TOWARD A CLIENT-DRIVEN REQUIREMENT MANAGEMENT FRAMEWORK FOR ACHIEVING BEST VALUE FOR MONEY

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Studies have demonstrated the relationship between project failure and poor requirement management. However, there is almost no research in the construction industry about developing clients' capabilities to manage their requirements. The research objective is to propose a systematic planning, management and tracking of client requirements to improve the efficiency of the project team and construction suppliers' ability to generate best value for money. A constructive approach based on three case studies is used to develop and test a client-driven integrated requirement management framework. Such a framework could drastically leverage project contributions to business strategy using far fewer resources, while reducing cost and schedule.

Keywords: client, design management, green buildings, information management, project management.

INTRODUCTION

In the much-heralded Latham Report (1994), value for money (VfM) was placed first in a list of eight client wishes: many clients remain dissatisfied with the VfM they receive from the construction industry. However, as Green (1996) noticed, the industry did not capture the essence of VfM; it only retained the cost reduction aspect of it, leaving aside the much more important aspect of client/users satisfaction. The British government has nonetheless adopted VfM as its policy, and has supported numerous initiatives that strive to change its procurement and project management practices. Key to these efforts is a change of focus in the definition of project and programme requirements from capital costs to fit for purpose and whole life cycle costs.

The most successful of these initiatives are built around Sir Egan's (1998) five key targets: committed leadership, customer focus, integrated teams, quality driven agenda, and commitment to people. They draw from the automotive industry and project management best practices to change the construction paradigm by encouraging process integration and measure of performance, thus promoting continuous improvement in delivering value. However, the processes adopted for paradigm change proved to be expensive and not as successful as expected. It is argued here that these initiatives failed to address management and cognitive issues. The management issue is about building purpose: a building is more than an end product; it is a means to achieve a business objective. VfM, from this perspective, is

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therefore not only about getting the best value from the project delivery process; it is also about maximizing the project outcomes for better services or business performance. The cognitive issue is about understanding the characteristics and purpose of the different activity systems in the process of defining and managing the expected project outcome with a minimum of waste.

This constructive research study aims to address the VfM management issue using a client-driven requirement management (RM) framework. It builds on the hypothesis that integration, alignment and balance of the management needs arising from the transformation, flow and value generation views for achieving VfM (Koskela 2000). The planning and design of a sustainable development demonstration project involving multiple stakeholders was used to experiment with a RM framework derived from system engineering and strategic management. The research preliminary findings are a first step to provide new empirical evidence on a unique case study where the building project purpose is the keystone of a business transformation programme.

MEASURING VALUE THOUGH REQUIREMENTS

The concept of VfM is explored using two perspectives: authors in Lean construction define value as the fulfilment of client requirements while minimizing the production of waste. Authors in IT and in project management associate Value with the ability to align projects and programmes with strategy (Henderson and Venkatraman 1999; Pmi 2003).

Whereas there is a consensus on the importance of capturing and managing client requirements, not much research has been done to explore how to define and manage clients' requirements within complex projects or programmes. An emerging view is that a programme is a set of projects and actions purposefully grouped to complete a transformation process, and, thereby, realize strategic benefits. Only fairly recently have programmes, such as OGC's (1999) "Achieving Excellence", conveyed the view that construction projects' outcomes could be one of the means of realizing strategic benefits. However, there are two key issues with today's industry practices in handling requirements that have to be resolved. One is the supplier's (professionals and contractors) understanding of the nature of the client (Bertelsen and Emmitt 2005); the second is about defining and delivering the best solution with a minimum of waste (Koskela 2000).

Defining client requirements demands a good understanding of what the client wants and why he wants it. It is common practice that the design team is responsible for establishing client and technical requirements. The issue in complex projects or programmes is that the "client" is a coalition of various stakeholders grouped together to achieve a specific business purpose. One of the key obstacles to the achievement of VfM is the need to cater for this range of stakeholders, each of whom may well have a different interpretation of what constitutes "good value" (Treasury 1994). Moreover, research demonstrates that there is no recognized process on how client requirements should be formalized within the brief: they are often established without the participation of key stakeholders, or lost or misinterpreted. Green and Simister (1999) and Barret and Stanley (1999) point out that identification of the client's needs and business opportunities through the briefing depends less on the ability to conceive design solutions, but more on the capacity to understand the nature of the client and to help him make strategic decisions, especially in complex projects and programmes,

when multiple stakeholders are involved. Projects have to satisfy the differing requirements of several parties; the process of achieving a consensus cannot be taken for granted. Requirements have not only to be managed within the coalition that constitutes the team of client representatives and suppliers who have the responsibility to deliver the building, but also within the client organization.

The second issue is about the construction production process. According to the TFV theory, the Transformation (T) view is the one that prevails in construction and in project management: the process is concerned with breaking down the proposed solution into a hierarchy of work elements that are organized in time. However, two more views have to be managed concurrently in order to achieve VfM: the Flow (F) view, which looks at how material and information is efficiently managed through time and space: it is concerned with eliminating waste and reducing the time waiting of information, and; the Value (V) view which is concerned with the fit between client, design requirement and the end product.

The problem managing the F and V views is two-fold: the traditional sequential design process, in which the focus on functional and technical requirements tends to overshadow client requirements, (Kamara *et al*. (2002); and the adversarial business context created by traditional contracting methods, which discourage collaboration between contract parties to define the solution that will best fit the business purpose (Koskela *et al*. 2006). Consequently, the building sector suffers from poor or incomplete scope definition, and frequently experiences considerable changes that result in significant cost and schedule overruns (Hamilton *et al*. 1996). Transactional contracting implies that the contractor's responsibility is limited to achieving the deliverable: at the given date; according to the solution prescribed by the bidding documents; and without interference from the owner during the process. This means great contractor independence, and thus aversion to collaboration. It also means that requirements are presented in a prescriptive way, eliminating opportunities for proposing creative solutions to problems.

Reports and studies suggest that the use of Integrated Teams and relational forms of contracting should overcome these issues, and improve value generation through a collaborative, multidisciplinary approach to managing requirements. The success of initiatives such as the UK Department of Health Procure-21 seems to confirm this assertion. Integrated teams, nonetheless, face new challenges in managing the complexity of handling the multiple layers of client and technical requirements concurrently. Methods and tools have been developed in other disciplines or industries to handle complex, evolving requirements effectively. The research aims at testing a client-driven RM preliminary construct developed in previous research.

A CONSTRUCTIVE RESEARCH APPROACH TO VFM

Constructive research treats practice as a fundamental category for making constructs as well as in ensuing theorizing (Lukka 2000). Researchers adopt two roles in the constructive research process: an inquiry role, in which the researcher should be able to view the activity systems from a systemic perspective, and create models or constructs about the activity systems as if they were looking at them from above; in the intensive stage of the study, the researcher's attention switches to the change process and, there, primarily to the individuals' and the organization's problem and solution processes.

The process of constructive research is complex and non-linear. It requires understanding and interpreting the real world; it also necessitates creating and experimenting with models of a new reality. The idea of a client-driven RM approach as a means of aligning project results with strategy emerged from prior research on enhancing construction project delivery processes. Systematic RM is the process of capturing the documented statement of stakeholders' and users' wants and needs (quality), and ensuring that the solution efficiently meets these requirements (conformance). The systematic management of Requirement processes is identified as a project key success factor in system and software engineering literature.

The research was designed as a series of steps or iterations, moving from literature to interviews and case studies, in which models are used at each step as mediating artefacts when interpreting and acting on the real world (Figure 1). This paper presents part of the results of the third iteration.

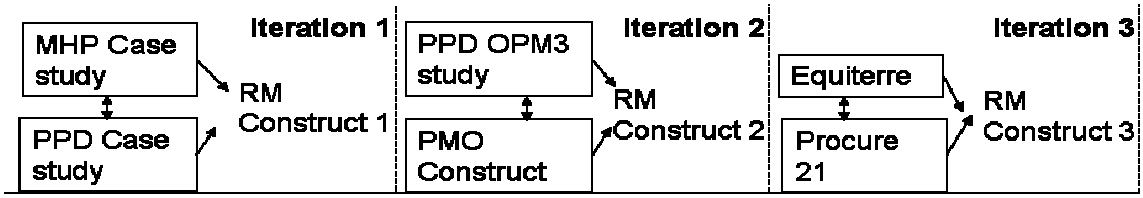

Figure 1: Constructive research iterations

The first iteration was conducted within the Canadian Services construction programme, which was experiencing serious problems dealing with complex evolving multiple client requirements. A weapon development programme using leading-edge RM processes was used as a case study to develop an RM concept of operations. The second iteration (Figure 1) explored the multiple levels of requirements of complex projects and programmes based on the Project Management Organizational Project Maturity Model (PMI 2004).

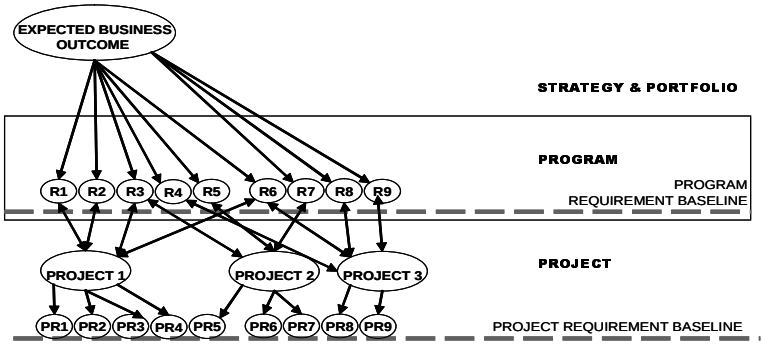

Figure 2: Programme requirement-based construct

This model contends that project outcomes should be aligned with strategy through portfolios, programmes and projects. Figure 2 proposes a systematic approach to provide this dynamic alignment from the strategy (providing the outcomes related to the business objectives) to operations (providing the building expected characteristics)

through layers of requirements. Kauppinen (2005) identifies three levels of requirements: business requirements – high-level objectives of the organization or customer; user requirements – describe user goals or tasks that the users must be able to perform with the product; and technical requirements – more detailed descriptions of the user requirements, are defined from the point of view of the expert. Sommerville (2004) points out that some of the key problems in managing requirements result from a failure to make a clear separation between the different levels of requirements. Strategic alignment was identified as a possible answer to the issue of managing different layers of requirements in the organization, from the strategy (providing the outcomes related to the business objectives) to operations (providing the building expected characteristics).

The aim of the construct was to provide real-time dynamic alignment capability to manage a complex construction programme. In this model, the programme requirement baseline is the mediator between strategic and project requirements. Deviation from the baseline induces three possible courses of actions: at the project level, taking corrective actions; at a programme level, adjusting the programme strategy in delivering the expected benefits, or; at the business strategy and portfolio levels, adjusting the strategy according to emerging strategies from the program and the project context.

RESEARCH METHODS

Two other case studies – in which Integrated Design Process (a multidisciplinary approach to problem-solving having its roots in concurrent engineering, where it is combined with parallel task processing to reduce cost and delays in design and production while increasing the process quality. By encouraging collaboration, IDP addresses numerous problems associated with the management of Flow (F) and Value (V) in sequential design, such as briefing process disclosure and feedbacks (V) problems, or design process resolution of wicked (F) problems) or relational contracting were used to encourage collaboration – were identified to develop and test the construct: the first as a reciprocal case (Yin 2003), the second as an instrumental case study. The paper presents the preliminary results of the latter, an on-going green building demonstration project in Canada. The case study process was divided into two phases: The first phase – the Constructive Research inquiry stage – focused on the observation of the client and design team interactions; the second phase, on the construct experiment for the management of requirements regarding sustainability.

The inquiry stage aimed at understanding the management and cognitive issues related to integrated design and defining the best strategy to test the RM construct. A total of five brainstorming and four design workshops were observed in École de Technologie Supérieure e-collaborative design tools laboratory. The workshops were filmed, and all electronic documents and drawings recorded. A qualitative, grounded research interview-based case study was carried out to identify the client stakeholders' wants and expectations. Nine interviews were conducted, five with the shareholders and four with the stakeholders, to establish the shareholders' business objectives and the stakeholders' needs, expectations and. requirements regarding sustainability. The resulting data were analysed using Nvivo7 software, and prioritized in Doors client requirement module of the Doors data model (Figure 3).

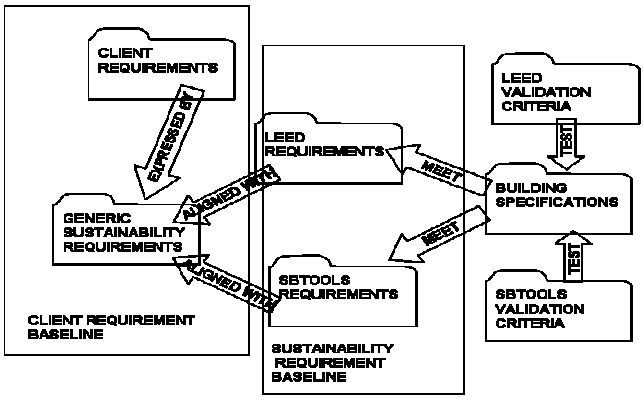

Figure 3: Doors data model

The model is the instantiation of the RM construct (Figure 1). The client requirement module (strategy) contains the sustainability business requirements, which are detailed in the generic sustainable requirement module. Generic requirements cover the programme's social, economic and environmental perspectives. They constitute the client's programme requirement baseline. The building requirements (LEED and SBTools) are the project sustainability technical baseline.

The intensive stage of the study aims at testing the use of systematic RM to manage the client's strategic and operational requirements. A preliminary RM modelling was realized to map the tracking process of the sustainability requirements. Two environmental benchmarking tools were selected to demonstrate the project's sustainable value: The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™, the most popular rating system for the design, construction, and operation of high performance green buildings in North America, and SBTool 07, benchmarking software developed as part of the Green Building Challenge process, an international effort to establish a common language for describing "green buildings". Finally, a LEED/SBTool baseline was created to verify proposed design solutions against LEED/SBTool sustainability requirements, and to validate these solutions against client sustainability requirements.

CASE STUDY DESCRIPTION

Maison du développement durable

The Maison du développement durable project aims at building a sustainable building demonstration project in downtown Montreal. The client, Equiterre, is a non-profit organization devoted to promoting social equity and a more sustainable world. Equiterre has built its reputation on programmes that are now a few years old. Its board felt that Equiterre had to redefine itself to deliver a more powerful message. Equiterre's strategic objectives are to leverage the organization influence in sustainable development by creating a pole of attraction, a model of what sustainable development should be; and to consolidate the organization and its partners. To do so, Equiterre has created a coalition with eight other non-profit organization sharing similar values; these will be the partners and the tenants of the project. It has also devised a new sustainability programme, of which the demonstration project is the keystone.

Competition for public and private funding is fierce. The project aims to be a strong public statement and a platform to launch new programmes. It will also help to recruit

public and private partners. As a demonstration project, it will attract visitors (and future members). It is totally funded through grants.

Equiterre has no experience in construction projects. However, it has formed a steering committee represented by executives and experts from large real estate organizations. The design team was selected through a multiple stage process based on the following criteria: working chemistry among the team and with Equiterre's project team; quality of their projects, experience in sustainable construction; and shared values with Equiterre. The team has realized the first certified LEED Gold project in the Quebec province, and has won numerous prizes. According to the contractual arrangements, the team had to use an integrated design process to achieve LEED/SBTool sustainability requirements. The aim is to receive international recognition by exceeding the most stringent certification requirements. The team also has to conduct workshops in Ecole de technologie superieure laboratory as part of the research programme.

The integrated design management process

IDP is an iterative approach originating from product and software development, designed to aggressively reduce uncertainties, in favour of earlier and better decision-making. It was successfully used in system engineering to drastically shorten the development time of software intensive advanced weapon systems, such as spy planes (U2 and SR71A) or satellites. Various formal or agile integrated design frameworks are now used in these industries.

RM plays a central role in these fields. Problems in handling requirements account for close to 60% of project failures (Standish Group 1994). Stage-gating, configuration management and requirement engineering methods and tools are considered as essential for developing the necessary capabilities for achieving required project performance. They are core requirements in achieving higher maturity levels in the Software Capability Maturity Model. It has proved in software development to drastically reduce waste, while providing a much better fit for purpose.

Integrated design is just emerging in construction, and there is no clear definition or framework for applying it. It has been identified as the best approach for delivering VfM, and it is also acknowledged as the best approach for delivering sustainable buildings. These two main strands – one driven by the Rethinking Construction movement, the other by the sustainability movement – are both aimed at increasing the industry's capability to deliver a better product with a minimum of waste. The first movement is client-driven; the second is supplier-driven. The Equiterre project is in the second category.

Testing the RM framework

The construction industry's aversion to innovation is well known. Testing an RM framework in an integrated design context is far-removed from traditional practice both on the client and supplier's sides. Alignment is not a concept commonly used in organizations that regard the management of real estate project portfolios. Alignment models are scarce, and belong to other disciplines. Moreover, critics of strategic planning and alignment maintain that the implicit dominance of a structured strategy process is questionable in an era when uncertainty and flexibility predominate. Ciborra (1997) argues that management, through knowledge and understanding of alignment, can classify their strategy in terms of boxes and linear relationships, but back in the real world, they have difficulty measuring those relationships or

formulating processes to apply the alignment maps in practice. In other words, conventional theory on alignment does not address cognitive issues. The testing plan was built around "soft" approaches to IT system implementation to mitigate these issues (Table 1).

Table 1: Key ingredients in the testing learning cycle (Walton 1989; Ciborra 1997)

Walton	**Ciborra**
Alignment: • Vision aligned with business, organization, and technology strategies • System design and operational use aligned with vision	Alignment: • Grounded approach to alignment: understanding the business phenomena to enrich the geometric notion of alignment
Ownership: • Organizational commitment (sponsorship); stakeholder support for IT • System designed to tap and promote user ownership • Users feel strong ownership of the system	Care: • Familiarity, intimacy and continuous commitment by the various actors involved in the design, implementation and use of the system Hospitality: • New technology is highly ambiguous. Acceptance has to face ambiguity: coping becomes hospitality
Competence/Mastery: • Competence and IT literacy • System designed to use and promote mastery • Users mastering the system	Cultivation: • Is based on frequent misalignment and misfit: the technology being accumulated is greater or different in its potential, than current internal or external needs

Equiterre has set a steering committee at the programme level and a technical advisory committee at the project level. The inquiry stage was divided into two: observation of the supplier-driven process and observation of the steering committee handling of the programme. The supplier design process was staged in a series of one day and half a day Workshops, held from August 2006 to February 2007. The intensive stage of experiment was started in parallel with the inquiry stage. A qualitative grounded research technique was used for Requirements elicitation and analysis at the programme level. A Programme Charter, which outlined the programme strategy objectives, was derived from this analysis. The sustainability related objectives were broken down into characteristics. Both Charter and characteristics were mapped into Doors using the traceability links and then frozen into the client requirements configuration baseline. The LEED and SBTools benchmarks were then mapped and each criterion linked to a client configuration item. They constitute the project technical baseline. The proposed concept is now being assessed against these two baselines.

DISCUSSION

The case study had a unique feature that enabled the parallel inquiry and intensive stages. Two sustainability benchmarks were identified to obtain international recognition. However, neither the client nor the design team realized that the benchmarks were built around opposite design strategies. In contrast to SBTools, LEED does not demand any change in the traditional Sequential Design process (T view). It is essentially a checklist. The objective is to gather as many sustainability points as possible. The trend in the industry is to develop the design, conduct the energy simulation, and add technology to increase energy efficiency up to the desired

score. There is no specification about if integrated design should be used, and how it should be managed. The design team was familiar with LEED and devised a series of workshops to meet the client's requirement for an integrated approach.

The brief prepared by the architect captured the space requirements, but not the business strategy and objectives, nor the constraints imposed by the project financing scheme. After one year of work, the concept was assessed against the programme expected characteristics and the project technical baseline. Whilst achieving most of the LEED sustainability criteria, the scheme did not achieve some core business objectives, and exceeded the cost targets. Management and cognitive issues were observed during the inquiry stage, with the conducting of workshops, which were also perceived by the client as quite ineffective and time consuming.

One management issue is the complexity of handling multiple levels of requirements. Because there was no organized process for managing the hierarchy of requirements, discussions moved from technical to business requirements and vice-versa: time was wasted in useless iterations between these two levels. A cognitive issue was the experts' difficulty in understanding what kind of information the client needed for decision-making. The experts pushed the client to make decisions to develop the design options, while the client was asking cost information to asses their business value. This is qualified as cognitive inertia and compartmentalization. One of the mechanisms behind such inertia is "groupthink", 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. Another possible mechanism is, paradoxically, almost the opposite of "groupthink", namely, fragmentation of viewpoints and lack of "shared mental models." Such fragmentation may make it impossible for experts from different contexts to "speak the same language" and exchange ideas about a problem.

The advantage to conducting the inquiry and intensive stage as two parallel processes was to make the client realize the value of a client-driven RM approach. SBTools shares System Engineering RM Vee model core principles of decomposition and abstraction: it was used as the sustainability technical requirement framework and integrated in Doors programme-based construct. The system is partitioned into finer and finer elements, while the requirements start at a highly abstract level to become more specific for the lower-level elements. SBTools first requires that sustainability targets be identified by the client at the beginning of projects (V). A reference model is developed by a third party to define the local benchmarks regarding common, good and best practices. A concept is generated through workshops and tested against the reference model. The client, after reviewing the score of the concept against the reference model, can then adjust his target. Then a series of steps are defined to refine the design for each component through design workshops. The result from iteration is adjusted against its related benchmark (T & V).

CONCLUSIONS

It is reported in this paper that preliminary research results from an instrumental case study aimed at providing a proof of concept for the programme-based RM alignment construct. They demonstrated the value of using client-driven RM to achieve VfM. The client was capable of comparing the proposed concept with his requirement baseline, and of identifying flaws in the design. They also highlighted the issues related to changing the industry's practices. Researchers have advocated that VfM is

best achieved through integrated approaches and relational contracting, but did not address the management and cognitive issues related to these approaches.

This research is exploratory and still ongoing. The exploratory systematic RM construct will have to be experimented on in the second phase of the project. A reciprocal case study has been conducted in parallel, and a conceptual framework was developed to explore the socio-technical aspects of VfM. The intensive stage will be used to validate, better understand and extend this framework. Questions about the cognitive issues and their articulation against TFV theory will be further investigated.

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