained by ‘a focus on short-term business cycles and a project-to-project culture’ (Newton et al. 2009). This project culture is also exacerbated by construction industry characteristics quite different to industrial manufacturing (Hampson 1993) such as location-dispersed sites, project cost, complexity, high risk of failure, limited repetitions in documentation and immobility of the final product, which make the construction industry unique (Nam 1990). Construction contracting in Australia is also regarded as a competitive and high-risk business (Uher 1994). This competitiveness is largely due to the fragmented nature of the sector with layers of often temporary contractor/sub-contractor relationships, with cost traditionally being the prime factor in the tender selection process (Hampson and Kwok 1997).

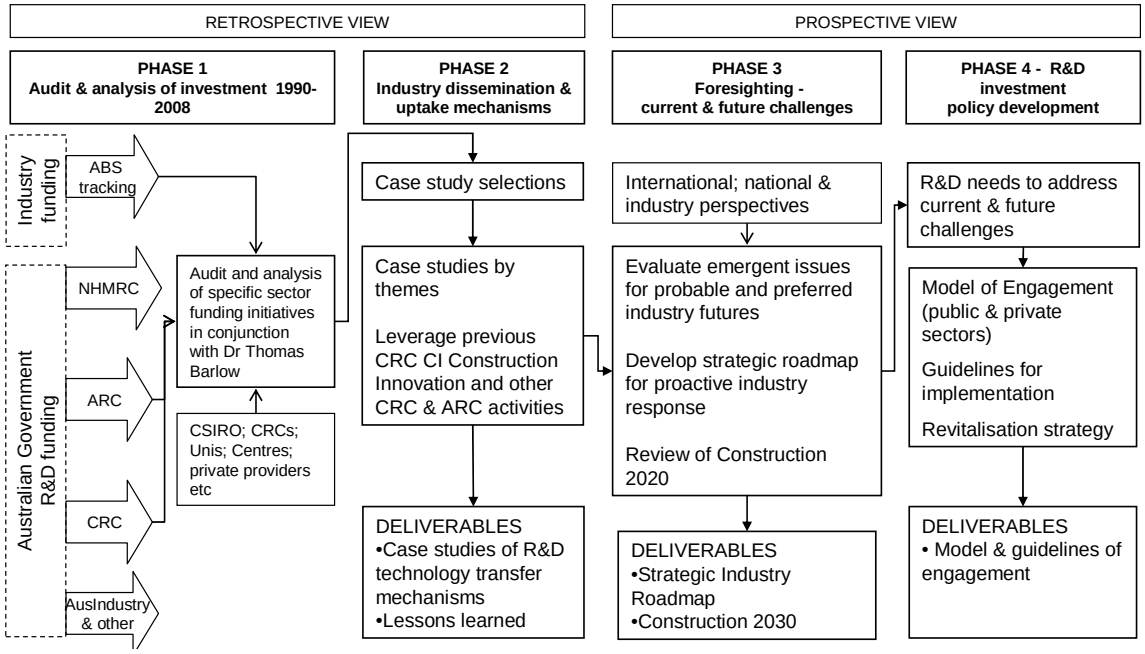
Research Intent

The intent is to develop new models of interaction and investment that maximise the value of R&D investment in this and like industries. These models will be based on improved understandings of the nature of future industry research needs, and lessons learned in diffusing research outcomes into public and private industry practice.

It will provide benefit to both public and private organisations in enhancing their uptake of R&D outcomes. This will be achieved through the active involvement of public sector infrastructure and building agencies, public sector social and economic infrastructure agencies along with industry leaders in innovation. The Chair of the Built Environment Industry Innovation Council (BEIIC) has stated that “this project will address many of our Council’s documented concerns and I look forward to working with your team to assure the effective shaping of our industry inputs, and dissemination of project outcomes” (2010).

To achieve these aims and intent, four project phases have been designed (Figure 2).

Figure 2 - Project Overview



Research Method

This research provides a unique opportunity for a comprehensive study of R&D investment in the building and construction industry in Australia. Innovation and innovative behaviour are seen as key opportunities to raise industry performance and meet new challenges as the industry evolves. To achieve its stated aims, this research will develop a methodology to analyse and understand the multiple facets of the industry through the investigation of three research questions:

1) What are the success criteria and critical challenges which impact the industry's ability to maximise benefit from R&D investment?

2) What input into, and outcomes from, strategic foresighting and roadmapping are required in order to develop an effective R&D investment strategy?

3) What policy directions and initiatives are required to promote the pathways identified in the strategic roadmap?

The methodology underpinning this research brings together the combined strengths of the research team, and the practical working knowledge of industry collaborators. Researchers will integrate existing construction and management theory from a number of areas, specifically open innovation, dynamic capability and absorptive capacity theories in the context of a strategic foresighting and industry roadmapping process.

Open innovation system theory will be utilised to develop a deeper knowledge of R&D investment, diffusion and uptake. In this context R&D is treated as an open system in which innovative and 'valuable' ideas (contributing to organisational competitiveness) can be obtained from both within and outside traditional organisational boundaries (Chesbrough et al. 2006). Barlow (2006) discusses the approach as the 'increasing tendency of big companies to down-source radical innovation and creativity to small firms and the corresponding

tendency of small firms to contract 'upwards' the development, scale-up, marketing and distribution of their radical new ideas' (2006:231). With the majority of organisations in the construction sector being small business (De Valence 2010:55), a key issue for this research is how open innovation systems can contribute to R&D diffusion and uptake.

Dynamic capability and absorptive capacity theories may provide additional insight into this approach. The former will be used to address the ability of organisations 'to shape, reshape, configure, and reconfigure enterprise assets so as to respond to changing technologies and markets' (Augier and Teece 2006:405). This ability enables organisations to identify and use those capabilities required to maintain advantage in a changing and competitive environment (Teece et al. 1997, Eisenhardt and Martin 2000, and Teece 2007). While absorptive capacity may be considered as one of these capabilities, explicitly considering this theoretical approach raises considerations of an organisation's 'ability to recognise the value of new, external information, assimilate it, and apply it to commercial ends' (Cohen and Levinthal (1990:128).

Further to this basis for investigation and analysis, strategic foresighting theory will be used to develop a unique, robust and valuable model of engagement for future industry R&D investment. In this context, foresighting is the intent-driven application of systematic and participatory future intelligence gathering and vision-building to inform decision-making and action-taking (Voros 2003, 2006 and 2009). Through this process, future state goals will be defined with associated short, medium, and long-term strategies proposed for an industry R&D roadmap (Roos and Pike 2008).

Adopting this combination of theory will both facilitate and challenge current research thinking in this field. AEGIS (1999) and de Valence (2010) highlight the diverse and complex nature of the building and construction industry in Australia. This potentially requires different strategic approaches to R&D and its dissemination across this industry, whilst the competitive nature of the industry may also inhibit the sharing of 'valuable' ideas. Through bringing together these theories in this specific context, this research seeks to highlight and address the tensions which exist in both the theory and in industry in order to better foster the uptake of R&D outcomes in this industry.

The four project phases designed to build new knowledge, and develop an industry R&D roadmap and policies for dissemination are:

Phase 1 –Audit and Analysis of Investment - 1990-2008

This phase involves an audit and analysis of R&D investment in the Australian building and construction industry. This includes the identification of trends in this investment, (in universities and government agencies) and its distribution by funding source. Outcomes of this phase will include: (i) recommendations as to how R&D investment in this industry might be strengthened; and (ii) benchmarking between this and other comparable sectors. This will draw upon data gathered from the Australian Bureau of Statistics and the Australian Research Council, using information from public and private organisations.

Phase 2 – Industry Dissemination and Uptake Mechanisms

Phase 2 will provide a deeper insight into R&D dissemination and uptake through exemplar case studies. This will develop the existing knowledge base developed by researchers at the CRC for Construction Innovation and the Queensland University of Technology, relating to the impact, diffusion and uptake mechanisms of research and innovation in public and private built environment organisations. These case studies will be used to determine the critical

characteristics of the processes of realising research support, direction-setting, project engagement, identifying and communicating research outcomes, and importantly, paths to adoption and impact.

Case study selection will take into account organisational engagement at various stages of the supply chain. In-depth understandings of the translation of R&D investment into tangible outcomes will be sought from these including: (i) explicit and implicit problems being addressed by the research; (ii) criteria for success and critical challenges; (iii) benefit/cost ratio and return on investment; and (iv) what would be the benefit if extended across whole industry?

These investigations will be based upon the successful *Building Research Innovation Technology and Environment* (BRITE) case studies previously undertaken through the CRC for Construction Innovation (Manley 2006), these studies will provide the hindsight to 'trace the interactions among … breakthroughs that led to present achievement' and to learn 'how basic research and synergies … took place and contributed to the system under study' (Gordon 2000:1). Through selecting and focussing on a discrete number of thematic case studies, researchers will undertake some initial 'backcasting' to examine decisions made up to 30 years ago in specific leading R&D programs (Courtney 2010). Case studies where the evolution from idea to policy to practice can be traced and analysed will be targeted. A further key outcome of this phase is a valuable industry knowledge base that captures a snapshot of the industry R&D strategies and practices at the present time.

Phase 3 – Foresighting – Current and Future Challenges

This phase will extend a solid base of technology and industry foresighting carried out by VTT Technology Foresight and Technology Assessment research unit (Finland) and Swinburne University of Technology (Australia). Foresighting in this context is the intent-driven application of systematic, participatory, future intelligence gathering and vision-building processes to inform present-day decisions and mobilise joint actions. To achieve this, foresighting and content experts are brought together to develop strategic visions and anticipatory intelligence. From these goal states, short, medium, and long-term strategies are defined in the context of a *roadmap* (with supporting strategic implementation actions). This is targeted towards different aspects of a business, with technology and R&D investment and activities being the focus of this project. Key assumptions in this process include: (i) visions serve as the basis for continuous evolution and innovation; (ii) clear roadmaps define the path from today (as-is) to the desired vision (to-be); and (iii) strategic implementation actions provide the means to follow the roadmaps to achieve the vision (Kynkäänniemi 2007 and Kazi et al. 2007).

The application of technology roadmapping to underpin industry policy formulation has long traditions in Europe (e.g. Finland), but has had limited use in Australia especially in the building and construction industry. No research relating to the application of technology roadmapping to inform decisions on business model choice has (to our knowledge) been undertaken. This research will thus provide a substantial contribution to cumulative knowledge in the field.

This work will better inform public policy development and shape public and private organisations' technology strategy. Along with the R&D roadmap, a key outcome of this phase will be the review and revitalisation of Construction 2020 (Hampson and Brandon 2004), to provide a focus for R&D investment in Australia through to 2030.

Phase 4 – R&D Investment Policy Development

The intent of this phase is to maximise the value of R&D investments to public and private organisations. The first step will be to identify: (i) priority opportunity areas and applications for R&D investment; and (ii) actions for implementation. The key tangible outcome of this will be a *Model for Engagement and Guidelines.* These will provide a clear set of strategies to allow public and private organisations to more profitably engage with research institutions to secure valuable short, medium and long term benefits. Through involving key players in the development of this output (i.e. the Built Environment Industry Innovation Council, relevant State Government Departments and key industry and research players) the developed policy outcomes will become central to R&D investment in Australia in the following decade. This final phase will be informed by dynamic capability and open innovation theory to facilitate uptake.

DISCUSSION

There are several anticipated outcomes of this research.

Firstly, this project will advance the knowledge base within innovation, construction and management research, as well as foresighting and roadmapping disciplinary knowledge. Specific theories, methodologies and tools in each of these disciplines will be extended and adapted to better address the specifics of the Australian building and construction industry.

Secondly, a new integrated innovation methodology has the potential to lead to better understanding and dissemination of R&D outcomes in the disaggregated, highly competitive, project-driven building and construction industry. Through a comprehensive exploration and integration of these relevant theories, contextualised through historical data and case study analysis, this study can make a leading edge contribution to the international knowledge base.

Thirdly, this research will build an extensive knowledge base of underlying drivers and key success factors for innovation in the Australian building and construction industry. This knowledge base will derive from the Phase 1 audit and analysis, Phase 2 case studies; and the extensive workshops proposed for Phase 3. Through data and knowledge from each phase informing the next, the process of refinement will result in targeted and relevant outcomes.

And finally, research outcomes will contribute to policy development for this industry, in Australia, for the coming decade. Through bringing together key industry players to develop an industry R&D roadmap, and pursuant policy guidelines, this research will provide a valuable resource for national and state public agencies, and private organisations to better capture the benefits of using R&D as a driver for competitive advantage.

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REFERENCES

Augier, M. & Teece D.J., (2006). Understanding complex organization: the role of know-how, internal structure, and human behaviour in the evolution of capabilities. *Industrial and Corporate Change*, **15**(2), 395-416.

Australian Construction Industry Forum (ACIF) (2002) in Newton, P., Hampson, K.D. & Drogemuller, R. (Eds) (2009). *Technology, Design and Process Innovation in the Built Environment.* Abingdon: Taylor and Francis.

Australian Expert Group in Industry Studies (AEGIS) (1999). *Mapping the building and construction product system in Australia*. Sydney: University of Western Sydney.

Barlow, T. (2006). *The Australian miracle*. Sydney: Pan Macmillan Australia.

Chesbrough, H., Vanhawerbeke, W. & West, J. (Eds) (2006). *Open innovation: researching a new paradigm*. Oxford University Press.

Cohen, W. M. & Levinthal D.A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly,* **35**(1), 128-152.

Construction, Forestry, Mining and Energy Union (CFMEU) (2010). National Secretary Dave Noonan at: *http://www* //*WAToday.com.au*.

Cooperative Research Centre for Construction Innovation (CRC CI) (2007). *Off-site manufacture in Australia: current state and future directions*. Brisbane: CRC for Construction Innovation.

Courtney, R. (2010). The process of examining the future. *Building Research and Information* , **38**(3), 351-354.

Department of Employment and Workplace Relations (DEWR) (2005). *Workplace tomorrow*. Canberra: Commonwealth of Australia.

Department of Industry, Science and Resources (DISR) (1999). *Building for growth: an analysis of the Australian building and construction industries.* Canberra: Commonwealth of Australia.

Department of Innovation, Industry, Science and Research (DIISR) (2009). *Innovation metrics framework project*. Canberra: Commonwealth of Australia.

Department of Innovation, Industry, Science and Research (DIISR) (2010). *Powering ideas: an innovation agenda for the 21st century*. Canberra: Commonwealth of Australia.

De Valence, G. (2010). Defining an industry: what is the size and scope of the Australian building and construction industry. *Australasian Journal of Construction Economics and Building*, **10**(1/2), 53-65.

Eisenhardt, K. M. & Martin, J.A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal*, **21**(10/11), 1105-1121.

Engineers Australia (2005). *Getting it right the first time*. Brisbane: Engineers Australia.

Furneaux, C., Hampson, K., Scuderi, K., & Kajewski, S. (2010). Australian construction industry KPIs. *CIB World Congress, May 10-13, 2010*. United Kingdom.

Gallaher, M.P., O'Connor, A.C., Dettbarn, J.L., & Gilday, L.T. (2004). *Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry.* Gaithersburg, MD: National Institute of Standards and Technology.

Gordon, T.J. (2000) *Science & technology roadmapping* in Glenn J.C. & Gordon T.J. (Eds). *Futures research methodology*. Washington, DC: American Council for the United Nations University.

Hampson, K.D. (1993). *Technology strategy and competitive performance: a study of bridge construction (PhD Dissertation).* Stanford University: Department of Civil Engineering and the Committee on Graduate Studies.

Hampson, K.D. & Kwok, T. (1997). Strategic alliances in building construction: a tender evaluation tool for the public sector. *Journal of Construction Procurement*, **2**(1), 28-41.

Hampson, K.D., & Manley K.M. (2001). *Construction innovation and public policy in Australia*, in Manseau, A. & Seaden, G. (Eds), *Innovation in construction: an international review of public policies*. London: Spon Press.

Hampson, K.D. & Brandon, P. (2004). *Construction 2020*: *A vision for Australia's property and construction industry*. Brisbane: CRC for Construction Innovation.

Kajewski, S.L., Crawford, J.R., Weippert, A., Tilley, P.A., McFallan, S.L., Remmers, T. R., Caldwell, G. & Haug, M. (2001). *A national perspective on the status of ICT in the Australian construction industry.* Brisbane: CRC for Construction Innovation.

Kazi, A. S., Hannus, M., Zarli, A. & Martens, B. (2007). *Strategic roadmaps and implementation actions for ICT in construction*. Finland: Strat-CON.

Kraemer-Mbula, E. & Wamae, W. (Eds) (2010). *Innovation and the development agenda.* Canada: Office of Economic and Community Development and International Development Research Centre.

Kynkäänniemi T. (2007). *Product roadmapping in collaboration.* Finland: VTT Publications.

Manley, K. (2006). *Innovate now!* Brisbane: CRC for Construction Innovation.

Nam C. (1990). *The process of product innovation in the building and heavy sectors of the US construction industry (PhD dissertation).* Stanford University: Department of Civil Engineering.

Newton, P., Hampson, K.D., & Drogemuller, R. (2009). *Technology, design and process innovation in the built environment.* Abingdon, UK: Taylor and Francis.

Organisation for Economic Co-operation and Development (OECD) (2010). *The OECD Innovation Strategy: Getting a head start on tomorrow*. OECD.

Property Council of Australia (2009). *Construction sector productivity: KPI framework.* Sydney: PCA.

Roos, G. & Pike, S. (2008). *An intellectual capital view of business model innovation* in Bounfour, A. (Ed.). *Organisational capital; modelling, measuring and contextualising.* Routledge.

Safe Work Australia, (2010) *Construction information sheet*. Canberra: Commonwealth of Australia.

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, **28**, 1319-1350.

Teece, D. J., Pisano, G., & Shuen A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, **18**(7), 509-533.

Uher (1994) in Newton, P., Hampson, K.D. & Drogemuller, R. (Eds) (2009). *Technology, design and process innovation in the built environment.* Abingdon, UK: Taylor and Francis.

Voros, J. (2003). The basic process (GFP): a generic foresight process framework. *Foresight*, **5**(3), 10-21.

Voros, J., (2006). Introducing a classification framework for prospective methods. *Foresight*, **8**(2), 43-56.

Voros, J. (2009). Morphological prospection: Profiling the shapes of things to come. *Foresight*, **11**(6), 4-20.

COUPLING PROJECT AND BUSINESS PROCESSES: EXEMPLIFIED BY DEFECTS AND ARBITRATION

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Drawing on a study on the emergence of defects and arbitration, this paper will analyse how project processes are coupled with business processes in construction. Linking the project processes and the business processes are crucial for performance and innovation in construction. What is less clear is the character of these linkages. This study is based on a social-constructivist approach using documentary material and qualitative research interviews with strategically selected representatives of the construction process as well as the arbitration process. This paper suggests that points of accountability on performance provide excellent points of departure for analysing the links between project processes and business processes. A number of theoretical perspectives on couplings in construction as knowledge flows, as functions and regulation, as governance, as a loosely coupled system, and as ties have been identified. In conclusion this paper has proposed an alternative perspective on couplings as constitutive, which explores and challenges the very ontologies at play when it comes to analytical units, relations and effects. Consequently, the paper has sketched out alternative policy implications when it comes to improving performance and innovation in construction, most notably by mobilising leverage to change the perception of what counts as satisfactory.

KEYWORDS: innovation, complex products and systems, organisation, quality, performance

INTRODUCTION

Defects in construction constitute a significant problem, which may account for as much as up to 10 % of the total turnover in the industry (Nielsen & Hansen 2004). A reduction of the resources spent on defects may therefore prove to be highly beneficial to the construction industry as long as the costs for reducing defects are lower than the benefits.

As pointed out by numerous authors (see e.g. Gann & Salter 2000) the coupling between business processes and project processes are crucial for performance and innovation in construction. Still, most contemporary project management theories are dominated by a perspective on singular projects, thus ignoring the history and context of the project according to Engwall (2003). Based on comparative study of the renovation of a hydropower plant and the establishment of a power transmission link, Engwall (2003) illustrates how projects are dependent on its history and embedded in an organisational context.

Drawing on a study on the emergence of defects and arbitration in construction, this paper will analyse how project processes are linked with business processes in construction. The

emergence of defects and arbitration offers a valuable site to gain insights into the fundamentals of construction since defects and arbitration represent a potential disruption of the taken-for-granted assumptions of the firm, yet defects and arbitration is a routine in construction since it happens on such a regular basis. Thus defects and arbitration open up the on-going process of linking the project and the firm for closer inspection.

The structure of this paper is as follows. First, the paper describes a backdrop of theoretical perspectives on couplings. Second, the paper introduces the research methodology of the study. Third, the paper presents the analysis of the social construction of defects. Fourth, the conclusion will summarise the findings of the study.

SOME THEORETICAL PERSPECTIVES ON COUPLINGS

In the following we will briefly introduce and discuss five different perspectives on couplings in construction: Couplings as linking through knowledge flows, couplings as functional and regulatory, couplings as governance, couplings as a loosely coupled system, and couplings as ties.

Coupling as linking through knowledge flows

As noted by e.g. Gann & Salter (2000), a major challenge for project-based firms is to link the project-based processes with the business processes of the firm. The project-based nature of construction implies that the interdependencies are primarily linked to the rather fluently, changing and ad-hoc patterns of cooperation with a rather great number of external firms. These links are important due to the relative high degree of autonomy of the individual project, while the individual projects to a large extent determine the overall performance of a firm. What is less clear is the character of these linkages or couplings.

Following the work on CoPS or Complex Products and Systems (see e.g. Hobday 1998 & 2000), Gann & Salter (2000) provides an analytical framework for understanding the construction industry as embedded in a context of both policy-making (regulatory and institutional framework) and knowledge production (technical support infrastructure). The model recognises not only actors but also activities taking place. Further, the model acknowledges not only the construction industry in a traditional sense – namely contractors and consultants – but it also includes the clients of construction as well as the manufacturing industry delivering products for construction. Within this resource-based approach, the couplings between different actors and activities are framed as knowledge flows.

Couplings as functions and regulation

The CIB Working Commissions W055 on "Building Economics" and W065 on "Organisation and Management of Construction" define the construction economic sector system as follows (Carassus ed. 2004: 10, original emphasis):

> "The construction economic sector system can be defined as *the organised complex of commercial and non-commercial relationships, between productive and institutional actors, taking part in the production and the management of services provided by the structures used, throughout their life cycle, as the living and working environment of a population.*"

According to Carassus (ed. 2004), the testing of the approach in nine countries has clearly illustrated its strength by highlighting differences related to institutional contexts, clients' procurement and actors. Further, the approach has identified significant similarities about the rising of services, the decreasing of construction industry weight, the heaviness of the

construction sector system, the significance of the stock and of its maintenance, and the coexistence of big companies with a very fragmented system. The economic meso-analysis approach provides us with a functional and regulatory perspective on the couplings of the construction economic sector system (Carassus ed. 2004).

Couplings as governance

An alternative perspective on the couplings as governance is delivered by Winch (2000 & 2002) in his overall conceptual framework for construction business systems. Based on Winch & Campagnac (1995), Winch (2000: 90-91) argued that although the organization of construction projects varies considerably from one project to another within a single country, nationally distinctive patterns in the organization of those projects can be identified and summarized in terms of conception, construction and control. Failing to distinguish clearly between the institutional level and the governance level of national business systems, he later revised the conceptual framework (Winch 2002: 390-391, original emphasis):

> *"At the* system level *are all the elements of the regulatory context of construction project management discussed in the earlier Editorial. This regulatory context structures the range of actions that participants on projects can take — while certain actions are standard practice, others are excluded from the business recipe. In turn, practice on projects at the* actor level *shapes the institutions of the regulatory context, pushing them to allow the actors on the project to innovate and deliver value for clients more effectively. The regulatory context thereby provides both constraints and opportunities. This is shown in Figure 1, which lays a system or institutional level over the actor level of the 3Cs from Figure 1 of Winch (2000).*
>
> *The relationships between the actors in the system can be seen as one of competitive collaboration. They must all collaborate together in coalitions on particular projects mobilized by clients in order to achieve their aim as firms of staying in business; at the same time they compete with each other for influence at the system as a whole. These types of dynamics are found in a number of industrial sectors that rely on highly skilled professionals."*

In this revised version of the construction business system, Winch (2002) has included both a system level focusing on policy-making and an actor level focusing on the construction project. However, the analytical framework does not include knowledge institutions except indirectly through their contributions to construction regulation etc. In addition in this revised version of the construction business system, the firm has been left out as an analytical category. Further, the interaction between the actor level and the system level is only characterised in the very broadest terms as "structuring of action" and "shaping of institutions".

Couplings as a loosely coupled system

In a review of studies on loosely coupled systems, Orton & Weick (1990) argue that most studies have a tendency to drift away from a dialectical interpretation of loose couplings and move toward unidimensional interpretation of loose coupling. Instead, Orton & Weick (1990: 205, original emphasis) argue that:

> *"The image that* should *emerge from this discussion is the following. If there is neither responsiveness nor distinctiveness, the system is not really a system, and it can be defined as a* noncoupled system. *If there is responsiveness without distinctiveness, the system is tightly coupled. If there is distinctiveness without responsiveness, the system is decoupled. If there is both distinctiveness and responsiveness, the system is loosely coupled. This general image is described here as the dialectical interpretation of loose coupling."*

Orton & Weick (1990: 217) goes on identifying five perspectives called voices of causation, typology, effects, compensations, and outcomes, which are then forged into a simple, sequential model in an attempt to reconceptualise the concept of loosely coupled systems.

Inspired by the work of Weick (see e.g. Orton & Weick 1990), Dubois & Gadde (2002) provides an example of the use of the concept of loosely coupled systems within construction. Dubois & Gadde (2002: 627) identifies a pattern of couplings build on two interdependent layers of individual projects and a permanent network of firms:

> *"The pattern of tight and loose couplings can be interpreted as a means of coping with the prevailing complexity in construction operations. The tight couplings in individual projects combined with the loose couplings in the permanent network embedded in the community of practice make it possible to come to grips with uncertainty and interdependence. In particular, it appears that the loose couplings in the permanent network provide the slack necessary to handle the tight couplings in projects."*

With this typology or metrics of tight/loose couplings in mind, Dubois & Gadde (2002: 61) concludes that the pattern of couplings among activities, resources and actors in construction seems to favour short term productivity while hampering innovation and learning.

Couplings as ties

A different, yet to some extent similar perspective on couplings is offered by social network analysis. In his seminal article "The Strength of Weak Ties", Granovetter (1973: 1376) argues for an analysis not only of strong ties, but also of weak ties, since weak ties are more likely to link members of different small groups rather than strong ties, which tend to be concentrated within particular groups. Granovetter (1973: 1978) goes on concluding:

> *"Linkage of micro and macro levels is thus no luxury but of central importance to the development of sociological theory. Such linkage generates paradoxes: weak ties, often denounced as generative of alienation (Wirth 1938) are here seen as indispensable to individuals' opportunities and to their integration into communities; strong ties, breeding local cohesion, lead to overall fragmentation. Paradoxes are a welcome antidote to theories which explains everything all too neatly."*

Social network analysis has been around for more than 40 years and have offered a number of insights on the strength, closeness etc. of ties. The perspective has also been applied within construction for analysis of project management (see among others Chinowsky et al. 2008 and Pryke 2004). What are common for these studies are the attempts to quantify the couplings between different actors – if not explicitly, then it would be rather easy to quantify the relations.

RESEARCH METHODOLOGY

What seems to be common to most of these perspectives on couplings is the underlying assumption of the pre-existence of these couplings and the main focus tends to be on the effects of these couplings on e.g. productivity and innovation. Although their characteristics may be different (weak/strong, tight/loose, knowledge flows etc.) and their ontological and epistemological grounding also varies, these perspectives seem less occupied with understanding the making of these couplings as routines. We would like to introduce an alternative perspective of couplings as stabilisation of sociotechnial change or routinisation – or in other words routines in the making. Thus, below we will spell out a somewhat alternative perspective that will focus more on couplings in the making.

Theoretical framework

This study applies the social-constructivist concept of technological frames developed by Bijker (1997) as part of the SCOT theory (Social Construction of Technology). The SCOT theory is a response to technological determinism, and it argues that technology does not determine human action. Rather, social actions and technologies mutually shape each other. Consequently, sociotechnical change can not be understood without understanding how technology is embedded in its context.

The theory includes three main parts. The first part of the theory is the sociological deconstruction of sociotechnical change by applying the two concepts of relevant social groups and interpretative flexibility developed earlier by Pinch & Bijker (1984) in their now classical study of the development of the bicycle. The interpretative flexibility means that an artefact has different meanings to different groups, which in turn generates different problems to be solved. The second part of the theory is the analysis of the social construction of sociotechnical change by the processes of stabilisation and closure. The third part is the explanatory and generalising part of the theory by applying the concept of technological frames and inclusion (Bijker 1997).

The technological frame encompasses goals, key problems, problem-solving strategies, requirements, theories, tacit knowledge, testing procedures, design methods and criteria, user practice, perceived substitution function and exemplary artefacts. The technological frames guide thinking and interaction within and between the different relevant social groups. Three different configurations of technological frames can explain sociotechnical development: 1) one dominant technological frame, 2) no dominant technological frame, and 3) more than one dominant technological frame.

Performance as the analytical focal point

Projects are having a relatively high degree of autonomy of the firm. But what, then, is coupling the firm and the projects together? The answer to this question may in particular be points of accountability. These points of accountability include all interactions were the performance of the project in its broadest sense of e.g. cost, time and quality is being assessed, documented and reported between the project and the firm.

These points of accountability may be stable and recurrent like e.g. business reporting systems or enterprise resource planning systems applied by firms to monitor cost and finance of projects, EDRM systems (electronic document and records management systems) for correspondence etc., digital project webs, various company specific software tools etc. The points of accountability may also be more irregular and ad hoc, when various types of problems are encountered in the projects like the case of defects and liability issues.

Defects and liability issues are in particular interesting to focus on because they represent a potential disruption of the taken-for-granted assumptions of the project and firm. As such defects open up the on-going process of linking the project and the firm for closer inspection. A process that is often so ingrained in daily practices that it can be hard to distil. A second reason for the focus on defects is almost contradictory. The recurrent character of defects, the heavy attention on liabilities in contracting, and the institutionalised procedures of arbitration make the management of defects a fairly familiar and routinized part of project life. Thus, the emergence of defects and the subsequent arbitration process are or becomes important points of accountability that effectively link the project processes of a building project with the business processes of a construction firm.

As a consequence, this paper will suggest that points of accountability on performance (or lack hereof) for example on defects, value, cost etc. provides excellent points of departure for analysing the links between project processes and business processes.

Research design

This study used a variety of methods including participant observation, documentary methods and qualitative interviews.

First, participation observation in a two-day course for building experts in arbitration has given important knowledge on how the arbitration process is taking place, what tasks and duties the building expert is supposed to undertake, and how the building expert is being trained to conform to the code of conduct of a building expert in arbitration.

Second, documentary material has been obtained from various sources. The documentary material includes e.g. agreed documents, guidelines on arbitration, reports on arbitration and information on different types and procedures of conflict resolution.

Third, qualitative interviews have been conducted with both representatives of the various actors of a construction project (client, consultant and contractor) and arbitration system in the shape of representatives from the secretariat of the board of arbitration as well as arbitration experts. The interviews were carried out as semi-structured interviews and the themes included:

- Perceptions of what is considered defects, failures and shortcomings.
- Experience of using the court of arbitration and expert appraisals.
- Effect of the use and judgements on the firm's practice and strategies.

The interviews were recorded and transcribed in full. Eventually, the interviewees had the opportunity to comment on the transcripts. Subsequently, the interviews were analysed using a meaning condensation approach, rather than a narrative, interpretative, categorisation or ad hoc approach (Miles & Huberman 1984; Kvale 1996).

CONSTRUCTING DEFECTS – DEFECTS IN CONSTRUCTION

The Danish Building and Construction Arbitration Court was established at January 1 1973. The Building and Construction Arbitration Court facilitates dispute resolutions within building and construction according to the agreed documents for construction works, design-build and consulting services covered by AB92, ABT93 and ABR89 along with the statute of the board. Other dispute resolutions or legal measures also exist like approved appeal tribunals, private lawsuits etc. The secretariat of the arbitration board is responsible for the administration of the activities of the arbitration board, including liaison between the opponents, lawyers, building experts, arbitrators etc. The arbitration board encompasses the following dispute resolution methods: Inspection and survey by experts, expert opinions on security provided etc., normal or simplified arbitration, pre-emptive conflict resolution, conciliation and mediation.

The liabilities of consultants and contractors are usually defined according to the agreed documents ABR89, AB92 and ABT93. When it comes to errors and negligences, the

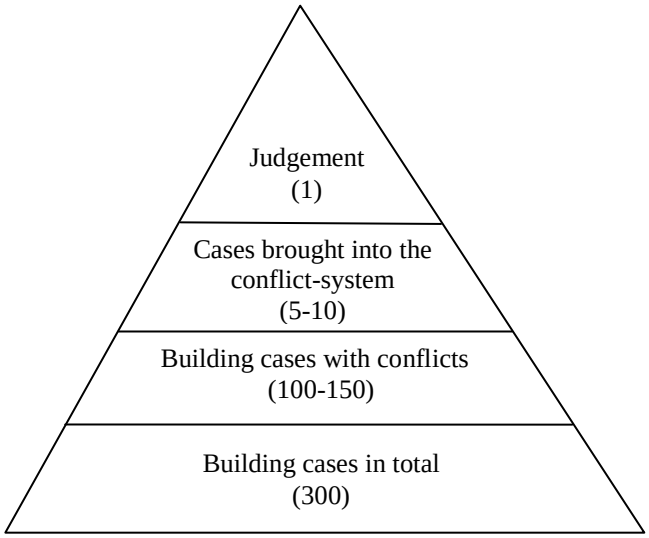
consultant are liable for damage occurring in connection with work assumed by him when such damage is the result of a lack of the necessary professional skill or care. The consultant cannot be held liable for damage arising from conditions which cannot be considered generally known in professional circles, for accidental damages, or for errors committed by the client or by others engaged by the latter (National Building Agency & Danish Association of Consulting Engineers, 1989). The liabilities of contractors are defined by the agreed document AB92 General Conditions for the provision of works and supplies within building and engineering (Danish Ministry of Housing, 1992, p. 9):

> *"§ 30. If the work has not been performed in accordance with the contract, with due professional care and skill or in accordance with any instructions given by the employer under § 15, it shall be deemed to be defective. The same shall apply whenever the contractor has failed to provide other services agreed upon in relation to the work."*

Building defects are considered as deviations from norms – an anomaly. The deviance is the object of an ongoing negotiation, where what is considered norms and what is considered as anomalies change over time and appears as the ongoing result of a mutual shaping process. Consequently, we will use the term 'deviance' rather than defects in our analysis to liberate ourselves from any of the connotations that is so deeply ingrained in the use of the term 'defects'.

Let us start the analysis with some empirical observations on the number of deviances. This is exemplified by the pattern of dispute resolution in one of the case firms (see Figure 1). The numbers in brackets refers to the number of building projects per year. These numbers are taking from a large consultancy firm. Clearly, the absolute numbers will depend on the size of the firm. Further, the numbers will depend on the type of firm in question. For example, the number of legal cases at a contractor is typically higher. In the contracting firm some 30-40 building projects per year was the norm. Now, the exact numbers are not that important. What matters is the scale or magnitude of disputes.

Figure 1: The dispute hierarchy in a construction firm. Source: Haugbølle & Forman (2009).



In a previous paper, Haugbølle and Forman (2009) have deconstructed the interpretative flexibility of the concept of defects or deviance, as we would prefer it, starting from the bottom and moving upwards. We followed/identified the controversies on "defects" between

the various relevant social groups in order to render the interpretative flexibility visible in relation to “defects” as well as the processes that allow the controversies to be closed. The four interpretations are deviance as normalisation, deviance as leverage/liability, deviance as a random effect, and deviance as precedent. Further, we have demonstrated how “defects” are socio-technically constructed through three main processes: concrete negotiations on the gap between expectations and realisation, setting and applying ground rules for the game of construction and arbitration, and by producing structures in the shape of norms or codes of conduct. Finally, we have argued that the construction of defects can be explained as the result of interaction between two dominant technological frames: the building frame and the juridico-legal frame. The first frame is constituted by relevant social groups like building engineers, architects etc., construction technologies etc. The second juridico-legal frame is constituted by relevant social groups like building experts, arbitration methods, arbitration courts etc. Consequently, the system of arbitration and expert appraisals along with construction practices and strategies is co-shaping a culture of deviance/defects that both intentionally prevent defects but simultaneously foster defects unintentionally.

DISCUSSION

In a schematic sense our core argument throughout this paper looks like this: Institutions like the legal system of arbitration is co-forming norms for performance, code of conduct etc. These norms along with other forces shape the behaviour of actors. The behaviour produces results and (sometimes) defects. In turn, the defects stimulate learning – correct or not. The lessons learned either maintains existing behaviour or re-shapes a new behaviour. The behaviour will reinforce norms for performance, code of conduct etc. In turn, the norms establish the foundation for institutions like arbitration. What, then, are the implications for our understanding of couplings in construction?

Before we look at that question, let us then return to the starting point that the couplings between project and firm are crucial to performance and innovation in construction (or any other project-based industry). In line with constructivist reasoning (see e.g. Bijker 1997), we may distinguish between explanandum (that, which needs to be explained) and explanans (that, which explains). Put as a simple formula, this statement reads:

EXPLANANS		EXPLANANDUM
Project + Firm	=>	Performance/innovation

The policy and management implications of above formula are rather straight-forward: If we improve the couplings between the firm and project, then prosperity will arise. If we adopt either of the previously described analytical approaches, our management strategies would fairly easy crystallise. We would improve the knowledge flows or knowledge information systems in companies (Gann & Salter, 2000), we would be counting the number and character of the ties in a social network (Granovetter 1973 and Chinowsky et al. 2008), we would clarify the functions and regulatory context in the construction economic system etc. In short, we would improve our sensitivity to the history and organisational context of projects as Engwall (2003) urges us to do.

We do acknowledge the validity of and the contribution to our understanding of construction fundamentals by each of these approaches or perspectives. We value for example the conceptualisation of ties as weak/strong and couplings as loose/tight, the inherent systemic perspective, and the focus on knowledge flows, functions and regulation.

We would however also hold that these perspectives are too limited in their scope and understanding of couplings in construction due to their unidirectional outlook on the relationship between explanans and explanandum in the formula above. What the different perspectives tend to overlook (possibly more in their actual research practice than as an epistemological grounding) is the reciprocity of the formula above. In fact, we would like to pose a more fundamental question to construction (and other project-based industries): What if the above formula is wrong? What if we have misunderstood the relations altogether? What if we are not dealing with couplings in this understanding as ties, links, flows etc. between project and firm, but rather as couplings between technological frames or sociotechnical ensembles. Thus, we would rather focus on the constitutive character of these couplings and their importance for our ontologies as we have illustrated in the briefly described study on defects and arbitration.

First of all, we would like to point out that the couplings are dynamic in character. This may be a rather trivial observation that most observers would agree upon. However, we would like to hold that being dynamic is not simply a question of changing a weak tie into a strong one or increasing the frequency of interactions as implied in social network analysis. Rather, the dynamism of a coupling implies that the relationship may be more significantly altered, or more precisely that the couplings are being reconstituted. The study on defects and arbitration has shown how the emergence of defects and the arbitration process significantly alter the relationship between the project and the firm. What starts out as a disagreement in a building project may be turned into a legal case. Further, the time frame may change dramatically from that of a more or less fixed deadline for the handing-over of the final building to the legal statute of limitations. A significant shift in actors or relevant social groups also occurs as we proceed through the four interpretations. First, building experts, lawyers, insurance companies, legal officers and arbitrators are the prominent actors. Second, although the building professionals still have a role to play, their roles as project manager, consultants, contractor etc. may be redefined as the roles of plaintiff and defendant as well as witnesses to be called to the stand.

Second, we would focus our attention on the constitutive forces at play and their impact on our ontologies on performance, innovation, project, firms etc. Consequently, the configuration of actors and arenas is kept in place through couplings that not only extends and reshapes the boundaries of the project and the firm, but also shapes what counts as satisfactory or not. Couplings are not just couplings but are the very forces that keep the network together and make the sociotechnical ensemble obdurate.

Our paper has provided a preliminary insight to some of these forces that shape our perception of performance and how these perceptions shape our actions through two dominant technological frames: the building frame and the juridico-legal frame. Put very simply, our main argument looks like this: The obduracy of “performance” or more specifically the non-performance of defects is shaped by two dominant technological frames: the building frame and the juridico-legal frame. The two dominant frames construct four interpretations of performance or “defects”: normal, leverage, random and precedent. Each of the four interpretations is constituted by a distinct setup of actors, meanings, arenas etc. Each

of these four interpretations represents some significant shifts in arenas, actors etc. as illustrated below:

From within the boundaries of the project…

To between the project and the firms involved…

To between the firms involved and the arbitration system…

To within the arbitration system and the construction sector

Third, the policy implication is not to skip the management recommendations of the other theoretical perspectives, but to supplement these or more radically to confront the limitations of these perspectives. So if we want to improve performance – lower number of defects, faster project delivery, cheaper buildings or whatever – then we would need to address those forces that shape our very perception of performance. Thus, we would (not only) be looking for improving the coupling between the project and the firm, but we would explicitly explore and challenge the very ontologies of what counts as a project and firm, and what constitutes performance and innovation etc.

This is not to say that we should not be investing time and energy in improving the couplings between project and firm, but there is an additional – maybe even alternative – but definitely very often overlooked approach, namely target the perceptions of what counts as satisfactory (or innovative or…). We can improve knowledge information systems in companies etc. but these activities are not basically addressing the core issue of what counts as satisfactory or innovative. Put differently, the baseline remains the same if we do not change it! So if we want to improve performance and innovation in construction, we would need to chance that very baseline. One very practical implication of this strategy would be not to avoid taking cases to arbitration court, but to elevate appropriate political pressure and actually strive towards getting cases there in order to use them to systematically change the legal perception of what counts as satisfactory.

CONCLUSION

In sum, this paper has identified a number of theoretical perspectives on couplings in construction as: 1) knowledge flows, 2) functions and regulation, 3) governance, 4) a loosely coupled system, and 5) ties.

Further, the paper has suggested that points of accountability on performance of for example defects, value, cost etc. provide excellent points of departure for analysing the links between project processes and business processes.

The paper has analysed the emergence of defects and arbitration in construction as the result of the mutual shaping of two technological frames: the building frame and the juridico-legal frame.

This paper has proposed an alternative perspective on couplings as constitutive, which explores and challenges the very ontologies at play (explanans/explanandum) when it comes to analytical units (project/firm), relations (couplings) and effects (performance/innovation).

Finally, the paper has sketched out a number of alternative policy implications when it comes to improving performance and innovation in construction, most notably by mobilising the necessary leverage to change the perceptions in both the industry and the legal system of what counts as satisfactory.

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REFERENCES

Bijker, W. E. (1997). *Of Bicycles, Bakelites, and Bulbs. Towards a Theory of Sociotechnical Change.* Cambridge, MA: The MIT Press.

Carassus, J. (ed. 2004). *The Construction Sector System Approach: An International Framework.* Rotterdam, The Netherlands: CIB. CIB Report 293.

Danish Ministry of Housing (1992). *AB92. General Conditions for the provision of works and supplies within building and engineering.* Copenhagen: Danish Ministry of Housing.

Chinowsky, P., Diekmann, J. & Galotti, V. (2008). Social Network Model of Construction, *Journal of Construction Engineering and Management*, Vol. 134 (10), 804-812.

Dubois A. & Gadde L. (2002). The construction industry as a loosely coupled system: implications for productivity and innovation, *Construction Management and Economics*, Vol. 20, 621-631.

Engwall, M. (2003). No project is an island: linking projects to history and context, *Research Policy*, Vol. 32, 789-808.

Gann, D. M. & Salter, A. J. (2000). Innovation in project-based, service-enhanced firms: The construction of complex products and systems, *Research Policy*, Vol. 29 (7-8), 955-972.

Granovetter, M. (1973). The Strength of Weak Ties, *The American Journal of Sociology*, Vol. 78 (6), 1360-80.

Haugbølle, K. & Forman, M. (2009). Shaping concepts, practices and strategies: Arbitration and expert appraisals on defects. *OTMC Journal (Organization, Technology and Management in Construction – an International Journal)*, Vol. 1 (1), 22-29.

Hobday, M. (1998). Product complexity, innovation and industrial organisation, *Research Policy*, Vol. 26, pp. 689–710.

Hobday, M. (2000). The project-based organisation: an ideal form for managing complex products and systems? *Research Policy*, Vol. 29, 871–893.

Kvale, S. (1996). *InterViews. An Introduction to Qualitative Research Interviewing.* Thousand Oaks, London & New Delhi: SAGE.

Latour, B. (1987). Science *in Action. How to follow scientists and engineers through society.* Cambridge, MA: Harvard University Press.

Miles, M. B. & Huberman, A. M. (1984). *Qualitative Data Analysis. A Sourcebook for New Methods.* Thousand Oaks, London & New Delhi: SAGE Publications.

National Building Agency & Danish Association of Consulting Engineers (1989). *ABR89. General conditions for consulting service.* Copenhagen: Danish Association of Consulting Engineers.

Nielsen, J. & Hansen, M. H. (2004). Svigt i byggeriet. Økonomiske konsekvenser og muligheder for en reduktion. København: Erhvervs- og Byggestyrelsen.

Orton, J. D. & Weick, K. E. (1990). Loosely Coupled Systems: A Reconceptualization, The Academy of Management Review, Vol. 15 (2), 203-223

Pinch, T. J. & Bijker, W. E. (1984). The social construction of facts and artifacts. *Social Studies of Science*, Vol. 14, 399-431.

Pryke, S. D. (2004). Analysing construction project coalitions: exploring the application of social network analysis, *Construction Management and Economics*, Vol. 22, 787-797.

Winch, G. M. (2000). Editorial: Construction business systems in the European Union, *Building Research & Information*, Vol. 28 (2), 88-97.

Winch, G. M. (2002). Editorial: Global Construction Business Systems, *Building Research & Information*, Vol. 30(6), 390–391.

Winch, G. M. & Campagnac, E. (1995). The organization of building projects: an Anglo/French comparison, *Construction Management and Economics*, Vol. 13, 3-14.

THE BUILDING SYSTEM AS A STRATEGIC ASSET IN INDUSTRIALISED CONSTRUCTION

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The growing industry segment within construction focusing on industrialisation, meet new challenges traditional construction firms never have encountered. The choice of a building system (technical and process platform) defines not only what resources and technology are needed, but also the organisation within the company, its market position, and possible growth. Using a resource-based view, the building system can be seen as a strategic asset for an industrialised construction company. In this paper, the characteristics of a strategic asset is identified and used to analyse two building systems as being a strategic asset at two industrialised construction companies in Sweden. Two companies participated in the case study, one specialised contractor and one more general contractor, both active in the housing segment. The building system is clearly a strategic asset in all aspects for the specialised contractor, while the asset for the general contractor lies more in the organisational power of the company than in the technical solutions. The company strategy should therefore differ. The specialised contractor should strive to clarify and strengthen their total offer to the client, while the more general contractor should continue to exploit its human resources, moving towards a more unique offer to their client.

KEYWORDS: industrialised construction, building system, strategic asset, technical platform, process platform

INTRODUCTION

The development of a more industrialised approach in construction has led to investments in firm resources for the companies involved (Lessing, 2006). They challenge the flexible and temporarily organised construction set-up by using production lines and tries to organise their production according to a more steady flow creating economies of scale (Gibb 2001). The investment in production equipment can be heavy, but the actual resource consists not only of physical equipment but also human capital and organisational knowledge (Grant 1991). The resource can be labelled a building system or a technical platform for construction. A building system is the method used to fulfil a need on the market and contains a physical solution to the problem, an organisation to sell, produce and deliver the physical solution and a continuous build-up of experience of the system in people and organisation (Söderholm 2010). Construction companies can own one or several building systems. Owning and nurturing one building system renders the company to be organised throughout to support its building system. This can also be a risk when looking at the market position, since agility can be important to meet market fluctuations.

By organising the firm according to an industrialised approach, the company tries to gain a competitive advantage implementing a strategy that no one else uses. In this case, the strategy incorporates organising business according to a building system. The building system is seen

as a strategic asset for the company in this paper. To sustain the competitive advantage the strategic asset must be unique so it cannot be easily copied (Barney 1991). Even very small differences can affect the competitiveness, thus it is very difficult to copy another firms strategic asset since it constitutes physical, organisation, and human ingredients. A strategic asset that creates sustained competitive advantage was characterised by Barney (1991) as an asset being rare, perfectly imitable, of high value, and non-substitutable. The aim of this paper is to describe the building system of two industrialised construction companies as a strategic asset and thereby gain knowledge on their competitive advantages.

THEORY

Junnonen (1998) concludes that the rapid change in the construction industry's business environment has made strategic thinking more important for construction companies. Construction firms have mainly focused on effectiveness in separate projects and not on long-term strategies (Price and Newson 2003). Construction can be characterized as a business with high uncertainty (Winch et al. 1998) and a dynamic technological environment (through changing technology in projects). This situation favours a strategy with organic structures (Burns and Stalker 1961) that are flexible and low in task specificity (Chakravarthy 1982). Furthermore, focus in construction firms is often the price sensitivity of the client. The construction firms are then likely to develop a competitor orientation (Zhou et al. 2009) instead of a customer orientation. The competitor orientation is negative for sustaining a market differentiation advantage (ibid.). On a business level, two factors govern success: (Porter 1981; Porter 1985) put forward the market position and environmental forces on the market, while (Mintzberg 1979; Wernerfelt 1984; Peteraf 1993; Hamel and Prahalad 1994) pointed to the importance of the internal resources. Hamel and Prahalad (1994) also stressed the connection between organisation alignment and market success, which was supported by Edelman et al. (2005) in examining the relationship between firm resources, strategy and firm performance. Small firms fit their strategies to their resource profile (ibid.). The environmental model of competitive advantage assumes that heterogeneity can never occur between firms because all firms have the same possibility to obtain any strategic resource others might have, since resources also are highly mobile (Barney 1991). In dynamical environments "superior profitability is more likely to be associated with resource and capability-based advantages than with positioning advantages resulting from market and segment selection and competitive positions based upon some form of 'generic strategy" (Grant, 1996), which favours the use of a resource-based view to understand how competitive advantage is sustained in construction.

From a resource-based point of view, the company's internal resources are as important as the market position (Flanagan et al. 2007). A firm can be regarded as a collection of resources and competitive advantage is created when these resources are utilized effectively (ibid). Resources can be both tangible and intangible: financial, physical, human, technological, reputation, and organisational (Grant 1991). Not all resources are strategic assets or critical resources (Flanagan et al. 2007). Rangone (1999) presents a method to identify strategic assets and quantify their link to the strategy in an SME. The resource-based view on core competence is valid in construction (De Haan et al. 2002) and identification and strengthening of strategic assets develops a firm's core competence (Flanagan et al. 2007). Wright et al (2001) describes the strong relationship between strategic human resource management and the resource-based view. Using internal resources to capitalise on core competence differs from fitting into a market niche and is referred to as market stretch

(Hamel and Prahalad 1994; Johnson et al. 2008). The strategic assets support one or several of a firm's basic capabilities; the innovation, production and market management capabilities (De Haan et al. 2002; Rangone (1999)). The firm-specific resources or strategic assets should meet the criteria of being valuable, rare, imperfectly imitable, non-substitutable and imperfectly mobile and gain their strategic advantage through being difficult for competitors to imitate thus creating heterogeneity and immobility as a competitive edge (Barney 1991), table 1.

Table 1: Characteristics of a strategic asset to create heterogeneity and immobility leading to a sustained competitive advantage

Rareness	**Imitability**
The asset is not common with current and potential competitors. Not common means that the no of firms possessing the asset is less than the no of firms needed to create perfect competition dynamics	The asset cannot be obtained by others. This could be due to unique historical conditions, a socially complex setting or a link that is causally ambiguous i.e. not easily understood by others (Dierickx & Cool 1989)
Substitutability	**Value**
The asset cannot easily be substituted for another solution. For a substitute to be an alternative, it must be both valuable and rare or non-imitable.	The basic condition for an asset is that it is valuable and exploits opportunities or neutralises threats in the environment. In other words an asset should be effective.

The characterization of the building system in Söderholm (2010) as not only being built up of a technological competence, but also of cooperative capabilities is recognized by Tyler (2001), who defines the cooperative capabilities as competencies in information processing, communication, knowledge transfer, intra- and interunit coordination, the ability to develop trust, and negotiation. As knowledge is integrated into the building system, communicating this knowledge to the client is a crucial success factor in tendering. Communicating knowledge and its value can be difficult and pose a risk (Ndofor and Levitas 2004).

METHOD

The empirical data is deducted from two cases in the Swedish building industry. The method of case study was selected for two main reasons (Yin, 2003). Firstly, strategic action in relation to a building system must be studied in its real life context. Secondly, this research is exploratory, seeking evidence of a strategic asset rather than hypothesis testing. The end goal is to develop a survey to characterise a strategic asset and the case study is used to generate preliminary data that can build up a questionnaire in a later study. Barney et al. (2001) suggested qualitative case studies as a method to empirically verify the theory of sustained competitive advantage in their retrospective of the development in research since the first publication of the theory (Barney 1991).

Problem formulation
The aim of this study is to describe the building system as a strategic asset thereby gaining an understanding of its competitive advantage. A building system can be managed in several ways; it can be proprietary and integrated into one company or it can be delivered by a sub-contractor, thus more open and less integrated into a company.

Selection of cases
Two criteria were used to select the case study companies. Firstly, the companies in the study must support a building system and have this as their strategy to gain a competitive advantage. Secondly, the companies needed to have a differing strategy when it comes to integration of the building system into the company. A choice was made to incorporate two companies; Lumi: 'one company – one building system with large integration' and Noin: 'one company – several building systems with less integration'.

Data collection
Data was collected in several ways. Interviews and workshops were used in earlier studies to collect data on the design process of Lumi, (Jansson 2010; Meiling 2010) and on the interaction between design and suppliers of Noin, (Sardén 2005; Cigén 2003). Archival analysis of documentation of building projects and working processes were also studied for both companies. The studies of Noin were complemented with supplementary interviews during 2010 to update any changes in building system strategy since 2005. The data revealed information on the building system and especially the interaction between the client and the company when adapting the building system to a specific project. The data from these earlier studies were re-used in the current study to support the analysis of a strategic asset.

Data analysis
The data was analysed confronting the theoretical framework of a strategic asset with the results of interviews and archival material. The imitability, rareness, value and substitutability of the building system were analysed.

In describing the cases, the basic capabilities proposed by de Haan et al (2002) and Rangone (1999) were used; innovation, marketing and manufacturing.

THE CASE OF LUMI

Company market and strategy
Lumi produces multi-family dwellings made up of volumetric modules. Lumi is a family-owned company of moderate size, 120 employees. The annual turnover is about 45 M€. Lumi was originally a sawmill, developed into an ordinary contractor and has since 1997 directed its production towards volumetric elements only. Lumi specialises in multi-family dwellings and their strategy is to take wholesale responsibility of the client from sales to completed building. They operate on the market of professional clients only i.e. they never sell directly to individuals only business to business. Through their technical solution they are able to address 85% of the market segment of multi-family buildings in Sweden. Lumi integrates sales, design, production and assembly of the building into one company. Their vision is to become the best contractor in the Nordic countries delivering industrially produced multi-family dwellings. Their key strategy is to take full responsibility for the client and his requirements from sales through design and production, thus offering the client full liability during the building process. Lumi works with design-build contracts only. Lumi does not nurture more than one building system and the entire company is organised to support the

self-owned building system. The numbers of competitors using the exact same building system is less than 5 firms, but on the Swedish market of housing more than 30 contractors are active. The building system is quite rare and provides an almost unique offer in its particular market segment. Substitutes generally cannot offer such low lead times, which leads to fast return on investments for clients.

Capabilities

Product development

The company as adopted a Lean way of working (Meiling et al. 2010). In effect, this leads to mistakes being displayed and used as experience feedback for making continuous improvements. Product development is a gradual activity performed partly within building projects and partly in research and development projects. The company has a long history of working together with universities and research institutes. The building system is today robust as a result. The cost level of producing the building systems makes it possible to offer prices generally 5% lower than competing building systems. The lower cost level limit has not yet been displayed. Ongoing work is directed towards extending the possibilities of building higher buildings to embrace even larger markets and to address the increasing demands on energy efficiency. The personnel (7 persons) involved in product development and design ranges from technicians with no academic training to one associate professor.

Marketing

The sales department (3 persons) has during the last 25 years built up a large contact network with returning and potential clients. Lumi has signed long term contracts with one of the largest clients in Stockholm. The contact network creates a socially complex situation, difficult for other companies to copy. To enter very early in the conceptual phase of a building project is crucial for the success of a specialised building system, since design decisions affect the possibility to use the building system efficiently. The most optimal timing is to enter the building project even before the building permit is given. The sales department is the project leader for the building project until the contract is signed and also performs estimation. During the sales process, the design department assists with technical solutions. The individual clients often have alterations during the design phase and those are handled by the project leader for design, which takes over the project from the sales department. During design, it is important for the project leader to sustain the building system by informing about limitations and possible alternative solutions to alterations suggested by the client.

Manufacturing

The design department documents the requirements from the client on drawings and specifications. Parts of the factory production are automated and the design department produces computer files that control the nailing portal. The design department consists of a multi-functional team working close together. Between 5-15 building projects are concurrently active in the design process at the same time in different stages of completion. Factory production does not start until finished drawings are produced.

The size of the modules is typically 4 x 8 x 3 metres (w x l x h). They have a simple light-weight timber frame, which is completed with insulation materials and covered with sheathing. The modules are produced in the factory during 3-4 weeks. Interior finishing and installation services are made in the factory as far as possible. The modules are finished to about 90% when leaving the factory and then transported to the building site where they are assembled into 2-6 storey buildings. On site completions takes 3-4 weeks. The on-site

assembly is accomplished by own teams specialised at mounting the building system. The site manager purchases materials needed to complete the project on site directly.

THE CASE OF NOIN

Company market and strategy

Noin produces multi-family houses, but also possesses a wide range of other production capabilities such as civil engineering and commercial buildings. Noin has international branches as well and is one of the four dominating contractors on the Swedish market. Noin is to be considered a large size company as defined by EU. The company consists of several division and can be seen as a corporation. Noin's vision is to be leading when developing future environments for living, working and communication. Noin operate on the business-to-business market and have professional clients as their customers. The ability to solve almost any problem the client would have is part of the company strategy, but lately Noin has begun to organise design and production in technical platforms. Those can be regarded as a building system, but with less investment in physical equipment. Noin can deliver almost any building the market desires. Noin has a history of being mainly a contractor, but the current movement is to integrate upstream to establish closer relationships with the client. Along that line, design-build contracts increase as do partnering projects and self-owned construction. Design can be made in-house, but just as often by external consultants. Noin works both on open-bid contracts and design-build contracts. There is also a division for property development, which sometimes acts as the client for the housing division. Noin sustains several technical platforms at the same time, one is the housing platform. Many other contractors on the market can deliver equal products as Noin. Their strength is their size, which enables them to have strong internal resources and thereby also highly competent personnel.

Capabilities

Product development

The building systems used by Noin are handled by a specialised division of technical experts. They are 130 persons in total and gather engineers, Ph.D:s and specialists from the entire corporation. The task for the product development team is to solve problems occurring in the building projects and perform product development work to support the building systems. Supporting the building systems must be done without actually controlling the production of the elements constituting the system. Therefore, much of the development is not focused on technical questions since these are handled by suppliers, but more on process questions i.e. how should the building system be communicated and sustained through conception, design, element production and on site assembly. Experience feedback is a current issue, since formal contacts between product development and production are non-existent. Noin are competent to run their own product development projects and engage in cooperation with universities only for long-term theory build-up. The high competence of the product development team creates a sense of security with the client, neutralising much of the uncertainties experienced in building projects (Winch, 2001). Noin is one of the most experienced contractors when it comes to passive and energy efficient housing in Sweden.

Marketing

Noin's contact network on the construction market is vast; Noin has offices in every part of Sweden and is almost always a contender in open bidding. They are often invited to place bids in building projects and are attractive as partners when developing new solutions together with clients. Due to the company's long history on the Swedish market (since the

turn of the 20th century), it has a unique historical condition creating a socially complex situation. The building systems are not unique in technical solutions and many alternatives exist. Noin strives to create a competitive edge through streamlining design, thus offering a more predictable and cost efficient product. The lack of a sales department to nurture the technical platforms makes the coupling between customer needs and technical solutions less obvious. Integration of such a function is currently not part of the company strategy.

Manufacturing

The basic technology for housing is prefabricated flat concrete elements, delivered to the site from a material supplier. The company does not own the factory where the elements are produced. Instead they could own the design process (in an open bidding) and the assembly process on-site. The assembly on site is Noin's core business and much of the organisation is designed to support work on site. Regardless of contract form, the work on site is supported by 3D-models, drawings and specifications. Virtual construction is increasing steadily at Noin and integration with the building site is within the scope for this particular development. The work on site is not automated in any way. On site completions for a housing project takes about 12 months and includes interior finishing and installation of HVAC services. Buildings can be constructed from two to at least 20 stories high using the building system for housing, but market demand seldom requires higher buildings than 15 stories. Purchase of materials is made by the site manager with strong support from the purchasing department where long term contracts are sealed with larger suppliers. At times, there is a conflict between the site manager who wants a certain material type and the purchasing department who wants the site manager to follow the signed contract for a similar material type.

CASE ANALYSIS

The analysis follows the properties of a strategic asset presented in Table 1. These properties should lead to heterogeneity and immobility in the market segment (Barney 1991), thus creating conditions for a sustained competitive advantage through owning a strategic asset, in this case the building system.

Rareness

The rareness of the building system is much higher with Lumi than it is with Noin. The building system that Lumi offers is only sold by a handful of other firms, while the parts to the building system of Noin can be bought from a material supplier. Lumi thus have a strong position in presenting a unique product offer. When it comes to production capabilities, both Lumi and Noin can be considered rare, but for different reasons. Lumi for their specialised production facilities and Noin for their highly competent on site personnel and great power due to company size, which guarantees the availability of extra resources should anything go wrong. The competence and versatility in production is the property that makes Noin rare, but this property is more suitable for building projects of a more challenging character, not standard housing projects. Examples where Noin's production capabilities provide a competitive edge in housing could be where foundation works are difficult, where the building height is large, or the building technology challenging or new.

Imitability

Lumi's building system is not unique in terms of the technical solution. Nor are the tools and machines especially advanced and could easily be copied. The strongest property is their contact network with clients, which creates the base for running the repetitive production. This contact network is socially complex to sustain and the lead time before a contract is

signed can 1-3 years, including the client's own sales process with inhabitants. The salesmen are continuously in contact with current and potential clients, detecting new building projects even before they are formulated.

Noin's building system is just as easy to copy when looking at technology. The building parts used are not even produced in a factory of their own, but are bought on the open market. The strength lies instead in the unique historical conditions created during a century, gradually building up Noin as one of the top contractors in Sweden. Therefore, the experience of working with the building system is very difficult to copy. Experience on assembly is a core competence with Noin, which has on site assembly as its core activity. The gradual experience currently gathering with the product development department will further decrease imitability of the building system.

Substitutability

Lumi's and Noin's building systems could be substitutable for each other. Both offer value to the client, in Lumi's case combined with both rareness and low imitability and in Noin's case combined mostly with value. Many other options on building systems also exist. It is more a matter of what the client's preferences are than an actual choice based on measurable parameters. The clients often also consider their own experiences with the building system, using their own stock as a knowledge base (Engström and Levander, 2010).

Value

Both Lumi and Noin offer value to their clients, but the nuances of value differs between them. Lumi offers a turnkey deal taking full responsibility for the entire building process form conception to realisation. This might seem as a very appealing offer, but building clients are generally used to having great insight and many opportunities for changes during a building project (Engström and Levander 2010). Therefore, the specialised offer can with some clients create uncertainty and equivocality due to its novelty (ibid). The clients that are returning clients to Lumi perceive great value in the wholesale process and furthermore a good economical value due to a lower price.

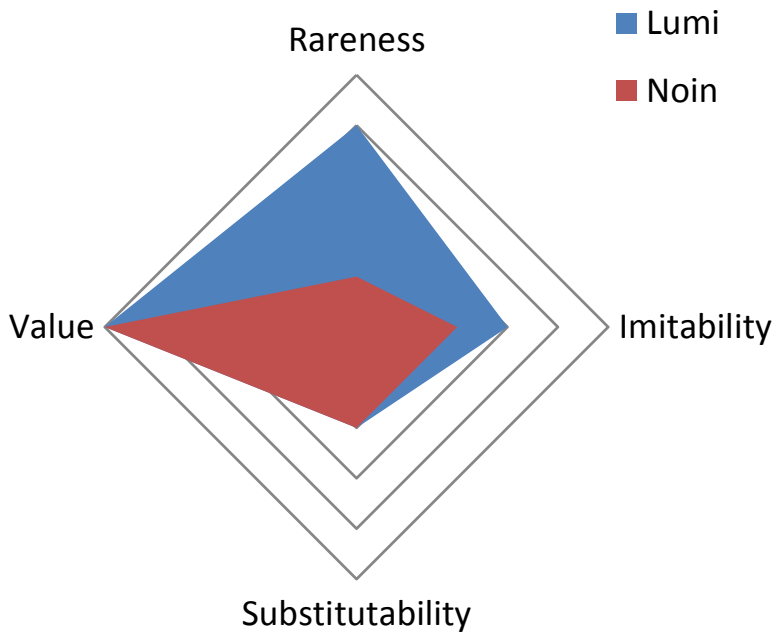
Noin on the other hand relies on the experience in production and the size of the company, providing a good security against situations where something unexpected happens. By Noin's possession of broad competence, they neutralise the threats or risks perceived by the client, being able to answer any question or any uncertainty the client might have. Noin's business model is more traditional to the construction trade, using general and design-build contracts as their main means to run projects.

CONCLUSIONS

The properties of a strategic asset were used to analyse the building systems of two different building companies, Lumi and Noin, figure 1. (Note that figure 1 is merely a graphical representation of the reasoning in the case analysis and not a quantified fact.) Lumi is a specialised contractor working with industrialised production of modules in an integrated building process with wholesale responsibility. Noin is a more traditional contractor currently organising their technical and organisation knowledge in technical platforms according to industrialised principles without taking the risk of owning their production facilities themselves. The specialised organisation and business model that support Lumi's building system identify their building system as a strategic asset. Their resources are directly aligned to support their strategy, which was identified as a factor increasing firm performance by

Edelman et al. (2005). Lumi's building system, seen as a strategic asset, supports all the basic capabilities in an SME; innovation, production and market management (Rangone 1999). Lumi's building system is not only rare, but also difficult to imitate, and creates great value for the client. When it comes to substitutability, alternatives do exist and Noin presents one of them. Noin's building system is not so clearly a strategic asset when looking at technology. The building system is not rare, it is possible to imitate, and a variety of substitutes exist. The value that Noin delivers to the client lies in their strong organisation and experienced personnel, which eliminates threats in the form of risks for the client. Strategic human resource management is shown to be part of Noin's strategic asset (Wright et al. 2001).

Figure 1: The four characteristics of a strategic asset for Noin and Lumi.



To further strengthen their human resources as a strategic asset, Ndofor and Levitas (2004) propose methods to communicate competence without disclosing the actual knowledge. The strategy for Lumi should be to nurture their uniqueness and work on communicating their building system to the client, while Noin should continue to exploit their human resources, but also focus on increasing their rareness in order to increase their competitive advantage. A proposal for Noin could be to expand their cooperative capabilities (Tyler 2001), which complement their technological competence, and become unique through process rather than product development.

Based on the comparative case study presented, a broader study is planned to further elaborate on the properties of a strategic asset in construction. The organisation of the companies could affect the maintenance of a building system to a greater extent than detected here. It could be interesting to match the identified strengths in this study against the communicated strengths by the companies to detect if their assets are exploited on the market. The strategies for manufacturing suggested by Winch (2003) could also provide basis for a deeper analysis of the strategic asset characterisation depending on the production strategy chosen.

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REFERENCES

Barney, J. (1991). Firm resources and sustainable competitive advantage. *Journal of management* **17**(1): 99-120.

Barney J., Wright M. and Ketchen D.J. (2001). The resource-based view of the firm: ten years after 1991. *Journal of Management* **27**(2001): 625-641.

Burns, T. and Stalker, G.M. (1961). The Management of Innovation. Tavistock Publications, London.

Chakravarthy, B.S., 1982. Adaptation: a promising metaphor for strategic management. *Academy of Management Review* **7**(1): 35–44.

Cigén, S. (2003) *Materialleverantören i byggprocessen: en studie av kommunikationen mellan träkomponentleverantören och byggprocessens övriga aktörer (in Swedish)*. Licentiate thesis, Luleå University of Technology. http://www.ltu.se/forskning/1.16009

De Haan, J., Voordijk, H. & Joosten, G.-J. (2002). Market strategies and core capabilities in the building industry. *Construction Management and Economics* **20**(2): 109-118.

Dierickx I. and Cool K. (1989) Asset Stock Accumulation and Sustainability of Competitive Advantage. *Management Science* **35**:1504-1511.

Edelman L.F., Brush C.G. and Manolova T. (2005). Co-alignment in the resource-performance relationship: strategy as mediator. *Journal of Business* Venturing **20**(2005): 359-383.

Engström, S. and Levander, E. (2010) Clients as drivers of innovation: lessons from industrialised construction in Sweden. Ph.D. workshop at Luleå University of Technology, Luleå, Sept 29 2010, http://www.ltu.se/forskning/1.16009?pureId=5055220&pureFamily=dk.atira.pure.families.publication.shared.model.Publication.

Flanagan, R., Lu, W., Shen, L. and Jewell C. (2007). Competitiveness in construction: a critical review of research. *Construction Management and Economics* **25**(9): 989-1000.

Gibb, A. (2001). Standardization and pre-assembly-distinguishing myth from reality using case study research. *Construction Management and Economics* **19**(3): 307-315.

Grant, R. (1991). The resource-based theory of competitive advantage. *California Management Review* **33**(3): 114-135.

Grant, R.M. (1996). Prospering in dynamically-competitive environments: organizational capacity as knowledge integration. *Organization Science* **7**(4): 375–387.

Hamel, G. and Prahalad, C. (1994). *Competing for the future: Breakthrough strategies for seizing control of your industry and creating the markets of tomorrow*, Harvard Business School Press.

Jansson, G. (2010) *Industrialised housing design efficiency*. Licentiate thesis, Luleå University of Technology. http://www.ltu.se/forskning/1.16009

Johnson, G., Scholes, K. et al. (2008). *Exploring corporate strategy*. Essex, England, Pearson Education

Junnonen, J. (1998). Strategy formation in construction firms. *Engineering Construction and Architectural Management* **5**(2): 107-114.

Lessing, J. (2006). Industrialised house-building: concept and processes. Lund, Department of Construction Sciences, Lund University.

Meiling, J. (2010) *Continuous Improvement and Expereince Feedback in Off-Site Construction: Timber Framed Module Prefabrication*. Doctoral thesis, Luleå University of Technology. http://www.ltu.se/forskning/1.16009

Meiling, J., Backlund, F. and Johnsson, H. (2010) Managing for Continuous Improvements in Off-Site Construction. Submitted to *Engineering, Construction and Architectural Management*.

Mintzberg, H. (1979). The *Structuring of Organizations: A Synthesis of the Research*, Prentice Hall.

Ndofor H.A. and Levitas E. (2004) Signalling the strategic value of knowledge. *Journal of Management* **30**(5): 685-702.

Peteraf, M. (1993). The cornerstones of competitive advantage: a resource-based view. *Strategic Management Journal* **14**(3): 179-191.

Porter, M. (1981). The contributions of industrial organization to strategic management. *The academy of management review* **6**(4): 609-620.

Porter, M. (1985). *Competitive advantage: creating and sustaining superior performance: with a new introduction*. New York, USA, Free Press.

Price, A. D. F. and Newson, E. (2003). Strategic Management: Consideration of Paradoxes, Processes, and Associated Concepts as Applied to Construction. *Journal of Management in Engineering* **19**(4): 183-192.

Rangone A. (1999) A resource-based approach to strategy analysis in small-medium sized enterprises. *Small Business Economics* **12**(1999): 233-248.

Sardén, Y. (2005) *Complexity and Learning in Timber Frame Housing: the Case of a Solid Wood Pilot Project*. Doctoral thesis, Luleå University of Technology. http://www.ltu.se/forskning/1.16009

Söderholm E. (2010) *Applicability of continuous improvements in industrialised construction design process*. Licentiate thesis, Luleå University of Technology. http://www.ltu.se/forskning/1.16009

Tyler B.B. (2001). The complementarity of cooperative and technological competencies: a resource-based perspective. *Journal of Engineering Technology Management* **18**(2001): 1-27

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal* **5**: 171-180.

Winch, G., Usmani, A., et al. (1998). Towards total project quality: a gap analysis approach. *Construction Management and Economics* **16**(2): 193-208.

Winch, G. (2001). Governing the project process: a conceptual framework. *Construction Management and Economics* **19**(8): 799-808.

Winch, G. (2003). Models of manufacturing and the construction process: the genesis of re-engineering construction. *Building Research & Information* **31**(2): 107-118.

Wright P.M., Dunford, B.B. and Snell S.A. (2001) Human resources and the resource based view of the firm. *Journal of Management* **27**(2001):707-721.

Yin, R. K. (2003). *Case Study Research: Design and Methods*. London, Sage Public.

Zhou K.Z., Brown J.R. and Dev C.S. (2009) Market orientation, competitive advantage, and performance: a demand-based perspective. *Journal of Business Research* **62**(2009):1063-1070:

STATE OF THE ART IN SUSTAINABLE FACILITY MANAGEMENT

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The European Union is targeting a sustainable development of the economy. Therefore it is important to develop better technologies and better management. Facility Management can contribute to a sustainable development of the built environment with regard to the interaction between companies and their business surroundings. This is because of its responsibility for the integration of primary processes and support processes within organizations. Facility Management influences the procurement and delivery of construction in direct and indirect ways. Direct influences on the sustainable development of the built environment are seen within the three main areas of responsibility: support of "primary processes", development of "space and infrastructure", and development of "people and organisations". Facility Management contributes indirectly to the overall objectives of sustainability concerning society, the environment and the economy. A review of the international literature in Europe in particular of scientific publications revealed up to now no common definition or consistent application of the term "sustainable facility management" in Europe. Therefore a preliminary SFM-model was developed and discussed in expert workshops.

KEYWORDS: Facilities Management, Built Environment, Sustainable Development, Sustainability Strategy, Europe

INTRODUCTION / OBJECTIVE

Sustainability has gained increasing importance for Facility Management in practice, education and research. "Sustainable operation" was the topic of a recent student project within the master study program "Sustainable Structures" at the University of Applied Sciences in Frankfurt am Main. In 2009 students interviewed visitors and exhibitors at the Facility Management Fair in Frankfurt am Main and recorded a strong interest in sustainability. At the same time the students learnt that practice has neither a common understanding of the term sustainability nor uses systematic procedures for its application (CAZ 2009, p. 19). These first interviews results were the starting point for further research in this field. The state of the art in Sustainable Facility Management was studied during a research semester at the faculty of architecture at NTNU – Trondheim Norwegian University of Science and Technology in 2010. The objective is to develop a basis for education and research focussing on Sustainable Facility Management and its contribution to construction procurement and delivery.

Facility Management background

Facility Management is responsible for of the support and improvement of primary activities within organizations. In the European context Facility Management means: "The integration of processes within an organization to maintain and develop the agreed services which support and improve its primary activities." (EN 15221-1) Facility Management therefore contributes to economic development. Furthermore Facility Management organizations themselves are also part of a growing sector within the economy. The European Facility

Management market volume has been estimated at about 655 billion EUR. (Teichmann 2009, p. 5) The value added for "construction" as one of the non-financial economy sectors in the European Union (EU-27) amounted to 465 billion EUR in 2005. The sector of "real estate, renting and business activities" included activities within the existing buildings and was estimated at about 1,171 billion EUR. (eurostat 2009, p. 300) Facility Management and the construction industry play a leading role in the development of the built environment. Both market segments are a strong part of the European economy.

Sustainability background

The sustainable development of the economy is one of the main objectives within the sustainable development strategy towards the year 2020. Sustainability is targeted with regard to the triple bottom line of social, environmental and economic targets. Important objectives for the sustainable development of the built environment are: "Reduce greenhouse gas emissions by at least 20% compared to 1990 levels or by 30%, if the conditions are right, increase the share of renewable energy in our final energy consumption to 20%, and achieve a 20% increase in energy efficiency." (EU 2010, p. 30) Sustainability is generally defined as a state or condition in which all human activities are required to consider the protection of the ecosystem earth and its functions. Furthermore, sustainable development means a securing the functionality of the components of the ecosystem for the present and future generations. (prEN 15221-4, ISO 15392) The basis for sustainable development was defined in the eighties:

"Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainability does imply limits – not absolute limits, but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new area of economic growth." (Brundtland et al. 1987, p. 24)

Sustainable development in construction

Buildings, constructions and facilities must be tailored to suit the company's need to maintain profitability and achieve business growth. The construction, operation and usage of buildings require a lot of energy and resources. "The volume of the total abiotic primary material used in the German economy was 1,342 million tonnes in 2003. That makes 16.3 tonnes per capita of the population. Almost half (53%) of this was raw construction materials (for instance sand, gravel and broken natural stone) and some other mineral raw materials, which are used in particular in the glass and ceramics industry." (Federal statistical office 2005, p. 7) According to Brundtland, sustainable business development can be achieved with enhanced technology and better management methods. Facility Management in particular can sustainably shape the interdependency between the built environment and the business environment, because FM adds a special area of responsibility at the interface between the companies' core business and the accompanying secondary business processes.

The scope of FM has been broadened from the purely technical matters, i.e. the smooth operation and maintenance of facilities to overall real estate management over the last 10 years. Rondeau puts in a nutshell as follows: "In a number of organizations Facility Management has moved from the boiler room to the board room." (Rondeau 2006, p. 554). Scandinavian research engineers have compiled a "facility management value map" which measures the added value produced by FM. Taking account of its use of resources, its processes and products, and its influence on the environment and on companies' core

processes. (Jensen et al. 2008, p. 297) Moreover, a clear trend in Facility Management is visible: FM is extending its scope from a single building to the building peripherals and the built environment: Facility Management is on the move!

What still needs to be discussed is, how FM can contribute to a sustainable development of the built ecological environment. Possible assumptions are that FM can enhance this development directly through its improved use of resources, FM processes and applied FM products as well as indirectly through its influence on the economic, social and ecological environments.

METHODOLOGY / APPROACH

Model design as first phase in the model building methodology

Model building encompasses four phases: model design, model experiments and findings, interpretation and rechecking of findings in practice, and incorporation of findings into theory (Pilop 2004, p. 8). This paper presents findings from the first phase "model design".

A review of the literature research was the basis for the development of a preliminary model. The model development was discussed with researchers and professionals in four international workshops:

1. Presentation of the idea and preliminary SFM approach and discussion with researchers from SINTEF and NTNU, workshop in August 2010 at SINTEF in Trondheim.

2. A SFM research approach for a European study was presented and discussed at the European Research Network group workshop in September 2010 at EuroFM Meeting in Lisboan.

3. First results of the literature reviews were reconsidered, workshop in October 2010 at the Centre for Real Estate and Facilities Management at NTNU – Norwegian University of Science and Technology in Trondheim,

4. Presentation and discussion of SFM model design with researchers from Denmark, Finland, Germany and Norway, workshop in November 2010 at the Centre for Real Estate and Facilities Management at NTNU – Norwegian University of Science and Technology in Trondheim,

Planning and realization of literature review

Prior to the literature review on the research topic "Sustainable Facility Management", relevant buzz-words were selected. Initial tests showed that the number of hits varies significantly between "Facility Management" and "Facilities Management". Major differences were also noted between "Sustainable" and "Sustainability". Accordingly, both buzz-words had to be entered independently and the results had to be summarized by category and in total. The only catalogues selected for the literature review were those which offered a quick and reliable data query, and a comprehensive and up-to-date literature portfolio and permitted a sorting according to the year of publication or the regional distribution of the publication location.

The literature review was conducted in three steps: first, the most up-to-date, internationally available total portfolio of literatures was queried systematically. Secondly, the chronological

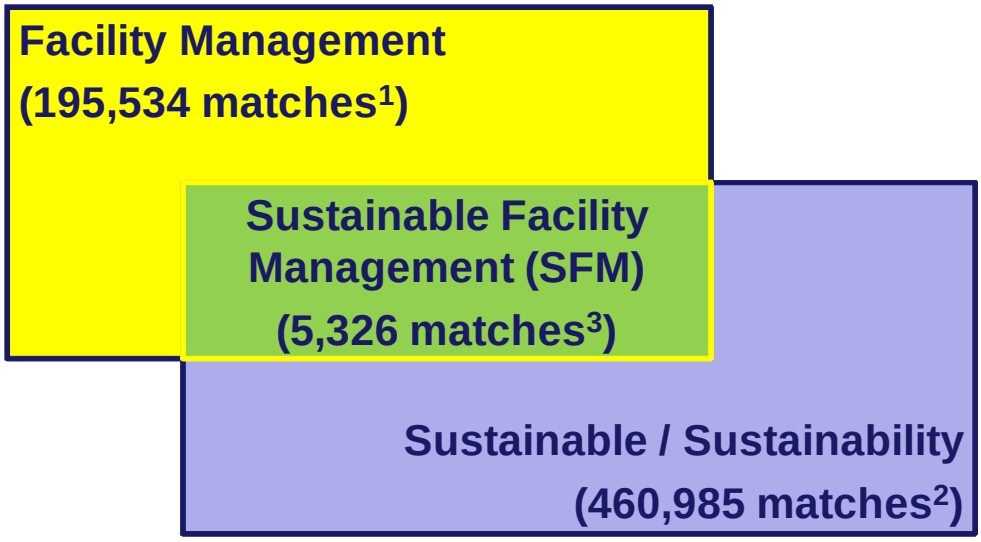
development of the publications within the last five years was investigated. Thirdly, the national distribution of publications within Europe was determined.

RESULTS

Results of the literature review

The following results were obtained: „WorldCat“ is an international publication catalogue covering mainly the American inventory and is accessible online at www.worldcat.org. “Facility Management” and “Facilities Management” produced 195,534 matches; “Sustainable” and “Sustainability” 460,985 and “Sustainable Facility Management” in all 4 combinations 5,326 matches (www.worldcat.org, query from Oct. 21st, 2010).

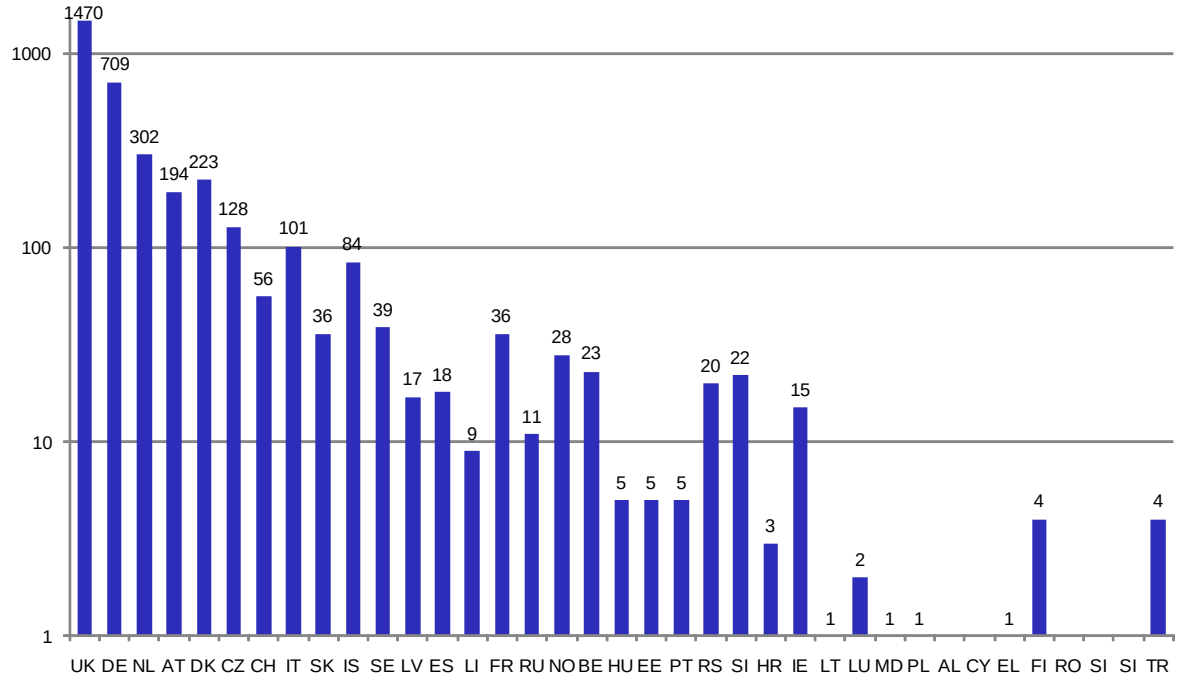
Figure 2: Results of international literature review in WorldCat



1. Facilities Management (FMies):134,702, Facility Management (FMy): 60,832.
2. Sustainability (Sy): 122,084, Sustainable (S): 338,901.
3. Sy & FMies: 2,109, S & FMies: 1,192, S & FMy: 1,419, Sy & FMy: 606.

„The European Library“ is a unified catalogue of national library catalogues in Europe. The unified catalogue allows sorting of the place of publication in Europe and is also accessible online: http//search.theeuropeanlibary.org. It is noticeable that the query in the European catalogue resulted in only 3,573 publications for the buzz-words “Facility Management” and “Facilities Management” and no hits at all for “Sustainable Facility Management”.

Figure 3: Number of Facility Management publications in European countries



It was therefore necessary to investigate alternative literature sources for European research papers. Furthermore, in the absence of matches for the buzz-words, a qualitative analysis of the published content would make sense. Out of the FM relevant magazines, i.e., “Facilities, “Building and environment” and “Journal of Facilities Management” and recent conference documentations, i.e., “European Facility Management Conference (EFMC)”, “International Council for Research and Innovation in Building and Construction – Facilities Management and Maintenance (CIB W 70)” and „International Conference on Sustainability Measurement and Modelling (ICSMM)“, SFM relevant publications were selected.

Preliminary Sustainable Facility Management model

In this section, basic principles are compiled and a preliminary structure and method for “Sustainable Facility Management” (SFM) are developed.

Facility Management contributes directly to a sustainable development of the built environment within the three major areas of responsibility: Support and improvement of the “main activities”, preservation and development of supply of services in the areas of both “space and infrastructure” and “people and organization”. Furthermore, FM contributes indirectly to the three overall target areas of sustainability: “the ecosystem, society and the economy”.

The preliminary SFM-model was developed in two steps:

1. Awareness of sustainability

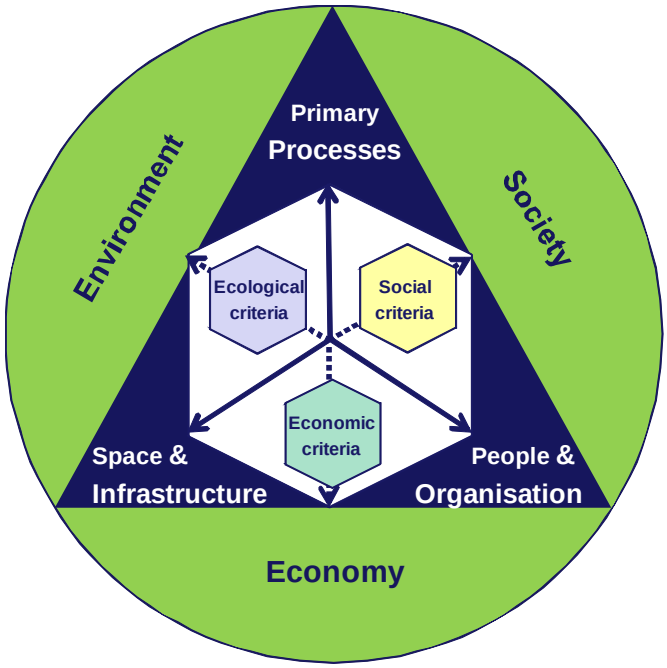
2. Integration of sustainability

1. Awareness of sustainability means to be aware if and how Facility Management impacts are sustainable. The organization’s surroundings become the focus of observation. What impacts on society, the environment and the economy are noticeable? How can sustainability be assessed in social, environmental and economic criteria? Up to now a comprehensive SFM

assessment tool is not available. Existing systems can be used in some cases. For example the US Green Building Council (USGBC) has published a guideline which is suitable for the assessment of existing buildings: „LEED 2009 for existing buildings operations and maintenance“ (LEED-EB 2009).

2. Integration of Sustainability targets the development of sustainable organizations through the integration of sustainable targets. After the basis of sustainable Facility Management is established and assessment targets and measurement categories are defined it is possible to view the whole system from a higher level. Gaining a perspective from outside the whole system makes it easier to see how the organisation interacts with its surroundings. The task is the integration of social, environmental and economic targets within the business strategy in Facility Management. The sustainable organization can be considered as one component of a sustainable society.

Figure 1: Basic structure of Sustainable Facility Management – SFM-Model.



The primary processes of companies can be defined by their mode, size and performance. European statistics on the economy separate them into four company sizes: Large enterprises (more than 250 employees), medium-sized (50 to 249 employees), small (10-49 employees) and microenterprises (1-9 employees). The eight main categories of non-financial business economy sectors are: mining and quarrying, manufacturing, electricity, gas and water supply, construction, distribution trades, hotels and restaurants, transport storage and communication, real estate renting and business activities. (eurostat 2009, p. 300) The development of SFM strategies needs to consider the various sizes and mode of operation of companies due to different frameworks and targets. An SFM strategy which incorporates the required FM services of a small-sized handicraft business providing construction services is not comparable with a large, internationally operating energy enterprise due to its different focus areas and contents.

FM services in the category „space and infrastructure“ support the real-estate related core processes of the companies and are, depending on the needs of the contractor, structured into: accommodation, workplace, technical infrastructure, cleaning and other spaces or

infrastructure. Services that have a direct impact on the built environment are: strategic space planning and management; conception and briefing of a room- and space-management program; design and building construction; lease and usage-management; building management and maintenance; refurbishment and/or reconstruction. Services in the area of technical infrastructure have an impact on the energy requirements and ecological quality of the built environment: energy- and energy-source management; sustainable environmental management; managing and maintaining the technical infrastructure; managing and maintaining the building's control system; maintenance of equipment; disposal management (including dangerous goods). (EN 15221-1)

The FM service category „people and organization" supports organizational core processes of companies and includes services in the following areas: health; safety at work; security and environmental issues; hospitality; information and communication; logistic and other supporting services. Examples of this FM service category are: office and welcome desk services; help desk; catering and vending machine services; organization of conferences, meetings and special events; human resources; supply of work clothes (EN 15221-1). As services provided in this category influence the quality of the workplace and result in specific demands for ecological products, they impact the interdependency between the company and the built environment.

Targets for SFM have to be structured according to the three dimensions of sustainability: society, the environment and the economy. Social targets may be: supply of adequate buildings for work and life; compliance with health, safety and security requirements. Ecological targets may be: reduction of resources, usage of recyclable building material; considering the separability of used material for re-use; reduction of energy consumption and usage of renewable energy sources; reduction of space requirements and soil sealing; safe-guarding the ability to maintain and de-construct buildings; preventing the usage of material causing excessive emissions (prEN 15221-4). Economic targets are: building space optimization for a most efficient usage; optimization of building life-cycle costs; facilitating the most efficient management methods.

DISCUSSION / CONCLUSION

The international literature research resulted in 195,534 matches for „Facility Management" and 5,326 for "Sustainable FM". The publications covered in this catalogue are mainly American (see figure 2). The query in the European union catalogue resulted in 3,573 matches in the „Facility Management" category. The majority of these publications are from the United Kingdom (1,470 matches), Germany (709 matches) and the Netherlands (302 matches). No hits were obtained in the buzz-word category "Sustainable FM" (see figure 3).

American publications in the Facility Management sector far outnumber European publications. Possible reasons for this huge deviation may be: possible different levels of up-to-datedness and completeness of the data banks used. Moreover, the fact that FM has been known in Europe for only 25 years and few research institutes exist may be reasons for few European publications in the FM area. For example, there is only one University chair in FM. Most of the FM degree programs are interdisciplinary programs and FM Professors reside in other university departments, e.g., business administration, architecture, construction engineering, building services engineering, mechanical engineering, life sciences and nutritional science and home economics. Another possible reason for the small amount in European publications may be the lack agreed definitions for FM services in Europe referred

to above. It may additionally be possible that the buzz-words have been stored differently in the different catalogues used and need to be queried by various possibilities.

Development trends in publications within the last five years and further trend indications

The number of international publications in the buzz-word category „Sustainability“ has been constant over the past five years. A declining trend for the “Facility Management” area was observed between 2005 and 2007, with a recovery in 2008 slightly above the 2005 level and drastic decline in 2009. “Sustainable FM” increased from 360 hits in 2005 to 677 hits in 2008 and decreased slightly in 2009 to 592 hits.

The qualitative in-depth analysis of publications showed that the term SFM is used differently. Most scientists use SFM mainly for ecological construction technologies or for techniques optimization to lower the energy consumption of existing buildings. Despite the fact that work is in progress in many locations, Jensen’s findings from two years ago are still valid: “The present knowledge about SFM is limited and incoherent, and there is a need to establish more research-based knowledge in order to define relevant strategies for different types of organizations and facilities.” (Jensen et al. 2008, p.4)

The following quotations reflect the most up to date perception of SFM:

“Sustainable facility management (SFM) is an 'umbrella' for various ways of reducing flows of energy, water and waste in the daily operation of the buildings, for instance by regularly monitoring the consumption, by using 'green accounting', by applying policies for sustainability, enhanced user awareness etc.” (Balslev et al. 2009, p. 1)

The conference paper “Delivering sustainable Facilities Management in Danish housing estates” by Balslev, Jensen and Jensen was presented at the International Conference for Sustainability Measurement and Modeling in 2009 (ICSMM 09). Susanne Balslev Nielsen, Jesper Ole Jensen and Per Anker Jensen are Professors and Researchers from the Technical University of Denmark and the Danish Building Research Institute. They indicate the central role of housing in sustainable development due to the large resource consumption. Current practice of housing administration in Denmark was the focus of their evaluation (Balslev et al. 2009).

In addition earlier scientific publications from the Technical University of Denmark “Sustainable FM – a new field of research and practice” (Jensen et al. 2008a) and “Managing facilities in a Scandinavian manner” (Elle et al. 2004) illustrate the Danish view on Sustainable Facility Management: “Sustainable Facilities Management (SFM) is one of the focus areas of the research centre. The concept covers social, economic and environmental sustainability; however our competences are implementation of new and sustainable technologies and practices in the built environment.” (Jensen et al. 2008, p. 1) “In the Scandinavian context, the main focus has been on environmental sustainability.” (Elle et al. 2004, p. 313)

Researchers from the UK have published “Barriers and commitment of the facilities management profession to the sustainability agenda” and illustrated the state of the art in Facility Management practice. The authors Abbas Elmualim, Daniel Shockley and Roberto Valle from the University of Reading - ICRC, The School of Construction Management and Engineering and Gordon Ludlow from the British Institute of Facilities Management (BIFM) analyse a survey of the experiences of facilities managers in the UK. The findings

demonstrate that “time constraints, lack of knowledge and lack of senior management commitment are the main barriers for the implementation of consistent and comprehensive sustainable FM policy and practice.” (Elmualim et al. 2010, p. 58) “Facility Managers have a great role in contributing to the reduction of the built environment impact on the environment and hence advancing the sustainability agenda across the three bottom lines of sustainability, the economic, environmental and social strands.” (Elmualim et al. 2010, p. 58)

From the US, the publication “A facility manager’s approach to sustainability” shows the role and responsibility of Facility Managers concerning sustainable and green practices. Christopher P. Hodges is founding Principal of Facility Engineering Associates and has over 25 years experience in the evaluation of building systems. (Hodges 2005, p. 312) "Reduction in water consumption, operations and maintenance (O&M) costs, building-related illnesses, waste and pollution, and increases in the comfort and productivity of occupants are also significant benefits of sustainable and green building practices." (Hodges, p. 314) "The primary incentive for following sustainable and green building practices is the reduction in energy consumption and the subsequent reduction in reliance on fossil fuel to produce that energy." (Hodges 2005, p. 314)

Final considerations on the definition of „Sustainable Facility Management“

FM has been defined as direct impact between companies‘ core processes and two categories of supporting service processes: 1. Building space and technical infrastructure; 2. Employee and organizational processes. Furthermore, the indirect impact on the environment, society and the economy has been described. FM influences the interdependency between the company and its environment, including the companies’ real-estate asset and infrastructure related constructions, which are also known as the built environment.

The publications analyzed focus on sustainable buildings and ecological modernization. This paper has not elaborated further on the interdependency of the companies’ core processes and their supporting FM processes. However, the corresponding dependency has been established by Jensen as part of a newly introduced SFM core research area at a scientific institute in Denmark (Jensen et al. 2008) and was included by Hodges in his survey on FM practices in the United Kingdom (Hodges 2006).

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REFERENCES

Balslev Nielsen, Susanne; Jensen, Jesper Ole; Jensen, Per Anker (2009): *Delivering sustainable Facilities Management in Danish housing estates*, conference paper: 2. International Conference on Sustainability Measurement and Modeling, ICSMM 09, CIMNE, Barcelona 2009.

BPF 2010: Department of Architectural Design and Management at NTNU – Norwegian University of Science and Technology, http://www.ntnu.edu/bpf, December 2010.

Brundtland, Gro Harlem (1987): *Our common future*, United Nation, General Assembly, Report of the World Commission on Environment and Development, 4 August 1987.

CAZ 2009: *Masterstudierende bei Facility Management Messe*, Campuszeitung der Fachhochschule Frankfurt am Main – University of Applied Sciences, Nr. 1, 2009, http://www.fh-frankfurt.de/de/.media/pressestelle/ffzarchiv/caz1.pdf, December 2010

CFM 2010: Centre for Facilities Management – Realdania Research, DTU Management Engineering, Technical University of Denmark, http://www.cfm.dtu.dk/English.aspx, December 2010

EN 15221-1: *Facility Management – Terms and Definitions*

prEN 15221-4: *Taxonomy of Facility Management*

EU 2010: Europe 2020 - *A European strategy for smart, sustainable and inclusive growth*, European Commission, Brussels, 2010.

Eurostat (2009): *Europe in figures*, Eurostat yearbook 2009

Elle, Morten; Engelmark, Jesper; Jörgensen, Bo et al. (2004): *Managing facilities in a Scandinavian manner – Creating a research agenda*, Facilities, Volume 22, Number 11/12 2004, pp. 311 - 316

Elmualim, Abbas; Shockley, Daniel; Valle, Roberto; Ludlow, Gordon; Shah, Sunil (2010): *Barriers and commitment of facilities management profession to the sustainability agenda*, Building and Environment 45 (2010), pp. 58-64.

Federal statistical office 2005: Energy, raw material and environment, Environmental economic accounting, 2005, http://www.destatis.de (request March 2011)

Hodges, Christopher P. (2005): *A facility manager's approach to sustainability*, Journal of Facilities Management, Vol. 3 No. 4, pp. 312-324.

ISO 15392 (2008): *Sustainability in Building Construction* - General Principles published in May 2008.

IFMALI (2010): IFMA Long Island Chapter, in: http://ifmali.org: *Welcome to the International Facility Management Association – What is Facility Management?*, December 2010.

Jensen, Per Anker; Balslev Nielsen, Susanne: *Sustainable FM – A new fild of research and practice*, ontwerpmanager, Vol. 3, 2008 (2008)

Jensen, Per Anker, et al. (2008): *Facilities Management best practice in the Nordic countries*, Centre for Facilities Management – Realdania Research, DTU Management Engineering, Technical University of Denmark, 2008.

KIT 2010: Institute for Technology and Management in Construction at Karlsruhe Institute of Technology, http://www.tmb.kit.edu/english/937.php, December 2010

Kyrö, Riikka; Määttänen, Eeva; Anttila, Anna; Lindholm, Anna-Liisa; Junnila, Seppo (2010): *Green Buildings and FM – A Case Study on How FM influences the Environmental Performance of Office Buildings*, CIB W070 Conference in FM, September 2010, Sao Paulo, Brazil, pp. 309-319.

LEED-EB 2009: *LEED 2009 for existing buildings operations and maintenance*, US green building council (USGBC), member approved November 2008, updated July 2010.

Metamorfose 2010: Centre for Real Estate and Facilities Management at NTNU – Norwegian University of Science and Technology, http://www.metamorfose.ntnu.no/english/index.php, December 2010.

Pilop, Marko (2004): *Die Methode der Modellierung und ihre Anwendung in der psychologischen Forschung*, Institut für Psychologie, Humboldt-Universität zu Berlin, 2004.

Rondeau, Edmond P. et al. (2006): *Facility Management*, second edition, Wiley & Sons, New Jersey 2006.

Ruiz, M.C.; Fernandez, I. (2009): *Environmental assessment in construction using a Spatial Decision Support System*, Automation in Construction 18 (2009), pp. 1135-1143.

Teichmann, Sven (2009): *FM Market Size in Europe*, European FM Insight, issue 11, p. 5-7, September 2009.

Wood, Brian (2006): *The role of existing buildings in the sustainability agenda*, Facilities Vol. 24 No. 1/2, pp. 61-67, 2006.

UNDERSTANDING THE STATUS AND DEVELOPMENT OF BUSINESS NETWORKS FOR CONSTRUCTION OPERATIONS

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This paper provides discussion on variety of relevant business networks and their development for construction operations. Various business networks in the context of temporary projects require special attention also from the managerial viewpoint. Such networks are of strategic importance and thus their should be monitored and maintained systematically. Practical tools for this purpose are rare or do not exist. A specific tool is proposed for estimating and communicating the degree of formal and informal relationships with regard of different networks on focus. Additionally, for future operations and network development new type of so called broker centred business networks are proposed as a new instrument that would help companies to be more agile and reactive in dynamically developing markets. However, local cultural conditions needs to be taken carefully in consideration when such networks are under development. Furthermore, local conditions is a vast country such as Russia can vary considerably from one region to another. The research behind of this paper has its origins on studies over operations of Finnish companiesin the Moscow and St. Petersburg area.

KEYWORDS: business networks, international construction, construction companies, management, Russia

INTRODUCTION

This paper encompasses networking of individuals, companies, institutions and other organizations for the creation of new business opportunities that can finally result in new operational manoeuvres (e.g. solution design and engineering, marketing project, customised product construction and delivery). Such arrangements can be temporarily or longer lasting systems and they are often called also business networks. Business network as a term has a rather broad coverage and it has a wide usage in spoken language rather than as a specific carefully defined concept. However, within this paper we use the term business network as a general reference to variety of networks enabling the creation and execution of business operations.

We adopt a perspective of a project supplier firm that has constantly multiple simultaneous delivery projects in its ‘project production line’. This is the usual business arrangement in the companies of built environment sector. More generally this is often termed as project based business. “The management of a business network is an area which includes novel research

themes that relate to several firms' activities, where the firms engage from time to time in mutual projects." (Artto & Kujala, 2008)).

LITERATURE REVIEW

The construction industry is a very heterogeneous combination of localised needs, various crafts, services, products and their professional providers. Even each service or product supplier can be seen as a business line of its own inside construction sector due to its specific characteristics, culture and terms of business. Different suppliers and other stakeholder are brought together around temporary projects in different stages of the production process. These conditions are often referred as fragmentation of the sector. On the other hand this is something we could also refer as construction project business that forms the main viewpoint of this study.

Project based business and the required arrangements can be characterised as temporary systemic set-ups. The following list incorporates the main contextual factors of the economic logic behind project business (modified from Kujala et al, 2008)

CONTEXTUAL FACTORS IN PROJECT-BASED BUSINESS

Business environment level:
- Accepted methods of doing business in the market segment (industry dominant logic)
- Behaviour and business culture
- Competitive situation
- Customers' strategies and preferences
- The distribution of capabilities and resources in the value chain

Company level:
- Market and technological uncertainty
- Resource, market and technological interdependence between projects
- Discontinuity between delivered projects to a customer or market segment
- Relative size and frequency of project deliveries

Project level:
- Project novelty – newness of the technical solution to the market
- Project uniqueness – similarity of a project compared to previously delivered projects
- Technical and organizational complexity of a project
- Uncertainty related to project goals, technology or implementation process
- Distribution and total cost in project lifecycle

Global internet enabled electronic-commerce, resources and financing opportunities have created new business environment where business networking is essential for all lines of businesses. Thus the business networking, its management and relating research have been very popular topics in different research institutions and provided also sources for consultative operations. The research and empirical evidence from live business operations have provided grounds for improved knowledge on business networking. Examples of such studies are (Benkler, 2006; Friel & López, 2005; Gloor, 2005; Kelly et al, 2009). Table 1 presents a synthesis of various main types of business networks that have been identified by

researchers. One should note that research community prefers to use term Inter-Organizational Relationships (IOR) since this as a term is more precisely expressing the phenomenon in question.

Table 1. Categories of business networks and their control for the visualisation of those with traffic lights.

TYPES OF BUSINESS NETWORKS	Degree of formal relationships	Degree of Informal relationships
Uncompelled Business Networking		
1. Long-term business network		
2. Short-term project network		
3. Business breeding networks (casual-contact networks, Virtual Breeding Environment)		
Technology enabled Business Networking		
4. Online networks (Collaborative Innovation Network, sales network)		
Service oriented Business Networking		
5. Service organizations (consultants, local agents)		
6. Professional associations (knowledge networks)		
7. Social/business organizations		

Networking and collaboration in networks have created a high interest in both research and in practical applications during the last decade, especially in the eBusiness area. In parallel with the development and spreading of Internet technologies, traditional collaboration networks have found new leveraging tools and the new collaborative business forms have emerged. Although many solutions have been based on ad-hoc applications of available technology, there have also attempts to create some systematic approaches for understanding collaboration in networks. The European project ECOLEAD (European Collaborative Networked Organizations Leadership Initiative) have recently addressed the development of new kind of solutions for business networking based on the virtual organization concept Camarinha-Matos et al, 2008). ECOLEAD vision: “In ten years, in response to fast changing market conditions, most enterprises and specially the SMEs will be part of some sustainable collaborative networks that will act as breeding environments for the formation of dynamic virtual organizations.”

The effectiveness of the virtual organization (VO) creation process is a critical element in collaborative networks. It is considered of importance that researchers have found that the concept of virtual organization (VO) appears particularly well-suited to cope with very dynamic and turbulent market conditions. The underlying rational the possibility of rapidly forming a consortium triggered by a business opportunity and specially tailored to the requirements of that opportunity. Implicit in this idea is a notion of agility, allowing rapid adaptation to a changing environment. In order to make this possible, a VO creation process is designed in the context of a virtual organization breeding environment context. A framework for VO creation is thus introduced and a set of assistance services are designed and tools developed.

RESEARCH RESULTS AND INDUSTRIAL IMPACT

The adopted leading business network vision is the movement from traditional business networking towards more agile solutions enabled by new goals and roles. Business networks and networking should not be only understood as a managerial focus area that needs additional attention. Furthermore new kind of activities and organizational arrangements are required for capitalizing the all potential business advantages arising from networked operations.

Virtual organizations, their content, dynamics and potential business impacts have been an active research and development field within last 10-15 years. One view is that virtual organizations are next stage of development of business structures (Warner & Witzel, 2004). Virtual organizations, their creation and maintenance have also seen to be closely linked to the advances of information and communication technologies. This has been a source of several major research and development efforts (Camarinha-Matos et al, 2005). Virtual business networks can be understood as an enabler for virtual organizations. Thus we see virtual business networks as a breeding that provides highest needed flexibility

- To have preparedness of participating players to set up a virtual organisation (VO) to meet market challenges
- To have different levels of commitments and rules in place than in a traditional, and more rigid, type of business networks.

Principles of new virtual business networks for dynamic markets

A broker is an example of a new player (individual or organizational unit) for enabling efficient creation, maintenance and operations of a virtual business network. Brokers have a specialized role in this business ecosystem as an engine that creates added value from VBE (Virtual Breeding Environment) and actively develops this environment. Brokers are (commonly) neutral players that can have confidential relationship with many parties. Brokers are experts in their field of business but also in communication, group work and decision making. Furthermore, advanced ICT tools and Web portals have an important role in these operations.

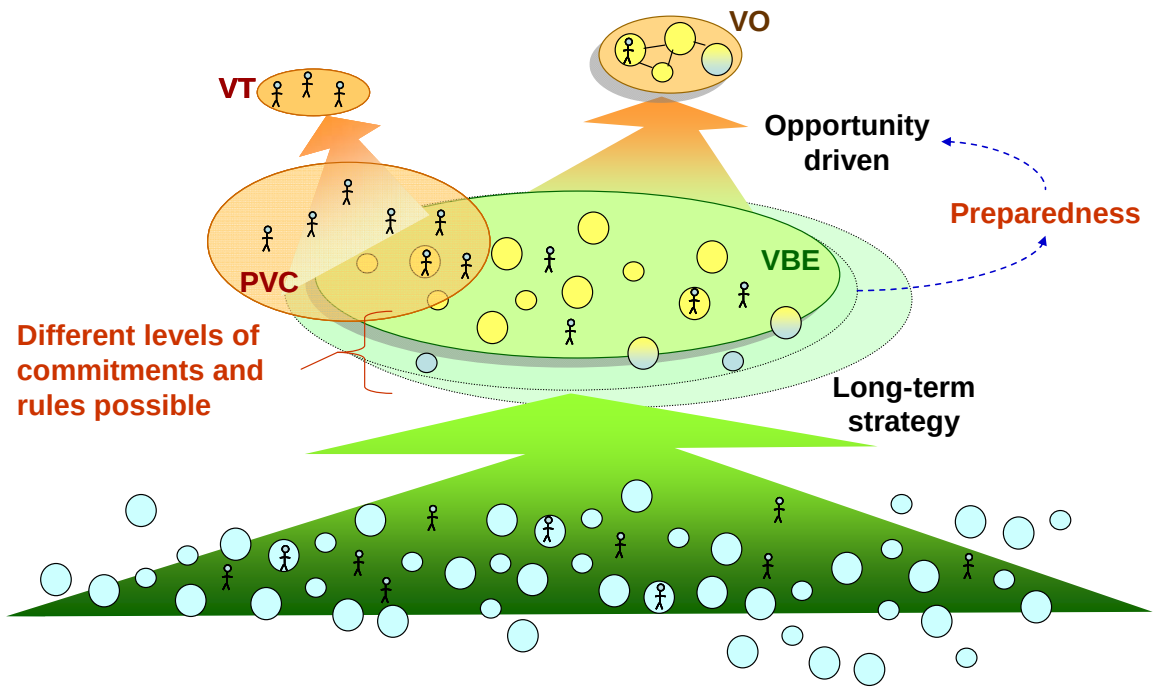
As practical activities brokers form a broker network or networks with specialized cooperative nodes to form dynamic business knowledge base.

Virtual Breeding Environment (VBE) aims to create preparedness within competent actors to set up a Virtual Organization (VO) that can contribute to meet changing market challenges. It has common operating principles and organizational model. When a VO is set up from legally independent organizations, it provides to the outside world a set of services and

functionality as one organization. VBE has an important role to act as a home for Professional Virtual Community (PVC). It is formed by skilled experts that find value from unofficial communicating with colleagues. Virtual Teams (VT) may arise from this social network when necessary to confront challenges common to the industry.

The concept of virtual organizations appears particularly well-suited to cope with dynamic and turbulent market conditions, such as the Russian construction market. It enables the possibility of rapidly forming a consortium triggered by a business opportunity and specially tailored to the requirements of that opportunity. Implicit in this idea is a notion of agility, allowing rapid adaptation to a changing environment. In order to make this possible, a VO creation process is designed in the context of a virtual organization breeding environment context. [Camarinha-Matos et al. 2008]

Figure 1. Virtual Breeding Environment for creating preparedness of participating players to set up a virtual organisation to meet market challenges. (Huovila et al., 2009)



Two approaches to form a VO can be identified: a top down process for a designed VO and a bottom up process for emerging VOs. In the previous case, a VBE member plays the role of an opportunity broker after having detected a collaboration opportunity. The forming of the VO is then coordinated by the VO planner who is either the opportunity broker or another partner. In the latter case, the broker announces the collaboration opportunity to the VBE members and then waits for the emergence of potential consortia. The selection of the most suitable consortium can be made by the customer, VO planner or the opportunity broker. Various research prototypes applying multi-agent systems and market-oriented negotiation mechanisms for the VO formation have been developed. [Camarinha-Matos et al. 2008]

Innovation networks

Innovation networks refer to the early stages of the development of business and project initiatives. Constant identification of new business opportunities in dynamic and turbulent conditions cannot be based on stable networks. Collaborative innovation network or CoIN, is a social construct used to describe innovative self-organized teams. One should note these network constructs are fairly unofficial and openness is strongly present for the creation of environment where knowledge sharing is perhaps the most important motivational driver.

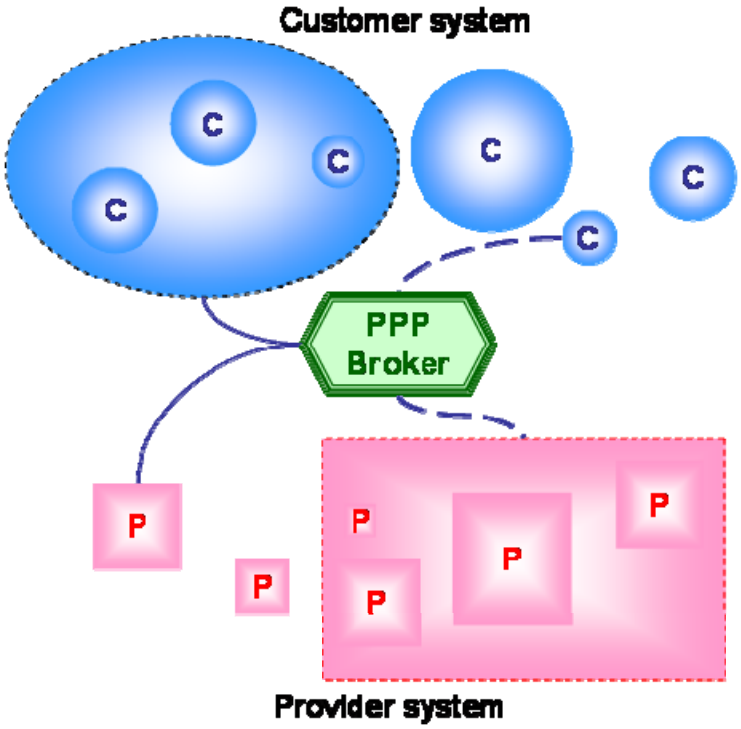
The five essential elements of collaborative innovation networks (what Gloor calls their "genetic code") are as follows (Gloor, 2005):

1. Evolve from learning networks
2. Feature sound ethical principles
3. Based on trust and self-organization
4. Make knowledge accessible to everyone
5. Operate in internal honesty and transparency

Broker centred business networks for sales

Business networks can be formed by opportunity brokers that detect appropriate business opportunities. The following figure shows an example of a Public Private Partnership (PPP) broker that helps in both setting up the customer system to the public demand side, and then connects that to the supply system built up in the delivery side.

Figure 2. PPP Broker.



Customer expectations in such an case can vary from a big customer with large service capacity needs that one service provider can not provide to small customers that lack competence to run the project efficiently or have no public bidding knowledge. Successful brokering requires expertise on business network management, public acquisition legislation and methods, and risk and value sharing.

Buzulukova (2009) has identified e.g. the following specific features in the Russian market: to progress fast, the decisions should be agreed with the general director of the company, in the early steps of collaboration distrust is common and all details should be documented, and difficulties to penetrate in existing relationships in construction. Business environments where everything is expected be agreed on paper, decisions must be brought to the top level and existing networks are strong and repulsive, are challenging for VBE brokers. They could work just to find the appropriate partner network, e.g. the bidding consortium or some finance agent. Or, if the principal agreements can be made at the level of the president of the company the brokers may act based on given mandate. The succeed the brokers need to justify the added value of their role, e.g. in finding paying customers, identifying customer needs, increasing service quality, saving time, managing risks or packaging a service tray individual actors couldn't make on their own.

Broker centred production and deliveries

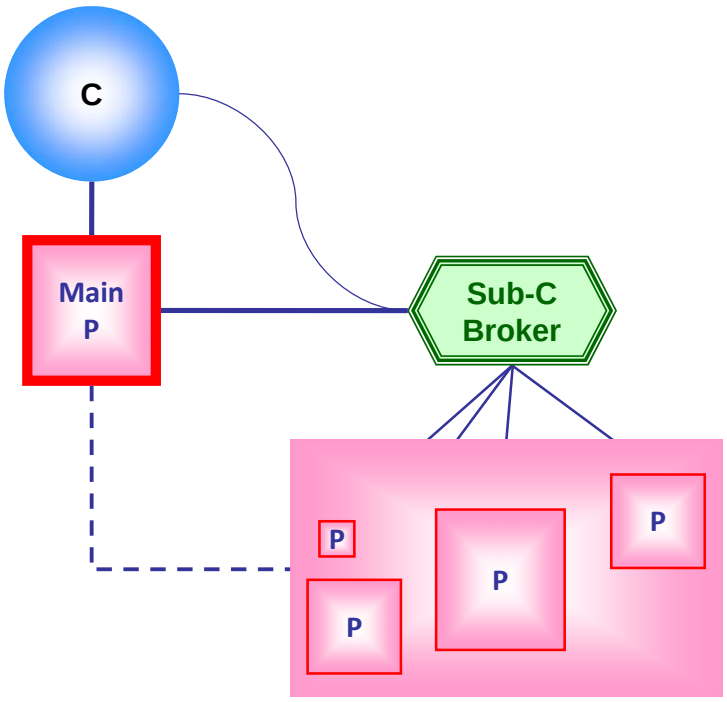
Brokers can act as operational coordinators of production and deliveries in a very successful manner even in the case of very complex mega projects. Evidence of that was provided in the BAA's Terminal 5 project (Brady et al, 2008). However, new kind of contracts were needed to create potential incentives. In this project the owner organization that is BAA decided to reimburse the costs of delivery and to reward exceptional performance and penalise inferior performance only in terms of profitability. This overall arrangement provided suitable arrangement for the successful work of a specialist the characteristics of which are very close to those of a broker.

Virtual design networks

In construction, customers may have specific service needs that can be provided by number of scattered small firms with specialized competence. The main contractor is often responsible for the design to the customer. Managing a network of specialized design firms can be run by a broker, having skills in managing a virtual design network.

The Subcontractor Broker creates and manages the virtual design network for the main provider, e.g. the main contractor that owns the customership (figure 3). Such broker can manage also some functions directly with the customer if that's required. The main provider outsources the subcontractor design network management to focus on customer relationship management and service innovation. The broker needs to have expertise on the VBE network ecosystem elaboration and management, project management, virtual organization management and legislation.

Figure 3. Subcontractor management Broker



Minina et al. (2009) identified that in informal practices in Russian companies social network is more important than professional, and that personal trust is more important than institutional. In addition, within local personnel the support and help each other on horizontal level exists and people are highly motivated by development opportunities. A Virtual design network could be built on these strengths when the broker has skills in human resource management and social networks. Relevant VO tools and e.g. social media could provide opportunities for innovative VT building for agile individuals and VOs.

DISCUSSION

We can see virtual business networks as a next stage of overall commercial systems development or something else but nevertheless they are different than the traditional business networks. Despite of this the existing cultural characteristics together with people's and institutions' expectations needs to be taken carefully into account when maneuvers towards virtual business networks are planned. The following reveals some important characteristics of business relationships in Russia that are very likely to stay as important factors affecting various operations.

- **The role of personal bonding and contacts** in the business-to-business markets can be considered to be of a very high importance (Ledeneva 1998; Michailova and Worm 2003; Fallon and Jones 2004).
- **Persons beyond the simple dyadic relationship i.e. third persons** are usually involved Michailova and Worm (2003)
- **The continuity of personal relationships** plays a very significant role. The longer staying of expatriates (than usually) would offer opportunities for establishing strong inter-personal relationships.

- **The relationship and contacts need to be maintained between projects and** naturally during the project execution in a continuous manner. This is a Russian expectation and thus ”silence” is to be avoided constantly.

Table 2. Benefits of long-term inter-organizational relationships in Russia

Functional (operational efficiency)	
Benefit	**Example**
– Joint problem solving	– Increased efficiency through solving problems in a mutually accepted way
– Reduced malfeasance	– Reduction of opportunistic behaviour
– Crises management	– Even deep crises can be solved on the basis of good personal relationships
– Transfer of fine grained information	– Access to information that enable to increase operational efficiency.
– Control benefits	– Ability to affect the actions those actors are connected to
– Process innovation	– Improved efficiency
– Reduction of transaction costs	– Reduction of monitoring costs – Enables the use of more efficient governance modes
Relational (indirect impact to operations)	
Benefit	**Example**
– Referrals	– Increased project marketing success
– Credibility	– Actors may need inter-organizational relationships to certain parties in order to be considered as a potential supplier.
– Position in the network	– Advantageous position in the milieu. Ability to participate in project deliveries

Organizations may leverage IORs to gain relational benefits, such as reputation and referrals, leading to increased success in initiating and marketing new projects to existing and potential customers. This implies that project actors need to assess the state of their IORs to relevant business and non-business actors in the milieu and proactively plan how they are to be developed and leveraged in the future

This finding highlights the strategic importance of IOR development, as actors participating in project deliveries need to spend a lot of time and resources and undertake several consequent projects to be able to build and cultivate their IORs and be able to fully reap their benefits

Technical delivery capability alone is not adequate, because the lack of IORs effectively eliminates the possibility to market successfully succeeding project initiatives. In Russian business-to-business markets, the importance of interpersonal relationships is emphasized and in order to be able to tender for industrial systems, the supplying organization must employ persons with strong interpersonal relationships to key business and non-business actors in the milieu. Repetitive and successful project deliveries can be considered as the primary

mechanism for building and maintaining long-term IORs. The competitive advantage has been created by developing strong relationships to the key actors through successful project deliveries and other relationship building activities in between projects.

Recommendations for new kind of actions and targets for business networking in Russia:

- Due to its strategic importance the company management should employ systematic procedures (tools, regular reviews, item in management meeting agenda) for business network management
- From informal personal relationships to more informal business relationships
    - The role of inter-personal relationships as a catalyst
    - Persistent relationship building
        - Several years before initial contract for first project signed
    - Capabilities in relationship building
- Companies seems not to do adequately safeguard from malfeasance
    - Building of long-term relationships that base on long-term inter-personal relationships provide a competitive advantage because they are difficult to imitate

  ➔Stable organizational structures as risk management

- The success or failure of the initial project delivery then determined whether the relationships could be further strengthened and leveraged to gain future business opportunities or not. Conclusion: Put more attention on project start-up.

CONCLUSIONS

The field of Inter-Organizational Relationships that is often referred as business networking has clearly elaborated during last decade into a disciple of its own. At the same time and particularly as a impact of Internet enabled eBusiness new dimensions and concepts have arisen in this field. Perhaps the most important of those is the Virtual Organization concept and its applications. Researchers have found that the concept of virtual organization (VO) appears particularly well-suited to cope with very dynamic and turbulent market conditions. This provides origins of some important proposals presented in this paper. It is considered that new kind of business networks which have been named as broker centred virtual organizations can play important role for construction business operations is Russia in near future. However, one should take into account local cultural factors that can broadly affect of the creation and maintenance of these networks.

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REFERENCES

Artto, K. and Kujala, J. (2008) Project business as a research field, International Journal of Managing Projects in Business, Vol. 1 No. 4, 2008, pp. 469-497

Benkler, Y. (2006) The Wealth of Networks - How Social Production Transforms Markets and Freedom, Yale University Press.

Brady, T., Davies, A., Gann, D. and Prof. Rush, H. (2008) Learning to manage mega projects: the case of BAA and Heathrow Terminal 5, Project Perspectives XXIX, pp. 32-39.

Buzulukova, E. (2009). Marketing and customer orientation. Presentation material of research seminar, Moscow, Higher School of Economics of Moscow State University, October 2009.

Camarinha-Matos, L.M., Afsarmanesh, H., and Ollus, M. (2005). Ecolead: A Holistic Approach to Creation and Management of Dynamic Virtual Organizations, Springer Boston

Camarinha-Matos L.M., Afsarmanesh H., and Ollus, M. (eds.) (2008). Methods and Tools for Collaborative Networked Organizations. ISBN 978-0-387-79423-5. Springer, New York.

Cova, B., Ghauri, P., & Salle, R. (2002). Project marketing — beyond competitive bidding. Chichester John Wiley & Sons.

Friel, D. and López, D. (2005) Towards an Understanding of Different Types of Business Networks, La Universidad de San Andrés Working paper 55, Buenos Aires, Argentina.

Gloor, P. (2005) Swarm Creativity: Competitive Advantage Through Collaborative Innovation Networks.

Huovila, P., Ryynänen, T. & Oostra, M. (2009). ManuBuild Business Model. VTT, Espoo, Finland.

Kelly, J.F., Pryke, S., Rigby, J. and Winch, G. (2009) Project Coalition as a Network Organisation, Proceedings of IRNOP IX (The International Research Network on Organizing by Projects), Berlin 11-13 October 2009.

Kujala, J., Artto, K. and Parhankangas, A. Factors influencing design and performance of the business model of a project-based firm , Project Perspectives, Vol. XXXI, 2008, 14-17

Minina, V., Dmitrienko, E. & Krupskaya, A. (2009). Competence of Human Resource Management, Presentation material of research seminar, Moscow, Higher School of Economics of Moscow State University, October 2009.

Warner, M. and Witzel, M. (2004): Managing in Virtual Organizations, London: Thomson Publishing Corporation.

NEGOTIATING ACCESS INTO FIRMS: OBSTACLES AND STRATEGIES

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Researchers often experience difficulties with the negotiation of access into firms for the purpose of data collection. The question we explore is: What are the main obstacles associated with access negotiation into firms; and what strategies do researchers employ to increase their chances of success? Our research work on the tendering process of contractors took place between 2006 and 2008. We successfully negotiated access into four firms (two each in Ghana and the UK) to observe live examples of tender preparation The techniques we employed in negotiating access were personal contacts, contacting firms through online details and professional institutions, etc. With all of this effort, our average success rate was less than 5 per cent. The main obstacles encountered were firms' reluctance because of commercial sensitiveness and fear that the data could eventually be divulged to their competitors or end up in the public domain. However, some firms agreed mainly because of the written assurances of confidentiality and anonymity in reporting the study; reputation of the researchers' academic institution; gatekeepers who spoke to their colleagues on our behalf; academic purpose of the study; and a feedback report which was promised in return for access to the case studies. Although the access through personal contacts is by far the easiest, it is not always possible. Researchers can approach firms as complete strangers, especially in a foreign country, and that could make the firms more likely to assist the research.

KEYWORDS: access, access negotiation, data collection, Ghana, UK

INTRODUCTION

Researchers often experience difficulties with the negotiation of access into organisations for the purpose of data collection (as explained by Buchanan *et al*. in Bryman 1988). This is particularly common when the data required is sensitive in nature (Koosimile, 2002). The research literature shows that the negotiation of access into fieldwork settings is a subject that covers various academic disciplines (as demonstrated in research studies carried out by Reeves, 2010; Matthiesen and Richter, 2007; DeVerteuil, 2004; and Mintzberg, 1973). There are significant similarities in the access negotiation obstacles encountered by researchers working in different academic disciplines, for example management, psychology, geography and sociology. There is also significant similarity in the strategies used by the researchers to negotiate access. Thus, access negotiation is an interdisciplinary subject in research theory and practice. Insights from different fields can help to develop a better understanding of the obstacles and strategies of access negotiation into firms from different perspectives.

Between 2006 and 2008, we successfully negotiated access into four firms (two each in Ghana and the UK) to enable us to carry out a live observation of the whole tendering process of contractors in the tendering and estimating departments of firms (reported in Laryea and Hughes, 2011; Laryea and Hughes, 2008; and Laryea, 2008). The aim here is to discuss our access negotiation experiences. We explore the main obstacles associated with access negotiation into firms; and the strategies used by researchers, here and elsewhere in the literature, to increase the chances of success. For the purpose of this study, access negotiation is the process of dialogue between a researcher and the people in a target firm to enable the researcher to obtain access into the firm for the purpose of data collection using techniques including observation, analysis of documents and interviewing people.

A REVIEW OF STUDIES INVOLVING ACCESS NEGOTIATION

Matthiesen and Richter (2007) discussed nine areas to consider and delineate when planning for access negotiation into firms. These are: level of access required, target organisations, benefits to participants, sponsors, stakeholders, participants, data management, time and resources required to undertake the study. A clear and good grasp of these areas should help to increase the chances of success and make a good first contact with participants. Table 1 summarises some studies involving extensive access negotiation into fieldwork settings.

Table 1: Summary of some studies involving access negotiation

Author(s)	Country	Research strategy, methods, etc.	Access negotiation obstacles	Access negotiation strategies	Time taken to negotiate access	Number of subjects or organisations
Reeves, C.L. (2010)	UK	Case studies using interviews, participant observation	Layers of gatekeepers	Using gatekeepers, establishing rapport with people in the fieldwork setting	Six months	One hostel
Mora-Ríos, J. *et al.* (2008)	Mexico	Participant observation, free-association technique, interviews	Ethical considerations, obtaining informed consent	Initial contact, meeting community leaders, snowball technique	Not specified	One community in Mexico (48 interviews with people in the community)
DeVerteuil, G. (2003)	US	Interviews	Factional divide, spatiotemporal limits	Spatial and temporal strategies (pp. 377-8)	Not specified	One emergency shelter for females
Sixsmith *et al*. (2003)	UK	Ethnographic case study using interviews, focus groups, questionnaire	Lack of personal contacts, little understanding of sociocultural context	Stakeholder analysis, advertising, gatekeepers, highlighting benefits to participants	Not specified	One community in England (146 individuals)
Koosimile, A.T. (2002)	Botswana	Case study One year (1997/08)	Suspicion, bureaucratic formalities, consent of respondents, micropolitics,	Letters, physical follow-ups, sponsors, gatekeepers, meetings, good self impression	Three months	26 science teachers in 8 Community Junior Secondary Schools
Mintzberg, H. (1973)	US	Structured observation	Not clearly described	-	Not specified	Five managers

Note: A detailed literature search carried out to identify a construction management study involving extensive access negotiation into firms for the purpose of data collection is yet to yield any meaningful result.

Negotiating access involves a constant process of approaching, entering, exiting a field setting containing data subjects (Delamont, 1992). Thus, access is not something that is negotiated once and then settled for the whole fieldwork (as also explained in most of the studies summarised in Table 1). Gaining access is a process, rather than a simple decision or event. In fact, access negotiations are likely to be continuous throughout the life of a research

project (Delamont, 1992). This view is confirmed in research by Koosimile (2002) and Reeves (2010) where the researchers' experiences shows that part of this involves negotiating general access into a fieldwork setting and then negotiating specific accesses within the fieldwork setting to get the cooperation and support of individual respondents.

Despite the difficulties associated with negotiating access into fieldwork settings, good planning, foresight and being proactive can help to increase the chances of success greatly. Koosimile (2002) conducted a one year case study on the implementation of a new science curriculum in lower secondary schools in Botswana. The study was based on 26 science teachers in eight Community Junior Secondary Schools in one village. The main research methods used were classroom observations, interviews, and document collection. The strategies used to negotiate access included initiating contact through official letters: one directed to the Permanent Secretary in the Ministry of Education, others to the individual school heads. This was followed up with physical visits to the Ministry and the schools involved. The Ministry's approval facilitated consent by the schools that participated.

Reeves' (2010) study into the daily life patterns of sex offenders within their probation hostel was based on a three-phase exploratory study conducted over 21 months using interviews and participant observation. Access negotiation involved the use of gatekeepers. The hostel manager was approached six months before the planned time for fieldwork through the researcher's friend who works with the manager. This approach was informed by suggestions from researchers such as Duke (2002); Wilkes (1999) and Winkler (1987) that the use of personal contacts to a study site can facilitate access negotiation and bypassing bureaucratic channels. Another issue mentioned by Reeves (2010: 318), although not in detail, is the role of gender in facilitating access negotiation. Researchers like Gurney (1991: 379) have earlier suggested that female researchers may be able to negotiate access quicker than their male counterparts especially when the research setting is a male-dominated environment. This is clearly an area for future research.

The aim of the research project carried out by Sixsmith, Boneham and Goldring (2003) was to explore the relationship between social capital, health, and gender in a socially deprived community in the Northwest of England. The study examined some of the main practical issues and strategies for maintaining credibility and trust. Access to participants was secured through advertising, snowballing, accessing gatekeepers, and street surveys. Mora-Ríos, J. *et al*. (2008) investigated the concepts of distress and well-being in a marginalized community in Mexico City with 3,016 inhabitants. The research methods used were participant observation, in-depth interviews, free-association technique, and focus groups. Access negotiation involved initial contact with the community through a group of psychologists already on the ground in the community. This was followed by meetings with community leaders and then gaining access to individuals using a snowballing approach.

A study carried out (within a homeless shelter for 18 single adult women with a maximum three-month stay) on how barriers originate, are encountered, and are potentially overcome within specific research settings revealed at least ten barriers to researcher access (DeVerteuil 2003): researcher's positionality vis-à-vis participants; outsider status i.e. distance between researcher and participants; social barriers (e.g., vastly different lived experiences between participants and researcher); strict social, religious, and gender boundaries; presence of factions i.e. the fact that many difficult settings are rife with division, cliques, and internal distrust; close doors or off-limit spaces i.e. ''not all aspects of the setting you wish to observe or everyone you wish to interview will be available''; spatiotemporal limits of a male

researcher trying to investigate an emergency shelter for women. The study discussed two sets of barriers in detail: the factional divide and inherent spatiotemporal limits.

Seven main points can be highlighted from the literature review in relation to access negotiation obstacles and strategies. First, there are multiple layers of access negotiation into firms. Second, gatekeepers can be both advantageous and disadvantageous. Gatekeepers act as a conduit for access between researchers and participants (De Laine, 2000) and they often have local influence and power to add credibility and validity to the project by their acceptance of it (Seidman, 1998). On the other hand, gatekeepers can erect barriers, prevent access and obstruct a research project (Berg, 1999 and Clark, 2010). Third, more than one technique often needs to be used to negotiate access. Fourth, a significant amount of sensitivity and skills is required in access negotiation. Fifth, personal contacts are useful but it is not always possible. Sixth, the main strategies for negotiating access in most cases are gatekeepers, making a good first contact, personal contacts, highlighting benefits to participants, and physical follow-ups. Seventh, the main obstacles to negotiating access into firms are layers of gatekeepers to overcome, ethics, confidentiality, informed consent, lack of personal contacts, micropolitics in organisations, suspicion and bureaucratic formalities.

NEGOTIATING ACCESS INTO FOUR FIRMS

The four firms involved in the study are hereafter referred to as Alpha, Beta, Gamma and Delta. Alpha and Beta are construction firms in Ghana. Gamma and Delta are construction firms in the UK. The experiences of ethnographic researchers such as Glidewell (1959), Johnson (1975) and Winkler (1987) inform our access negotiation preparations. Most of them spent a considerable amount of time on negotiating access. Thus, it was important to learn from their experiences to help us overcome potential access negotiation problems.

The research interest here was the bidding process of contractors, which involves commercially sensitive information including prices and competitors. Past studies of contractors in the UK, for example Skitmore and Wilcock (1994: 142) had showed that gaining access to commercially sensitive information of contractors is difficult. Therefore, one access negotiation strategy was to use personal contacts and gatekeepers in target firms. This was informed by the advice given by Glidewell (1959) and Winkler (1987), each of whom spent about one-third of their research project time in negotiating access, in relation to the use of early planning and friends and contacts within target firms as tools for negotiating access. Johnson (1975) even suggested the use of slight deception to gain access despite its ethical implications explained in Gill and Johnson (2010) and Bell (1999).

A number of our industry contacts provided assistance with our access negotiations. One of them suggested that the lead researcher should mention the fact that he was carrying out the research work as a foreigner in the country of study. According to him "…this will make the recipients more likely to assist your research". We found the advice to be in contrast with suggestions in the literature, which suggested that the use of personal contacts was a factor that would make firms more willing to assist the research. However, in the end, two of the case study firms were firms where we had no personal contacts at all.

In two of the cases, a written letter was sent to contractors in the first instance. The request was specific, honest and straightforward. The researcher was seeking an opportunity to observe live tender processes to write up case studies for a doctoral study. In the end, the contractors who agreed mainly did so because of the influential role of the gatekeepers who

spoke to their colleagues on our behalf; the academic purpose of the study; the written assurances of confidentiality and anonymity in reporting the study; and a feedback report which was promised in return for access to the case studies. It was also mentioned in the letter that the researcher's professional background as a Quantity Surveyor could enable him to provide an extra pair of hands to the bid team for some routine tasks.

The letter to contractors explained the purpose of the study but there was no specific mention of the interest in learning about how contractors price risk. It was felt important not to distort the research by prompting the contractors about how they incorporate risk into their prices, because such a direct prompt might not reveal the true position of risk in the context of their own bid pricing processes. The approach taken was to help in separating the variables being measured from external influences or the researcher's own prompts.

It was generally difficult to secure access into the four firms and a wide range of ideas and skills had to be employed. Each contractor was clearly concerned about the commercially sensitive nature of the data involved in the study. For example, the managing director of one of the targeted firms in Ghana said: "…it would be impossible for us to allow you or anyone else to come in and see our prices. That is all the power we have as contractors. Even here in the company, only about two or three of us are involved in the final stages of what we price the bid at. Then we lock it in a safe." In the UK, similar difficulties were experienced in negotiating access. For example, the director in charge of estimating in one firm emailed us the following response: "…I'm afraid that much of the detail we think you are likely to need will be too commercially sensitive for us to grant your request or release to you as this is effectively into the public domain." Therefore, the access negotiation process was difficult. The detailed process used to negotiate access into each of the firms is now explained.

Alpha access negotiation

Alpha is one of the leading building and civil engineering construction firm in Ghana. The firm employs approximately 1700 people and has an annual turnover of ¢7 billion cedis. The main factor that facilitated access negotiation into Alpha was the use of personal contacts. The lead researcher, whose professional background is Quantity Surveying, resigned from his full-time job in order to take up the full-time PhD position. However, due to practical training requirements of the professional exam of the Ghana Institution of Surveyors (GhIS), I was required to affiliate with a quantity surveying practice in Ghana to keep his knowledge of quantity surveying practice updated. Although Alpha is primary a contractor, it has professional Quantity Surveyors working in their tendering department so it was an acceptable place to train for the GhIS qualification. The researcher negotiated a one-day per week working arrangement with Alpha in order to satisfy the professional training requirements. The reason I negotiated the professional training arrangement with Alpha is because of the personal contacts I had in the firm. Prior to the PhD, I used to work on construction sites of a university in Ghana as a client representative. It is in the course of this work that I met some of the key employees of Alpha who was contractor for a couple of projects at the university. When I resigned from my post at the university to take up the PhD position I used my contacts in Alpha to negotiate the professional training arrangement. By the time it emerged that my PhD research work would involve a live observational study of the tendering process of contractors, I had developed sufficient ground and trust in Alpha to help me obtain access for the study. I was known to them so there was little cause to suspect that I was coming in as a "spy" or be an "intruder". This situation facilitated access. Without prior engagement with the key people at Alpha, I doubt that I would have been able to secure access into the tendering department of this leading firm in Ghana. All contractors I came

into contact with in the course of the study are very sensitive about commercial issues and are not likely to take a risk on the survival of their business just to help a researcher. Fortunately, I did not even need to put in a formal letter to request for access. I simply visited the firm and discussed the study with the key people I knew. With their approval, I was granted access and supported throughout my research work. Thus, as advocated by Winkler (1987), the use of contacts within target organisations remains a powerful tool for negotiating access.

Beta access negotiation

The access negotiation into Beta was similar to the processes used to gain access into Alpha. On the type of work that Beta does, the Technical Manager said: "...we are building and civil engineering contractors who do all kinds of jobs apart from roads. We do design and build and unit rate contracts. Most portions of their work are often subcontracted." The lead researcher came into contact with a number of contractor's representatives in the course of his work on university construction sites. Most of these people were senior and influential people in their firms. One of the contractor's representatives became a very close friend who later helped to negotiate the access I required to carry out the case study in Beta. Here too, there was not really the need for a formal access request letter. I had visited the firm a few times prior to the time of the research work so I was known to them. My key contact in Beta and prior engagement with the firm proved useful in oiling the wheels of the access negotiation.

Gamma access negotiation

Gamma is one of the UK's top 20 construction firms (Hansford, 2008). The access negotiation into firms in the UK was clearly more difficult. After several attempt to persuade contractors for a case study opportunity had failed, an email was written to the Civil Engineering Contractors Association (CECA) to ask for help with contacts of contractors who would be most likely to help. Prior to this, we had the Institution of Civil Engineers (ICE) who issued an email to their members to introduce the research and the help needed. This effort did not yield any case study opportunity but we felt very grateful to the ICE. CECA replied our email with a list of four contacts and we wrote to each of them for a case study opportunity. Two of them declined outright citing reasons of commercial sensitiveness. The Managing Director of the third firm said it was "possible" for them to "look into the request" at a meeting of the company's board.

With no positive response from any of the firms after a while, frustration was clearly setting in as a result of the difficulties encountered. It was decided to call the contact in the fourth firm. He held a high position in the firm and as we spoke on the phone, I explained the study to him. The discussions went well and one reason for this is because the contact details had been supplied by CECA. He himself was not directly involved in the tendering processes of the firm. Therefore, he promised to discuss the request with the chief estimator on our behalf. Fortunately, the initial response was positive and the lead researcher was invited to the contractor's office to discuss the access request. The firm called the university to confirm my identity. When I arrived in the firm, a new tender process was about to commence. I pressed for an opportunity to shadow that particular one because of the time available for the study and the request was granted. With the Gamma case study secured, we started to look for another case study opportunity. As a result of our success with negotiating access into Ghana, we believed that we would be able to secure access into another firm.

Delta access negotiation

Delta is also one of the UK's top 20 construction firms (Hansford, 2008). During the time of carrying out the Gamma case study, a detailed search was carried out on the internet for

contact details of personnel in construction firms in the UK. Thus, employees of contractors were contacted through email for an opportunity to shadow one tender process in their firm. Emails were written to 87 contractors. 86% responded with an outright answer of "No" citing the "intrusive" nature of the study and the "commercially sensitive" nature of the information involved. Most of them, however, wished us "best of luck" with the study! 12% of the firms said they needed to discuss the access request at the management board level. To date, no formal response has been received from any of the firms. After several follow-up emails, phone calls and assurance of confidentiality and anonymity, only two contractors agreed in principle to consider granting access for the study. One of them asked if we would be willing to travel a long distance away from Reading to the location of the company's head office. Our answer was "Yes". He promised to get back to us after discussion with senior colleagues but to date we have received no response. Just around the time when the access to another case study started to prove elusive, the Business Development Manager in Delta contacted us with a request for more information about the study. We supplied her with ample information and contact details of officials in the university with whom she could confirm the purely academic nature of my study. After a week, she wrote to confirm the access approval and asked us to liaise with their human resources department concerning the details of the opportunity. The access negotiation success rate in the Delta case was clearly low i.e. from initial contact with 87 firms, only one firm granted access for the study.

DISCUSSION

Five main points are brought forward for discussion. First, the main factor that facilitated access negotiation in Alpha and Beta was the use of personal contacts. Personal contacts facilitated the access negotiation process greatly which confirms assertions in Matthiesen and Richter (2007) and Winkler (1987). Access negotiation into Gamma and Delta was more difficult and the main factor that facilitated access was the key people (gatekeepers) in the firms. This reinforces the importance of gatekeepers in access negotiation (see a detailed discussion relating to this point in Clark's (2010) study on the relationship between gatekeepers and researchers). Second, time taken to negotiate access was fairly long in the case of Gamma and Delta. Here, Winkler's (1987) advice on early planning in studies of such nature would be helpful. DeVerteuil's (2004) study examined barriers to researcher access and provides some useful suggestions for overcoming access negotiation difficulties. Third, access negotiation success rate varied in the four cases. The main concern for most contractors was not intrusion (as suggested in Gill and Johnson, 2010) but commercial sensitiveness of the information involved (as suggested in Skitmore and Wilcock, 1994). Fourth, one of the incentives to Gamma and Delta was the feedback report that was promised in return for the access to case studies. The firms were comfortable with the presence of the researcher and appreciated the extra pair of hands provided by the researcher for some routine tasks, and were keen to receive a feedback report which was promised in return for access to the case studies. After the study, we visited the firms involved to have a feedback session with them on our observation of their tender process specifically and the whole study generally. Matthiesen and Richter (2007) have discussed giving feedback to participants. And researchers like Koosimile (2002) have discussed in their study the importance of not only entering a research setting but also exiting the setting. Fifth, the frustration encountered in the access negotiation processes is not unique to this study. Similar situations of frustration have been encountered by other researchers like Winkler (1987). Matthiesen and Richter (2007) and Clark (2008) offer suggestions for dealing with frustration and fatigue issues in research. This reinforces the importance of persistence in access negotiations.

CONCLUSION

The question explored was: What are the main obstacles associated with access negotiation into firms; and what strategies do researchers, here and elsewhere in the literature, employ to increase the chances of success? Our research work on tendering processes of contractors in Ghana and the UK took place between 2006 and 2008. We successfully negotiated access into four firms (two each in Ghana and the UK) to enable a live observation of the whole tender process of contractors to be carried out from start to finish. The average time spent in each firm was six weeks. The techniques we employed in negotiating access included the use of personal contacts, writing to firms we found listed on the online databases of relevant trade and professional association, reaching out to contractors' employees through professional bodies' publications, etc. With all of this effort, our average success rate was less than 5 per cent, which significantly reinforced the message from the literature in connection with the difficulties involved in negotiating access into firms. The main obstacles encountered were firms' reluctance to allow data collection on information relating to commercial aspects of their work and fear that this could eventually be divulged to their competitors or end up in the public domain. However, with the assurances of confidentiality and anonymity given, some firms agreed. The firms that agreed did so mainly because of these assurances. The reputation of the academic institution where the research work was being carried out also gave them some confidence in our ability to handle the issues of confidentiality. Another reason was also because we found gatekeepers within the firms who understood and supported the rationale and academic nature of the study. The gatekeepers, who were in senior management positions, spoke to their colleagues on our behalf to open the door for initial meetings with their colleagues in charge of the tendering and estimating departments where our study was carried out. A feedback report was also promised in return for access to the case studies. Although the access through personal contacts is by far the easiest, it is not always possible. Researchers can approach firms as complete strangers, especially in a foreign country, and this could make the firms more likely to assist the research.

REFERENCES

Bell, J. (1999) Negotiating access: Ethics and the problems of 'inside' research, In J. Bell (Ed.) *Doing your research project: A guide for first-time researchers in education and social science*, **3ed**, 37-47, Buckingham: Open University Press

Berg, J. A. (1999) Gaining access to under researched populations in women's health research, *Health Care For Women International*, **20**, 237-243

Buchanan, D., Boddy, D. and McCalman, J. (1988) Getting in, getting on, getting out and getting back. In A. Bryman (Ed.) *Doing research in organizations*, London: Routledge

Clark, T. (2007) 'We're over-researched here!' Exploring accounts of research fatigue within qualitative research engagements, *Sociology*, **42**(5), 953-970

Clark, T. (2010) On 'being researched': why do people engage with qualitative research?, *Qualitative Research*, **10**(4), 01-21

Clark, T. (2010) Gaining and Maintaining Access Exploring the Mechanisms that Support and Challenge the Relationship between Gatekeepers and Researchers, *Qualitative Social Work*, published online 6 April 2010

Clark, T. and Sinclair, R. (2008) The costs and benefits of acting as a research site, *Evidence and Policy,* 4(1), 105-20

De Laine, M. (2000) *Fieldwork, participation and practice: Ethics and dilemmas in qualitative research,* Thousand Oaks, California: Sage

Denscombe, M. (2007) *The Good Research Guide*, **3ed**, Maidenhead: Open University

DeVerteuil, Geoffrey (2004) Systematic Inquiry into Barriers to Researcher Access: Evidence from a Homeless Shelter, *The Professional Geographer*, **56**(3), 372-380

Duke, K. (2002) Getting Beyond the "Official Line": Reflections on Dilemmas of Access, Knowledge and Power in Researching Policy Networks, *Journal of Social Policy,* **31**(1), 39-59

Gill, J. and Johnson, P. (2010) *Research Methods for Managers*, **4ed**, London: Sage

Glidewell, J. C. (1959) The entry problem in consultation, *Journal of Social Issue,* **15**(2), 1-59

Gurney, J.N. (1991) Female Researchers in Male-Dominated Settings, in M. Pogrebin (ed.) (2002) *Qualitative approaches to criminal justice: Perspectives from the field*, London: Sage

Hall, D. and Hall, I. (1996) Negotiating and agreement, In D. Hall and I. Hall (Eds.) *Practical social research: Project work in the community*, 56-75, London: Macmillan.

Hansford, M. (2008) *Contractors File 2008, Top 20 Civil Engineering Contractors*, New Civil Engineer, Edited by Mark Hansford, London: Emap Inform

Johnson, J. M. (1975) *Doing field research*, New York: Free Press

Koosimile, A.T. (2002) Access negotiation and curriculum change: Lessons from Botswana, *International Journal of Qualitative Studies in Education*, **15**(2), 205-223

Mora-Ríos, J., Medina-Mora, M.E., Sugiyama, E.I. and Natera, G. (2008) The meanings of emotional ailments in a marginalized community in Mexico City, *Qualitative Health Research*, **18**(6), 830-842

Matthiesen, J.K. and Richter, A.W. (2007) Negotiating access: Foot in the door… or door in the face, *The Psychologist*, **20**(3), 144-147

Mintzberg, H. (1973) *The Nature of Managerial Work,* New York: Harper and Row

Reeves, C.L. (2010) A difficult negotiation: fieldwork relations with gatekeepers, *Qualitative Research*, **10**(3), 315-331

Rossman, G.B. & Rallis, S.F. (1998) Entering the field, In G.B. Rossman and S.F. Rallis (Eds.) *Learning in the field: An introduction to qualitative research*, 91-112, London: Sage

Saunders, M.N.K., Lewis, P. and Thornhill, A. (2007) *Research methods for business students*, **4ed**, Harlow: Pearson

Seidman, I. (1998) *Interviewing as qualitative research: A guide for researchers in education and the social sciences*, New York: Teachers' College Press

Silverman, D. (1997) *Qualitative Research*, London: Sage

Sixsmith, J., Boneham, M. and Goldring, J.E. (2003) Accessing the community: Gaining insider perspectives from the outside, *Qualitative Health Research*, **13**(4), 578-589

Skitmore, M. and Wilcock, J. (1994) Estimating processes of smaller builders, *Construction Management and Economics*, **12**, 139-154

Wilkes, L. (1999) Metropolitan Researchers Undertaking Rural Research: Benefits and Pitfalls, *Australian Journal of Rural Health*, **7**, 181-185

Winkler, J. T. (1987) *The fly on the wall of the inner sanctum: observing company directors at work*, In: Moyser, G. and Wagstaffe, M. (Eds), Research methods for elite studies

PROJECT MANAGEMENT - WISE AFTER THE EVENT

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Construction project management theory, to the extent that it exists, draws on ideas taken from mainstream project management theory and its fundamental assumption that universal solutions are applicable to projects that are more or less the same. A common explanation when things go wrong, and source of debate, is the perceived uniqueness of the industry. In this paper we investigate if we can learn anything from looking more closely at the practices in an industry that by and large is even more unique than construction. We ask ourselves what mystic processes make the event industry deliver under high pressure to firm deadlines and what can we learn from one sector to another. The paper draws on individual experiences from event industry. The conclusions highlight areas in which research towards understanding performance mechanisms in projects can fruitfully be undertaken.

KEYWORDS: deadline, power, project practice

INTRODUCTION

Projects and project management have been given a great deal of attention in the literature over the past decades, and numerous are the articles that seek to further our understanding of project management and the management of projects. At present, influential project management thinking tends to assume that all projects are fundamentally similar and the universal approaches to project management as prescribed by leading institutes for practitioners, such as APM and PMI, are self-evidently justified. Neat and tidy assumptions allow for a set of guiding principles that by and large have served to be very useful in practice. Of course, every once in a while critical voices are raised pointing out specific critical characteristics that should be improved, or at least studied. For example, Payne and Turner (1999) found that, contrary to conventional thinking, experienced project managers' considered that tailoring project procedures according to the size and 'skill mix' of a project would probably raise the chances of success. Further examples cited in the literature include: size (Songer & Molenaar, 1997), complexity (Baccarini, 1996); uncertainty (Meyer *et al.*, 2002); technological novelty (Shenhar, 1998); pace (Lindkvist *et al.*, 1998); and perceived novelty by project teams (Brockhoff, 2006).

The realisation that an appropriate managerial approach should be tailored for particular types of project to achieve successful outcomes notwithstanding, some of the underlying assumptions of traditional project management do not hold up to scrutiny. It is not surprising therefore that project management in numerous publications has been accused of being weak in terms of a theoretical basis (e.g. Williams, 2005). Conventional project management also struggles to deal with present-day projects characterised as 'structurally complex', 'uncertain'

and ‘tightly time-constrained’, especially in those cases where concurrent engineering has been adopted to accelerate the pace of work. The emphasises on ‘management as planning’, ‘conventional controlling’ and isolating the project from its environment, all ignore the interdependencies existing in the systems of projects as well as overlook the often unavoidable impact of the environment.

Construction is in many ways the epitome of a project-based industry and project-based organisational forms have long been the norm in the sector. De-centralisation and dispersed modes of working are especially important defining characteristics (cf. Leiringer *et al.*, 2009). The industry’s leading firms have tended to adopt a decentralised structure to enable different divisions to compete in different market sectors (Kao *et al*., 2009). These different divisions in turn work on projects that are temporary, often one-off and rarely undertaken within a standard framework. The construction project management literature frequently struggles to bridge that construction on the one hand is heralded as unique and on the other hand the temptation to be influenced by ideas taken from production and project management; both of which share tendencies to prescribe universal and repeatable solutions. As such the debate, to the extent there is one, struggles with schizophrenia. Such a statement is of course on the verge of being flippant. Perhaps a more acceptable summary of current prevailing theories of project management in construction is: that they traditionally have tended to draw upon managerialist theories in which structural determinants of power have been dominant. Structural hierarchies within firms and formal contracts between firms govern individual behaviour on the project. In most cases relationships on the individual level are acknowledged, but considered to be subordinate to the more high level organisational relationships.

The question we ask here is what if construction is not all that unique at all. What if we took the level of uniqueness one step further? Or put somewhat differently, what can we learn from a sector that by all intents and purposes is even more ‘unique’ than construction? Our point of departure is the theory of construction as ‘production by projects’ as propagated by Winch (2006), and the call for additional theoretical insights that are needed to understand construction production processes. To start we present an industry where projects is the way of performing and organising, and where projects is the only basis for social structure, power and finance – the event sector. It is argued that traditional management theories fall short in explaining, or predicting, the behaviour on most event projects. The second part of the paper presents vignettes of different aspects of event projects each highlighting how individual determinants of power are all important in understanding how projects are managed successfully. In so doing, we make no pretence to be objective. The vignettes are indeed highly subjective, but they do we set out a reality that it is shared by a group of people with extensive experiences of managing events. Particular attention is given to the governance structures that ensure that people perform although they are very loosely tied to the temporary project organisation. The preceeding discussion then focuses on how networks of suppliers get around organising event projects with a high degree of temporality and with staff working on a project by project basis.

EVENT PROJECT MANAGEMENT

The event business

Although exceptions exist, projects are commonly carried out by temporary organisations populated by individuals belonging to a variety of permanent organisations or firms. For a majority of these firms the execution of projects or undertaking certain activities on projects

forms the dominant basis of their overall activity. Thus, they are either commissioned by others to contribute to the realisation of external projects, or they carry out internal projects which are financed and commissioned by themselves. The activities of many firms extend over both such categories. Some firms engage in one project at a time, others are involved in the delivery of a host of projects at various stages of maturity. As mentioned above, construction firms predominantly fall into the latter category with the majority of the work force being employed by the firms to work on one or a few projects at a time.

In the event business projects are common and made up by suppliers in networks. Indeed, for many of the suppliers their working life is network-based and they do not belong to a permanent organisation. When there is a project there is a job, when there is no project there is no job. Not only is the event industry organised in projects – the whole business lives its life through projects. Most suppliers and specialists are self employed. Specialists, e.g. a set designer or a choreographer, get their next job based on their individual network and performance on the current project. The progression from project to project is based on an intricate mix of power, dependent on who you know and what you have achieved; the old cliché about 'your latest performance' certainly rings true. Or as stated by a production manager: "you are no better than your last job".

Event project management, project management and organising

Reviewing the project management literature it is only in the mid 1990s that studies on event project management appear. Hartman *et al.* (1998) compare project management practices in the 'live entertainment industry' and 'traditional project management oriented industries'. They conclude that 'culture, communications, stakeholder' involvement and planning' are key features along with a strong focus on people. The latter has become more prevalent as the concept of events has become more broadly used and events have become more commonplace and now include both private and public interests (Bittner, 2001). The capability to meet deadlines is put forward as a key characteristic of the event industry; interestingly completion on budget is not (Hartman et.al., 1998). Another interesting issue is the event industry's "comfort with risk and uncertainty". In a study on the winter Olympics in Lillehammer Löwendahl (1995) notes the "extreme task uncertainty" in the event industry and argues for the importance of being capable to manage uncertainty. Most staff undertakes activities they have not done before, usually with a large degree of volunteers and with difficulties to translate previous experiences directly into the project. There are of course settings that could be considered as repetitive such as the recurring touring organisations who hit the road on a regular basis. But then again these are mostly assembled with a new team, a new artist production and new patterns of travel (Cunningham, 1999).

Löwendahl (1995) also points to the fact that there are multiple owners, unclear boundaries, a squeezed project life cycle and no structured reporting and governing patterns in the event projects. All of these aspects create challenges and generate continuous changes for the participants to deal with. A challenge for the organising committee for the Olympics, as for most event planners, is the transformation of the organisation from planning to execution mode as the organisation changes structure with a significant increase of staff and volunteers in the run-up to the event. The European athletics Championship in Göteborg 2006 went from around 30 in planning to more than 3200 in the execution phase (Lindahl & Modig, 2007). Similar challenges have been observed for other sport events as well (e.g. Hanlon & Jago, 2000). The capability to manage an organization that goes from very few members to many is crucial for performance.

In “one-off” temporary organisations, like event organisations, staff tend to stay on for the complete run of projects (Løwendahl, 1995). Not as in many project-based industries where competence or contract governs whether you are in the project or not. This can make the organisational transfer from planning to execution mode difficult, as those who are excellent planners also have to face the challenge of executing their plan (Getz, 1997).

VIGNETTES OF PROJECT MANAGING EVENTS

From a project management perspective there is little written about how to actually manage staff and how to utilize networks of suppliers in the event industry. With a few notable exceptions, such as Bowdin’s (2006) work on communication and managing resources, there is not much written on how the, often *ad hoc*, actual project management is carried out

Facing an industry where most projects are different and delivered by new networks of suppliers each time, it is a challenge to adopt established project management theories to predict and explain project performance and behaviour. What follows are vignettes that represent the techniques that are used at various phases of the project. Examples are taken from a rock festival, a stopover in a global sailing competition, naming ceremonies for ships and big formal dinners. These are all events that encompass large groups of people and investments, see Table 1.

Table 1: An overview of the events referred to in this paper.

Event	Duration/ Audience, visitors	Budget (approx)	Planning time/staff	Personnel during execution
Rock festival	1 day/ 20.000	€ 700.000	6 months/4	250
Global sailing, stopover	1 week/ 100.000	€ 2.500.000	13 months/5	100
Naming ceremony 1	1 public day/ 20.000	€ 600.000	5 months/4	75
Naming ceremony 2	4 hrs/ 6000	€ 35.000	2 months/4	20
Formal dinner	1 evening/ 400	€ 40.000	3 months/6	60

Planning

The promoter deems a tour feasible and signs the contract and the producer accepts the artistic concept and starts the process. Gut feeling and cost estimates based on experience is usually the basis for the decision to start. Initial planning is conducted by a limited number of people with most of the power residing with the promoter or producer. It is not uncommon with reference groups or similar arrangements at large public events, but this has more to do with legitimatization than planning. The initial planning work is left to a select few. These individuals also manage the recruiting of key staff and hence get to decide who that shall have key roles in executing the project.

In the rock festival initial planning was carried out by four persons with the functional division of programme, site, production and coordination responsibilities. The planning started 6 months ahead of the festival. In the global sailing competition the stopover was initially planned by a group of two during a 12 month bidding stage. These two were then replaced by a group of five with the functional division of project management,

communication, site/production and marketing/sponsors This group worked together for a period of 13 months. The rock festival group was unchanged until three months before execution and the sailing competition remained unchanged until four months before execution.

The functional division of responsibilities is based on the individuals' track record within their field. Their competence is tacit and is noticeable only through their action. Memos and PMs are seldom written.

Power

There is a direct link between power and planning. Those who do the planning are inexorably also those who structure the supply chains and decide who belongs to the project and who does not. Crudely put, they decide who will have an income from the project. Additionally, power is also linked to the execution of the event. Take, for example, a stage performance. With the firm deadline, once on stage there is no room to discuss options – the show must go on. The stagehands, as necessary as they are for getting equipment on and off stage, find themselves in a strict hierarchical setting. The stage manager decides what they can and cannot do, when they get food and where they shall sit when not working. They need to be in sight and in standby for stage work all the time. Staff that do not accept the rules have to leave and will lose their role in the team and their belonging to the event.

Another example related to power comes from a network of people working on festivals. A stage manager was not re-contracted for another year and went on to post a complaint on Facebook. It was quickly observed and distributed by the planning team for the festival the stage manager had previously worked to other planning teams and effectively shut the complaining stage manager down for work at several other festivals. Power is clearly related to social structure and deeply intertwined with relationships, belonging and behaviour.

Ownership is also related to power, an example of which can be found in a publicly funded project concerning a historical ship. This project was not considered important from a political perspective and had conveniently been allowed to fall between chairs until it was almost finished and naming ceremonies involving the king and queen came onto the agenda. Then there was a struggle for position between various agencies and authorities that previously had not been keen to support the project. Based on their political clout they quickly stepped in to dominate the decision making and positioned themselves in visible roles. The value of association to events is powerful and affects behaviour.

Workforce and teams

Staff at an event are functionally divided and distributed over the event area. The people checking tickets seldom get to work backstage, cleaners work different hours than the artists etc.. Many of the jobs are really quite simple. Putting up fences, loading and unloading trucks, running errands and being a catering assistant are all very important functions for the show, but are never recognised as key functions and can hardly be considered glamorous in their own right. There are also hierarchies among staff. At the bottom-end are the volunteers guarding a fence along the perimeter of the event site and at the top are the stagehands working with the artists.

Being in this supplier situation with no real power, or say so, stimulates bonding among the staff at the bottom of the project food chain. The event staff is part of the event, but their actions are limited to their functional role. If catering staff comes on stage it is frowned upon. Likewise the sailors on the ship in the naming ceremony were important for the ship, but in

the event concept they were simply a part of the staff that got the ship to the naming ceremony.

The feeling of belonging is crucially important and measures are taken to actively enforce it. There is for example the phenomenon aptly called “T-shirt management. Although the actual work is simple one becomes a part of the event as soon as one slips into the T-shirt stating that you are one of the ‘crew’. Another important token is the backstage pass, or any other form of event credentials. The managers that have the power to distribute these have the most power and influence over the workforce during the execution phase of an event.

Leadership

Leadership is different in the various stages of an event. However, it is always carried out in a strict hierarchical context. There is only one promoter, one stage manager and so on. The leadership is affected by the urgency of the work at hand. In the early planning the group is small and belongs to a smaller network of people. Whilst in the execution phase the group is large and the deadline rules supreme and governs everything. The show must go on no matter what.

Once a performance is underway on stage at a festival, or as is often the case on several coordinated stages, there is no additional time. The stagehands must stay at the stage at all times, the bands need to get on and off on time as they otherwise spoil another bands schedule or miss the curfew. It is in situations like this the commanding leadership style is utilized. You do not discuss with the stage manager about where to put a case, you do as you are told. The job is conducted under strict rules, but with a ‘comradeship’. This is also the biggest challenge to managers at events, to get the most out of the staff, often under-payed and working long hours, whilst balancing this with the power of belonging.

Performance

Regardless of type of event the ‘performance’ is the key activity. This is what sets the event industry apart from other industries. When a band is due on stage it happens; the Queen gets picked up on time for the naming ceremony; and the pyrotechnics at the festival next to the airport are synchronized with take-offs and landings. Time coordination and meeting the deadline is what governs the event industry!

Numerous are the times when people have borrowed equipment from other artists on the bill, when staff smilingly have explained that all the teddy bears are gone because of the large attendance as if this was part of the plan, that there now is ice cream instead of hot dogs etc.. All of these actions stem from an *ad hoc* decision making processes drawing to varying extent upon a pre-conceived plan. Simply put, you do what you have to do in order to get on with the performance. The very planning is the preparation where experiences get interwoven with possible scenarios. In the case of a large sport event a group of ten people were involved in a detailed planning and a scenario building exercise well in advance of the event. In this case there were even a large number of PMs written, but when asked how these were used at the event the reply was “Not at all, they are on the shelf”.

Close down

Resources are quickly discharged once the event is over. The following day most of the equipment has gone back to suppliers. It is hard to even get a cup of coffee from the once so friendly catering personnel. One could say that the content has left and there is only infrastructure left - an experience that brutally dawned on the city of Athens after the Olympics in 2004.

At the global off-shore sailing competition the site manager went around to the sailing syndicates to get their payments due on site. This was a necessity as when they left that port there were only three more days of the nine month event and all the companies, with a large group of them registered on Cayman Islands and similar places, were going to be liquidated. Either the port organizer got the money on site, or they would stand a risk of not getting them at all.

Evaluation and feedback

The project was a success, so there is basically no follow up. This is the common mindset on events of all shapes and sizes. After the champagne has been consumed what is in focus is the next show. If it is a tour the select few move on and the local crew is left behind. If it is a recurring festival everybody is tired and evaluation has to come later, often not until next planning phase. Proper design, as is produced in construction, is not produced at the festival, rather the site manager develops a plan that is tested and then changed over the subsequent festivals. What works will be kept. If it is a global sailing competition it is two years until next time and you do not know if you will be involved. And so it goes... of course, events where public authorities are involved, e.g. city fairs, usually get evaluated concerning how they contributed to the increase of jobs, hotel stays and various tourism and hospitality criteria. Evaluation of the management processes and project organisation are seldom evaluated. In the case of naming ceremony 1, which also included a seminar day, there was no evaluation of the performance of the event or the responsible organisation. As it had worked along the intended plans, it was ok. As with many project-based industries the knowledge moves with the participants and the client has no interest to gather the team, which most likely is somewhere else performing a new event.

DISCUSSION

So, what did we learn while studying the field of event management? It can be concluded that the way the event industry goes about managing their projects, their temporary set-ups for the temporary objectives, requires a lot of planning. But even more it requires the capability of revising and changing up until the very end in order to deliver performance at deadline. Planning and power resides with a few. Two issues will be further discussed below; how the event industry gets around organising event projects and how the actual managing of the projects is carried out

Organising

As is clear from the examples above organising, just as Löwendahl (1995) described, takes place in an uncertain environment. Personnel are functionally divided and most perform basic assignments, often without clear work descriptions. This is achieved through a hierarchical and complex structure where networks of suppliers, such as freelancing production staff, event technology companies, staff hire firms, flower suppliers, caterers etc. make their specific delivery. All involved perform their tasks on the basis that it will determine their next job. Even if the event is a team effort on the surface it is rooted in the individual’s drive to stay in the network, to get into the next project.

Compared to construction, which brings together multiple, often local, suppliers performing according to specifications over often extended timeframes, the event industry is to a much higher degree temporary. The challenge for organising in the event sector is to perform technically with the support of human resources within a defined timeframe. The intangible output and objective of many event projects require a flexible organisation governed by definite goals. The result is an organisation that accepts hierarchical structures, acknowledges

delimitations of assignments and where roles and power relations are more important than organisational boxes. Networks and the threat of exclusion form an important complement to the contract – which could be verbal or in the form of an email

Actual management

Motivation is a key ingredient in managing paid personnel, as well as volunteers. We derive from the examples above that the leadership required needs very high competence in balancing between comradeship and authority. This kind of leadership has to be based on strict plans to allow for quick decision making, as well as a capacity to deviate from these plans in order for the event to go ahead. This puts strain on the relationship between the manager and the team, a relationship that in order to be efficient needs that both parties are aware of the specific conditions of the event industry and the importance of achieving the deadline. By the identified but tacit competence the contracted staff is expected to deliver, if not there is no next job. This type of extreme relational contracting is different from the one we see in construction that usually is framed by details and contracts defining the delivery.

Conclusion and further research

A final note is required here in the authors' experience. We would like to emphasise that the present paper has been written from a self-consciously confrontational perspective. The aim of the paper has been to illuminate and expose the structures that govern event project management and how this impacts on individual agency. In so doing we have tried to challenge conventional wisdoms from a construction perspective. Our hope is that this stimulates debate and hence contributes to the development of construction project management literature.

Studying the event industry provides us with a number or relevant questions to ask when debating organising and project management in construction. Not least of these is the power of the network. We believe that studying the event industry can also shed some light on the debate concerning a theory of construction. The project management toolbox that already exists can certainly be further developed. The event industry with its rapid projects gives us a great field to study and observe uncertainty, time constraints and complex organisational structures.

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REFERENCES

Bittner, R. (2001) *Die Stadt als Event*. Campus/Edition Bauhaus, Frankfurt.

Baccarini, D. (1996), The Concept of Project Complexity – A Review, *International Journal of Project Management*, **14**(4), 201-204.

Bowdin, G., Allen, J., O'Toole, W., Harris, R., McDonnell, I. (2006) *Events Management.* Elsevier, Oxford..

Brockhoff, K. (2006), On the Novelty Dimension in Project Management, *Project Management Journal*, **37**(3), 26-36.

Cunningham, M. (1999) *Alive and kicking. The touring industry in the 1990-ies*. London: Sancuatry Music Library

Getz, D. (1997). *Event management & event tourism.* New York: Cognizant Communication Corp.

Hanlon, C., & Jago, L. (2000). Pulsating sporting events: An organisational structure to optimise performance. Paper presented at the Events beyond 2000: Setting the agenda, Sydney, Australia.

Hartman, F., Ashrafi, R., Jergeas, G. (1998) Project Management in the live entertainment industry: what is different. *Int. Journal of Project Management*, 16, 269-281.

Kao, C., Green, S. D. and Larsen, G. D. (2009) Emergent discourses of construction competitiveness: localized learning and embeddedness, Construction Management and Economics, 27(10), 1005-1017.

Leiringer, R., Green, S.D. and Raja, J.Z. (2009). Living up to the value agenda: the empirical realities of through-life value creation in construction. *Construction Management and Economics*, 27(3), 271-285.

Lindahl, G., & Modig, N. (2007) Organisational change in the run-up to a major sport event: The case of the European Athletics Championships 2006. Proceedings of IRNOP VII Project Research Conference, October 11-13, Xian, China.

Löwendahl, B. (1995) Organizing the Lillehammer Olympic Winter Games. *Scand. J. Management*. No 4, 347 – 362.

Meyer, A.D. Loch, C. H. & Pich, M.T. (2002), Managing Project Uncertainty: From Variation to Chaos, *MIT Sloan Management Review*, 43(2), 60-67.

Payne, J.H. and Turner J.R. (1999), Company-wide Project Management: The Planning and Control of Programs and Projects of Different Type, *Project Management Journal*, 17(1), 55-59.

Shenhar, A.J. (1998), From Theory to Practice: Toward a Typology of Project-Management Styles, *IEEE Transactions on Engineering Management*, **45**(1), 33-48.

Shone, A. & Parry, B. (2004) *Successful Event Management A practical handbook*. Thomson, London.

Silvers, J. (2004) *Professional Event Coordination*. Wiley, New Jersey, USA.

Songer, A. D. & Molenaar, K.R. (1997), Project Characteristics for Successful Public-Sector Design-Build, *Journal of Construction Engineering and Management*, 123(1), 37-40.

Williams, T. (2005), Assessing and Moving on From the Dominant Project Management Discourse in the Light of Project Overruns, *IEEE Transactions on Engineering Management*, 52(4), 497-508.

Winch. G.M. (2006) Towards a theory of construction as production by projects. *Building Research & Information*. 34(2), 164-174.

DESIGN COORDINATION PROCESS IN CONSTRUCTION COMPANIES: REALITY AND IMPROVEMENTS

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The last ten years have seen many changes in the Brazilian civil construction industry with heavy investment in the sector and tough competition. Many construction companies, helped by the formalization of their processes with the ISO 9001 certification, adopted design coordination policies with a view to anticipating decisions regarding the definitions of the characteristics of the product and production. This paper provides suggestions for improved design coordination process in construction companies, consolidated by undertaking literature review and case studies in four construction companies in the city of Recife/Brazil. The results have shown that the companies formalized the design coordination process based on certification; there is a growing concern on how best to coordinate designs, with registration and analysis of the information from coordination meetings and compatibilising designs and the increases in design use for production and design assessment tools. However, there is also high improvement potential, especially arising from the informality at some stages, such as the initial feasibility study of the projects and the need to develop designs before starting the job.

KEYWORDS: design; coordination; building construction.

INTRODUCTION

Construction context

The past ten years (2000-2010) have been characterized by major changes in Brazilian civil construction, which has undergone different periods of development, whether technological (enhancing building techniques and use of new materials), management (implementing the ISO 9001, OHSAS 18001 and ISO 14001 standards) and, more recently (2006-2010) the remarkable growth of the real estate market (Souza, 2009).

Many construction companies, helped by formalizing their processes with ISO 9001 certification, have adopted design coordination policies in order to take decisions on definitions of the product's characteristics and production systems. However, the results of the frantic pace of real estate launches are that there are fewer designers available and it is essential to increase productivity and effectiveness of the design coordination process. Ceotto (2008) pointed the reality is that there is an increase in errors in technical solutions and

design compatibility, burdening the cost of the projects and increasing their deadlines. Very often important stages in the job are started without the design having the correct details or even provided with the necessary advance for analysis by whoever is going to carry it out.

Accordingly, Fabricio (2002), Loturco (2008), Whole Building Design Guide-WBDG (2009) and Melhado et al. (2010) agree that there is no good job management with a bad design, and the design coordinator's role is even more important than ever before. Design coordination began as a result of the absence of forwarding job requirements at the concept stage and the need for support of streamlined construction and the best use of technology and resources.

Building design coordination

Design coordination can be defined as an activity that provides support for developing designs, whose prime objective is to guarantee that they consider the overall objectives of the project, increasing the quality and constructability (Franco & Agopyan, 1993).

It is understood that design coordination seeks to synergically integrate the requirements, knowledge and techniques of all those involved in this stage, requiring from the design coordinator expertise in the necessary flow of information at this stage, authority to take decisions and settle disputes on behalf of the entrepreneur. Moreover, it is expected that the design coordination conducts the decision-making process in relation to the general solution compatible with the design and maximum efficiency of the next stages in the production process, respecting the overall parameters of cost, deadline and quality of the project.

Solano and Picoral (2001) stress how important the existence of coordination is in order to guarantee that the technical solutions developed by the designers of the different specialties are compatible with each other and optimised globally. Therefore, as the solutions of the construction subsystems become more complex, involving increasingly skilled professionals, it is even more important to have multidisciplinary solutions and design coordination.

Melhado (2005) and Ceotto (2008), on the other hand, emphasises the need for coordination throughout the design process, which must encourage interactivity between the members of the design team to thereby improve the quality of the produced designs.

The Brazilian Association of Design Coordinators and Managers (AGESC)[1] (2006) list the major problems associated with the design coordination process:

- lack of basic coordination instruments (no definition regarding design scopes and designer contracts);
- unskilled design coordinator and with no decision-making authority;

[1] The AGESC developed in 2006 Manuals Scope of Contracting Projects and for the Real Estate industry partnership whit several Brazilian organizations, such as: ABAP (Associação Brasileira de Arquitetos Paisagistas), ABECE (Associação Brasileira de Engenharia e Consultoria Estrutural), Sinduscon (Sindicato da Indústria da Construção Civil do Estado de São Paulo), ABRASIP (Associação Brasileira de Sistemas Prediais), ABRAVA (Associação Brasileira de Refrigeração, Ar condicionado, Ventilação e Aquecimento), SECOVI-SP (Sindicato das Empresas de Compra, Venda, Locação e Administração de Imóveis Residenciais e Comerciais de São Paulo), ASBEA (Associação Brasileira dos Escritórios de Arquitetura), SINDINSTALAÇÃO (Sindicato da Indústria de Instalação – SP), ABRIEP (Associação Brasileira da Indústria do Esporte), ANP (Associação Nacional de Paisagismo). The Manuals can be accessed through the website at www.manuaisdeescopo.com.br.

- lack of design guidelines without which the designers are unable to establish the premises to be adopted;
- no defined responsibilities of those involved in each stage of design development;
- no defined work flow (precedence and expected deadlines) and validations (of content and decisions in the design stages);
- no coordination meetings (with previous work of compatibilising the designs);
- constant accompanying the cost of design decisions (possible use of check lists);
- no ongoing cost assessment of design decisions, designers and the coordinator.

Although similar problems may appear with regard to design coordination, it should be reflected that the solutions for each construction company may need different actions, since they can be at different levels of development in this process.

OBJECTIVE

This paper presents suggestions for improved design coordination process of construction companies, and which are consolidated by literature review and case studies in four construction companies in the city of Recife, Pernambuco, Brazil.

CASE STUDY RESEARCH

Research methodology

The methodology adopted in the case study research involved four stages. Stage 1 – literature review on literature addressing the problems and actions for improving the design coordination process in building construction. At the stage there were notable works of Melhado, et al (2005), AGESC (2006) and Ceotto (2008) as relevant sources for the construction through interviews conducted in person with the project coordinatior of each company. The references adopted to prepare the questionnaire were based on the literature review and the authors' experience over more than ten years working in the area concentrating on the matter under study. The questionnaire was subdivided into three parts: characterization of the construction company, characterization of the design coordination process, and a check list containing best design coordination practices. Stage 3 – interviewing proper. Field investigation by applying the questionnaire in building construction companies to check the existence of the items in the questionnaire in four construction companies in the city of Recife. Stage 4 – analysis of the results and providing suggestions for improved design coordination process. As a consequence of the analysis results and base don literature review, suggestions were established to improve the processo f coordinating projects, wich included: defining the most appropriate profile and activities relevant to team, the need to have indicators of the management of project coordination, in addition to comments on the benefits resulting from implementation of the system theme quality mangement ISO 9001. It is also worth noting the presentation of the outcomes of the attention to the listo of best practices of four companies participating in the case study research.

The case studies were researched with four construction companies working in the city of Recife, Pernambuco State, Brazil, to assess design coordination and to what extent best practices are included in this process. It began in June 2008 and was completed in March 2009 over a nine-month period. The characterization of the companies in the case studies is given in Table 1.

On looking at Table 1 it is noticeable that all companies have the ISO 9001 certificate, practically at the same time, with average certification time of six years; only one company (B) has certification in environmental management systems (ISO 14001) and occupational health and safety (OHSAS 18001). Company B stands out for having the largest number of projects at the design stage and in progress and it should also be mentioned that it works in three other cities in Northeast Brazil.

Table 1 - Characterisation of construction companies

Characterization of companies	**A**	**B**	**C**	**D**
Time of existence	33 years	25 years	53 years	40 years
Number of employees	600	1200	600	150
ISO 9001 certification	Yes	Yes	Yes	Yes
Year of ISO 9001 certification	2002	2002	2003	2002
ISO 14001/OHSAS 18001 certification	No/No	Yes/Yes	No/No	No/No
Number of projects in progress/being designed	6/3	32/33	5/3	3/3

RESULTS FINDINGS

The four construction companies in the case study research and their design coordinators are identified by letters A, B, C and D. It should be mentioned that the information provided below was given spontaneously and separately by the design coordinators in each of the construction companies in the study.

Design coordination process

The purpose was to identify the organisation of the design coordination process of each company in the study, taking as reference the operational investigation element (questionnaire).

The design coordinator

It was found that in all four construction companies the coordination is done by the company's own personnel, and the design coordinator was a university graduate of civil engineering in two companies and architecture in the other two. The design coordinators had a direct communication channel with the directors of the companies and, in the case of company B, since it had more designs in progress, the coordinators were first subordinate to the technical director then the general director.

Regarding the design coordinator's tasks and responsibilities, this connection with the strategic decisions of the companies was found based on the work done by the coordinator, namely: to make new projects feasible; to participate in defining the requirements programme – initial briefing of the project; to hire designers; to plan the stages in design development; to act as a link between the incorporation and job; to assess designers; to analyse designs; to decode the best solution for the company in event of doubts and design requests; to coordinate all stages from the concept of the product to interfaces between the designs and arrange for the "as built" for the job delivery stage.

This information contributes to finding the strategic nature of the design coordinator's role, whose activities range from the beginning to the end of the job construction process, either giving support to the initial activities of the product's concept (facilitating new projects) or then producing information for their use (providing the 'as built' for the job delivery stage).

The design coordination team

During the investigation with the companies, a question about the direct participation of other sectors in the design coordination process was asked. Companies B, C and D informed that the engineering team on the project actively participates in the coordination activities, which is indicates the concern not only with the aesthetic and functional nature of the designs but also with the rational execution of the work. Only company A said that no sector participates directly in the process other than the actual design coordination, which characteristic hinders the design/job integration, not involving the team in the decisions that will probably be taken during the job.

ISO 9001 benefits, indicators and improvements

According to the results obtained, it was found that design coordination was an informal process and adopted the Quality Management System based on the requirements provided in the NBR ISO 9001 standard, and the companies began casting a critical eye on what already existed. With regard to design coordination, all companies participating in the study attested to benefits from the ISO 9001 certification, mainly the following: better flow between processes; lower costs; solutions in design before execution; standardising the stages; defining each function's responsibilities and activities; organisation of files and copies of the designs and interaction between the agents of the different designs. Also based on NBR ISO 9001, the companies were asked if there were indicators in the design process and which were they. Companies A, C and D had indicators, as Table 2 illustrates.

Table 2 – Design indicators

Company	Indicators			
A	Number of design revisions	-	-	-
B	Degree of compactness	Wet/dry are ratio	Average thickness of concrete structure	Number of intakes per m^2
C	Degree of compactness	Slenderness ratio	Percentage of front windows	-

Company B was the only one not to have a measurable indicator at the time of the interview, and the coordinator explained that previously the intention was not to delay the arrival of the designs on the jobs but due to the accelerated increase in number of jobs in recent months, there was no due follow-up of this indicator.

Company C is shown to be concerned with measuring indices that provide information for new designs and support decisions on them, such as for example, "wet/dry area ratio". The same occurs with company D, which delegates to the design coordination process the activity of measuring data considered important in developing its projects, such as, for example, the indicator of "percentage of window frames on a facade". Company A stressed that its indicator "number of design revisions" is used to classify the origin of the revision by a designer, namely, errors of compatibilisation, and alterations required by the job. Company A coordinator also explained that this indicator helps in assessing designers, identifying the problems of each type. On new indicators, the company A design coordinator mentioned that

he intends to also adopt other indices to monitor the designs, such as: compactness, reinforcement of the structure per m^2, formwork per m^2 and wall density per m^2.

In relation to planning to adopt new indicators in company A, it may be considered that among the three companies that have indicators, the average is four indicators per construction company, which shows that these companies are concerned with developing instruments that produce information for new projects, as support for the design coordination process. It is worth mentioning that the aforementioned indicators are associated with design content and there are no specific indicators to assess the design process.

The coordinators were also asked at which points the company identifies prospects of improvement in order to collect data for possible future activities that add value to the process. The points mentioned were: inclusion of the flow of activities in the coordination process in the documented procedure of the quality management system; advancing analyses and decisions before the production stage; more active participation of the suppliers at the stage of the design preparation; creation of cost indicators for design decisions; developing contract models with the designers; final assessment of the design to act as a basis for the next designs.

Best practices of design coordination in the construction companies

At this stage of data collection, a list was made of some best practices of design coordination and the questions asked whether they are used in the companies under study. Interviews were presonally conducted with the companies project managers in order to collect information listed in the check list (questionnaire). The best practices of project management were gathered from the literature review, and it has as main source the works of Melhado et all (2005), Fontenelle (2002) and Associação Brasileira de Gestores e Coordenadores de Projetos (2006). The check list in the questionnaire was divided into four steps: market research, design development, product production and post-works. We found the following results: in the stage of market research, we dealt with some items for the initial phase of idealization and dissemination of the product; the second stage, project development, was based on the coordination aspects of the process, such as methodology, hiring methods, and evaluations of designers; step in making the product, we identified items that contribute to lead the procedure for the projects coordination in this phase, for example, if the worrk team often evaluates projects, and finally, in after work, questions were raised concerning aspects that could contribute to future company projects.

Table 3 shows a summary with the data of the four companies relating. For each question from the table, the project coordinator responded “yes” or “no”, if there are some additional important information, we listed them from the numbering contained in the table, and with comments below.

(1) Although company A does not hold meetings or surveys with the target public, it does hold meetings with investors and directors of real estate brokers to define the product;
(2) For market surveys, the consulting services of a research institute are used;
(3) When hiring designers, contracts are verbal at the start of the job;
(4) Company D has now adopted the practice of starting design coordination with all designers hired in the last project and intends to extend it to the next projects;
(5) Company B coordinator claimed that the designers are partners and already know the type of construction and does not think it necessary to formalise specifications for the designs;

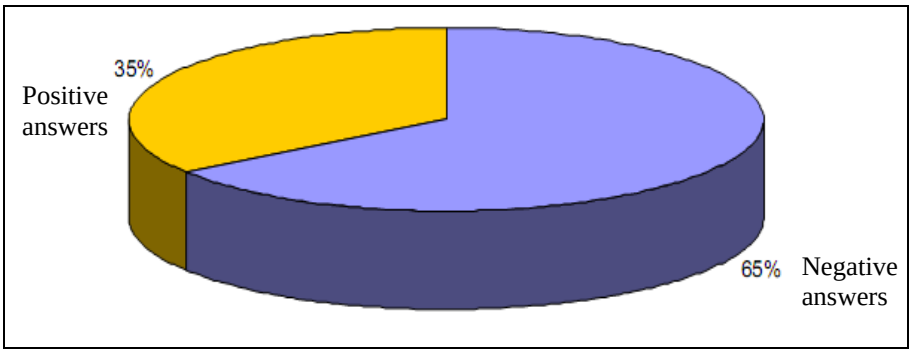
Table 3 – Best practices in the construction companies

Item	Description	Companies			
		A	B	C	D
Market research					
1	Is market research applied before purchasing the land?	Yes	Yes	No	Yes
2	Is any research done in sales events to assess positive and negative points of the product?	No	Yes	Yes	Yes
3	Is any meeting held between people with the same profile from the target public for discussing another alternative or market niche?	No (1)	Yes (2)	Yes	No
Design development					
4	At the start of design development, are all designers contracted?	No	Yes (3)	Yes	Yes (4)
5	Is the designer of the architecture, structure and facilities given some formal document containing specifications for preparing the design? (Scope)	No	No (5)	Yes	Yes (6)
6	Is a meeting held with all designer for presenting the product?	Yes	No	Yes	Yes
7	Do the designers know of the design plan?	Yes	No (7)	Yes	Yes
8	Does the company keep records of the practices adopted for preparing the different designs (guideline notebook)?	No (8)	Yes (9)	Yes	Yes
9	Does the design plan consider defined stages for delivery of pre-designs, adaptations, final designs and their analyses?	Yes	No	Yes (10)	Yes
10	Are designer assessments made based on qualitative criteria of the design-product and design-process?	Yes (11)	Yes (12)	Yes	Yes
11	Do the designers know which criteria will be assessed?	Yes	Yes	Yes	Yes
12	Is there a check list for analysis and receipt of the design?	Yes	Yes	Yes	Yes
13	Are there information technology tools to help in design coordination?	No (13)	No	No (14)	Yes (15)
14	Do production (Job) engineers take part in the design development stage?	Yes (16)	Yes	Yes	Yes
15	Are designs made for production? Which?	Yes (17)	Yes (18)	Yes (19)	Yes (20)
Product production					
16	Do the works start after completing all final designs?	No (21)	No	Yes	No
17	Do the architect and other designers visit the job at regular intervals?	No (22)	No	Yes	Yes
18	Does the production team assess the designs?	Yes	No	No (23)	No
19	Is the methodology for modifying the design during production formalised and disseminated?	No	No	Yes (24)	Yes (25)
Post works					
20	Does the customer satisfaction survey contain data on the design for the user's assessment?	No	Yes	Yes	Yes
21	Are the post-works assessment used to adapt future designs?	Yes	Yes	Yes	Yes
22	Are the designers informed about the results of these surveys?	No	No	Yes	No
23	Is a meeting held for the design closure and its general assessment, involving other sectors at the end of the job?	No (26)	No	No (27)	Yes

(6) On information to be conveyed to the designers, company D prepared a Design Quality Plan similar to the Works Quality Plan, containing the job data, planning of the design stages, design guidelines and information about the design information management tool;
(7) The design plan developed by company C is general for all designs and this is why it is not given to the designers;
(8) Information is given informally to the designers and considering the experience of the designers on other designs with the company;
(9) Company D prepared a notebook with architectural recommendations;
(10) Company C's design plan defines the closing of each predefined step, formalised by holding validation meetings;
(11) Designer assessment in company C considers quality, deadline and compliance;
(12) In company D the criteria assessed are only deadline and quality of fulfilling the request, similar to company C;
(13) Information technology tools adopted by company A are the MS Project for preparing the Design Plan and the company is currently studying the implementation of a file management system through the web;
(14) Company C intends to implement an IT tool based on information exchanged between the designers over the web to help coordinate designs;
(15) Company D recently adopted a design coordination support system, with file management, exchanging information between designers, recording coordination minutes and designer assessment over the internet; this system has contributed to integrating the designers and spreading information on the designs, according to the design coordinator;
(16) Only in some works, depending on their deadline, engineers are invited to participate in preparing the designs in company B;
(17) The production designs prepared in company A are masonry and formwork;
(18) In company B masonry and formwork were mentioned as production designs;
(19) Production designs contracted by company C are masonry, waterproofing, facade, formwork and timbering;
(20) In company C the designs prepared for production are masonry, facade coating and, at the study stage, the waterproofing design;
(21) Regarding the start of the works after completing all designs, company A has focused its actions on establishing this methodology in the new projects;
(22) When requested, the architect and other designers visit the works in company A;
(23) Company C intends to have the work team also assess designers;
(24) It is found in company C that the organisation level in defining the changes is not only of the overall design but also of repairs to the units; there is a reform notebook given to the client as guidance for the changed designs and which contains the company's rules for undertaking such modifications;
(25) Design modifications during production are also carefully addressed in company D, adopting a specific procedure for this purpose;
(26) The goal of company A's coordination is to take this general design assessment until completion of the job;
(27) In the last design, which had participation of ABCP through its contractors to develop the designs, the company held a meeting at the end of the coordination stage, which included the testimonial and assessment of each agent involved, which had a positive repercussion on all participants; the company intends to do another assessment at the end of the job.

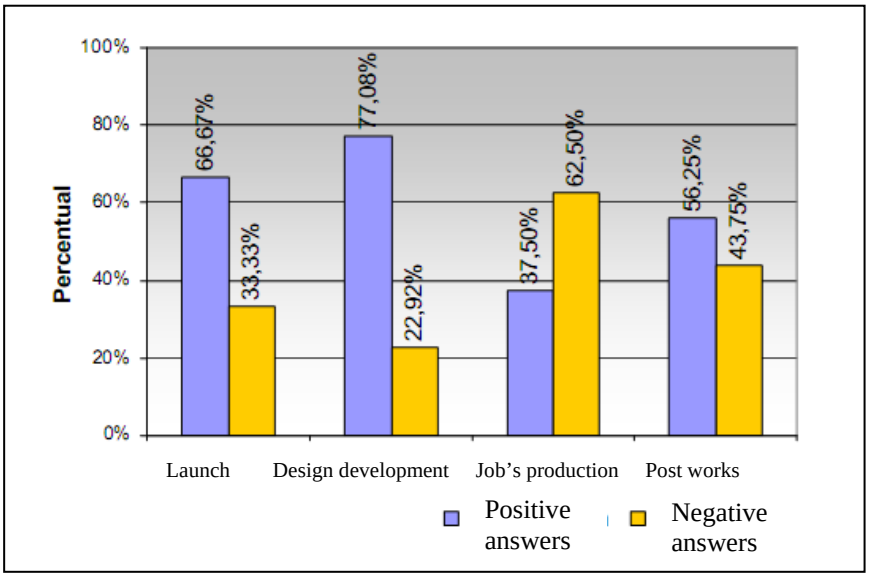
Figure 1 illustrates the companies' compliance (positive answers) with items in the questionnaire.

Figure 1 – Compliance with best practices in construction companies



The graph in Figure 1 shows that of the total 23 (twenty-three) items in the check list there was a total of 92 answers, 60 of which were positive. This is a sign of compliance with the best practices mentioned in the check list (65% total); while 32 were negative regarding the items mentioned in the research instrument, corresponding to 35% of the total. There is therefore high development potential of the items in the coordination process by taking actions that consider the 35% negative answers. Separating by project stages, we found the percentages of each of them that company compliance with the best practices listed in the check list (Figure 2).

Figure 2 – Percentage of complying with best practices at each stage in the project



The graph in Figure 2 shows that in the project's development stages, three of them have their percentage of adopting best practices overcoming the negative answers, as follows: launch, design development and post-works. The job's production stage proved deficient in adopting best practices, 62.5% of negative answers compared to positive answers (32.5%).

The items described in the check list that obtained 100% compliance by the companies were: undertaking designer assessment; designers' knowledge on which criteria they will be assessed; participation of production engineers in the design concept stage; preparing designs for production and use of post-occupation assessments in adapting future designs. The items that had fewer positive answers were also listed, with at least two companies that answered

the question, in the lowest to highest number of companies that considered it: design closure and assessment meeting; the designers being informed of the results of post-occupation surveys; assessment of the designs by the production team; start of the job after completing all designs; use of information technology tools to help coordinate designs; existence of a formal scope containing specifications of the design delivered to the designer. The main suggestions for improved design coordination are listed below.

SUGGESTIONS FOR IMPROVED DESIGN COORDINATION PROCESS

Design coordinator

The choice of the professional responsible for doing the coordination work must take into account such factors as: profile of the construction company, type of project, deadline, cost and public for which the projects are designed. Predominant factors in the design coordinator's resume are understood to be: job experience, knowledge of budget and planning, experience in dealing with teams, and mastering information technology tools. The coordinator's profile must include characteristics of leadership, negotiation and dispute settlement, persistence, insight and organisation.

Design quality plan

This is included in a document to be prepared by the design coordination to inform the designers about the premises of each design and the sequence to be adopted in carrying out the design coordination work. It shall contain: general data of the project and company, design team and those in charge, design development timetable, delivery calendar, requirements for each design, design assessment methodology, standard for directories and names of designs, use of IT tools and other information considered relevant, specific for each design.

Design coordination meetings

Communication between the stakeholders and compiling and organising information must necessarily undergo good planning and design coordination meetings, which must provide initial planning, defining an objective and meeting agenda, setting the start and finish time and register decisions, justifications, those responsible and completion dates. Care should be taken that there are sufficient meetings, specific and focusing on decisions involving three or more matters at the same time. Only those involved must attend the meeting, which must be short, having minutes taken of the decisions that, first and foremost, must be very clear and brief. The designers must be encouraged and asked to hold meetings of understanding with each other in advance, without necessarily in the coordinator's presence, so that the proposed solutions are compatibilised, so that only the necessary decisions are left for the meeting. Failure to comply with this item has caused many designers not to discuss interfaces at the meeting, making it unproductive, long and very often undecided.

Design management system

There are various benefits of standardising by using a design management system, some of which are: centralisation of the files in a single database, understanding the design and its stage only by reading the file name, access only to current designs, systematic creation of a design development timeline, and so on.

Design planning and programming

Good planning must foresee expected results in order to achieve the objectives of each stage. Benefits achieved are: goods and services delivered according to order requested in advance; control of design interfaces; problem and dispute settlement in advance; higher degree of assertiveness in taking decisions. Programming must consider milestones in order to validate the content and decisions at each design stage so that, when moving on to a subsequent stage, there is no risk of going back on definitions already made. This is a major delay factor where very often decisions are taken by someone without the necessary authority to do so.

Design and designer assessment

Assessment encourages more closely meeting customer requirements and acts as a feedback tool. It is therefore necessary to inform the designers in advance what is expected from the products created and other factors considered relevant for the company. Weights may also be attributed to these factors, considering the level of importance of each of them. This assessment must be performed by the coordinator in the presence of the client, and items must be assessed such as providing the services, proactive problem solving, interacting with the other designers, meeting deadlines, and quality in presenting the designs and specifications, for example.

Indicator of the design coordination process

Since this is a process involving several agents, interfaces and stages, the assessment of the overall coordination process based on a single indicator must consider a set of indicators and, from them, adopt weighting criteria to reach a general indicator that assesses the process as a whole. The proposed indicator must consider the assessment of the designer, the design and the design coordinator.

Design versus job execution integration

The design stage cannot be considered “watertight”, so little isolated from the executive stage of the job. In the traditional production process of a project, there is a sharp division between the two stages: that of designs and actual execution. However, steps must be taken to allow closer interaction between these two stages. As an element that contributes to this interaction, the Works Execution Plan (WEP) is recommended, consisting of a set of activities that allow some benefits, for example: interaction between designers, entrepreneurs and builders; the importance of coordination actions; multidisciplinary view of the designs; closer involvement of the executive teams in technical decisions; and importance of control and feedback of the processes. If the resident engineer does not participate in the design coordination stage, the idea of the Works Execution Plan will be to present to this professional and the whole team involved in the work those points considered in the design stage, major construction details and the technical choices adopted. At this moment, the designers’ participation is essential, defending the design characteristics and being proactive in considering changes that contribute to enhancing the design with repercussions on suitable technical solutions.

CONCLUSIONS

Within the design development process, it was found how important and necessary were the efforts to improve design coordination, principally by adopting follow-up tools and assessment of the quality of goods and services produced by the process. Interviewing the construction companies showed that the design coordination process was based on the ISO 9001 certification and also that there was high potential for improvement. The results were positive, with evidence of the concern of the companies participating in the study on the best

way to conduct their design coordination process, by introducing specific tools to do so. The best practices study showed the 35% potential for taking actions that consider improving the design coordination process. Lastly, it is considered that the set of suggestions proposed in this study could be adopted gradually, planned in steps, when the completion of one step will encourage taking the next.

REFERENCES

Associação Brasileira de Gestores e Coordenadores de Projetos. (2006). *Manual de escopo de serviços para coordenação de projetos.* Webpage accessed 30-12-2006 at: http://www.manuaisdeescopo.com.br/Main.php?do=ListaManual &refresh=true

Associação Brasileira de Normas Técnicas (ABNT). (2008). *NBR ISO 9001: Sistemas de gestão da qualidade – requisitos.* Rio de Janeiro.

Ceotto, L. H. (2008). Coordenação de Projetos - um assunto que necessita maior prioridade de desenvolvimento. *Téchne*, São Paulo, n. 135, p.43-44.

Fabrício, M. M. (2002). *Projeto simultâneo na construção de edifícios.* 2002. 329 f. PhD thesis (Doctorate in Civil & Urban Construction Engineering) – Polytechnic School, University of São Paulo. São Paulo.

FONTENELLE, E. C., *Estudos de caso sobre a gestão do projeto em empresas de incorporação e construção.* 2002. (Master in Civil & Urban Construction Engineering) -. Polytechnic School, University of São Paulo. São Paulo.

Franco, L. S & Agopyan, V. (1993). Implementação da racionalização construtiva na fase de projeto. São Paulo, 1993. *Boletim Técnico,* Departmento of Civil Construction Engineering. Polytechnic School, University of São Paulo, São Paulo.

Loturco, B. (2008). Projetos coordenados. *Téchne,* São Paulo, n. 135, p.40-42.

Melhado, S. B. et al. (2005). *Coordenação de projetos de edificações.* São Paulo: O Nome da Rosa Editora, 120 p.

Melhado, S. B., Adesse, E., Bunemer, R., Levy, M. C., Luongo, M. & Manso, M. A. *A gestão de projetos de edificações e o escopo de serviços para coordenação de projetos.* Webpage accessed 20-09-2010 at: http://www.revistatechne.com.br/engenharia-civil/135/artigo93370-1.asp

Solano, R. S. & Picoral, R. B. *Coordenação de projetos na construção civil: subsetor edificações: a análise dos procedimentos em uma empresa especializada*. In: Anais do I Workshop Nacional Gestão do Processo de Projeto na Construção de Edifícios. São Carlos: EESC/USP, 2001. 5p.

Souza, R. *Empresas redesenham seu modelo de negócios.* 26 Fev. 2009. Gazeta Mercantil, São Paulo. 26 Feb 2009. Webpage accessed 03-03-2009 at: http://www.felsberg.com.br/info_ clipping_conteudo.asp?i=37076&desc=if

Whole Building Design Guide. *Engage the integrated design process*. Webpage accessed12-12-2009 at: http://www.wbdg.org/design/engage_process.php

THE DESIRE FOR THE CONSTRUCTION INDUSTRY TO MOVE TOWARDS LIFECYCLE CARBON EMISSIONS ANALYSIS

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A significant reduction in carbon emissions is a global mission and the construction industry has an indispensable role to play as it is a major carbon dioxide (CO_2) generator. Over the years, various building environmental assessment (BEA) models and concepts have been developed to promote environmentally responsible design and construction. However, limited attention has been placed on assessing and benchmarking the carbon emitted throughout the lifecycle of building facilities. This situation could undermine the construction industry's potential to reduce its dependence on raw materials, recognise the negative impacts of producing new materials, and intensify the recycle and reuse process. In this paper, current BEA approaches adopted by the construction industry are first introduced. The focus of these models and concepts is then examined. Following a brief review of lifecycle analysis, the boundary in which a lifecycle carbon emission analysis should be set for a construction project is identified. The paper concludes by highlighting the potential barriers of applying lifecycle carbon emissions analysis in the construction industry. It is proposed that lifecycle carbon emission analysis can be integrated with existing BEA models to provide a more comprehensive and accurate evaluation on the cradle-to-grave environmental performance of a construction facility. In doing so, this can assist owners and clients to identify the optimum solution to maximise emissions reduction opportunities.

KEYWORDS: Carbon dioxide, emission, building environmental assessment, buildings lifecycle

INTRODUCTION

The increased atmospheric concentration of carbon dioxide (CO_2) has become a very critical and urgent problem, having been shown to exacerbate many environmental hazards (Lu et al., 2007). As a major industry in most countries, the construction sector emits significant amounts of carbon directly and indirectly from various activities (Goldenberg, 1998). According to US EPA (2008), the construction sector in the United States (US) ranks third highest in terms of CO_2 emissions, and the building industry consumes almost 40 percent of

the nation's energy (USA Census Bureau, 2003). In the United Kingdom (UK), the construction industry consumes nearly 50 percent of all primary energy in the country.

As a measure to encourage the design and construction of more environmentally responsible buildings, various building environmental assessment (BEA) concepts have been developed. Despite their widespread usage in practice, current BEA approaches evaluate general environmental performance of a building (Cole, 1998), rather than focusing primarily on carbon emissions. More importantly, emission levels are normally based on the energy consumed during the operational stage. There is currently a lack of systematic approaches to audit and benchmark the lifecycle CO_2 emissions generated by a construction facility (Ayaz and Yang, 2009). Existing BEA mechanisms are considered inadequate to promote environmentally beneficial products and processes, as their linear nature does not allow for optimisation in the context of cradle-to-cradle design (Braungart and McDonough, 2007).

Considering lifecycle carbon emissions is financially beneficial to developers as they can increase profitability through more efficient resource usage and by providing customers with greater satisfaction through the use of low-carbon and low-cost materials. Nonetheless, the lack of knowledge around lifecycle carbon analysis approaches makes its implementation uncertain. This paper summarises the current development of BEA tools, followed by a discussion on the relation between the cradle-to-cradle concept and carbon auditing. The paper concludes by examining the challenges of analysing lifecycle carbon emissions in the construction industry.

ENVIRONMENTAL PERFORMANCE OF A BUILDING

To assess the energy consumption of buildings, of either a specific part or the whole building lifecycle, involves the use of two basic types of tools: those for assessment and those for rating (Ding, 2008). BEA tools include energy-labelling, energy audit/analysis and building performance evaluation. Developing energy labelling, in terms of energy efficiency, is recognised worldwide, helping to identify the quality of energy performance, opportunities for energy saving, and to increase a building's resale value and rental income. The purpose of building labelling and certification is to overcome barriers relating to lack of information, high transaction costs, long lifetimes of buildings and the problem of displaced incentives between the builder and buyer, or owner and tenant (Levine et al., 2007).

The first labelling scheme for buildings was begun by the Building Research Establishment in the UK to assess the overall impact of buildings on the environment, embracing all factors, including carbon emissions, recycling and indoor air quality (Prior, 1993). Since then, a range of labelling schemes have been instigated, to the point where many countries have their own schemes running parallel to others – such as the Blue Angel and Green Dot in Germany, AENOR Medio Ambiente in Spain, and Singapore's energy smart labelling system. These labelling systems are considered very beneficial in checking the efficiency of buildings and their components (Lee and Rajagopalan, 2008).

Regional schemes have positive benefits in identifying culturally and economically appropriate responses to the regional environment (Stevenson and Ball, 1998). However, they can also lead to confusion and reduce the scope for comparisons between products labelled by different schemes. West (1995) considered lack of credibility as a problem with labelling, as well as the cost and effort involved in developing a large-scale building performance labelling system (Larsson, 1999). A study that compared the comparative

advantages of implementing ISO 14000 and eco-labelling concluded that the former is more likely to steer the construction industry towards improved environmental performance (Ball, 2002).

Other methods developed and implemented by organisations concerned with climate change include environmental impact audit programs, which help consumers identify opportunities for upgrading the energy efficiency of buildings (Levine et al., 2007). For example, the Eco-Management and Audit Scheme (European Union, 2001) provides a standardised and comprehensive list of environmental aspects. Aimed at obtaining energy efficiency in construction, building energy analysis has also been implemented in the building sector to both reduce its energy dependency and further compliance with international carbon reduction agreements. Other energy simulation programmes exist, such as the Hourly Analysis Program and PowerDOE, which provide very similar results to building energy analysis (Rey et al., 2007).

BREEAM is another approach that has made an impact worldwide; with Canada, Australia, Hong Kong and other countries using its methodology in developing their own environmental building assessment methods. Many countries have also developed several tools to evaluate energy consumption and carbon emissions in construction. The comprehensive Green Building Evaluation and Labelling System has been implemented in Taiwan, and is considered useable in other countries with similar temperature and weather patterns (Tam, 2007).

Hong Kong, in comparison, has introduced GBTool – a building environmental assessment framework. Compared with other assessment schemes, GBTool covers the broadest platform of performance categories and criteria and also features new assessment approaches such as a negative scoring system, absolute sustainability indicators, and a multiple indicators strategy (Lee and Burnett, 2006). Other early BEA tools implemented in Hong Kong include the Hong Kong Building Environmental Assessment Method (HK-BEAM) (Lee et al., 2007), which uses an energy budget approach and is claimed to be applicable to a wide range of buildings and premises types.

DRAWBACKS OF BUILDING ENVIROMENTAL ASSESSMENT

Despite the success of these tools to date, some weaknesses have been identified. As Ding (2008) has noted, criticisms of BEA include:

- The assessment process is usually carried out when the project design is almost finalised (Crawley and Aho, 1999; Soebarto and Williamson, 2001), limiting the use of BEA methods as design guidelines.

- Since BEA methods are used to evaluate building designs, they are less useful for selecting optimum projects where different options or locations of development are considered at the feasibility stage (Lowton, 1997).

- Some assessment tools such as BREEAM, BEPAC, LEED and HK-BEAM has limited emphasis on the financial aspects in the evaluation framework. The project may be environmentally responsible but offer insufficient financial returns to the developers.

- Most BEA methods were developed for local use and do not allow for national or regional variations. While the GBTool has been developed for regional use, there are still some limitations, namely: when evaluating buildings, the weights are scored subjectively (Crawley and Aho, 1999); the complexity of the GBTool framework makes it difficult to use; the GBTool has led to a very large and complex system, causing difficulties and frustration for over-stretched assessors rather than producing a global assessment method as intended (Curwell et al., 1999).

- BEA methods have overly comprehensive criteria.

- Current BEA methods cannot measure and evaluate qualitative environmental issues.

In view of the limitations of the existing BEA tools, Soebarto and Williamson (2001) have developed a multi-criteria building environmental performance assessment methodology and tool which allows designers to test design strategies against different sets of criteria. Likewise, Ding (2008) also proposed a multiple criteria approach to help rank alternatives in identifying optimum design solutions and facility operation. Todd (1998) has also suggested providing qualitative and quantitative assessment scales for many of the environmental criteria in order to make alternative types of judgments, particularly where data for the more desirable quantitative assessment is either not available or prohibitively expensive to acquire.

LIFECYCLE ASSESSMENT

Lifecycle assessment (LCA) is a method used to evaluate the environmental load of processes and products (both goods and services) through their lifecycles from cradle-to-grave (EEA, 2002; Fava, 2004; Fava, 2006; Sonnemann et al., 2003; Taborianski, 2004; Vigon et al., 1993). It has been used broadly since 1990 to calculate energy consumption and carbon emissions and detailed studies have been made of the potential of LCA for use in the building industry. An LCA tool being developed for buildings in Hong Kong was found to be a useful design tool for optimising building design and also a practical decision-making tool to evaluate a building's sustainability. Other research has also developed and made various LCA tools available for implementation in environmental assessment (Centre for Design, 2001; Erlandsson and Borg, 2003; Forsberg and Forsberg, 2004).

As a tool to evaluate the environmental impact of the building industry, LCA provides an assessment of energy consumption throughout a building's lifecycle from cradle-to-grave. McDonough and Braungart (2002) take the cradle-to-grave concept to cover raw material extraction, manufacturing, build, use and disposal of waste, at which point their value is considered to be zero. Steffen (2006) describes theconcept as a linear or one-way process, with potentially useful materials at the end of product's life becoming landfill as waste materials (Bisset, 2007; US Green Building Council, 2005).

An alternative to cradle-to-grave is Braungart et al.'s (2007) cradle-to-cradle concept, which envisages the flow of materials as a cyclical process (Miyatake, 1996). In this model, the idea is that no material will go to waste, as previously depleted materials will be regenerated through recycling (Tischner et al., 2001). In this way, building construction becomes less dependent on raw materials, and the value of materials is designed to be upgraded or maintained. Braungart et al. (2002, 2007), who term this concept eco-effectiveness, comment that it results in products with environmental benefits that contribute to economic growth and social development. Moreover, the concept also involves the design of materials flowing

within different products' lifecycles, as using materials in another product's cycle may be more efficient than reusing it in the next cycle of the same product (Kibert, 2008).

Of course, recycling materials and products is not new and can be an industry in its own right – as evidenced by the existence of scrap yards, tip shops and second hand (or pre-loved) garment shops, etc. However, some industries such as automobile, electronics and appliances are becoming increasingly interested in applying the cradle-to-cradle approach. For instance, Xerox copiers that are leased, refurbished and go through multiple lifecycles, single-use 'disposable' cameras that may actually be reused up to ten times (Cottrill, 2003); and Apple's reuse and recycling of electronic equipment, including computers and displays from any manufacturer (Apple, 2010).

APPLYING LIFECYCLE ANALYSIS IN CONSTRUCTION PROJECTS

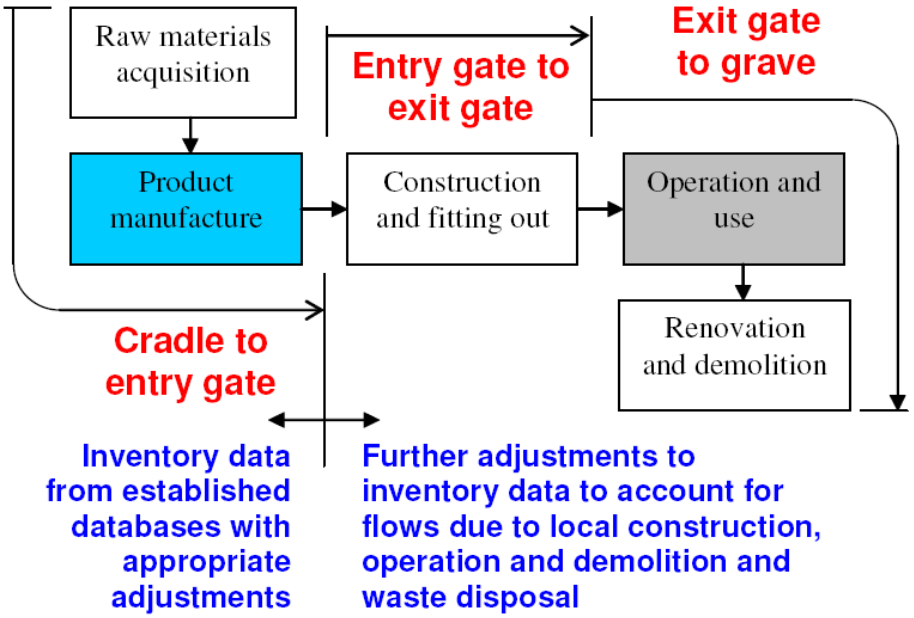
In the construction industry, Simon et al. (2007) have applied cradle-to-cradle concepts to identify how significant improvements in the quality of waste disposal can be achieved by the application of selective deconstruction procedures. They found that it encourages the development of modified procedures for disposal of buildings, where disposal contributes to the recovery of materials with zero loss in material performance. In terms of specific materials that can be reused or recycled, the most prevalent are metals such steel and aluminium. Steel is the world's most recycled material as it is cheaper to recycle steel scrap than to mine virgin ore, and steel recycling saves 74 percent energy compared to producing new metal (Steel Recycling Institute, 2006). In the case of aluminium, remelting requires only 5 percent of the energy required to make aluminium from ore (Millbank, 2004).

Liu (2009) has developed a model to track the steel construction lifecycle, termed the 'resource loop'. This model accounts for materials used and energy flow by aligning the cradle-to-grave model with the cradle-to-cradle model (El Haggar, 2007; Steffen, 2006), in the form of a closed loop system, where the material waste of building production is used in making other products. Liu (2009) found that transportation greatly influences cradle-to-cradle design, as the transportation process consumes high energy both in the construction / deconstruction and reusing / recycling processes.

Therefore, it is necessary to carefully consider and evaluate the lifecycle emission of construction facilities, *viz.* the extraction and processing of raw material, production processing, distribution, operation and waste management, etc. The carbon emissions for a construction facility should be presented as the tonne of carbon dioxide equivalent (tCO_2e) generated by each metre square of the floor space or per dollar spent on the construction at least from the cradle to grave perspective (Figure 1).

This can be realised by first delineating the emissions generated during the manufacturing and transportation processes up to the point of the entry gate of a construction site. While further processing would be necessary on site, the energy consumed during the construction process until the facility is built (i.e. to the exit gate) should be carefully accounted for. More importantly, one should not undermine the energy usage during the operational stage and that used for disposing the materials at the end of the facility's life. The lifecycle CO_2 emissions shall help clients, design team members, contractors and end-users to make an informed decision as to what design and materials to be adopted for the construction of the facility (*cf:* PAS, 2008).

Figure 1: A cradle-to-grave concept for assessing the carbon emissions in the construction industry.



In general, the implementation challenges of the lifecycle carbon emissions analysis comprise four groups (El Haggar, 2007; Proveniers et al., 2009):

- Conceptual challenges – including inexperience with the lifecycle carbon emissions analysis concept, lack of lifecycle carbon emissions reduction design and building materials, as well as associated risks.

- Economical challenges – due to the traditional way of thinking focusing only on initial investment, not being willing to pay more, and pre-judgement of the expense involved.

- Actor challenges – the many people involved in a lifecycle carbon emissions analysis process can cause internal and external conflicts of interest among parties. The complex relationships between industrial activities and different stakeholders make it difficult to implement lifecycle carbon emissions analysis strategies (Savitz, 2006). For instance, reuse and recycling of materials is still essentially the responsibility of the contractors, manufacturers and end users, while designers are required to determine the reusability and recyclability of materials at the design stage. Additionally, current lack of experience with the lifecycle carbon emissions analysis concept in the building industry makes implementation difficult, for example, tracking material flow and products' lifecycles are very hard. Although there are some tracking methods that can be used, such as economic-input-output and lifecycle analysis, these are of uncertain value unless accurate and reliable information is available (Hermreck and Chong, 2009).

- Measurement challenges – recent material and energy accounting methods are not broad enough to provide sufficiently comprehensive data (Liu, 2009).

CONCLUSIONS

This paper reviews studies of building environment assessment tools, which deal with energy and carbon calculations in specific parts of the building lifecycle. The review also identifies the importance of the lifecycle carbon emissions analysis concept where, in addition to reducing energy consumption and carbon emissions, long-term economic benefits are possible. It is noted that very few studies have taken place that consider the environmental impact of the reuse and recycle phase of construction and that further development of existing assessment tools is needed in this area in order to provide sufficiently accurate information. In addition, the prospects for implementation of the lifecycle carbon emissions analysis concept are presently limited due to the lack of experience and knowledge of consultants, contractors and owners, and their ability to work collectively.

While many studies have confirmed that a construction facility produces a significant amount of CO_2 throughout its lifecycle, a radical rethink of how to improve the current building environmental assessment approaches to incorporate the lifecycle carbon emissions is imperative. Apart from the operational phase, with the highest contributor to CO_2 emissions, any emissions generated during the planning and design phase, material manufacturing phase, construction process phase, maintenance and renovation phase, as well as deconstruction and disposal of waste material phase should be taken into consideration. By adopting a lifecycle carbon emissions analysis concept, the potential for reducing the dependence on raw materials, recognising the negative impacts caused by producing new materials, and intensifying the recycle and reuse process should increase across the construction industry.

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REFERENCES

Apple (2010). *Apple recycling program*. Webpage accessed 10 August 2010 at: http://www.apple.com/recycling/computer/

Ball, J. (2002). Can ISO 14000 and eco-labelling turn the construction industry green? *Building and Environment*, **37**, 421-428.

Bisset, R. (2007). *Buildings can play a key role in combating climate change*, UNEP news release. Webpage accessed 5 July 2010 at: http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=502&ArticleID=5545&l=en:

Braungart, M., McDonough, W. & Bollinger, A. (2007). Cradle-to-cradle design: creating healthy emissions – a strategy for eco-effective product and system design. *Journal of Cleaner Production*, **15**(13-14), 1337-1348.

Centre for Design at RMIT (2001). *Background report LCA Tools, data and application in the building and construction industry*. Webpage accessed 8 July 2010 at: http://buildlca.rmit.edu.au/menu8.html

Charter, M. & Tischner, U. (2001). *Sustainable solutions: developing products and services for the future*. Sheffield: Greenleaf Publishing.

Cole, R. J. (2005). Building environmental assessment methods: redefining intentions and roles. *Building Research and Information*, **35**(5), 455-467.

Cottrill, K. (2003). Dell and the reverse computer boom. *Traffic World*, **267**(50), 23.

Crawley, D. & Aho, I. (1999). Building environmental assessment methods: application and development trends. *Building Research and Information*, **27**(4/5), 300-308.

Curwell, S., Yates, A., Howard, N., Bordass, B. & Doggart, J. (1999). The Green Building Challenge in the UK. *Building Research and Information*, **27**(4/5), 286-293.

Ding, G. K. C. (2008). Sustainable construction – The role of environmental assessment tools. *Journal of Environmental Management*, **86**, 451-464.

EEA (2002) *Case studies on waste minimisation practices in Europe*. Copenhagen: European Environment Agency.

Erlandsson, M. & Borg, M. (2003) Generic LCA-methodology applicable for building, construction and operation services-today practice and development needs. *Building and Environment*, **38**(7), 919-938.

European Union (2001). *Allowing voluntary participation by organizations in a community eco-management and audit scheme (EMAS)*. Regulation (EC) No. 761/2001 of the European Parliament and of the Council of 19 March 2001, Official Journal of the European Communities, L114/1, Brussels: European Union.

Fava, J. A. (2004). *Why take a lifecycle approach? Lifecycle initiative*. Paris: United Nations Environment Programme Division of Technology, Industry and Economics Production and Consumption Branch.

Fava, J. A. (2006). Will the next 10 years be as productive in advancing lifecycle approaches as the last 15 years? *International Journal Lifecycle Assessment*, **11**(Supp.1), 6-8.

Forsberg, A. & von Malmborg, F. (2004). Tools for environmental assessment of the built environment. *Building and Environment*, **39**, 223-228.

Haggar, S. E. (2007). *Sustainable industrial design and waste management: cradle-to-cradle for sustainable development*. London: Elsevier Academic Press.

Hermreck, C. & Chong, W. K. (2009). Embodied energy of CDW recycling and technical metabolism due to regional differences and building designs. *Proceedings: 2009 Construction Research Congress*. April 5-7, Seattle, WA, American Society of Civil Engineers, 526-536.

Kibert, C. J. (2008). *Sustainable construction: green building design and delivery*. Hoboken, NJ: John Wiley and Sons, Inc.

Larsson, N. K. (1999). Development of a building performance rating and labelling system in Canada. *Building Research & Information*, **27**(4/5), 332-341.

Lee, S. E. (2008). Rajagopalan priyadarsini – Building energy efficiency labelling programme in Singapore. *Energy Policy*, **36**, 3982-3992.

Lee, W. L. & Burnett, J. (2006). Customization of GBTool in Hong Kong. *Building and Environment*, **41**, 1831-1846.

Lee, W. L., Yik, F .W .H. & Burnett, J. (2007). Assessing energy performance in the latest versions of Hong Kong Building Environmental Assessment Method (HK-BEAM). *Energy and Buildings*, **39**, 343-354.

Levine, M., Ürge-Vorsatz, D., Blok, K., Geng L., Harvey, D., Lang, S., Levermore, G., Mehlwana, A. M., Mirasgedis, S., Novikova, A., Rilling, J., & Yoshino, H. (2007). Residential and commercial buildings. In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Metz, B., Davidson, O. R., Bosch, P. R., Dave, R. & Meyer, L. A. (eds): Cambridge and New York: Cambridge University Press.

Liu, L. F. (2009). *Tracking the lifecycle of construction steel: the development of a resource loop*. Unpublished Thesis, School of Engineering. Kansas: University of Kansas.

Lowton, R. M. (1997). *Construction and the Natural Environment*. Oxford: Butterworth Heinemann.

Lu, J., Vecchi, G. A. & Reichler, T. (2007). Expansion of the Hadley cell under global warming. *Geophysical Research Letters*, **34**, 5 pages.

McDonough, W. & Braungart, M. (2002). *Cradle-to-cradle: remarking the way we make things*. New York, NY: North Point Press.

Millbank, P. (2004). *Aluminum recycling vital to global supply chain*. Aluminum International Today. Webpage accessed 6 August 2010 at: http://www.allbusiness.com/primary-metal-manufacturing/alumina-aluminum/232827-1.html

Miyatake, Y. (1996). Technology development and sustainable construction. *Journal of Management in Engineering*, ASCE, **12**(4), 23-27.

PAS (2008). *Publicly available specification 2050 – specification for the assessment of the life cycle greenhouse gas emissions of goods and services*. London: BSI British Standards.

Prior, J.J. (1993). *BREEAM / new offices (version 1/93): an environmental assessment for new office designs*. Garston, Watford: Building Research Establishment.

Proveniers, A. G. W. J., de Vries, B., Collas, D. P. M., Advokaat, B. & Nieuwenhuijsen, I. (2009). A cradle to cradle (C2C) decision support model for the development of mixed functional areas. In: *Changing Roles: New roles, New Challenges*. Wamelink, H., Prins, M. & Geraedts, R. (eds.): Delft: TU Delft. 645-654.

Rey, F. J., Velasco, E. & Varela, F. (2007). Building energy analysis (BEA): a methodology to assess building energy labelling. *Energy and Buildings*, **39**, 709-716.

Simon, M., El-Haram, M. & Horner, R. M. W. (2007). Cradle-to-cradle – a concept for the disposal of building at the end of their lives? *Proceedings: International Conference on Whole Life Urban Sustainability and its Assessment*. June 27-29, Glasgow Caledonian University, Glasgow. M. Horner, C. Hardcastle, A. Price & J. Bebbington (eds.), 14 pages.

Soebarto, V. I. & Williamson, T.J. (2001). Multi-criteria assessment of building performance: theory and implementation. *Building and Environment*, **36**, 681-690.

Sonnemann, G., Castells, F. & Schuhmacher, M. (2004). *Integrated life-cycle and risk assessment for industrial processes*. Boca Raton: Lewis Publishers.

Steel Recycling Institute (2006). *Steel recycling holds strong despite inventory crunch*. Webpage accessed 6 August 2010 at: http://www.recycle-steel.org/PDFs/2006RatesRelease.pdf

Steffen, A. (2006). *World changing: A user's guide for the 21st century*. New York, NY: Harry N. Abrams, Inc.

Stevenson, F. & Ball, J. (1998). Sustainability and materiality: the bioregional and cultural challenges to evaluation. *Local Environment*, **3**(2), 191-209.

Taborianski, V. M. & Prado, R. T. A. (2004). Comparative evaluation of the contribution of residential water heating systems to the variation of greenhouse gases stock in the atmosphere. *Building and Environment*, **39**(6), 645-652.

Tam, V. W. Y. (2007). The effectiveness of the green building evaluation and labelling system. *Architectural Science Review*, **50**(4), 323-330.

Todd, J. (1998). Incorporating lifecycle assessment concepts and other suggestions for enhancing the GBC 98 assessment framework. *Proceedings: Green Building Challenge '98*. October 26-28, Vancouver, BC, Vol. 1, 330-336.

USCB (2009). *Guide to Data Sources, Definition: NAICS 23, Construction*, U.S. Census Bureau. Webpage accessed on 2 December 2010 at: http://www.census.gov/epcd/naics02/def/NDEF23.HTM Business Dictionary.com

USEPA (1993). *Lifecycle assessment: inventory guidelines and principles*, EPA/600/R-92/245, Office of Research and Development, Washington, DC: U.S. Environmental Protection Agency.

USEPA, (2008). *Quantifying greenhouse gas emissions in key industrial sectors in the U.S.*, Sector Strategies Division, Washington, DC: US Environmental Protection Agency.

USGBC (2005). *LEED new construction version 2.2 reference guide*. Washington, DC: U.S. Green Building Council.

West, K. (1995). Eco-labels: the industrialization of environmental standards. *The Ecologist*, **25**(1), 31-47.

EXPLORING THE LIMITATIONS OF TRADITIONAL APPROACHES TO WORK-LIFE BALANCE FOR SUPPORTING PROFESSIONAL AND MANAGERIAL STAFF

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There are significant difficulties in the application of 'work-life balance' to organisations within the construction industry. Although academic definitions aim to enable individuals to maintain a satisfactory equilibrium between work and non-work activities, the reality is that the concept is synonymous with women and caring responsibilities. Our research aims to investigate the extent to which work-life balance initiatives operate within professional and managerial staff in construction related work. This paper draws on qualitative data collected from over 100 interviews conducted in the UK with people employed in a variety of settings. Interestingly, the traditionally gendered view is challenged by some men in the sample who voice strong need to operate locally in order to stay close to home and occasions where female respondents prioritise their career ambitions. With regards to the employment context, the self-employed report working long hours, yet commend much greater levels of satisfaction with flexibility in managing their time commitments. Overall, informal approaches to managing work-life balance are most common; however, there is significant variation within and between organisations. Many respondents correlate this to specific managers' style. Our argument is thus threefold: (i) more gender-balanced research is required within male dominated industries if work-life balance policies are to achieve their full potential; (ii) where the existing debates have overlooked the employment context this is an important variable in establishing and maintaining work-life balance; and (iii) while a seismic shift in industry culture is required to address issues reported by our respondents, this will be difficult to achieve. Innovative solutions are required to negotiate changing societal conditions.

KEYWORDS: work-life balance, 'new man', professional workers, managers, qualitative research

INTRODUCTION

Work-life balance is an important theme in mainstream HRM literature. However, understanding of the concept is varied. Traditionally it has been considered a female-oriented term, used to refer to organisational initiatives that offer women the opportunity to balance their caring commitments with an opportunity to participate in the employment market. 'Work' has been considered as something that comes in the way of 'life' (i.e. caring responsibilities). More recently it has been recognised that work-life balance should be about *"the ability of individuals to pursue successfully their work and non-work lives, without undue pressures from one undermining the satisfactory experience of the other"* (Noon and Blyton, 2007: 356; emphasis added).

Eikhof et al (2007: 326-327) argue that for many professional employees in particular, the notion of work being something negative is outdated and in fact the opposite is now true: work can be a source of satisfaction and self-fulfilment. Watts (2007) takes this further recognising that paid work shapes identity (see also Reeves, 2001, cited in Watts, 2007: 38) and that the considerations of 'life' need to extend beyond caring commitments, to include the value of personal wellbeing. However, for the purposes of this research boundaries are drawn to deliberately exclude those activities that are considered non-work related, i.e. 'life', so that no uneven weighting is given to people with caring responsibilities or housework, etc. 'Division of labour' in the home and 'wellbeing' form separate debates in their own right in the literature (see for example Singleton and Maher, 2004; Smithson and Stokoe, 2005). In other words, our focus is on investigating literature on how 'work' is arranged, or not, so that both men and women do not feel overburdened.

In the light of the traditional female-orientation of work-life balance as a concept, and in the view of the equality agenda where equality (in terms of work-life balance or otherwise) is achieved when women have the same opportunities; and the same pay and so forth as men, the question is: do organisational work-life balance initiatives address the needs and wishes of both men and women? Effectively this provides a reverse order investigation into 'equality:' what about work-life balance in terms of men having the same opportunities and access to organisational support as women?

We will explore this research question with reference to a heavily male-dominated sector: the construction industry (focus of the conference). This inherent gender-imbalance allows us a deliberate advantage in questioning value-ladenness of the concept.

Theoretically the research question is investigated through a critical discussion of literature on work-life balance. Empirically we draw on qualitative interview data, before an integrated discussion of the limitations we found in the traditional approaches to work-life balance for supporting professional and managerial staff in the contemporary organisation/ society.

TRADITIONAL APPROACHES TO WORK-LIFE BALANCE

Work-life balance as a concept has roots somewhere in the 1960s when studies were first initiated to look at the linkages between work and family, and soon surfaced with a multitude of work-family related concepts such as work-family conflict, work-family enrichment, work-family balance (Gregory and Milner, 2009: 1).

Academically, explanations of work-life balance then developed in their focus and scope from 'family friendly' to 'flexible working' in an attempt to move toward 'genderblind' terminology (Smithson and Stokoe, 2005: 149). Earlier definitions suggested a division between work and life was necessary in terms of time and space, as in Felstead et al (2002: 56): *"the relationship between the institutional and cultural times and spaces of work and non-work in societies where income is predominantly generated and distributed through labour markets"*. More recent literature suggests that this view is limited in that *"for the majority of people, 'work' is a major part of their 'life', rather than something distinct which can be separated out and presented as a hypothetical juxtaposition (work-life)"* (Noon and Blyton, 2007: 355).

Focus of policies/ initiatives: accommodating caring responsibilities

With focus on how 'work' is arranged, or not, so that professional employees can achieve work-life balance (adopting the definition by Noon and Blyton, 2007: 356 above) it is important to establish the nature of organisational work-life balance policy and practices. According to Taylor (2008: 64-65) there are four main types of initiatives which commonly make up a work-life balance policy: flexible working, leave and time off, childcare facilities and health and well-being. Flexible working comprises 'atypical' working time patterns; for example, part-time work, compressed hours, term-time working, job sharing, flexitime and homeworking. These arrangements may be set for a temporary period of time or on a permanent basis. In terms of leave and time off, it is now a requirement in law in many countries, for example the UK, that an employee is allowed to take few days off at a short notice to make arrangements for care of dependants (in addition to maternity and paternity leave and other such provisions). In practice the vast majority of employees rarely take advantage of the opportunities available to them (Taylor, 2008: 65) so many organisations offer voluntarily more generous entitlement to support their employees. Beyond leave to accommodate for caring responsibilities, some employers offer career breaks or sabbaticals to established members of staff. Childcare facilities usually refer to larger organisations provisions of nursery places for pre-school children or after-school and holiday clubs for school age children. Finally, 'health and well-being' embraces a broader provision of support services with the primary aim of assisting employees themselves to reach a better work-life balance. Occupational health services are a well established example of this type of support.

It is clear here that much of the focus in the provision of support centres on employees' caring responsibilities; perhaps rightly so, but this does limit the application of the initiatives to particular segments of the labour force and thus exclude significant proportions of valuable employees.

Another theme prevalent within the literature on work-life balance identifies a significant tension around the primary beneficiary of these initiatives; thus the following section enquires whether organisational work-life balance policies and initiatives are in place to help achieve organisational goals or to provide a mechanism of employee support.

Focus on benefits to the employer

There is evidence to suggest that many work-life balance and flexible working initiatives are introduced primarily to meet operational needs of an organisation or as a response to labour market conditions; such as extended hours of operation, variations in staffing requirements and knowledge transfer (retaining older workers or working mothers for example), rather than as a mechanism of employee support (Fleetwood, 2007; Taylor, 2008: 63-64).

The main difference between employer-friendly and employee-friendly working arrangements relates to trust: for example, employer-friendly ways of arranging work are associated with a much lower level of trust where employee-friendly forms of flexible working seem to require high level of trust (particularly on part of the organisation). It is well-known that many flexible working systems fail because managers do not trust their workers (Felstead et al, 2002). Trust correlates with the approach, or philosophy, an organisation takes to managing people. The up-take and nature of work-life balance initiatives in construction organisations may be poor because of the traditionally 'personnel management' type (Druker and White, 1996) approach to managing people. Personnel management is based on the values, needs and working patters of 'traditional men' (breadwinners whose role in the home is limited). More individualistic and liberal, employee-centred, styles may require wider application of the principles of human resource

management (HRM), which are closely associated with not only accommodating difference but valuing difference and individuals (Doherty, 2004). HRM supports the view that formalistic measures, such as development of organisational procedures, are likely to achieve only modest behavioural change (ibid: 437). 'True employee-centeredness' requires attitudinal change (Smithson and Stokoe, 2005: 157). To develop this yet a step further, a combination of a business case, legal regulation and social regulation, and further *"humanisation of the workplace"* (Doherty, 2004) at present suggest a viable way for taking the work-life balance agenda forward. For Sturges (2008: 132), sending out a consistent message is crucially important. This refers to integration of organisational policy and procedures horizontally; i.e. making sure they support each other, but also ensuring the value system of the organisation is vertically aligned.

Really, building on the somewhat controversial contribution of Eikhof et al (2007) from the point of view that work is not necessarily 'bad' and needing to be contained through working time and related interventions, the argument becomes that work-life balance initiatives should (and can be) mutually beneficial. To illustrate the point rather aggressively: isn't the assumption that work always interferes with life simplistic? Rather than (simply) trying to increase the time we have available with family, wouldn't a truly balanced view be considerate of our needs both at work and outside? Therefore, is it useful to prioritise one over another (work or life); surely we can enjoy both and for that very reason find "balance" difficult to achieve?

Current thinking on work-life balance is thus flawed as it focuses on either those who have caring responsibilities or those who are overworked, existing only as a response to Equal Opportunities or Health and Safety Legislation rather than as proactive solutions aiming for overall wellbeing and/ or performance.

Then, more broadly, we question whether it should be the worker (traditionally female employee) that forms the focus of work-life balance initiatives. Within a holistic framework of analysis at least, clearly all stakeholders should 'have a voice;' that is, all individuals, organisations, professions and society at large. Here, we highlight the emergence of the 'new man' as follows.

NEW DEVELOPMENTS IN THE WORK-LIFE BALANCE AGENDA

It is important to view work-life balance from the male perspective for two reasons. Firstly, the working population in the construction industry is heavily male dominated. Organisational work-life balance initiatives that only cater for the minority (women) in the sector are not achieving their full potential (Smithson and Stokoe, 2005: 149). Secondly, but related to the need to form efficient and effective organisational policy and practice, the question about supporting the work-life balance of men is pertinent as the notion of the 'new man' emerges (Hearn, 1999; Watts, 2009:42). The new man is arguably keen to spend time with the family and values personal wellbeing, where traditionally the male role has been that of a breadwinner with long working hours (Watts, 2009: 43).

In the last decade, the popularity of the work-life balance agenda has strengthened academically (ibid: 2) but it has also gained government/ political support in the UK and the European Commission (Bryson and Karsten, 2009: 40). While much of the legislative developments have extended the rights of women, there are changes that seek to address the previously limited provisions for men, for example a father's right to use up maternity leave

(Stevens and Phillips, 2009). Indeed to support this, Hakim (2008) argues for a gender-neutral social policy to address the imbalance of men's much more restricted choices regarding their involvement with family than women.

RESEARCH METHODS

This paper draws on qualitative in-depth interviews within an overall interpretive paradigm relating to people employed in the construction industry. Altogether over 100 interviews were conducted in the UK with people employed in a variety of settings from sole practitioners[1] to large organisations in the industry. All respondents held professional/ managerial roles in the participating organisations. The sample includes group level directors, middle managers (contract-, programme- and project managers) and junior/ operational site-based managerial staff (such as foremen) together with professionals such as architects, design co-ordinators, quantity surveyors and engineers. All interviews were tape recorded, transcribed verbatim and analysed using qualitative data analysis software (NVivo).

FINDINGS

The data reveals significant concerns over maintaining a satisfactory work-life balance. Interestingly, the traditionally gendered view is challenged by some men in the sample who voice strong need to operate locally in order to stay close to home and occasions where female respondents prioritise their career ambitions. With regards to employment context, the self-employed report working long hours, yet command much greater levels of satisfaction with flexibility in managing their time commitments. Overall, informal approaches to managing work-life balance are most common; however, there is significant variation within and between organisations. Many respondents correlate this to specific managers' style.

Time management and flexibility emerged as the significant themes in terms of the challenges to achieving satisfactory work-life balance (for both men and women). These are explored next before our integrated discussion and conclusion on the limitations in the traditional approaches to work-life balance for supporting professional and managerial staff in the construction industry.

Time management and travel

Our qualitative analysis revealed real issues with the long working hours culture; a theme that was said to be *"close to the heart for lot of people"* and *"part of the industry."* One operational director noted that *"construction is a busy business. You end up spending a lot of hours here when maybe you should be with the family"*. One manager noted their motive to tackling the problem stemming from the 20% "staff churnage" rate it had induced. Different mechanisms were employed to deal with the problem, including allowing staff to come in early and leave early in the afternoon. This was also helpful in reducing the time required for travel as rush hour traffic was avoided. Another project manager said: *"the trouble is they [members of staff] won't take time off!"* She had divorced because of the hours she put in, but now considered it lucky that her current partner also works in the construction industry and

[1] Sole practitioner defined as a professional practicing alone; the proprietor of a professional practice

hence understands. One senior contracts manager also personalised the problem with long working hours: *"that is my own problem, I don't take any time off."*

Many frequently took work home over weekends in addition to long hours put in during the week; the expected daily working time averaged around 10-11 hours, although the contracted hours were 7,5 per day (37,5 hrs/ week). Working hours were noted to always increase nearing project completion. One site manager commented that *"the managers taking on programmes of work do not think of employees who will be doing the work, and plan unrealistic hours. This affects the employee doing the job, not the one agreeing/ planning it."* This was especially relevant for employees on a fast-track project, which had been built around 12 hour shifts. Some personnel on the project did not mind this since there was nothing else to do when they were living away from home during the week.

One engineer mentioned a *"look busy culture"* and was insistent he would not take part in it. Another professional employee, a quantity surveyor, actively sought work within a particular division of an organisation because of the Monday-Friday work ethic that was prevalent in that part of the company. Local authority architects were prevented from overworking by the 'clocking in' mechanism in place (flexi-time), which created transparency in working time together with the tight restrictions on numbers of hours worked. One local authority employed salaried architect said that *"it's fantastic; you're thrown out of the building at 6.30pm!"* However, another respondent from a local authority admitted that she still took work home in the evenings. There was a trade-off in terms of the type of work: their projects tended to be less creative and smaller but this was countered by relative job security, clearly defined working hours and flexi-time as well as locally-based projects.

A comparison of the attitudes towards long working hours between the local authority salaried architects reported above and company principals and self-employed architects in the sample revealed stark differences. One female company director reported working 75 hours a week (six 12,5 hr days); but, because 'the employer' is her own company, she felt she was investing in her future and therefore did not resent the long hours. When she was asked about work-life balance, she replied *"What's that?"* Similarly, one of the male sole practitioners said to regularly work from 8am to 8pm (12 hour day) but combined work-related trips into his local town with a swim and a round of golf, or walked his dogs in the middle of the day. He described it as *"mixing business with pleasure"*.

An intriguing paradox is apparent here. On the one hand, there is a lack of understanding on the part of the employers about their employees' work-life balance and the respondents highlight significant concerns regarding this. At the same time, while the self-employed work equally long hours, their attitude is notably positive. This contrast between the salaried and self-employed respondents is fascinating - it is not as if there is a trade off between employment security and work-life balance with the salaried personnel as keeping up with the job is a key driver for working the long hours. Cleverly many of the self-employed respondents have developed a niche specialism, such as conservation, as a mean to guarantee them an element of job security. Central to the dissatisfaction of those employed thus appears to feature a lack of control over their working lives. Clearly, the [time] demands of employers take priority over the work-life balance of their employees and thus the historical view of 'flexibility' serving the employer interests prevails (Fleetwood, 2007; Taylor, 2008).

Many organisations tried to reduce the need for travel by regional organisational structures, such as the North, Midlands and South in one company, but this helped only in reducing the need to stay away at the project location overnight. In some instances, indeed, it had extended

the travelling distance to and from the project. Many of the directors in the participating organisations travelled long distance to and from the office themselves and so on the one hand understood the strain it can put on the working day, but on the other hand expected a similar commitment to the job/ organisation from their employees. Interestingly however, one director noted: *"when I started here it was mentioned that my daily commute would be 90 miles each way but this has never been mentioned since. It would be nice if someone asked 'how is it going'."* Few respondents mentioned working from home occasionally, which eased the burden of travel. Flexibility to do this was available especially if someone's child was ill or other circumstances at home needed supporting. Another way of easing the burden of travel was lift sharing. As noted above, many adjusted their working time to avoid rush hour traffic.

One foreman described how he had turned down jobs because they involved staying away from home. Another foreman described himself as *"a family man at heart"* and liked to be close to home: *"if they asked me to go to London or somewhere, forget it."* The costs of extensive travel were summarised well by one contracts manager:

- *"No life outside of work*
- *Expensive to operate a job*
- *Tired employees with reduced performance (and potential impact on their health too)."*

Some viewed the travel in positive light: *"[it] gives you a break to think."* Younger engineers viewed lodging away as an adventure, an opportunity to see new places, meet new people and save money. Also, as alluded to above, those on the fast track project frequently made reference to it being much easier to cope with the 12 hour shifts when staying away during the week. The team had taken to socialising together at nights, to go swimming and have dinner together: they were *"like a little happy family."* One quantity surveyor mentioned that he *"would like to get out a bit more!"* Quantity surveying was mentioned as one job which requires least travel in the industry.

However, in most cases staying away was not all that frequent on an individual basis. Those who were actually staying away during the interviews noted that it was their first time away in four-eight years with the company, and others said that they had only ever stayed away once. One site manager had opted for a project further away now having worked locally for four years.

Three engineers had a very 'realistic' view commenting that it was really down to each individual's own choice. Managers could ask for their employees to travel or stay away overnight, after all it was a well-known feature of the work, but everyone had the opportunity to refuse the request and find a job elsewhere. On a similar 'realistic' vein, one site manager said: *"you just get used to it."* Some noted that since you get the car and fuel paid for it was reasonable to expect the drive. However, another engineer in the past had used his resignation to make a point, to *"try and make management listen."* Although our interview sample is limited in size, it is interesting to note that many of the 'lower level employees,' such as foremen, had stronger inclination to challenge the decisions of their managers, while those higher up the hierarchy and employees in professional roles, such as design co-ordinators, more readily adjusted to the working conditions offered to them and/ or perhaps negotiated preferred ways of adjusting. One female design co-ordinator for example much preferred to

stay away during the week than commute on a daily basis. Her view aligns with Eikhof *et al's* (2007) notion of work being seen as 'good' for professionals.

Commuting was not an issue for the architects who operated as sole practitioners. They generally worked from home; only one had separate premises away from his home. Others worked from 'study' rooms in their homes or from especially built/converted offices attached to their house. Several mentioned that they tried to keep home and work environments separate but were happy to see clients in the evenings and at weekends if necessary.

Overall, we found that there were limited formal rules, guidelines or policies in place about travel in the participating organisations; and those in place concerned mostly the car as a benefit. Therefore, much of the management practices in terms of arranging travel/ staying away and monitoring or managing the expectations over long-term were informal. Divisional differences and variations in relation to the employment status of the research participants were also apparent, both in terms of management style and geographical operating radius. In one extreme example, a person working on a telecommunications project had to drive 200 miles for only an hour's work and then carry on elsewhere on a regular basis. Another respondent, an architect, who had visited Scotland, the Isle of Man and London during the previous few days, reflected "*you have to go where the work is"*. The geographical radius of work was particularly relevant factor for some employees choosing to work in particular part(s) of a company. Travel was also noted to impact on the company's and the industry's ability to recruit the best personnel.

In summary, the data presented clearly confirms that long working hours are a key issue affecting work-life balance of professional/ managerial employees in the construction industry. Perhaps that is nothing new; but, we reveal that the more senior managers (company directors and contracts managers) in particular are well aware of the costs of long working hours and travel both to the business and individuals. Interestingly, this is not related to gendered assumptions of caring responsibilities in the home; rather the focus is on employee well-being and organisational performance. This supports our argument that work-life balance must include much broader range of considerations than is traditionally thought.

At the same time, one of the organisational challenges to supporting work-life balance was employees' commitment to their job/ organisation: *"the trouble is they [members of staff] won't take time off!"* This confirms Eikhof et al's (2007) contention of truly balanced consideration of work *and* life, not one over another. However, some argue that this is linked to the notion of presenteeism, which is 'necessary' in order to 'get on'; if these employees were reluctant to work long hours or to travel their career prospects could be severely compromised (Sturges, 2008).

Flexibility

In terms of flexibility, variation between respondents between and within different companies was notable. Commonly a 'two-way' arrangement was agreed to be in place where the organisation expected employees to put in the hours needed to complete their work at a location required. In return, some of the employees were given the opportunity to work from home, attend doctors or dental appointments during working hours, get time off work when moving house for example and arrange holidays as best suited their life and work circumstances. Key to success in such a system was balance. In three companies flexibility was also noted in relation to providing support with family problems.

However, it was also recognised that flexibility was likely to be particularly applicable only in certain parts of the organisations; more linked to specific managers' style/ approach to managing their people, and therefore informal. The formal systems and structures of the participating organisations were rigid and inflexible, for example, employees were not allowed to carry forward holiday entitlement although they were required to put in long hours to finish a project (and perhaps miss the opportunity to take leave because of their commitment to the project). In staffing, flexible employment strategies were used extensively. In particular, contracting organisations brought in agency and freelance staff to complement permanent employees in staffing projects.

In interviewing some of the architects, it became clear that flexibility in terms of working time is more evident among those who are self-employed, sole practitioners or company principals than those who are employed by practices; a theme also noted by Carter and Cannon (1988). The abovementioned differences in attitude between them were further stressed here. Particularly for the self-employed respondents, flexibility was attractive and important as illustrated in the following quote: *"I feel I ought to be able to work on it the hours that I want to. It [self-employment] has been very good for me architecturally and from the point of view of being able to organise my time".* A practice principal echoed this: *"You work when the work is there and do it to suit yourself. It's very flexible being in the position that we're in. If I worked for a company it would be more restrictive ... I'm probably a bit more in charge of my own destiny being in this position".*

Indeed, all the sole practitioners mentioned flexibility as an advantage, although one held a more reserved view by saying that it was impossible to plan the day because the demands of different projects may eat into the evenings too. The flexi-time arrangement in place in the participating local authorities, quite a common 'flexible working' type work-life balance initiative (Taylor, 2008), helped accommodate childcare: *"If you're in a local authority, it's a much better and easier environment to cope with children, I can take the children to school and still get to work".* Another local authority employee, who had experienced long hours as the norm in previous private sector employment, now enjoyed being able to *"be at home doing other things. That's where the flexi-time is rather nice, if I know I'm not having a busy day then I can go in a bit later… and that to me is such a relief compared to private practice."*

One of the key reasons time flexibility is possible in local authority work is because the majority of the work tends to be local and carried out within the local authority boundaries. These employees do not usually have projects or meetings which are held at considerable distances, as can be the case in the private sector. As a result, it is easier to predetermine starting and finishing times and be able to operate flexible working hours. This lends considerable support for Fleetwood's (2007) thesis that many problems in balancing work and life stem from poor workload planning, a theme noted above in relation to time management too. It appears that flexibility is consistently expected by employers of their employees, but little is offered in return. One of the architects in the sample estimated she had worked 300 hours of unpaid overtime over the past year and was in dispute with her employer as a result; recently she had collapsed through ill-health following nineteen consecutive days of work without any time off.

In some private sector organisations, professional employees reported that even small degrees of time flexibility were frowned upon, even by their colleagues! One respondent said that *"I can ask for an hour off and I'll make it up but it's not looked upon as 'being the right thing to do'."* Many of the sole practitioners in architecture and principals of architectural practices

also remarked on the lack of flexibility when they had been employed in other firms; one had received a written warning for arriving at work late most mornings despite the fact she stayed later in the evenings and was actually working more hours than she was contracted for. Interestingly, although flexibility regarding use and organisation of time was perceived as a benefit, none of the self-employed respondents cited it as a consideration in establishing their own practice.

DISCUSSION AND CONCLUSION: THE LIMITATIONS OF TRADITIONAL APPROACHES TO WORK-LIFE BALANCE FOR SUPPORTING PROFESSIONAL AND MANAGERIAL STAFF

Two key points surface here: (1) we found no differences in the preferences of men and women in terms of their commitment to work and life. In fact, our small scale study suggests that it is possible that men, particularly within a male dominated industry such as construction, will 'suffer' very similar difficulties to those usually considered relevant for female workers. In several cases we heard of divorces or relationships ending due to the pressures of work (this really is work-life *conflict* of most explicit form). Equally, one respondent noted that *"my partner works in construction so he understands."* Notably, the latter was from a female participant in the study. Time management is clearly a feature that allows satisfactory negotiation of the requirements for [periodic] long working hours and personal/ family well being. Those in charge of their own time (primarily the self-employed) highlight that it is not necessarily a reduction in working hours that is required for achievement of satisfactory 'balance'; perception of control denotes their contribution voluntary and hence is acceptable. In developing a more gender-balanced work-life balance agenda, it is therefore essential that we explore how issues around working time can be managed so that the cultural barriers (such as presenteeism) are removed. To this effect, we are working to initiate a larger scale study that will explore the issues raised here in depth.

(2) Another fascinating thing about our data was the fact that many of the participating organisations actually practice work-life balance 'bottom up.' That is, supporting employees informally, rather than formally. It appears that in those workplaces where the environment is conducive to work-life balance, organisational policy and systems need to develop to match the level of managerial flexibility and two-way negotiation in place on a divisional/ individual level. Current literature presents the opposite as true. The latter approach, top down policy, will be necessary for achieving change in those organisations where even fellow employees frown upon flexible employment. Thus, this is another area important to study in detail; particularly in light of the abovementioned cultural barriers that are still in place to hinder the uptake of work-life balance initiatives across all organisations/ more widely in the society. Change may be on the way with new generations entering the workforce with their value system, such as the 'new man.' At present, the main beneficiary of work-life balance is still often the organisation.

Our findings support Fleetwood's (2007) suggestion that many work-life balance problems are caused by poor planning and organising by employers and their expectations that employees will work (any number of) extra hours and travel considerable distances to meet workload demands. This is a theme that appears to be culturally embedded in the profession. It is evident that all the problems in time pressure and lack of work-life balance are countered by the satisfactions that professional and managerial staff achieve from the nature of their

work. This aligns with Eikhof et al's (2007) suggestion that people enjoy their work and see it as life affirming.

Our argument is thus threefold: (i) more gender-balanced research is required within male dominated industries if work-life balance policies are to achieve their full potential; (ii) where the existing debates have overlooked the employment context this is an important variable in establishing and maintaining work-life balance; and (iii) while a seismic shift in industry culture is required to address issues reported by our respondents, this will be difficult to achieve. Innovative solutions are required to negotiate the changing societal conditions and levels of commitment professional and managerial personnel exhibit towards their work.

REFERENCES

Bryson, C. and Karsten, L. (2009) Managing uncertainty or managing uncertainly? In Leopold, J. and Harris, L. (eds) *The Strategic Managing of Human Resources* (2nd ed). Harlow: Prentice Hall Financial Times

Carter S. and Cannon T. (1988) 'Women in Business'. *Employment Gazette* 96, 10 pp 565-71.

CIPD (2009) *Employee outlook: working life in recession; quarterly survey report*, London: Chartered Institute of Personnel and Development

Doherty, L. (2004) Work-life balance initiatives: implications for women, *Employee Relations*, **26**(4), 433-452

Druker, J. and White, G. (1996) *Managing people in construction*, London: IPD

Eikhof, D.R., Warhurst, C. and Haunschild, A. (2007) Introduction: What work? What life? What balance? *Employee Relations*, **29**(4), 325-333

Felstead, A., Jewson, N., Phizacklea, A. and Walters, S. (2002) Opportunities to work at home in the context of work-life balance, *Human Resource Management Journal*, **12**(1), 54-76

Fleetwood, S. (2007) Why work–life balance now? *International Journal of Human Resource Management*, **18**(3), 387–400

Gregory, A. and Milner, S. (2009) Editorial: Work-life balance: a matter of choice? *Gender, Work and Organization*, **16**(1), 1-13

Hakim, C. (2008) 'Is gender equality legislation becoming counter-productive?' *Public Policy Research*, September-November, 133-136

Hearn, J. (1999) A crisis in masculinities or a new agenda for men? In Walby, S. (ed) *New agendas for women*. London: Macmillan

Noon, M. and Blyton, P. (2007) *The Realities of Work*. Basingstoke: Palgrave.

Singleton, A., and Maher, J. (2004) The "New Man" Is in the House: Young Men, Social Change, and Housework, *The Journal of Men's Studies*, **12**

Smithson, J. and Stokoe, E.H. (2005) Discourses of work-life balance: negotiating 'genderblind' terms in organizations, *Gender, Work and Organization*, 12(2), 147-168

Stevens, M. and Phillips, L. (2009) Fathers gain the right to use up maternity leave, *People Management*, 24th September

Sturges, J. (2008) All in a day's work? Career self-management and the management of the boundary between work and non-work, *Human Resource Management Journal*, 18(2), 118-134

Taylor, S. (2008) *People Resourcing* (4th ed). London: CIPD

Watts, J.H. (2009) 'Allowed into a man's world' meanings of work-life balance: perspectives of women civil engineers as minority workers in construction, *Gender, Work and Organization*, **16**(1), 37-57

REVALUING BENCHMARKING – A TOPICAL THEME FOR THE CONSTRUCTION INDUSTRY

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Over the past decade, benchmarking has increasingly gained foothold in the construction industry. The predominant research, perceptions and uses of benchmarking are valued so strongly and uniformly, that what may seem valuable, is actually abstaining researchers and practitioners from studying and questioning the concept objectively. This paper addresses the underlying nature of benchmarking, and accounts for the importance of focusing attention on the sociological impacts benchmarking has in organizations. To understand these sociological impacts, benchmarking research needs to transcend the perception of benchmarking systems as secondary and derivative and instead studying benchmarking as constitutive of social relations and as irredeemably social phenomena. I have attempted to do so in this paper by treating benchmarking using a calculative practice perspective, and describing how this perspective develops more thorough knowledge about benchmarking and challenges the current dominating rationales. Hereby, it is argued that benchmarking is not a neutral practice. On the contrary it is highly influenced by organizational ambitions and strategies, with the potentials to transform organizational relations, behaviors and actions. In closing it is briefly considered how to study the calculative practices of benchmarking.

KEYWORDS: benchmarking, construction, calculative practices, critical

INTRODUCTION

I start this paper with an analogy about value rigidity by Robert Pirsig (1974):

'[T]he most striking example of value rigidity I can think of is the old South Indian Monkey Trap, which depends on value rigidity for its effectiveness. The trap consists of a hollowed-out coconut chained to a stake. The coconut has some rice inside which can be grabbed through a small hole. The hole is big enough so that the monkey's hand can go in, but too small for his fist with rice in it to come out. The monkey reaches in and is suddenly trapped… by nothing more than his own value rigidity. He can't revalue the rice. He cannot see that freedom without rice is more valuable than capture with it.' (Pirsig, 1974: 312)

The analogy is a well-known philosophical story of how rigid values can keep us trapped in an undesirable situation. The monkey should not be labelled unintelligent – he is simply not able look at his situation objectively and revalue the rice; he does not understand that it is his own fist that traps him, his own desire for the rice. He rigidly holds on to the rice, because he values it so strongly that he never considers that an alternative to food could be preferred.

The introductory story is chosen, because I find it well-suited as an illustration of my main point in this paper: We as benchmarking researchers and practitioners risk getting caught in a self-created captivity of rigid values, if we do not constantly challenge and revalue the way we perceive and use the concept.

I find the predominant research, perceptions and uses of benchmarking valued so strongly and uniformly that it may actually be abstaining researchers and practitioners from studying and questioning benchmarking objectively. I consider the existing benchmarking literature and research as being results of industry's demand for straightforward guidance (Barrett & Barrett, 2003), which to a great extent ignores the fact that the area of function is a socially constructed world.

My objective for writing this paper is to shed light on the importance of revaluing benchmarking. I claim that in order to gain and learn more from benchmarking, we need to challenge the dominating rationales and transcend the prevalent studies, discussions and theories that surround the concept. I do so by questioning the values and challenging some of the accepted premises for the effectiveness of benchmarking.

In the next paragraph I describe the value rigidity of benchmarking and argue for why it is important to revalue the concept. Subsequently, I introduce *calculative practices* as a theoretical proposal for a revaluing. In closing, I account for how benchmarking can be understood and investigated as calculative practices and how such a perspective can develop new knowledge about benchmarking by challenging the current dominating rationales, thus, helping us to revalue and gain something greater from doing and studying benchmarking.

THE VALUE RIGIDITY OF BENCHMARKING

World-wide change in construction is high on the agenda, and a comprehensive effort is made to improve quality and efficiency in the construction industry. As a result, benchmarking has gained foothold in construction and can be found in various designs, deployments and contexts (e.g. Beatham *et al.*, 2004; Costa *et* al, 2004; Haugbølle & Hansen, 2006; El-Mashaleh *et al.*, 2007). The stakeholders range from governmental ministries, researchers and consultants to contractors and construction clients (e.g. The Benchmark Center for the Danish Construction Sector, Constructing Excellence, CII BMM, EIB International Comparisons of Construction, Chile National Benchmarking System, Comparison of house-building productivity in Scandinavia). The diversity in designs, uses, contexts and stakeholders has led to an uncertainty in how to perceive, thus, to use benchmarking in the construction sector (Rasmussen, 2010).

The emergence of benchmarking in construction derives from the pandemic excitement over the management concept, that throughout the 1990s and up until today, is considered to be a crucial part of managerial strategies in order to improve processes, productivity and market positions (Chen, 2005; Dawkins *et al*, 2007). Benchmarking is producing normative ideals and standards through comparisons. It enables companies to look upon themselves in comparisons to others with the ambition of reducing the differences to the "best in class", thus becoming alike or superior (Andersen & Thygesen, 2004). A general definition of benchmarking is the process of measuring and comparing performance with the objective of identifying organizational weaknesses that can be improved by organizational adaption of *best practices* from leading companies. Performance before and after adopting best practices is measured, hence assessing the success of adopted practices by comparing previous performance to the new achieved performance. But the focus is not simply on copying practices of others but on learning how to improve organizational performance by sharing ideas (Watson, 1993). But how this "learning how to improve" is facilitated and come into existence in an organizational context, I find widely overlooked. The research topics and definitions of benchmarking "[…] are predominantly outcome orientated: they address the

purpose of benchmarking, not in terms of its essence, but in terms of its potential contribution to organizational success" (Moriarty & Smallman, 2009: 488), and a broad normative consensus surrounds the concept (Triantafillou, 2006). When reading the growing literature on 'benchmarking construction' it shows the same tendencies: It is mainly dominated by pragmatism (e.g. the development of new benchmarking models, case-oriented studies verifying benchmarking systems through quantifications, normative descriptions of benchmarking implementation), and in general (ap)praising the management concept, thus participating in constituting benchmarking as a prudent route to improvement for industry. Fernie *et al* (2006) argue that measuring performance is important when exercising control, but falls short when seeking reliable explanations for; the link between practice and performance, trying to fully understand the organizational changes measurements generates and how best practices are diffused. They also point out that it is '[...] necessary to recognize that different industry sectors and organizations are characterized by recipes, logics and organizational routines that reflect a historical understanding of both context and practices.' (Fernie *et* al, 2006: 99). The distribution of research topics in 'Benchmarking: An International Journal' in the period 1994-2008, is indicating the lacking attention these kind of research questions: Only 4 % of publications were conceptual (Anand & Kodali, 2008) and none addressed the underlying nature of benchmarking (Moriaty & Smallman, 2009). I see this distribution of research topics as an indication of an endorsement and acceptance of the premises for the effectiveness of benchmarking (that measuring and comparing performance and adopting best practices leads to organizational improvement). The consequence of this is that the underlying nature of benchmarking – the mechanisms that make benchmarking work in organizations – get no or little attention. It is the mechanisms (change of organizational processes, organizational adoption of best practices, individuals striving after excellence and performance goals etc.) that in the end result in organizational improvements, and not the process of measuring, comparing and identifying best practices to adopt.

With limited explanations of how benchmarking initiatives, KPIs measures and adoptions of best practices lead to improvement (Fernie *et al*, 2006), it is no surprise that construction research literature suffers under the same inadequacies as benchmarking research literature: Knowledge about how benchmarking and adoption of best practices impacts organizational practices remains underexplored. With this knowledge gap, I see a risk of benchmarking ending up, like the monkey trap, depending on value rigidity for its effectiveness. Consider this: would benchmarking be effective, if there were no common acceptance of the premises for benchmarking – that performance measures and adoption of best practices would lead to improved performance? This is a critical question that has been the basis for writing this paper: since the effectiveness of benchmarking is reliant on the mechanisms that are activated when doing benchmarking and adopting best practices, it is paradoxical that these remain underexplored. The current interpretation of benchmarking has a normative presupposition; that identifying organizational weaknesses and learning and adopting practices from others will improve performance. Simultaneously, it presupposes that any increase in performance is desirable and beneficial. It may be this pleasant expectation to benchmarking that makes it a commendable practice for improvement. Benchmarking and the appertaining performance measures are perceived and acted upon as being rational representations of reality that facilitate decision makers to take action and make rational objective decisions. But the objectivity of benchmarking collapses when we start asking critical questions: e.g.; what kind of performance should be measured? How can performance be measured and what measures represent performance? What does not count as performance? What happens in the process of valuing and quantifying performance measures into indicators, and are they satisfactory representations of the measured performance? How are performance indicators translated into

performance opportunities and organizational actions? Behind these questions is a large potential for subjectivity that has a potentially enormous influence on benchmarking design, objectives, validity, implementations and interpretations.

At risk of being misinterpreted, I must emphasize, that I do not claim that benchmarking is inefficient. Nor do I claim that the premises and present valuing of benchmarking are incorrect or undesirable. I simply argue that in order to avoid getting caught in a self-created captivity of rigid values, researchers and practitioners must call more attention to the mechanisms that are prerequisites for benchmarking's effectiveness. Thus, contributing to alternative understandings and interpretations of benchmarking that enable us to look at benchmarking objectively and question the rising consensus that surrounds the concept. In this paper I do so, by introducing calculative practices, which I find well-qualified to provide knowledge about how to study and understand the mechanisms that constitutes the effectiveness of benchmarking.

CALCULATIVE PRACTICES – A WAY TO REVALUE BENCHMARKING

Much like my description of benchmarking, accounting practices in organizations had for a long time been perceived as rational practices with objectively empirically verifiable descriptions of reality that provides managers an unambiguous space for necessary actions and decision making. The perception of accounting practices as rational is based on assumptions that through general accepted and structured procedures, model-based analysis and quantifications emerges a conclusive indisputable outcome in guises of figures. But unlike benchmarking, this embedded interpretation of accounting practices has been revalued, and today accounting research is questioning the practices of quantifying reality into figures that can be analyzed and acted upon by managers as if they were pure evidences. One major argument is that accounting practices are not purely initiated to calculate cost or evaluate a particular investment opportunity but are instead always intrinsically linked to a particular strategic or programmatic ambition (e.g. increase efficiency, encourage responsibility, improve decision making etc.), thus going beyond the task for which they are deployed (Boland & Pondy, 1983; Miller, 2001). The functional dualism resulted in ambiguous interpretations, and researchers realized that the sociological mechanisms of accounting practices are pivotal elements for their functioning. Recognizing this left the roles and organizational impacts of accounting practices in organizations obvious objects of study - commonly referred to as *calculative practices* in the accounting literature. Calculative practices break with the traditional perception of accounting practices as rational, secondary and derivative, and instead characterize them as intrinsic and constitutive of social relations and social phenomena (Miller, 2001).

Research on calculative practices is dominated by a number of discourses, most predominant, that calculative practices develop notions of normality and creates rationality. Additional, that calculative practices quietly and almost unnoticed force individuals to adjust their actions by visualizing deviation from managerial stated targets or the perception of normality generated through the accounting practices. Having these discourses as premises for the investigation of calculative practices it becomes evident that accounting figures cannot be reduced to instrumental extensions of managerial intensions. Instead they should be studied as a key resource to stimulate individuals and organizations ability to commit to desirable targets through reflective self-organization, hence enabling new ways of acting upon and influencing

the actions of individuals, driving them to pursue the notion of "normality" created by the calculative practices (Miller, 2001).

Quantification of Differences

An inevitable emerging phenomenon that calls for attention when studying calculative practices is called *commensuration*; the process of valuing and transforming, in nature, incomparable entities into a uniformly calculable metric (Espeland & Stevens, 1998), thus, facilitating comparisons of entities that without the commensuration would not have been subjects to comparisons. These kinds of transformation of qualitative incomparables are highly prevailing in accounting; e.g. Miller & O'Leary (1987) describe how standardized accounting procedures make a firm's varied assets and liabilities, from raw materials to workers, uniformly calculable in monetary terms. The sphere of application of commensuration discussions does not solely associate to accounting and the production of financial figures. Commensuration is crucial and emerges as a fundamental feature of social life in the way we as humans categorize and make sense of the world (Espeland & Stevens, 1998). These kinds of logics are implicit and taken highly for granted as rational parts of everyday life decision making. They are parts of the accepted logic humans use to transform qualities into quantities through series of aggregations. But when moving the discussion from individual's everyday life commensuration to commensuration as an organizational phenomenon, the complexity and controversies increase significantly;

"Commensuration as a practical task requires enormous organization and discipline that has become largely invisible to us. Commensuration is often so taken for granted that we forget the work it requires and the assumptions that surround its use. It seems natural that things have prices, that temporality is standardized, and that social phenomena can be measured. Our theories presume that we commensurate when choosing and that values can be expressed quantitatively. Commensuration changes the terms of what can be talked about, how we value, and how we treat what we value. It is symbolic, inherently interpretive, deeply political, and too important to be left implicit in sociological work." (Espeland & Stevens, 1998: 315).

The complexity and controversies linked to commensuration is depended on whether the commensuration is taken for granted, the acceptance of how the different entities are commensurated and how the quantificated qualities are applied in practice. The different entities need to be classified in ways that make them comparable. "If the categories of classification are broadly agreed upon, commensuration may appear to be a simple matter of specifying incremental differences between otherwise similar things." (Espeland & Stevens, 2008: 408). But commensuration can also have hidden agendas and motives inherent, and can be used by decision makers to hide behind quantifications by providing an obscure, thus undisputed, foundation, for controversial decisions. "Quantification is a way of making decisions without seeming to decide." (Porter, 1995: 8). Decision-makers are increasingly using calculations to produce a facade of objectivity and transparency, thus replacing the relevance of the separate entities through standardized relations and quantification of differences (Espeland & Stevens, 1998) with the quantified outcomes of commensuration and the decisions based on these.

What Calculative Practices can do for Benchmarking Research

I have criticized the literature to be overwhelmingly prescriptive with little recognition of the underlying nature of benchmarking in organizations, and inadequate in addressing the sociological effects of benchmarking, though these are prerequisites for the organizational

improvements that are the expected output of benchmarking. Thus, I see an emerging value rigidity of benchmarking assuming 'improved performance' as a given outcome.

In this section I seek to explain how a calculative practice perspective can be of assistance in revaluing benchmarking. I do so by describing how such a perspective can influence or challenge the current knowledge about benchmarking, and how this will develop more interesting and thorough benchmarking research.

Calculative practices reject benchmarking as a neutral practice. Instead it shall be understood as constituted by its calculative practices and the way these influence behaviors, actions, perceptions and decision making processes in organizations. The object of research is not the benchmarking system but rather the calculative practices that emerge in organizations due to the system. Such a perspective will contribute to the current knowledge about benchmarking, by studying the underlying nature of benchmarking and create a basis for questioning the premises for its effectiveness.

Calculative practices state that the work and conventions used to make numbers, and their meaning and consequences, shall never be presumed (Espeland & Stevens, 2008). "Only by analyzing particular instances of quantification in context can these purposes and meanings be revealed. As with language, purposes and meanings of quantification are established through use." (Espeland & Stevens, 2008: 405). By applying this critical perspective on numbers and the appertaining quantifications, calculative practices offers a way to underpin a research framework for critically studying; how benchmarking is ascribed meaning and acted upon in organizations, the relationship between measured performance and organizational practices, individual interpretations and managerial intensions etc. – all premises for the effectiveness of benchmarking.

Calculative practices provide an understanding of benchmarking systems as powerful contributors that influence and change behaviors, attitudes, perceptions and decisions in organizational settings. Such a perspective makes benchmarking constitutive of social relations, thus its calculative practices legitimate objects of investigation (Miller, 2001). Understanding the sociological effects of benchmarking's organizational impacts are crucial elements in the quality control of benchmarking systems, since any system that has the ambition to change (behavior, processes, perceptions etc.), needs to verify that the underlying intensions are achieved and that the immanent logics of the systems do not overshadow common sense. Understand benchmarking from this perspective is a requisite to meditating upon and challenging benchmarking to change in particular ways. In order to do so, it is necessary to apply an outside view and look objectively upon the systems – and this is what calculative practices can do for benchmarking research.

BENCHMARKING AS CALCULATIVE PRACTICES

Applying calculative practices as a theorization of benchmarking will recognize benchmarking as intrinsic and constitutive of social relations and social phenomena, hence, reveal answers to *how* benchmarking systems change organizational processes in different organizational settings, instead of taking such effects for granted. It would dismiss the idea of measures and performance indicators as neutral representations of reality; hence, we need to study them and their effects. By questioning the production of numbers as a rational practice, we cease to study benchmarking as a process aiming at providing genuine objective

information about organizational performance for decision making, and study it instead as a managerial strategy to intervene in established organizational settings.

Calculative practices change the prevalent perception of measurements by moving interest from conveying the world to defining and creating the world through control and governing of actions, and in this way forcing people into ways of thinking and acting. Thus benchmarking is not separated from the reality it seeks to provide information of. On the contrary, it is intrinsically linked to reality, since it shapes and creates reality. Benchmarking becomes a phenomenon that utilizes individual's reflective self-organization towards self-serving personal interest optimization. Through performance measures and comparisons, it creates the references or normalization for such self-organization of individuals, by constructing the world in terms of how individuals should make rational decisions about certain things (Miller, 2001), in order to attain the most personal gain. Benchmarking becomes diagnostic and highly dependent of subjective interpretations and strategic objectives (Miller, 2001). Diagnostic in the sense that it prescribes to individuals in the organization, what the top executive of the company pay attention to and assess individuals/departments/companies on the basis of. At the same time it creates organizational perceptions of 'normalized performance'. The dependence of subjective interpretations is referring to the attention individuals pay to the measures, the fact that their performance gets measured, and the normalization of performance the measures give rise to. It is this deployment of new interpretations that, according to calculative practices, constitute benchmarking – and other performance measurement, accounting and control systems – as effective strategic managerial tools. These management tools are results of the prevailing acceptance of individuals as being free (and consequently their actions). Organizational impacts are best achieved by influencing the individual's interpretations and not by acting directly on individuals. Benchmarking is making use of moderate liberalistic regulation and acts on individual's interests through external regulations. It creates a rationality that forces individuals to interpret and relate their actions to measures and to being measured, thus, invoking their awareness (and self-interest) in how to adjust in order to realize self-serving interest optimization. Calculative practices claim that it is this fostering of an action oriented organizational behavior that eventually end up changing organizational processes and achieving organizational improvement; Benchmarking acknowledges individuals freedom of action, but simultaneously makes them act appropriately by creating the social room for maneuvers. Benchmarking systems are models of rationality constructed to normalize performance that generally seen, standardize the organizational actions acting on the common interest of individuals – thus becoming appropriate methods for pursuing purposes.

Studying the Calculative Practices of Benchmarking

When entering the field to study benchmarking as a phenomenon constituted by its calculative practices, it is evident that this cannot be studied directly. Compared with natural scientific phenomena and the dominating benchmarking studies, social fields are unique and ambiguous in the sense that they both are shaped by and exercise symbolic interactions (Blumer, 1969).

So where to begin in this unexplored sociological field of benchmarking? An important factor that appears when understanding benchmarking as constituted by its calculative practices is the system design; by acting on interests of individuals, an understanding of the dominating interests in the field of intervention is pivotal for the success of a benchmarking system. If the system is to realize strategic programmatic ambition by changing how individuals perceive themselves, their actions and their surroundings, it is crucial that it is using the correct

preconditions. The importance of these preceding design criteria invoke an (till now underexplored) interest for researchers to investigate and understand the relations between these building blocks of benchmarking systems and the sociological effects they actualize. Mappings of such social relations and interactions between individuals and benchmarking systems can illuminate whether a system has the strategic programmatic intended effect or gets misinterpret and ends having unforeseen unintended organizational effects.

What we can do as researchers to map the relations between system and individuals, is to study the interactions that people in the field of intervention engage themselves in, since it is through interactions phenomena are realized and ascribed meaning (Berger & Luckmann, 1971).

"[T]he thing itself is a field of interactions between human beings who try to understand themselves and others […] Through this interactive understanding, the human beings of the field ascribe things and phenomena properties that make their routine or enquiring behavior more or less meaningful. By interacting with themselves and others, humans create in a social field a set of individual and collective actions that together evoke the social field's methods of functioning." (Andersen *et al*, 1995: 177).

The calculative practices of benchmarking systems are studied as the relations (e.g. perceptions, articulations, decisions, actions etc.) that are changed, eliminated or emerged due to the benchmarking system. A mapping of such relations will reveal the calculative practices, hence, the underlying nature of benchmarking and its effectiveness.

CONCLUSIONS

The effectiveness of benchmarking is reliant on its sociological effects. Therefore it is paradoxical that knowledge about such effects is very limited. If we as researchers do not engage in studying this underlying nature of benchmarking, we risk getting caught in a self-created captivity of rigid values.

This paper has challenged some of the dominating premises and rationales of benchmarking and has transcended the perception of benchmarking systems as secondary and derivative. By applying a calculative practices perspective on benchmarking, it has been argued how benchmarking can be understood and studied as constituted by its calculative practices, and as social phenomena. In order to avoid value rigidity, it is necessary to apply an outside view and look objectively upon benchmarking – and this has been argued to be possible through a calculative practices perspective. Applying this perspective when assessing benchmarking systems will potentially illuminate whether a benchmarking system has the strategic programmatic intended effects or gets misinterpreted and ends having unforeseen unintended organizational effects. Such knowledge about benchmarking is a requisite to meditating upon and challenging benchmarking to change in particular ways.

Much different from the current prevailing perceptions, calculative practices regard benchmarking as diagnostic and highly dependent of subjective interpretations and strategic objectives. It is highly influenced by organizational ambitions and strategies, and can be understood as a managerial strategy to intervene in established organizational settings and influence behaviors, actions, perceptions and decision making processes in organizations. It is considered to be a way to make use of moderate liberalistic regulation. By acting on individual's interests through external regulations, benchmarking influences individual's

actions and creates a rationality that forces individuals to interpret, relate and adjust their actions to performance measures. It makes use of individual's strive after self-serving personal interest optimization.

When studying the sociological impacts of benchmarking, the object of research is not the benchmarking system but instead the calculative practices that emerges in organizations due to the system. Understanding the benchmarking as its calculative practices can reveal answers to *how* benchmarking systems change organizational processes in different organizational settings, instead of taking such effects for granted. It is the fostering of an action oriented organizational behavior, that eventually end up changing organizational processes, and achieving organizational improvement. Benchmarking acknowledges (and makes use of) individuals freedom of action, but simultaneously makes them act appropriately by creating the social room for maneuvers. Benchmarking systems are models of rationality constructed to normalize performance that generally seen, standardize the organizational actions acting on the common interest of individuals – thus becoming appropriate methods for pursuing purposes.

Studying the calculative practices of benchmarking requires a mapping of the social relations and interactions between individuals and benchmarking systems. This will ultimately reveal the underlying nature of benchmarking, thus its effectiveness.

REFERNECES

Anand, G. & Kodali, R. (2008). Benchmarking the benchmarking models. *Benchmarking: An International Journal,* **15(**3), 257-291.

Andersen, I., Borum, F., Kristensen P.H. & Karnøe P. (1995). *On the Art of Doing Field Studies:* Handelshøjskolens Forlag

Andersen, N.Å. & Thygesen, N.T. (2004). Styringsteknologier i den udsatte organisation. *GRUS,* **73**, 8-29

Beatham, S., Anumba, C., Thorpe, T. and Hedges, I. (2004), "KPIs: a critical appraisal of their use in construction", *Benchmarking: An international Journal,* Vol. 11 No. 1, pp. 93-117

Barrett, P.S. & Barrett, L.C. (2003). Research as a kaleidoscope in practice. *Construction Management and Economics,* **21**, 755-766.

Berger P.L. & Luckmann T. (1971). *The Social Construction of Reality*: Harmondsworth, Penguin

Blumer, H. (1969). *Symbolic interactionism:* Engelwood Cliffs, NJ: Prentice-Hall

Boland R.J. & Pondy L.R. (1987). Accounting in Organizations: A Union of Natural and Rational Perspectives. *Accounting, Organizations and Society,* **8(**2/3), 223-234

Chen, H.L. (2005). A competence-based strategic management model factoring in key success factors and benchmarking. *Benchmarking: An international Journal,* **12(**4), 364

Costa, D. B.; Formosco, C. T.; Kagioglou, M.; Alarcón, L. F. (2004), "Performance Measurement Systems for Benchmarking in the Construction Industry" In: Conference on the International Group for Lean Construction, 12., 2004, Helsingor. Proceedings IGLC-12, 2004. pp. 451-463.

Dawkins, P., Feeny, S. & Harris, M.N. (2007). Benchmarking firm performance. *Benchmarking: An International Journal*. **14(**6), 693-712

El-Mashaleh, M. S., Minchin, R. E. And O'Brien W. J. (2007), "Management of Construction Firm Performance Using Benchmarking", *Journal of Management in Engineering*, Vol. 23, No. 1, pp. 10-17

Espeland, W.N. & Stevens, M. (1998). Commensuration as a Social Process. *Annual Review of Sociology*. **24**, 313-343.

Espeland, W.N. and Stevens, M. (2008). A Sociology of Quantification. *Arch.europ.sociol*, **3**, 401–436

Fernie, S.; Leiringer, R and Thorpe, T. (2006), "Change in construction: a critical perspective", *Building Research and information*, Vol. 34, No. 2, pp. 91-103

Haugbølle, K., Hansen, E. (2006), "A typology of benchmarking systems", Construction in the XXI century: Local and global challenges: Proceedings of the Joint International CIB W055/W065/W086 Symposium Construction in the 21st century, Napoli, Edizioni Scientifiche Italiane

Miller P. (2001). Governing by Numbers: Why Calculative Practices Matter. *Social Research*, **68**(2), 379-396

Miller P, & O'Leary, T. (1987). Accounting and the construction of the governable person. *Accounting Organizations and Society*, **12(**3), 235-265

Moriarty, J.P. & Smallman, C. (2009). En route to a theory of benchmarking. *Benchmarking: An International Journal*, **16(**4), 484-503.

Pirsig, R.M. (1974). Zen and the Art of Motorcycle Maintenace – An Inquiry into Values: William Morrow

Porter, T. (1995). Trust in Numbers: The Pursuit of Objectivity in Science and Public life: Princeton University Press, Princeton.

Rasmussen, G.M.G. (2010), Benchmarking – A tool for judgment or improvement?, *CIB World Congress 2010*, Salford Quays, United Kingdom

Triantafillou, P. (2006). Benchmarking som normaliserende styringsteknologi. *Politica*, **38**(1), 22-39

Watson, G.H. (1993). Strategic Benchmarking: How to Rate Your Company's Performance against the World's Best: Wiley, New York.

MAPPING INNOVATION – FACILITATING INNOVATION IN THE DANISH CONSTRUCTION INDUSTRY

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By adopting a theoretical framework from strategic niche management research (SNM) this paper presents an analysis of the innovation system of the Danish Construction industry. Theories within SNM look upon innovation in a sector as a socio-technical phenomenon and identifies three levels of socio-technical interaction within which sectorial innovation can be explained. The analysis shows a multifaceted landscape of innovation around an existing regime, built in the existing ways of working and developing over generations. The regime is challenged from various niches and the socio-technical landscape through trends as globalization. Three niches (Lean Construction, BIM and System Deliveries) are subject to a detailed analysis showing partly incompatible rationales and various degrees of innovation potential. The paper further discusses how existing policymaking operates in a number of tensions one being between government and governance. Based on the concepts from SNM the paper introduces an innovation map in order to support the development of meta-governance policymaking. By mapping some of the most influential trends and promising niche innovations and relate these to the existing regime, the innovation map can act as a medium in which policymakers, interest organization and companies can develop and coordinate future innovation activities.

KEYWORDS: Innovation, policymaking, niches, SNM, sector development

INTRODUCTION

The construction industry is often characterised as a tradition bound low innovation sector which struggles with low productivity. Consequently has a small but significant strand of Danish research been conducted around innovation e.g. Clausen (2002), Simonsen (2007) and Vind and Thomassen (2009).

Nevertheless, innovation processes *are* going on at all levels of the construction industry - from the builders at the construction site to the major development programs.

Despite the strong interest in stimulating innovation in Danish industry, the innovation programs are facing striking difficulties. Clausen (2002) concludes in his analysis of sectorial development programs that a mapping of innovation activity in construction industry is needed, focusing the interplay between strategically oriented and formalized activities and informal innovation processes on construction projects. (ibid: p. 13)

In this way it relevant to investigate how the construction industry capacity for innovation can be accelerated so that and how the industry can respond to new societal challenges such as the move towards CO2-neutral societies.

Ambition

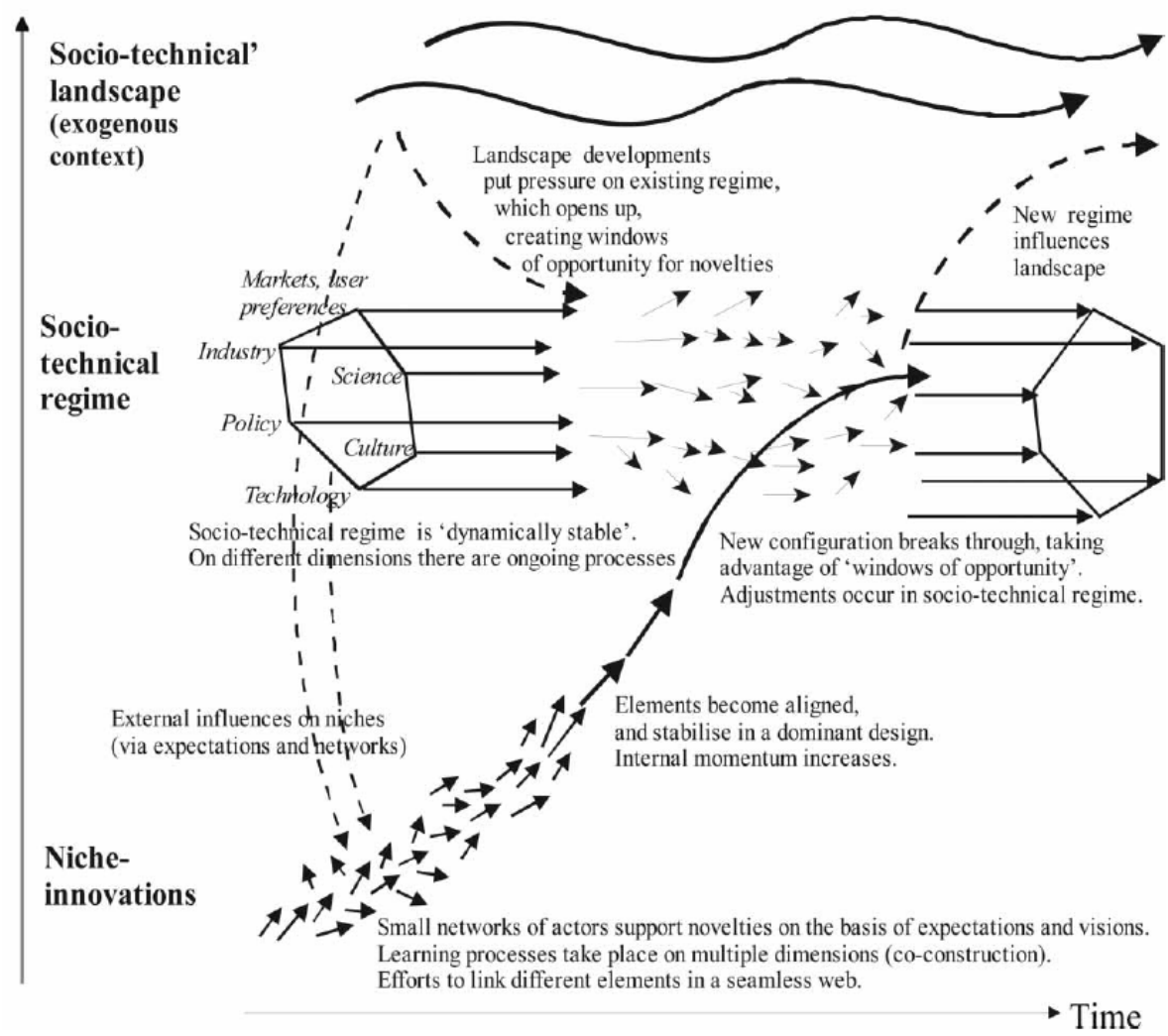
The ambition of the paper is to present an analysis of the innovation system in the Danish construction industry (Thuesen et al 2011) and discuss strategies by which innovation activities can be stimulated and coordinated.

Theoretical framework

The research of the innovation system of the Danish Construction industry draws upon a theoretical framework from strategic niche management research (SNM) (Schot and Geels 2008).

Theories within SNM look upon innovation in a sector as a socio-technical phenomenon and identify three levels of socio-technical interaction within which sectorial innovation can be explained (Schot and Geels 2008, p. 545) and is illustrated in the following figure.

Figur 1: Innovation in an innovationssystem explained in three levels (Schot & Geels 2008, p. 546)

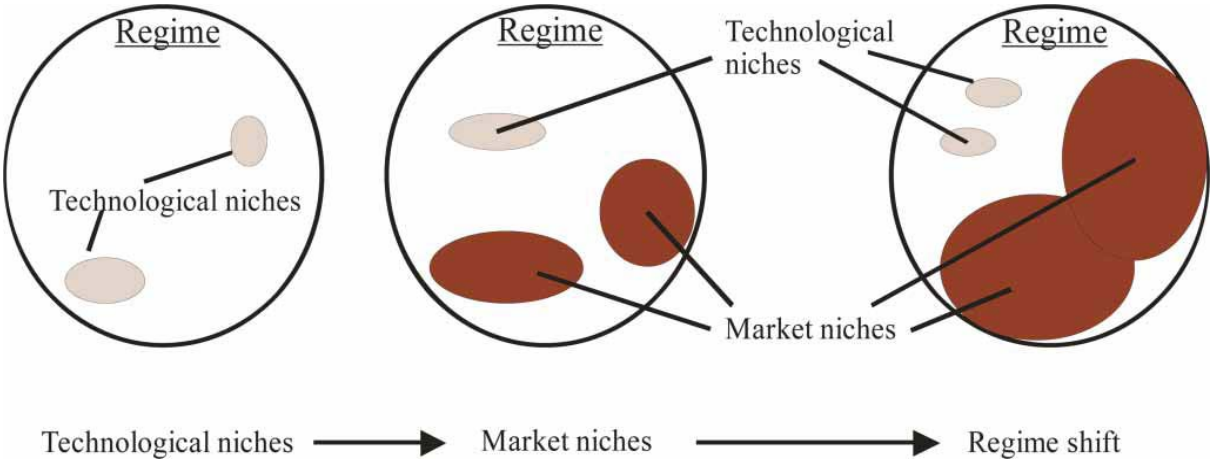


Niches form the micro-level where radical novelties emerge. The socio-technical regime forms the meso-level, which accounts for the dominating stabilized socio-technical pattern of interaction which is reproduced by institutionalised learning processes. The macro-level is formed by the socio-technical landscape, an exogenous environment beyond the direct influence of niche and regime actors (e.g. macro-economics, deep cultural patterns, macro-political developments).

According to Geels and Kemp (2007) have researchers within sociology of technology and evolutionary economics stressed the importance of niches as driver of innovations, from where new socio-technical regime can be developed (Schot 1998 and Livinthal 1998). Niches work as incubations environments for new ideas by being protected from the traditional selection mechanisms of the marketplace.

By distinguishing between market and technological niches Schot & Geels (2008) explains how innovation can be achieved through institutional learning processes linking technological niches to niche markets. These changes could potentially lead to regime shift as outlined in the following figure.

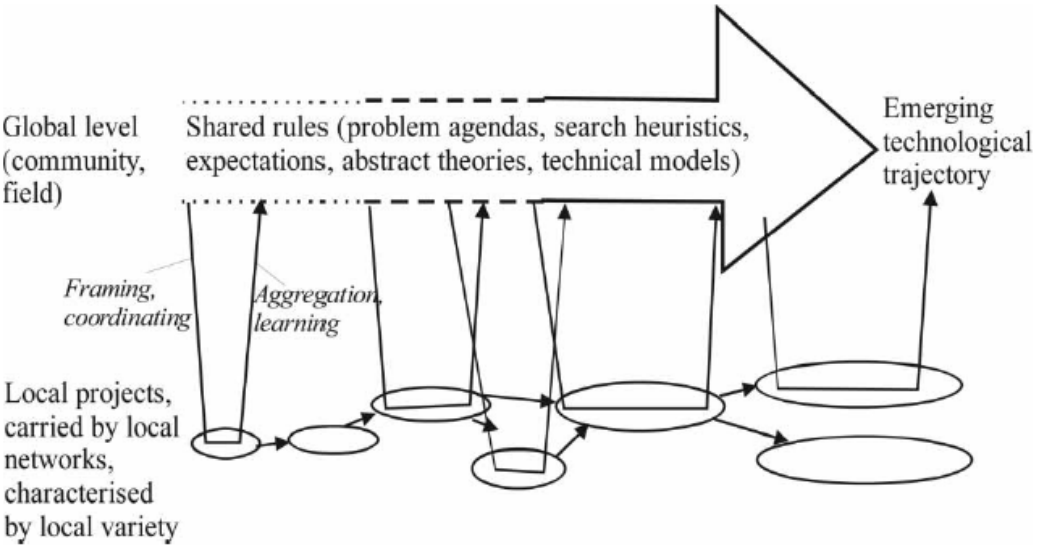
Figur 2: Regime shifts from niche development (Schot & Geels 2008, p. 540)



The regime is challenged as (1) technology matures in some closed technological niches (2) these technical solutions addresses a limited market need (3) and through the growth of the markets the technologies further matures and win wider acceptance in the entire regime.

An important premise for the development and maturation of ideas in the form of niches are learning processes and the building of social networks that support new innovations and investments (Schot et al 1994, Kemp et al 1998 & 2001 and Hoogma et al 2002). The development of niches through these activities is achieved through ongoing project-based learning processes which over time provides a certain direction / rationality as outlined in the following figure.

Figur 2: Niche learning processes (Schot & Geels 2008, p. 544)



It is precisely this common sense making which integrates the niches and develop its own sense of identity - a rationality that legitimizes the stakeholders' actions even though they may be in opposition to the dominant regime. Jensen et al (forthcoming) explain the rationality based on three mutually constitutive concepts an interpretive resource, a sector representation and a strategic orientation. Thus, they want to explain how a "tool" (the interpretive resource), forms a certain image of the existing regime (sector representation) and develops corresponding practices (strategic orientation). Rationality in the niche can thus be explained by using a key metaphor in which a set of problems (the sectorial representation) can be unlocked with a corresponding solution (strategic orientation) by the key (the interpretive resource).

Since the rationalities of the niches may differ, niches not always represent the same innovation potential. Thus is Geels and Kemp (2007) operating with three different degrees of radicalism reproduction, transformation and transition, as outlined in the following table (page 445)

Table 1: innovation potential at different levels of radicality (Geels and Kemp 2007, p. 445)

	Reproduction	**Transformation**	**Transition**
Levels involved	Regime dynamics	Pressure from landscape	Pressure from landscape
		Adaptation and reorientation in regime	Increasing problems in regime, and attempts at re-orientation
			New innovation in niches that eventually break through
Role of actors	Incumbent regime actors	Pressure from outsiders	Pressure from outsiders
		Incumbent regime actors respond through re-orienting	Incumbent actors fail to solve regime problems
		Innovative trajectories	Outsiders develop new innovations

METHOD

Based on the theoretical concept, the collection of empirical material for analysing the innovation system draws on multiple sources like qualitative workshops, semistructured interviews, existing analysis and analysis of central texts.

The analysis of the existing regime draws upon a Foucauldian analysis of the development of the Danish construction industry (Gottlieb 2010) combined with an analysis of the past 25 years of development of construction based on the driving myths of construction (Thuesen et al 2009). Finally the IT element is covered through Berard (2006) and Jensen (2011).

The analysed niches in Thuesen et al (2011) have been selected according to their innovation potential and the main drivers of the development being either the governmental or sectorial driven. The niches are the established concepts around Lean Construction, BIM (Building Information Modelling) as a part of a general digitalization of the Danish construction industry and an emerging niche around new industrialization termed "system deliverances". The empirical material for analysing the niches consists of two qualitative workshops, eight qualitative interviews combined the central texts and theories of the niches. The material was collected in the period from the autumn of 2009 to the spring of 2010 starting with execution of the two workshops in communities around the niches followed by semi-structured interviews (Kvale, 1996) of persons in playing different roles the niche development. By asking the persons similar and different question based on their role it was subsequently possible to identify coherency and differences in their understanding of the niche and its relation to other niches and the existing regime. The material from Thuesen et al (2011) is supplemented by material on BIM from Berard (2006) and Jensen (2011).

ANALYSIS

The analysis of the innovation system is structured in three sections, firstly focusing on establishing an understanding of the predominant regime, secondly juxtaposes the three niches and finally analyzing the niches up against the existing regime.

The construction regime - developed through generations

The existing regime is developed through generations in a process characterised by periods of more and less stability and moments of radical changes in the construction practices. Although the moments of change encapsulates periods of fundamental different construction practices as between the premodern (-1945), modern (1960-70) and postmodern (1980-) construction the historical practices are to some extent sedimented in the present postmodern construction practices. Based on a historical analysis (Gottlieb 2010) the postmodern construction regime is identified as having the following characteristics according to the theoretical dimensions Technology, Industry, Market /customers, Policy, Culture, Education and research.

Table 2: Overview of the building regime

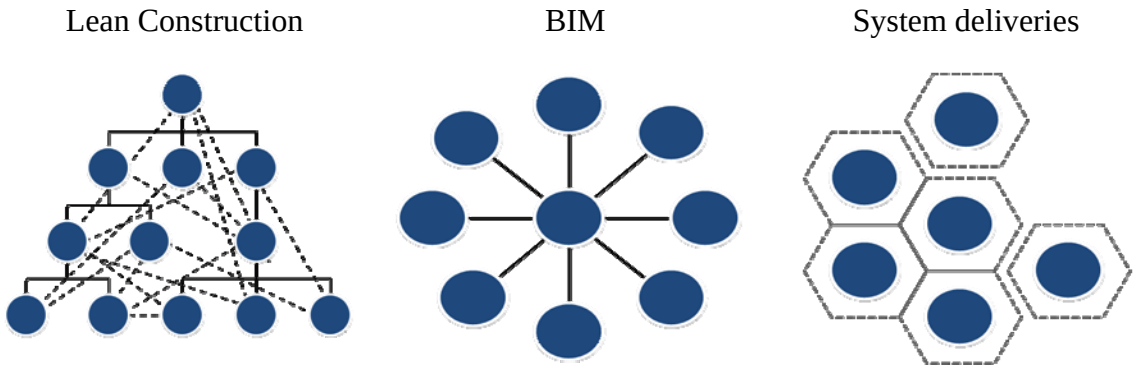
Dimension	Characteristics
Technology	Building materials: many different materials are in play all though there has been a preference around concrete elements since the introduction in the 60'ties. Processes: Phase models, in-situ production, planning tools based on Critical Path Method (CPM) wide spread, but “islanded” use of information technology, project management as the predominant management philosophy.
Industry	The organization of the industry is characterized by strong interest organizations representing many different professions like crafts, engineers, architects, contractors, and material producers. The value-chain is fragmented with a strong separation of design and production.
Market and customers	The market is heterogeneous and characterized by fluctuation. The customers are addressed by the architects, who tailor unique projects specifically to the customers' individual needs.
Policy	The sector is regulated around competitive bidding, tendering systems, shared standards and general conditions for work and supply. The development of the regulation happens in close collaboration between the interests organizations and the governmental anchoring (Danish Enterprise and Construction Authority, EBST), but also increasing EU.
Culture	The cultural organization of the industry is based on professions which are sustaining craft differentiated education institutions with a strong element of apprenticeship learning processes. The building organization has over time developed a strong separation between design and production favouring the development of cultures around problem solving. The institutional learning processes have the past 30 years, been centred on the myth about the unique building, make the actors perceive the nature of the build process as complex or even chaotic. Final there is a strong focus on collaboration rethorics among actors in the future development of the industry.
R&D	The organization and division of labour is mirrored and reproduced by the educational system. This system spans a wide way of cultural knowledge's from tacit and embodied situated in crafts to explicit and scientific in the academic professions. The central management practice is Project management, which is inscribed in the educational system and is influencing the research agendas.

The regime is situated within a broader societal context which challenges it and creates new possibilities of innovation. Trends like globalization, climate change, an aging population, new technological breakthroughs partly destabilize the regime making it vulnerable to niche innovations and other dynamics. When this happens it can be understood as windows of opportunities for change of the existing regime.

Niches represent different sources of innovation

This window of opportunity might be addressed by different niches. We will here look closer to the niches around the Lean Construction, BIM and System deliveries illustrated in the following figures.

Figur 4: Illustration of niches



While the niches all try to address the regime, they represent different logics for building developments that are more or less compatible. The table below summarizes some of the key differences in rationality between the three niches.

Table 3: Different rationalities of the niches

	Lean Construction	**BIM**	**System deliveries**
Key (Logic)	Hierarchy of process planning tools around LPS	The object oriented 3D model / BIM	Mass-customization
Understanding of the existing regime (Sectorial representation)	The complex and chaotic building process makes long-term planning impossible.	The construction industry as a series of inconsistent and uncoordinated information flows	The construction industry as an under-modularized mode of production characterized by project-specific problem solving and short term collaboration, which hinders innovation and specialization
Solution (Strategic orientation)	Development of tools and processes for optimizing value and flow based on short term planning and involvement of crafts	The development of a shared object-oriented classification and information infrastructure able to ensure unequivocal information capable to coordinate the complexity of the construction process	Project independent design and production of modular and customizable products and services through product platforms, strategy partnerships and value-chain integration

The three niches perceive the existing regime from various perspectives and are consequently formulating different problems and solutions. In LC is the building process considered as complex and even chaotic, which prevents long-term planning. As a result is LC developing tools and processes for optimizing value and flow based on short term planning and involvement of crafts symbolised in the Last planer system LPS. The perspectives offered by the BIM and System deliveries niche is different as they claim that the building process can be tamed and standardized so that information flows and processes can be coordinated. System deliveries also notes that the short-term collaborative constellations often prevents the

development of the industry, and thus seeks to create a better process understanding across the actors enabling value-chain integration. As the different niches don't have identical understandings of the regime their diagnosis of the regimes problems are different. Their different diagnoses and keys (logics) also allow different strategic development directions. While LC is trying to handle the complexity of the building process through short-term planning, the BIM concept is trying to manage complexity through common systems and standards for information exchange (interoperability) and final are System Deliveries strategy to reduce complexity through modularization.

While the niches have different rationalities, they are also major differences in terms of radicalism. This is supported by a combination of the various dimensions of compatibility between the niches and the overall regime as illustrated in the following table.

Table 4: Different radicality of the niches

Dimension	Regime	Lean Constr.	BIM	System deliveries
Technology				
Production	On-site	On site	On site	Off-site
Optimization of design-production	limited	Modest	Modest	Significantly
Application of IT	Limited	Limited	Significantly	Modest
Industry				
Value chain	Fragmented	Fragmented	Fragmented	Integrated
Design and production	Separation	Separation	Separation	Integration
Driver of development	Interest Organisation	Interest Organisation, Contractors	Interest Organisation, Consultants	Contractors, architects, producers
Focus	Project	Project	Project	Products/service
Market and customers				
Varians	Unique	Unique	Unique	Unique & standard
Design-production	Specific	Specific	Specific	Generic
Policy				
Political focus	Significantly	Limited	Significantly	Limited
Use of standards	Significantly	Limited	Significantly	Limited
Participation of Interest organisations	Significantly	Modest	Significantly	Limited
Culture				
View of buildings	Unique	Unique	Unique	Unique & standard
Perception of the building process	Complex/chaotic	Complex/chaotic	Complex	Standard/complex
Collaboration	Limited	Significantly	Modest	Significantly
Learning vehicle	Individual	Individual/project	Individual/system	Company
Development culture	Sector dialog	Project dialog	Sector dialog	Company dialog

R&D				
National research activities	-	Limited	Modest	Significant
Development horizon	Short	Short	Short	Long
Origin of research	Inside CM	Inside CM	Inside CM	Outside CM
Educational anchoring	Significant	Significant	Modest	Limited

The differences in compatibility offers different potential for sectorial innovation, while Lean Construction tries to change the regime from within reproducing the existing building practices (*reproduction*) system deliverances fundamentally tries to reorganize the regime from outside (*transition*). In between these BIM is trying to digitalize the existing regime while not fundamentally changing the organisation of the industry (*transformation*). The different levels of innovation potential are enabled by general trends in the landscape. Thus are all the developed by international traffic of knowledge and ideas from the globalization. Furthermore is the BIM and system deliverance specifically enabled by the widespread adoption of IT.The niches are thus having different innovation potential as summarized in the following table

Table 5: Different radicality of the niches

	Lean Construction	**BIM**	**System deliveries**
Potential	Can strengthen the effectiveness and value-creation within the existing regime Short ROI – can be implemented at project level	Enables a more efficient exchange of information between building partners. Enables a greater complexity in construction	Addresses productivity challenge Delivers product of high quality, faster and cheaper
Barriers	Can't facilitate cross-project optimization – pursuing economy of scale. Requires change a in cultures	Hard to get all parties to agree => implementation is difficult. Can't optimize across the value chain – pursuing economy of scale. Long ROI	Long ROI Can't be realized at the project level, but requires a market of a certain size and extensive knowledge of customer needs Requires reorganization of the division of labor in regime.

The conflicting rationalities among the niches internally and towards the regime put emphasis on development of policy practices and tools, which will be able to handle these differences.

DISCUSSION

A central part of the existing regime is a strong discourse on creating sectorial development through consensus and dialog between the various stakeholders in the industry primary represented by the interest organizations.

This principle, that also permeates Europe, as illustrated by the French term (*Dialogue Social*), is a historical part of Danish political culture and has been termed "cooperative tradition" and "corporatism" (Jorgensen 2002, Rothstein et al 1999). However the practice of focusing on creating a consensus on "one" specific developmental agenda is made difficult by the industry's diverging interests and niche incompatibilities. Attempts to create one development agenda leads to a low level of innovation and lock the industry in a development path which only a few will find comfort in. Consequently policy practices attempting to create common goals and visions risk preserving the existing construction practices and hinder the development of a more innovative sector.

There is therefore a need to develop a set of regulatory practices that is able to handle ambiguities with different interests and incompatibilities, while attempting to turn this premise into a strength by creating a framework for experimental activity. The shift in regulatory practices is outlined in the following table.

Table 6: Regulatory practices

	1945-		**1990s-**
Societal frame	Modern	►	Postmodern
Understanding of the sector (Sectorial representation)	Irrational, traditional and unable to meet the acute housing shortage	►	Many different symptoms of the sector in imbalance
Development agenda (Solution)	One (industrialisation)	►	Many (Lean Construction, BIM, system deliveries …)
Policy practice	Central control and coordination of the development	►	Decentralized coordination and central framework management
Basis for policy	Leadership (set the agenda, create the rationale)	►	Reflexivity (Understanding of the niches rationalities and their compatibility)

The basis for adopting this alternative approach to regulation of industry is the development of analytical skills to identify, conceptualize and organize existing and new niches and their rationalities. Moreover to develop strategies and allocate resources to the accelerate translations of niches through informed experimental activity and anchoring community formation around the niches.

The consequence of the diversified strategies means that the common industry initiatives will move from being attempting a "unipolar" development to become "multipolar" with multiple centers. It also means that (even) more emphasis is made on using companies as innovation drivers.

A central premise for the facilitation of innovation through in this perspective is the development of a "language" through which the industry can understand and articulate innovation and strategies. Here it is appropriate to draw on the theories presented in this paper. Through concepts as niches, regimes, etc. these theories offers a typology which can be ordered in a map. Such a map could provide an overview and orientation points for

navigating in the innovation system. Moreover, the map could clarify the interfaces of key players such as the different interest organizations and governmental institutions. Consistency and transparency in the innovation activities can be developed internally among government agencies and between public and private players including construction companies. This will enable the construction industry quickly to respond to new innovation opportunities locally as well as globally.

CONCLUSION

Based on the theoretical framework from strategic niche management research (SNM) the paper presents a strategy for understanding and facilitating innovation activities in the sector by mapping the predominant regime, overall societal trends and different niches.

The analysis shows a multifaceted landscape of innovations around an existing regime, built in the existing ways of working and developing over generations. This regime is challenged from various niches and the socio-technical landscape through micro and macro trends. The detailed analysis of the three niches (Lean Construction, BIM and System Deliveries), and their compatibility with the existing regime, show how they represent partly incompatible rationales and various degrees of innovation potential.

There is therefore a need to develop a set of regulatory practices that is able to handle these ambiguities with different interests and incompatibilities. Such a practice should be based on analytical skills to identify, conceptualize and organize existing and new niches' rationalities, focus on developing strategies and allocate resources to informed experimental activity and anchor community formation around the niches.

By mapping some of the most influential trends and promising niche innovations and relate these to the existing paradigm, the innovation map can act as a medium in which policymakers, interest organization and companies can develop and coordinate future innovation activities.

REFERENCES

Berard O. (2006). Bygherrekrav vedrørende 3D-modeller, visualisering og simulering IT-undersøgelse i byggeriet. Sammenfatning af resultater. B3D konsortiet det digitale byggeri.

Clausen, L. (2002). Innovationsprocessen i byggeriet - Fra idé til implementering i praksis, BYG·DTU R-031, Lyngby

Geels, F.W. and Kemp, R. (2007) Dynamics in socio-technical systems: Typology of change processes and contrasting case studies, Technology in Society, **29** 441–455

Gottlieb, S. C. (2010) The constitution of Partnering - A Foucauldian analysis of dispositives, space, and order in Danish Construction", PhD Thesis, , Department of Management Engineering, Section for Planning and Management of Building Processes, Lyngby: Technical University of Denmark.

Hoogma R, Kemp R, Schot J, Truffer B. (2002). Experimenting for sustainable transport: the approach of strategic niche management. New York. Spon Press

Jensen E.A. (2011): Udredningsarbejde vedr. IKT-anvendelse i det almene byggeri. Byggeskadefonden. København

Jensen, J., Gottlieb, S. and Thuesen, C. (forthcoming), Governing the sectorial code: Theorizing Danish construction sector dynamics, working paper

Jørgensen H. (2002) *Consensus, Cooperation and Conflict, the Policy Making Process in Denmark*, Edward Elgar, Cheltenham.

Kemp R, Schot J, Hoogma R. (1998) Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. Technol Anal Strateg Manage;10:175–96

Kemp R, Rip A, Schot J. Constructing transition paths through the management of niches. In: Garud R, Karnoe P, editors. Path dependence and creation. Mahwah, NJ: Lawrence Erlbaum Associates Publishers; 2001. p. 269–99..

Kvale, S. (1996). *Interviews An Introduction to Qualitative Research Interviewing*, Sage Publications.

Levinthal, D.A. (1998). The slow pace of rapid technological change: gradualism and punctuation in technological change. Ind Corporate Change 1998;7(2):217–47.

Rothstein B. and Bergsström J. (1999). *Korporativismens fall och den svenske models krise.* SNS Förlag, Stockholm.

Schot J, Hoogma R, Elzen B. (1994) Strategies for shifting technological systems. The case of the automobile system. Futures 1994;26: 1060–76.

Schot JW. (1998). The usefulness of evolutionary models for explaining innovation. The case of the Netherlands in the nineteenth century. Hist Technol. ;**14** 173–200.

Schot J. and Geels FW. (2008) Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy, Technology Analysis & Strategic Management, Vol. 20, No. 5, September 2008, 537–554

Simonsen, R. (2007) Et ledelseskoncept i politiske arenaer – Lean Construction i dansk byggeri, Byg.DTU, Lyngby

Thuesen, C., Jensen, J. S., and Gottlieb, S. C, (2009). Making the Long Tail Work - Reflections the development of the Construction Industry the past 25 Years", in Dainty, A. 25th Annual ARCOM Conference, 7-9 September 2009, Association of Researchers in Construction Management, Nottingham, UK, pp. 1111-20

Thuesen, C., Koch, C. Monrad, D., Henriks, M. (2011) Styrkelse af dansk byggeris innovationssystem, DTU report

Vind, B. and Thomassen M.A. (2009). Byggeriets innovation. Innovation af byggeriet i teori og praksis. Udg. af Byggeriets Innovation, København.

RENOVATION AS A BUSINESS OPPORTUNITY

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The building stock and its connected flows can be viewed and analysed from a number of perspectives. Today, the dominant issue regarding the building stock is the challenge to cut greenhouse gas emissions. The question of whether old buildings should be rebuilt or renovated has been a key focus of research and literature. The rebuild option should result lower renovtion activity than has expected. Renovation could, however, be a growing market if the building stock is upgraded.The focus of the study is commercial renovation, which has been analysed from the demand-supply perspective at the industry level. The construction economics and evolutionary economics theories have been applied to the analysis of demand and supply, respectively. The main research material consists of three cross-sectional surveys and official statistics.Renovation covers a diverse range of business sectors. In some of these sectors the customers, operating methods and building technologies used are virtually identical to new construction. The development of information technology and production technologies has helped construction sector companies to meet this type of demand in both markets. Traditional construction sector companies have not viewed the more challenging renovation market as an attractive enough option. As a result, buildings are demolished or rebuilt instead of repaired or renovated.

KEYWORDS: building stock, refurbishment, renovation, evolutionary economics, industry

INTRODUCTION

The built environment in which we will be living in the future will consist, in part, of today's built environment. The latter does not, however, meet the needs of today in all respects. We have already set development goals for the built environment of the future that will be impossible to attain with new construction alone. The need to renovate in Europe will be further driven by directive 2010/31/EU on the energy performance of buildings. With this directive, existing buildings will be given energy saving targets alongside new builds.

The significance of the built environment as both one of the key causes of climate change and as a key means of mitigating it has boosted research into how to transform existing buildings into energy-efficient buildings. In The Energy-Efficient Buildings PPP Multi-annual roadmap it is said that materials, products, components and building techniques used in new buildings need to be further developed and adapted to the constraints of existing buildings (European Commission, 2010). In this context, there is little attention paid to how this will be realised and what kinds of challenges this presents for construction companies.

Repairing the built environment is not an end in itself; it is a tool for producing the kind of environment which people, society and businesses want and which functions well. Improving the building stock calls for a holistic and innovative approach. For companies in the construction sector, renovation presents an opportunity to reform operating practices and business functions.

In this paper I aim to identify ways in which renovation activity can be boosted. I combine the conventional construction economy theories with theories of evolutionary economics to find out how the supply of commercial renovation services meet demand.

The remaining part of the paper is organised as follows. Firstly, I introduce some of the theoretical foundations of construction economics, evolutionary economics from the renovation standpoint and put them in cross-disciplinary frame. Second I describe the research material and findings. In the discussion section, I examine the past development of renovation activities and outline the future paths. Finally, I present my conclusions.

THEORETICAL BACKGROUND

The European Committee for Standardisation defines refurbishment as modification and improvements to an existing building in order to bring it up to an acceptable condition (Technical Committee, 2010). Refurbishment is just one of some 20 other terms used to describe the various processes employed to counter the effects of depreciation (Mansfield, 2000). In this article it has been used in parallel with the term renovation. The term renovation is used widely among construction researchers.

Demand

Schmookler (1966) demonstrated through extensive analysis of time series and cross-sectional patent data and historical case studies, that demand-pull influences were important: the more intense the demand, the more creative groups and individuals were drawn to work on unsolved problems and the more patentable inventions they generated.

Economists regard demand as the requirement for goods or services for which the customer is both able and willing to pay. The customers base their decision to renovate or new build on similar criteria, and the refurbishment decision is often seen as postponable. The individual's and the economy's demand with respect to housing depends on the preference for improved housing compared to other goods, and on price. In the industrial and commercial sectors, consideration is given to the demand for the ultimate product that the buildings help to produce and, hence, is dependent on the state of the economy and on expectations. Similarly, refurbishment of social-type construction products depends on the need for such improvement and on competing claims on resources, especially finance (Hillebrandt, 2000).

A Dutch study analyses the decision-making between repairs and rebuilding into object-specific and owner-specific factors. The choice between life cycle extension and replacement of existing buildings is at itself a vital but very difficult decision. The object related factors are either physical quality and economical quality or owner related like tenure and capacity. The emerging ecological awareness of the building and real estate trade tends up to now mainly towards improving the energy efficiency of buildings. Especially in the case of older building, the question will raise to what extent the investments needed to achieve that level countervail replacement by new construction. The life cycle extension by renovation and reuse of existing stock is generally more sustainable, more effective and more efficient than replacement by new construction. (Thomsen & van der Flier 2009)

A Canadian case study (Dong, Kennedy & Pressnail 2005) focused on low-rise wood construction and concluded that choice between retrofitting and rebuilding there is potential trade-off among different negative environmental impacts. Retrofitting minimize embodied energy, water pollution, solid waste generation, resource use, capital costs, life cycle costs

and get back invested money. Rebuilding minimise operational energy, life cycle energy, global warming potential, air pollution and annual operating costs.

Supply

Traditional economics emphasises the profit-making focus of businesses and the fact that the market seeks to balance supply and demand. This hypothesis tends to simplify the way businesses and markets operate. Since this hypothesis could not be used to analyse the effect of technology development or the impact of unexpected events outside the market, a new theory was needed. This led Nelson & Winter (1982) to present "An evolutionary theory of economic change."

The first hypotheses of evolutionary economic theory corresponded to the hypotheses of natural evolution. Where genes were seen to control natural evolution, routines were considered to control the economy—companies especially. The hypotheses of evolutionary economic theory have developed significantly since their origins.

The article "Economic development by creation of new sectors" Saviotti & Pyka (2004) presents the importance and role of qualitative change in economic development using two hypothesis 1) growth in variety is a necessary requirement for long-term economic development 2) variety growth, leading to the development of new sectors, and productivity growth in pre-existing sectors, are complementary and not independent aspects of economic development.

Saviotti & Pyka's theory fits well with Gruneberg's (2009) idea that growing economies open up more funding for construction projects and demand for improved housing, non-residential buildings and infrastructure increases as a result. As economic activities become more complex and production processes more specialised, more diverse types of construction are required and expectations are higher in terms of the comfort, convenience and performance of buildings. Saviotti & Pyka's theory is also compatible with Ruddock's hypotheses regarding the construction sector's extraordinary diversity and heterogeneity. Diversity is not only a point of contention between new building and renovation but also between different renovation activities (Hillebrandt 2000; Itard 2008).

According to Schot & Geels (2007), technological change is generally relatively stable, but is every so often punctuated by brief periods of rapid change and by technological discontinuity. In evolutionary theories, radical technical change is often explored in two ways: either as a process that proceeds in small steps or as a process that is accomplished by a great leap forward which opens up new markets and creates new branches of industry.

The small steps approach represents sustainable development. The gradual steps improve the performance of established products, with respect to performance characteristics that mainstream customers in major markets have historically valued. A great leap change, on the other hand, can be achieved by disruptive technologies which may have worse product performance, at least in the near-term. Disruptive technologies bring to a market a very different value proposition than had been previously available (Christensen, 1997).

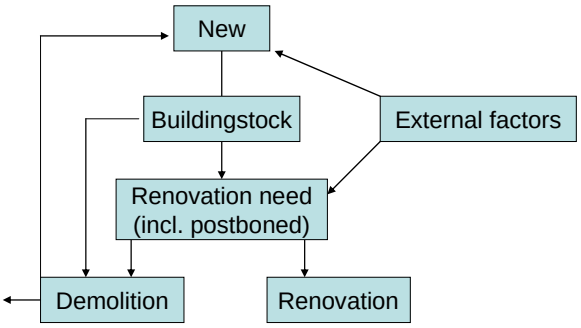
Cross-disciplinary theoretical approach

The focus of the study is the development of professional renovation of existing buildings at the industry level. A number of alternative theories have been proposed over the years regarding whether the development of the industry is influenced by demand or by supply. The objective of this study is to clarify the effect of both demand and supply on the development of the renovation sector. Theorisation specific to the construction sector has been applied to demand for renovation. Renovation supply is analysed using evolutionary economic theory.

The study focuses on the point in the lifespan of a building at which, for technical or functional reasons, a need for renovation exists, and on buildings which have future use potential. In some cases, changes are sought for buildings that are in otherwise good condition. Premises which have fallen out of use are transferred to new ownership prior to the decision moment or are demolished.

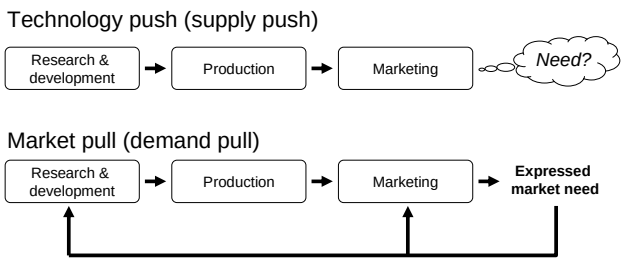
The *owner of the building* either postpones renovation work, renovates the property, or demolishes it in order to erect a new building in its place (figure 1). Companies, the public sector and private households base their renovation decisions on the same grounds as new construction decisions. A special characteristic of renovation is that it is aimed at the *existing building stock*. Demand for renovation services can therefore also be created based on requirement. The availability of *financing* is a fundamental requirement for realising this demand. The *operating environment* also influences the demander's decisions.

Figure 1. Decision options on the demand side.



According to evolutionary economic theory, renovation can be interpreted from the point of view of companies as a *traditional market* or as a *new market* requiring *development*. If supply side suffers lack of demand or need entirely new customers, it can arouse demand by developing new, attractive products and services (figure 2).

Figure 2. Options to get new market (Martin, 1994).



COMMERCIAL RENOVATION

Research material

The demand side analysis bases for data that has been gathered up in cross-sectional studies of Finnish building stock related renovation activities. The studied years were 1982, 1990 and 2000. The data included reasons why renovations have or have not been carried out, problems encountered concerning renovation work and who conducted renovation.

The supply side analysis bases for official statistics. The data has been collected during 2000–2008 from companies with more than 20 employees. During 2009 the sampling also included companies with 10–19 employees.

Demand development

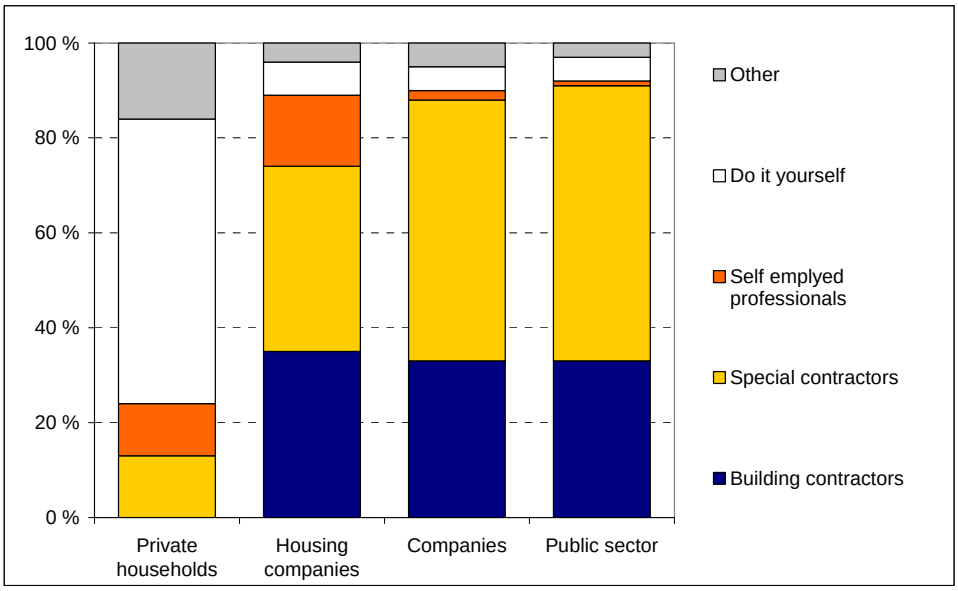
Companies have relinquished their internal property building organisations (figure 3) and are downsizing their building stocks. The ownership and management of buildings has subsequently developed as a specialised business sector in its own right. In addition to commercial premises, companies also own residential buildings, the renovation work for both which is contracted out to specialised firms, in the same way as new construction. The prime motivation for commercial renovation is interior modification. (Lehtinen & Pajakkala, 1982; Vainio et al. 1990; Vainio et al. 2001)

The public sector has retained ownership of its buildings, but has relinquished its building organisations. The public sector financial system and decision-making have both favoured new construction. The renovation requirements of buildings in the public sector clearly outweigh the financial resources available to carry them out. The renovation of public buildings is today outsourced virtually entirely to private companies (figure 3). The procurement of renovation works is subject to Public Procurement Act regulations and, as a result, contracts are commonly awarded simply to the cheapest bidder. (Lehtinen & Pajakkala, 1982; Vainio et al. 1990; Vainio et al. 2001)

Private households account for sixty per cent of the Finnish building stock and for around half the total renovation volume. The majority of household renovation works are carried out as house or apartment self-build projects aimed at improving levels of quality and equipment. Decision-making and, to some degree, the renovation work itself are carried out independently by the owner (figure 3). Tax deductions have spurred the employment of professional builders in renovation work and the level of satisfaction among household consumers is high. Life circumstances, temporary accommodation and a wide range of other related reasons can result in renovation work not being carried out. (Lehtinen & Pajakkala, 1982; Vainio et al. 1990; Vainio et al. 2001)

Under the housing company system, many homeowners in Finland own shares in the apartment building or terrace block in which they live and, as shareholders, participate in decision-making regarding the maintenance, repair and renovation of the property. The level of renovation of the housing stock of housing companies is, however, below requirements. In the early 1980s the reason for this shortfall was considered to be the poor availability of financing for repair and renovation works. However, despite today's much improved access to financing for housing renovation, renovation activity has not increased. The core of this problem lies in the decision-making process of housing companies and in the broad socio-economic spectrum of their shareholders. Housing companies typically invest in renovation only as a last resort. (Lehtinen & Pajakkala, 1982; Vainio et al. 1990; Vainio et al. 2001)

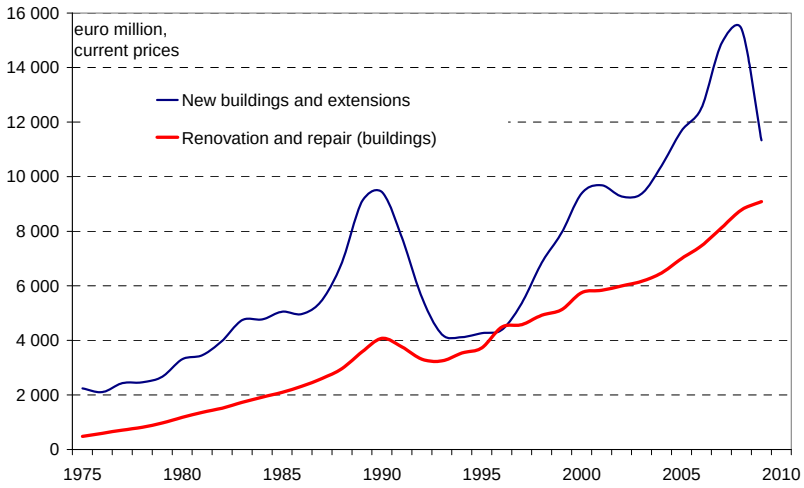
Figure 3. Repairer by orderer (Vainio et al. 2000)



Supply development

According to the statistics, renovation and new building are today almost equal in size (figure 4). At the beginning of the 80s most renovation projects were carried out by building owners or their organisations. Only a quarter of building renovation activity was commercial. For this reason, developers, designers and the construction industry did not even consider building renovation as construction activity. Neither did the banks, which paralleled loans for building renovation with consumption credit. Commercial building renovation increased during the 1980s to 40 per cent of all renovations. (Lehtinen & Pajakkala, 1982)

Figure 4. New building construction and renovation output in Finland (Construction and Housing Yearbook).



Projects in receipt of public funding in the 90s were required to involve skilled labour in their planning and implementation. This requirement increased the share of commercial renovation to seventy per cent. Structural changes towards partial renovations increased the share of specialised contractors available to carry out the work. (Vainio et al. 1990; Vainio et al. 2001)

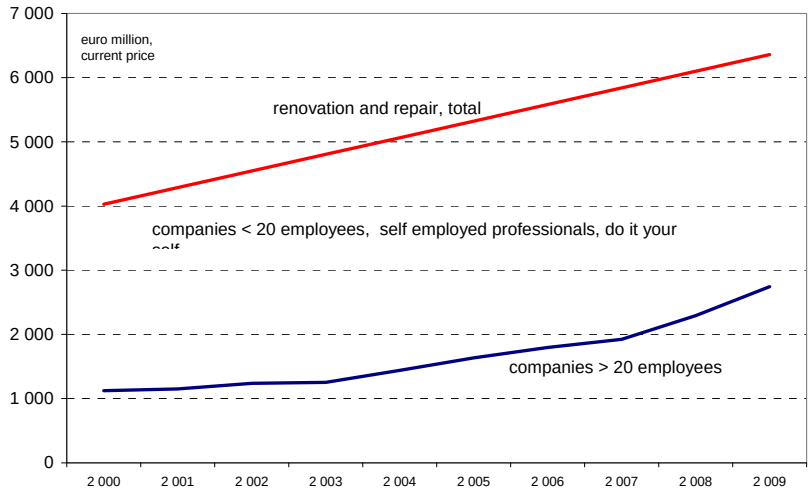
Table 1. The development of renovation markets (Official Statistics of Finland; Vainio et al. 2000).

	Building renovation % / new %	**Commercial renovation per total renovation %**
1980s	25% / 75%	25%
1990s	35% / 65%	40%
2000s	40% / 60%	70%
2010s	45% / 55%	~ 75%

Around half of all commercial renovation is carried out by construction sector companies with more than 20 employees (Official Statistics of Finland). The remainder falls to small Finnish or Estonian companies under 20 employees in size and self-employed professionals. Some of them are operating in grey business. Manufacturers and retailers of construction products have invested in the provision of installation services for their products. These services employ a large proportion of the abovementioned self-employed professionals as fitters and installers.

The participation in renovation activity of companies over 20 employees in size has been monitored since the year 2000. During this period, renovation work has accounted for just 50–60 per cent of turnover, and the figure is in decline. It is to be noted that the turnover figures for these companies include works subcontracted to other companies within the same sector. Some HVAC companies specialise in repair and renovation (share of turnover 75–100%). Renovation is a more important market to building finishing contractors than to housing developers.

Figure 5. Renovation, total and share carried out by big companies (Official Statistics of Finland)



Cross-sectional studies have identified key problems. At the beginning of the 80s, the Finnish construction industry's undeveloped technology, inability to produce tailored solutions and general lack of know-how presented technical challenges for building renovation. (Lehtinen & Pajakkala, 1982) National research programmes were subsequently implemented to resolve these technical issues. The first of these progammes was carried 1986–1990. The research

programme concluded that building renovation would develop into a secondary sector of the building industry.

The next “wave” of problems were related to planning and to building owners. In addition, the expertise of designers and builders of new builds was not applicable to renovation projects. Know-how was required for surveying, determining renovation needs, and renovation planning. Issues related to co-operation between different project parties also needed improvement. Deficiencies were identified in the availability of services connected with building renovation, model agreements and suitable materials, prefabricated products and machinery and equipment. Training was also recommended to be extended to building owners. (Matilainen et al. 1991). Renovation technology for prefabricated buildings, as well as the maintenance know-how of real estate owners and the tools to assist them, were added to the existing list of development needs.

Numerous public research programmes and campaigns were carried out during 2000–2010. Some of these have been focused on solving existing mould and moisture problems. Energy efficiency has also been on the research agenda. The Ministry of the Environment has also launched a Strategy for Renovation 2017, which includes the development of renovation processes and is based on the idea of demand generating supply.

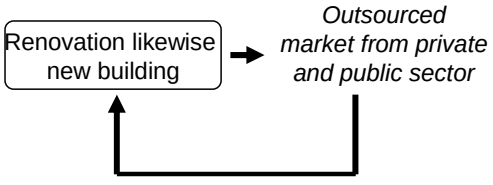
DISCUSSION

Past

As anticipated at the beginning of the 1980s, renovation has grown to equal size than new construction. In the same way as the new construction sector, renovation does not comprise a single uniform market, but consists of numerous individual submarkets covering a range of different customer and service provider segments.

Commercial renovation has also increased and construction sector companies have occupied the ready markets. Such ready markets include, for example, the market-driven demand for renovation which arose following the relinquishing of building management organisations by companies and the public sector. Another ready market has been the renovation and repair of building interiors. Corporate and public sector buildings are typically taken out of use during extensive repairs or renovations and thus effectively resemble new construction projects.

Figure 6. The supply side has just entered to renovation market without development or market effort.



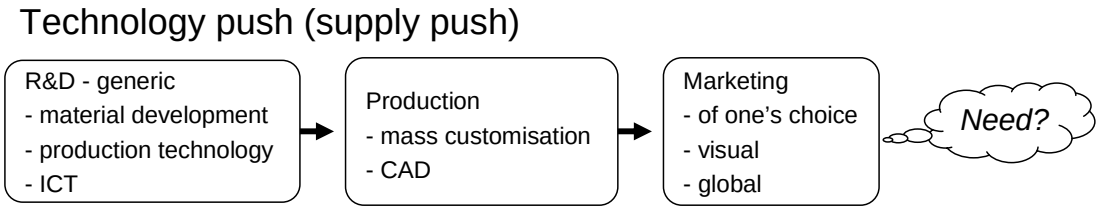
The majority of renovation works are carried out by fairly small construction firms or self-employed builders/installers whose operating culture does not involve any structured development activity. They just do what customer order.

Larger companies have shown little interest in renovation due to the high levels of activity in new construction. Globalised investment markets have made it easier for companies to secure financing for new construction. Companies operating from leased premises are not bound to the premises and so have been able to freely move to new premises as their needs require. Older buildings have been left empty as a consequence. Instead of renovating them, they are either demolished or leased temporarily until new buildings are developed in their place. This development has been anticipated, as the scale of renovation activity in the commercial property sector has been undersized.

No real attempt has been made to penetrate the potentially big, but challenging renovation market presented by housing companies. The public sector has been pushing this market forward via technical research for the past quarter of a century. In recent years the research focus has been switched to the core problem areas: communication, decision-making and financing models.

Private households have benefited from the construction products industry's active investment in R&D. The construction products industry has developed technologies enabling production of specialised products for both new construction and renovation and has provided also installation services for its products. The do-it-yourself (or contract-it-yourself) market has developed effective distribution channels and increased the use of IT in planning. Development efforts have, however, tended to be more generic than purposely renovation-oriented. Also the decoration business has inspired to renovate homes. In addition to surface modifications, so-called renovation investments should be made to help maintain-or preferably, improve-the building.

Figure 7. The building product industry has taken market by new production technology, ICT and marketing.



Future

The European Union (2010) has set targets for cutting building-stock-related greenhouse emissions. It has been recognised from the outset that these objectives will not be achieved with new construction methods alone, but also by improving the energy efficiency of the existing building stock.

The energy saving potential of the building stock has been assessed internationally as well as in specific Finnish studies, and the theoretical models indicate significant potential. Upon closer examination, however, it becomes evident that the proposed measures are economically untenable; recently renovated buildings are not worth immediately re-renovating, and the proposed renovation measures are prevented, for example, by the existing structural solutions. Now that the dust as settled, the Finnish recommendations are now in favour of making energy efficiency improvements primarily as part of standard renovation

work. Few renovation or refurbishment measures aimed at improving energy efficiency can be cost-effectively carried out independently. (Heljo et al., 2011)

These policy recommendations lead us back to the original need to develop the renovation sector. No developmental leaps, small steps or other direct attempts have been made to enter the renovation market. The market has been approached second hand, using new construction know-how.

Three key focus areas of evolutionary economics research have been technological change, sector renewal, and the birth of new sectors. Numerous alternative paths to renewal have been identified. Renewal can be achieved through new companies and technologies. A sector with a strong identity is also able to react to change.

Renovation research has focused on the building stock and on developing tools for property owners. This approach has been appropriate for property owners who have own organisations to carry out needed renovations. If renovation services are outsourced, however, the companies providing the services must be involved in the development work. In practice, this is possible if the attention of the construction sector's bigger players can be drawn to renovation.

At its simplest level, the construction delivery chain includes design, product pre-fabrication, and assembly on site. This delivery chain has been jointly developed across organisational boundaries. Whilst information technology is an essential tool here, the most essential factor is the chain's desire to operate together to achieve the desired end result.

In terms of renovation, households have benefited in particular from just such development work as this which has been initiated by the construction products industry. Development work has been conducted within the supply sector to create demand and to serve customers who do not have professional construction skills or know-how.

New construction has also been developed in co-operation with the customer. The latest innovations in the construction sector, especially in building services, have been put to use in projects where developers have needed to stretch beyond traditional solutions. Now would be an ideal opportunity to put forward the challenge of working together not only to repair buildings, but to fully refurbish them.

Energy efficiency poses new challenges for renovation. These challenges are shared in part with new construction. The global market offers products and components which can be combined to provide solutions to the renovation needs of customers. In many cases process and value innovations are needed instead of product development.

For many, lack of financing is an obstacle to renovation. Financial support and financing schemes aimed at new construction have in the case of some actors produced building stocks which are too large to be sustainable. The energy efficiency of the built environment can be improved through compact construction, both at the building and regional levels. The sum of these factors would be a renovation solution to change current modes of operation and service provision so that the building stock can be reduced.

CONCLUSION

This study examined the period from the 1980s, when building construction was not recognised as part of the building industry in Finland. In the past 30 years, the building renovation industry has grown almost as large as the new construction industry. Initially, building renovation was expected to become a subsector for the building industry. Today it is not any more an alternative market that balances the economic cycles on the new construction market. It is main market for small size companies. This is the main reason why many of the problems that existed 30 years ago persist even today.

Many companies of the building industry have grown from local renovation markets to national or even international markets. Companies that use the more traditional technologies of the building industry have stayed in the building renovation sector. The vacuum left by the evolution of the companies of the building industry leave space to new companies with strong service expertise.

Improving energy efficiency creates new challenges and needs for building renovation. For building renovation, this is a one-time opportunity to become a completely new kind of industry. It is possible that the new take on building renovation may produce competition for the companies currently engaged in new construction. The lessons can be picked from building product industries that have push market by utilising generic technology development and marketing.

REFERENCES

Christensen, C.M. (1997), *The innovator's dilemma: when new technologies cause great firms to fail*, Harvard Business School Press, Boston.

Dong B., Kennedy, C. & Pressnail, K. (2005). Comparing life cycle implications of building retrofit and replacement options. *Canadian Journal of Civil Engineering,* Vol. 32, No. 6, ss. 1051.

Euroopan Komissio. (2010). *Energy-efficient buildings ppp - multi-annual roadmap and longer term strategy*. European Commission.

European Parliament; European Commission (2010). Directive 2010/31/EU The energy performance of buildings. *Official Journal of the European Union* L 153/13.

Gruneberg, S. (2009), "Construction markets in a changing world economy" in *Economics for Modern Built Environment*, ed. L. Ruddock, Taylor & Francis, pp. 153-167.

Heljo, J., Nippala, E., Hekkanen, M., Kurvinen, A. & Vihola, J. (2010). *Energiatehokkuuden parantaminen nykyisessä rakennuskannassa (EPAT) [Upgrading energy efficiency]*. Ministry of Environment.

Itard, L., Meijer, F., Vrins, E. & Hoiting, H. 2008, *Building Renovation and Modernisation in Europe: State of the art review*, University of Technology, Deltf.

Mansfield, J. (2002). "What's in a name? Complexities in the definition of "refurbishment", *Property Management*, vol. 20, no. 1, pp. 23-30.

Martin, M. (1994). *Managing Innovation and Entrepreneurship in Technology-based Firms. Wiley-IEEE. p. 44.* Wiley-IEEE, Espoo

Matilainen, J., Lehtinen, E. & Vainio, T. (1991). *Korjausrakentaminen 1990. Osa 2. Korjausten syyt [Reasons for renovation]*, VTT, Espoo.

Ministry of Environment (2007). *Korjausrakentamisen strategia 2007-2017 [Renovation strategy 2007-2017]*, Ministry of Environment, Helsinki.

Nelson, R.R. & Winter, S.G. (1982). *An evolutionary theory of economic change*, Harvard University Press, Cambridge.

Official Statistics of Finland (OSF): *Renovation building* [e-publication]. Helsinki: Statistics Finland [referred: 25.2.2011]. Access method: http://www.stat.fi/til/kora/index_en.html.

Pajakkala, P. & Lehtinen, E. (1984). *Talonrakennusten korjaustoiminnan määrä 1980-luvulla [Renovation 1980'],* VTT, Espoo.

Saviotti, P.P. & Pyka, A. (2004). "Economic development by the creation of new sectors", *Journal of Evolutionary Economics*, vol. 14, no. 1, pp. 1-35.

Schot, J. & Geels, F.W. (2007). "Niches in evolutionary theories of technical change: A critical survey of the literature", *Journal of Evolutionary Economics*, vol. 17, no. 5, pp. 605-622.

Technical Committee CEN/TC 350 (2010). *FprEN 15643-2 Sustainability of construction works - Assessment of buildings*. European Committee for Standardization, Brussels.

Teece, D.J., Pisano, G., Shuen, A. (1997). "Dynamic Capabilities and Strategic Management", *Strategic Management Journal,* 18 (7), pp. 509-533.

Thomsen, A. & van der Flier, K. (2010). "Upgrade or Replace? The effect of the EPBD on the choice between improvement or replacement ", *Urban dynamics & housing change - Crossing into the 2nd Decade of the 3rd Millennium ENHR 2010, 4-7 July*, ITU, Faculty of Architecture, Istanbul.

Schmookler, J. (1966). *Invention and economic growth*, Cambridge.

Vainio, T., Nippala, E., & Lehtinen, E. (1991). *Korjausrakentaminen 1990. Osa 5. Yhteenveto (Value of renovation 1990'),* VTT, Espoo.

Vainio, T., Jaakkonen, L., Nippala, E., Lehtinen, E. & Isaksson, K. (2002). *Korjausrakentaminen 2000-2010 [Renovation 2000-2010],* VTT, Espoo.

FRAME WORK FOR QUALITY IMPROVEMENT OF INFRASTRUCTURE PROJECTS

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In order to achieve high quality that not only gives acceptable return value to society but also satisfies the needs of all the stakeholders of infrastructure projects, comprehensive understanding of issues pertaining to the quality of the project is needed. The aim of this study is give an overview the most common procurement methods used in constructing infrastructure transport projects and analyze how these methods contribute to the desired quality of the final product in relation to client competence. An on-line survey of construction actors was carried out to ascertain quality level of Swedish infrastructure transport projects and determinant factors of quality problems. An equal number of respondents indicated that the quality of infrastructure projects has either increased or remained same level over the past twenty years. They also pointed out luck of client competence that is vital in realizing the desired quality level through proper procurement, monitoring and evaluation procedures. Public clients heavily rely on traditional design-build procurement that requires considerable client involvement of a project. Thus, the association of quality problems and luck of client competence may not be a mere coincidence but an overlooked outcome of current situation.

KEYWORDS: Competence, infrastructure transport, procurement, quality, warranties

INTRODUCTION

Transport infrastructure transport projects are essential to economic activity and growth of a society. They are characterized as havin long-life and long gestation processes as well as being capital intensive (Grimsey and Lewis, 2002; Ng and Loosemore, 2006). The sheer size of transport infrastructure projects often necessitates government involvement in terms of financing, developing, operating and maintaining them. Rienstra and Nijkamp (1997) outlined several arguments that explain government involvement in delivering infrastructure transport. One of the arguments is divergence of interest between public and private sector that makes transport infrastructure a product that cannot be easily delivered by the private sector (Rienstra and Nijkamp, 1997).

However, government involvement has been reduced for a lot of reasons while private sector participation has been on the rise lately (Grimsey and Lewis, 2002; Hodge and Greve, 2007). Private sector involvement in developing major infrastructure transport projects such as roads and railways were often motivated by the financial constraints faced by the public sector (Hodge and Greve, 2007). The private sector may provide more efficiently and faster delivery of infrastructure transport than public sector (Nilsson, 2009). Private sector efficiency allows government to share the associated risk of asset procurement and service delivery with the private sector (Cheung and Chan, 2010). Development of new products and technologies that lead to cost reduction and quality improvement contributed to increased private sector participation (Cheung and Chan, 2010) even though cost-cutting and desire of better quality are sometimes difficult to achieve both of them simultaneously (Estache eta al., 2009).

Lædre et al. (2006) and Tookey et al. (2001) argue that some of the causes of project success and failure can be traced back to the procurement method and how the owners selected that method. The owners or clients are the most critical to project success (Molenaar and Songer, 1996) and their characteristics such as expertise and experience are the moderating factors on the performance procurement system chosen (Luu et al., 2003). A UK government report (HM Treasury, 2008) claims that "*performance in the successful delivery of outcomes is strongly dependent on the skills of the client, not simply on the contract structure*".

The Swedish construction industry is facing a shortage of skilled workers and ageing of existing staff (FIA, 2005). Since quality performance and the effectiveness of any selected procurement method partially hinges on the competence of client's workforce, it is crucial to examine how different procurement methods could be affected by the scarcity of client competence, experience and expertise. The aim of this paper is to give an overview the most common procurement methods used in constructing infrastructure transport projects and analyze how these methods contribute to the desired quality of the final product in relation to client competence. Identifying some of factors that are associated with quality problems i.e. lack of competence and at what stage of the construction process that these factors are critical will allow us to contemplate which procurement method is appropriate to certain situations.

LITERATURE REVIEW

A survey conducted by the International Federation of Consulting Engineers (FIDIC, 2004) found that decreasing quality of construction is a worldwide phenomenon that is mainly caused by inappropriate mechanism of project delivery such as poor consultant and contractor selection, bad design, poor project supervision and inadequate material and workmanship. Other authors (Rienstra and Nijkamp, 1997; Jha and Iyer, 2007; Nguyen et al. 2004) identified several factors that have significant influence on the quality performance of a project however one common denominator of all these inadequacies or quality problems is the lack of client competence. Rienstra and Nijkamp (1997), Jha and Iyer (2007) claim that project manager's competence, top management support and interaction between project participants are external contributors that enhance the project quality performance from its existing level while owner's competence is an internal contributor in the sense that owners tend to retain the quality performance at the existing level itself. A competent project manager and project team were highly ranked among the top five project success factors in a study carried out by Nguyen et al. (2004). Landin (2000) found that client incompetence often were blamed on flawed expectations and requirements placed on contractors. Respondents pointed out incompetent client were unaware of the requirement they should or did in fact place on the supplier and thus contractors were inclined towards not to following these requirements (Landin, 2000). The FIDIC (2004) finding also highlights the importance of client competence during the planning and design stage as well as during the tendering and construction stages. It emphasizes how the actors from the demand-side of the construction process such as client and engineer (consultant) could play a big role in improving the quality of construction.

During the operation and maintenance phase, assessment of the quality is challenging since the expected life of many infrastructure projects is quite long. Customer satisfaction surveys are sometimes used as a proxy for the quality level of a product. Though this approach can give an indication of quality level at certain point in time, it could be difficult to objectively assess the quality level of road infrastructure from end-users' point of view. A survey of Swedish Transportation Administration (STA, 2010) exemplifies the difficult of ascertaining

reliable measurement of satisfaction level from road users. The survey found that drivers were not only dissatisfied with road conditions but also private and professional drivers have different opinion about the level of dissatisfaction. Many road administrations from the countries that participated in this study reported shrinking staff due to retirement and to the attractiveness of private sector employment. This report also has noted that new types of contracts require broader project management skills and practical experience and thus there is need for key competences such as operations, road surfacing and specialist engineers (STA, 2010).

RESEARCH METHOD

After a pilot survey with a number of practitioners and academics in the field of construction, an on-line questionnaire containing 29 questions was sent to 128 selected respondents (45 contractors, 35 clients, 37 consultants, and 11 regional traffic offices). The composition of respondents was intended to ensure a fair representation of different stakeholders of construction projects that would allow us to ascertain the extent of quality concerns in the sector. Through the author's research reference group and organization websites as well as professional association's websites, the appropriate persons in each organization that could answers our questionnaire were identified. After few questions related to the information of respondents, respondents were asked their general assessment of the quality problems today and the past. In order to establish the prevalence of quality problems in relation to different phases, respondents were asked their opinion about how often quality deficiency occurs and who discovers as well as what actions are taken when quality problems are discovered.

Cui et al. (2004) state that warrant contracting is usually used with performance-based specifications and is intended to replace stringent quality control and inspection regimes associated with traditional procurement. Three possible scenarios have been envisioned to happen when quality deficiency is discovered; complete removal of the defective product or structure, repair without complete removal, and deductions from payments if the quality is not exactly the required level but acceptable within certain limits. This set of questions was intended to give us a sense of understanding on whether warranty contracting has improved quality of construction projects.

The rest of the questions of the survey (15 questions) were statements that are intended to ascertain important attributes such as competence of construction actors, project characteristics etc. that may have contributed quality problems or lack of quality improvement. Respondents were also asked to comment on each question and statement in order to solicit their candid view about the quality of infrastructure projects.

FRAME WORK FOR QUALITY IMPROVEMENT

Construction quality

Brockmann (2009) argues that construction projects such as buildings or infrastructure are typically quasi-credence goods meaning that their qualities are ex-ante intangible but ex-post tangible. His argument is based on the classification of three types of quality (Darbi and Karni, 1973); *search qualities* which are known before purchase, *experience qualities* which are known costlessly only after purchase, and *credence qualities* which are expensive to assess even after purchase. Construction goods do not exhibit search qualities since the quality of construction goods cannot be determined at the time of signing contract (Brockmann, 2009). However, once the contract is carried out and the project is completed ex-post search qualities could become tangible. Similarly, construction goods also differ from experience goods since experience qualities are based on a high frequency of contracting between the same client and contractor (Brockmann, 2009). The nature of construction business and government regulations as well as competition rules does not foster repetitive interaction among actors in construction sector. On the contrary, Vassallo (2007) argues that quality of most of infrastructure projects are observable after their use and classified them as "experience goods". He claims that infrastructure quality is verifiable though the cost of measuring quality is not usually low.

It could be argued that since different procurement methods provide construction clients an opportunity to influence design and construction qualities, a client's internal capacity and available resources such as design and inspection teams as well as his competence and skills play a major role determining whether the desired product has the characteristics of search, experience, or credence qualities. If a client or his representative has the capability to carry out all the necessary quality control and quality assurance activities, this will ensure that the quality of the project becomes not only observable but verifiable during the construction until the operation phase starts or even during the warrant period. When client and contractor has also long term relationship, high frequency contracting that is a necessary condition for experience qualities (Brockmann, 2009) could be materialized. The quality of realization during operation and maintenance is may be what makes construction goods to be treated as quasi-credence goods. The quality and long term performance of the infrastructure is subject to many external and stochastic factors such as the level of usage of infrastructure, efficiency of intended operation, weather, and frequency of planned and unplanned maintenance.

Client competence

A client organization with highly skilled and sufficiently experienced workforce is most likely capable to ascertain many project risk factors than client organization with less endowed human capital resources. There are distinctive competencies that are highly required when client is employing a specific procurement method. The traditional procurement (Design-Bid-Build) where client has multiple contracts with different actors for the provision of infrastructure projects is a good starting point to identify most relevant responsibilities of client. Client is expected to have enough manpower resources with appropriate skills and expertise in different areas such as financial, technical and contracting management. Some of the notable client competences are; ability to define project scope and objectives, establish design criteria and performance requirement, carry out preliminary survey and geotechnical investigations, ensure constructability of design, perform control and inspection of quality performance, and prepare possible mitigation actions and procedures when performance objectives are not met.

Competences that are needed for risk sharing activities where the client uses a procurement strategy such as design-build and performance-based contracts with warranties are much similar to the above list except that client is oblige to prepare RFPs for DB contracts instead of complete design of the project. Xia and Chan (2010) found previous experience with DB related projects is among the key competences that DB clients in China should possess. Competences that are needed for risk transferring activities where client engages procurement strategies such as design-build-finance-operate (DBFO) with or without maintenance and other forms of PPPs are now more related to management, financial, legal, and commercial activities.

A resourceful client organization could use these extraordinary technical competencies and expertise to transform experience qualities to search qualities or even credence qualities to experience qualities. This transition between types of qualities would have certain implication on how client selects appropriate procurement methods. Thus, the above representation could improve understanding the impact of different procurement methods on client's workforces and their skill development. The most common procurement methods and how they defer in terms of quality aspect will be discussed next.

PROCUREMENT METHODS

Procurement methods are often classified based on how construction activities such as design, construction, and operation and management are delegated among actors in the project. Different financing options of infrastructure projects also influence this classification. Love et al. (2008) classified the following four procurement systems; traditional (separated), design and construct (integrated), management (packaged), and collaborative (relational). Our short description of procurement methods is similar to Love et al., (2008) classification and will be described below.

Traditional procurement (separated)

Traditional procurement method of design-bid-build (DBB) with negotiated or separated competitive bidding fits this type of classification. DBB procurement method is prescriptive by nature where owners with in-house designers or with appointed consultant prepare the project design and tender documents. Quality control (QC) and quality assurance (QA) activities are either carried out altogether by the contractor or sometimes the client is responsible for quality assurance while contractor is responsible for quality control process. In Sweden, 20 years ago, the client (Swedish Transportation Administration) has transferred quality control and quality assurance to the contractors and accepts only the final project if it meets the expected quality level of performance.

Mandell and Nilsson (2010) studied some 1400 road construction and renewal projects procured by the Swedish road administration between 2000 and 2009. The large majority of these projects were procured in the form of unit price contracts or DBB. Pietroforte and Miller (2002) noted that DBB was the most dominant form of infrastructure procurement after the Second World War in the US although during the last decade Design and Build (DB) has grown steadily in both private and public sector. Gransberg et al. (2007) indicate that unit price contracts dominate procurement of projects in the transport sector in US. One shortcoming of DBB approach is that it does not take into account the increasing operation and maintenance costs of the ageing infrastructure (Pietroforte and Miller, 2002). Furthermore, DBB procurement focuses the price of the project rather than quality.

Management (packaged)

Construction management (CM), Management contracting, and Design and mange belong to this category. Basically, an owner enters agreement with a construction firm that carries out leadership, administration and management of specified services (Koppinen and Lahdenperä, 2004b). According to Koppinen and Lahdenperä (2004b), CM is seldom used in road construction because of the relatively small number of contractors involve in road construction that is easily manageable by clients.

Design and build procurement (integrated)

In order to address certain problems associated with DBB and improve the performance of construction projects, integrated design-build (DB) procurement and its variants such as design-build-operate/maintenance (DBO/M) have been promoted to be an appropriate alternative procurement strategy. DB is an integrated procurement system where the client contracts with a single contracting organization to carry out both design and construction responsibilities with or without inclusion of operation and maintenance contracts. One common feature of these types of contracts is that client is responsible for entirely and directly financing the project (see Pietroforte and Miller, 2002). DB would allow contractors to tender the most economical design that meets the requirements of the client and use materials and innovation techniques that produces desirable outcome for the client. However, DB procurement method demands different skills and competences than the traditional procurement (DBB) that public servants are accustomed (Koppinen and Lahdenperä, 2004b). A distinct criterion for DB contracts is the requests for proposal (RFPs) along the price and technical proposals. The RFPs contains owners' objectives and needs with respect to quality and the design/builders are required to interpret those requirements and submit their proposals (Gransberg and Molenaar, 2004).

There is no definite agreement on whether the overall quality achieved under DB procurement is better than DBB. Koppinen and Lahdenperä (2004a) claim that client's expectation of design quality does not differ between DB and DBB though contractors under DB tend to choose only the necessary design that leads to savings One major problem found by Gransberg and Molenaar (2004) is that owners of public projects who have used DB procurement often executed with DBB mentality because majority of RFPs contained a DBB construction quality control plan requirement. Xia and Chan (2009) argue that the use of DB procurement does not mean that an inexperienced client can simply leave all the project and responsibility to the DB contractor. Design-Build procurement is much easier for a client with sufficient design and past construction experience (Xia and Chan, 2009).

Public-Private-Partnerships and its variants (relational)

A further categorization of procurement methods is based on how financing of the project is formulated. This category is an extension of integrated design-build variations except that the private sector is now financially involved in the provision of a project. Design-Build-Finance-Operate or BOT, as it is known outside the US (Pietroforte and Miller, 2002), Build-Own-Operate-Transfer (BOOT), and Build-Own-Operate (BOO) belong to this group. These procurement methods have longer contract period than the typical integrated procurement methods financed by the publicly sector. Jefferies and McGeorge (2009) argue that there is no clear-cut definition between public-private-partnerships (PPPs) and BOOT except that one can observe an increase in the number of stakeholders of PPP projects. Design-Build-Finance-Operate (DBFO) or Build-Operate-Transfer (BOT) is another example of PPPs arrangement.

Though the use of PPPs for procurement of public infrastructure projects is not something new to most of the developed and developing countries, comprehensive performance assessment of the projects undertaken with PPPs has been difficult due to the divergence between the duration of PPPs contracts and the longevity of infrastructure projects. Infrastructure projects could last decades or centuries while PPPs contracts are often in the range of 30 years. Thus, it is difficult to have a full assessment of infrastructure projects that are constructed under PPPs arrangements. Procurement of infrastructure projects with PPP involves many parties with conflicting objectives and thus requires extensive client competence and expertise (Cheung and Chan, 2010). . Estache et al. (2009) claims that the private operator may heavily invest in cost reduction technologies without taking into consideration their impact on the quality of the project. Realized quality could be better or worse under private contracting depending on the impact of any cost reduction technologies employed by the private actors (Estache et al., 2009). PPP arrangements to surface transport infrastructure are complex with many pitfalls and thus require strong client competence and expertise (OECD, 2008). The report suggests that public sector experience with the design and build procurement provides adequate knowledge and capacity that is needed to handle complex PPPs arrangements. Based on international experiences, Swedish Transport Adminstration report (STA, 2008) accentuates the importance of highly competent client organization for efficient and successful PPP projects. According to the report (STA, 2008), the only infrastructure project that has been built with PPPs arrangements so far is Arlanda railway link (Arlandabanan).

RESULTS AND DISCUSSION

Sixty three respondents that translate to a 53% response rate completed the survey. According to the respondents, quality of construction projects constructed in last five years is either at the same level or even better than the quality level of projects built twenty years ago. Same numbers of respondent (44%) believe that quality level is higher today or has not changed during this period.

Responses from client side were almost inconclusive when asked who finds out quality problems during construction (client or contractor). A possible explanation for this inconclusiveness could be that the client has little opportunity to discover quality problems during this phase since quality assurance responsibilities were transferred to the contractor. Respondents indicate that clients' complain is limited to few isolated projects (41%) though 32% of them pointed out that client complain about quality problems is present in majority of the projects. With regard to quality problems discovered during the final inspection, 44% of the respondents say that few isolated projects encountered quality problems while 26% of them indicated that majority of the projects experienced quality problems.

A combined 41 respondents (64%) indicated that quality problems discovered during the final inspection get fixed by means of reparations without complete removal or contractors accepted payment deductions. The situation is somewhat different when it comes to quality problems during warranty period or shortly after it expires. Majority of respondents (42) indicate that clients very seldom discover or complain about quality during this period. If quality deficiencies are discovered during the warrant period, a complete removal or payment deductions are not the preferred options. 25 respondents or 42% of them say that very seldom contractors remove the defected part or structure. Another 20% (20 respondents) say that payment deductions do happen very seldom. The prevailing measure to rectify quality problem during warranty period is reparation without complete removal. These responses

give an indication on how project managers and client representatives react when they discover quality problems but the underlying fact is that these kinds of decisions require higher competence and experience that is in short supply in the client organization's workforce as the following responses suggest.

Responses from the questions related to competence of client with regard to quality problems of infrastructure projects were very strongly negative. Respondents indicated that client's lack of competence is major factor of quality problems of infrastructure projects. Approximately 82% of respondents partially or totally agree when we stated that the quality problem in the finished structure is highly dependent on the client's competence. Similarly, 72% of them indicated that tendering documents contributed quality problems of final product. Respondents also pointed out (80%) that designers of the project play a major role on the quality problems experienced in the finished project.

The above finding provides an opportunity to investigate the role of client competence on different procurement methods and how much skills, expertise and competence of client workforces and client experience is demanded by each type of procurement method.

A prognosis from FIA (FIA, 2005) points out that one third of the construction industry's workforce will retire between 2005 and 2015. The study also shows that the construction industry has a higher proportion of older people and a smaller proportion of younger employees compared to the total employment. In Finland, employees' retirement and reduction of client staff are reported to be behind diminishing client experience and competence (Koppinen and Lahdenperä, 2004b). The implication of human capital scarcity is that public clients face an uphill battle in attracting new talented and competent graduates as well as retaining them in a competitive market. Some of the respondents in our survey also raised this issue of ageing client workforce, non-replacement policy of retired staff and their concern of new skilled workers not joining the public transport sector.

Love et al. (1998) state that no one procurement method is likely to be better than others for any project although one procurement method could be more appropriate or suitable than others for an individual project. In Sweden, traditional procurement (Design-Bid-Build) or unit price contract has been the most dominant contract form used for the delivery of transport infrastructure projects (Mandell and Nilsson, 2010; Trafikverket, 2008). The question is whether this heavy reliance of DBB method in the Swedish infrastructure transport is supported by undisputed higher performance achievement compared to other procurement methods or the Swedish Road and Railway administration has chosen it for other reasons.

While cost effectiveness, strong client control of the project, and flexibility are some of the benefits associated with DBB, one cannot overlook the downside of the use of DBB procurement for several reasons. First, if the client's lack of competence (as our survey indicates) is due to a shortage of skilled and experience workforce then the use of DBB could exacerbate the situation since DBB requires higher client involvement. Secondly, the use of DBB contracts has been seen as one of the factors that contributed to the lower productivity and lagging performance of the Swedish construction industry (Mandell and Nilsson, 2010; Nilsson, 1999). Thus, a lack of client competence and its negative impact on quality of infrastructure projects will worsen the situation and inflict further distress to the sagging industry's productivity.

Several possible explanations have been offered as to why a clients or owners keep using repeatedly the same procurement method especially the dominance of the traditional procurement method. Familiarity of DBB within the industry and its ability to satisfy public accountability, client control over the project's outcome and cost certainty makes easy and attractive method for public sector to rely on more often than other procurement methods (Love et al., 2008, Koppinen and Lahdenperä, 2004a). Avoidance of uncertainty is another explanation. Lædre et al (2006) claim that owners select a well known procurement route since unknown procurement method could introduce new uncertainty. When owners attain experiences from the use of certain procurement procedure and management routines, it will encourage them to keep using this combination in their next project (Lædre et al., 2006). Koppinen and Lahdenperä, (2004b) suggest that DBB procurement are generally considered to be suitable when client wants to settle upon a design before construction commitments, take advantage of existing designs or the client has the only experience necessary for this kind of project. Lædre et al (2006) state that public owners are not motivated to be creative when selecting the procurement route because creative thinking is seldom rewarded while project failure will be criticized. Thus, it is convenient to use the same procurement system. One important question that could be raised about the heave reliance of public sector on DBB procurement method is "can the benefits and confidence that a continuous use of DBB offers to the public sector be sustainable for a long period of time?

The use of warranty contracting has given some leeway for the public sector to deal with quality problems that could arise from contractors not complying with the specifications and the design (Cui et al., 2004; FHWA, 2007). Federal Highway Authority report (FHWA, 2007) state that warranties offered an alternative way of to assure performance when State highway agencies faced staff and budget shortage and still needed to increase the quality and life-cycle performance of pavement. Warranties guarantee that contractors are responsible to repair and replace defects both during the construction and warranty period (Cui et al., 2004). One of the main features of warranties is that quality is measured based on actual product performance over time rather than construction materials and workmanship (Guo et al., 2005). In other words, contractor has the incentive to use any construction methods and products as long as they meet client's specified quality performance. The finding of our survey seems to support that contractors with warranty obligations have actually succeeded to produce the desired quality performance of infrastructure projects. More than seventy percent of respondents have indicated that only few or no infrastructure projects encountered quality problems during the warranty period or after the warranty expired (after 1 to 3 years).

The frequent use of DBB procurement raises other concerns on top of its susceptibility for human capital shortages. In the US, economic factors and change of procurement laws will cause an increase of public client's use of other procurement methods such as DB, DBO and BOT (Pietroforte and Miller, 2002). Similarly, Lædre et al. (2006) state that, since April 2000, UK government requires projects should be procured by public-financing-initiative (PFI), prime contracting, or design-build. In Sweden, limited projects have so far been procured with other procurement method than traditional DBB method. However, the use of performance-based contracts such as DB (with short-term warranties) and DBOM (with long-term warranties) is painted as good move toward public sector readiness to embrace PPPs arrangements (STA, 2008).

CONCLUSIONS

The success and failure of infrastructure project to achieve their performance objectives in terms of end-users' needs and societies' economic benefits are determined by number of factors including the procurement strategy. The choice of an appropriate method to procure a specific infrastructure project depends on many factors and client competence is one of the most important of them. The client is not only the owner of the project and the initiator of the concept but also represents the end-user and thus responsible for determining their needs objectively, interpreting them accurately and selecting design and construction teams that can deliver successfully the desired product. All these activities and responsibilities require a very strong client competence with skills, expertise and experiences necessary to carry out their technical, financial and management duties.

As our survey and other previous studies mentioned in this paper indicate, lack of client competence is one of the factors that contribute quality problems of infrastructure projects. Traditional procurement method, which is the most common method used by the Swedish Transportation Administration (STA), demands the highest client involvement in the project compare to other procurement methods. In light of shortage of skilled and experienced workforce in the public sector and the heavy reliance of the sector on this traditional procurement, it is plausible to assume that the association of quality problems and luck of client competence is not a mere coincidence but an overlooked outcome of current situation.

Many benefits that are associated with traditional procurement method such as client's control of the project, design flexibility and familiarity of the sector with this method and public sector's achievement of quality standards through warranties cannot be disregarded. However, the need to have enough public sector staff with good skills and competencies is very crucial to improve that quality of infrastructure transport projects. Strong and broader client competence would enable the public agency staff to properly identify the needs of the customers that are necessary inputs to determine the performance requirement and the objectives of the project. Increased client competence would ensure that many unknown quality attributes are transformed to known elements and know-unknowns will be shared or transferred accordingly. On one hand, product with quality attributes similar to manufacture goods (search goods) could benefit a procurement method that relies more on standardization and the use of more prefabricated products. On the other hand, product with experience and credence qualities would benefit more on the use of procurement methods that foster frequent and long-term relationships such as performance-based contracts and PPPs arrangements. Furthermore, other procurement methods such as relational (PPPs), integrated (DB), and performance-based contracts (DBOM) require strong client competence, skills and expertise that match those possessed by the commercial and business-oriented private sector.

REFERENCES

Brockmann, C. (2009). *Economics for the modern built environment.* (L. Ruddock, Ed.) Taylor and Francis.

Cheung, E., & Chang, A. (2010). Suitability of procuring large public works by PPP in Hong Kong. *Engineering, Construction and Architectural Management , 17* (3), 292-308.

Cui, Q., Bayraktar, M. E., Hastak, M., & Minkarah, I. (2004). Use of warranties on highway projects: A real option perspective. *Journal of Management in Engineering , 20* (3), 118-125.

Darby, M., & Karni, E. (1973). Free competition and the optimal amount of fruad. *Journal of Law and Economics , 16* (1), 67-88.

Estache, A., Iimi, A., & Ruzzier, C. (2009). *Procurement in Infrastructure: What Does Theory Tell Us ?* Retrieved from World Bank Policy Research Working Paper Series: Available at SSRN: http://ssrn.com/abstract=1435140

FHWA (2007) Highway quality compendium. Federal Highway Agency: FHWA-IF-07-012, Webpage accessed 15-09-2010 at:
http://www.fhwa.dot.gov/construction/pubs/hif07012/07012.pdf

FIA (2005). *Kompetensförsörjning inom anläggningsbranschen-Slutrapport (In English: Competence in the civil engineering sector - Final report).* FIA - FÖRNYELSE I ANLÄGGNINGSBRANSCHEN (Renewal in the Civil Engineering Industry).

FIDIC (2004). *Improving the quality of construction.* FIDIC- International Federation of Consulting Engineers.

Gransberg, D., & Molenaar, K. (2004). Analysis of Owner's Design and Construction Quality Management Approaches in Design/Build Projects. *Journal of Management in Engineering , 20* (4), 162-169.

Gransberg, D., Del Puerto, C., & Humphrey, D. (2007). Relating Cost Growth from the Initial Estimate to Design Fee for Transportation Projects. *Journal of Construction Engineering and Management , 133* (6), 404-408.

Grimsey, D., & Lewis, M. (2002). Evaluating the risks of public private partnerships for infrastructure projects. *International Journal of Public Management , 20* (2), 107-118.

Guo, k., Minchin, E., & Ferragut, T. (2005). The shift to warranties and performance specifications: what of method specifications?. *Construction Management and Economics,* 23(9), 953 – 963

Hodge, G., & Greve, C. (2007). Public–Private Partnerships: An International Performance Review. *Public Administration Review , 67* (3), 545-558.

HM Treasury. (2008). *Infrastructure procurement: delivering long-term value,* Webpage accessed 11-10-2010 at:
http://www.hm-treasury.gov.uk/d/bud08_procurement_533.pdf

Jefferies, M., & McGeorge, W. (2009). Using public-private partnerships (PPPs) to procure social infrastructure in Australia. *Engineering, Construction and Architectural Management , 16* (5).

Jha, K and Iyer, K. (2006) "Critical factors affecting quality performance in construction projects", *Total Quality Management*, 17(9), 1155-1170.

Koppinnen, T., & Lanhdenperä, P. (2004a). *Road sector experience on project delivery methods.* Webpage accessed 15-11-2010, from VTT, Finland: http://www.vtt.fi/inf/pdf/tiedotteet/2004/T2260.pdf.

Koppinnen, T., & Lanhdenperä, P. (2004b). *The current and future performance of road project delivery methods.* Webpage accessed 15-11-2010, from VTT, Finland: http://www.vtt.fi/inf/pdf/publications/2004/P549.pdf

Lædre, O., Austeng, K., & Klakegg, O. J. (2006). Procurement Routes in Public Building and Construction Projects. *Journal of Construction Engineering and Management , 132* (7), 689-696.

Landin, A. (2000). ISO 9001 within the Swedish construction sector. *Construction Management and Economics, 15* (5), 509-518.

Love, P., Davis, P., Edwards, D., & Baccarini, D. (2008). Uncertainty avoidance: public sector clients and procurement selection. *International Journal of Public Sector Management , 21* (7), 753 - 776.

Love, P., Skitmore, R. and Earl, G. (1998). Selecting an appropriate procurement method for a building project. *Construction Management and Economics*, Vol. 16, pp. 221-3.

Luu, D. T., Ng, S. T., & Chen, S. E. Parameters governing the selection of procurement system – an empirical survey. *Engineering, Construction and Architectural Management , 10* (3), 209 - 218.

Mandell, S., & Nilsson, J.-E. (2010). A Comparison of nit price and fixed price contracts for infrastructure construction projects. No 2010:13, Working Papers, Swedish National Road & Transport Research Institute (VTI).

Molenaar, K., & Songer, A. (1998). Model for public sector design-build project selection. *Journal of Construction Engineering and Management, 124* (6), 467-479.

Ng, A., & Loosemore, M. (2006). Risk allocation in the private provision of public infrastructure. *International Journal of Project Management , 25* (4), 66-76.

Nguyen, L. D., Ogunlana, S., & Xuan, D. T. A study on project success factors in large construction projects in Vietnam. *Engineering, Construction and Architectural Management , 11* (6), 404 - 413.

Nilsson, J.-E. (2009). *The value of puplic-private-partnerships in infrastructure*. Retrieved from No 2009:3, Working Papers, Swedish National Road & Transport Research Institute (VTI)

OECD (2008) *Transport infrastructure investment:: options for effeciency*. International Transport Forum, Transportation Research Center. www.internationaltransportforum.org

Pietroforte, R., & Miller, J. (2002). Procurement methods for US infrastructure: historical perspectives and recent trends. *Building Research & Information , 30* (6), 425-434.

Rienstra, S., & Nijkamp, P. (1997). Lessons from priavete financing of transport infrastructure: Dutch infrastructure in the 19th century and European projects in the 20th century. *Revue économique , 48* (2), 231-245.

Tookey, J., Murray, M., Hardcastle, C., & Langford, D. (2001). Construction procurement routes: re-defining the contours of construction procurement. *Engineering, Construction and Architectural Management , 8* (1), 20-30.

STA. (2008) A Swedis model for PPP in infrastructure investment. Webpage accessed 15-09-2010 at: http://epppc.hu/documents/cikkek945aswedishmodelforpppininfrastructureinvestment.pdf

STA. (2010). *The road to excellence - An international benchmarking between national road admistrations.* Swedish Transportation Adminstration (Trafikverket). Weppage accessed 10-11-2010 at: http://publikationswebbutik.vv.se/upload/5591/2010_075_the_road_to_excellence_.pdf

Vassallo, J. (2007). Implementation of Quality Criteria in Tendering and Regulating Infrastructure Management Contracts. *Journal of Construction Engineering and Management , 133* (8), 553-561.

Xia, B., & Chan, A. (2010). Key competences of design-build clients in China. *Journal of Facilities Management , 8* (2), 114-129.

COST CONTROL AND SCOPE MANAGEMENT IN MAJOR NORWEGIAN PUBLIC CONSTRUCTION PROJECTS

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This paper presents results from a big qualitative study of 23 Norwegian Government Projects from the period of 2000 to 2010. The study looked at the performance of the projects in a wide range of fields, though it was strictly limited to the execution phase. In this paper we look at findings and observations related to the project owner role in the management of the project scope. The concept "scope" includes features and functions of the project result, as well as the work needed to realize it. There will be uncertainty related to the scope in both of these dimensions. Scope management is about ensuring that the project delivers the scope necessary to provide the desired value, and not more. Scope management is a steering process, and thus includes the basic activities of establishing a plan for reference, keeping control of progress, analyzing deviations and implementing changes. In the projects investigated we made observations indicating that this was not well taken care of, and we partly ascribe this to deficiencies in the project governance. The paper discusses findings from the study in the light of the theory, and seeks to point out key elements of improvement.

KEYWORDS: Scope management, Change management, Cost control, Project Governance, Project Management

INTRODUCTION

Researchers at the Norwegian University of Science and Technology (NTNU) have undertaken a study of 23 big Norwegian public investment projects, among those 19 construction projects. The projects in the sample had been subject to a special quality assurance scheme during the planning phase, and the main objective of the study was to learn how well these projects had performed in the execution phase.

The study showed that the projects had performed well. Out of a sample of 23 projects, 22 were delivered within their cost frame, 20 were delivered according to their schedule, and 21 with a quality and capacity according to given specifications.

Despite the achievement on these performance measures, deeper investigations of the project processes revealed that there is still room for improvement. An area where the researchers had especially many remarks was the handling of scope changes, where it appeared to be a lack of routines and procedures in the project managerial systems. The general principles for handling and managing scope were not consistently perceived among the projects and the

project owner organizations. This makes the projects vulnerable for unintended increases in scope and cost, and may also inflict lower cost efficiency.

In this article we will look at why changes in scope will have to be expected in projects, and how they can be managed. We will then present the findings and observations from our study related to this subject, and then analyze and discuss them in the light of the theory.

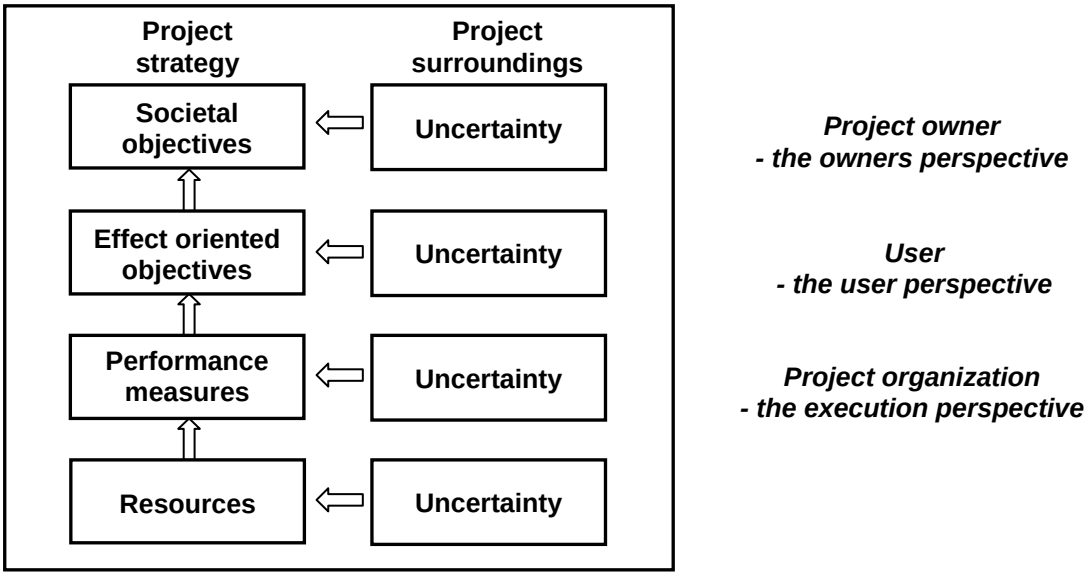
THEORETICAL BASIS

Controlling the project scope and scope changes, is a central part of the project management function. As a basis for the later analysis and discussion of the findings, we will first look into the concept of "scope" and the need for scope management to be an integrated part of the project management system in projects.

Project objectives and scope

A project is defined by Project Management Institute (PMI) (2004 p 5) as "…a temporary endeavor undertaken to create a unique product, service or result". The project task has the characteristics of uniqueness, is limited in time and is managed by result oriented goals (Packendorff 1993). Samset (2001) points out that the objectives of a project include more than just the performance measures of time, cost and quality. The projects are initiated on the basis of a need and a desire to reach a certain state in the future. Thus projects will also have objectives related to the use and the value of the project result, as well as goals for the project process itself. The relation between the different objectives can be illustrated in the following framework:

Figure 1: Logical Framework. Source: Samset (2001: 96).



The hierachy of objectives in figure 1 shows the relation between the immediate performance measures of the project process, and the superior objectives of the effects and value of the project results. To the right we have added the different actors involved in the project and their perspective on objectives and measurement of the success of the project.

The performance measures will typically be given in terms of time, cost and quality. The achievement of these will be the focus of the project organization executing the project. The

effect oriented objectives is the first order consequences of the project, and related to the direct use of the project result and the instant benefits for the user. The societal objectives represent the benefit and value for the project owner and society. These are superior objectives in a long term perspective (Samset 2001).

Notice that there is uncertainty related to whether the objectives in all levels of the goal hierarchy can, and will, be achieved, given the conditions and resources on the sublevel. The higher level, the higher uncertainty concerning whether the goals will be achieved. Also note that the uncertainty will be present after the project execution phase has ended.

Project Scope

According to the well known Project Management Body of Knowledge (PMBOK) of PMI (2004) the term ”scope” can refer to both *product scope* and *project scope.*

Product scope refers to the characteristics and functions of the project product or other project deliverables. Product scope will be closely related to the effect oriented goals, and is often referred to as the specification of requirements.

To PMI (2004) *project scope* is the scope of work needed to realize a product or result with the given functions or features. The project scope is thus the work necessary to deliver the product scope.

In this article we will use the term “scope” about both product and project scope as defined above.

Scope uncertainty

As showed in figure 1, the projects ability to achieve its different goals will be subject to uncertainty. The concept of uncertainty is often perceived as possible outcomes with negative impacts, namely “risk”, even though the upside of possible positive outcomes, the “opportunities”, should be included (Chapman and Ward 2001).

Christensen and Kreiner (1991) shows that uncertainty in projects can be categorized in two main groups; *Operational* and *contextual* uncertainty. Operational uncertainty, also called task uncertainty, is the uncertainty related to the actual execution of the project, like methods, costs and technical matters. Contextual uncertainty is uncertainty related to the surroundings of the project. According to Christensen and Kreiner (1991) the contextual uncertainty affects the ability of the project to meet the needs or demands that initially caused the need for the project. This means that there is a risk of compromising the *relevance* of the project. The uncertainty in this matter will be related to the problem of knowing what will meet the needs, and, in the next step, specifying this sufficiently. Kreiner (1995) points out that needs and solutions may change during the project execution, and a client could not be expected to be able to provide a detailed description of the requirements in early phases. Thus, too eager attempts to reduce the operational uncertainty might lead to increased exposure to contextual uncertainty, because the project will be less flexible considering changes in conditions and the explicit communicated needs.

In brief, we conclude that there will always be uncertainty related to the scope of the project. Even though it might reduce the uncertainty in the scope of work, it is not always appropriate to lock the scope of the project with too detailed specifications, since this will increase the exposure to contextual uncertainty that might reduce the value of the project result. Changes in scope must be considered to be a natural part of the project process, but have to be

managed well to ensure that the project achieve its objectives in the most efficient way possible.

Scope management

As we have seen, scope uncertainty will be present at many levels. Some examples are:

- Scope uncertainty related to changes in external conditions
- Scope uncertainty related to the choice of project concept; The ability of the project results to meet the needs and demands and provide value to the project owner
- Scope uncertainty related to technical solutions; Whether the chosen solutions and specifications will satisfy the needs of the users
- Scope uncertainty related to the deliverables/results; Whether the deliverables can be realized within the planned scope of work, as well as within the cost and time frames
- Scope uncertainty in contracts; Uncertainty concerning the number of man hours, masses, soil mechanics, technical matters, etc

The project success in the execution perspective will be closely related to the achievement of the performance measures. A cost efficient execution in terms of value for money will depend on proper cost control. The need for resources like time and money are a function of the scope of work to be undertaken, which is also an uncertain variable. The control of the scope, including the management of changes, is a key factor in the quest for achievement of goals and project success. We will look closer into the concept of scope management.

Scope management activities

Scope management is by Turner (2009 p 101) defined as: "…the process of ensuring that:

- An adequate, or sufficient, amount of work is done
- Unnecessary work is not done
- The work which is done delivers the desired performance improvement"

In the framework of the PMBOK (PMI 2004) scope management is one of the nine "knowledge areas" of project management. It is here expressed that scope management is basically a question about defining and controlling "… what is and is not included in the project…" (PMI 2004 p 103). Scope management is in PMBOK divided in five processes:

- *Scope planning;* The creation of a detailed plan of how to manage the scope of work.
- *Scope definition;* Specifications of the project result and the scope of work needed to implement it. Formulation of project objectives, specification of requirements and success criteria.
- *Create WBS;* The breakdown of the project scope in to manageable components of work according to the given structure.
- *Scope verification;* Inspection and formal approval of the project results.

- *Scope control;* Keeping changes of scope and the consequences of changes under control. Analysis of suggested scope changes, revision of the project objectives and plans. Ensuring that changes are formally approved.

A general management process typically consists of the generic activities of defining a baseline reference, controlling the progress and initiate changes as a response to deviations from the baseline. The processes given above are such activities.

First of all, the management system itself needs to be planned, designed and implemented in the organization. Often will a lot of the systems and guidelines be given by the basic organization, but some procedures and routines will also have to be project specific.

The scope baseline is defined by the project objectives, specification of the functions- and features necessary to meet the objectives, and the scope of work to be undertaken to meet these requirements. A clarification of what kind of changes of requirements and external conditions the project is, and is not, responsible for handling must be a part of the scope definition.

Keeping track of the project progress and trying to forecast deviations from plans are necessary control activities in the project management process. The control function of scope management includes everything from keeping track of the work done, to ensuring that the project meets the demands and contributes to the achievement of the overall project objectives.

The control function also includes change control. Changes of scope will inflict many of the other parameters in the project, like time and cost. The consequences of suggested changes thus need to be analyzed to provide a relevant basis of information before they are approved and implemented.

Scope management and the role of the project owner

Being the executing part, the project organization is responsible for exercising the daily management activities. The project organization will typically have the formal authority to make minor changes of plans that do not alter the requirement specifications, project objectives or given cost and timeframes.

The project owner orders the project and is responsible for governing it. A part of the owner role is to control the project, ensuring that the project delivers the results according to the plans and within the given frame conditions. The owner is responsible for supporting the project with the resources necessary to accomplish the task. The project organization must be empowered with some autonomy, but must also be instructed in which premises and terms that limits its authority. To balance these elements is the essence of governance (Klakegg et al 2009). For scope management the owner role will typically involve the following activities:

- Define the project and project mandate
- Set the frame conditions and premises for the project
- Approve major changes in scope
- Approve changes in the other premises like time, cost and quality

- Provide the project with sufficient resources

The project owner will also be responsible for the presence of the necessary managerial systems in the basis organization.

One should also notice that many of the premises and frame conditions the project operates under are not necessarily under the control of the project owner. Examples of such contextual uncertainty are national safety regulations, political interference and laws and regulations. Changes in these could inflict costly changes in the project scope. It is important that the responsibility for managing such elements of uncertainty is assigned an owner.

EMPIRICAL DATA: OBSERVATIONS AND FINDINGS IN NORWEGIAN GOVERNMENT PROJECTS

About the study

The findings and observations presented in this article were done as a part of a bigger study of 23 Norwegian large government projects, among these 19 construction projects, executed between 2000 and 2010. The projects in the study were the first projects to be completed after being subject to the process of Quality Assurance 2 (QA2) in the Norwegian quality assurance scheme. The QA2 is a process where the project is being reviewed by external consultants with the purpose of assuring that the project has a consistent and realistic basis for management and steering in the execution phase. The scheme is mandatory for all Norwegian government projects with a cost frame higher than 500 million NOK, and has to be completed before the approval of the project execution is passed in the Parliament. The study was undertaken to learn more about the effects of the quality assurance scheme, and thus be able to take measures to improve it in the next step.

The researchers examined a wide range of issues concerning execution and management of the projects. The researchers chose the perspective of the project organization, and the fields investigated were mostly on a project management level. However, the role and function of the project owner, the project governance, was also one of these areas.

The study required a comprehensive collection and analysis of information. The sources of data were basically written documentation like termination reports, reports from external consultants, documents from the executive works in the agencies and ministries and public accessible documents like propositions and annual reports. There were also done interviews with key personnel from the projects, agencies and ministries. The analysis was qualitative and strictly limited to cover just the execution phase of the projects.

Findings and observations

The researchers found a surprisingly well performance of the projects what comes to the achievement of the performance goals for the project execution. The study showed that out of 23 projects, 22 were delivered within their cost frame, 20 were delivered according to their schedule, and 21 with a quality and capacity according to given specifications.

Despite this success, the researchers did many observations concerning the management of the projects that drew their attention. Insufficient management of changes in frame conditions and scope were a common remark in many of the projects.

The findings and observations related to the definition of the projects were the following:

- Insufficient mandates; Many of the projects had insufficient or ambiguous mandates. In some cases the mandates were even missing.

- Immature concepts; Projects where the whole project concept had to be redefined after the investment decision and start-up.

- Improper cost estimates; The cost estimates were based on too optimistic assumptions, and did not include the uncertainty in the scope of work properly

- The lack of clear limitations for the project responsibilities in the interface with adjacent projects; Clarifications of scope came a long time after the investment decision.

Concerning the practical handling and management of scope changes we did the following observations and findings:

- Scope changes without the grant of extra resources; In many cases the projects were imposed to make costly changes of scope without being granted any extra funds

- Scope changes without the revision of the project objectives; Some scope changes were implemented without any real foundation in the project objectives

- Scope changes without any formal change of project mandate; Formal routines concerning implementation of the changes were not present, or were not followed

- Transferring of scope between different budgets; In some cases parts of the project scope were transferred to or from other projects or budgets

The organizing and models of interaction between the project owner, the project organization and the users was also a subject in the study. Of concrete findings concerning scope management in this matter we did the following observations:

- Unfavorable organization of responsibility and authority among the managerial levels and units; One project were organized in two units where one was responsible for the management of the requirements, and the other unit time and cost. This made it difficult to make consistent and balanced decisions

- Some projects were treated as pure procurement projects, with very little autonomy

Some findings were positive. We found that many projects had well defined mandates and realistic plans. We also observed that extra financial resources were granted and proper revisions of mandates and plans when scope changes had been imposed.

It was not a part of the researchers' ambitions to try to reveal the consequences of the observed deficiencies in the scope management described here. Yet, we did reveal that some of them had experienced unintended scope creep during their execution. We also saw that the lack of a clear defined scope made it hard to work out good estimates and proper budgets. In one case there arose an argument between the project owner and the project of whether some implemented adjustments of scope were changes or not. In the case where the responsibility and authority or the management functions were organized impractical, the project reported about the problem of suboptimalization.

In an overall view, the study revealed clear indications of insufficient scope management. In the following we shall look at the findings and observations in the light of the theory.

ANALYSIS AND DISCUSSION

In the previous sections we looked at what kind of elements, or processes, that had to be present for ensure a consistent scope management in projects. We also saw that there must be a clear division of the responsibilities and authority between the project organization and the project owner. In the following discussion we will categorize our findings under to themes: The definition of the project, and the control and management of scope changes.

The Project Definition – the baseline

The lack of a clear definition of what is included in the project and what is not was a common observation in many projects. A central document in this matter is the project mandate, supplemented by the project plans and/or a requirement specification. In many of the projects the mandate document was ambiguous or missing, though detailed specifications and plans were mostly present.

Many of the projects were started with detailed plans concerning technical solutions, specifications and deliverables. This was probably due to the fact that they had all been through comprehensive planning in front of the investment decision. In the project mandates there were however seldom stated what kind of scope uncertainty that was supposed to be handled within the given cost frames. As we have seen, there will always be a need for minor adjustments and changes in plans when the detailed planning starts and the practical matters have to be sorted out. The difference between changes of plans that required formal approval from the ones who could be decided by the project autonomous was not obvious, and it was not easy for the projects to sort it out. The projects were also given financial reserves to handle uncertainty, but a description of what kind of uncertainty they were supposed to handle with these reserves were not present.

In some cases the cost estimates and cost frames for the projects were too low, considering the uncertainty their actually operated under. This might be due to the fact that detailed plans were used to estimate the costs at an early stage, something that led to an underestimation of the scope uncertainty and thus the project total cost. In some of these projects even small deviations from the plans were used as an argument in the attempt to expand the budgets. In these cases the project organizations stated that the deviations were changes in scope, and required additional funds. Such a discussion is highly relevant at the time of project planning, but not half way in the execution phase.

Some of the projects in the sample had overlapping scope with other projects. We observed that clarifications concerning the responsibilities of realizing common elements were not always done properly. In one of the construction projects the responsibility for the financing of common groundwork and infrastructure were not clear at the time the project were decided executed. In this case, the infrastructure turned out to be very costly, and the project ended up with a bigger part of the bill than what was considered reasonable by the project organization.

Despite the fact that most of the projects were started with detailed plans, the researchers also found some where conceptual scope changes were made during the execution. The reason for this was ascribed to the decision on executing projects with immature concepts. In these cases a great deal of the chosen solutions and scope had to be revised after the investment decision.

It is here worth noticing both the criticality of not having a mature concept, but also the high risk of losing control over the costs in such a case if the project definition is unclear.

As we have seen in earlier sections, scope management is about defining and controlling "…what is and is not included in the project…" (PMI 2004 p 103). In a steering process it is of vital importance to have a baseline to measure against. In all of the examples mentioned above, this reference, in form of a clear project and scope definition was not present. We consider this as a fundamental deficiency in the scope management of these projects.

Scope and change control

As we have seen, the process of "scope control" in the PMBOK (PMI 2004) includes the control and management of changes. Change management encompasses, as we have seen, the process from revealing the need for a change, to the point where the change is decided and implemented. The process also involves an analysis of the impact of the change on other parameters such as time, cost, and resource requirements.

In our study we observed a lot of different practice concerning the handling of changes. A typical observation was that costly new requirements were imposed on the project, without sufficient funds to cover the extra expenses. These situations were mostly observed when there were changes in national standards or legislation, and where the projects were forced to adapt the new requirements.

In some cases we observed how parts of the project scope were transferred to other projects or budgets, or the opposite, where the projects were given the responsibility to finance or realize scope that had no actual relation to the project objectives. The researchers' impression is that such budgetary moves sometimes were done to avoid a cost overrun, or to be able to realize scope that originally was outside the project mandate. Such practice contributes to disguise the project cost efficiency. The behavior also undermines the managerial system, and the relationship of trust between the owner and the project organization.

In addition to the points mentioned above, the actual implementation of the changed plans was often insufficient. In some cases we observed that the scope was decided expanded in one process, but the necessary increase in budgetary frames were done much later. It was also a general lack of formal approval of changed mandates and revisions of the project plans following the scope changes.

Lack of proper scope management?

As we have seen, a proper project definition that could serve as a reference for the scope management was not present in many projects. An unclear defined scope makes it hard to judge what is included in the project and what is not, and thus identify scope changes. All the projects investigated had financial reserves to handle uncertainty. What kind of scope uncertainty that was to be covered by these reserves was in most cases unclear.

We also observed that the management of changes was improper in many projects. Some projects were also ordered to implement changes that increased total project cost, without being granted more funds or without a change of mandates or plans. The transfer of costs between different budgets is also a witness of inconsistency in the change management.

Consequences of missing scope management

Scope management is a central process in project management. Deficiency in this area weakens the ability to achieve project objectives at all levels in the goal hierarchy. To realize too much, too little, or wrong scope in a project will directly affect the cost efficiency.

The consequences of the observed lack of scope control were not assessed by the researchers. Still, observed signs implied that these projects had faced an increased risk of scope creep and loss of cost control. An ambiguous project definition also seems to have been a disadvantage in the work out of realistic time and cost estimates, leading to too low estimates and budgets the uncertainty taken in to consideration.

Managerial issues

The findings and observations presented show a lack of proper routines and procedures for scope management in the basis organization hosting the projects, but also insufficiencies in the exercise of the management processes. A lot of these issues sorts in our opinion under the project governance, and hence the responsibility lies with the project owner.

To provide the project with a proper defined mandate is an important part of the project governance. It is also the responsibility of the project owner to ensure that the implementation of changes is done in a proper process. Necessary financial resources must follow the imposed changes, together with a set of reviewed objectives if relevant.

The project organization is responsible for seeking the necessary clarifications and decisions. Being the executing party, the project organization will be the actor with the most detailed information and practical knowledge about the project. Thus the project will have to analyze and communicate the effects and consequences of the imposed scope changes.

The project mandate could be considered to be a contractual agreement. In this perspective, the work out of the document is something both the project owner and the project organization must be involved in. In this process, all unclear issues should be sorted out, so that the parts can agree on the content, including the division of responsibility and authority.

At last, the project owner is also responsible for providing routines and procedures in the basis organization that includes the requirements mentioned above.

CONCLUSION AND SUGGESTIONS TO FURTHER WORK

Conclusion

The scope of a project includes both characteristics of the results of the project, as well as the scope of work required to realize it. We have seen that it will always be uncertainty related to the scope in both of these dimensions. Also, it is not appropriate to try to reduce this uncertainty by locking the scope of the projects to early in the project process.

Scope management is about keeping control of what the project are responsible for delivering. In many of the 23 Norwegian Government Projects we investigated, we observed that scope management was not well taken care of. Many of the projects in the sample had a lack of a proper definition of what scope the project organization was responsible for realizing. A clear definition of responsibilities and authorities related to the handling of uncertainty in scope was not always present. We also observed a lack of procedures and routines, as well as a practice, concerning the changes of scope.

Missing scope management increases the risk of unintended increases in scope ("scope creep"), loss of cost control, and reduced cost efficiency.

The majority of the issues discussed in this paper are related to project governance. From the authors' point of view, many of the findings in the study are signs of insufficient project governance. The project owner is responsible for the presence of proper systems and routines for scope management, as well as fulfilling the owner role according to the given responsibilities and authority. In many of the projects investigated the role and function of the project owner did not seem to be well understood.

Suggestions to further work

We believe the findings and observations in this study indicate a need for a review of the principles for the establishment of a steering basis and system for scope management, including the handling of scope uncertainty. We have seen an obvious need for a set of clear guidelines and systems for the management of scope in the projects as well among the project owners. Such systems should be based on a good framework, based on clear and rational principles. A creation of such a framework should be a prioritized scope for researchers wishing to contribute to the improvement in the field.

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REFERENCES

Books

Chapman, Chris og Ward, Stephen 2003. *"Project Risk Management – Processes, Techniques and Insights"*, 2nd edition, John Wiley & Sons Ltd, Chichester England

Christensen, Søren & Kreiner, Kristian 1991, *"Prosjektledelse i løst koblede systemer"*, 1. utg, 11. opplag (2003) Jurist og Økonomforbundets Forlag København.

Klakegg, Ole Jonny, Williams, Terry, Magnussen, Ole Morten 2009 *"Governance Frameworks – For Public Project Development and Estimation"* Project Management Institute Inc.

Project Management Institute (PMI) 2004, *"A guide to the Project Management Body of Knowledge (PMBOK)"*, 3rd edition, Project Management Institute Inc Pennsylvania USA

Samset, Knut 2001, *"Prosjektvurdering i tidligfasen - fokus på konseptet"*, Tapir Akademisk Forlag, Trondheim

Turner, J Rodney 2009; *"The Handbook of Project-Based Management: leading strategic change in organizations"*, 3rd edition. McGraw-Hill, New York

Articles in scientific journals

Chapman, Chris og Ward, Stephen 2001. “Transforming project risk management into project uncertainty management”, *International Journal of Project Management* 21 (2003), 97–105

Kreiner, Kristian 1995, ”In search of relevance: Project management in drifting environments”, *Scandinavian Journal of Management*, Vol **11**, no 4, 335-346

Packendorff, Johann 1993, ”Projektorganisation och projectorganisering - Projektet som plan och temporär organisation”, *FE-Publikation* **1993:145**, Handelshögskolan Umeå

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