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Exploring project participants' satisfaction in the infrastructure projects

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Project participant's satisfaction has been identified as an important factor of the project success. A well-functioning and high-quality infrastructure is essential for the functioning of the society. The purpose of this paper is to examine the project participants' satisfaction in the infrastructure projects. The assessment method is a mutual project evaluation system that measures satisfaction from different project stakeholders. The study aims to find areas of development of the infrastructure projects by analysing the level of performance of different participants and to compare the results with the other types of the construction projects. The Finnish project evaluation database of over 200 projects was used to identify the project participants' levels of performance and satisfaction. Statistical analysis was used to measure the project participants' satisfaction with each other's performance and to compare differences between the infrastructure projects with the housing and office projects. The result indicates that in the light of the project participants' satisfaction, performance of the infrastructure projects has been evaluated at a lower level than other project types, especially by clients and contractors. It is notable that infrastructure projects differ slightly more from the residential housing projects than from the office projects. The results show that project participants in the infrastructure projects are less satisfied with each other's performance. The study highlights that the infrastructure projects are unique and different, in which case the corresponding reproduction of the skills or repetition as in the residential projects do not occur. In other words, from one project to another, essential matters differ considerably, which emphasizes the project-specific adaptability and agility of the project participants to achieve project success.

Keywords: Client satisfaction, infrastructure project, performance measurement, project participant's satisfaction, project success.

Introduction

Project success and performance measurement have received considerable attention in construction. In the development of performance measures, client and project participants' satisfaction has become one of the key success factors. These soft performance indicators are used to complement traditional project success factors, such as costs, schedule and quality (Pinto and Rouhiainen, 2001; Yasamis *et al.*, 2002; Chan and Chan, 2004; Nzekwe-Excel *et al.*, 2010). Project success, therefore, should be examined from a more holistic perspective, rather than only using traditional performance measures (Lehtiranta *et al.*, 2012), which are too simple to accurately measure the complexity of a construction project (Dainty *et al.*, 2003).

The fundamental characteristics of construction, such as the temporary nature and uniqueness of each project, complicate the evaluation process and emphasize the need for the development of an effective and efficient project evaluation system (Kumaraswamy and

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Thorpe, 1996). Due to the nature of construction, the goals of the project are not unambiguous to all parties but they form a complex entity. Each party in the project team observes the goals from his/her own viewpoint and each participant may have their own bases of evaluation regarding the success of the project and attaining the goals (Kärnä, 2009). Therefore, attaining the project goals requires systematic evaluation or feedback of the operations of the project organization (Liu and Walker, 1998).

Use of project participants' satisfaction as a success indicator can also be justified by assessing other characteristics of the construction project. In the construction supply chain, a party's ability to create value for other participants and for the project is a fundamental factor for project success (Love and Holt, 2000; Love *et al.*, 2000; Toor and Ogunlana, 2010). In practice, the performances of each member of the construction project coalition are interdependent, where the poor performance of one party will affect the performance of the next party (Kanji and Wong, 1998). A collaboration of construction clients and project participants based on the recognition and acknowledgement of each participant and their requirements is essential to improve project satisfaction (Nzekwe-Excel *et al.*, 2010). However, there has been little systematic research in the area of evaluation project performance in the viewpoint of the main project participants, especially in infrastructure projects. Most of the studies in the field of satisfaction and project success in construction have mostly investigated the relationship between the client and the contractor, which does not address the holistic and complex nature of a construction project, where the overall performance and success are a function of the performance of each participant. In addition, little attention has been paid to investigate the performance of different types of projects within the construction industry.

The purpose of this paper is to examine the project participants' satisfaction in infrastructure projects. The assessment method is a mutual project evaluation system that measures satisfaction from different project stakeholders. The study aims to find areas of development in the infrastructure projects by analysing the level of satisfaction of different participants and to compare the results with the other types of the construction projects by utilizing the Finnish project evaluation database. The findings of this paper seek to raise knowledge about the evaluation on the success of the infrastructure project and bring new perspectives to understand the construct of stakeholder satisfaction in construction projects in general.

Project performance measurement assessment

Project success

First, it is appropriate to explore infrastructure project-specific features. Infrastructure has been often considered as a key component in the economy (Threadgold, 1996) and also one of the basic services to industry and households (Martini and Lee, 1996). A high-quality physical infrastructure is thus a mandatory requirement for functioning businesses, competitiveness in a global market and human well-being. Traffic routes, as well as other types of infrastructure, are proprietary to the society or located on public land. Therefore, in these projects, the clients are typically public organizations and, in most cases, they are also the owners.

Infrastructure projects are usually considered as large-scale systems characterized by being physically or dimensionally large, with a large number of subsystems and components, and complex relations between these components (Yeo, 1995). In infrastructure projects, there are significant challenges for both clients and contractors for delivering the project successfully due to increasing complexity in design and the involvement of a multitude of stakeholders (Doloi, 2009). Also new contractual forms, such as public–private partnership, make infrastructure projects increasingly complex organizational setting (van Marrewijk *et al.*, 2008).

Since infrastructure projects can take many years to complete, responding to the changing interests and demands of stakeholders over the life of the project can make project management a challenging task (Friedman and Miles, 2002; Al Nahyan *et al.*, 2012). Therefore, it is important that the stakeholders are identified and managed (Nguyen *et al.*, 2009). Additionally, infrastructure projects may affect a large number of separate actors, who have varying and often conflicting interests. The goal of the client is to ensure that infrastructure services are available to the end-user, while the purpose of the industry and service providers is to make profit for the shareholders. The production circumstances and system processes of infrastructure projects differ significantly from those of residential construction, although the tasks of project management function similarly across fields.

Project success and factors affecting it have received considerable attention in construction. However, determining the concept of project success unambiguously has been problematic and it appears to be a complex issue. Although the consensus of the content of the project success has not been reached, some of the

main trends can be observed, which are on the one hand related to the content and the factors of the affecting project success and on the other hand to ways of measuring it.

Recent literature in the field of construction project management suggests that project success is a multi-dimensional concept (Toor and Ogunlana, 2010; Al-Tmeemy *et al.*, 2011; Lehtiranta *et al.*, 2012). Traditional objective project success measures, such as budget, schedule and quality measures, have been complemented with subjective measurement indicators, also known as soft measures (Chan and Chan, 2004). Subjective measures also take into account the satisfaction among key people in the parent organization, key project participants and key users and clients of the project effort (De Wit, 1988; Leung *et al.*, 2004). Koutsikouri *et al.* (2008) found that 'super-soft' factors, which are related to the socio-political dynamics of inter-disciplinary team work such as shared values, creativity and innovation, are important in achieving project success and positive outcomes.

In general, client satisfaction could be determined by the extent to which a physical facility (product) and a construction process (service) meet and/or exceed a customer's expectations (Yasamis *et al.*, 2002; Kärnä, 2009). This definition recognizes the importance of understanding, evaluating, defining, and managing expectations so that the clients' requirements are met. According to Pmbok (1996), this requires a combination of conformance to specifications (the project must produce what is said it would produce) and fitness for use (the product or service produced must satisfy real needs). It also emphasizes the role of the project management: success requires the participation of all members of the team, but it remains the responsibility of management to provide the resources needed to succeed, continuous improvement of management of the project as well as the quality of the product. Thus, satisfaction of the participants is directly affected by management mechanisms, rather than by particular project goals (Leung *et al.*, 2004).

Baccarini (1999) proposed to divide project success into dimensions: project management success and product success. The project management dimension consists of traditional criteria (cost, schedule and quality) project management process and stakeholders' satisfaction. Product success is composed of owners' strategy; user's satisfaction; profitability and market share. Similarly, a framework developed by Al-Tmeemy *et al.* (2011) incorporates criteria that align the project efforts with both the short- and long-term goals of the companies. Their framework is integrating three success dimensions: project management success, product success and market success, where client satisfaction is an indicator of a product success. Cooperation between the project participants and clients is based on the recognition of each party's influence, and acknowledgement of each participant and their requirements is important in improving project satisfaction (Nzekwe-Excel *et al.*, 2010).

Client satisfaction appears to be the most general indicator of the project success (El-Sheikh and Pryke, 2010), and even determined almost as a synonym for a project success by some authors. Although the project owner or client plays an important role in determining project success (Wang and Huang, 2006), it has been argued that the concept of the 'client', which has prevailed throughout the twentieth century, is now obsolete and is being replaced by the reality of project stakeholders. The project should be managed for the benefit of all its stakeholders (Newcombe, 2003; Li *et al.*, 2013). Therefore, Yang *et al.* (2011) suggest the use of stakeholder satisfaction as a criterion for measuring project success in addition to the traditional measures of time, cost and quality. In general, two types of stakeholders can be identified. Internal stakeholders are the project participants, such as project consultants, contractors and other suppliers, but also include the client and financiers. The external stakeholders are composed of private and public actors (Winch, 2004; Stretton, 2010). Evaluation of stakeholder demands and influence should be considered as a necessary and important step in the planning, implementation and completion of any construction project (Olander and Landin, 2005). The importance of the satisfaction of the participants and team members in the construction project has also been noted in the discussion of key performance indicators (KPI) (Chan and Chan, 2004). KPI's are performance standards that focus on the critical factors for the success of an organization or project.

It has been widely stated in construction that the performance of the main contractor has significant implications for the quality perceived by the client. According to Barrett (2000), the quality of construction projects can be regarded as the fulfilment of expectations (i.e. the satisfaction) of those participants involved. He highlights the importance of harmonious working relationships between the participants to achieve quality. Quality improvement efforts will lead to higher product and service quality, which will lead to improved client satisfaction (Torbica and Stroh, 2001). The quality of construction projects includes a mix of product and service quality dimensions (Yasamis *et al.*, 2002). In the construction production process, the delivery method is an important service factor. For example, Design-Build (D&B) contractors' performance has been found to be below client expectations, and reliability was the most important variable, as assessed by the construction client (Ling and Chong,

2005). In contrast, the levels of satisfaction with the collaborative relationships in three alternative delivery methods have been examined in recent research, where the level of satisfaction with collaboration was found to be generally higher in D&B and Construction Management than in Design-Bid-Build projects (Lehtiranta *et al.*, 2011).

Project success measurement

Construction can be characterized as a specific type of project industry, with specific features concerning production, such as temporality, restricted location and one-off products. Complexity of the construction with a large number of project participants also complicates the evaluation of the project outcome and emphasizes the need for developing effective and efficient evaluation system (Kumaraswamy and Thorpe, 1996). When examining satisfaction, the research focus in construction has been mainly on a client–main contractor relationship and there is lack of proper investigation of satisfaction and performance measurement in the project participants' perspective although the parties' satisfaction has been identified as an important criterion for the success of the project.

Project stakeholders may have different backgrounds and dissimilar goals and ways of thinking, which are some of the difficulties inherent in the measurement and evaluation of construction projects. Each project participant looks at the project from his or her own perspective and has his or her own criteria for measuring success. To achieve the project goals, a systematic evaluation of the organizations' performance is required to provide feedback for guiding the participants' behaviour (Liu and Walker, 1998). Each firm in the construction supply chain is both a customer and a supplier, and the value created by them is a fundamental factor in the success project (Love *et al.*, 2000). Because the performance of each participant in the construction project coalition is interdependent, other participants should assess their performance.

Lehtiranta *et al.* (2012) strongly emphasize a holistic approach and the importance of the main project participant's performance in discussing the success of the project. They found a strong correlation between project participants' satisfaction with each other's performance and the owner's perception of project success. According to their investigation, multi-directional performance measurement across vertical and horizontal relationships could provide new insights on the determinants of construction project success.

Satisfactory participant performance has been recognized as a prerequisite for maintaining harmonious working relationships. Satisfaction surveys provide project participants with information that can be used to help improve their performance. It has been suggested that contractors can improve their performance in most aspects of satisfaction. In terms of criteria in need of improvement, project participants, clients and designers considered the correction of defects a priority (Soetanto *et al.*, 2001). Dissatisfaction factors in infrastructure projects have also been investigated recently. According to one study, the designers' performance has been evaluated as poorer than that of the other main participants (Kärnä *et al.*, 2011).

It is essential to understand the satisfaction requirements of each project participant and explore the factors of satisfaction. The key participants need to assess each other's performance on a regular basis to continuously improve their own performance for the benefit of the overall project success (Soetanto *et al.*, 2001). By continually measuring team cooperation and integration, performance can then be managed in a proactive way, rather than having to rectify poor performance after it has occurred (Baiden *et al.*, 2006).

The literature analysis supports the assumption that as a part of the complex and dynamic construction industry, project participants' satisfaction corresponds with the wider perceptions of project success. In the construction industry, the quality of the end product and thus client satisfaction is highly influenced through independent work done by the participants involved in the construction project and the co-operation between participants (Kärnä, 2009; Lehtiranta *et al.*, 2012). The satisfaction levels of construction clients and the project participants can be enhanced by focusing on the values of their satisfaction attributes and improving the integration of the project team (Nzekwe-Excel *et al.*, 2010). Measuring the project participants' satisfaction can be used, for example, in perceiving needs for development and targeting operations in the project level. It can be also used as a tool for project participants' mutual learning and efforts for continuous improvement. Stakeholder approach also challenges the current methods of measuring project success.

Methods and empirical data

Measuring method

Data for this study were gathered using a comprehensive database of Finnish project feedback and benchmarking tools, which were recently developed in Finland to improve quality and cooperation between the project participants in construction (Kärnä, 2009). The project feedback and benchmark system is a technologically advanced and versatile feedback system for the entire construction industry. The simple Web

interface facilitates the giving and receiving of mutual feedback at different stages of the project. It is operated by the Finnish Construction Quality Association (Rakentamisen laatu RALA ry).

The basis of the feedback system is standard evaluation, wherein the main participants evaluate each other's performances. The system identifies five role alternatives for participants: client, project manager/consultant, architect/designer, main contractor and sub-contractor. In practice, the project manager or the representative of the main contractor establishes the project in the feedback system and draws up a feedback plan. In the feedback plan, project information and participants are entered and the feedback evaluations are determined and started. The baseline of the feedback systematics is the mutual performance assessment, where all evaluations are bi-directional, thus the feedback giver can evaluate one or multiple participants' performance in the particular project. The questionnaire is answered electronically using an Internet form, which displays the project and participants performance being evaluated. After the feedback givers have evaluated the performance and completed the questionnaires, the evaluations are saved in the system and reported to the project participants. In the context of this study, the term feedback flow depicts one particular performance evaluation between the project participants.

Using the project feedback system, the owner would establish goals in terms of performance. By monitoring the project team's progress in reaching these goals, team members can re-evaluate the characteristics of the processes necessary to reach them. A multi-faceted feedback system also denotes the areas needing improvement in the entire industry and gives opportunities for setting benchmarks for customer satisfaction. A standard feedback system may be considered more objective than a contractor's own feedback survey because social interaction components are not accounted for in the standard system (Kärnä, 2009).

The evaluation consists of 15 electronic questionnaires, which are specific to each evaluation (feedback) flow, such as the project consultant's evaluation of the main contractor's performance (Appendix 1). The questionnaires can be adapted to fit the needs of a particular project. Feedback related to the operations of other project participants is provided after participants respond to statements regarding performance on a 5-point Likert scale, where 1 and 5 represent very low and very high satisfaction levels, respectively. Specific questions depend on the flow of feedback, and the common evaluation factors are:

(1) Project management,
(2) Collaboration,
(3) Staff,
(4) Goal accomplishment.

Project management refers to general factors related to project management, which have traditionally been measured through the quality, costs and schedule. Project management should be systematic and premeditated and it should cover risk management and, for general contractors, the effective guidance of subcontractors (Pmbok, 1996). It has also been observed that the project participants' abilities related to cooperation factors have a great impact on the successfulness of a project (Woodward, 1997; Karim and Adeli, 1999; Eden *et al.*, 2000; Kärnä *et al.*, 2009). Factors for measuring cooperation are, for instance, the functionality of the cooperation, and factors related to information flow and problem-solving capabilities. The staff is strongly connected with skills and expertise and resource-related factors, which are perceived as a critical success factors in the construction industry (Pinto and Slevin, 1989; Songer and Molenaar, 1997). Accomplishing goals naturally refers to the assessment of attainment of various goals, which usually takes place after the project has been completed.

The questions were developed and tested on the expert workshops. A total of five workshops were organized in 2005 and 2006. Each workshop had 10–15 participants from the strategic and tactical management of associations and companies as well as people responsible for development and quality matters in the construction. The questionnaires were then piloted in the real construction projects and finally in the production environment.

The basis for the contents of the questions was formed by the various tasks in construction and the requirements they set for a construction project. The project evaluation questions concentrate on the matters that each project participant considers important, and, on the other hand, those that each participant can assess. The tasks and requirements of various participants in construction were grouped into fields that are similar to each other although the contents of the questions were determined by the role and task of the participant.

In Finnish construction projects, the responsibility of the overall project management mainly falls in the hands of a specially assigned project consultant or, in special cases, those of the main contractor. The importance of the project consultant's role may be unfamiliar in countries where project management is normally assumed to be the architect's responsibility (Lehtiranta *et al.*, 2012). In Finland, the project consultant takes care of the overall project planning, scheduling, contracting and supervision, whereas the architect's role is

restricted to expert consultancy. Thus, in the Finnish construction industry, and in this report, the term 'designer' is used to encompass all professionals who produce plans and designs for a project. The designer evaluations included in this study are usually, but not always, related to architects. In this study, the 'owner' is used as a synonym for 'client'.

Description of the data and analysing methods

The main goal of the paper was to explore infrastructure projects' performance as evaluated by project participants and to compare the results to the other project types. This provides information on the characteristics of the infrastructure project and holistic view of the project performance as assessed by the project participants. Achieving this goal requires a versatile statistical approach.

The original data sample used in this study consist of a total of 520 performance evaluations (separate feedbacks) addressing 214 construction projects. However, the study concentrates on analysing only statistically significant project evaluations, presented in Figure 1. Performance evaluations between participants are bi-directional, but the accumulated quantities of data are asymmetric. It is worth to clarify that in this context the term feedback flow depicts one particular performance evaluation between the project participants. The owner-related performance evaluations represent exceptions to the mutuality of assessment, as the feedback system does not support an evaluation of the owner's performance.

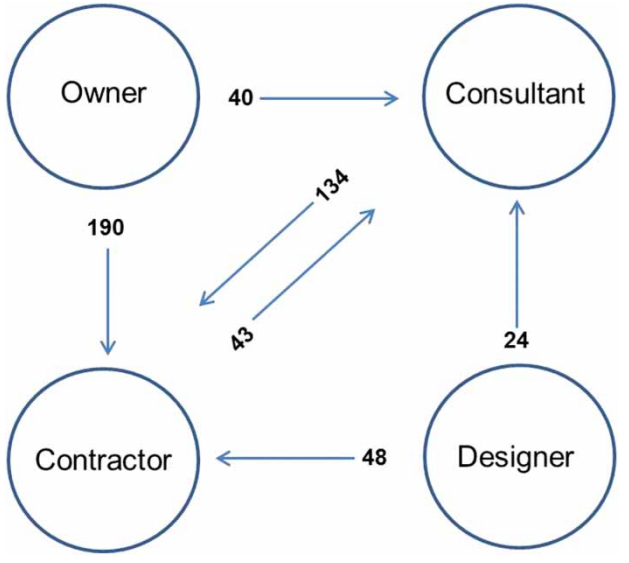

Figure 1 The number of the performance evaluations between the project participants

Project types are categorized into three classes according to the nature of the project outcome. The first type of project outcome is infrastructure, which consists of roads, railways and maritime projects as well as communal engineering and maintenance of infrastructure. The second project type is composed of projects related to office and business premises. The third project type consists of residential houses. The number of projects of each type is presented in Table 1.

The variable of performance resulted from variables measuring the success of the project. First, for each, evaluations of the different projects were combined by taking average values for each question. Then, questions were merged to 'success/satisfaction' variable by giving exactly the same weight for each existing question and taking the average from these. Analysis of comparison was performed with this formed 'success/satisfaction' variable.

First average grades were investigated to find out the level of project participants' satisfaction in the each project type (Figure 2). A *t*-test was performed to determine whether the difference between the grades of the different project types was statistically significant (Figure 3). The *t*-test evaluated the averages of random variables within a normal distribution and the homogeneity of variances. Additionally, a *t*-test was conducted according to variance testing in pairs. The test was performed by calculating the *t*-value, which was then compared to the limit taken from the *t*-distribution, in which the null hypothesis was that there are no differences between the project types, $H_0{:}\mu_x = \mu_0$.

Finally, the data were analysed to determine which factors were most important in producing the differences between project types (Table 2). In practice, the variance homogeneity of the variables was tested with an *F*-test in which the null hypothesis was that the variances are equal. If this test showed that the variance homogeneity was less than 5%, the variables' expectation homogeneity was tested with independent samples *t*-test. Accordingly, when the variance was not equal (homogeneity of greater than 5%), the expectation homogeneity was tested with a Welch test. In both cases, the null hypothesis was that there are no differences between the variables.

Table 1 Number of each project type in the study

Project type	Number of the projects (*n*)
Infrastructure (INF)	52
Office and business (OFF)	83
Residential housing (HOU)	79
Total	214

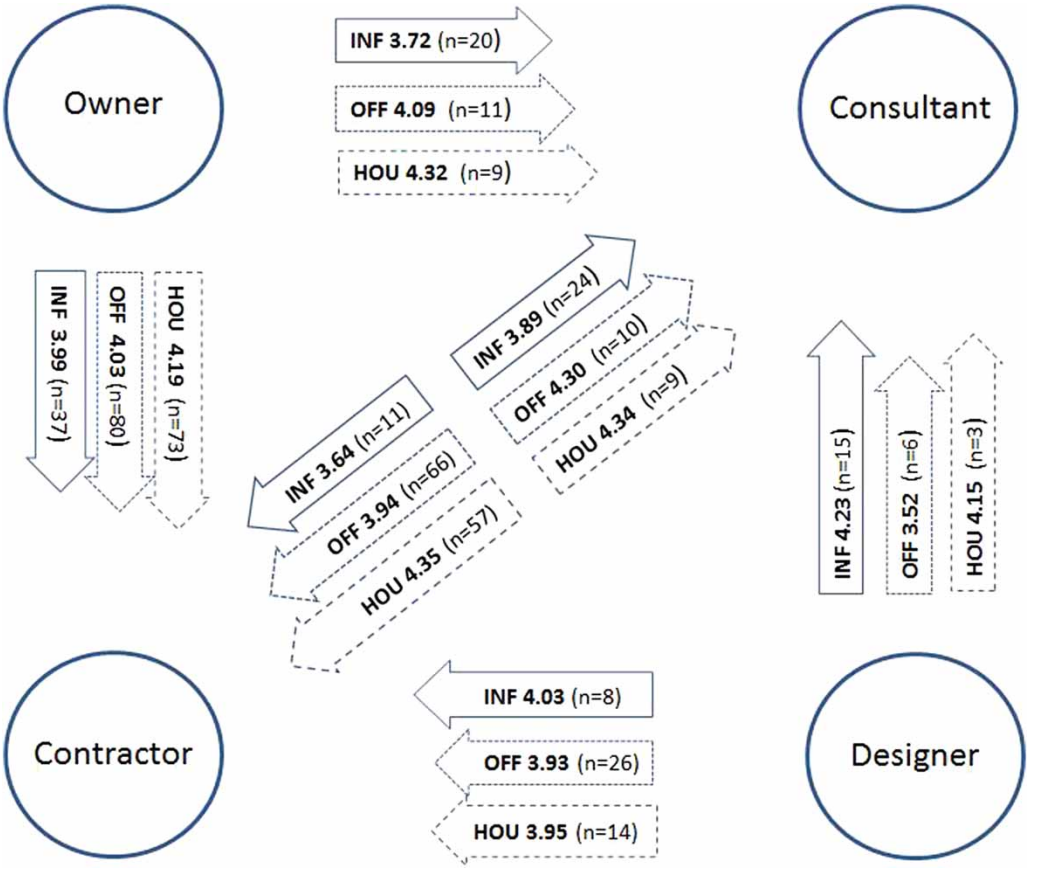

Figure 2 Comparison of average grades from four main participants across three project types
INF, infrastructure project; OFF, office project; HOU, house project

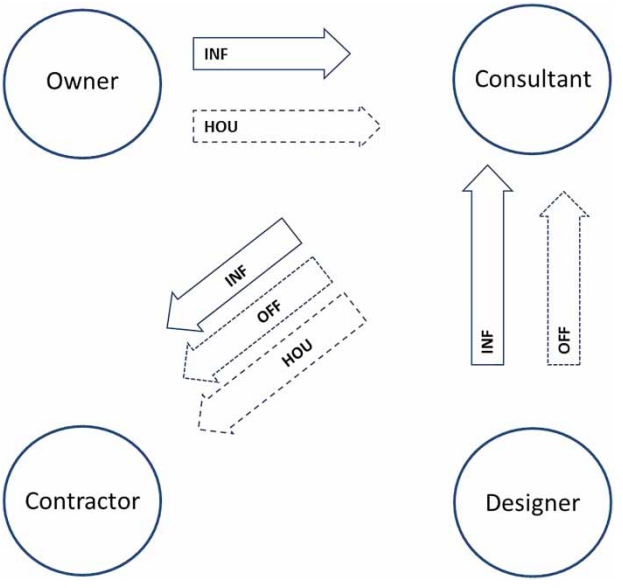

Figure 3 Statistically significant differences between project types (*t*-test)

Results

Comparison between infrastructure projects and other project types by the level of performance/satisfaction

Comparison by project type for the four main participant's mutual performance evaluations is depicted in Figure 2, where the direction of the arrow represents the flow of each performance evaluation and the length of the arrow describes relative level of satisfaction. The average Likert grades of the various participants, categorized by project type, are also presented in the arrows. The grades show that, on average, the most positive evaluations were given in residential building projects. The consultant's performance in infrastructure projects received poorer grades from the owner and contractors when compared to other fields, yet they received the best grades from the designers.

Next, the statistically significant differences of the project participants' evaluations by project type were examined. Figure 3 shows only the evaluations with statistically significant differences between the project

Table 2 Performance evaluations by the project type with the statistical significant factors

Feedback giver	Feedback recipient	Project type	Factors[a]
Designer	→Consultant	INF–OFF	Project management*
Contractor	→Consultant	INF–HOU	Project management*
–	–	–	Staff and skills*
–	–	INF–OFF	Project management*
Consultant	→Contractor	INF–HOU	Project management***
–	–	–	Cooperation***
–	–	–	Staff and skills**
–	–	–	Environment and safety***
–	–	–	Finishing and handover***
–	–	INF–OFF	Project management**
–	–	–	Cooperation*
–	–	–	Environment and safety*
Owner	→Consultant	INF–HOU	Project management**
–	–	–	Cooperation**
–	–	–	Staff and skills**
–	–	INF–OFF	Cooperation*
–	→Contractor	INF–HOU	Project management*

HOU, residential housing project; INF, infra project; OFF, office building project.
[a]The significance limits in expectation testing were set to three different levels: *5%, **1% and ***0.1%.

types. According to the *t*-test, the levels of satisfaction between parties have statistically significant differences in three feedback evaluations. First, infrastructure projects differ from residential projects in the owner's evaluation of the consultant's performance, where the performance of the residential projects is at a higher level. Second, infrastructure projects differ from office projects in the designer's evaluation of the consultant's performance. In that case, the infrastructure project performance has been evaluated higher than office building projects. Third, all three project types differ in the consultant's evaluation of the contractor's performance. The last observation is the fact that satisfaction has been the highest in the residential projects.

Comparison of project factors based on evaluations and project types

Finally, the data were analysed to determine which factors were the most important in producing the differences between the project participants' satisfaction of each other's performance by project types. It allows finding out specifically what factors caused the differences. As stated earlier, the contents of each of the evaluation are comparable with each other; however, the details of the questions are context related and determined by the role and task of each participant.

The results of the analysis are given in Table 2, listing only the statistically significant results. The columns show the evaluation providers and recipients (feedback evaluations), the type of the project and the general factors behind the differences. In Table 2, statistical significance is indicated by the use of star symbols (*). The number of stars indicates the significance level: one star (*) for 0.05, two (**) for 0.01 and three (***) for 0.001 or 0.005.

In general, significant differences were found in five project participants' feedback evaluations, covering eight project type comparisons (Figure 3), which are depicted in Table 2. When examining which factors are common differences, factors related to project management appear to be significant in every evaluation flow except for the owners' evaluations of the consultant's performance. Additionally, the most significant factors can be found from the factors, which are related to the consultant's evaluation of the main contractor's performance.

The consultant's evaluations of the contractor's performance showed the largest differences between infrastructure projects and residential projects. In this evaluation flow, the success of residential projects has been superior to that of other project types in every category: project management, cooperation, staff and skills, environment and safety, and finishing and handover. In this feedback evaluation, infrastructure and office projects also have statistically significant, albeit smaller, differences.

In the infrastructure projects, the designer's feedback to the contractor has a statistically significant difference when compared to office projects in regards to project

management, where designers are more satisfied with the infrastructure projects. In the contractor's feedback to the consultant, infrastructure projects are significantly different from and score lower than the other project types.

Discussion

The research results show that performance of the infrastructure projects has been evaluated at the lower level than other project types, especially by clients and contractors. It could be stated that project participants in the infrastructure projects are less satisfied with each other's performance. The results show that the only exception seems to be the designer's evaluation of the project consultant's performance. This result may be due to the specific characteristics of the infrastructure projects, especially the large scale, with a large number of components (Yeo, 1995). Infrastructure projects are also typically long-lasting projects and subjects to changes over the life, which has an impact on project management (Friedman and Miles, 2002).

According to the statistical analysis, the infrastructure projects differ slightly more from the residential housing projects than from the office projects. The owner's evaluation of the main contractor's performance is different between infrastructure and residential projects with regard to project management. Particularly, the result is shown in the contractor's risk management; the degree of risk management is clearly lower in infrastructure projects. Also in the contractor's evaluation of the consultant's performance, factors related to contracts and risk management are emphasized, but also the activities in the bidding phase. In residential building projects, the consultant's organization and division of responsibilities has been clearer and is related to improved satisfaction.

It is also notable that the cooperation was emphasized especially in the owners and project consultant's evaluations and it appears in every type of the projects. Cooperation is then the significant dimension of the project success, which stresses the main participant's abilities for sound and flexible collaboration during the project. This result supports also recent project success research (Cooke-Davies, 2002; Koutsikouri *et al.*, 2008).

When examining the differences between project types, it appears that, on average, the best feedback was given to residential projects. Differences between the participants' evaluations of residential construction and infrastructure projects may be influenced by differences in production conditions and changes, which are more stable in residential house construction projects than in infrastructure projects. Typically, infrastructure projects are affected by geographically vast areas, which have direct impacts on factors, related to the project management. Interestingly, similar production-related factors can also be perceived when exploring the project consultant's evaluations of the main contractor's performance, where factors related to environment and safety are emphasized. Some of these results may be due to the fact that infrastructure projects shape and change the environment in significant ways. Environmental impacts may also be emphasized because traffic routes, as well as other types of infrastructure, are proprietary to the society or are located on public land.

Conclusions

The study attempted to open the black box of project participants' satisfaction, and provided some empirical evidence regarding the participants' perceptions of the project success in the infrastructure project environment. Recent research in the field of construction has strongly suggested that the stakeholders' satisfaction with the project is reflected in the success of the project (Leung *et al.*, 2004; Nzekwe-Excel *et al.*, 2010) and continues to have an indirect influence throughout the project, including end-user satisfaction, which can be said to be the ultimate goal of the whole construction industry. However, project success is a complex, multidimensional issue (Tmeemy *et al.*, 2011) that also impacts performance measurement, where the holistic methodological approach is strongly suggested (Lehtiranta *et al.*, 2012). These fundamental factors also justify the viewpoint of this research.

The results of the statistical analysis indicate that significant differences are apparent in performance among project types. The infrastructure project performance differs from that of other project types, particularly in the owner's and designers' evaluations of the consultant's performance and in the consultant's evaluation of the contractor's performance, which differs in all three project types. Because the results reinforce the theory of differences between the various project types in construction, research and practical development, future work should focus on the special features of each project type across the entire field of construction.

According to the results, it appears that project management, in general, is more challenging in the infrastructure project than in the other types of projects. Further according to the results, in the field of project management in infrastructure projects, the following factors are emphasized: the level of reporting and documenting, an adequately systematic approach to risk management, success in adhering to the schedule and matters related to quality assurance. Thus, these factors are important for the success of infrastructure

projects, and commitment to improving them enhances the ability to produce a high-quality built environment. However, it can be predicted that in the future, infrastructure projects will become more complex to manage, when new forms, such as public–private partnership become more common (van Marrewijk *et al.*, 2008).

From the results of the study, one very practical conclusion can be drawn. Infrastructure projects are unique and different, in which case the corresponding reproduction of the skills or repetition as in the residential projects do not occur. In other words, in one project to another, essential matters differ considerably, which highlights the project-specific adaptability and agility of the project participants. A special characteristic typical of construction projects is that the participants' cooperation and actions are interdependent, which was also emphasized in this study. The project success is strongly determined by the ability of the various parties to create value for each other during construction. Then, the subjective experiences of the main participants, such as the designer, main contractor and consultant, indicate the project's success. Therefore, it could be said that the internal satisfaction of the construction project is determined by the soft skills related to the cooperation of the parties during the project in addition to traditional project management factors.

This study examined the performance and methods of measuring success in construction and emphasizes the significance of subjective 'soft' values in addition to the more traditional hard measurement methods. Project participant satisfaction is strongly linked to user satisfaction, although this cannot be explicitly deduced from this study. It is natural that reaching the set goal also affects the positive experiences of the end-user. Linking the end-user evaluations of the success of the project will be also one of the future challenges in the field of project success research in the construction. However, end-users require a different approach to evaluation of the construction process, handover and usage as well as functionality throughout the life cycle. This requires that the special features of infrastructure should be taken into account when developing the systematics for user orientation and the methods of measuring it. For example, recent findings from a road maintenance project emphasizes that user satisfaction is strongly influenced by information received about the project (Hartmann and Hietbrink, 2013).

For research, and as a developmental goal for the entire industry, it will be important to create new ways of assessing the evaluation of project parties and end-users and to assess mutual effects during the entire life cycle. Advanced supply chain models, including project stakeholders' satisfaction, are a foundation for the successful value chain. As part of the complex and dynamic construction industry, multi-directional project evaluation responds to the need for accurate performance measurements, corresponding to wider perceptions of project success, including participants' satisfaction with the construction process.

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Appendix 1. An example of the survey questionnaire*The project consultant's evaluation of the main contractor's performance*

1. PROJECT MANAGEMENT BY THE MAIN CONTRACTOR

Project management was systematic and methodical
Reporting and documenting were well carried out
Risk management was systematic and extensive
The construction schedule was well managed
Quality assurance was performed systematically and efficiently
Extra and alteration works were carried out flexibly and efficiently
Sub-contractors were efficiently instructed

2. COOPERATION BETWEEN THE PROJECT CONSULTANT AND THE MAIN CONTRACTOR

Cooperation was sound and flexible
The contractor presented feasible alternative solutions
The contractor solved problems efficiently
The contractor took good care of the information exchange during the project

3. THE MAIN CONTRACTOR'S STAFF AND SKILLS

The site management was skilled and professional
The construction workers were skilled and professional
The sub-contractors were skilled and professional
The staff was skilled and professional
The organization and the distribution of duties were clear
Adequate resources were allocated to the project

4. ENVIRONMENT AND SAFETY

The site was clean and in good order
Occupational safety issues were well taken care of
Environmental issues were well taken care of

5. FINISHING AND HANDOVER [question only in final feedback]

Handover controls and inspections were well carried out
The level of handover material and documentation was good
The quality requirements set for the building and premises were well met
The requirements set for the functionality of building service technology were well met
As a whole, the construction works were well managed