The Engineering Project Organization Journal, 2013
Vol. 3, No. 4, 198–212, http://dx.doi.org/10.1080/21573727.2013.832671

Collaborative risk management processes: a constructive case study

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Received 17 January 2013; accepted 22 July 2013

Risk management (RM) has been identified as an essential factor for success in complex construction projects in which it needs to be based on collaboration and coordination between participant organizations. The complexity approach to project management suggests basing management processes on integration and communication between organizations. However, the literature is scarce on both complexity-based and collaborative applications of RM. Herein, a constructive case study approach is applied to propose, test and analyse three processes for collaborative RM in a Finnish shopping centre construction project. The constructs include (1) a risk workshop, (2) a process for involving the contractors in RM and (3) a process of utilizing performance feedback for RM. The findings suggest that the constructs usefully complement single-organization-focused RM approaches. Researchers and practitioners are encouraged to take advantage of the complexity approach to project RM and advance the standard frameworks to meet the needs of complex multi-organizations.

Keywords: Collaboration, complexity, constructive research, multi-organization, risk management.

Introduction

'The expectations for the project were high, but the outcome looks even better'. The owner's praise at the opening of a shopping centre was the result of a challenging effort to turn a project that began somewhat chaotically into a success story. Success in this case project, or in any large construction project, cannot be attributed to a single individual or organization but to the organization of the contributors such that their skills are used at the right time and in an effective manner (Walker, 2007). The associated project delivery method, construction management (CM), is based on a high level of collaboration between the key participants: the owner, the project consultant, the contractors and the design group. One of the most influential factors determining construction project success is the way a multidisciplinary organization, or a multi-organization handles risks (Cherns and Bryant, 1984).

The scope of traditional risk management (RM) standards is frequently focused on a single organization. However, most project-specific risks, such as constructability, changes in orders and conflicts in documents, require a joint management effort of several project participants (Rahman and Kumaraswamy, 2002). Complex risks with significant life cycle impacts, such as sustainability, are often not identifiable or manageable by a single organization. RM enables project owners and other participants to identify, assess and respond to the threats and opportunities that may influence project goals throughout a project's life cycle. The considerable potential of multi-organizational delivery is frequently left unutilized when RM processes are run unsystematically and/or within single-organizational boundaries. One of the major drawbacks related to advancing collaborative RM is the lack of established processes, as well as the scarcity of related research literature.

These observations have led to the need to design and analyse RM processes that complement traditional, standard-based, single-organization-focused RM processes by bridging organizational boundaries. The design of complementary collaborative RM processes requires fitting RM processes to the characteristics of the project environment and organization (International Organization for Standardization ISO, 2009; Project

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Management Institute, 2009) and addressing organizational (or social) complexity as the dominant type of complexity (Pryke and Smyth, 2006; Hertogh and Westerveld, 2010; Lehtiranta, 2011). The complexity-based approaches to construction project management (PM) theory and practice guide the researcher (or practitioner) to focus on interfaces of integration, knowledge sharing and communication (Cooke-Davies *et al.*, 2007; Cicmil *et al.*, 2009). Furthermore, applying Xue *et al.*'s (2010) definition, collaborative working on project RM (i.e. collaborative RM) would mean 'joint working of project stakeholders to effectively and efficiently accomplish' RM.

This study was motivated by the challenges identified in large Finnish CM projects. Their RM challenges are likely similar to those of other large construction projects, especially those based on high levels of collaboration, such as in the case of partnerships and alliances. The objective of this study is to propose, test and analyse three collaborative RM processes (constructs) that are based on the complexity approach. The constructive research approach involves applying a practical solution (the constructs), collecting practical learning related to the constructs' functionality and potential for improvement and discussing the theoretical contribution.

Multi-organizational CM projects

The construction industry is based on coordinated activities by a growing number of companies with a narrowing focus of differentiation. As a project-based industry, organizational structures in construction are only built for a defined project time span. Therefore, construction projects have been referred to as temporary organizations (Walker, 2007) or temporary *multi*-organizations (Cherns and Bryant, 1984; Lizarralde *et al.*, 2011). The concept refers to project organizations that consist of a multi-disciplinary composition of participants employed by independent firms that accomplish a predetermined task in a scheduled time frame on a one-off basis (Cherns and Bryant, 1984; Walker, 2007). The participants of a multi-organization are interdependent during the project but independent of each other outside it. While working towards shared project goals, they need to look after their own interests, which include, for example, increasing productivity, improving service, maintaining existing clients and attracting new business (Walker, 2007).

The challenges related to multi-organizational project delivery include multidisciplinary and multi-location fragmentation, price competition, poor communication (Cherns and Bryant, 1984), lack of clear structure in terms of hierarchical authority (Janowicz-Panjaitan *et al.*, 2009), divergent or contradictory objectives and practices (Lehtiranta, 2011), conflicts between the project and parent organizations (Kenis *et al.*, 2009) and knowledge silos (Sydow *et al.*, 2004). In fact, most of the risks associated with construction projects stem from multi-organizational collaboration (Keinänen, 2009; Lehtiranta, 2011) and social complexity is identified as the dominant type of complexity (Hertogh and Westerveld, 2010).

Typically, these observations will lead to managing the multi-organization itself as a risk (i.e. threat) to project delivery. From this perspective, RM involves the challenges related to appropriate risk allocation and the functional integration of RM needs in individual participant organizations. An opposing or complementary approach would be to treat the multi-organization as a way to manage risks. This approach is supported by the common request for increased collaborative working as a facilitator for improved performance (Xue *et al.*, 2010). Multi-organizations provide opportunities to flexibly mobilize resources to accomplish complex and unique tasks (Söderlund *et al.*, 2008), engage in creativity, innovation (Swan, 2002) and knowledge creation (Sydow *et al.*, 2004), and utilize collaborative working structures and collective expertise to optimize project and mutual learning (Fong, 2005; Bakker *et al.*, 2010).

The context of this study, CM project, is a delivery method in which a professional, consultant-like construction manager leads the project in close collaboration with the owner (Kiiras *et al.*, 2002). The three main variants of CM contracts, CM service, CM contracting (CM@Risk) and CM consultancy, involve a slightly different division of contractual responsibilities and reward sharing. The arrangements of contractual and non-contractual project relationships in the CM service delivery are illustrated in Figure 1.

CM projects are more organizationally complex and more susceptible to risks related to financial, commercial, scheduling, quality and safety goals than traditional Design-Bid-Build projects. Special risk sources in CM projects stem from incomplete designs when contracts are made, splitting the construction work into several (sometimes numbering in the hundreds) trade contracts as well as concurrent implementation of design,

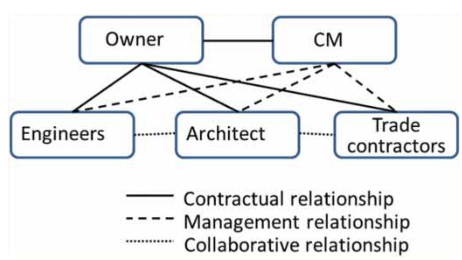

Figure 1 Contractual and non-contractual relationships in a CM project multi-organization (CM service)

procurement and construction work (Keinänen, 2009), which increases the need for collaboration and coordination between participant organizations. Furthermore, the project owner continues to be the decision-making authority concerning design changes, trade contracts and price-quality decisions throughout the project. The delivery method aims to lengthen design times, shorten overall delivery times and improve construction performance by unifying the goals of the involved parties. Target pricing with sanctions and bonuses are common between the owner and the CM.

The importance of coordination and collaboration between both contractual and non-contractual partners in CM projects requires complementing traditional PM approaches by bridging the gaps between contractual borders with advanced multi-organizational management structures. The procurement-based, collaboration-intensive and risk-bearing features of CM supported adopting previously unexploited RM processes in the case project.

Towards complexity-based project RM

Project risk is defined as the 'effect of uncertainty on objectives', and project RM is defined as the 'coordinated activities to direct and control an organization with regard to risk' (International Organization for Standardization ISO, 2009). Project RM applications are based on standards, such as the PMBOK practice standards for project RM (Project Management Institute, 2009) and the APM body of knowledge (Association for Project Management, 2006). The traditional, structured and systematic RM frameworks have become common in construction projects. The process involves RM planning, risk identification, qualitative risk analysis, quantitative risk analysis, response planning, and monitoring and controlling risks (Project Management Institute, 2009).

However, two features of contemporary project environments make the paradigm of proactive systematic RM inadequate. First, the complexity and dynamism of construction organizations, processes and environments make it impossible, or at least extremely impractical, to forecast and arrange a response for every imaginable risk at the beginning of the project. The frequent emergence of unanticipated risks requires adaptable and flexible organizational structures and management responsibilities. RM is not only a process or methodology but is also connected to the organization's preparedness of responding to risks as they arise (Bannerman, 2008). Second, the increasing importance of inter-organizational collaborations challenges RM processes to stretch beyond traditional discipline-specific organizational boundaries. For instance, optimal RM in CM projects requires the sharing of information between the owner, architect, designers and contractors throughout the project delivery life cycle. RM frameworks can be founded collaboratively and through team work to support information sharing and response coordination (Rahman and Kumaraswamy, 2005).

A paradigmatic change from deterministic to complex systems approaches would fit the dynamic environments and organizational structures of contemporary construction projects as both a research and management approach (Cicmil and Hodgson, 2006; Cooke-Davies *et al.*, 2007; Bredillet, 2010). The implication of complexity theory for PM practice relates to the variability of project goals and success criteria, unpredictability of future events and complex multi-organizational interaction (Cicmil *et al.*, 2009). In the case of RM, these features are visible, for example, as the emergence of unpredictable risks, and the challenges of mobilizing the identification and response within the multi-organizational team. The complexity approach suggests responding to challenges with dynamic, wide-perspective structures and techniques (Cicmil and Marshall, 2005; Shenhar and Dvir, 2007), integrating the system components to work effectively (Walker, 2007), and managing by coordination, communication and control (Baccarini, 1996; Walker, 2007). In the context of RM, communicative and trustful links among the members of the multi-organization are required (Pryke and Smyth, 2006; Lehtiranta, 2011). Cicmil *et al.* (2009) suggest socializing rather than delegating project control.

Some RM processes are explicitly prescribed to multi-organizational contexts and reflect the complexity approach. They are typically related to projects in which the delivery methods include specific requirements and incentives for collaborative RM (Osipova and Eriksson, 2011). For example, partnership- and alliance-related RM concepts (Bresnen and Marshall, 2000; Chan *et al.*, 2004) aim to direct focus from risk allocation (i.e. procurement) to integration, i.e. shared concern for risks. Some processes, however, are mainly independent from the delivery method. Lichtenberg (2000) recommends involving a multidisciplinary team in risk identification, analysis and response, and Rahman and Kumaraswamy (2005) propose joint RM to be founded in collaboration and as a team to support information sharing and response coordination.

Methodology

The constructive approach

Constructive research is a type of empirical field research that aims to produce new knowledge as a normative application (Kasanen *et al.*, 1993; Lukka, 2000). The constructive research problem must have practical relevance, the problem must be connected to theory, the solution must be practically functional and the solution must make a theoretical contribution (Kasanen *et al.*, 1993). The result of constructive research is scientifically justified processes, practices, tools, organizations and among others, which aim to solve real-world problems and make a theoretical contribution (Lukka, 2000). Oyegoke's (2011) suggestion of a specialist task organization procurement approach and Alsakini's (2012) design of models to manage the virtualization of construction firms are examples of result-oriented operations research with a constructive approach. The constructive research process involves (1) selecting a practical research problem, (2) conducting a pre-study, (3) generating one or more solutions to the problem (i.e. constructs), (4) testing the constructs in a case study, (5) making practical conclusions and (6) making theoretical conclusions (Kasanen *et al.*, 1993).

Constructive research is distinct from action research in two main ways. First, constructive research always focuses on the construct as an outcome, whereas action research may have other goals. Second, the researchers' interaction with practice and practitioners is common in constructive research but obligatory in action research.

Constructive research problems can generally be based on anecdotal evidence, practical experience or theoretical work (Oyegoke, 2011). Herein, the choice of the research problem is practice-based; the need to improve collaborative RM is commonly encountered in the Finnish construction sector. Literature sources have contributed by adding structure and defining the problems.

The pre-study, which is usually based on the literature, should provide the researcher with a thorough understanding of the research problem and its context (Oyegoke, 2011). The experience of the researcher and participants will have an influence on their understanding of the problem and the context. Herein, understanding of the problem and context was acquired through a comprehensive review of international RM literature, with a specific focus on collaborative solutions.

The innovation phase is creative and heuristic by nature but it needs to be firmly grounded on the actual problem and the knowledge gathered through the pre-understanding phase (Lukka, 2000). In this case, the constructs result from the suggestions of researchers based on the pre-understanding phase, the target project's specific needs and the preferences and amendments of the project organization's key individuals in the application phase. In this manner, the innovation process becomes an iterative consultation between the researcher and the practitioners to ensure the constructs' practical suitability. All the constructs seek to address issues related to sharing and developing RM knowledge and committing participants to coordinated responses.

The practical conclusions about the constructs are based on pre-set hypotheses, which serve as a basis to anticipate and evaluate the functionality of the constructs in the case project. The theoretical conclusions about the constructs reflect on their ability to demonstrate aspects of the complexity approach to collaborative RM.

Validity and evidence in constructive research

A distinction should be made between the validity of constructive research and the validity of the construct, both of which feature in constructive science. Construct validity is commonly connected to the functionality of the construct, i.e. its ability to solve the organizational problem that it was designed for (Lukka, 2000; Oyegoke, 2011). A pilot case study is the preferred method to test and improve a construct, and commonly accepted research methods such as conducting interviews can be used to gather quantitative evidence, qualitative evidence or both (Oyegoke, 2011).

In pragmatic research, practitioners can be trusted to give (subjective) first-hand experience on how they perceive the functionality of the constructs. Whereas a single-case setting can been seen as providing limited contextual evidence, the richness of data is increased by involving multiple participants who represent several disciplines and have prominent experience on previous projects.

However, it is not within the scope of a case study to make conclusions on particular causal relationships or provide widely generalizable results. In the case of project RM, construct validity cannot be demonstrated objectively because the number of identified risks is not directly related to either the riskiness of the project or the functionality of RM. In fact, RM's success should be measured by the *lack of* risks that have negatively influenced project goals. However, the goal of RM is project success and the level of project goal achievement can be quantified in terms of budget, schedule, quality and, decisively, client satisfaction. Project success can, therefore, be used to refute a null hypothesis stating that the RM process does not work.

The constructive piece of research as a whole can be validated if, and only if, (a) the construction exists and (b) variations in the functionality of the construction causally produce variations in the testing outcomes (Pekuri, 2013 following Borsboom *et al.*, 2004). Projects are unavoidably one-off endeavours where parallel tests or detached causal relationships are not feasible.

However, the extremes of possible causal relationships can be outlined. In the negative extreme of outcome variations, the constructs would have no positive effect on, or would influence negatively, the goals of project RM, which connects to the constructs' null hypothesis. The positive extreme is a situation where all emerged risks are efficiently managed with the help of the constructs. The researcher's task is to evaluate the position between these extremes.

Case study and data

The case study was set in a shopping centre construction project that was delivered as CM service. The scope of the project involves a 60 000 m^2 building and a construction time of 23 months (11/2010–9/2012). The project was successful in terms of schedule, budget, quality and client satisfaction. The project owner was a large, professional, private and stock-listed retail sector company. The CM service provider was selected based on the key individual's experience and demonstrated potential for the project. The CM's only contractual relationship was with the owner. All design and construction contracts were made between the owner and the vendors, in keeping with traditional Design-Bid-Build contracts. The CM was responsible for tender processes and site management. Neither the owner nor the CM service provider was familiar with the CM service delivery method. All applied constructs were new in the current form for all participating companies, including the owner and the CM.

The researcher was involved as a change agent in developing the three RM processes. This task included creating the project RM plan in collaboration with the PM team, observing the workshop related to construct 1 (RM workshop), giving an informative session about the principles of construct 2 (contractor integration) and collecting the feedback and running the workshop related to construct 3 (performance feedback). Other observations are based on 20 formal theme interviews, informal discussions on construction site and meetings, participant observation, performance feedback analysis and project document development and reviews between November 2010 and October 2012. The interviewees were selected to thoroughly reflect the key participants in large construction projects. The participants include four owner representatives, seven CM representatives, two architects, four engineers, one sub-contractor and two user representatives. The participants have between 7 and 32 years of experience with construction projects. Sixteen of the theme interviews were conducted during the period of April to May 2011, and 4 were conducted in October 2012. Other discussions and observations were scattered throughout the project.

In the early stages of the research project, the interviews aimed to identify focal development needs in the project organization performance, especially in the applied RM processes. Towards the end of the project, the interviews and discussions were focused on evaluating the constructs and future development needs for multi-organizational RM. In practice, the interview structure was tailored to suit each occasion, based on the interviewee's role and the researcher's prior knowledge about the project. The majority of the interviews (16) were tape-recorded and transcribed. The remainder of the interviews, discussions and observations were captured by research notes.

Results

Construct 1: risk workshop

Establishing construct 1

Generally, the crucial challenges related to RM can be pinpointed as residing within risk identification and risk response. Risk identification is positioned as a precondition for risk analysis (Flanagan and Norman, 1993) but the identification methodology is not often elaborated in research. In a multi-organizational context, the dynamic network structure over which the RM knowledge and expertise are spread challenges the utilization of the collective knowledge base in construction projects. Furthermore, early project phases are stressed by a lack of common understanding of the goals and special features of the project and an unfamiliarity with project RM goals and processes.

Complexity thinking recommends focusing on the building of participant interaction and 'socializing', rather than delegating risk awareness and responsibility (Cicmil *et al*., 2009). This observation stresses the importance of connecting shared goals and motivations with the attempts to utilize collective expertise for RM. Effective risk identification and response planning rely on human experience and expertise (Forbes *et al*., 2008). Group methods, such as brainstorming (Chapman and Ward, 2003) and focus groups (Puchta and Potter, 2004) can be used to gather information from deliberately selected participants (Krueger and Casey, 2009). As a project RM tool, the focus group approach allows for the involvement of a multidisciplinary group of experts for project-specific risk identification. It, therefore, responds to the needs of a changing environment in which predetermined check-lists are inadequate.

Consequently, construct 1 is a focus group application for project-specific risk identification and response planning, further referred to as the risk workshop. This research project followed the risk workshop application that was called in by the project owner around the time the construction works began (November 2010). An effective time for the risk workshop is during the early phases of the project, when the key project participants are selected but works have not begun. Depending on the project, it may be useful to have one workshop in the beginning of the project and another or several others when more key participants have been selected.

The aims of the risk workshop were to share information on the project's focal success factors and special management processes and to increase the levels of risk knowledge, communication, motivation and opportunity. The workshop was thereby meant to trigger thoughtful, risk-based project planning. Approximately 50 people from 7 organizations representing the owner, the CM, the designers, the tenant agent and the researchers participated. The role of the moderator, which is stressed by Krueger and Casey (2009), was shared by the owner, who presented the project's goals and main concerns, and 'an outsider', i.e. a researcher, who explained the threats and opportunities inherent to the CM delivery method. Furthermore, the workshop aimed to ensure that all key participants know their roles in the project and its RM process.

The risk identification and preliminary response planning were conducted in three predetermined sub-groups focusing on PM, design and procurement and production. Krueger and Casey (2009) recommend a manageable size of a maximum of 12 participants per group. Each sub-group included participants from most of the participating organizations and the individuals for each sub-group were selected based on the expected relevance of the theme. The discussions were moderated by sub-group leaders according to a questioning procedure that was briefly explained to them. The sub-group leaders collected the results, i.e. lists of identified risks and their respective responses, and presented them in a collective wrap-up session.

Testing construct 1

The expectations set for construct 1, and the means for collecting evidence on its functionality and development needs are summarized in Table 1.

Hypothesis 1 suggests that the workshop increases the participants' understanding of the project and its risks. The evidence supporting this hypothesis is based on the opinions of 16 participants (4 owner representatives, 4 CM representatives, 6 designers and 2 user representatives). The project goals, PM structure and specific risks from the owner's perspective were explained as the introduction of the risk workshop. During the group work, the participants shared experiences about similar projects (despite not being explicitly asked to do so) and opinions on the central concerns of the present project. Because all projects and project environments are different, it was essential to rely on case-based brainstorming instead of check-lists. The workshop was deemed to be 'useful practice to prepare for a long project in a turbulent environment' (Architect).

Table 1 Construct 1 hypotheses and bases for conclusions

Construct 1 risk workshop		
Hypotheses	Rival theory	Basis for construct validation and improvement
H1. Risk workshop increases participants' understanding of the project and its risks	H0. Does not result in successful RM	Project success in terms of budget, schedule, quality, and client satisfaction
H2. Risk workshop facilitates the mobilization of collective expertise to identify risks in multi-organizational teams		Researcher observations
H3. Risk workshop initiates collaborative RM		16 expert opinions on functionality and development needs

The participants are used to project kick-off workshops that are not focused on risks but agreed about the significance of the added focus on RM. 'It is useful to share risk knowledge and it's good to know that someone [owner and CM] pays attention to it' (Commercial consultant). Most of the pilot workshop participants felt that the increased risk awareness improved their understanding of and commitment to the project and enhanced its chances of success. 'The risk communication helps everyone understand how their work is related to the entity and helps to clarify the limitations in the work performance of others' (Owner). Furthermore, the workshop increased the participants' understanding of their own roles in the project, thus supporting efficiency and motivation. 'My role in a larger whole became clearer' (Architect). 'Knowing the whole picture and your role in it is motivating' (Commercial consultant).

Most participants (14 out of 16) supported hypothesis 1 and felt that the workshop increased their understanding of the project and its risks. However, two engineers reported negative opinions on the resources spent on the workshop. 'There was no real usefulness. Mostly we were talking about commercial risks, which have little to do with structural design. Everything important (from our perspective) was already taken care of' (Structural engineer). The lack of a proper summary report was a concern to some parties because a report was only compiled for the use of the management group. 'We did not get feedback after the workshop, which would have been useful' (Commercial consultants). The selection of the invited group must ensure that everyone benefits from participating. To ensure the usefulness of the results, a summary needs to be delivered to the participants shortly after the workshop.

Hypothesis 2 proposes that the workshop facilitates the mobilization of collective expertise to identify risks in multi-organizational teams. The evidence supporting this hypothesis is based on the participants' opinions and researcher's observation. Furthermore, project success can be considered as evidence of successfully identified and managed risks, i.e. refuting the null hypothesis.

Hypothesis 2 was supported by the productive risk identification session in multi-organizational teams. As a result of the workshop, a list of approximately 200 risks was compiled. This was the first initiative for the systematic gathering, analysing, and sharing of risk data in the case project. The extensive list was later usefully categorized and prioritized. The teams intuitively added their assessments of risk severity and suggestions for risk response based on past experiences even though only identification was requested. This implies that the steps of a systematic RM process are inextricably interconnected in the brainstorming process. In contrast, the different sides of risk, i.e. threat and opportunity, were not addressed in a balanced manner, although they were introduced as the basis of RM. Practitioners only focused on threats.

The 90-minute duration was somewhat brief for the task because of rich discussions. Multi-organizational teams were found to generate perspectives that may otherwise have been neglected. 'The extensive discussion of financial and commercial risks was an eye-opener for many designers/architects' (Architect).

Hypothesis 3 argues that the workshop initiates collaborative RM. This means that the key participants would know and commit to their roles and activities in the project RM process. The evidence is based on researcher's observation, three CM representatives and two owner representative reports on the continuity of the collaborative RM process. Furthermore, project success can be considered as evidence of successfully managed risks, i.e. refuting the null hypothesis.

The risk identification workshop engaged parties who had previously not played a role in RM, such as most designers. The RM goals, processes and roles were explained in the workshop to the extent that they were available. A risk log database was established as a result of the workshop, which was the first step towards systematic RM. 'We have started to use this risk log and the most important risks are reported to the management group' (CM). This database later formed the core of RM knowledge sharing, and the updating of the risk information was integrated into customary meeting processes. The CM was responsible for collecting risk information from the participants, updating the risk log, and reporting significant changes to the owner. This practice was introduced in the workshop and generally well-received because it was not perceived to cause much extra work. Therefore, the workshop could be regarded as a useful initiator of the collaborative RM process, as stated by hypothesis 3.

However, two features were found to hinder the efficiency of initiating the collaborative RM process. First, the project RM process was not fully established at the time of the workshop, which hindered the influence of engaging participants in the process. Second, parties other than the project consultant were not required to contribute in updating the risk database throughout the project. 'They [the CM] have a risk log in place but it does not yet function completely from our perspective' (Owner). In the future, the project RM process needs to be more clearly introduced to the project team both in the risk workshop and on paper. Some participants considered a series of similar workshops useful to share risk information regarding several stages of the project. The process for involving a multi-organizational team of key participants in contributing to the risk log updates needs to be clarified and the updates need to become more frequent (e.g. monthly).

Construct 2: contractor risk integration

Establishing construct 2

Because the case project delivery was based on hiring dozens of contractors working together on the construction site, there was a need to efficiently introduce and secure the commitment of each new contractor to the project RM process.

The procurement phase, with its tendering requirements and contract scopes, sets the foundation for collaborative working in the multi-organization in general and for the collaborative RM processes in particular. Traditionally, research has focused on risk allocation, which is mainly based on the choice of project delivery method and the structuring of contract clauses. However, the selection of an appropriate contracting method and the scope of contracts are not sufficient to ensure a collaborative approach to RM (Rahman and Kumaraswamy, 2002). Although the allocation of risks is inarguably a significant determinant of RM success, focusing on it leads to the dominance of single-organizational management strategies. Complexity-based approaches favour socialized control over delegation (Cicmil *et al.*, 2009).

Construct 2 has been designed to respond to the common concern of contractor performance and involvement in the owner's RM process during the project. The construct involves a procurement and project planning process that integrates contractors into the project RM process. The purpose of the construct is to trigger the risk awareness and self-management of contractors by sharing project-specific risk information in the procurement phase and by asking the contractors to develop contract-specific risk identification and response planning documents.

The suggested method is rooted in the Performance Information Procurement System (PIPS), which is a process for best-value procurement and project RM. The PIPS process includes identifying the best-value vendor for a specific project and directing quality control from the project manager to the contractor (Kashiwagi, 2010). This is done by including risk identification and response planning as one of the decisive criteria for contractor selection. The process then requires the contractors to report risk information and their consequent project planning on a weekly basis. The method aims to minimize the need for the supervision of the project owner or consultant.

In this study, the scope of the construct was scaled down from the original suggestion, according to the wishes of the CM staff. The procurement team was not willing to apply RM understanding as a basis for contractor selection in their first pilot project. Therefore, a streamlined version of the PIPS, called 'contractor risk integration', was adapted to the case project. The process aims to involve contractors in the project RM process by making risk identification and response planning a required part of weekly meetings and project planning. It was applied to all key contractors (approximately 20), from the beginning of construction works in March 2011 until project completion in October 2012.

Testing construct 2

The expectations set for construct 2 and the means for collecting evidence on its functionality and development needs are summarized in Table 2.

Table 2 Construct 2 hypotheses and bases for conclusions

Construct 2 contractor integration		
Hypotheses	Rival theory	Basis for construct validation and improvement
H4. Contractor integration improves trade contractors' understanding of project characteristics and risks	H0. Does not result in successful RM	Project success in terms of budget, schedule, quality, and client satisfaction
H5. Contractor integration promotes trade contractors' risk responsibility and risk communication		Researcher observations
		Eight participant opinions on functionality and development needs

Hypothesis 4 suggests that contractor integration improves trade contractors' understanding of project characteristics and risks. The evidence supporting this hypothesis is based on the self-reporting of two trade contractors and six management staff opinions (five CM and one owner representative). Project success can be considered further evidence of the construct's success (i.e. not failing): the trade contractors had a role in the project RM process, and they performed according to the project goals.

The construct was better received by the contractors than the CM staff had expected. 'The practice has been surprisingly successful: the contractors have taken it on without problem and the issues have been better thought out' (CM). Both contractors and the CM generally found talking about project risks when initiating the contract to be beneficial. 'We have gained well-thought-out risk lists from the contractors in contract negotiations' (CM). 'It is a useful practice to go through the risks related to the scope of the project at the beginning of the project' (Trade contractor). Based on participant opinion, construct 2 was found to fulfil the expectations set in hypothesis 4.

After experiencing the implementation of the limited version of the construct, the owner and CM were open to considering the full scope, including utilizing RM plans as contractor selection criterion. 'A short risk assessment as a part of tender would be a fair way of improving risk awareness' (Owner). It was likely that the benefits expected from construct 3 would be maximized if the contractor who understood the project and its risks best was the contractor selected to do the job.

Hypothesis 5 holds that contractor integration promotes trade contractors' responsibility and communication of risks. The evidence supporting this hypothesis is based on minutes of site and contractor meetings, as well as the evaluations of the five CM staff members and one owner representative regarding contractor risk communication. The implementation of the construct included incorporating risk assessment at the beginning of the contract and frequent risk items on the agenda in site meetings and contractor meetings. Thus, project risks were now explicitly managed from the contractors' perspective, which was an improvement over the previous practices. 'Everyone is the best expert in their field and is the best person to identify the relevant risks' (Trade contractor). However, many of the same issues had been handled before under different labels. The main advantage of the construct was that risk communication was now systematically dealt with and recorded in writing during every site and contractor meeting.

However, risk communication resulted in additional benefits. The case project contractors reported being in a better position to handle their work due to the communication of risk. They felt that they could trust the help of the CM facilitating their work when necessary. The process promoted collaborative responses to identified risks. 'Risk management process has enabled all (on-site) participants to keep on track of issues and to be committed to solving them' (Trade contractor). 'We now think more about if there is something we can together do to respond to the risks' (CM).

The contractor integration process was also found to need further improvement to take full advantage of the increased communication. The process requires experience, as well as educating the contractors during the tender phase. For example, in the case project, the contractors' view on risks was limited to their own work performance and the legal requirements. From the owners' perspective, a wider focus would be desirable. 'Not all risks have come up despite the practice' (CM). Better guidance on the contractors' risk lists would be useful. 'Now they are focused on safety, but a wider focus on financial, scheduling, and quality risks should be encouraged' (CM).

Construct 3: performance feedback

Establishing construct 3

A third process was required to focus on risks related to quality and performance. Traditionally, quality and performance information is tracked through supervision, and poor performance or construction and design errors are discovered mostly post-fact. In the pilot project, a more proactive method for observing and managing quality and performance risks was sought.

Project complexity refers to, among other things, the multitude of project success perspectives depending on the premises of the participants (Cicmil *et al.*, 2009). The approach to utilizing, instead of avoiding, complexity leads to the favouring of information that can be gathered within the collaborative working interface. The approach is supported by the finding that participants' satisfaction with the performance of others has been shown to reflect project success (Lehtiranta *et al.*, 2012). Because success management is analogous to RM, the finding implies that an important dimension of collaborative RM is to measure and react to participant feedback on collaborative working and the performance of others. Utilizing feedback as a component of RM is based on the ideologies of treating performance measurement as RM (Kashiwagi, 2010) and acknowledging multi-directional performance evaluations as accounts of project success (Lehtiranta *et al.*, 2012).

Construct 3 is a methodology for identifying strengths and weaknesses in collaborative interfaces by collecting and responding to multi-directional performance feedback from participants. The construct has two main purposes. First, it is meant to serve as a structured quality risk identification system that utilizes the project participants' observations. Second, it functions as a development (learning) system because the participants receive useful feedback on their own performance from the perspectives of others.

The multi-directionality of feedback means that various parties who work together provide feedback for each other despite contractual relationships. Similarly, they receive feedback from various directions. Multi-directionality is seen as an essential concept to understand project organizations because contractual networks and organizational charts are insufficient to capture actual interactions and work flow patterns (El-Sheikh and Pryke, 2010). Non-contractual relationships frequently outweigh contractual relationships in terms of interaction and connectedness of workflow during project execution. Thus, the participating companies will be able to provide more accurate evaluations of each other's actual performance during project execution than, for example, the owner.

The feedback construct was applied in two rounds: once when the construction works had been on-going for approximately 6 months (April to May 2011) and again at the end of the project (October 2012). The collection of feedback was based on a commercial performance feedback system called ProPal, which allows project participant companies to evaluate each other's operations on a scale from 1 to 5, where 1 is poor and 5 is excellent. The factors being evaluated are grouped into four general areas of project performance: PM, collaboration, staff and goal achievement. Bidirectional evaluations were carried out among the project owners, project consultants, main contractors and designers. In the first round, interviews were used to support the analysis of the strengths and weaknesses of collaborative interfaces. A workshop was held after the first round to disseminate the results and generate innovative development initiatives based on the findings. The results of the second round were delivered as a summary report for the participants.

Testing construct 3

The goals set for utilizing performance feedback and the means for collecting evidence on functionality and development needs are summarized in Table 3.

Hypothesis 6 suggests that multi-directional performance feedback facilitates the identification of strengths and weaknesses in multi-organizational project delivery. The first feedback round was carried out to capture an interim account of the satisfaction within the project delivery team while there was sufficient time for corrective measures. In the first round, 16 members of the project delivery team, representing the owner (4), CM (4), designers (6) and user representatives (2) participated in giving and receiving of feedback regarding each other's performance. After the first feedback round, the project participants received reports on their performance as evaluated by other participants, which enabled them to learn the strengths and weaknesses of their own performance. For example, the feedback identified that the majority of the CM's performance weaknesses were related to PM and the main architect's to goal achievement.

Table 3 Construct 3 hypotheses and bases for conclusions

Construct 3 multi-directional performance feedback		
Hypotheses	Rival theory	Basis for construct validation and improvement
H6. Multi-directional performance feedback facilitates the identification of strengths and weaknesses in multi-organizational project delivery	H0. Does not result in successful RM	Performance feedback including 36 participants
H7. Multi-directional performance feedback facilitates the innovation of process improvements during the project		Workshop report with identified performance strengths and weaknesses and performance improvement ideas
H8. Multi-directional performance feedback facilitates multi-organizational learning		Researcher observations on functionality and development needs

The second feedback round was conducted at project completion and provided information on the participants' overall satisfaction with the performance of others. For the second round, 27 members of the project delivery team, representing the owner (2), CM (3), designers (3) and contractors (20) participated in giving and receiving feedback regarding each other's performance. Every participating company received a copy of the feedback and a summary of the evaluation results was delivered to the owner and the CM. Several participants intended to include the evaluations as part of their lessons learned and use them to identify the strengths and weaknesses they could work with in future projects. Hypothesis 6 was, therefore, validated merely by the implementation of the feedback rounds with the intended scope and by delivering the results to the participants.

Hypothesis 7 proposes that multi-directional performance feedback facilitates the generation of innovative process improvements during the project. This was based on the notion that the lessons learned sessions alone do not adequately support the utilization of silent knowledge and learning. 'Lessons learned usually come too late. The learnings need to be captured and utilized during the project' (CM service provider). Findings related to the hypothesis are based on observing the results of the workshop that was arranged after the first feedback round. The workshop aimed to increase the opportunities related to learning and utilizing feedback for performance improvement. The researcher (author) initiated the workshop by identifying six common weaknesses from the performance feedback and interviews up to that point.

The observations on the workshop provided strong support for hypothesis 7. The workshop was well-received and resulted in constructive and concrete ideas for process improvements in response to the identified problems. For example, the project team decided to clarify each key role in their delivery organization in writing, create a clear process for schedule management and clarify the designers' role in the RM process. Furthermore, it was observed that the feedback round enabled knowledge sharing that may not otherwise have occurred. ‘I was surprised to hear that we still have this issue [ambiguity of design management process] in the project’ (Owner).

At the end of the project, the CM reported that approximately half of the process improvements that were created as a result of the workshop were implemented. For example, a new role, ‘RM coordinator’, was actualized and assigned to appropriate individuals in key participating organizations. Risks were taken as part of design management reporting and meetings. However, not all of the ideas had been implemented. This relates partly to limited resources and the rate of change in the organization. ‘We would have needed a designated person to remind us about the development issues’ (CM service provider). Furthermore, some ideas were based on longer term development needs and could only be addressed in future projects.

In conclusion, the process including performance feedback and the related innovation workshop can facilitate the generation of innovative process improvements during the project, but the organization must support and supervise the application of ideas. If a functional RM plan with related responsibilities and frequent supervision practices is in place, the ideas could be included as part of such a plan.

Hypothesis 8 suggests that multi-directional performance feedback facilitates multi-organizational learning. Learning and its applications can occur either during or after the project. Comparison of the performance feedback data from the first and second feedback rounds implies that performance improvement is related to the identified weaknesses during the project. For example, the CM’s aggregate performance score on PM-related factors rose from 3.1 on the first feedback round to 3.9 on the second. Similarly, the main architect’s PM score had risen from 3.5 to 4.1. The improvement may also relate to factors other than the feedback collection and workshop, such as the influence of overall satisfaction at the end of the project. This may cause more positive evaluations of participant performance or of participants’ general learning regarding integration of PM processes within the case project towards the end of the project. However, because participants were observed to make initiatives on performance improvement during and after the first performance feedback workshop and later reported having established a number of these initiatives, support exists for hypothesis 8 during the project.

The second feedback round provided more traditional data for lessons learned after the project. Evaluation summaries were delivered to the participant companies so they could learn about the strengths and weaknesses of their performance as perceived by other participants. A lesson-learned workshop would likely strengthen the influence of feedback. Such a workshop was held for the CM staff. However, conclusions on actual learning could only be made based on demonstrated application in subsequent projects, which is out of the scope of this study. Therefore, the pilot case confirms that utilizable data for post-project learning can be produced with performance feedback, but the processes for efficient utilization of such data are left for future research. Great development opportunities are embedded in future research and practical applications of performance feedback as interim reports and as lessons learned if the connection from feedback to development initiatives and practice is well-managed.

Discussion

Practical relevance

The results provide evidence that the suggested collaborative RM processes can be validated as applicable, useful and beneficial for bridging the gaps that have been identified within the scope of single-organization-focused RM standards and the needs of multi-organizational CM projects. These complementary processes are rarely explained in research and standard frameworks, which require that they be re-established inefficiently from project to project. Because multi-organizations are the default delivery structures in several industries, including construction, this advancement would be potentially significant.

The risk workshop was found to serve its purpose of addressing a wide variety of multi-organizational expert insights for collaborative risk identification and response planning. Further, the workshop construct has the potential to initiate collaborative RM more efficiently if participants are selected and more carefully briefed, and if the overall project RM process is explained clearly as a part of the workshop.

The contractor integration process was deemed to promote better risk awareness and communication in the applied limited form. To leverage the full potential of the construct, it could be further advanced in Finnish CM projects towards its origins in best-value procurement.

The multi-directional performance feedback was found to facilitate identification of the strengths and weaknesses of each participant’s performance and to discover innovating initiatives for performance improvement. In the future, the process could be better integrated with project delivery so that each key participant would be aware of feedback goals and is committed to the implementation of the resulting improvements.

The three constructs formed the core of the project RM framework. When project success is considered evidence of effective RM, the framework can be deemed to have fulfilled its purpose. However, in future projects, the constructs should be carefully applied as a part of a holistic, multi-organizational RM (and PM) process. Furthermore, constructs are always bound by space and time in which they are developed (Pekuri, 2013). Therefore, the construct (or their re-developed versions) will be deemed useful only until conditions change to the extent that they no longer function, or until a better solution is developed.

Theoretical connections

The study is grounded on and has implications for complexity theory. Practical responses to project complexity need to address the relational and communicative nature of project planning, control and organization (Cicmil *et al.*, 2009). However, these practical applications have yet to be thoroughly described in the literature.

The developed and analysed constructs aim to turn multi-organizational complexity into an advantage for risk identification, assessment and response, providing substantial added value for multi-organizational projects. The constructs are designed to respond to the complexity of construction project risks by systematically increasing the opportunity for risk communication, response innovation and flexibility in the sharing of risk responsibility. This approach also assists in adapting to high levels of uncertainty, including the consequent dynamic changes in project goals and emerging unanticipated risks.

A successful complexity-based approach requires integration on several levels between multi-organizational participants, organizational levels and management processes. The constructs provide useful examples of RM initiatives that reach beyond discipline-specific organizational boundaries and indicate a potential for integration between organizational levels and management processes.

For example, the risk workshop (construct 1) or, indeed a series of workshops as a future enhancement, provides a systematic method to share and gather dispersed risk knowledge in multi-disciplinary teams, which is often recommended but not explained in research. The contractor integration (construct 2) helps to leverage the complexity of multi-organizational collaborative interfaces by increasing risk communication and opportunities for case-by-case flexible approaches to emerging risks. The multi-directional performance feedback (construct 3) responds to the opportunity of utilizing multiple perspectives of project performance to the benefit of performance improvement and collaborative RM. As several of the new or strengthened links of risk communication are not based on contractual or supervisory relationships, the constructs can be seen as steps for addressing the informal organizational structures, which Walker (2007) and Lizarralde *et al.* (2011) stress as essential to match the needs of complex multi-organizations.

When the construction project is analysed as a complex, open system, potential for integration can be found within the system parts (Walker, 2007). For example, the analysis of the constructs has indicated that collaborative RM and inter-organizational learning and collaborative working are inter-related concepts and goals. In addition to advancing RM approaches, these methods were found to support learning and collaborative working itself.

Deficiencies and potential for improvement were found where integration of organizational or management structural elements were suboptimal. For example, the risk workshop could be more useful if all participating members had a vested and supported interest in its results. The contractor integration process could be more efficient if the owner of the CM had connected the elements on the requested risk analyses with the project overall goals. The performance feedback could lead to improved performance if all parties included this feedback as part of their long-term development agenda and if the benefits of implementing the performance improvement initiatives were known and shared throughout the project organization.

Based on complexity thinking, the efficiency of collaborative RM could be developed by improving the integration of the related management functions. For example, Osipova and Eriksson (2013) demonstrated that additional collaboration incentives beyond general contract conditions can be used to create opportunities for collaborative RM throughout the project.

Limitations, applicability and the need for further research

A limitation of this study is that the observations are based on a single project. The constructive research approach aims to compensate for the limited number of pilot studies with the accumulated experience of the participants and researchers. The participant opinions and researcher observations were generally consistent regarding the usefulness of the construct, except where mentioned relating to the usefulness of the risk workshop. However, a consecutive case study would be useful for attaining evidence on the improvements of the constructs.

The constructs were not tied to any particular procurement method. Similar problems that have been initiated in this study can be found within several organizations. Therefore, it is suggested that they may be applied to any large construction project where the participants wish to engage in collaborative RM. In this paper, the constructs have been described mostly as individual processes. A remaining and pressing challenge for temporary multi-organizations is to include RM as a continuous and parallel component of PM processes with an adequate multi-organizational scope. Advancing the single-organizational RM standards or frameworks for multi-organizational implementation would significantly lessen the effort required to apply project RM. Researchers and practitioners alike are encouraged to take advantage of the complexity approach to project RM and advance the standard frameworks towards the needs of interconnected multi-organizations.

The case project participants' openness to adopting new processes is likely above average, and thus the application of the constructs may encounter more resistance in average projects. The success of complexity-based PM approaches depends on the extent to which they are understood as integrative and communicative processes throughout the organization. Oyegoke (2011) explains that complex organizational processes interfere with the implementation of constructs and should be carefully planned for. Furthermore, knowledge, skills and competences that reflect rigid rather than complexity-based PM are significant restrictions to development (Cicmil *et al.*, 2009). Finally, complexity researchers stress that managers should take the advice provided with care, by 'fine-tuning and developing their own "complexity" based approach which resonates with their own values, experience, and understanding of their local organizational environment' (Cicmil *et al.*, 2009).

Conclusions

In multi-organizational contexts, no individual party can solely execute effective RM and collaborative working should be utilized as a means for RM. A constructive approach was applied to establish and evaluate three collaborative RM processes in a complex construction project. Construct 1 was a risk workshop, construct 2 consisted of contractor integration into project RM and construct 3 consisted of a multi-directional performance feedback system.

The constructs were found applicable, functional and further open for improvement. They enable the project's multi-organizational participants to identify, assess and respond to both expected and emerging threats and opportunities during the project life cycle. They make a contribution to CM project practice as useful processes that integrate the RM activities and expertise of several multi-organizational participants, which is not addressed in standard RM frameworks. The constructs also represent rarely explicated, practical applications of the complexity approach to PM theory. Within the premises of the complexity approach, the constructs systematically increase the integration of project participant organizations' RM processes, opportunity for risk communication, response innovation and flexible sharing of risk responsibility.

As a recommendation, standards and general RM frameworks should be complemented by adaptable processes that address multi-organizational complexity, especially in terms of interaction, learning and collaborative working. The complexity approach is suggested as a suitable basis for further research and practical developments regarding collaborative RM.

References

Alsakini, W. (2012) Two models for managing the virtualisation of construction management firms in the context of Finnish construction markets, Aalto University doctoral dissertation 108/2012, School of engineering, Department of civil and structural engineering, Espoo, Finland.

Association for Project Management (2006) *APM Body of Knowledge*, 5th edn. Association for Project Management, UK.

Baccarini, D. (1996) The concept of complexity – a review. *International Journal of Project Management*, **14**(4), 201–4.

Bakker, R.M., Cambre, B., Korlaar, L. and Raab, J. (2010) Managing the project learning paradox: a set-theoretic approach toward project knowledge transfer. *International Journal of Project Management*, **29**(5), 494–503.

Bannerman, P.L. (2008) Risk and risk management in software projects: a reassessment. *Journal of Systems and Software*, **81**(12), 2118–33.

Borsboom, D., Mellenbergh, G.J. and van Heerden, J. (2004) The concept of validity. *Psychological Review*, **11**(4), 1061–71.

Bredillet, C.N. (2010) Blowing hot and cold on project management. *Project Management Journal*, **41**(3), 4–20.

Bresnen, M. and Marshall, N. (2000) Motivation, commitment and the use of incentives in partnerships and alliances. *Construction Management & Economics*, **18**(5), 587–98.

Chan, A.P.C., Chan, D.W.M., Chiang, Y.H., Tang, B.S., Chan, E.H.W. and Ho, K.S.K. (2004) Exploring critical success factors for partnering in construction projects. *Journal of Construction Engineering & Management*, **130**(2), 188–98.

Chapman, C.B. and Ward, S. (2003) *Project Risk Management: Processes, Techniques, and Insights*, Wiley, Chippenham, Wiltshire.

Cherns, A.B. and Bryant, D.T. (1984) Studying the client's role in construction management. *Construction Management & Economics*, **2**(2), 177–84.

Cicmil, S. and Hodgson, D. (2006) New possibilities for project management theory: a critical engagement. *Project Management Journal*, **37**(3), 111–22.

Cicmil, S. and Marshall, D. (2005) Insights into collaboration at the project level: complexity, social interaction and procurement mechanisms. *Building Research & Information*, **33**(6), 523–35.

Cicmil, S., Cooke-Davies, T., Crawford, L. and Richardson, K. (2009) *Exploring the Complexity of Projects: Implications of Complexity Theory for Project Management Practice*, Project Management Institute, Newton Square, PA.

Cooke-Davies, T., Cicmil, S., Crawford, L. and Richardson, K. (2007) We're not in Kansas anymore, Toto: mapping the strange landscape of complexity theory, and its relationship to project management. *Project Management Journal*, **38** (2), 50–61.

El-Sheikh, A. and Pryke, S.D. (2010) Network gaps and project success. *Construction Management and Economics*, **28**(12), 1205–17.

Flanagan, R. and Norman, G. (1993) *Risk Management and Construction*, Wiley-Blackwell, Somerset.

Fong, P.S.W. (2005) Aspects of learning and knowledge in construction projects, in *Proceedings of the Construction Research Congress 2005: Broadening Perspectives,* San Diego, CA, 5–7 April 2005, pp. 431–40.

Forbes, D., Smith, S. and Horner, M. (2008) Tools for selecting appropriate risk management techniques in the built environment. *Construction Management & Economics*, **26** (11), 1241–50.

Hertogh, M. and Westerveld, E. (2010) Playing with complexity: management and organization of large infrastructure projects, Doctoral dissertation, Erasmus University Rotterdam. Thieme Amsterdam BV, Amsterdam, The Netherlands.

International Organization for Standardization ISO (2009) *ISO 31000:2009 - Risk Management: Principles and Guidelines. 2009*, International Organization for Standardization ISO, Geneva, Switzerland.

Janowicz-Panjaitan, M., Bakker, R. and Kenis, P. (2009) Research on temporary organizations: the state of the art and distinct approaches toward "temporariness", in Kenis, P., Janowicz-Panjaitan, M. and Cambre, B. (eds.) *Temporary Organizations: Prevalence, Logic and Effectiveness*, Edward Elgar, Cheltenham, pp. 56–85.

Kasanen, E., Lukka, K. and Siitonen, A. (1993) The constructive approach in management accounting research. *Journal of Management Accounting Research*, **5**(Fall), 241–64.

Kashiwagi, D. (2010) *A Revolutionary Approach to Project Management and Risk Minimization*, Kashiwagi Solution Model, Tempe, AZ.

Keinänen, J. (2009) Improvement of conflict resolutions in construction industry, doctoral dissertation, Helsinki University of Technology, Construction Economics and Management, Espoo, Finland.

Kenis, P., Janowicz-Panjaitan, M. and Cambre, B. (eds.) (2009) Conclusions: toward an integrated view of temporary organizations: future research agenda and managerial implications, *Temporary Organizations: Prevalence, Logic and Effectiveness*, Edward Elgar, Cheltenham, pp. 259–76.

Kiiras, J., Stenroos, V. and Oyekoge, A. (2002) *Construction Management Contract Forms in Finland,* Report 47, 2002, Helsinki University of Technology, Construction Economics and Management, Espoo, Finland.

Krueger, R.A. and Casey, M.A. (2009) *Focus Groups: A Practical Guide for Applied Research*, 4th edn. Sage Publications, Thousand Oaks, CA.

Lehtiranta, L. (2011) Relational risk management in construction projects: modeling the complexity. *Leadership & Management in Engineering*, **11**(2), 141–54.

Lehtiranta, L., Kärnä, S., Junnonen, J.-M. and Julin, P. (2012) The role of multi-firm satisfaction in construction project success. *Construction Management and Economics*, **30**(5–6), 463–75.

Lichtenberg, S. (2000) *Proactive Management of Uncertainty Using the Successive Principle: A Practical Way to Manage Opportunities and Risks*, Polyteknisk Press, Copenhagen, Denmark.

Lizarralde, G., Blois, M.D. and Latunova, I. (2011) Structuring of temporary multi-organizations: contingency theory in the building sector. *Project Management Journal*, **42**(4), 19–36.

Lukka, K. (2000) The key issues of applying the constructive approach to field research, in Reponen, T. (ed.) *Management Expertise for the New Millennium*, Publications of the Turku School of Economics and Business Administration. A-1, Turku, Finland.

Osipova, E. and Eriksson, P.E. (2011) How procurement options influence risk management in construction projects. *Construction Management and Economics*, **29**(11), 1149–58.

Osipova, E. and Eriksson, P.E. (2013) Balancing control and flexibility in joint risk management: lessons learned from two construction projects. *International Journal of Project Management*, **31**(3), 391–9.

Oyegoke, A. (2011) The constructive research approach in project management research. *International Journal of Managing Projects in Business*, **4**(4), 573–95.

Pekuri, L. (2013) Perspectives on constructive research approach – in search of the basis for validation, Master's thesis, Oulu Business School, University of Oulu, Finland.

Project Management Institute (2009) *Practice Standard for Project Risk Management*, Project Management Institute, Newton Square, PA.

Pryke, S. and Smyth, H. (eds.) (2006) Scoping a relationship approach to the management of complex projects in theory and practice, *The Management of Complex Projects – A Relationship Approach*, Blackwell Publishing, Oxford, pp. 21–45.

Puchta, C. and Potter, J. (2004) *Focus Group Practice*, Sage, London.

Rahman, M.M. and Kumaraswamy, M.M. (2002) Joint risk management through transactionally efficient relational contracting. *Construction Management and Economics*, **20** (1), 45–54.

Rahman, M.M. and Kumaraswamy, M.M. (2005) Assembling integrated project teams for joint risk management. *Construction Management & Economics*, **23**(4), 365–75.

Shenhar, A. and Dvir, D. (2007) *Reinventing Project Management: The Diamond Approach to Successful Growth and Innovation*, Harvard Business Press, Boston, MA.

Söderlund, J., Vaagaasar, A.L. and Andersen, E.S. (2008) Relating, reflecting and routinizing: developing project competence in cooperation with others. *International Journal of Project Management*, **26**(5), 517–26.

Swan, J. (2002) The construction of "communities of practice" in the management of innovation. *Management Learning*, **33**(4), 477–96.

Sydow, J., Lindkvist, L. and DeFillippi, R. (2004) Project-based organizations, embeddedness and repositories of knowledge: editorial. *Organization Studies*, **25**(9), 1475–89.

Walker, A. (2007) *Project Management in Construction*, 5th edn. Blackwell Publishing, Oxford.

Xue, X., Shen, Q. and Ren, Z. (2010) Critical review of collaborative working in construction projects: Business environment and human behaviors. *Journal of Management in Engineering*, **26**(4), 196–208.