THE INFLUENCE OF PROCUREMENT ON PERFORMANCE OF INTEGRATED DESIGN IN CONSTRUCTION

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Abstract

There is an emerging trend in the construction industry to adopt integrated design. It is expected that buildings defined using this approach will deliver better performance or better value for money. There are though, two opposing views regarding the changes to be done to adapt traditional design practices to this new organization of work. Advocates of sustainable construction posit that it is a matter of evolving from a sequential to an iterative design process, whereas the British government supports the view that a change in how projects are procured is required to transform the context that dictates relationships among the members of the team.

The objective of the research is to study the influence of procurement on the performance of integrated design teams. It analyses integrated design through case studies reflecting these views. The research is conclusive regarding the influence of procurement on team efficiency. It demonstrates that traditional procurement processes reinforce socio-cognitive barriers that hinder team efficiency. It also illustrates how new procurement modes can transform the dynamic of relationships between the client and the members of the supply chain, and have a positive impact on team performance.

Keywords: Integrated Design; Procurement; Team Dynamics.

Introduction

Numerous reports and studies acknowledge problems with the sequential approach to design and delivery of construction projects. Dupagne (1991) identifies, among those, the lack of iterations in the design process, the lack of consideration of constraints within subsequent phases or the unnecessary constraints set in design for these phases, and the lack of leadership and accountability; leading to sub-optimal solutions, poor constructability and operability, rework in design and construction, and lack of innovation.

Two solutions derived from best practices in manufacturing are suggested to tackle these problems. Advocates of sustainable construction (Larsson 2002, Löhnert, Dalkowski and Sutter 2002) suggest redefining the design process from sequential to iterative, while maintaining traditional project lifecycle and procurement modes. In contrast, British leaders of the movement for rethinking construction (Latham 1994, Egan 1998) argue that a change to the context in which the design is realized is essential, and advocate abandoning fragmented and transactional procurement routes in favor of integrated and relational procurement.

However, while the problems with the sequential design and delivery approach to construction have been discussed, the topic of the impact of integrated team's new organization of work on design practices has been little researched in the construction industry. Researchers in lean construction (Huovila, Koskela and Lautanala 1997) argue that traditional design practices are built around the input and output processes and perform poorly in managing flow, or meeting client requirements. They posit that concurrent engineering is a better fit to integrated design, suggesting that existing practices are ill-adapted to this new organization of work.

Koskela et al. (2006) also contend that the incapacity of the industry to move from sequential to integrated design resides in the adversarial business context created by transactional contracting methods. In a transaction, the seller is bound to delivering to the buyer a specified outcome for an agreed price. Risk and responsibility of results are on the shoulder of the seller, who has no incentive for collaboration with other contract parties in defining the solution that will best meet expected results. Relational contracting is based on recognition and striving for mutual benefits between the parties. This type of contract is usually long-term, develops and changes over time, and involves substantial relationships between the parties.

Koskela's (2000) theory of production was used as a starting point to get a better understanding of the influence of procurement on the performance of integrated design. The design process and outcome of two projects - the first using a traditional transactional approach, the second a new relational procurement approach - were investigated. Research results describe how procurement can affect the dynamic of the team by creating a context that encourages or hinders collaboration and innovation.

Integrated design or integrated teams?

Integrated design was devised during the Second World War to speed up the development and construction of new complex weapons. It proved to drastically reduce the time to market and product development costs, while delivering superior products. It is why it was widely adopted by the manufacturing industry in the 1980's. Integrated design was only introduced in construction in the beginning of the 1990's for the design of sustainable buildings to solve problems in the sequential design process, which was generating sub-optimal buildings at higher costs (Larsson 2002, Löhnert, Dalkowski and Sutter 2002, Zimmerman 2006). The integrated design process is described by Larsson et al. (2002) as:

"A method for realizing high performance buildings that contributes to sustainable communities. It is a collaborative process that focuses on the design, construction, operation, and occupancy of a building over its complete life-cycle. The integrated design process is designed to allow the client and other stakeholders to develop and realize clearly defined and challenging functional, environmental, and economic goals and objectives. It requires a multi-disciplinary design team that includes or acquires the skills required to address all design issues flowing from the objectives."

This proposed new design process shares with sequential design and delivery the breakdown of the project lifecycle into a series of phases marked by milestones, during which interim deliverables (brief, concept, preliminary design, working drawings) are reviewed and approved. They differ in the organization of the work to produce these deliverables. In a sequential process, problems are distributed among people that work and develop systems in isolation. They meet only for coordination purpose. Members of the project teams will change from phase to phase. There is little opportunity for optimization. (Larsson 2002).

Integrated design process demands inclusive participation of key team members during the whole project lifecycle. Whole system thinking and whole lifecycle costing are priorities The core of the team effort is invested in the early stage of the project. The design process is not linear but utilizes iteration loops for problem-oriented analysis and optimization of design alternatives

(Löhnert, Dalkowski and Sutter 2002). The building is first outlined as a holistic system which is partitioned at each step into finer and finer elements, whilst the sustainability requirements start at a highly abstract level to become more specific for the lower-level elements. A sustainability benchmarking based on sustainability targets is done at the end of each iteration, providing feedback loops to refine the proposed solutions.

The adoption of the integrated design process by the industry remains scarce. Discussions with practitioners reveal four issues that hinder its rapid adoption: (1) the clients lack of understanding of his role in this new design process, (2) the lack of incentives for design professionals to change their practice, (3) the nature and fragmentation of procurement within the "design-bid-build" process, and (4) the absence of recognized code of practice or body of knowledge to support this new form of collaborative work.

The British government has adopted a different route to integration that addresses some of these issues. Two seminal reports (Latham 1994, Egan 1998) relate the construction industry's poor performance with adversarial procurement practices. They condemn these practices as been responsible for the industry's high fragmentation, lack of quality outputs, and low productivity. They also contend that integrating the value chain overall processes encourages continuous improvements and reduces waste. Integrated collaborative design is considered as an approach that establishes design as the common thread linking organizations together (Austin 2001). Following the recommendations of these reports, the British government changed public procurement practices to favor integrated teams and integrated supply chains.

These two views of integrated design converge in their aim to deliver superior value by assembling, integrating, and harnessing all the collective skills and capabilities of clients and their supply chains. Both views, however, fail to consider or address the socio-technical problems affecting the performance of multidisciplinary teams. Integrated teams in construction are usually coalitions of representatives from various organizations that have different cultures and organization of work. They are often brought in together for the first time and are assigned to the project on a temporary basis. In contrast, integrated teams in the manufacturing industry are usually teams that have worked together for a long time on multiple projects. They share the same culture and organization of work and design processes. This is why there is a high risk that design coalitions may not perform as well, or even be dysfunctional. Recent research on intra-teams boundaries within design-build projects (Moore and Dainty 2001) supports this assertion. There is a need to provide a better empirical and theoretical ground to understand the dynamic of integrated teams in construction and the influence that procurement can have on their performance. The cases provide a fertile ground for an empirical investigation of this topic.

Research question:

- How procurement influences the performance of integrated design in construction?

Research Methods

Investigating integrated design team performance represents a challenge, since it requires crossing boundaries between organization and design sciences – the core principle in this type of organiztion of work being the co-production of the design solution by client and supply chain. Choosing the paradigms driving the research is also a crucial and difficult question. Patton (2002) describes the research paradigm as a way of making sense of the complexity of the real world. It is considered as being deeply embedded in the researcher or practitioner's social models. Its strength is also its principal weakness; the very reason for action is hidden in the unquestioned assumptions of the paradigm.

Positivism or technical rationality is the research paradigm in the design sciences (Schön 1995). However, an interpretivist perspective was adopted as it is better suited to investigate this complex social phenomenon. Interpretivists see the social world, as opposed to the physical world, as socially constructed. They are more interested in understanding specific cases within a particular context than hypothesizing about generalizations and causes (Patton 2002). Triangulation of theories, methods, and sources were used to capture and analyze data from multiple perspectives.

Van de Ven (2007) calls for process instead of variance logic to investigate complex organizational phenomena. The phenomenon here, to be studied, is teams' integrated design process. Process data have characteristics that make them difficult to analyse and manipulate: they deal with sequences of "events"; they have multiple levels with ambiguous boundaries; their temporal embeddedness varies in terms of precision, duration, and relevance; they tend to be eclectic, drawing on phenomena such as changing relationships, thoughts, feelings, and interpretations ((Langley 1999).

A social science process approach has also its limitations. Blackler, Crump and Mcdonald (1999) argue that social research on teamwork practices does not take into account the rapid pace of changes in the organization of work. It is based on biased assumptions, avoiding featuring elements of context as variables that can impact team effectiveness, such as the hierarchical aspect of group regulation, the politics of relationships between different experts or functional groups, the nature of the broader institutional contexts, and ways in which participants have become socialized to participate within these structures. They advocate instead a context approach to research, using activity theory to explore the dynamic of teams. Activity theory focuses on activities instead of processes, and provides a much richer framework than traditional variance or process approaches used in social science to investigate complex phenomena. A triangulation of qualitative research methods, based on activity theory and grounded research, were used to investigate the two case studies.

Research Objectives:

- Identify the socio-cognitive factors that affect the performance of integrated design teams.
- Establish the effects of transactional and relational contracting on these socio-cognitive factors.

Maximum variation and intensity were sought in the choice of the cases. The first is a longitudinal case conducted in Canada. Documents pertaining to the development of the design, design deliverables, and electronic correspondence were made available for the research. Eight brainstorming and design workshops were conducted in e-collaborative design laboratory of École de technologie Superieure. They were videotaped. Observation strategies derived from Ancona's Team Process Observation Guide (2005) were used to analyze disturbances or contradictions affecting the team dynamic. Two rounds of interviews were conducted, one with partners/tenants' directors and employees at the end of the first phase to capture the strategic intents, and one with the integrated team after the concept phase. A total of 19 persons were interviewed.

A second case was undertaken to study a new procurement framework put in place in a leading British initiative. Data were collected in three steps. Firstly, a series of interviews with six representatives from Office of Government Commerce, the Department of Trade and Industry, Constructing Excellence and Construction Industry Council were conducted to understand the context surrounding Rethinking Construction related initiatives. Research was narrowed down to Procure 21 and Achieving Excellence initiatives. Secondly, interviews were conducted with 2

Office of Government Commerce representatives, the Department of Health director of Construction, and the Procure 21 program manager. Thirdly, interviews were conducted with personnel from the Hospital planning department, the new unit staff, and the principal supply chain representatives. 20 persons were interviewed. National Health Procure 21 and knowledge portals were also explored in details; Procure 21 tools and process map were downloaded, and analyzed.

A semi-structured interview protocol and long interview technique were used in both cases. The interviews lasted between 40 and 120 minutes. All interviews were recorded and fully transcribed. A debrief memo was written after each interview. Interviews were also conducted with subject matter experts in project and value management. Client representatives, project managers, design professionals, and construction managers were invited in focus groups to discuss and comment on the research findings at each step of the process. All data were captured and coded using NVivo 7 software.

Research Results

The aim in both cases was to demonstrate the superior performance of integrated teams. The first to deliver more sustainable buildings, the second to drastically improve the quality and efficiency of care within a mental health rehabilitation unit. In the first case, a sustainability roadmap was devised to reengineer traditional design processes. In the second case, a revolutionary relational procurement framework, Procure-21, was implemented to transform the context in which projects are planned, designed, and built, whereas in the first case, traditional transactional procurement route was utilized

The focus of the research in the Canadian case was to explore further problems of efficiency in adopting a process approach to the integrated team. In the British case, which is considered a model of best practices in integrated teams, the research concentrates on the influence of new procurement routes on the efficiency of these teams by transforming the context of the relationship between the client and the supply chain.

The Canadian case

This case describes the context and dynamic of a project coalition whose mandate was to innovate not only by delivering an outstanding demonstration project for sustainable construction, but also in the process of designing it. The project was an opportunity for the project client, a non-profit activist organization in sustainable development, to position the organization as the “Voice of Sustainable Development”. A sustainability adviser was appointed by the client to show the way, on how to organize the integrated design process.

The integrated team was composed of three representatives from the architect firm, four representatives from the engineering firms, the sustainability adviser, three client’s representatives, and various experts. Ancona (2005) proposes seven categories to structure the observation of the team dynamic: task and maintenance functions, decision-making, communication, influence, conflict, atmosphere, and emotional issues. “Task and Maintenance functions” is the glue that holds the team together. Task functions help the team to organize themselves to get the things done. Maintenance functions hold the team together so that the members can continue to get along with one another. It is expected, in a performing team, that its members build together a shared view of the project purpose, agree in the best way to achieve it, and on how they will stay on target. It is also expected that all team members have their “voice” heard and that all ideas are opened to discussion. This is consistent with the integrated design core principle of open collaboration to stimulate team ability in generating innovative solutions.

Results from observations suggest the team to be dysfunctional. The design team formed an in-group and views of the client, the consultant, and other experts remained fragmented regarding the project objectives and the design process. Surprisingly, interviews and focus groups with design professionals and facilitators confirmed that the dynamic of this team was not uncommon in construction. Explanation for this anomaly could be found in research in team performance and in organizational learning.

Druskat (2002) relates performance of integrated teams to their ability to come up with shared mental models. Authors (Weick and Roberts 1993, Druskat 2002) also contend that, since shared mental models affect behavior, their content is of central importance in team effectiveness. Shared mental models are socially constructed cognitive structures that represent shared knowledge or beliefs about an environment and its expected behavior. They influence team member behavior and improve coordination by enabling members to anticipate one another's actions and needs. Druskat (2002) identifies three core components in the performance of team: (1) psychological ownership over team processes and outcomes, (2) continuous learning, and (3) heedful interrelating. It is acknowledged, from recent ethnographic research on team dynamic, that there could be multiple barriers – cognitive inertia, lack of self-regulation, knowledge boundaries – hindering integrated teams ability to develop shared mental models.

The first problem, cognitive inertia, plays against psychological ownership and heedful interrelating. It is associated with two typical behaviors amongst experts of different disciplines: "groupthink" and "compartmentalization". "Groupthink" is, a mode of thinking that people engage in when they are deeply involved in a cohesive in-group. "Groupthink" typically leads to an overestimation of the in-group, closed-mindedness, and stereotypes of out-groups; and "compartmentalization," a fragmentation of viewpoints and a lack of shared mental models. Groups tend towards the opposite of sharing the unique information or knowledge held by individuals, preferring to jointly discuss held information or knowledge (Stasser and Titus 1987). Fragmentation may make it impossible for experts from different contexts to "speak the same language" and exchange ideas about a problem (Engeström, Engeström and Karkkainen 1995).

In this case, contractual agreements formalized one-to-one relationship between the client and each of his suppliers. There were two parallel contractual work agreements that were made by the client, splitting the coalition in three groups: the design team, the sustainability adviser, and the client representatives and experts. A first contract was formalized between the client and the sustainability adviser's firm, a second one between the client and the architect firm, and the engineering firms were subcontractors by the later. The engineers' interventions were tightly controlled by the architect and limited to technical insights and specifications regarding the building systems and structure. Terms and conditions of these contracts were kept confidential. Therefore, these working arrangements remain unknown to the other members of the coalition. Contracts increased fragmentation between experts, encouraging groupthink and the creation of parallel communication and decision-making outside of the team boundaries.

> *"I don't want a middleman between me and the decision-maker, if not it makes a terrible mess…".*
>
> [Project architect]

The second type of problem is related to the nature of project coalitions. There is a lack of self-regulation of typical collaborations in coalitions, where team members coordinate their activities through talking to one another in addition to interacting with their tools. Participants duplicate each other's efforts and many problems often fail to resolve quickly or to anyone's satisfaction (Zager 2006). The model relationship between client and design professionals carried in transactional procurement defines a problem-solving process that depends on agreement on ends: only experts (professionals) practice the rigorously technical problem-solving based on specialized scientific knowledge (Schön 1995). Clients and users are expected to provide inputs –

clear problems and requirements – for which the experts will provide outputs, e.g. design solutions. Therefore, without clear rules, contractual agreements become the rules that determine the relationships among actors in the case observed. Design professionals therefore repeated the traditional design process described in their code of practice, hampering the development of shared ownership.

> *"The architects went into a corner and came back with a concept. I can understand that it is the way they work, but I have a problem with this because we did not have the chance to build the ownership of the concept…"*
>
> [Client representative]

The third type of problem relates to the "knowledge boundaries" that specialized knowledge creates and which hinders mutual learning. The characteristics of knowledge that drive innovative problem-solving within a function actually hinder problem-solving and knowledge creation across functions (Carlilse 2002). There is also the aspect of "knowledge at stake". There is stickiness with the common knowledge used by practitioners. Power and influence of dominating actors are often revealed, that create barriers to developing shared meanings by refusing to change the knowledge and interests from their own domain (Carlilse 2002). As argued by the project architect:

> *"At one moment there are design professionals that are trained to do work. We cannot design teams. If we design a horse in a team around a table, we will end up with a camel".*
>
> [Project architect]

The architect used the power provided by his ownership of the design knowledge and the cohesiveness created by his binding contractual relationship with the rest of the design team to take control of the process that was outlined by the sustainability adviser, breaking the team cohesion and imposing his rules. Moreover, the architect forced the creation of a parallel process for decision-making; demanding separate meetings with the client's executive for dealing with this task, creating a parallel communication network. This generated conflicts and emotional issues between suppliers, due to the gain of privileged access to the decision-maker.

In summary, it was acknowledged that the fragmented transactional agreements had a negative impact on the team dynamic, fragmenting and polarizing the work between the signatories of the agreement, and channeling team effort to meet contractual deliverables instead of defining optimal solutions.

The British case

Much of the research work and initiatives in the UK regarding integration of teams and supply chain revolve around reengineering construction practices based on process models derived from the automotive industry. Procure-21 is one of the new procurement routes adopted by the British Department of Health. The aim was to improve performance in delivering better buildings and to develop a design process that is centered on the patient and healthcare staff.

Procure-21 distinguishes itself from other initiatives by taking a context instead of a process approach to transform existing design practices. The change in context is imposed by the relational contracting framework, which dictates new rules and division of labor within the team, while redefining the roles of key stakeholders. It is structured on the following principles:

- To form an integrated team at the outset of project planning and maintain it throughout delivery.
- To promote the implementation of collaborative work by the adoption of a coherent cost management approach built around "Target Costing."

- To pre-qualify a small group of principal supply chain partners that has demonstrated a specified set of capabilities.
- To change culture and process through senior level determination to change, the redesign of activities to support the change, training in the skill for collaborative working, and the creation of an environment in which people can expect support rather than blame.

An innovative element of the framework is its reframing of the design and delivery lifecycle into a definition and a delivery phase. In the first phase, the supply chain works on an agreed cost-plus basis to accompany the client in the different stages of planning and design. The goal is to maximize value through the definition of the best fit for purpose at a lesser price. When the project definition achieves an acceptable level of certainty, the supply chain can make a firm commitment to a guaranteed maximum price and a schedule. This price includes provision for risks agreed by both parties. The goal of the second phase is to achieve cost reduction through innovation, standardization, value engineering, and process improvement. Cost savings are equally shared between the client and the supply chain. Cost overruns are absorbed by the principal supply chain.

One of the key characteristics of Procure-21 is that it is no more the design professional but the client who is leading project definition. The framework imposes changes to traditional design practices by redefining the relationship between the client and its suppliers. It achieves this by encouraging fruitful exchanges through partnering, and building trust amongst the integrated team members and between the team and their related organizations, addressing the design problems identified by Huovila, Koskela and Lautanala (1997) that are related with the flow and value generation views

The theory behind the concept of partnering is that removing the adversarial relationship generated by transactional contracting and establishing long-term relationships eliminates industry barriers to collaboration and stimulates value generation. Building trust is also an essential component in building the team dynamic. As asserted by the Director of construction of the department of health, who devised the framework, changing the procurement process is not sufficient to change people's mental models, which are deeply embedded in decades of adversarial relationships. There is also the issue of breaking down barriers built around specialized expertise.

> *"You then, of course, need trust between all these parties. That is not an automatic thing. It has to be earned, in many ways the hard way. Trust, then brings respect. Once trust creates respect, you are able to remove large chunks of wastage, because if one says to the other, "I cannot do it differently," the other will trust and respect their expertise and will not challenge them. It is therefore done quicker and more directly. Ever time that it is successful, more trust and respect is generated to the point where it becomes cognitive. The time one lets the other down is the time where the whole thing falls apart. One knows the other does not want that, so they work hard to maintain that situation. I think a very powerful bond is created, because the onus is on both sides to not let the other down, both professionally and personally. Neither wants to be thought of as incompetent."*
>
> [Director of construction of the department of health]

Waste reduction (flow) is central to the framework. It is achieved at two levels: at the project definition level, by eliminating the multi-level hierarchical decision process and by avoiding duplication of roles; and at the supply chain level, through process improvements and value engineering. To achieve this, the power structure of the traditional work configuration in construction is reshuffled. New players are introduced – the project director, the design champion and facilitators. The role of the quantity surveyor is evolved to include quality assurance and quality control. The hierarchy of relationships (structure of power and influences) is redefined between the client, the design professionals and the builder. Finally, a clear divide between the

roles, responsibilities, and hierarchy of interactions is established between the client and the supply chain. The responsibility for defining the "why" and the "what" is placed under the leadership of the client: in this case the project director and the design champion. The project director is the one having the final say on all decisions regarding the scope of work of the project.

> *"The role of Project Director was something that we created. There was no such thing at the time and we drew the distinction between Project Management and Project Directorship. The latter is more strategic and involved with the operational side of the hospital in order to better understand what the solution is supposed to deliver. Therefore, what we tried to promote was a better understanding of some of the techniques that are associated with health care planning, rather than health care construction."*
>
> [Director of construction]

Therefore a shared leadership is established, the project director ensuring the project governance and orchestrating the interplay between the client organization and the supply chain, the design champion leading the group of users and patients in establishing client requirements, and the project manager leads the supply chain in articulating the optimal way to meet these requirements. The role of the design champion is central to break knowledge boundaries, group thinking, and compartmentalization.

> *"We have moved around to put the patient and the patient needs in the centre. It's not as powerful as it can be, because the stakeholders are not as informed as the professionals, so they can't really chance… So it's a bit of tokenism. Tokenism can be destroying if the person who is contributing doesn't feel strong enough to challenge the professionals and when that person or that group doesn't have its roots in a community or in a group of staff or whatever, so selecting people to be involved in stakeholders is also important, in the sense of who you get buy-in to a project…It is not about knowing construction or anything like that, it's about knowing how to manage, or what I call 'project champions.' You work with a doctor or nurse in order that they may understand the process. [You are] cascading information and gaining ownership in the sense that, hearing the process from someone whom they can identify more easily with, is a supplementary process, rather than hearing it entirely from me."*
>
> [Project Director]

Weick and Robert (1993) argue that in a highly differentiated and complex context, a group could function as a highly integrated and effective team through the vigilant collaboration of key stakeholders. In this case, the project director's main role is to ensure vertical and horizontal integration. He has executive power and answers directly to the project owner within the Board of the Trust. He also deals directly with the project manager, who has a similar role within the integrated supply chain regarding the management of the scope boundaries. These two ensure an efficient management of the flow.

The project manager and the design champion work together in the definition and management of stakeholders' wants and expectations. The result of these new rules and division of work is the efficient development of shared mental models by building up shared ownership, mutual learning, and heedful interrelating between users and supply chain (Table 1).

Table 1. Building shared mental models

Involvement of patients and staff in design	"There was a design group that was meeting all the time, that was looking into the design and so on until it was agreed and then everybody signed, and said we agreed on the design. So many, many meetings to discuss the design, to challenge and have explained how the design would ensure patient comfort and how it related to patient involvement." [Project director]
	"You have to work in clinical areas truly to know how things would work, but I think they had to sit face to face with them and have alterations done on the plan and have suggestions put forward by them as how this might work was an invaluable part of the process. I think allowing clinicians and kind of the staff involved to have input into it was invaluable as well." [Staff]
Mediating design features	"What was done was Gary decided that, as the design evolved and as we had discussions, he would take away the design and put it up on the wall in the ward, and then patients, they meet as a group once a week, he would explain how the design… and then bring back to us any concerns that they might have." [Project director]
Solving business issues through design	"I mean, even, and it was interesting watching her work, Karen was involved… Hudson… Yeah, his ideas at the unit were based on the needs of his relative inevitably. And some of the ideas he had were… not clinically appropriate. And the architect was able to, I guess, see through it… I mean she was really very easy to work with and come up with lots of suggestions, kind of the problems that we threw out. She was good, very good." [Psychiatrist]
Users' innovation	"I think the working relationship between the providers and now Peter and the staff to deal with the problems, and come up with imaginative solutions for the design for which, you know, inherently probably come from our end, I think, rather than their end." [Psychologist]

Results clearly demonstrate the positive impact of the procurement framework on the dynamic of the integrated team. Users were allowed full participation in the design process, generating most of the innovations. As asserted by staff and psychologist, their participation in the design process not only permitted to integrate innovative solutions for improving the rehabilitation of the patients but also allowed for building buy-in and co-ownership of the design process. It was observed, as a result, drastic changes in patient behaviors, including an important reduction of aggressions, much faster reintegration of patients into the community, and much better retention of staff. The project was delivered within time and budget.

Discussion and conclusions

This paper reported results from case studies examining the influence of procurement routes on the performance of integrated teams. Results first describe the socio-cognitive problems related to integrated teams in transactional contractual arrangements of design-bid-build, and then illustrate how innovative procurement approach can help resolve some of these problems and improve team performance. It was demonstrated that integrated team is a new paradigm of work that requires a change of context in order to break barriers to team performance.

The Canadian case illustrated the limitations of a process approach to change practices in design. It also illustrated how transactional and fragmented procurement generates an adversarial context that increases the intensity of socio-cognitive barriers. In contrast, the new context of relationships created by Procure-21 framework helped mitigating the socio-cognitive barriers identified in the Canadian case.

The research remains exploratory. More empirical research is needed to better understand the dynamic of integrated team and how procurement could be tailored to leverage team ability to perform. Moreover, while new forms of procurement can create better context to integrated team work, there are still fundamental problems that remain unanswered regarding design professional's ability to perform in this new context. Existing bodies of knowledge and training curricula of design professionals are ill-adapted to integrated teams. Future investigations should explore how to best realize the necessary transformations to existing design practices.

Key Lessons Learned:

- Problems with integrated design team efficiency are related to context and not process: they are not technical but socio-cognitive.
- Fragmented transactional contracting increases socio-cognitive barriers that hinder integrated design team performance.
- New forms of relational contracting may help to mitigate socio-cognitive barriers and improve integrated design team performance.
- Changing the context through procurement does not address the problem of obsolete design practices. There is a need to develop a professional body of knowledge and training that is adapted to integrated design.

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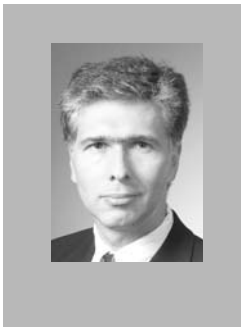
Author's Biography



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