Towards a framework for successful supply chain transformation:
Applications to the Dutch construction industry

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Abstract
This paper introduces a Supply Chain Excellence Maturity Model (SCEMM) that can be used by organizations to implement the various concepts of Supply Chain Management (SCM). The SCEMM measures the maturity of organizations on five different organizational aspects and distinguishes four maturity levels on each aspect. Over the last years the SCEMM instrument has been used for various types of organizations in the Dutch residential housing construction supply chain. The empirical results demonstrate that most organizations in this industry are still far from the higher SCM maturity stages.

Keywords: Collaboration, Maturity, Construction

Introduction
Over the last two decades, the concept of Supply Chain Management (SCM) has drawn a lot of interest from both academicians and practitioners. From the theoretical models, it is evident that SCM leads to improved quality, availability, speed, flexibility and cost performance for the end-user and at the same time improved operational and financial performance for all organisations participating in SCM efforts; cf. (MacNeil, 1974), (Baden, 1995), (Stephenson, 1996) and (Li, et al., 2006). However, there appears to be a huge gap between the theoretical concepts of SCM and its application in real-life settings. Despite the promises of the SCM theories and a wide variety of successful SCM implementations, the concepts of SCM are still not widely implemented by the mass of organizations; cf. (Winch, 2000), (Moberg, et al., 2003) and (Richy, et al., 2009).

One possible reason why real-life SCM implementation has fallen behind its theoretical potential might be the apparent lack of clear and workable implementation frameworks and associated tools (Naslund & Williamson, 2010). To overcome such obstacles, this paper suggests a framework that can be used by practitioners for making SCM implementation more workable.
Although SCM is a general purpose concept and philosophy, many papers have advocated a contingent view; i.e., applying SCM is likely to be dependent on the specific circumstances; cf. (Cox, 2001), (Das, et al., 2006), and (Flynn, et al., 2010). Therefore, this paper will focus on implementing a general SCM framework in the Dutch construction industry, and more specifically for companies who play a role in the construction, renovation and maintenance of residential housing.

The remainder of this paper is organized as follows. First, a description of the various characteristics of the Dutch construction industry is given, after which it describes which elements triggered the adoption of SCM as an improvement tool in this industry. Next, some implementation problems of SCM are described and the possible role that maturity models can play in evaluating SCM implementation at the level of individual companies and collaborating parties. After this, the SCEMM (Supply Chain Excellence Maturity Model) is introduced and some empirical results of the SCEMM instrument are presented. The paper closes with conclusions and pointers for further research.

**Characteristics of the Dutch residential housing construction industry**

The production of residential housing is the biggest subsector within the Dutch construction industry and is responsible for almost 40% (€ 23.6 billion) of the total annual turnover of € 59 billion. Within this subsector almost 50% of the production is related to new residential housing projects, 30% is related to renovation and 20% to maintenance of residential housing (ABN AMRO Sector Research, 2012).

One of the characteristics of the construction industry in general is the lack of “innovative spirit” among organizations to engage in sustainable business models. Only 0.2% of the turnover in the Dutch construction industry is spent on R&D investments; which is very low compared to the percentage in capital-intensive (3.6%) and labor intensive (1.7%) industries. Building and construction also scores low in terms of the proportion of knowledge employees in the total workforce (Schout, et al., 2011). In a study of 58 different business sectors looking at their innovative performance, the Dutch construction industry ranked 55; see (Jong & Muizer, 2005) and (Volberda, 2012). The Dutch construction industry also has the reputation for being “conservative” (Pries & van Heijgen, 2005). One of the reasons for this reputation could be that traditional construction firms always have been focusing more on technological innovations and less on innovations in supply chain collaboration. This lack of innovative spirit made the Dutch construction industry to operate in a traditional, fragmented way and to lag behind with respect to SCM implementation.

The traditional main actors in the construction supply chain are the initiating organization (client), the architect, the advisor, the contractor, and the supplier and sub-contractor. In the traditional organization model (see Figure 1), the responsibilities for the initiation, design, and construction phases are strictly separated between the various organizations. The client puts up a “requirement specification” with the assistance of an architect or a project management advisor. The architect then designs the building and is sometimes supported by an advisor. Only when the design is completed a contractor is selected to construct the building. This traditional fragmented organization model does not use the possibility of optimizing the chain of activities (from initiation to maintenance) with a focus on reducing life cycle costs and improving quality. In other words, by using the fragmented (traditional) business model sub-optimization is eminent.
Another characteristic of the Dutch construction industry is the persistent existence of failure costs. Here failure costs are defined as costs associated with products or services that have been found not to conform to requirements and have to be reworked; cf. (Crosby, 1979), (Juran & Gryna, 1988) and (Vrijhoef, 1998). These failure costs are estimated to be as high as 11% of the total annual construction industry turnover (€ 59 billion in 2011); cf. (Busker, 2010) One of the drivers for failure costs could be the above mentioned traditional/fragmented supply chain relations, where contractors and suppliers are selected on a project basis through a rigid tendering process, with the dominant criterion being the lowest bidding price, leading to myopic optimization. Such practices result in a lack of collaboration among the players in supply chain, fragmentation, mutual distrust and a lack of possibilities for learning and improvement between projects; cf. (Love & Li, 2000) and (Vrijhoef, 2011). The problem of the relative huge failure cost and the potential of SCM to overcome such inefficiency has long been around and discussed. However, until recently it appeared that the existing culture of conservatism and lack of entrepreneurial spirit have prevented the required fundamental changes.

**The adoption of SCM in the Dutch construction industry**

Over the last three years, the Dutch construction industry has witnessed a dramatic jump in interest towards using the SCM concepts and methodology. This “sudden” leap in management attention might be explained by several factors, but there is little doubt that a major factor is due to the fact that the credit crunch hit the residential construction market hard.

Since the start of the economic crises in 2009, production in the construction industry has decreased by 20%. Especially the construction of residential housing and the renovation market were severely affected, whereas the maintenance market was consolidated. In 2013 another decrease of -5% in production is expected (EIB, 2013). In a declining market, one way to maintain a market position is reducing (failure-) costs and improving business performance on key performance indicators (KPI’s) such as Time, Quality, Turnover and Profits.

The possibilities of SCM as a driver for costs reduction and value enhancement in the construction industry have already been established almost two decades ago in (Latham, 1994) and (Egan, 1998). These publications triggered the use of SCM in the UK construction Industry and led to significant performance improvement of companies implementing SCM on the mentioned KPIs (DTI Construction Statistics Annual, 2004). Since the improved performance of SCM were highly desired and required in the Dutch construction industry, nowadays many organizations are looking at ways to implement the underlying SCM concepts.
Where traditionally organizations were competing on their strategic assets (investment in scale, scope, equity) and on the ability to deploy these assets, competition in the current market situation is more-and-more on complex bundles of skills and accumulated knowledge, exercised through organizational processes. Companies are extending outside their legal boundaries as a new way of organizing and forming competitive networks of companies. Thus organizations need to develop strategically aligned capabilities not only within the company itself, but also among the organizations that are part of its value adding networks (Day, 1994).

As mentioned, SCM is highly desired but the implementation of the various SCM concepts is fairly new within the Dutch construction industry. The effort to work more closely together and apply the SCM concept is called “ketensamenwerking” which can be directly translated as Supply Chain Collaboration (SCC). Organizations, though interested and eager to start using SCC, are feeling somewhat uncomfortable as they do not have the practical implementation tools readily available. In other words, the need for a practical SCM implementation tool that can create SCC in the residential housing industry is quite high; cf. (Noordhuis, et al., 2012) and (Noordhuis & van der Veen, 2012).

Fundamental to SCC as used in the Dutch housing construction industry is that a win-win situation is created; all parties involved in a construction project should benefit in terms of profitability and the collaboration should lead to better performance (in terms of better quality, faster & more dependable projects and lower life cycle costs) for the integral project (from initiation to maintenance) leading to more satisfied end-users compared to the “traditional” way of working.

Tendering for each single project and each single subcontractor is replaced by relying on a stable set of partners. Benchmarking and joint continuous improvement programs are used to ensure competitive pricing. Partners discuss projects early on (at the initiation stage) and include life cycle costing aspects in their decision making/optimization process. Rather than the client deciding on everything and giving detailed instruction to all other parties, as is typically the case for traditional projects, within SCC everybody is expected to use their own (creative and innovative) ideas and specialization within a given set of mutual agreed guidelines, objectives and targets. In SCC all parties share all information and align their objectives by agreeing on a set of key performance indicators (e.g., on time, costs and quality). When these performances are realized, all parties involved also share the extra benefits from SCC. More specifically, SCC in Dutch housing construction industry focuses on:

1. **Process improvement** between the various parties involved, e.g. a joint value stream map and applying other Lean tools for quality improvement and optimal flow;
2. **Joint decision making** by, e.g., involving all relevant parties early on in the construction process (in the initiation phase) so that maintenance aspects can also be used in construction decisions;
3. **Long term relationships** with cross reference project evaluations by using a joint measuring / monitoring and learning / benchmarking tool.

It is important to note that within the Dutch construction industry the application of the SCC methodology helps to break away from existing practices; there are new ways to select partners, to work together, to share information, to make decisions et cetera. Although the general concepts of SCC are fairly easy to grasp, as mentioned, unfortunately not many practical tools are readily available to implement this new way
of operating. This observation was the start for the development of an SCM maturity model.

**Developing a maturity model**

One type of tool, which appears to be popular amongst practitioners, for implementing fundamental business changes (such as SCC in the Dutch construction industry) is the maturity model. Typically a maturity model consists of various “fields” of interest and various “levels” that can be achieved within each field; the higher the level, the more mature the unit of analysis is in that field. From an assessment (frequently a self-assessment) on the maturity level of each field, the model provides the organization with some idea of its own level on the relevant capabilities and an improvement agenda to reach the next maturity level.

With respect to a maturity model for SCC, the underlying idea is that higher levels of SCC could lead to more projects being finished within the targets set on time, quality and costs. Moreover, it might be argued that SCC can lead to improved level of innovation both in process (one single process agreed by all parties involved) and in product (each party will have the opportunity to use their expertise to find new solutions jointly) in a more sustainable way (Crawford, 2006). Becoming an excellent SCC player is therefore not only important for companies themselves, but also for the partners whom they work with.

Summarizing; to reach the desired outcomes of SCC, an organization must develop its own SCC skills. The extent to which such skills are developed can be measured by a SCM maturity model. For this purpose, the *Supply Chain Excellence Maturity Model* (SCEMM) described below was developed.

Essentially SCEMM is an adaptation of a business maturity model in (Schepers, 2002) for the purpose of SCC in the (Dutch) construction industry. Similar to the model in (Schepers, 2002), SCEMM combines the ideas of “levels” originating from (Software Engineering Institute (SEI), 2002) and (Lockamy III & McCormack, 2004) with the concept of “fields” which go back to (Turban, et al., 1999). Within SCEMM, for every maturity level and every field (organisational aspect), a real estate specific typology is made, for which respondents can decide if it represents the way their own company is organized/ functions. The five fields / organisational aspects in SCEMM are:

1. **Strategy and policy making**: this evaluates the way in which the strategy and policy making process is organized. On the lowest maturity level, strategy and policy making is an internally oriented, unstructured process. On the highest level, business strategy and policy making is a joint effort between supply chain partners.
2. **Monitoring and control**: this aspect looks at the way the company monitors and controls it performance and learns from its mistakes. On the lowest maturity level monitoring and control is mainly financial and input oriented. On higher levels there is a strong focus on both financial and non-financial (output) performance aspects such as time, quality and revenue.
3. **Organization and processes**: this aspect describes the way the organization is designed and (internal) cooperation is formalized. On the lowest maturity level there is a strong degree of task orientation. The more mature an organization gets, there is a strong degree of process orientation, with more internal / external processes leading the cooperation between departments, divisions and (external) partners.
4. **People and culture**: this defines the way employees are “seen” and the climate in which people are working together. On the lowest maturity level, employees are seen as production units which can be easily replaced. On higher maturity levels, an employee is an asset for the organization and very hard to replace.
5. *Information technology (IT)*; this aspect evaluates how IT-policy, IT-management and IT-maintenance is organized. On lower maturity levels there is less structure and integrality between systems (isles of automation). On higher maturity levels there is alignment among IT policy, IT management, IT maintenance and business strategy & targets.

The maturity levels within SCEMM are:

1. **Pioneer level**: The organization operates with an initial vision as its most important guiding principle. The employees collaborate in an informally organized manner, which is possible because of the organization’s limited size.

2. **Process level**: The organization begins to professionalize by making and recording process agreements at departments or teams level. Within this ‘island organization’, each unit operates with its own systems and procedures. Whilst collaboration within the units is structured, collaboration between units still takes place on an ad hoc basis.

3. **System level**: The entire organization operates with synchronized processes, procedures and systems. The organization’s various units exchange information and work together in a well-organized manner (internal SCC) on jointly-formulated strategies and organizational objectives.

4. **Network level**: The highest level in the maturity model is the network level. The organization has involved the value chain partners in the network and collaborates with them in areas such as strategy formation, information exchange and management of the value chain. Systems, processes and procedures have been coordinated with each other both internally and externally, and there is extensive collaboration across the value chain.

![Figure 2: Supply Chain Excellence Maturity Model. Source: adapted from (Scheper, 2002)](image)

In the first three maturity levels (per business dimension) individual companies are developing their internal collaboration. To reach the fourth maturity level (i.e., Supply Chain Excellence), the internal supply chain is extended with external companies to reach another breakthrough in creating value in the Supply Chain. This is due to the fact that individual companies often need other strategic partners in creating value for (end) customers (Turban, et al., 1999). The levels together with the fields make it possible to plot organizations on their maturity per business dimension; see Figure 2.

The use of SCEMM goes together with a two crucial assumptions. First, a balanced score (maturity) on all pillars is necessary for an organization to perform well; cf. (Scheper, 2002) and (Khaiata & Zualkernan, 2009). Based on data collected from 265 Dutch housing corporations, this hypothesis was indeed confirmed (Scheper, 2002). In addition, the same hypothesis was confirmed by data collected among 30 CRM-
managers (Batenburg & Versendaal, 2004). A second critical assumption is that higher maturity scores leads to improved financial and non-financial (i.e., quality) performance. The required score depends on the environment of the organization and the level of development the environment requires (Lockamy III & McCormack, 2004).

The objective of SCEMM is to establish an insight in their current SCC maturity through a self-assessment, set priorities for improvement actions and track if the company develops itself on the five organizational aspects in a balanced way (Turban, 1999). Furthermore, the outcome of the SCEMM can also help in the selection of strategic partners in the Supply Chain. The general thought behind this is, that organizations who for example operate at Level 3 will not reach supply chain excellence if they select strategic partners who only operate at Level 1 or 2 and do not have the ambition to reach Level 3 or 4. So knowing your own maturity levels and that of your potential business partners can help to make better choices.

**Empirical findings**

During the last three years the model has been used to evaluate the current SCC maturity of 33 construction industry companies. The organizations are categorized as housing associations (clients / initiators), construction companies and suppliers to the construction companies. When the SCEMM is used for a specific organization, several employees (from directors to blue collar workers) are asked to fill out a questionnaire consisting of 15 Likert scale questions per pillar (total 75 questions). The SCEMM score for that organization is the average of the SCEMM scores per pillar derived from the respondents within that organization. Below the empirical results of the use of SCEMM on the basis of 33 organizations and 274 respondents will be discussed, see Table 1 for a breakdown of the respondents. These 33 companies volunteered to test their SCC performance by using the SCEMM tool.

**Table 1: Response table SCEMM**

<table>
<thead>
<tr>
<th>Group</th>
<th># of companies</th>
<th>%</th>
<th>Total # respondents</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing associations</td>
<td>5</td>
<td>15.2</td>
<td>77</td>
<td>26.1</td>
</tr>
<tr>
<td>Construction companies</td>
<td>15</td>
<td>46.5</td>
<td>117</td>
<td>42.7</td>
</tr>
<tr>
<td>Suppliers</td>
<td>13</td>
<td>39.3</td>
<td>80</td>
<td>29.2</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td></td>
<td>274</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3 shows the overall average SCEMM scores of the three types of organizations. Several observations can be made from Figure 3:

- The average in all three types of organizations center on the higher side in Level 2 and Lower side of Level 3. This implies that, in terms of SCC, there is still ample room for improvement. If parties want to reach the level of supply chain excellence (Level 4), all of them need to develop themselves at least one/two additional levels to reach the end of Level 3 / Level 4 (note that the boundary between Level 3 and 4 marks the turning point, from internal SCC to external SCC).
- It can be observed that the scores of the three types of organization on all fields are approximately equal, with a possible exception for the score on organization & processes for housing associations.
- Although the differences are not very large, the suppliers have the highest overall maturity score, followed by construction companies and the housing associations. An early conclusion (based on only 5 housing organizations in the database) would be
that housing associations seem to be the ‘weakest’ link that have to develop their maturity in order to be an equal partner of construction companies and /or suppliers.

- From the perspective of alignment, all parties seem to lag behind on the IT aspect.

Figure 3: SCC Maturity for housing associations, construction companies and suppliers

Another way of analyzing the SCEMM results is to compare the top 20% scoring organizations with the remaining 80% of organizations in the same supply chain position. The goal of such analysis is to see whether there is a group that is leading the pack when it comes to Supply Chain Maturity. Especially, because the Dutch construction industry is in the early stages of adopting SCC, such a leading group would be of interest for benchmarking and learning purposes.

Figure 4: SCC Maturity for Top 20% and other 80% of construction companies

Unfortunately, the number of housing associations is too limited to make the 20%-80% analysis. Comparing the top 20% score of construction companies with the rest (80%) of the population, the maturity scores clearly differentiate, see Figure 4. The top 20% companies operate at approximately a half point higher maturity level compared to their peers. It is interesting to see that the gap is lowest (almost non-existing) for People & Culture. This might indicate that the front runners have not invested enough in the development of the organization in this field.

A similar analysis for the suppliers is depicted in Figure 5. Also here it can be observed that there is a gap of approximately half a point between the top 20% suppliers and the others. For the aspect Monitoring & Control and IT appears to be even higher than that. The front runners in this group have the highest maturity scores near the end
of Level 3 which is a good starting point to grow into Level 4 and achieving Supply Chain Excellence.

Conclusions and further research
To support organizations in the Dutch housing construction with their early efforts to implement the various concepts of SCC, a maturity model called SCEMM was developed. On the basis of the first 33 organizations that used SCEMM, it can be concluded that from a practical point of view it is an easy-to-use practical tool for organizations to make the first steps towards adopting and using SCC. Especially the fact that SCEMM brings several different fields together which are usually dispersed within the organization, has helped organizations to see where their qualities are and where they need to improve. Organizations have been using the SCEMM as a reference point for decision making on which focus areas to invest in, to achieve true and aligned supply chain collaboration and becoming supply chain excellent.

From an academic viewpoint the SCEMM is still in its infancy state. Further research is needed on the validation of the model and its underlying typologies of companies on different maturity levels. Furthermore, the relation between the maturity levels, the alignment of the different organizational aspects and their output performance are point for future research. A representative sample of housing corporations, construction companies and suppliers will help to get better and more valid research results. The results of the SCEMM have to be used for individual action plans which can help companies reaching higher levels of SCC. The actions which will have the biggest impact of reaching a higher maturity level can also be focus of further research.

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