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Assessing key dimensions to effective innovation implementation in interorganizational project teams: an Integrated Project Delivery case

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This research examines the architecture, engineering and construction (AEC) industry's use of the contractually followed Integrated Project Delivery (IPD) format as an administrative innovation to reduce inefficiencies and fragmentation in ventures involving multiple agents and contractors. A promising integrative theoretical framework, developed by Klein and Sorra [The challenge of innovation implementation. Academy of Management Review, 21, 1055–80], emphasizes two constructs in the successful implementation of innovative organizational processes: climate and value-fit. This paper presents an IPD case study via the lens of Klein and Sorra's model to: test the model's fit to interorganizational AEC project teams; bring insights to effective implementation of IPD as an innovation; and expand our understanding of administrative innovations' implementation. The case study provided a unique opportunity to this research as five months into the project, the owner decided to give up IPD and revert to a more familiar project delivery method (i.e. construction management at risk). Using mixed methods, the researchers report e-mail correspondence, kick-off meeting observations, project team meeting minutes and interview data from the three months between conceptual design and design development phases. Data were analysed qualitatively and via social-network analysis to identify individual behaviours and organizational actions associated with the implementation of IPD. Findings verify the significance of climate and value-fit constructs in IPD implementation as an innovation in AEC project teams. Additional insights show that the manner of interactions among interorganizational team members as well as their interactions with respective home organization constituents 'make or break' innovation implementation success. Results provide insights for IPD implementation in AEC project teams and build a theoretical foundation for expanding the discussed model in future research.

Keywords: Innovation, Integrated Project Delivery, interorganizational project teams.

Introduction

Innovation broadly refers to ideas, processes, or products perceived to be new by individuals or societies (Rogers, 1995; Slaughter, 1998). Harris (2003) points out that innovation is the only real sustainable source of growth, competitive advantage, and new wealth due to rapid commoditization, time compression, and intense international competition. Administrative innovations can be particularly valuable for organizations (e.g. finance management systems) because they not only improve existing workflow practices (Vakola and Rezgui, 2000), but also lead to novel and even breakthrough products.

Like any innovation, administrative innovations need to be implemented effectively to achieve their intended benefits. Innovation implementation is 'the process of gaining targeted organizational member's appropriate

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and committed use of an innovation' (Klein and Sorra, 1996, p. 1055). Implementations in multi-party collaborations require entities to develop stable patterns of interaction, agreed upon roles and responsibilities, and similar values, which can be a challenging feat (Garud *et al.*, 2013). To date, theory (Rogers, 1995; Slaughter, 1998; Garud *et al.*, 2013) and empirical analyses (Klein *et al.*, 2001; Holahan *et al.*, 2004) offer insights into individual, structural, and climate factors that contribute to effective innovation implementation in organizations. However, how administrative innovations are implemented in interorganizational project teams, with multiple and at times competing interests, personal and organizational histories, differences in information sharing experiences, and definitive outcomes by which they are measured (Hartmann, 2011; Nofera *et al.*, 2011; Hollenbeck *et al.*, 2012), can offer a unique but telling setting by which to understand organizational collaboration and innovation.

Integrated Project Delivery (IPD), as a contractually binding project delivery method, was recently initiated in the architecture, engineering, and construction (AEC) industry to promote integration among participants in interorganizational project teams. Before AEC teams can partake of IPD's benefits, they need to learn how to effectively implement this administrative innovation that includes: a collaborative project team consisting of key project stakeholders established at early project stages and work based on open-book management; a concurrent and multilevel design process in which information is openly shared and the project team works on trust and respect; collective risk management; a common objective through which the success of any project team member depends on the success of the entire project; and the use of risk/reward sharing (AIA, 2007).

A recently developed, promising theoretical framework by Klein and Sorra (1996) emphasizes climate and value-fit elements in the successful implementation of innovations. Their model presents implementation effectiveness as an organizational-level construct rather than an individual's effective use of a given innovation, which can provide a considerable insight into the complexities related to the initiation and sustainment of collaboration in interorganizational project teams. In much of the same ways that departments within one entity develop within-firm collaborative patterns (Garud *et al.*, 2013), interorganizational representatives must construct and enhance patterns across firms' boundaries. Via the lens of Klein and Sorra's (1996) model, this paper examines an IPD case study to test the model's fit to interorganizational AEC project teams, understand further the determinants of administrative innovations' implementation, and offer insights to from the IPD implementation as an administrative innovation.

Background and point of departure

Innovation implementation model and constructs

Diffusion of an innovation into organizations progresses through three general phases: initiation, adoption, and implementation (Rogers, 1995). *Initiation* refers to the process of recognizing a need, searching for solutions, becoming aware of existing innovations, identifying suitable innovations, and proposing some to adopt. *Adoption* encompasses decisions to use one of the options generated from initiation, often imposed by senior organizational managers onto lower-level team members (Klein and Sorra, 1996). Innovation *implementation* denotes appropriate and committed use of the innovation. The actions of an organization in each phase appear to be driven by the perceptions of its leadership about organizational resources, viability of existing mechanisms and products, and values (Christensen and Overdorf, 2000).

According to Klein and Sorra (1996), many organizations fail to achieve benefits from innovative processes, procedures, or equipment due to failure in the implementation phase. They argue that effective innovation adoption and implementation require the proper implementation climate and an effective value-fit of the innovation to organizational values (Figure 1). Four key constructs provide the framework of their model.

Implementation climate in their model concerns 'targeted employees' shared summary perceptions of the extent to which their use of a specific innovation is

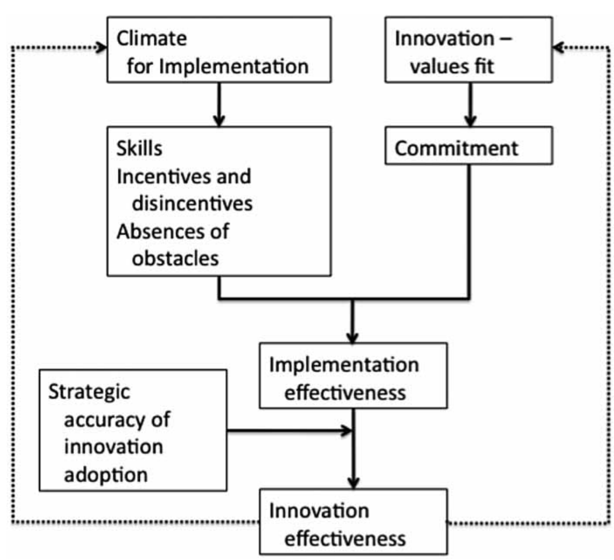

Figure 1 Innovation-implementation model (Adopted from Klein and Sorra 1996)

rewarded, supported, and expected' (Klein and Sorra, 1996, p. 1060). In a strong implementation climate, organizations provide training opportunities to help their employees gain the required *skills* to implement the adopted innovation, recognize the active and proper use of it via a *reward system*, and establish mechanisms (e.g. continued training sessions, feedback mechanisms and trouble shooting assistance) to *remove obstacles* as they occur during the innovation's implementation. In contrast, employees report inadequate support, are not rewarded, and face many problems with an innovation in a weak implementation climate (Klein and Sorra, 1996; Garud *et al.*, 2013).

Value-fit refers to 'the extent to which targeted users perceive that use of the innovation will foster (or, conversely, inhibit) the fulfillment of their values' (Klein and Sorra, 1996, p. 1063). Task values, mediated through work values, are reflections of personal values such as friendship, happiness, and success (Roe and Ester, 1999). When senior management in an organization decides to adopt an innovation, its fit to employee values at personal and organizational levels would affect its implementation. Implementation's association to value-fit might be stronger in flat organizations compared to hierarchical ones (Klein and Sorra, 1996). Yet, in both types of settings, a good value-fit leads to *commitment*. When an organization and its employees have good value-fit for an innovation, they tend to devote more time and effort to learning and properly using the adopted innovation (Roepke *et al.*, 2000).

The transition period between an innovation's adoption and its routine use, that is, the implementation period, is the time where targeted employees are exposed to an innovation during their active operations. ***Implementation effectiveness*** refers to employees' consistent and quality use of a given innovation and is critical in achieving ***innovation effectiveness,*** although not solely sufficient (Klein and Sorra, 1996).

According to the model, in organizations where strong implementation climate is coupled with good value-fit, employees are enthusiastic about the adopted innovation and committed, consistent, and creative use of the innovation is observed. There might be different combinations of these two constructs at various levels in organizations when implementing an innovation (i.e. strong to weak implementation climate; good, neutral, and poor value-fit). However, at the far negative end of these combinations, where weak implementation climate and poor value-fit are observed, essentially little innovation use exists and employees accordingly feel relieved (Klein and Sorra, 1996).

The integrative elements in their model go beyond individual (Tabak and Barr, 1999), organizational (O'Connor and McDermott, 2004), and environmental (Damanpour and Gopalakrishnan, 1998) factors and present a more holistic view to innovation implementation. To date, several studies empirically tested the model constructs, showing relations between climate, implementation effectiveness, and innovation effectiveness (Klein *et al.*, 2001) as well as climate and values fit on implementation effectiveness (Holahan *et al.*, 2004) and validating the sub-metrics of the two main constructs (i.e. skills, incentives, and absence of obstacles and commitment) (Dong *et al.*, 2008). In considering organizational units as complex entities rather than looking at individuals in organizations, the model provides a framework for examining the implementation of administrative innovations by interorganizational project teams. This framework may be especially helpful when examining layers of inter-firm relationships, where firms engage subcontractors, who in turn engage other entities, but where all organizations, primary or subcontracting, stand to gain from information sharing and mutual adjustment (Garud *et al.*, 2013).

Innovations in the AEC industry and IPD

In the AEC industry, a low level of innovation is recognized as a significant barrier for the development of the industry (Dulaimi *et al.*, 2002). Slaughter (1998) argued that low innovation levels occur consistently throughout the industry sectors and can take many forms: Technical innovations involve either 'product' or 'process' (e.g. technology evolution from computer-aided design to building information modelling (BIM) (Azhar *et al.*, 2008), whereas administrative innovations include changes to organizational structure, introduction of advanced management techniques, and implementation of new corporate strategic orientations (Maqsood, 2006). Four distinguished drivers of innovation in construction include external pressure, technological capability within an organization, need for knowledge exchange, and need to span across boundaries of departments, organizations, and partnerships (Bossink, 2004).

Driven by the need for sustainability, energy-efficient built environments (i.e. external pressure), and increased collaboration across disciplines (i.e. boundary spanning across organizations), recent research calls for innovative delivery practices to improve team integration (Riley and Horman, 2005; Lapinski *et al.*, 2006; 7 Group, 2009; Swarup *et al.*, 2011). It is a challenge to establish effective integration among participants in AEC project teams. Though sharing a common interest in project success (Taylor and Levitt, 2007), participants differ greatly in their skills, motivations, availability, and support.

Recently established as a response to this call, IPD was developed as a delivery method, where integration

Figure 2 Project team sizes, roles, and tiers in IPD projects

is required by a multi-party contract (AIA, 2007). This innovative delivery method aims to: (a) produce predictable project outcomes via reliable delivery practices; (b) overcome team coordination deficiencies; (c) adopt technology innovations such as BIM to improve information sharing; (d) promote interdisciplinary collaboration among various project participants to optimize structural, mechanical, electrical, and lighting systems for energy-efficient buildings; and (e) advocate a collaborative working culture (Sive, 2009). To achieve IPD's intended benefits, AEC project teams first need to comprehend how to effectively implement this administrative innovation.

Innovation implementation in interorganizational AEC project teams

Innovation research is more focused on traditional, hierarchical organizations, while mechanisms and rates of innovation in project-based industries such as AEC are different (Taylor and Levitt, 2007). For example, wide adoption of innovations in AEC processes high demands coordination (Homayouni *et al.*, 2010) and thus higher trust levels and mutual understanding among participating parties (Dossick and Neff, 2011; Dewulf and Kadefors, 2012). To obtain meaningful buy-in for innovative processes, consensus needs to be built among parties that can be achieved not through a 'marketing' campaign to members, but instead through low-efficiency meetings that stress equal participation (Lewis *et al.*, 2001).

Specific to AEC and IPD teams, interorganizational project teams form Tier 1 (e.g. owner's representative, designer's representative, and general contractor's representative), which receives support from other participants in Tier 2 (e.g. owner, designer, and contractor's team members within their organizations) and Tier 3 (e.g. subcontractors, consultants, and suppliers) (Figure 2). The size of IPD project teams can vary from a relatively small number of individuals to a vast number (AIA, 2010). The institutional, process, temporal, and geographic boundaries among these tiers complicate implementation of administrative innovations. Therefore, an IPD case offers a unique opportunity to examine administrative innovation implementation in interorganizational project teams.

Case study

The study case is a small-scale, newly constructed, sustainable office-building project, located in a Midwest state. The project owner is a small organization that promotes sustainable construction. The architect is a middle-sized company based in the same state as the owner's organization. With experience in development, the owner first hired the architect to form the conceptual design for the project. With the rendered conceptual design documents, the owner was motivated to seek donors for this sustainability showcase project. One major supplier, involved early in the process as a key donor, requested the use of IPD. The owner accepted this request. Except for this major donor/supplier, the project provided the first IPD experience to all project team participants. IPD at first received sufficient interest from all team members. Two months into the project, key team members (i.e. owner, architect, and major supplier/donor) collectively selected a general contractor. Three months into the project, the team kicked off the IPD process. What makes the project a unique case for this study is that five months into the project (which was two months after the IPD team kick-off meeting), the owner decided to switch to a local contractor, abandon IPD, and pursue a more familiar delivery method (i.e. construction management at risk). The case study provided a unique opportunity to examine administrative innovation implementation in an interorganizational AEC team, namely IPD 'failure' in this project.

Methods

The researchers longitudinally collected in depth data on the case study using mixed methods. Starting right after the conceptual design stage, the researchers collected all project participants' e-mail correspondence for three months until IPD was abandoned. The researchers also observed and voice-recorded the IPD kick-off meeting. Lastly, structured interviews (GAO, 1991) were conducted with five Tier 1–3 participants from different key organizations in the project team, right after IPD was abandoned.

Social-network analysis

To analyse the longitudinally collected e-mail and project meetings data, a matrix was developed in which the number and direction of communications among individuals were recorded. In this process, an ID was assigned to each person, which showed the relationships among organizations and tiers of communication and protected participant privacy. The matrix was then entered into UCINET and converted into system files for the social-network analysis data (SNA). Based on the system files, the visual net-draws and metric data were generated. To demonstrate the information exchange patterns in the network more clearly in the net-draw and understand if team interactions fit the collaborative nature of IPD, further ID coding, color-coding, shape coding, and the scheme of organizational tiers as represented in Figure 2 were applied.

Two types of metrics were used in this analysis: centrality (overall, in- and out-degree, closeness, and betweenness centrality) and geodesic distance. *Centrality* refers to the importance of a node (i.e. person) based on the network structure and its position in the structure (Halgin, 2008) and includes out-degree and in-degree centrality metrics. *Out-degree centrality* was measured by the number of emails each person sent to others on the project team and the number of times each person talked to others during meetings. *In-degree centrality* was measured by the number of emails received by an individual from others on the project team and the number of times each individual was the intended target of a verbal message during meetings (Hanneman and Mark, 2005). *Closeness centrality* refers to how far from all other individuals in a network a particular person is. This study measured eigenvector centrality, as a method of measuring closeness centrality, to identify influential individuals within the whole team by reducing the impact of regional groups (Hanneman and Mark, 2005). *Betweenness centrality* in this study assessed individuals' abilities to connect or break the communication of others on the team (Hanneman and Mark, 2005). *Geodesic distance* refers to the numbers of links composing the shortest path between two nodes, is the index of influence cohesion (Borgatti *et al.*, 2002), and identifies the closeness of two individuals in the existing network.

Interviews

Each structured interview, conducted right after IPD was abandoned, took about one hour where participants were asked questions organized around three main constructs of Klein and Sorra's innovation implementation model (1996): implementation climate, innovation-values fit, and implementation effectiveness.

For *implementation climate*, researchers asked participants about their perceptions of team members' skill levels, the reward structure, and obstacles faced in the project. Participants' self-reports of their proficiencies in product quality, customer satisfaction, and experiences in collaborative projects were used to assess the *skill level* of team members. For organizational *reward structures*, researchers asked participants about their organization's enthusiasm for participating in the project and their level of anticipated financial and public relations rewards from participation in the IPD project. Participants were asked to identify *obstacles* to project success and classify them as internal or external, in an adaptation of Tung's (1979) environmental-threat measure.

For *innovation-values fit*, questions were asked to identify the project team's commitment and value-fit to the IPD process. To assess *commitment,* project team members were asked about their willingness to devote time, resources, and energy to the IPD process. To determine *value-fit*, projet-team members were asked about the extent to which the IPD project had support or buy-in from key stakeholders in their respective organizations. These open-ended questions provided an insight into the IPD process' fit to each organization's culture.

For *implementation effectiveness*, the researchers asked questions to discover (a) problems addressed, (b) progress achievement using IPD, and (c) project quality. Questions regarding project team members' *commitment* to the IPD process were developed from Reichers *et al.*'s (1997) measure of organizational cynicism. To assess the extent to which major design or construction *problems are being adequately addressed*, questions were developed from Tjosvold *et al.*'s (1986) definition of constructive controversy. Whether the project was making *adequate progress* was judged by comparisons of current progress compared to the project timeline and member satisfaction with the IPD process. Perceptions of overall *project quality* were evaluated by an adaptation of Tjosvold *et al.*'s (1986) overall group product-quality measure.

Analyses

To analyse the interview data qualitatively, the interviews were audio recorded with participant consent, and then transcribed. When transcripts were sent back to interviewees for confirmation, participants asked for only minor modifications. Once verified, the data were qualitatively analysed by using Atlas ti (2012) software.

Three tests are used to establish the quality of this exploratory case study (Yin, 2003): construct validity, external validity, and reliability. Data collected from multiple project participants via different paths (i.e. structured interviews, email records, meeting minutes, and researchers' observations in team meetings) and participants' verification on interview transcripts assured construct validity. Next, use of Klein and Sorra's (1996) innovation implementation constructs in categorizing and qualitatively analysing the interview data satisfied case study's external validity. Lastly, a database was developed that organized interviews and all team information exchanges to ensure reliability of the case study (Yin, 2003).

Findings

Applying the innovation-implementation model

Study findings in this section are organized according to Klein and Sorra's innovation implementation model (1996) constructs: **implementation climate** (i.e. skills, reward system such as incentives and discentives in place, and establish mechanisms to remove obstacles); **value-fit** (i.e. leading to commitment); and **innovation and implementation effectiveness.**

Analysis on participant *skills* showed the following. The owner is an experienced developer in residential and light commercial construction, based at the project's location. The architect, experienced in sustainable structures, has long been working with the owner and was directly selected for this project. One Tier 3 level major supplier, involved early in the process as a key donor, had IPD and sustainability experience, and initiated this administrative innovation's adoption. Under this supplier's leadership in the IPD process, the project team shortlisted a number of contractors to interview. Following the best value procurement method, the project team took a variety of factors into account in selecting the contractor including: experience with high performance; sustainable and small-scale/high-profile showcase buildings; openness to collaboration; familiarity with lean construction practices (Matthews and Howell, 2005); and cost estimates. A middle-size contractor from a neighbouring state was selected. Tier 1 and 2 members of the owner, architect, and contractor teams had no experience with the contractually followed IPD. However, they reported to have worked in collaborative project teams. All parties' experience with BIM as a concept to share information, open information exchange using various web-based technologies, and lean construction principles were limited. Despite his sophisticated portfolio, the contractor lacked the necessary skills (e.g. know-how in the environment) and resources at the project's location.

Project participants' main incentive to adopt IPD was to be exposed to this administrative innovative and become competitive in the market for new jobs. All team members were expected to perform according to the IPD spirit in the project. No *incentives or disincentives* were provided for its implementation. IPD includes risk sharing in the case of cost overruns, which are determined by contract, and a reward system, where financial savings are shared as an incentive to achieve intended project outcomes. In this project, before contract's risk and reward sharing clauses were resolved, IPD was abandoned.

One month after contractor's selection, the project team kicked off the IPD process in a meeting led by an independent IPD professional. The kick-off meeting also provided a training opportunity to all parties. During this meeting, several other mechanisms were also discussed to prevent *obstacles* with IPD implementation including: owner's representative to act as the project steward and enable effective flow of information among team members; a web-based system to enable transparent sharing of project data; and pull sessions to keep the project and IPD implementation on target. None of these mechanisms were successfully adopted or followed in the project. In summary, study data showed that *implementation climate* for IPD on this project was promising at the beginning. However, it failed to continue strongly.

In their interviews, all participants reported good innovation-value fit to IPD at individual levels, were *committed* to IPD, and willing to spend extra time on learning and successfully implementing it. The contractor's Tier 1 member, however, mentioned that he had been sceptical about effective IPD implementation in this project, given its fairly late introduction in the process (i.e. after conceptual design completion). At the organizational level, all project parties, except for the owner organization, reported full commitment to IPD. The primary owner representative's comments, however, showed weak *innovation-value fit* to IPD at organizational level:

> The reason [for IPD adoption] is because it was the condition of [the major donor's] contribution to the project. They originally had a conditional support. … I actually like the concept. I did some study starting with a book. … I'm not really anti-IPD. I just think there is a proper scale. I'm still intrigued by it. I learned a lot.

It was clear from the owner's interview that before fully committing to the process, he accepted to adopt IPD, selected a contractor with the rest of the project team mainly based on qualifications, and hired an IPD specialist to execute the IPD contract and train project team members in a special meeting session—all based on the major donor's guidance. However, the owner at this point still was hesitant about the IPD's value-fit to this project and his organization. He was still continuing cost estimates with his organization and local subcontractors even though the contractor had already been selected. The major donor's representative also acknowledged that they should have communicated better with the owner earlier in the process to decide whether the owner had a good value-fit for IPD. Owner representative's continued comments provide additional proof for weak innovation value-fit:

> I would say a ghost here should be the different motivations of team members. I think [the major donor] is a very deliberate big organization, very rational, very methodical. Sometimes we are ready-fire-aim kind of people. We don't use this to institutionalize decision-making. We were [a] very hands-on owner-developer. Whereas, [the major donor] was trying to bring in a level of sophistication with [the] building contractor we just didn't need. There is a significant financial premium to be paid for that.

To measure *innovation implementation effectiveness*, problems addressed, progress achievement using IPD, and project quality issues, project participants were asked about specific outcomes. Major scope and administrative changes to be addressed in the project included: parking lot capacity, mechanical-system design, and design decisions based on supplier/donor identification. Many of these maters were addressed, but decisions were not reached collectively as the owner dominated the decision-making process in all these matters. Moreover, the budget never came to the satisfactory position for the owner, and the design quality was not fully satisfactory to all participants. Finally, five months into the project, the owner decided to give up on IPD.

Applying social-network analysis

Visual SNA map (net-draw) illustrates the information exchange among all project participants over the length of the IPD process. The labels of each node show the team and tiers to which the node belongs, as well as the ID number. From the net-draw based on the geodesic distance illustrated in Figure 3, the researchers found that Tier 1 members of the project team communicated closely with each other via e-mails. The geodesic distance between Tier 1 members is mostly 1, the smallest value, meaning that they contacted each other directly without anyone in between to pass the information.

A problem visually identified in Figure 3 is that one of the owner representatives (a1) trespassed tier boundaries to contact some of the suppliers (i1, j1) directly without involving the contractor and the designer teams. Such behaviour goes against the IPD spirit, raising a red flag for a potential problem, which was then also confirmed via interviews (i.e. owner commented on cost estimating works on the side to drop the budget).

By analysing the centrality and geodesic distance of the network, several other issues were identified. To start, a professional IPD consultant provided a training session at the IPD kick-off meeting. In this particular meeting, many conversations were directed by one individual to all other members, which blurred the analysis of interactions between individuals. For clarification, those message exchanges, mostly instructive for IPD in nature, were filtered out and an SNA net-draw was then generated. As shown in Figure 4, most participants joined in active discussion during this meeting. However, when the exchanges were analysed in detail, the researchers found the owner's project manager (a2), who was project steward as a Tier 1 member, did not have much conversation with others. This lack of interaction can also be observed in the centrality parameters shown in Table 1.

Table 2 reports differences in centrality among participants measured via number and direction of e-mail exchange during the IPD process. Generally, Tier 1

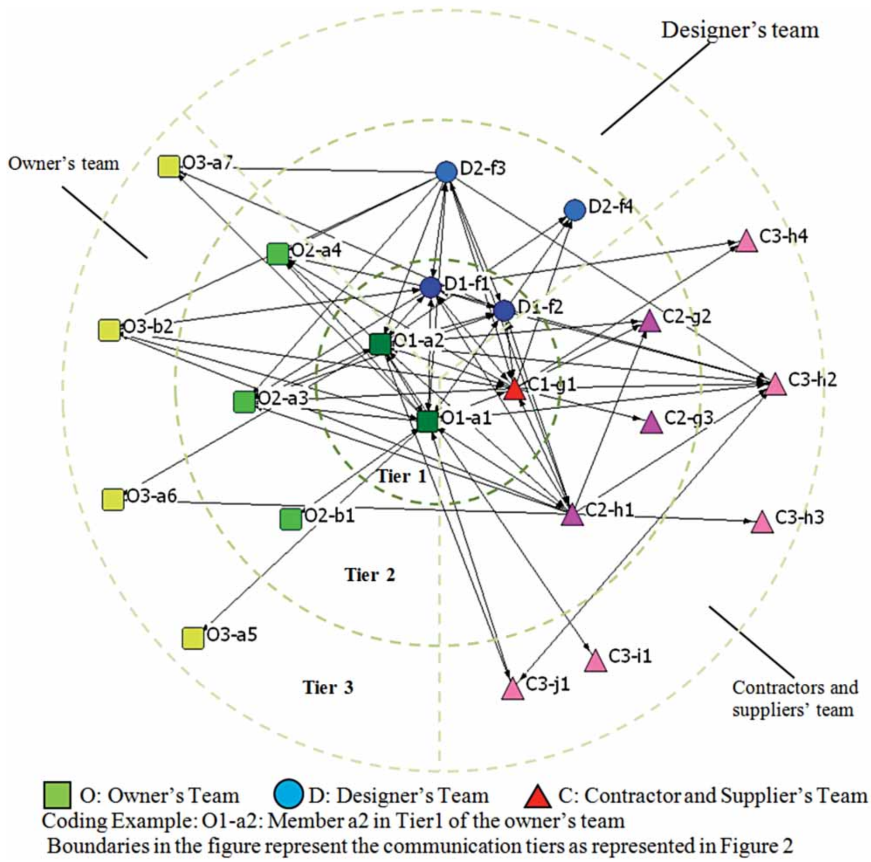

Figure 3 Visual SNA map of information exchange among project participants via emails over course of IPD process (arranged based on organizational boundaries and tiers of communication as presented in Figure 2)

members on different teams manifest a relatively high degree of overall centrality, which means they had more influence on members at other tiers. The in degree-centrality parameters also indicate that all major participants (i.e. Tier 1 members and the major suppliers at Tiers 2 and 3) had relatively close levels of connection with all other members.

The owner, however, was more active in giving information to others, considering the high out-degree centrality (.95 versus <.66–.06). As mentioned before, closeness eigenvector centrality can help identify who is more central on the whole team by minimizing the influence of regional groups. Among the major participants, the Tier 1 member of owner (a1) was the most central and has the most influence, whereas the general contractor, designers,and suppliers are considerably less central in what should be a team operation according to IPD.

The scores on a1 and a2 owner representatives' betweenness centrality (76.333, 61.129) compared to non-owner major participants (30.262–4.095) indicate that a greater amount of communication between Tier 1 and 3 members went through them. Despite a low percentage (18.2%), the big variation coupled with the structured interview shows the owner had too much control. Note also that two members (a1, a2) have high centrality within the whole team. Although a2 was assigned as a project steward, his leadership was considerably less than would be expected across out-degree, in-degree, closeness, and betweenness centrality measures. Finally, the major supplier's unusually high centrality values as a Tier 3 member at this stage of the IPD process is explained by the leadership role in suggesting and implementing IPD's adoption in this project.

Additional interview-based insights

Additional insights revealed through interviews, but not fitting into Klein and Sorra's (1996) framework, have important ramifications to IPD project implementation and are presented here. First, although a project steward from the owner team was assigned to *manage and monitor* the project team's communication, the information flow and IPD execution were not efficiently managed in this project. The project steward's lack of

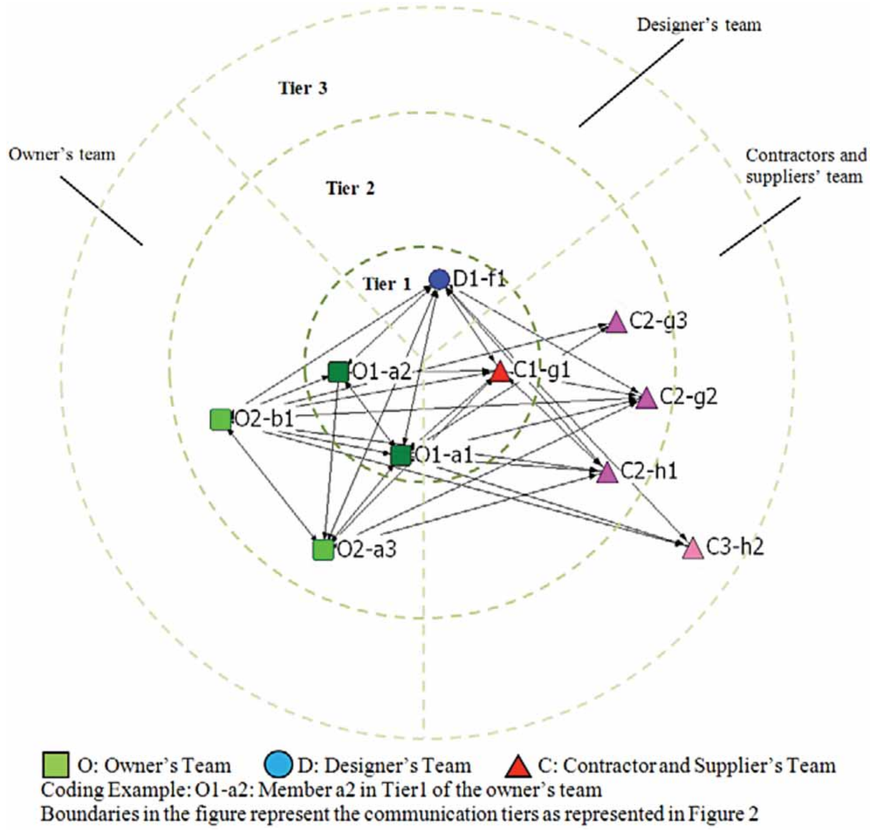

Figure 4 Net-draw of IPD kick-off meeting (arranged based on organizational boundaries and tiers of communication as presented in Figure 2)

industry experience, combined with the other owner representative's dominating authority, contributed to this outcome.

Second, many major scope and administrative decision changes happened through the IPD phase of the project, including mechanical-system change from an under-floor distribution with a raised floor system to a pressured air system. Even though the contractor and his Tier 3 subcontractors were involved in discussions for such decisions, it was ultimately the owner who declared his decision based on his priorities without further *negotiations*.

Table 1 Team members' centrality measures at the IPD kick-off meeting

Key project parties	Organizations	ID	Communication tiers (Figure 1)	Centrality			Closeness centrality (Eigenvector)
				Degree (%)	Out-degree	In-degree	
Owner's team	Owner	a1	1	100.0	144	162	0.468
		a2	1	55.6	24	13	0.083
		a3	2	77.8	136	121	0.466
	Consultant	b1	2	100.0	153	156	0.506
Designer's team	Designer	f1	1	88.9	105	113	0.383
Contractors' and suppliers' teams	General contractor	g1	1	77.8	79	80	0.301
		g2	2	55.6	15	12	0.06
		g3	2	22.2	3	2	0.011
	Major supplier	h1	2	55.6	64	63	0.242
		h2	3	33.3	3	4	0.018

Table 2 Centrality measures for selected team member communication via e-mails

Key project parties	ID	Communication tiers (Figure 1)	Degree centrality: Degree (%)	Degree centrality: Out-degree	Degree centrality: In-degree	Closeness centrality: eigenvector	Betweenness centrality
Owner	a1	1	66.7	95	37	0.523	76.333
	a2	1	66.7	66	32	0.437	61.129
Designer	f1	1	52.4	21	39	0.361	10.662
General Contractor (GC)	g1	1	66.7	33	36	0.338	30.262
Major supplier	h1	2	61.9	47	25	0.344	19.445
	h2	3	38.1	6	31	0.253	4.095

Third, the owner's priority for attracting donors further complicated the delivery process, as reported by project participants. Traditionally in supplier procurement, for example, the contractor is responsible for the procurement of suppliers based on specifications provided by the designer. The owner is not too much involved in making specific system and material decisions. In IPD, the owner participates more in this process to make sure requirements are met. In this project, however, the owner excessively intervened in decision-making with an intention to find suppliers who could donate materials to this sustainability-demonstration building. As the owner's team worked on the donors, they took charge of disseminating information to other project parties, yet left the other participants mostly waiting in ambiguity.

Summary of the findings

Two reasons potentially contributing to IPD implementation failure in the case study are significant: the owner's domination and fear of risk; and the project steward's lack of experience and inability to constraint the owner's actions. These 'individual contributors' to project failure suggest a weakness in Klein and Sorra's (1996) model, that climate and value-fit are necessary but not sufficient for innovation implantation. The inadequacies of the project steward contributed to the challenges that arose in this project. However, the owner violated the commitment that participants made to the project. IPD is a collaborative process that heavily relies on individual commitment to share concerns and problems solved with others (AIA, 2007; Sive, 2009). Even a highly experienced project steward was unlikely to have overcome those actions. In short, a larger problem in the case study is the owner's breaking participants' trust and choosing to act independently as in construction management at risk mode of project delivery (AIA, 2007). A more in-depth study of the findings reveal further insights to model's fit to interorganizational AEC teams.

Table 3 summarizes and triangulates the study findings and shows how the lack of several mechanisms in the case-study project led to IPD implementation failure. Applying Klein and Sorra's (1996) model, the case study reveals that the participants, including the owner, could be said to have a *weak implementation climate* (despite a promising start) and *neutral innovations value-fit* (i.e. poor value-fit for the owner and good value-for the rest of the organizations in the project team). As a result, this innovation, or any other like it, would be expected to face disregard and difficulty in implementation. Participant communications observed in this case study along with interview statements align with these attitudinal and behavioural patterns. In this case, the project resulted with innovation implementation failure.

The summary in Table 3 points out that existing issues in communication patterns among project participants and deficiencies in team structure can also contribute to the failure of administrative innovations' implementation in interorganizational project teams. These patterns may also act as corrective factors when innovation is not being successfully implemented. Klein and Sorra's model does not clearly identify individual failure and rather emphasizes structural and process elements. Although not explicitly explained by the implementation climate and the innovation-values fit constructs of their model, the outcomes herein align with several studies in the literature pointing out the importance of communication practices and behaviours in effective innovation implementation (Adler, 1995; Poole, 2011; Reinholt *et al.*, 2011). Communication behaviours must be explicated for even the best fitting climates and innovation values can go awry when there are lapses in information sharing. In the current case study, the violation of trust and commitment as well as the failure to monitor neophytes' development of commitment to information sharing suggests

Table 3 Summary of key findings from qualitative and network analyses

Key constructs	Interview conclusions	Network analysis	Interpretation
• Value-fit • Climate • *Structure*	Looking for donors and motivated to come up with lower construction cost, owner took over authority of supplier procurement	Owner trespassed tier boundary in his email communication by contacting supplier (i1, j1) directly without involving contractor and designer	Owner's lack of value-fit in IPD implementation was instigated by cost concerns. Owner's authority dominated communicative processes and team climate
• Climate • *Communication* • *Structure*	Project steward (a2) had little authority due to lack of experience and influence by other owner representative (a1)	In email communication, two Tier 1 members (a1, a2) have close centrality with each other	Assignment of project steward is not clear, which hampers project team's communication-management efforts
• Value-fit	Major donor's request is core reason why owner pursued IPD	As a Tier 3 member, the major donor /supplier was unusually involved in team's decision-making	Owner organization did not have a good value-fit with IPD
• Value-fit • *Communication* • *Structure*	Contractor was skeptical about IPD success in general, especially given late introduction of IPD into the project	In both IPD kick-off meeting and email communications, general contractor (g1) is in least central position, and negatively influences information output among participants	Contractor's team did not have good value-fit for IPD implementation. Project's climate and structure did not provide corrective measures to improve contractor's position

Note: Constructs in italics mark the proposed additions to the Klein and Sorra's model (1996).

that Klein and Sorra's model (1996) be expanded to include communication aspects.

Discussion

Study findings provide support for the use of Klein and Sorra's innovation implementation model in examining interorganizational AEC teams' administrative innovation implementation. From the standpoint of a successful IPD implementation, the study shows that skills such as openness to transparent information sharing and experience with similar facility types and project environment are important factors contributing to implementation climate. In addition, innovation-values fit is critical for key organizations', especially owner's, commitment to IPD. Further, early involvement of all parties, including the contractor, needs to be facilitated for success, and the training of project participants on IPD is necessary, but not sufficient for success. Finally, mechanisms to remove obstacles should be embedded throughout the process.

Applied to complex interorganizational projects, the elements of implementation climate, and value-fit are necessary but not sufficient to insure project success (Adler, 1995; Poole, 2011; Reinholt *et al.*, 2011). Rather, the manner of interactions within the interorganizational team as well as between team members and their respective home organization constituents 'makes or breaks' project success (DiMarco *et al.*, 2010; Druskat and Wheeler, 2003; Morgeson *et al.*, 2010). Recognizing the importance of communication for the organization's success, groups develop and/or adopt different tools to facilitate contact. Along with climate and value-fit constructs (Klein and Sorra, 1996), communication mechanisms and behaviours are foundational to effective innovation implementation, especially in interorganizational teams.

The hallmarks of 'successful' joint collaboration are information sharing, problem solving, identifying mutual gains, supporting or assisting others, and providing timely feedback (Adler, 1995; Poole, 2011). A robust information exchange climate for innovation implementation is necessary, not only to implement innovation successfully, but also to improve the climate and structure of a project's organization (Nofera *et al.*, 2011). In particular, a project steward who is able to coordinate information exchange and motivate project team members of all tiers to promote information sharing is of critical importance to successful innovation implementation. Communication and schedule patterns of interaction are also instrumental in the AEC industry for collaboration, effective information exchange, and innovation adoption (Dossick and Neff, 2011; Homayouni *et al.*, 2010). Unfortunately, both the project steward and the communication patterns were inadequate in this case-study project, which, if robust, could have fostered a better innovation implementation climate and/or innovation-values fit for IPD implementation.

In an ideal IPD project, the communication behaviours of Tiers 1–2 project team members as integrators would serve a critical role in commitment to the innovative process, degree to which key problems are addressed, and maintaining a high standard of quality in the project. In keeping with recent summations of effective team leadership behaviour (Morgeson *et al.*, 2010), the project steward and Tiers 1–2 members would serve in integrator roles and evidence a complement of monitoring, managing, challenging, and negotiating behaviours. Monitoring refers to members' vigilant scanning of the internal and external environments for information and events that might influence the project. Managing behaviours refer to cooperative acts to resolve differences and communicate with other groups, and seek to buffer the project from external forces (Druskat and Wheeler, 2003; Morgeson *et al.*, 2010). The extent to which team members challenge the status quo suggests new ways of completing work, and also contributes new ideas (Morgeson *et al.*, 2010). The integrators' ability to negotiate in an integrative manner, especially with regard to elaborating on the rationale for decisions and seeking mutual concessions, may be critical for team collaboration and creativity (Druskat and Wheeler, 2003; Meiners and Miller, 2004).

Yet, in the case study, implementation challenges, which could have been overcome, were not. For example, the major supplier initiated IPD implementation, influencing the owner. The owner was not fully motivated to implement IPD—namely, to enable improved coordination and integration among team members in order to facilitate an improved process and project outcomes. Additional communication problems such as solo decision-making and not consulting other shareholders plus the lack of a shared culture on the team ultimately contributed to the IPD implementation failure. The degree to which the lack of owner motivation in the owner might have overcome any cohesive action by the other participants is unclear (Klein and Sorra, 1996; Dewulf and Kadefors, 2012), but will have to be verified in future studies.

Power in organizations can serve to create both hierarchy for efficient decision-making and heterarchy for better communication (Sage and Dainty, 2012). However, the owner representative's (a1) dominating power over others in decision-making (Cobb, 1984; Hartmann, 2011) in the case study identifies the need for negotiation and conflict management capabilities of all project team members (Tjosvold *et al.*, 1986). These undercutting decision impositions yet again show omissions in the Klein and Sorra (1996) model, which assumes equal levels of power among Tier 1 and Tier 2 members and does not articulate how team homeostasis is again achieved. Most importantly, these changes and the way they were administered by Tier 1 team members (not only the owner taking the lead in decisions but also project members not being as proactive in shaping decisions) show the gap between IPD's innovation-values fit for Tier 2 organization members on the project team and communications reflecting their conflicts and concerns. Iorio *et al.* (2012) also highlight the importance of having facilitators play less central roles in task interaction to foster the information exchange in the context of international virtual networks for the AEC industry. Consequently, future investigations should consider a more explicit assessment of participants' communication behaviours.

Conclusions

As a response to the posed research questions, this paper: (a) found Klein and Sorra's innovation implementation model (1996) constructs to be useful in examining IPD implementation as an innovation in interorganizational AEC teams; (b) through structured interviews and social-network analysis, identified additional structural and communication constructs, which could foster innovation implementation; and (c) concludes with a set of propositions to guide future research:

PROPOSITION 1 *Project team climate, structure, innovation-value fit, and communication constructs all contribute to effective innovation implementation in interorganizational project teams.*

PROPOSITION 2 *Project team innovation-value fit is enhanced by broad patterns of information sharing, joint decision making, and following established roles and protocols, which together enable effective collaboration in interorganizational project teams.*

PROPOSITION 3 *Effective information sharing among Tier 1–2 participants offers a means to counteract weaknesses in team climates, structural elements, and innovation-value fit in interorganizational project teams.*

Study findings are exploratory in nature. Future research will use these findings to further test the constructs developed here and modify Klein and Sorra's (1996) innovation-implementation model. These findings can not only help AEC project teams implement

IPD projects more successfully, but may also provide insights to how successful and innovative interorganizational project teams collaborate to achieve their objectives.

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