Developing a monitor for the characterisation of supply chain collaboration and the measurement of its effectiveness in the Dutch social housing sector

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Abstract

In the Dutch building sector, and in the social housing sector in particular, supply chain collaboration between housing associations and their supply chain have been quite popular since last five years or so. Many associations and their supply chain partners have tested, and in many cases continued to apply various representations of supply chain collaboration. This has varied from newly built houses to maintenance of existing stock, and many other characteristics influencing the collaboration. In all cases the parties involved have aimed and hoped for better performance of projects as a consequence of applying supply chain collaboration. Two main issues have arisen amongst the associations and their supply chain partners: How do various representations of supply chain collaboration applied by different parties relate to each other characteristically? How does supply chain collaboration in projects of different kinds influence the performance outcomes of these projects, and thus give evidence of the appropriateness and effectiveness of supply chain collaboration. Therefore a supply chain monitor has been developed as an instrument to assess the levels of the resources and processes in projects, versus the performance outputs and outcomes of these projects. This paper presents the background, purpose, development and structure of the supply chain monitor and compares it

to other models, in order to discusses the internal validity and usefulness of the monitor to characterise supply chain collaboration and measure its effectiveness in projects.

Keywords: supply chain collaboration, social housing, taxonomic characteristics, measurement, effectiveness.

1. Introduction

As in many other sectors supply chain collaboration has been shaped by the context of application. In its specific context the application of supply chain collaboration in construction has been shaped. The organisational approaches to supply chain collaboration have particularly been influenced by the one-off, temporal nature of projects; the large number of firms involved in the definition, design, manufacture and assembly of built objects involving many relatively small firms; the dispersed power and governance regimes; and the initiating role of clients. These characteristics and other specific aspects of building have influenced how firms in the building industry operate, how they manage their inter-firm relationships, and thus, how they collaborate. In order to address improvements of this situation, managerial and organisational arrangements as part of collaboration between firms need to be addressed.

A more integrated approach to supply chain collaboration has been suggested as a solution to the many problems and deficiencies existing in building, including the social housing sector. On the other hand, the restrictions on increasing the level of integration in building also need to be taken into account. The underlying principle of supply chain collaboration would be that the supply chain that is delivering a single product should not be fragmented nor consist of distributed functions. Instead, supply chain collaboration would lead to a more stable and repetitive production environment. The premise here is that the supply chain would function better when approached and reconceptualised as a single entity, an extended enterprise or a single virtual organisation. The deeper issue here is whether the industry could or should develop itself structurally towards the standards and practices of a more integrated and repetitively operating industry, and improve performance levels consequently (Vrijhoef 2011).

2. View on the Dutch social housing sector and the trend towards supply chain collaboration

Social housing in The Netherlands is the domain of housing associations. The Dutch social housing sector is larger than in most countries. Roughly one third of the total housing stock is labelled as social housing, 10% is privately rented, and 55% is privately owned property (CBS 2012). Housing associations are organizations which function as hybrid organizations between state and market: They are bound by legislation to primarily provide social housing for households with lower incomes, and households and individuals with special needs for care. On the other hand they can act as private parties being active on other (commercial) domains of the real estate market as well. This made housing associations relatively free to decide how to finance and organize their investments and activities in housing and other real estate development activities. Recent years, however, changes in European and Dutch governmental rulings have forced housing associations to diminish their commercial activities. Combined with the economic crisis, housing associations are forced to come up with different and new strategies to be able to finance and invest in the (re)development and maintenance of their

current stock. One of the strategies to do so is to improve their real estate development and maintenance process.

Housings associations are typical parties on the Dutch social real estate market that perform all real estate management disciplines that regular developers would do, but in a social context including the care of neighbourhoods and its inhabitants (Figure 1). Based on this wider responsibility, they can be viewed as 'social investors', not only on the level of classical types of fund, portfolio, asset and property management of real estate development (Van der Kuij 2014). But it includes issues of social well-being and care of often socially weaker types of users. As a consequence, in contrast to many 'regular' developers on the 'normal' real estate market focussed on a limited number of activities, housing associations are used and expected by their users and governments to perform more varied activities and different types of roles typically connected to social real estate.

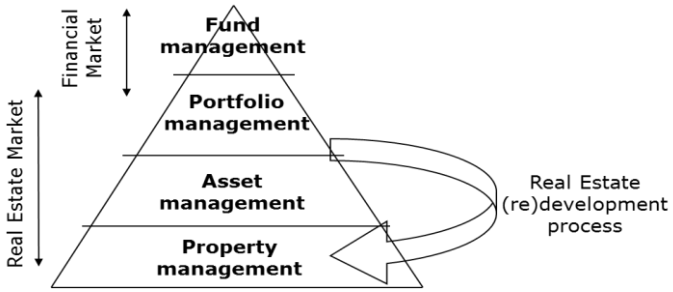

Figure 1: Real estate management disciplines

Most of the recent efforts to apply supply chain integration and strategic forms of collaboration to the Dutch building industry have taken place in new house building, notably by housing corporations in cooperation with large builders (Building Business 2010a). In addition, a few housing corporations have begun to apply supply chain integration to their renovation programmes as well (Building Business 2010b).

3. Introducing the supply chain monitoring project

3.1 Background of the supply chain monitoring project

The aims of applying novel types of supply chain arrangements have deemed to lead to increased process efficiency, increased customers satisfaction and the contribution to such goals including sustainability, liveability and energy efficiency. Explorative research in the past years, such as Koolwijk (2013), contribute to the belief the supply chain integration leads to promising results on these fields. However, from their background, as explained, housing

associations are used to coordinate the activities themselves and therefore they are sceptical towards integrated models and innovation of the process on ‘how they always performed’. The ‘believers’ in supply chain integration are convinced of the possible improvements in the process. Housing associations in general, however, still need to be convinced by actual facts and figures on what process changes really are effective.

Based on this idea, a group of leading housing associations having experimented with various, in some cases ‘home grown’ applications of supply chain collaboration and the main contractors involved in those collaborations have showed to be eager to know the typical differences and similarities of their respective approaches, and the effects those approaches have in projects, for instance compared to traditional projects.

3.2 Purpose of the supply chain monitoring project

Since 2008 housing corporations have shown increased interest in the principles of supply chain collaboration. Individual projects have shown variable improvements. the development and introduction of an integrated process format, the application of new collaborative tools and working methods has been a part of the supply chain integration. In terms of collaborative working methods, the integrated process formats applied have included various ways of collaborative working and supportive measures to facilitate supply chain integration on an operational level. One can distinguish a number of issues that are of importance for the successful application of supply chain integration in real estate. First of all it is key to select and involve the right supply chain partners and people. Amongst them a positive and constructive atmosphere must be created actively. Establishing trust and transparency is a major prerequisite, combined with the alignment of business objectives and commercial interests of the supply chain partners. Not only on a strategic and contract level, but also on a tactical and operational level processes, procedures and systems must be aligned. In essence it is to think and act as one firm, with everyone involved to be committed to add value to the supply chain. Besides it is important to take a multi-project approach to the business. Repetitive working must lead to strategic thinking, increased innovation and continuous improvement. This also enables to keep teams together for multiple projects, and to learn collectively as a result of continued work. The last issue is to measure the results, i.e. effectiveness of the output in terms of the levels and predictability of time, quality, costs, sustainability and health and safety, and finally the satisfaction of users and the project team (Figure 2) .

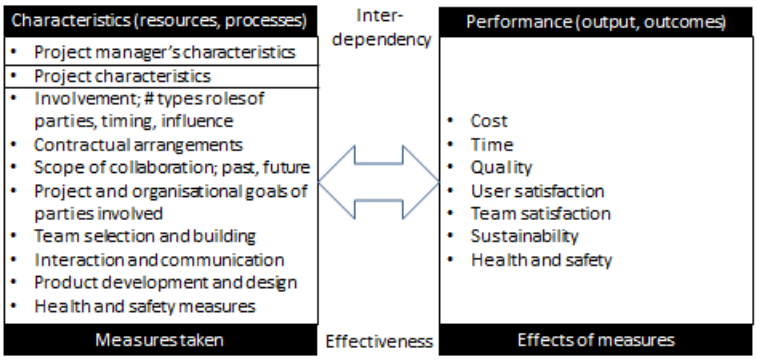

Figure 2: Purpose of the supply chain monitor

4. Literature overview of supply chain collaboration in construction and its measurement

4.1 Characterisation of supply chain collaboration and its adoption in construction

Various supply chain concepts have emerged in parallel in theory and practice, in particular in manufacturing. These concepts are highly related and show much conceptual overlap This has led to much ambiguity between the definitions of the different concepts. Generally all supply chain concepts have originated from logistics and materials management (Christopher 1992). Gradually the concepts have evolved towards broader approaches to the supply chain, including additional aspects such as marketing and supplier involvement in product development (Cooper et al. 1997). Along this development supply chain management evolved from merely focussing on inventory planning and logistics management towards more comprehensive outsourcing strategies for instance including economic issues and risk sharing with suppliers (Williamson 2008).

In addition to supply chain management, supply chain collaboration and cooperation often include the establishment of collaborative information systems, particularly in fast consumer goods and retail sectors (Soosay et al. 2008). Further to supply chain collaboration and cooperation, supply chain alliances and partnerships have fostered more equal relations between supply chain firms viewed as partners. Often such alliances and partnerships reside on a strategic or tactical level between the firms involved, for instance including integrated arrangements to finance and risk sharing, but not necessarily collaborative management of activities on an operational level (Persson & Virum 2001).

As in other sectors of industry, supply chain collaboration in the construction sector is aimed at the alignment of the supply chain from client to suppliers. In first instance supply chain integration needs to bring transparency to the building process and build trust among supply chain partners. In practice this means that all parties are involved from the very beginning to the very end of real estate projects. Moreover supply chain integration goes further. It often implies

a multi-project approach, so that the group of parties and people involved are able to engage in a learning curve. Firms are then enabled to invest in innovation of products, processes and systems for a longer period of time. Therefore supply chain integration is often being supported by a long-term focus and strategic collaboration. The effects envisaged include the reduction of lead time, project risks and costs, and also the improvement of quality, satisfaction and profitability. Another opportunity for improvement is the introduction and reduction of life cycle costs while suppliers and maintenance firms are involved and play their part in the development and the design. Close and intensive collaboration, shared objectives, and the achievement of long-term success and improvement are key issues here (Vrijhoef 2011).

4.2 Measuring the effectiveness of supply chain collaboration in construction

Organizational effectiveness or performance is the ultimate dependent variable in much organization and management research (Cameron and Whetten, 1983). Discovering the independent variables that define effective and ineffective organizations is the major challenge for organizational evaluation (March and Sutton, 1997). Recent conceptualization of organizational effectiveness has been broad resulting in five major approaches: goal-attainment approach, system-resource approach, multiple/strategic-constituencies approach, competing-values approach, and the ineffectiveness approach (Glunk and Wilderom 1996, Henri 2004).

4.2.1 The purpose of measuring effectiveness of supply chain collaboration

The two main questions of this research are: (1) *How do various representations of supply chain collaboration applied by different parties relate to each other characteristically? (2) How does supply chain collaboration in projects of different kinds influence the performance of these projects, and thus give evidence of the effectiveness of supply chain collaboration?*

The purpose of this research to develop a model of organisational effectiveness that: (a) is applicable across a broad group of different types of building project organisations; (b) defines the characteristics of different organisation forms (with a focus on those characteristics that distinguish supply chain collaboration from other forms); (c) measures the output and outcomes generated by these organisations for different stakeholders.

Based on our measurements we also try to find a causal relationship between the output, outcomes and certain characteristics thus defining the determinants (or predictors) of performance. In other words, in this study the differences in the dependent measures are considered to represent performance caused by the variations in the independent measures.

4.2.2 Choosing an approach to the measurement of effectiveness

Taking the purpose and goal of this study means our model needs an integrative approach that looks at the means used for the achievement of specific goals and the degree in which the

organization is able to deliver according to the expectations of different stakeholders. This integrative perspective is provided by the multiple-constituencies approach to organizational effectiveness. A model that is based on the multiple-constituencies approach broadens the scope of the goal attainment and system resource models by adding the expectations of the various interest groups that circle around the organization (Conolly et al., 1980).

The multiple-constituencies (or stakeholder) view takes explicitly into account that organizations serve multiple goals: each type of organizational constituency (such as owners, employees, customers, the community, etc.) is supposed to have different interests vis-à-vis the organization, and will therefore apply different evaluation criteria (Glunk and Wilderom, 1996). Put more simply by Carton (2004), each stakeholder will have a different perspective of what is "valuable" thus influencing their view of organizational performance.

5. Development of the supply chain monitor

5.1 Structure of the monitor

The supply chain monitor has been developed in the two year monitoring project based on interviews and monthly focus groups of the parties involved in the project including six housing corporations and seven main contractors. The elements of the monitor have been predefined based on previous research and literature introduced above, next discussed and shaped with the parties involved, and structured into sets of variables and subjects, and finally operationalised in an online questionnaire by the team of the university (Table 1). The type of scales used to measure the variables are codes as follows: continuous (con), interval (int), categorical (c), nominal (n), ordinal (o), interval (i) or ratio (r).

Table 1: Structure of the supply chain monitor

Components (dependency)	*Variables*	*Subjects, questions asked within the components (and types of scales used)*
Project (independent variables)	*Project characteristics*	*Name, type and location of project (c),Construction phase (c), Function (c), type of contract and delivery method (c), floor surface* (con), *amount of floors* (con), *technical complexity (o)*
Resources (independent)	*Project managers (client contractor)*	*Age* (con), *Education (c), Gender (c), employers' company name*
	Organisations involved	*Roles of project team (c), phase in which involved (c), names and addresses of team members.*
	People involved	*influence of each team member (o), selection criteria used to select team members(o), methods used to compose the team (c), team procedures (o), joint location for the team (c), joint history of the team (0), level of support from management (o)*

	Past and (potential) future involvement	*Extent of previous collaboration in single or multiple projects (o), intentions or agreement for future collaboration in single/multiple projects (o)*
Processes (independent)	*Transparency*	*level of accessibility of financial and additional information between client, contractor and subcontractors, and vice versa (o)*
	Systems/ Procedures	*use of joint information sharing (c), joint risk management (c), joint planning i.e. lean planning (c), joint decision making and evaluations (c), joint quality assurance (c)*
	Collaboration	*Use of team building and joint training of the project team (c), purpose of training (c)*
	Finances	*Use of financial incentives (risk/reward) (c), level of joint purchasing (c), level of project risk sharing (c)*
	Design	*Use of BIM (c), purpose of BIM (c), use of design concepts of references(c), use of prefab (or similar) solutions (c), use of maintenance history (c)*
	Logistics	*Use of integrated logistics during construction (c)*
	Health & safety measures	*Involvement of team in H&S plans during design (n), safety measures taken (c), level in which H&S plans were useable during construction (o), amount of safety visits (by authorities) (con), scores given by authorities (int), use of accident records (o)*
Output (dependent)	*Project goals*	*Areas of goals formulated (c), level of formulation of goals (o), level of goal achievement (o)*
	Finance	*Ratio between cost estimate(s), awarded bid and final costs of construction, and total investment costs (r), reasons for changes in cost (c)*
	Planning	*Ratio between estimated duration at the definition and design phases, and actual duration at the end of the project (r), reasons for changes in duration(c)*
	Quality	*Amount of defects (con), defects that postponed the final completion of project (con), working days used to solve defects (con and r, when divided by total construction time), outcome of air permeability test (o), outcome of ventilation performance test (o), outcome of thermo graphic inspection (o)*
	Sustainability	*Ratio between planned label (BREEAM, GPR or EPA energy label) at the end of definition and design vs achieved label after construction (r)*

	Health & safety	*amount of accidents leading to a non-attendance longer than 1 day (con), amount of people sent away because of violating H&S codes (con), project manager's view on H&S (o), amount of effort needed to get achieve H&S goals and attitude (o)*
Outcomes (dependent)	*User satisfaction*	*Method used to measure user satisfaction (type), Score of user satisfaction versus average of previous projects (o)*
	Project manager (client) satisfaction	*opinion about the project team (o), effort of team members (o), responsibility taken by team members (o), involvement of team members (o), performance of team (o), view on the collaboration (o), chances of repeating this way of collaboration (o)*
	Project manager (main contractor) satisfaction	*Same as above row of client's project manager*
	Team satisfaction	*Opinion about team atmosphere (o), Fun working in the team (o), Room for new ideas (o), attitude among team members (o), efficiency of the team (o), transparency amongst team members (o), involvement of team members (o), room for improvement of team functioning (o), pride in working for the team (o), self-esteem (o)*

5.2 Comparing the supply chain monitor to other models

Besides the supply chain monitor, other models have been developed in recent years aimed at the same kind of topics and the impact on performance levels. However only few models have explicitly connected the analysis of the construct of the phenomenon at hand and the effects it causes. Various aspects of those models can be compared; the topics covered, the aims, the variables used, and the types of measurement scales used. Anticipating further comparisons, in this paper we started to compare the supply chain monitor's structure to two other models (Table 2).

The comparison shows a few similarities and differences: Separate elements in the respective models' structures are comparable as such, but often formulated differently, and in some cases individual elements in the one model refer to two or more elements in another model. Two basic differences can be found in the balance between groups of dependent and independent variables within each model, and the presence of specific elements at all in the models, as shown in the table below. Different backgrounds, contexts and aims may be causes of these differences, and must be studies further.

Table 2: Structure of the supply chain monitor compared to other models

	Supply Chain Monitor	*Esmaeili et al (2013)*	*Eriksson & Westerberg (2011)*
Project	*Project characteristics*	*Contract type* *Project characteristics*	*n/a*
Resources	*Project managers*	*n/a*	*n/a*
	Organisations involved	*Timing involvement*	*number of contractors*
	People involved	*Team selection* *Team interaction*	*n/a*
Processes	*Transparency*	*n/a*	*payment based on incentives* *performance evaluation*
	Involvement	*Owner's role*	*client and contractor jointly selecting subcontractors*
	Collaboration	*n/a*	*soft parameters in bid evaluation* *use of collaborative tools*
	Design	*n/a*	*integration of design*
	Health & safety measures	*n/a*	*n/a*
	n/a	*Delivery method*	*n/a*
Output	*Finance*	*Cost performance*	*Cost*
	Planning	*Schedule performance*	*Time*
	Quality	*Quality*	*Quality*
	Sustainability	*Sustainability*	*Environmental impact*
	Health & safety	*Health & safety*	*n/a*
Outcomes	*User satisfaction*	*n/a*	*n/a*
	PM satisfaction	*Absence of conflict*	*n/a*
	Team satisfaction	*Absence of conflict*	*Work environment*
	n/a	*n/a*	*Innovation*

6. Discussion

This paper has presented the background, theoretical founding and development of the supply chain monitor for the characterisation of supply chain collaboration and the measurement of its effectiveness in the Dutch social housing sector. More specifically the paper has presented the supply chain monitor 'from inside out' with few comparisons with other models, and in way analysing the construct and internal validity of the monitor as it developed as such. We must be aware the monitor like comparable models have partly been developed deductively from generic theory, but partly those models have inductively been built in a particular practical context, in a segment of the construction industry of a particular country, not excluding additional contextual factors influencing the structure, aims and outcomes of such models.

Therefore the external validity of the monitor 'from outside in' i.e. compared to other concepts and examples of performance measurement models in theory still needs our attention and will be discussed in a following paper positioning the supply chain monitor within the field of effectiveness and performance measurement of project management and project organisation in construction theory, and wider in more generic organisational and management theory.

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