

Supplier Development: The Gateway to Supply Chain Management in the Construction Industry

Glenn Ballard¹ and Jan Elfving²

Abstract

Research Question: How to show that main contractors can lead supplier development, the gateway to supply chain management?

Research Method: Design Science

Findings: Main contractors with repeated projects in geographic areas can lead supplier development.

Limitations: Other main contractors and other industry firms playing design and construction roles may be able to lead supplier development in different ways—a question for future research.

Implications: I.1 The construction industry is not reliant only on clients to lead supplier development/supply chain management. I.2 Selecting better performing suppliers increases the profitability of main contractors. I.3 Suppliers' performance can be improved through feedback and training.

Value for Practitioners: Understanding the benefits of supplier development

Keywords: Construction, supplier development, supply chain management, strategic management

Paper type: Full

Introduction

It has been claimed that supply chain management is the solution to poor construction industry performance (Egan, 1998 and less directly, Latham, 1994), but the industry has struggled to implement it. The few successful implementations have mostly been driven by clients; e.g., BAA (Potts, 2009) and Slough Estates, (Rimmer, 2009), and some researchers have argued that only clients are able to lead supply chain management; e.g., Briscoe et al. (2004). Others have noted that clients must have stable demand in sufficient quantity to sustain supply chain management, and that such clients can impact only a relatively small part of the industry (Cox et al., 2006; Morledge et al., 2009). Among

1 Research Associate, Project Production Systems Laboratory, University of California Berkeley, ballard@ce.berkeley.edu

2 Sr. Vice-President, Skanska Finland, jan.elfving@skanska.fi



others, Tuomela-Pyykkönen et al. (2015) claimed that inherent characteristics of the industry make supply chain management impossible. Dubois and Gadde (2010) identified industry behaviors as an obstacle, and Bygballe et al. (2010) added industry attitudes to the list of obstacles.

If it is the case that only clients can drive supply chain management, and if it is also the case that only a limited number of clients are able to do so, and if the inherent nature of the industry and its way of operating is itself an obstacle to supply chain management, then supply chain management is not viable in the construction industry as a whole. Further, if supply chain management is needed for substantial improvement in the delivery of construction projects, then hope for substantial improvement in industry performance is futile.

This paper argues against this dire conclusion, first by contesting claims that industry behaviors and attitudes cannot be changed, then by arguing that the nature of the industry is not an obstacle to supply chain management, and finally by demonstrating that at least one other industry player, main contractors with recurring projects in geographic regions, is well suited to lead supply chain management. In accordance with design science research methodology, the demonstration consists in the design, implementation and evaluation of a supplier development program for a main contractor, Skanska Nordic, whose implementation of a supplier development program provides a gateway to complete supply chain management.

Supplier development is the gateway; both foundation and starting point, for supply chain management because it proactively manages the supply base, initially at the first tier, expanding efforts to improve performance beyond the buyer to include its suppliers of goods and services. Further, the solution offered is a model for what others can do who also deliver construction projects largely through goods and services provided by others and may also be a model for such companies in other project-based industries. Supply chain management is completely implemented when the system of companies that constitute the supply chain becomes the focus of improvement and all companies benefit from improvement of the system.

That supply chain management offers benefits to the construction industry and its customers is widely accepted among industry researchers and advanced practitioners. We accepted that assessment and did not consider additional argument needed in its support. It has been shown that the number of clients with ongoing construction programs is too small to impact more than a relatively small part of the industry. If only clients can lead construction industry supply chain management, the industry as a whole will not enjoy those benefits. The objective of our research was to demonstrate that supply chain management could be led by other industry actors than clients. It remains for future research to show how supply chain management can be led by other industry players than main contractors with recurring projects in geographic areas.

That Skanska Nordic benefited from its supplier development program is presumably not an issue. If they had not benefited, they would not have continued the program, and others similarly situated would not be incentivized to follow their lead. We did not try to determine if others also benefited, but we can share our assumptions.

1. The program improved the qualifications of goods and services suppliers, which may have reduced the extent to which workers received substandard pay and substandard working conditions.
2. Buyers of construction's products select main contractors based on their demonstrated ability to deliver projects that meet all client requirements. Skanska Nordic's supplier development program helped it improve that capability. Presumably doing so increased the value delivered to its clients, so those clients benefited from the supplier development program.
3. Extending the frame of reference, if we supposed that all main contractors similarly situated to Skanska Nordic were to embrace supplier development, that would elevate construction industry performance beyond that of a single company. Eventually, doing so would provide no competitive advantage other than a head start for early adopters. Further improvement would be dependent on going beyond supplier development to managing entire supply chains, which presumably would even further reduce waste in the industry and increase value delivered to its clients, and indirectly to the customers of those clients and society at large.

After this introduction, the paper has the following sections:

- Research methodology
- Why the construction industry has struggled to implement supplier development and supply chain management: A review and critique of the literature
- Inherent characteristics of the construction industry
- General prescriptions for supplier development in the literature
- Supplier development programs led by main contractors
- Conclusions & recommendations for future research
 - Acknowledgements
 - References

Research methodology is described in 2.0 so readers understand the role of Skanska Nordic's Preferred Supplier Program (hereafter PSP), how it was developed, and how it was assessed. In 3.0, industry practices and attitudes said to be obstacles to supply chain management are identified and shown to be changeable and changing, after which the remaining obstacles are those inherent in the nature of the construction industry. 4.0 explores these obstacles and concludes that adaptation of the classical manufacturing-based supply chain management model is feasible for construction. In preparation for presenting Skanska Nordic's PSP, 5.0 reports general recommendations from the literature for forming and managing supplier development, and what has been done previously by way of supplier development in the construction industry. 6.0 describes Skanska Nordic's PSP, how it was developed and how it has performed against its objectives. Conclusions are drawn and recommendations for future research are made in 7.0, followed by Acknowledgements and References in 8.0 and 9.0, respectively.

Research Methodology

The research described in this paper was done through a combination of 1) critical review of the literature on supplier development and supply chain management in the construction industry, and 2) design science research methodology. The first was used to identify inherent characteristics of the construction industry that require adaptation of the supply chain management model developed in manufacturing. The second was used to develop a supplier development program for Skanska Nordic that demonstrates that adaptation for main contractors with recurring projects in geographic regions.

The origin of design science research methodology can be traced to the paper by Kasanen et al. (1993) in which the authors propose to focus management accounting research on the design of more effective accounting systems. In this, they followed Johnson and Kaplan's (1987) claim that management accounting had become increasingly irrelevant to practice. The methodology was subsequently applied by Van Aken (2004) more broadly to management as such, proposing that management research be regarded as a design science alongside medicine and engineering, which seek to improve the human condition, as distinct from an exclusively explanatory science like physics and chemistry.

After Van Aken's generalization, others applied the design science methodology to specific fields of management—to the design of information systems (Peppers et al., 2007), to organizational development (Trullen and Bartunek, 2007), to operations research (Manson, 2006), to operations management (Holmstrom et al., 2009), and to construction management (da Rocha et al., 2012).

Steps in the Design Science Research (DSR) Process

Figure 1 shows the DSR process adopted by Manson (2006), who notes that developing a solution is a design process that produces an artifact of some kind (construct, model, instantiation) and emphasizes the learning through prototyping, which is characteristic of design. Initial prototypes tend to be deficient in some degree relative to their intended purpose. Remedies for these deficiencies are incorporated in new artifact designs until that point when design evaluation questions can be answered positively or the researcher accepts defeat. The two design evaluation questions are (Manson 2006 quoting von Alan, et al. 2004): 1) What utility does the new artifact provide?, and 2) What demonstrates this utility?

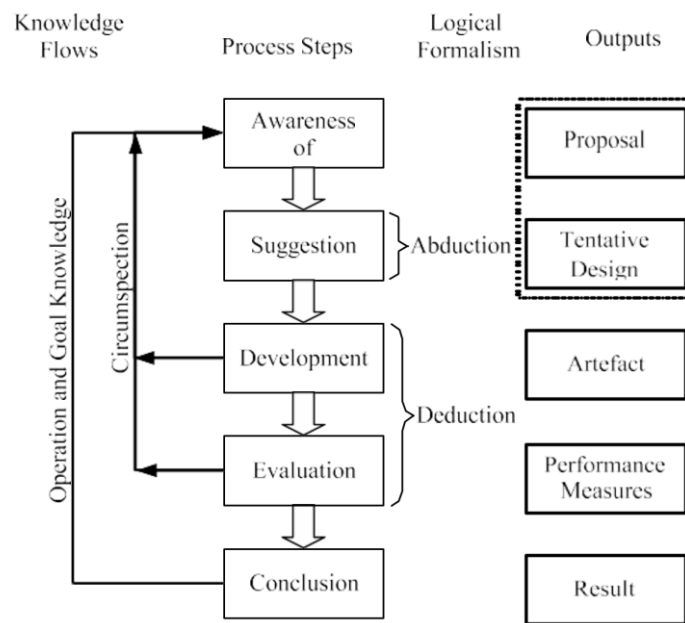


Figure 1: The general methodology of design research (Manson 2006)

Application of the Design Science Methodology in this Research

In the Introduction, supplier development was positioned as the gateway to complete supply chain management. Extending improvement efforts beyond a buyer of goods and services to their suppliers is the key first step. Consequently, the problem for DSR in this research was how to develop suppliers in the construction industry. Its practical relevance is to the challenge of improving the performance of main contractors when the vast majority of the work on their projects is done by suppliers. The research potential lies in the question how to compete supply chain against supply chain in the construction industry and how to develop suppliers and strengthen supply chains in the face of the industry barriers identified by the numerous researchers.

The artifact to be produced is a supplier development program for Skanska Nordic, representing main contractors with recurrent projects in multiple geographic regions. The artifact's intended utility is to improve the performance both of suppliers and of the main contractor. Achievement of the goals of supplier development are used to demonstrate the artifact's utility.

Why the construction industry has struggled to implement supplier development and supply chain management: A critical review of the literature

This section consists of three parts: 1) a clarification of terminology related to supplier development and supply chain management, 2) obstacles to the construction industry's implementation of supply chain management found in the literature, and 3) assessment of those obstacles.

Clarification Of Terminology

Handfield, et al. (2000) define supplier development as “...any activity that a buyer undertakes to improve a supplier’s performance and/or capabilities to meet the buyer’s short-term or long-term supply needs.” Suppliers are developed by various means, which include evaluation and feedback, incentives, competition, and consulting.

This definition, and the very term supplier development itself, may be taken to imply the dominance of the buyer in the relationship. Indeed, the expression may suggest that the object of improvement is the supplier, not the buyer as well, and not the supply chain of which buyer and seller are both members.

Other terms have been included in the literature search. “Supplier alliances” are collaborative relationships between companies spanning single or multiple projects; the term often used for the latter is “strategic alliances”. Treatment in the literature is mostly on dyadic relationships, and not on the buyer’s strategic orientation toward developing its supply base (Gadde and Dubois, 2010, Crespín-Mazet et al., 2014). The authors just mentioned use the term “strategic partnering” to refer to relationships with customers and suppliers spanning multiple projects. Kull et al. (2013) understand “supplier integration” to differ from “supply chain integration” in its exclusion of customers. “Supply chain integration” is used by Eriksson (2015) as a synonym for “partnering”; although “strategic partnering” might be more appropriate to clearly designate relationships extending beyond single projects.

The term “partnering” demands attention because it has been a frequent topic in the literature, but its definition has been elusive. The industry and academia’s attention to partnering was prompted in no small part by the Latham Report (Latham, 1994), which itself was motivated by a concern with reducing construction claims. Partnering has often referred to the relationships between the parties on a single project, and, especially in North America, has been pursued without altering commercial terms or project organizational structures (Gransberg et al., 1999; Sparkling et al., 2015). In Europe, partnering has become a much weightier concept, referring as it does to the entirety of relationship management. However, its tendency to ignore the supply chain management conceptual framework renders it less preferable for present purposes than terms drawn directly from that framework.

“Supply chain integration” is perhaps the closest to “supplier development”, and it could be argued that the latter is an element within the former. “Supplier relationship management” (Herrmann and Hodgson, 2001) suggests the collaborative, long-term nature of the relationship, and “supply chain integration” clearly specifies development of the entire supply base, but “supplier development” is the expression used in most of the relevant literature, hence that term has been retained, with a reminder to the reader that the relationship can be collaborative and to the mutual benefit of both parties, and that “development” refers fundamentally to the supply base as a whole.

Why the construction industry has struggled to implement Supply Chain Management

The construction industry's struggle to implement supply chain management has been attributed to the inherent nature of the industry, to traditional practices, and to traditional attitudes.

Among the industry characteristics seen as inherent are custom products, discontinuous business relationships, fragmentation and more generally, the industrial structure of construction (London and Kenley, 2001; Dubois and Gadde, 2002; Morledge et al., 2009). Tuomela-Pyykkönen et al. (2015) identify "...varying relationship lifecycle, the unique and complex nature of products and services, customisation and the non-repetitive and temporary nature of projects" as obstacles to supply chain management. Tuomela-Pyykkönen et al. (2015), Ellegaard et al. (2009); and Eriksson (2015) identify discontinuous business relationships and separation between design and construction as obstacles to supply chain management. Eriksson (2015) further elaborates this specification of construction industry attributes: "...SCI [supply chain integration] is especially challenging in project-based supply chains due to: the discontinuous demand for projects; the uniqueness of each project in technical and financial terms; uncertain demand requirements and production conditions; and the complexity of each project in terms of a high number of specialized but interdependent suppliers and their activities." On these points, see also the following authors (Dainty et al., 2001; Anne Skaates et al., 2002; Gil, 2009; Eriksson and Pesämaa, 2013). Eriksson goes on to say, "Accordingly, buyers often rely on competitive tendering, in order to execute every new project to the lowest possible cost, resulting in disjointed supply chains...."

Traditional industry practices identified as obstacles to supply chain management include buying on low price, managerial focus on individual projects, separation between designers and constructors and purchasing structure. Dubois and Gadde (2000): "...prevailing supply arrangements established to handle the particular conditions in the construction industry makes it unlikely for partnering to reach outside the individual project." That diagnosis does not appear to have changed much in the following ten years. In 2010, Gadde and Dubois stated that reasons for slow take-up of "strategic partnering" in construction are primarily "...related to the decentralisation to projects and the competitive tendering featuring purchasing transactions." Crespín-Mazet and Portier (2010), Dubois and Gadde (2000), and Araujo et al. (2003) also identify purchasing structure as an obstacle to supply chain management in construction.

Traditional industry attitudes identified as obstacles to supply chain management include distrust and adversarial behaviors. Bygballe et al. (2010), speaking about partnering in construction, note the need for more emphasis on relational aspects and also that the focus has been almost exclusively on relationships between buyers and main contractors, excluding the relationships between main contractors and their suppliers. Mistrust and anti-collaborative behaviors are noted by several authors, including Ellegaard et al. (2009) and Laan et al. (2011). Table 1 summarizes the problematic attributes.

Table 1: Construction industry attributes said to be obstacles to supply chain management in the literature

Industry characteristics	custom products, discontinuous business relationships, fragmentation/industrial structure of the industry
Industry practices	buying on low price, managerial focus on individual projects/purchasing structure, separation between designers and constructors
Industry attitudes	distrust, adversarial behaviors

Are industry practices and attitudes unavoidable obstacles?

In the following, we focus our attention on the industry practices and attitudes in Table 1, and seek answers to two questions: 1) Which of the practices and attitudes really are obstacles, and 2) If they are obstacles, can they be changed? We argue that the practices and attitudes identified as obstacles to supplier development and supply chain management can be changed; namely, buying on low price, separation between designers and constructors, managerial focus on individual projects, distrust, and adversarial behaviors. We address the question what industry characteristics cannot be changed and if they are truly obstacles to supply chain management in section 3.44.0.

Buying on low price

Awarding contracts for goods and services on the basis of low price is clearly widespread in construction and is clearly an obstacle to supply chain management (Briscoe and Dainty, 2005; Ellegaard et al., 2009), but what causes that managerial practice? What is the basis for Eriksson's (2015) inference in "Accordingly, buyers often rely on competitive tendering, in order to execute every new project to the lowest possible cost,..."? The practice of competitive tendering seems to result from one or more of three assumptions: 1) that each dyadic contractual relationship may occur only once or infrequently, 2) that the available companies are indistinguishable in terms of the service they provide, or at least that the differences are small enough that differences in price can justify taking low bids, and 3) that over dependence on specific suppliers increase buyer's risk. We take these three assumptions in turn.

First the assumption that contractual relationships are likely to reoccur infrequently. We contend that the assumption is false; not that contractual relationships are always frequent, but that they are not necessarily infrequent and can be made to occur frequently.

Proposition 1: The opportunity for contractual relationships between main contractors and their suppliers is not limited by the nature of the construction industry, but rather by the geographic range and capacity of suppliers, and the number of project opportunities offered by the main contractor within each geographic region.

Projects may differ in many ways, and some projects may require contracting with very specialized firms whose services are needed only very infrequently. However, that is the exception rather than the rule. Consider a main contractor that is in the business of constructing buildings. That will involve excavation, some type of substructure (pilings,

mass slab, etc.), steel, concrete or wood superstructure, heating and cooling, plumbing, electrical power, lighting, interior walls, vertical access (stairs, escalators, lifts), roofing, floor and wall coverings (paint, carpet, wood, tile, etc.), and so on, all of which have their corresponding specialty contractors. Only the limited geographic range and capacity of a specialty contractor and the number of project opportunities limits the number of contractual engagements with a main contractor. Given a main contractor with recurring projects within the geographic range of a specialty contractor, only the latter's capacity limits the number of contracts between them. Note also that highly specialized contractors are selected based on qualifications, not because they are indistinguishable from alternatives, but precisely because they differ from others in their capabilities.

The second assumption, that candidates differ only in price, is true for some types of goods and services, but the claim that all candidates differ only in price is false, and even if true at a time, it can be made false by buying on the basis of qualifications together with supplier development. Best value procurement, an alternative method of evaluating candidates that balances cost against qualifications, has proved successful (Molenaar and Johnson, 2003), which would be impossible if candidates were indistinguishable except for their bids.

Proposition 2: The assumption that candidates differ only in price is false.

We accept the truth of the third assumption, that dependence on specific suppliers should be limited in order to reduce the buyer's risk, but contest the criterion for independence. Price competition and limitation of bidders can co-exist if the number of bidders is sufficient to insure that more than one will have the available capacity, and if bidders do not collude.

Proposition 3: Competition between alternative suppliers of the same service can co-exist with limiting the number of those suppliers.

Managerial focus on individual projects

Construction businesses make their money on projects, and most managers of construction firms would likely identify the project as the battleground between competitors. However, an individual project engages only a fraction of a buyer's suppliers, and projects are ill equipped to develop suppliers while struggling to deliver value to their customers and complete on time and budget. Decentralization to projects has also limited most partnering efforts to single projects, as opposed to strategic partnering, which extends across multiple projects.

To unpack this issue further, a distinction is needed between suppliers of goods and services. Within specific geographic regions, main contractors with recurring projects in those regions tend to have framework suppliers³ for goods such as lifts, precast concrete, bathroom pods, asphalt and other components of constructed assets. Using the categorization from Cox (2009), these framework agreements have traditionally been a

³ Framework suppliers are those with whom a buyer has made agreements concerning pricing and purchasing of those suppliers' products. For example, Skanska Nordic might have a framework agreement with Otis Elevator to exclusively use their elevators on housing projects and for prices to pay for them.

form of supplier selection based on pricing. The geographic range of these suppliers is often national or even multinational. Such purchasing agreements are much less common as regards the specialty contractors that provide installation and testing services on construction projects. Their geographic range tends to be more limited than for suppliers of goods.

Until fairly recently, there was little done to develop framework suppliers of goods. The relationship was considered to be exclusively transactional, with no relational component. As regards specialty contractors, they have been traditionally contracted at the individual project level. We suggest that an obstacle to more strategic development of both goods and services suppliers is failure to understand how else to compete supply chain versus supply chain in the construction industry, together with the lack of sufficiently centralized procurement functions to enable deployment of needed policies. Competition between supply chains certainly involves competition between companies for projects, but projects have the burden of execution and have little time or energy to devote to supplier development beyond the project itself. We return to this topic in sections 5.2.4 and 6.2.

Proposition 4: An obstacle to supplier development by main contractors is failure to understand how to compete supply chain vs supply chain except through individual projects.

Proposition 5: Projects cannot fully carry out the policies and practices required for supplier development by a construction main contractor.

The managerial practices and attitudes discussed above have been critiqued by advocates of lean construction (Koskela and Howell, 2002), and are clearly subject to change, and in fact are changing (Thomsen et al., 2009). To further assess the feasibility of supplier development in construction, it is necessary to consider more structural peculiarities of the industry; characteristics that may be less changeable than the above managerial practices.

Separation between designers and constructors

Design-bid-build remains a dominant form of project delivery even today in some industry sectors and locations, but there is increasingly in use forms of project delivery that allow integration of constructors into the design phase of projects (early contractor involvement is the corresponding term used outside the U.S.); e.g., design-construct, construction management at risk, project alliancing, and integrated project delivery (El Asmar et al., 2015; Gehrig, 2009; Kulkarni et al., 2012; Molloaglu-Korkmaz et al., 2011). This fact alone is sufficient rebuttal of the claim that separation of design and construction is an inherent feature of construction.

Are industry attitudes unavoidable obstacles?

Alternatives to design-bid-build have increased in number. Among them, construction management at risk and design-construct may limit the role of constructors to cost estimating and constructability review of design documents and models, but greater



involvement of builders in the design process, especially to develop process designs in parallel with product designs is entirely possible. Project alliancing and integrated project delivery both involve shared risk and reward commercial terms, at least among the owner, lead design firm, and lead construction firm, which lends itself to more intense collaboration throughout the project, and to more extensive integration of product and process design. Alignment of commercial interests has proven to be an effective countermeasure to distrust and anti-collaborative attitudes. When the profits of all project companies are dependent on project outcomes, company owners are motivated to give their people permission to collaborate. Organizational integration of designers and constructors tends to increase trust and decrease adversarial relationships, especially when supported by shared risk and reward commercial terms.

Inherent characteristics of the construction industry

The obstacles remaining to be examined are characteristics that are inherent in the very nature of the construction industry. Here we explore if these inherent characteristics are truly obstacles, or if the classic manufacturing-inspired supply chain management model can be adapted for the construction industry.

Characteristics understood to be inherent to the construction industry such as production of custom products and discontinuous business relationships are differences between project-based industries and repetitive manufacturing, where supply chain management was born. To echo Morledge et al. (2009), these attributes may make it impossible for supply chain management to look the same in construction as in its birthplace, but rather than give up, the construction industry should look for ways to apply the fundamental principles of supply chain management and ways to promote the desired behaviors and outcomes. As regards industry fragmentation, the remaining characteristic that might be inherent in the nature of the industry, it is relevant to note that supply chain management itself is a countermeasure to industry fragmentation by coordinating and aligning the operations of individual companies. However, fragmentation also denotes the large number of smaller companies in the industry. The local nature of construction, especially for smaller projects, suggests that fragmentation is in part an inherent industry characteristic.

Peculiarities of the construction industry

In order to remove any doubt that supplier development and supply chain management are possible in the construction industry, in 4.1, we describe differences between construction and manufacturing and in 4.2, if those differences impact construction's implementation of supplier development and supply chain management.

Differences between construction and repetitive manufacturing

"Repetitive manufacturing" designates those firms that manufacture multiple copies of product designs; e.g., refrigerators (Whirlpool), automobiles (Toyota), and wrist watches (Seiko). Toyota is used as representative of such firms, looking for differences between them and firms, including construction companies, that produce custom products, using a complete product design only once. Every company directly involved in

construction projects has suppliers, and consequently every such company may benefit from supplier development. This study is limited to construction main contractors, but may be applicable in part to developers, larger specialty contractors, and larger design firms that subcontract substantial amounts of work.

Toyota is a key customer for its suppliers; i.e., Toyota represents a large percentage of their suppliers' market demand. That is not often the case in construction where suppliers of goods can be much larger than the contractors that purchase goods from them.

Question #1: Is the size of the buyer relative to that of its suppliers relevant to the feasibility and potential benefits of supply chain management?

Construction main contractors that operate in different countries and across multiple regions within countries are limited by the geographic range of their suppliers; more so for suppliers of services than for suppliers of goods. The 'manufacturing' of service suppliers is primarily done on site. Even when prefabrication or modularization are used extensively, final assembly and commissioning are done on site. Construction is a type of fixed position manufacturing, in which the product being constructed ultimately gets too large to move through workstations, so workstations must move through the product (Schmenner, 1993). In addition, construction's products are frequently embedded in the earth, making location a critical design consideration (Ballard, 2017).

In contrast, Toyota's product is transportable. They have a small number of manufacturing plants in multiple countries, and can develop suppliers for those specific locations.

Question #2: Is the geographic range of service suppliers a factor in the feasibility of supplier development in construction?

The risks posed to construction main contractors from sub-tier suppliers, the risks from poor performance, financial instability, or illegal activities do not appear to be felt by Toyota or have been managed. Toyota is dependent on its suppliers, but that dependence can be reduced by having two or more providing the same goods or services in a specific vehicle program (Womack et al., 1990). On very large construction projects, the work can be divided between two service suppliers. That is not feasible on smaller projects where half the work may be too small to attract bids except in extreme economic conditions. Further, in some construction markets, suppliers of goods and services have monopolies. That does not appear to be the case in the automotive industry⁴.

Sheer scale may be a factor in Toyota's ability to screen and audit at sub-tier levels. In Sweden, Norway and Finland alone, Skanska has 18,000 suppliers of project-related materials and services at the first tier (with some overlap; some specialty contractors

⁴ A search for 'monopolies in the automotive industry' and related terms found only reference to oligopolies (the OEMs) and to supply of aftermarket auto parts.

purchase the materials they install). In comparison, Toyota appears to have far fewer first tier suppliers in the entire United States⁵.

Implications of Differences between Repetitive Manufacturing and Construction

Do these differences between construction main contractors and repetitive manufacturers such as Toyota make it infeasible or imprudent for the former to develop suppliers and manage supply chains? It is proposed that the differences (see Table 2) require adaptation of supply chain management for construction, as opposed to mere imitation, but do not make supply chain management infeasible or imprudent. For example, while true that many goods suppliers dwarf even their largest construction industry customers, a construction buyer need not constitute the majority of a supplier's demand in order to have influence over the supplier. Unless the supplier has monopolistic pricing power, competition compels them to keep prices at market levels. Further, many suppliers, especially service suppliers, are smaller than the main contractors that buy their products. It is likely rare that a single construction buyer represents anything approaching 50% of a service supplier's sales, so suppliers of these services are in competition among themselves for the buyer's contracts in the regions in which the suppliers operate. However, there can exist local monopolies by service suppliers when they are the only, or the only competent supplier of that specific service in a region.

Proposition 6: A construction buyer need not constitute the majority of a supplier's demand in order to have influence over the supplier, unless the supplier has a monopoly.

Another consideration related to the economic power of the buyer over suppliers is what might be called the 'sweet spot' strategy, according to which a supplier's dependence on a buyer must be sufficiently large for them to be willing to change, but not so large as to make the buyer overly dependent on the supplier and to reduce the supplier's incentive to improve. Even if competitive pressure regulates non-monopolists' pricing, if a buyer contributes too little to the supplier's turnover, they may choose to work elsewhere rather than change in response to buyer requests.

The fact that construction buyers are often dependent upon suppliers with limited geographic range, especially for services, makes supplier development and supply chain management even more important, but requires that supply chain management be organized around geographic regions, and not focus exclusively on suppliers on whom the largest amounts of money are spent. This is not entirely different from Toyota, Honda, or Nissan, who have supplier development programs specific to each country in which they have manufacturing plants (Sako, 2002). Construction companies that specialize in certain types of products typically use a composite strategy for organizational differentiation, both geography and product. For example, large industrial contractors such as Bechtel

⁵ The relative number of first tier suppliers is inferred from a statement on a Toyota Motor website describing the various supplier associations they had established around the world. 109 suppliers, were said to be members of the Bluegrass Automobile Manufacturers Association in July 2011.

http://www.toyota-global.com/company/history_of_toyota/75years/data/automotive_business/production/purchasing/cooperative_association/index.html

have offices in various locations around the world, especially where their industrial clients are located, and have multiple sub-organizations housed within each office, structured around product types such as petrochemical, power, mining, and transportation.

Table 2: Peculiarities of Construction

	Toyota	Skanska
Economic power over suppliers	High--Toyota is presumed to be the source of at least 30% of revenues for most of its first tier suppliers	Low--For most of its first tier goods suppliers, Skanska's purchases are a small % of their revenues. For 49% of its first tier service suppliers, Skanska was the source of less than 10% of their revenues in 2014
Scale: number of first tier suppliers	Relatively low; in the hundreds	High--In the Nordics alone, Skanska has 18000 suppliers of goods and services
Ability to control sub-tier suppliers	High: Toyota's first tier suppliers typically are larger, managerially sophisticated firms that impose controls on their own suppliers	Low: Skanska Nordic's first tier service suppliers, are comparatively smaller and less sophisticated. In 2014, 31% had less than 30 employees and 51% had less than 100 employees
Ability to avoid being held hostage	Medium—two or more suppliers of components and systems is maintained for each vehicle program at each manufacturing plant, except for systems with very high capital cost	Goods Suppliers: High ability, apart from monopolies ⁶ . Service Suppliers: Low Apart from very large projects, it is not feasible to contract with more than one supplier of a service

Toyota has an advantage over the construction buyer in dealing with a relatively small number of suppliers that are typically themselves large companies. However, this again shows the need for supplier development in construction, where there is a much higher risk that suppliers will be technically or managerially challenged, and where there is even the risk of illegality. Toyota may not run the risk of engaging suppliers that, directly or through their subcontracting chains, do not follow employment laws and regulations, but that is a serious risk for construction buyers. A series of publications in a Swedish business daily, *Affärsvärlden*, estimated the grey market in construction labor and products to amount to SEK 11 bn (\$1.56B⁷) annually in Sweden alone (*Affärsvärlden*, 2012).

⁶ European Commission on Competition and Cartels:
<http://ec.europa.eu/competition/cartels/cases/cases.html>

⁷ Calculated at the exchange rate on June 30, 2012 from Oanda currency converter.

Monopolistic suppliers of construction goods exist in a number of different parts of the world. They increase the cost of construction, not only through coercive pricing, but also by rejecting efforts to improve transactional and logistics efficiencies. Reducing dependence on monopolistic suppliers is one objective of supplier development. This applies also to monopolistic service suppliers in specific geographic regions, but the appropriate strategies may differ between goods and services. Suppliers with a monopoly over goods must be confronted with competitors, whereas suppliers with monopoly over services may be persuaded to embrace competition in exchange for help expanding into adjacent regions.

Table 3: Construction Peculiarities and Solutions

Construction Peculiarities	Solutions
Relative economic power of buyers and suppliers	'Sweet Spot' Strategy
Scale (number of suppliers)	Select/Develop better performing and lower risk suppliers locally, so that every district within every region within every country where the main contractor has continuing operations has an increasingly competent and competitive supplier base.
Ability to control sub-tier suppliers	Insist on transparency/open books; audit; screen out those most likely to feel pressured to reduce costs through illegal means.
Ability to avoid being held hostage by suppliers	Multiple preferred service suppliers of every type in every region.
Ability to avoid monopolistic pricing by suppliers	Monopolistic goods suppliers must be confronted with competitors. Monopolistic service suppliers may be swayed by the prospect of increasing capacity and market share, in exchange for engaging in competition.

Prescriptions for supplier development in the literature

Among others, Ketchen and Giunipero (2004) identified a fundamental shift in business strategy, presumably applicable across all industries: "The intersection of strategic management and supply chains offers implications for managers. To the extent that competition is 'supply chain versus supply chain,' a new way of thinking is necessary. This thinking seems to be at an embryonic stage today."

In earlier sections of this paper, obstacles to the construction industry's engaging in supply chain management and competing supply chain vs supply chain have been analysed and countermeasures offered. The intent here is to demonstrate through the design and implementation of a supplier development program how that can be done by industry organizations with high dependence on suppliers of goods and services; specifically main contractors with recurring projects in specific geographical regions.

Design of a supplier development program is well advised to find and use foundational principles. An additional review of the literature was done to identify prescriptions for supplier development that might be applicable to the construction

industry. 6.1 will take up the question what can be learned from previous construction industry implementations of supplier development and supply chain management.

Most researchers agree that supply chain management should be applied in construction and that supply chain management has become a necessity as a result of several changes in the construction industry; principally the joint impact of increasing demands for better project performance from customers (inspired in part by the success of lean production concepts and methods (Womack et al., 1990; Egan, 1998)), and an increase in the amount of fabrication and installation that is performed by specialty contractors, and not by main contractors. With so much of the work being done by suppliers, selecting and developing the capabilities of those suppliers offers a plausible means for improving performance and customer satisfaction.

We turn now to an examination of the literature in which prescriptions are offered. We include publications focused on project-based industries as well as those more specifically focused on construction. Our objective is to answer the question how main contractors with recurring projects in multiple geographic regions should do supplier development, the gateway for full-blown supply chain management. The findings are divided between broader prescriptions about strategy and more specific means and methods for shaping and carrying out a supplier development program.

Supplier Development Strategies

The advice provided here is meant to apply very broadly to supplier development in different industries. However, note the recognition in #5 that context matters, even within a given industry.

1. Set goals for supplier development based on strategic objectives. These goals can be “...more immediate and short-term in nature, including delivery, order cycle times, and quality, and less immediate and more long-term goals such as strengthening a supplier’s managerial, product development, and operations capabilities” (Wagner and Krause, 2009).
2. Focus optimization on the whole vs the parts. Supplier development should be focused ultimately on strengthening capability of the entire supplier base, assuring that competent and cost competitive suppliers are available for all goods and services needed by the buyer (Wagner and Johnson, 2004).
3. Decide if to Make, Buy or Develop Suppliers for each good and service needed by the buyer (Handfield et al., 2000).
4. Invest in supplier development in proportion to the risk to be avoided or the gains to be made. This implies being able to evaluate suppliers’ capability, to assess the risk and potential benefits they represent, and to categorize suppliers accordingly (Matook et al., 2009).
5. Customize your supplier development program; follow principles, don’t copy. The design of a supplier development program is best developed experimentally, in the sense of learning through trials how to do supplier development in a specific company, involved in a specific line of business, at a specific time in history and in specific places on the planet. Doing so reveals and creates internal advocates, critical to successful implementation (Ketchen and Giunipero, 2004).

These findings from the literature contribute to answering our question: How should main contractors with recurrent projects in multiple geographic locations do supplier development? They provide a framework within which to construct such a supplier development program. In the next section, we explore the literature for advice regarding means and methods.

How to do Supplier Development

Although they do not fully answer our question, Tuomela-Pyykkönen et al. (2015) make a distinction required in order to get to an answer; namely, a distinction between “...procurement activities...related to single projects... and long-term procurement perspectives beyond single projects.” The latter is said to include “...the creation of the pool of potential suppliers, supplier-base management, developing relationships and business processes with suppliers, supplier capability development, and purchasing strategy development.” These functions cannot be performed by projects. This starting point allows breaking our question about supplier development into sub-questions:

- To what extent is centralization of procurement power needed in order to do supplier development?
- How should the pool of potential suppliers be created?
- Should some suppliers be given preference, and in what categories?
- How should suppliers be developed?

Centralised vs distributed procurement

This issue belongs with Proposition 5 stated earlier: Projects cannot fully carry out the policies and practices required for supplier development by a main contractor in construction. Many researchers have noted the construction industry’s focus on individual projects and inattention to developing the supply base (Gadde and Dubois, 2010; Bygballe et al., 2010). Developing supply base capability is a strategic initiative and requires a corresponding organization, and corporate procurement is the obvious choice, but as will appear, must work very closely with line management.

There appear to be three possibilities, either 1) remove supplier selection from individual projects, 2) limit choice to a set of prequalified suppliers, or 3) provide information that enables project managers to make better choices. Appropriate selection from the three possibilities varies with the category in which the suppliers are placed. Framework suppliers of critical components (e.g., lifts) must be used by all projects. There may be a number of preferred suppliers of specific services; in which case, any may be selected. Suppliers of less critical goods and services may only need to meet minimum qualifications in order to be eligible for selection. In all cases, some centralization of purchasing is required in order to select suppliers preemptively or to qualify a set of suppliers to whom contracts may be awarded. In practice, especially during a period when a supplier development program is being put in place, no qualified suppliers may yet be available to provide a desired good or service. In that case, exceptions will be made until development increases the pool of qualified suppliers.

Creating the pool of potential suppliers

Luzzini et al.'s 2014 paper addresses the question how to design vendor evaluation systems, which seem to be understood as near-equivalent to supplier development. Their guidelines for describing instances of vendor evaluation systems are questions that need to be answered in designing, implementing and evaluating the performance of a supplier development program. But note that there may be different answers to questions depending on "...the specific characteristics of each company." (Luzzini et al., 2014). They pose four questions:

1. How is a VES (vendor evaluation system) strategically aligned?
2. How is the VES process configured?
3. How is a VES executed?
4. What are the VES benefits and costs?

Preferred suppliers

Araujo et al. (2016) provide a basis for categorizing suppliers within a supplier development program. "Since buying firms are no longer able to take on leading positions in all core technology areas they depend on, they need to strategize with regard to their supplier relationships. Translation interfaces are appropriate for technologies where the buyer is content to be a follower. Interactive interfaces are required for technologies where the buyer desires to be a leader."⁸

In order to apply these supplier categorization ideas, we must translate them from a product development to our selected construction context; i.e., main contractors with recurring projects in multiple geographic regions. Such contractors may do some project construction work with their own forces; e.g., erection of building structures made of concrete, and placing and finishing in situ concrete. Otherwise, construction work tends to be done by specialty contractors. Main contractors may fabricate some of the components of constructed assets; e.g., precast concrete or asphalt, but more technologically sophisticated components, such as lifts, are produced by specialty firms.

To follow Araujo et al.'s (2016) categorization, the main contractor should select firms that provide components that offer competitive advantage in terms of functionality, quality or cost. In some cases, it may be a matter not of selecting such firms but of developing them. In those cases, the fit between corporate cultures and between key individuals within each company will be decisive: "Research has shown that buying firms ability to benefit from supplier relationships is dependent upon their intraorganizational abilities to collaborate." Araujo et al., 2016).

Individual supplier development

Projects have a role to play in developing individual suppliers, but cannot carry the entire burden. Corporate procurement and line management must collaborate. Corporate procurement can qualify suppliers and sign framework agreements with preferred suppliers of goods and services, but need feedback from projects about supplier performance. Further, suppliers tend to be limited in geographic range, from capacity constraints or

differing code requirements. To include both suppliers of goods and services, we propose that business line regions are the appropriate locus of competition between supply chains for main contractors with recurring projects within those regions.

Proposition 7: Business line regions are the appropriate locus of competition between supply chains for main contractors with recurring projects within those regions.

The argument for Proposition 7 is made, consistently with design science research methodology, by constructing a supplier development program based on business line regions and evaluating its performance against supplier development objectives (See section 5.0 below).

Managing and improving individual suppliers

Ghijsen et al (2010) propose the following influence strategies for supplier development:

- “Information exchange: The source supplies information with no specific action required or otherwise indicated.
- Recommendation: The source stresses that specific target action is needed for the latter to achieve desired outcomes.
- Request: The source asks the target to act without mentioning any subsequent positive or negative sanctions.
- Promise: The source offers a specified reward to the target if the latter complies with the source’s stated desires.
- Threat: The source informs the target that failure to comply will result in negative sanctions.
- Legalistic plea: The source contends that target compliance is required by formal agreement.”

These are means for influencing individual suppliers within a supply chain; most often the first tier supplier with whom the buyer has a contractual relationship. There are also other means for influencing individual suppliers; e.g., consulting and supplier clubs (Jones, 1994; Sako, 2002; Dyer and Hatch, 2006). Dyer and Hatch (2006) report the interesting finding that suppliers working for Toyota and for U.S. motor vehicle manufacturers performed better for Toyota in product quality and delivery, even when fabricating components for all these buyers on the same manufacturing lines. One big difference: GM, for example, billed suppliers for the entire savings accrued from GM consulting, whereas Toyota at most divided the savings, and usually charged nothing at all.

Selection of means for influencing suppliers depends on their relative importance to the buyer and the relative power of buyer and supplier (Cox 2009). For suppliers of made-to-stock materials and widely available services, the appropriate influence strategies are information exchange, recommendation and request. If these are ineffective, different suppliers can be awarded contracts. More demanding influence strategies are appropriate for suppliers that cannot be easily replaced, and the most demanding, consulting and supplier clubs, are appropriate for suppliers who can help the buyer develop new capabilities or engage new customers.

Supplier Development Programs led by Main Contractors

The strongest evidence for supplier development's feasibility in construction is that it exists, although limited. In 6.2, the most complete implementation of which we are aware to date; namely, Skanska Nordic's Preferred Supplier Program (PSP), is described. But for comparison, to reveal the advance that Skanska Nordic has made, we first review the most comprehensive main contractor-led supplier development program prior to Skanska Nordic's; namely, BuildingConfidence (see website in References).

BuildingConfidence⁹

King and Pitt (2009) describe a program implemented by Morgan Ashurst plc, a large main contractor operating in the U.K. Unfortunately, few details are provided concerning formation of the supply base, evaluation of supplier performance, methods of supplier development, or benefits and costs of the program. There have undoubtedly been more instances of main contractor-led supply chain management or supplier development, but unfortunately not captured in scholarly publications. Of those described in the literature, the most completely developed that we found was BuildingConfidence.

Led by Lend-Lease (www.achilles.co.uk/images/pdf/Lend-Lease-case-study.pdf)¹⁰, several major U.K. construction companies joined together in 2009 to create a shared program for screening service suppliers and providing feedback. The program, BuildingConfidence, is based on audits performed by Achilles, a firm that also provides auditing services in other European industries. Audits cover primarily subcontractors, some of whom also fabricate, and buyer members (i.e., main contractors). However, anyone in the construction supply chain can participate, including engineering and design consultants. Buyer members like Lend Lease, Skanska and Shepherd undergo the audits themselves, in order to appeal to their suppliers to do so.

The firms audited pay a fee for the service. Audits cover legal requirements, quality management (ISO 19001), environmental (ISO 14001), health & safety (ISO 18001), training and personnel development, and financial stability. The content of audits is structured by a steering committee composed of main contractors ("buyer members"). These main contractors, 17 of them in early 2015, pay an annual fee to Achilles and tend to have relatively large projects in the U.K., typically numbered in 10s, not 100s, at one time, and to subcontract in large packages that include fabrication and procurement. As a result, after six years, according to the Achilles' BuildingConfidence website, there were still only about 2000 suppliers participating in the audits.

Main contractors have been challenged to get suppliers to pay for the audits, and so have focused initially on the larger suppliers, some of whom are now becoming members and making the audit a requirement for their own subcontractors. Owners—for example, British Land—are also beginning to include the audit requirement in their contract documents.

⁹Information on Achilles' BuildingConfidence was obtained from www.achilles.com/en/communities/100-buildingconfidence (accessed Feb 6 2017) and from interviews with senior managers in two of the founding member companies, Skanska U.K. and Shepherd.

¹⁰ In 2015, this website was the basis for information regarding the origination of BuildingConfidence, but now Firefox posts a warning not to open, and the authors have been unable to find an alternative URL.

The initiative promotes continuous improvement. Non-compliances are graded in terms of the required period in which to take corrective action: A-1: immediate, A-2: within one month, A-3: within one year. One example of the effectiveness of this feedback and corrective action requirement: after three years of audits and corrective actions, Skanska U.K. has a 5 star rating, the highest achievable.

The primary driver of the initiative is risk reduction--avoiding contracting with suppliers who do not meet legal requirements. A secondary objective, at least for Skanska, is reducing the number of suppliers. After four years, they have reduced their direct suppliers from 7500 to 4000. As of 2015, there is no measurement of correlation between profitability and supplier selection in BuildingConfidence.

There may be exceptions, but the main contractors driving BuildingConfidence appear to rely on the motivational impact of measurement and feedback to improve performance, and do not yet use more proactive methods for developing suppliers, such as training, consulting, and supplier teams. Shepherd has done supplier conferences, which are reported to be beneficial, but the impact is relatively marginal, given the long time lapses between events.

Skanska Nordic's Preferred Supplier Program

As previously stated, there are two primary objectives of design science research: 1) Design, implement and assess the utility of an artefact; a construct, tool, or method, and 2) make a contribution to relevant theory. In the design science research reported in this paper, the proposed theoretical contribution is a) the differentiation of obstacles to supply chain management in the construction industry between those that can be changed and those that are structurally embedded, b) negation or clarification of several assumptions regarding those obstacles, and c) identification of an additional obstacle not previously identified; namely, failure of main contractors to understand how to compete supply chain against supply chain. The artefact to be assessed for its utility is a supplier development program structured around business line regions-Skanska Nordic's Preferred Supplier Program (PSP).

Skanska is an international development and construction company headquartered in Stockholm, and active in a variety of sectors, including residential and commercial buildings, civil infrastructure, and industrial construction. Skanska has operations in Europe, South America, and North America. In the 2016 ENR list of Top 225 International Construction companies (ENR), Skanska was the 10th largest by revenue, which amounted to more than \$17 billion USD.

As shown in Figure 2, in 2010, Skanska, through its Nordic Procurement Unit, began exploring the feasibility of a Preferred Supplier Program in Sweden, Finland, and Norway, where Skanska's annual purchases were approximately 5 Bn Euro (\$6.1B¹¹) and involved 52,000 suppliers of goods and services, approximately half of which supplied directly to projects. The authors managed the development of the PSP (the second author was Manager of Skanska's Nordic Procurement Unit and the first author provided consulting support), trying different approaches and responding to the data generated in those attempts; in other words, learning through prototyping. The progress of the Preferred

¹¹ Calculated at the exchange rate on June 30, 2010 from Oanda currency converter.

Ballard and Elfving: Supplier Development the Gateway to Supply Chain Management in Construction Industry

Supplier Program, from its starting point in 2010 to late 2016, is described in the following sections on context, development, deployment and performance.

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Skanska Finland internal study of work flow	Skanska Finland launched a long-term SCM									
	Skanska Finland developed production management		Skanska Finland deployed production management							
	Skanska Finland developed vendor managed inventory				Skanska Finland deployed vendor managed inventory					
				Skanska Finland developed terminal logistics	Skanska Finland deployed terminal logistics					
				Nordic Procurement Unit (NPU) was formed	NPU feasibility study of PSP	NPU developed PSP pre-qualification	NPU deployed PSP pre-qualification			
								NPU developed PSP supplier	NPU deployed PSP supplier	
								NPU developed supplier development activities beyond feedback (supplier)	NPU deployed supplier development activities beyond feedback in Sweden and	NPU developed supplier development activities beyond feedback in Sweden and
								NPU developed PSP supplier segmentation	NPU deployed PSP supplier segmentation	NPU developed PSP supplier segmentation

Figure 2 Skanska Nordic's supplier development Timeline

The PSP was developed based on strategies from the general management literature on supplier development (section 5.0), and from previous limited instances of supplier development in the construction industry (section 6.1). The program involves prequalification of suppliers, performance evaluation at the completion of each contract, and the use of feedback, recognition, supplier clubs, and limited consulting as methods of development.

Context - Background

A supply chain management initiative was launched in Skanska Finland in 2006. In order to provide sufficiently stable demand, the first objective was to improve production management and to standardize logistics solutions (Elfving and Ballard, 2011). Other initiatives were also explored, but were not as successful; e.g., to turn buyers into value

stream (aka, supply chain) managers¹². Working with suppliers of engineered-to-order products such as precast concrete elements, current state processes were mapped, future state maps created, and changes needed to create the future state were identified (Rother and Shook, 2003). Few of these changes happened, primarily because of decentralized project-centric procurement and management of the supplier base.

In procurement, the main focus prior to 2009 had been to standardize processes, such as sourcing processes, and to increase purchasing of goods through framework agreements. These framework agreements were focused on price reduction, not performance improvement. It had been rare that identified problems were solved because the focus on commercial terms overwhelmed capability building. A few centrally organized persons took care of the framework contracts. The project specific procurement staff was located on projects. In 2009, strategic sourcing (framework agreements) and a large part of project specific procurement was centralized on the Nordic level under the Nordic Procurement Unit (NPU). Land acquisition, financial assets, engineering and consulting services are outside the scope of NPU. In 2009, its first year in operation, NPU handled 27% of Skanska Nordic's total purchasing volume with 450 employees. In 2014, NPU handled 50% of purchasing volume, a spend of nearly 2.5 bn € (\$2.8 bn¹³), with 230 employees. The centralized organization enabled large process savings, as well as bundling of volume and specialization, dedicating purchasing professionals to focus on important categories of goods and services. The category manager role is short and long-term category planning, strategic sourcing, and follow-up supplier performance and development activities. Category planning includes both commercial and supplier development activities. The category managers are supported by the supplier management team, which manages the Preferred Supplier Program and plans and runs specific supplier development activities. The larger volume also enabled development of a stronger procurement support organization for training and supplier management. People from more advanced industries and companies such as Toyota, Scania, Nokia and Ericsson joined the team.

Prior to the PSP, development of goods suppliers had been limited to correcting monopoly situations; for example, developing alternative sources for bitumen (for asphalt production), reinforcement steel, and finishing materials; and establishing framework agreements for goods, focused on pricing. Except for a few local attempts, there had been nothing done systematically with service suppliers, which were engaged project-by-project, with no documented evaluation of performance.

PSP Development

Skanska launched PSP to make its Nordic companies more competitive. The company outsources 70-90% of its production by cost, depending on region and business line. Its financial, safety, quality and environmental performance is very dependent on how well its suppliers perform. Also the company wants to grow its market share even when the market as a whole does not grow, which requires taking market share from competitors, which in turn requires an increase in supplier base capacity and competence.

¹² Most buyers had neither aptitude nor interest in extending their responsibilities. The two exceptions became category managers, responsible for short and long-term category planning, strategic sourcing, and follow-up supplier performance and development activities.

¹³ The exchange rate for June 30, 2016 was found using Oanda's currency converter.



It was assumed that Skanska would become more competitive if there are a sufficient number of increasingly competent and competitive suppliers of goods and services everywhere in the Nordics the company might have a project. There are 4 sub goals of the program: reduce risk, consolidate the supplier base, incentivize suppliers to perform better, and improve project profitability.

The starting point and foundation of the program is to ensure that Skanska is working only with legal and financially sound suppliers. A pre-study confirmed the general opinion that there is a significant grey (illegal) market in construction in the Nordic countries. Financial instability of suppliers also poses risks; especially in the case of small suppliers with limited managerial capability--in 2010, more than 50% of suppliers had less than 50 employees, many less than 10.

In PSP, suppliers are to be rated based on their performance-not only price. Naturally, Skanska wants to expand work with well functioning suppliers and reduce or entirely avoid working with suppliers that perform poorly. Finally, suppliers are to be helped to develop their capabilities, with baselines defined by their performance on Skanska projects, and long-term relationships are to be cultivated with suppliers selected not only for their high strategic importance but also for their willingness and ability to learn and improve.

The general prescriptions found in the supplier development literature and presented earlier in section 4.0 of this paper were followed; namely:

- PSP goals were aligned with Skanska's long-term strategies and objectives.
- Optimization was focused on the supply base as a whole
- Decisions were made if to make needed goods and services themselves or to purchase them from suppliers, and in the latter case, if suppliers needed development.
- Suppliers were categorized in terms of the risk to be avoided and the potential benefits of investment in development.
- PSP was customized for the peculiarities of Skanska's businesses in the Nordics—Finland, Norway and Sweden.

Adjustments included building the PSP from bottom up and developing geographically limited suppliers within their regions. 'Developing from bottom-up' means that the first objective was to make sure that basic criteria were met, such as conformance of suppliers with legal requirements and Skanska requirements concerning safety and environmental. Traditionally supplier development in Skanska had taken a top-down approach, focusing on suppliers on whom most money is spent and those with capability to work with R&D. That worked well in advancing Building Information Modelling, but this new task was to work with many and smaller suppliers in order to increase Skanska Nordic's capability. Many of the smaller suppliers lacked competence in basics and had no fulltime safety, environmental or quality manager and only part-time administrators. Most of these supplier companies were family owned and used tier 2 suppliers when their own staff were insufficient. On the other hand, the smaller suppliers are often much more agile with less bureaucracy and flatter decision making routines. This may be one reason why projects tended to prefer to work with smaller suppliers and it is quite typical that each project management team had informal relations with many of the local suppliers. Informal means that even if they work together repeatedly, contracts had been project-by-project and few

local framework agreements have been in place. The disadvantage was that these relations and good practices were not shared between projects, even within business line regions. A greater disadvantage was that even if there had been informal relations, Skanska as a company was not a preferred customer to these suppliers because each project selecting suppliers based on their “informal relations” had caused the number of suppliers to expand. In 2010, 55% of Skanska Nordic’s spend went to suppliers where Skanska made up less than 10% of suppliers’ total revenues. In addition, a typical Skanska supplier had a low IT maturity, usually with only accounting tools in place.

Including all business lines, in 2010, at the outset of PSP development, Skanska had 50 regions in the Nordic countries with about 4000 construction projects ranging in size from less than 100 000€ up to one billion€ (\$122,000 up to \$1.2B¹⁴). Regions were organized around geographic areas for building construction, and around product types for civil construction (infrastructure), which typically has ‘offices’ with larger geographic areas.

As an example, Skanska’s company in Finland is divided into residential, commercial, and civil business lines. Residential and commercial have the same five geographic regions (Figure 3), each further divided into districts, while civil is divided into tunneling, highways, bridges, etc. Both regional structures cover the entire country. The managerial hierarchy follows these structures. There is a Manager of the Southern Finland Residential region, who has profit and loss responsibility, and a corresponding Nordic Procurement Unit manager. Each has district managers as direct reports. Some regions bundle together residential and commercial at the regional level, but divide them at the district level. For example, the Hus Göteborg region in Sweden consists of four districts, two residential and two commercial.



Figure 3: Skanska Finland’s Commercial and Residential Buildings Regions (Courtesy of Skanska)

An hypothesis tested in this research is that the proper locus for supply chain vs supply chain competition is business line regions which share local suppliers. Most people in the industry would likely identify the project as the locus of competition in

¹⁴ The exchange rate at June 30, 2010 was found using Oanda’s currency converter.

construction, and the construction contractors bidding for the project as those who are competing. An alternative perspective is embedded in the structure and function of the PSP. Main contractors such as Skanska and its direct competitors actually compete supply chain vs supply chain in business line regions because the supply base from which to select differs from region to region. In Skanska Nordic, fully half of construction service providers serve only one region within a country, and only 31% operate in all a country's regions. The relevant service supply chain is defined by the region, and the financial performance of single projects is a function of the capacity and competitiveness in each region. When there is inadequate capacity for a service in a region, Skanska takes the initiative to develop existing specialty contractors or to bring in capacity from outside the region, which is also a countermeasure to service supplier monopolies. Given the structure of Skanska Nordic's PSP around business line regions, it follows that ownership of the PSP must be with line management, with procurement playing a strong but supporting role.

PSP development began with the study of single projects in one business line in Sweden, Norway and Finland, then expanded to a regional level in each country. Every part of the program was developed and tested in a selected business line region before it was rolled out to the next region. Although there was some overlap, basically development occurred in the order: prequalification, performance evaluation, and means for supplier development beyond simple feedback. Supplier segmentation categories and membership criteria developed in parallel.

Pre-qualification

The primary objective of pre-qualification is risk management, to secure that suppliers fulfil legal and Skanska specific requirements before contract negotiations take place. Prequalification is done through a self-evaluation that differs in some degree by country, but all have around 80 questions about basic company information, safety, environment, quality, ethics, risks, etc. (<http://www.skanska.se/sv/Om-Skanska/For-leverantorer/>).

In the early stages of developing the PSP, assessment of 522 suppliers within selected business line regions of Finland and Sweden found that 61% of the 522 suppliers that submitted prequalification documents did not meet legal or Skanska requirements. Further, another study of projects in selected regions found that 54% of the cost of subcontractors was expended on suppliers that did not meet minimum or Skanska requirements. This was decisive in gaining senior management support for investing in supplier development.

Evaluating supplier performance

The primary objective of performance evaluation is to reduce cost by assessing supplier and Skanska project performance, promoting improvements, and selecting better performing suppliers. Performance of both framework suppliers of goods and subcontractor suppliers of services are evaluated, but differently. Framework suppliers are evaluated for their on-time delivery and quality by the Nordic Procurement Unit. Service suppliers considered to be critical to successful project delivery are evaluated for their performance on each Skanska project in which they are awarded contracts. This criticality criterion radically reduces the number of suppliers to be evaluated. For example, in Skanska's Southern Finland Residential Building Region, by 2016, a total of 1374 suppliers had been

evaluated, of which 363 had an 'A' rating, with average performance evaluations equal to or greater than 4.0 out of 5.0 after completion of at least one project, and 71 after at least five projects. The evaluation, conducted by project management and procurement personnel from the business line region in which the project is located, consists of eight parts: time, quality, cost, safety, environment, complaints handling, cooperativeness, and development.

The first measurements of quality and on-time delivery were made in 2011 with 26 of the largest and most managerially sophisticated framework goods suppliers, none of whom had previously been asked to provide measurement data. A little less than half of the suppliers were able to properly measure either quality or delivery performance. With help from NPU specialists, just one year later, in 2012, the number of framework suppliers submitting measurement data each month increased to 35 and the average on-time delivery was 95%. Quality targets were subsequently set with each framework supplier depending on where improvement was needed; e.g., service levels, defect rates, packaging to prevent product damage and reduce packaging waste, and improving current product specification such as changing from oil-based to water-based paint on wood windows for better aesthetic appearance. If delivery or quality ratings fall below 95%, corrective action is required and Skanska provides consulting assistance as needed. If ratings fall below 85%, NPU searches for alternative suppliers.

Supplier segmentation

Segmentation of suppliers was done to differentiate how Skanska works with suppliers, to identify relationships in which to invest, and to make it easier for projects to see if the supplier has been selected by Procurement. The categories in 2016 were Not Approved, PreQualified, Approved, Preferred and Key.

Suppliers are placed in the first two categories automatically; in Not Approved when no screening has been done or screening reveals credit rating, tax status or other failures to meet minimum qualifications. The system automatically places suppliers in the Prequalified category when they meet minimum qualifications.

Suppliers are categorized as Approved once they have completed at least one project with a performance rating of 2.0 or above. Preferred and Key Suppliers have not yet been designated in all regions, but the intent is to categorize as Preferred suppliers those that complete a minimum of 5 projects with an average performance rating of 4.0 or above. One possibility is to select a sufficient number of service suppliers of each trade critical to project success, typically 5, but varying with the demand for their services in each region. This is intended to maintain competitiveness (they are to compete against each other for project awards), and also to provide opportunity for continuous improvement from project to project. Key suppliers are to be selected from Preferred suppliers that share values, vision and strategy with Skanska and also meet critical business needs of business units through increasing potential for award of project contracts, generation of value, or promotion of innovation. Designation of Approved, Preferred and Key suppliers is scheduled to happen in 2017.

Decisions to categorize suppliers are made in category planning. The Sourcing Board makes decisions about A and B suppliers. The Category Manager and Portfolio Manager make decisions about C suppliers. Portfolio Managers oversee all categories/category

managers. Because of the larger number of projects in Sweden, there is a portfolio manager for each business line. The Sourcing board is the highest governing body and consists of senior line and procurement people.

Developing suppliers

As noted previously in section 4.2.5, means for influencing suppliers include information exchange, recommendation, request, promise, threat, legalistic plea, consulting and supplier clubs. For suppliers in categories below Preferred, only the first seven, from simple feedback through legalistic plea, are used, with the occasional exception of providing advice regarding how to meet minimum requirements.

In 2015, 44 suppliers were engaged in such joint development initiatives in Sweden and 29 suppliers in Finland, with performance and commercial information regularly exchanged. Development plans to date have mostly targeted quality, delivery, sustainability or safety; e.g., improving work methods to achieve floor surface tolerances and using safer lifting equipment.

A first supplier team (aka, 'supplier club', 'supplier association') was successfully completed in the 2nd half of 2013 with 8 framework suppliers, but the demand for support from Skanska exceeded the capacity needed to expand further. Process improvement with selected suppliers is being used instead. Sponsors for Key Suppliers will be drawn from Skanska top management outside the Nordic Procurement Unit. Development plans will be co-produced and co-signed with the supplier, and follow-up meetings held at minimum twice yearly.

Learnings from PSP development

PSP development revealed interesting findings. First, fulfilling legal requirements was a major challenge. Nearly half of all suppliers had issues either with legal or Skanska requirements, some of which are quite challenging for smaller suppliers. Of course, many legal requirements are appropriate, but sometimes the bigger players use legal requirements to prevent smaller players coming into their markets. Standards and certificates are typical examples of these. CE (Conformité Européene) standard is most common in the Nordic countries, and often strongly supported by major players to protect their own markets. But besides a possible desire to conceal the problem and requirements difficult for some suppliers to fulfill, also lack of awareness and criminality are reasons why such a large percentage of suppliers fail to meet basic requirements.

Suppliers with whom Skanska has framework agreements performed much better against legal and Skanska requirements. This was not unexpected because framework suppliers were more carefully examined in the selection process. In addition, there is only a handful of dedicated specialists (less than one hundred) who are allowed to do framework agreements, whereas nearly everyone on projects (several thousand) can conduct project specific purchasing.

A second major finding from the development phase: Because pricing had previously been the only selection criterion, with few exceptions, goods suppliers did not measure quality and delivery performance systematically and use it for self improvement or in marketing, and Skanska did not measure service supplier performance systematically and share it to encourage improvement. When problems occurred, the focus was exclusively on

fixing the immediate problem, not on preventing reoccurrence. There were also cases where supplier performance measurements differed from measurements made by projects. For example, in one case a supplier reported over 96% delivery accuracy, while Skanska measured below 80%. Examination revealed that Skanska was giving equal weight to every defect, while the supplier was weighting their defect count by the cost to repair in the shop. In other words, the supplier was not measuring defects from the customer's perspective, but from their own as producers.

It took much more time than expected to define and work out processes for performance measurement together with suppliers. However, once Skanska demanded and followed up the supplier performance measurement, there has been a positive trend upwards.

PSP Deployment

By 2016, PSP prequalification and performance rating had become part of Skanska Nordic's management system, but a number of concerns had to be overcome in order to get to this point. Many senior managers had seen previous exercises that had failed and there was concern about Skanska investing in improving the supply base and competitors getting the benefit of better performing suppliers for free. There was also concern about the cost/ benefit ratio that could be achieved. During the first two years, top management evaluated PSP progress every six months and decided if to continue or to stop the program. The thinking was always, start small, piece-by-piece, bottom-up and with people and projects most open and embracing. Then slowly expand the group, from project to region, to next region, and so on. As more data became available, more fact-based decisions could be made. As project performance improved, organisational confidence grew. When more than half of the regions were on board, it was decided to make PSP part of the management system. Prequalification was deployed in 2013 and supplier performance evaluations in 2014. Different ways of differentiating higher level supplier segments are still being considered and evaluated, and were to be deployed in 2017.

Learnings from PSP deployment

Many important lessons were learned from deployment:

- Incentives for senior managers push them away from longer-term investments.
- Supplier development is very complex from the involvement of many players within and outside the company.
- The construction buyer who embraces supplier development must be wary of creating a competitive disadvantage.

Administration of the Preferred Supplier Program is challenging, with more than 1000 projects (that change generally every 18 months and cover a wide range in size) and, at the end of 2015, 18000 suppliers in the Nordics. The challenge is to keep it simple and avoid creating more bureaucracy.

Different business lines have different geographic structures in different countries.

Incentive structures tend to be built so that short-term gains are prioritized over long-term gains. The set-up cost for supplier development is quite high even if the business case is strong. Therefore, when senior management is evaluating various initiatives, funding for supplier development depends on visionary leadership that looks beyond annual

business plans. There is also a fine balance needed between tightening the selection criteria and maintaining competitiveness. If selection criteria are tightened too quickly, there may be too few qualified suppliers to meet capacity demands, and those few may command monopolistic pricing.

Supplier development requires collaboration cross-functionally in the company but also with external players. This is also one reason why at least in the beginning the progress is slow because everyone needs to be on board. The time required to communicate and train people was underestimated.

PSP performance through 2016

Demonstration of effectiveness was done by measuring performance against the goals of the supplier development program: 1) reduce the risk to Skanska from poor performing suppliers, 2) consolidate suppliers, 3) improve supplier performance, and 4) improve project profitability. Since the first assessments in 2010:

- The number of suppliers that do not meet minimum requirements has been reduced to less than 1%, either as a result of disqualification or actions taken by suppliers to meet those requirements.
- As shown in Figure 4, the number of suppliers of goods and services to Skanska projects has been reduced from 26,000 to 18,000, a reduction of 31% while spending on project goods and services has increased by 16%.

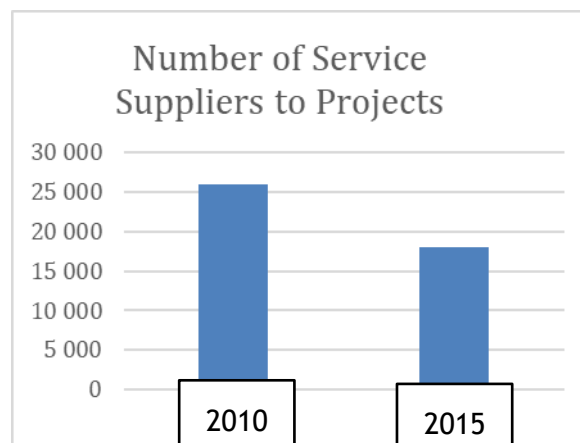


Figure 4: Reduction in Number of Service Suppliers to Projects

- In addition, as shown in Figure 5, spend on suppliers with 100 or more employees increased from 39% in 2010 to 47% in 2014. Spending has also increased on suppliers with more dependence on Skanska, and hence more responsive to improving their performance. In 2010, 55% of first tier suppliers received less than 10% of their annual revenues from Skanska. That was reduced to 49% in 2014. In 2010, 35% of suppliers had less than 30 employees and 61% less than 100 employees. In 2014, 31% of suppliers had less than 30 employees and 51% less than 100.



Figure 5: Spend on Suppliers with ≥ 100 Employees

- Framework suppliers (of goods) have improved their ratings in on-time delivery and quality. Average on-time deliveries to project sites improved from 83.9% in 2012 to 98.5% at the end of 2016, with 37 framework suppliers submitting measurement data (Figure 6). Quality measurements of framework suppliers averaged 98.7% at the end of 2016, the first year in which consistent and comparable measurement data was collected, with 38 suppliers reporting (Figure 7).

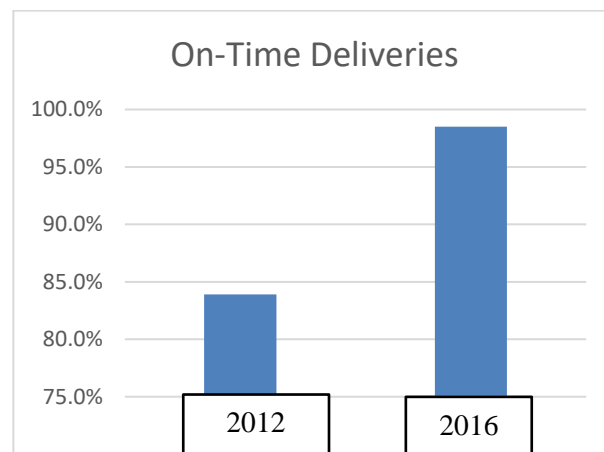


Figure 6: Improvement in On-Time Deliveries

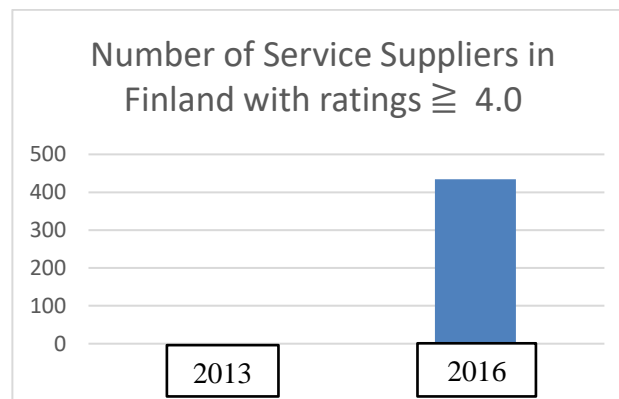


Figure 7: Service Supplier Performance Improvement

- Suppliers of services (subcontractors) improved their ratings in performance on projects. As an example, in all business lines in Finland, zero suppliers rated 4.0 or above (on a scale where 5.0 is best) in 2013, but 434 in 2016.
- A number of indicators show that PSP has led to improvement in project profitability, even though as yet incompletely deployed. In a study conducted in 2014, a positive correlation was found between Skanska's profitability on projects and the ratings level of the projects' suppliers. On projects that exceeded targeted tender margin, 73% of the suppliers were rated above average. On projects where the targeted tender margin was not achieved, only 36% of the suppliers were rated above average. In 2016, the initial business line region in both development and deployment, Southern Finland Residential, had the highest project profitability, and project profitability in all business line regions in Finland was positively correlated with the number of suppliers with performance ratings equal to or greater than 4. Lastly, Skanska was the most profitable large main contractor in Sweden and Finland in 2014, 2015 and 2016. These results have helped enormously to shift the company away from buying on least price.
- Business line regions report their supplier development progress monthly within Skanska Nordic; prequalification statistics, supplier performance evaluations at completion of project contracts, delivery and quality performance of Framework suppliers of goods, top risks and status of efforts to mitigate. Feedback is also provided suppliers regarding their performance and, where appropriate, needed improvement. Internally, extensive information is available on each individual supplier, down to performance on each project on which they have worked, and audit findings.

PSP performance through 2018

As noted in the paper, the Preferred Supplier Program was preceded by centralization of procurement in the Nordic Procurement Unit, and even earlier by standardization of project planning/control and on-site and off-site logistics in Skanska Finland. This starting point was chosen in order to provide more stable demand signals, before trying to manage supply. Managing supply was made possible through the Nordic Procurement Unit because policy could be enforced and information management systems provided.

The head start enjoyed by Skanska Finland has continued, although the differences between the three Skanska Nordic countries is decreasing. On that point, in the years after 2015, the Preferred Supplier Program stopped being a program and became Skanska's way of working in all three Nordic countries.

One objective of the Preferred Supplier Program was to reduce Skanska's risk from engaging unqualified suppliers. That was the first part of the Program to be implemented, and it has become standard practice in all three countries - Qualifying and evaluating suppliers remains on the same or higher level than in 2018 compared to 2015 in all three Skanska Nordic countries. Spend on suppliers that do not qualify has essentially disappeared. The only exceptions are suppliers on which there has been very little spend or who misunderstood the qualification process.

As regards another key objective, supplier consolidation, all three countries have been able to maintain or improve on 2015 levels.

- In Q2 2019 in Skanska Norway, the supplier base has been consolidated so that 96% of total spend goes to 20% of suppliers, and 92% of spend is on prequalified suppliers.
- In Q2 2019, in Skanska Sweden, 65% of spend was prequalified, versus 50% in 2015.
- In Skanska Finland, prequalified spend was 92% (Table 4) compared to 64% in 2015.

Table 4: Skanska Finland Spend on PreQualified Suppliers

Company	Region	Prequalified and approved suppliers, order spend, Q3/2019, rolling 12 months	Order spend total, Q3/2019, rolling 12 months	Status Q3/2019, based on order spend
Skanska Infra Oy		38 997 682	45 772 016	● 85 %
Skanska Industrial Solutions Oy		3 717 394	4 996 144	● 74 %
Skanska Rakennuskone Oy		4 327 475	4 856 282	● 89 %
Skanska Talonrakennus Oy	South Residential	105 513 000	107 049 164	● 99 %
	South Commercial	73 749 596	83 176 704	● 89 %
	East	42 615 671	45 916 663	● 93 %
	West	67 675 317	73 535 458	● 92 %
	North	14 293 040	15 496 128	● 92 %
	M&E	1 668 429	2 260 330	● 74 %
BU Finland Q3/2019, including Skanska Oy & Skanska Industrial Solutions Oy		359 471 693	392 496 412	92 %
BU Finland Q2/2019, including Skanska Oy & Skanska Industrial Solutions Oy		358 861 369	402 961 330	89 %

A third objective was to increase spend on better performing suppliers. In Skanska Finland, total suppliers have decreased from 5000 in 2013 to 1218 in 2019 Q3. And in that same time period, 137 suppliers out of 1218 received 53% of the spend, compared to 434 out of 5000 suppliers in 2013 (Table 5).

Table 5: Skanska Finland Spend on Better Performing Suppliers

Company	Region	Order Amount, suppliers with average score over 3,5	Total Order Amount [EUR]	Status Q3/2019
Skanska Infra Oy		9 651 572 €	45 772 016 €	● 21 %
Skanska Industrial Solutions Oy		1 090 139 €	4 996 144 €	● 22 %
Skanska Rakennuskone Oy		248 945 €	4 856 282 €	● 5 %
Skanska Talonrakennus Oy	South Residential	88 806 250 €	107 049 164 €	● 83 %
	South Commercial	30 978 886 €	83 176 704 €	● 37 %
	East	22 130 088 €	45 916 663 €	● 48 %
	West	39 835 172 €	73 535 458 €	● 54 %
	North	8 716 557 €	15 496 128 €	● 56 %
	M&E	810 307 €	2 260 330 €	● 36 %
BU Finland Q3/2019		202 267 915 €	383 058 889 €	● 53 %

Increasing profitability was the fourth objective. As shown in Figure 8 below, Skanska Finland's profitability has improved each year of the last eight years. It is highly probable that improvement in supply chain performance has been a key driver of revenue and profitability, which supports the objective of demonstrating that profitability increases with contracting better performing suppliers, as opposed to selecting on low price.

Note however, that another objective, to increase market share, has not yet been achieved. As shown in Figure 3, revenue has remained pretty level, while profit margins have increased. That was the result of a management decision to grow market share patiently rather than subordinate profits.

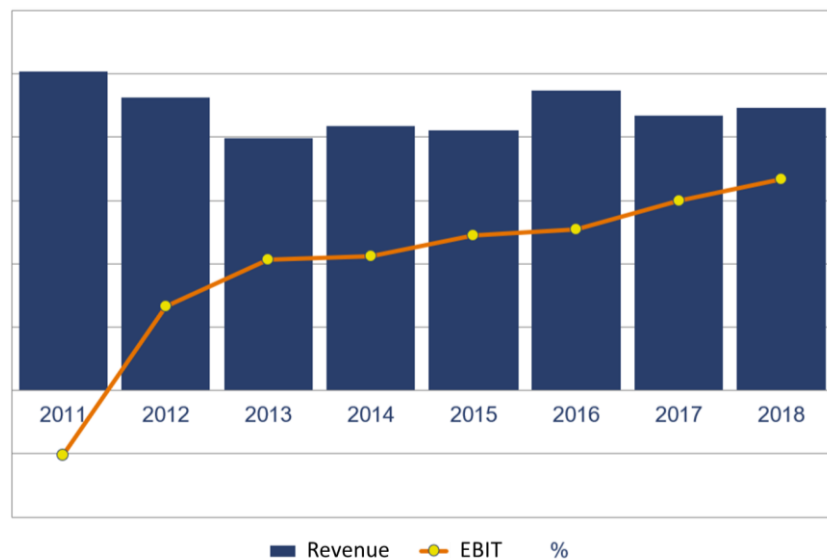


Figure 8: Revenue and EBIT in Skanska Finland between 2011-2018

The profitability has not only improved but also performance relative to competitors in the last several years (figure 9).

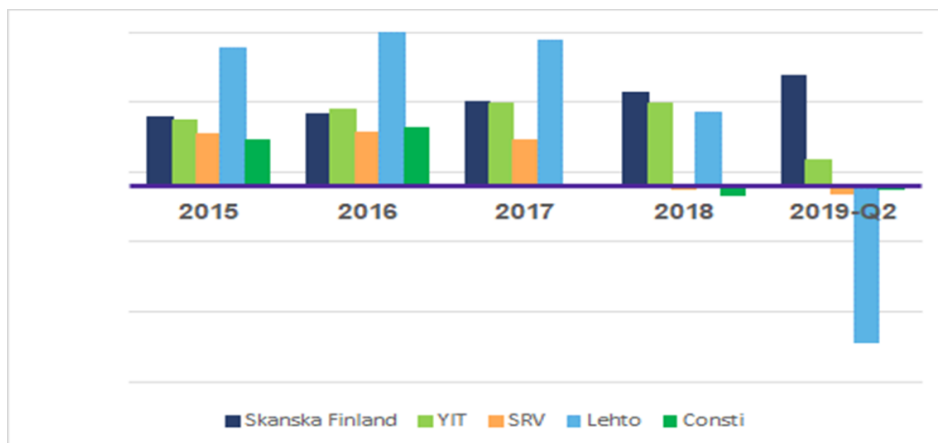


Figure 9: Skanska Finland profitability compared to closest competitors (source: Annual reports)

Overall, profitability has been on a good level in three Skanska Nordic countries (Figure 10).

It took nearly a decade from concept development to business as usual, and now supplier development activities have become routine. The next phase is to work in a structured way on innovations with external partners, for which the Preferred Supplier Program has laid a solid foundation.

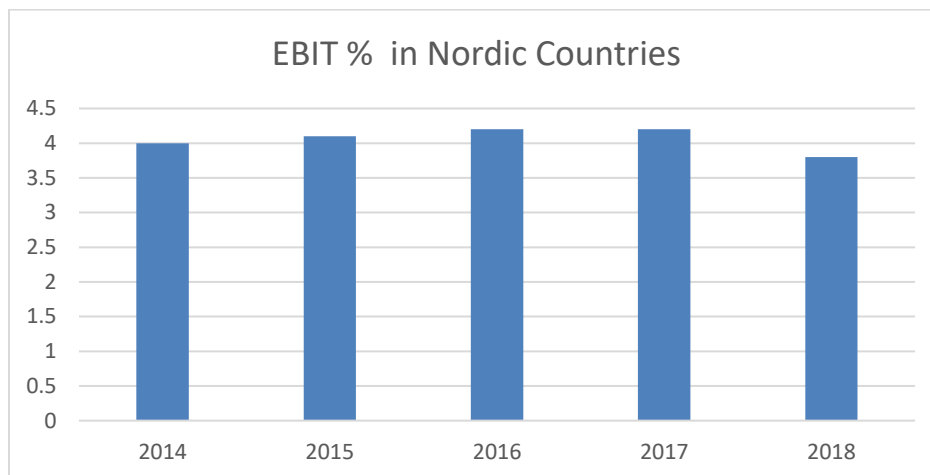


Figure 5: EBIT% in Skanska Nordic-all 3 countries

Conclusions

In the Introduction, we stated the problem we intended to solve and how we intended to solve it.

“To avoid the conclusion that supply chain management and construction are not a good match for one another, it is necessary to show that the traditional attitudes and practices that are obstacles to supply chain management can be overcome, that supply chain management can be implemented in a way that accommodates inherent industry characteristics, and that supply chain management can be driven by other construction industry participants than clients. This paper proposes to have contributed to that objective by a) identifying which obstacles are inherent and which are not, b) negation or clarification of key assumptions regarding those obstacles, c) identification of an additional obstacle not previously identified; namely, failure of main contractors to understand how to compete supply chain against supply chain, and d) demonstrating that and how main contractors with recurring projects in geographic areas can develop their suppliers—to be done by developing and implementing a Preferred Supplier Program for Skanska Nordic and measuring its impact on company and project performance.”

In this section, success in achieving the objectives of the paper is assessed and recommendations for future research are provided.

Which obstacles to supply chain management in the construction industry are inherent and which can be changed?

Characteristics of the construction industry that have been identified as obstacles to supply chain management include inherent characteristics such as production of custom products and the multitude of components and skills needed to produce them. These cannot be changed but have been shown to be consistent with supply chain management when adapted for industry characteristics. Arguments have also been made that traditional attitudes and managerial practices are not inherent to the industry; that they can and are being changed. These attitudes and practices include adversarial relationships among project participants, buying on low price without consideration of qualifications, and

managerial focus on individual projects. Documents describing counter examples have been referenced, and the success of the PSP initiative cited as evidence where relevant.

Clarifications about obstacles

Propositions have been advanced and supporting arguments made regarding claims about certain obstacles to supply chain management in the construction industry. The propositions are:

- Prop. 1: The opportunity for contractual relationships between main contractors and their suppliers is not limited by the nature of the construction industry, but rather by the geographic range and capacity of suppliers, and the number of project opportunities offered by the main contractor within each geographic region.
- Prop. 2: The assumption that candidates differ only in price is false.
- Prop. 3: Competition between alternative suppliers of the same service can co-exist with limiting the number of those suppliers.
- Prop. 6: A construction buyer need not constitute the majority of a supplier's demand in order to have influence over the supplier, unless the supplier has a monopoly.

Previously unidentified obstacle to supply chain management in the construction industry

Although related to managerial focus on individual projects, failure to understand how to compete supply chain versus supply chain in the construction industry has not been previously identified as an obstacle to supply chain management. Three propositions address this obstacle:

- Prop. 4: An obstacle to supplier development by main contractors is failure to understand how to compete supply chain vs supply chain except through individual projects.
- Prop. 5: Projects cannot fully carry out the policies and practices required for supplier development by a construction main contractor.
- Prop. 7: Business line regions are the appropriate locus of competition between supply chains for main contractors with recurring projects within those regions.

Centralization of procurement is claimed necessary in some degree for supply chain management to be feasible in construction, but procurement and line management must each play a role; procurement in providing information management systems and carrying out policies and strategies, line management in evaluating suppliers and using procurement-provided information to select better performing suppliers. Business line regions are proposed as the locus of competition between supply chains. Regions are relatively independent parts of organizations, bringing corporate functions to the individual projects through which construction companies generate and deliver value, for both their customers and themselves. Projects are rightly preoccupied with execution, with little energy for development. The company itself is too large to serve as the unit of analysis for development, and also has its own work to do; namely, provide the enabling functions such as strategy, finance, marketing, accounting, etc. Regions marry enabling functions with execution/delivery, and should be responsible for operational improvement.

Demonstration that and how main contractors can lead supplier development

Design science research methodology requires that an artefact be evaluated for the utility provided and that an explanation be provided regarding what demonstrates this utility. The artefact to be evaluated in this instance is a main contractor-led supplier development program. The utility it provides is of two kinds. It serves as a demonstration that main contractor-led supplier development is feasible and beneficial. Benefits consist in improving the selection of suppliers, improving the supplier base from which selection is made and improving the performance of the main contractor. Demonstration of that utility is provided by measured performance of the supplier development program, reported in sections 6.2.4 and 6.2.5 (PSP Performance). Skanska Nordic's supplier development program is not a solution even for all main contractors, but its success does answer the question if supplier development can be driven by someone other than clients, and it offers hope that the same can eventually be said for the entirety of supply chain management, for which supplier development is the gateway.

Recommendations for future research

If one in every three service suppliers do not meet basic requirements, as was found to be the case in the Nordic countries, a minimal level of supplier development would seem to be urgently needed in the construction industry as a whole. To what extent is compliance with basic requirements an issue in the construction industry? Are there differences geographically or by industry sector? Are those differences a result of different practices, and can effective practices be adapted for use elsewhere?

Further research is needed on the claim advanced in this paper regarding regional offices as the loci of competition between supply chains. Regional offices as competitive loci may or may not be appropriate for all industry sectors or for differently situated players within a sector. Generally, how do supplier development opportunities differ for various players; e.g., owner, developer, main contractor, principal designer/engineer, specialty contractors, and specialty engineering firms?

One major opportunity is for main contractors and the various specialist firms involved to map and improve engineering, fabrication, and delivery processes for fabricated (engineered-to-order and made-to-order) products.

Hopefully, this paper contributes to the long overdue embrace of supplier development and supply chain management by the construction industry. We invite industry practitioners and academics to put their shoulder to this wheel and push it past the tipping point.

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