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Organising for supply chain management

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Many companies have introduced the supply chain function in their organisation. Little attention, however, is devoted to the way the supply chain function is organised, e.g. the range of responsibilities it has, the position it occupies in the hierarchy and the skills it requires. The literature on this is scarce. This paper provides initial benchmarking data on company decisions regarding the roles and responsibilities of their supply chain managers and how the various supply chain tasks are coordinated and integrated. Our empirical study in the food, pharmaceutical, and chemical industries shows that differences in supply chain organisational structures are not random. We find that the way the supply chain function is organised seems to depend on the industry and its complexity and, we might speculate, on the strategy of the organisation. By highlighting and trying to explain these differences, we hope to raise top management awareness regarding the structuring options for their supply chain function and the importance of this issue for the organisation.

Keywords: supply chain organisation; supply chain skills; integration

1. Introduction

As supply chain management (SCM) is a fairly recent management discipline, the definition of the supply chain function is still rather vague and a subject of discussion (Bowersox *et al*. 2007, p. 4).

Originally, the responsibility for logistical activities was dispersed throughout the organisation and the term 'logistics', if used at all, typically referred to tasks such as transportation, distribution, and warehousing. From the 1960s, we have witnessed the emergence of logistics organisational structures. Recognising the need for total cost control and driven by the need to better integrate the various activities performed to manage the material flow from suppliers to (direct) customers, companies started to group logistic functions into a single organisational unit. 'Logistics', or 'materials management' as some called it, sprang from the integration of inbound activities (often previously called 'purchasing' or 'procurement') and outbound activities (i.e. physical distribution). The phenomenon was studied extensively and was widely documented. We refer for example to the work undertaken by A.T. Kearney (1978, 1991), the research at Michigan State University on logistics organisation and best practice (Bowersox 1992, Bowersox *et al.* 1989, 1999) and the research at Harvard Business School on the materials manager (Miller and Gilmour 1979, Miller

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et al. 1981). The empirical work led by Miller (Miller and Gilmour 1979, Miller *et al*. 1981), for example, provides some evidence, particularly from the USA, of the more integrated organisational structures for logistics in the 1970s. While the terminology differs – Miller *et al*. refer to the materials manager, rather than the logistics manager – their analysis points in the same direction as the work by Bowersox. Miller and Gilmour (1979) argue that 'purchasing, production and distribution are not separate activities but three aspects of one basic task: controlling the flow of materials and products from sources of supply, through manufacturing, and out through channels of distribution into the hands of customers'. Their research shows that, by the late 1970s, 40% of the firms surveyed could be classified as 'fully integrated', which is the structure characterised by all three materials and logistics functions (purchasing, production planning and control, and distribution) reporting to a single person (Miller *et al*. 1981). Moreover, in 50% of the companies, they observed 'partially integrated' structures with two of the three functions reporting to a materials manager. This left only 10% of companies with what they called a 'segmented structure', where the three functions were headed by persons each reporting to a different executive with the CEO or general manager as the ultimate integrator.

In the same research, the concept of '*integrativeness*' in materials management was introduced. By this was meant the investment made by an organisation in integration. This is related in essence to the frequency and intensity of lateral relations that cut across the organisational boundaries between the subunits purchasing, manufacturing, (physical) distribution, etc. (Van Dierdonck and Miller 1980). With hindsight, we can see that this concept has become a key aspect of today's SCM.

Since the time of these studies, important evolutions have taken place which have given rise to the concept of SCM. In essence, the focus has shifted from the logistical function to the logistical process. As Bowersox *et al*. (2007, p. 357) puts it, 'the critical question became not how to organise individual functions, but rather how to best manage the overall logistical process'. As a consequence, the scope of what we now call 'SCM' is much broader than what we used to call 'logistics' or 'materials management', even though the areas have conceptually much in common.

Firstly, SCM emphasises the need to integrate among different independent organisational units. The scope is not only the material flow within the walls of a particular organisation; it includes at the one end also the suppliers and even the suppliers' suppliers, and at the other end the customers and even the customers' customers. Ideally, one should look at the supply chain from the sources of raw materials to the final customer. SCM is about joint planning beyond the boundaries of a single enterprise, in the extended enterprise, in order to maximise customer service, reduce risk, and improve cost (Bowersox *et al*. 2007, p. 8). This makes the task of integrating all these activities different from and more complex than the tasks of the materials manager. In addition, the fact that the scope extends beyond the corporate boundaries of an organisation to include different legally independent organisational units makes some of the traditional integration mechanisms less effective or even irrelevant.

Secondly, there is an internal broadening of scope. Materials management was in almost all cases exclusively related to logistical activities such as purchasing, production planning, or physical distribution. SCM, in contrast, stresses the need to integrate with other, not directly logistical organisational units such as R&D, manufacturing, marketing, and others. As suggested by Parker and Anderson (2002), this broader scope requires new tasks and new skills of the person who manages the various interfaces. In particular, they argue that effective supply chain integration requires the combination of technical, business, and interpersonal skills.

Information and communication technologies (ICTs) have been an important enabler of this trend towards a broader and more integrated SCM (Bowersox *et al*. 2007, p. 6). Even back in the seventies, Galbraith (1973) and later Tushman and Nadler (1978) described the relationship between Information Technology (IT) systems and organisational structure. Based on their views, one could expect that the ICT evolution would have an important impact on the supply chain organisational structure. This is not surprising, given the importance of the information flows

that accompany the flows of goods in a supply chain. After all, the well quoted definition of logistics by the Council of Supply Chain Management Professionals specifically mentions the information flows related to the flows of goods and services (Council of Supply Chain Management Professionals 2010). It is clear that the emergence of powerful and integrative IT systems such as Enterprise Resource Planning is impacting supply chain structure and performance (Stevens 1989; Hendricks *et al*. 2007).

These evolutions motivated us to initiate a study on the supply chain organisation. More specifically, it was our intention to address the following research questions:

RQ 1. How do companies define SCM in terms of scope? Which activities lie within the responsibility of the supply chain function?
RQ 2. Which integration mechanisms do supply chain managers use to coordinate with other departments within or outside the company?
RQ 3. Which roles are played by supply chain managers in carrying out their tasks?
RQ 4. What is the required skill set for the supply chain manager?
RQ 5. How strategic is the supply chain function in the organisation?
RQ 6. How global is the SCM function, and what is the geographical structure of the supply chain activities?

The answers we have obtained to these questions provide some initial benchmarking data on company decisions regarding the structure of the supply chain function, including the role and responsibilities of supply chain managers. At the same time, we have gained various insights that help us to explain the differences we observe.

2. Organising the supply chain function: literature overview

A key issue in SCM is the need for more integration between different subunits within an organisation and among the different organisations active in the supply chain (Slone *et al*. 2007). Integration in the context of SCM has been defined as 'a process of interaction and collaboration in which manufacturing, purchasing, and logistics work together in a cooperative manner to arrive at mutually acceptable outcomes for their organisations' (Pagell 2004, p. 460). As Pagell (2004, p. 460) states: 'In essence, the entire concept of SCM is really predicated on integration. Well managed supply chains are ones where all value creating processes work together to provide the highest level of customer value'. Stevens (1989) goes one step further and states that integrating specific supply chain functions will lead to higher performance in terms of higher customer service and lower inventory investments.

There appears to exist a widespread consensus in the literature on the need for and the value of integration, but little knowledge exists on how to achieve such integration. The literature on this topic devotes most of the attention to concepts, techniques, planning systems, and generally ICT-based systems that help organisations to integrate the supply chain activities better (e.g. Hendricks *et al*. 2007). However, much less attention has been given to SCM organisational structure and the profile of the managers in this structure. By structure, we mean the way the various supply chain tasks are being allocated to individuals and organisational units, and the way coordination between these individuals and units is accomplished. In the section that follows, we review the organisational design literature to understand how companies organise their supply chain function.

2.1. *Organisational design literature*

Key concepts in the organisational design literature are the concepts of differentiation and integration, coined by Lawrence and Lorsch (1969) (see also Ketokivi *et al*. (2006)). Lawrence and

Lorsch explain the process of organisational structuring as follows. As systems become large, they differentiate into parts, and the functioning of separate parts needs to be integrated. In essence, designing an organisation includes two steps: a first one – the differentiation – is the allocation or division of tasks to individuals, to subunits, to divisions, etc. The authors see differentiation not only as a result of differences in tasks, but also, or even primarily, as a result of the fact that each department has a different external environment to deal with. Once allocated, the various tasks should be integrated, which refers to the integration step. They describe the process of creating differentiation and the need for integration graphically by using the following metaphor: 'the human body is differentiated into a number of vital organs which are integrated through the nervous system and the brains' (Lawrence and Lorsch 1969, p. 7).

As discussed by Galbraith (1973), Germain *et al*. (2008), and many others, different organisational structures have different degrees of integrativeness. This depends on the integrative structure, which is a function of the accumulation of different integration mechanisms. These integration mechanisms can be grouped into two categories: hierarchical structures and lateral structures (both informal and formal).

In the first category – the hierarchical structure – integration is embedded in the main task of a manager supervising two or more organisational units: he/she sets common goals, makes interdepartmental trade-offs, acts as the communication link, resolves conflicts, etc. The information flows in this type of organisations are typically vertical.

In the second category – the lateral structure – integration is established through lateral coordination mechanisms. These can be divided into two subcategories. In the first one, integration between two organisational units takes place by establishing rules, procedures, policies, standards, service level agreements (SLAs), contracts, or higher level plans (Martinez and Jarillo 1989). These mechanisms are established 'off-line' in the sense that they take place before the actual transaction. Examples in the supply chain context are agreements on reorder levels or inventory service levels in the case of vendor-managed inventories. Another example is the so-called sales and operations plan, allocating products and production volumes to various plants.

However, integration can also take place during the transaction, through the establishment of lateral 'on-line' mechanisms. These can be informal and stimulated by such actions as departmentalisation, i.e. the grouping of persons into the same organisational unit, improving the physical proximity such as co-locating suppliers and manufacturers, or job rotation between units (Martinez and Jarillo 1989). Informal direct contacts are the simplest form of lateral relations. This is a voluntary organisation because it is formed at the initiation of those comprising it. The actors involved perceive a situation and spontaneously communicate among themselves to resolve the issue. The mechanisms can also be formalised in the form of task forces dealing with temporary issues, committees for more permanent issues, liaison functions, or integrator functions (Galbraith 1973). We found an interesting example in a company where a representative of the buyer company was participating in the master production planning process of a major supplier.

2.2. *A contingency perspective: no universal structure fits all organisations*

The contingency perspective on organisational design implies that there is no universal, optimal structure that fits all organisations. The ideal organisational structure depends on the situation. Various 'situational' factors have been identified, for example, the environment, the strategy, the organisational task, or information processing needs. Central however to all these factors is the concept of uncertainty. The uncertainty one has to deal with in organisational decision making determines the required integrativeness of the decision-making system, including the organisational structure (Lawrence and Lorsch 1969, Galbraith 1973, Tushman and Nadler 1978, Germain *et al*. 2008).

Ever since Chandler (1962) formulated his 'structure follows strategy' paradigm, our thinking has been influenced by it. Based on this paradigm, the ultimate contingency variable is the strategy of the organisation which includes the environment the organisation chooses to compete in and the competitive factors it chooses to compete on. This is the essence of, for instance, the manufacturing strategy literature that basically states that the ideal manufacturing system is determined by the manufacturing strategy (sometimes also called manufacturing task), which in turn depends on the competitive strategy (Skinner 1978, Hayes *et al*. 1988).

There is not necessarily a contradiction between the two viewpoints (uncertainty or strategy as the contingent variable). An important conclusion drawn from the work by Miller (Miller and Gilmour 1979, Miller *et al*. 1981) on the organisation of materials management was that there exists no universally valid optimal structure. What constitutes the ideal structure depends very much on the situation. An important situational factor was found to be the degree of uncertainty the organisation had to deal with in its materials management task. This uncertainty in turn was related to the competitive strategy of the organisation and to what was called the tolerance for slack. Task uncertainty and tolerance for slack were therefore intermediate variables between strategy and organisational structure.

3. Research methodology

The purpose of our study has been to gain insight into how companies organise their supply chain function and to understand why structures are different. The character of the research is therefore mainly descriptive, but at the same time has the ambition to help companies organise their supply chain responsibilities and to define the corresponding implications for top management and human resource executives in supply chain organisations.

Data have been collected by means of a survey. A particular difficulty was the identification of the respondent. The ambition was to have the questionnaire sent to the highest ranked supply chain manager in the company, or in the business unit in case of a complex organisation with different business units. It was important to reach a sufficiently large number of highest ranked supply chain managers, as this tells us how the supply chain organisation is structured. The difficulty was that in most organisations there was no department with the name of SCM or an executive carrying the title of supply chain manager. The function existed, but carried various names. For example, we encountered several 'supply chain directors', but also some 'logistic directors', and one or two 'director operations and sourcing', 'director procurement and logistics', 'director supply chain and manufacturing', and even a 'supply chain competence leader' and a 'head of commercial management: SCM'. We therefore asked the potential respondents prior to sending them the questionnaire to identify their job responsibilities, so we could verify whether they were effectively active in a managerial supply chain function.

The questionnaire was sent to 100 top-level supply chain managers, in three selected industries, in 2008: chemicals, pharmaceuticals, and food and beverages. These 100 supply chain managers represent almost the entire population of the larger multinational companies active in Belgium and the Netherlands in those three industries. The choice of focus on this region was based on the close relationships the research team had with these companies, which allowed us to have direct access to the highest ranked supply chain manager. These three industries have been chosen because they all have a strong manufacturing focus, yet operate in different strategic contexts. Whereas the food and beverages industry is characterised by low growth and low investment in R&D, companies in the pharmaceutical industry primarily compete on the basis of new product development and the technology to produce these new products (Lagnevik *et al*. 2003). Sourcing of raw materials is a strategic domain in the chemical industry, whereas in food and in other perishable goods industries, sourcing and logistics is mainly focused on tightly matching supply with demand.

Table 1. Number of respondents per industry and company size.

Annual sales	Pharmaceuticals	Chemicals	Food and beverages	Total
<€ 100 million	0	4	2	6
€ 100–250 million	1	1	2	4
>€ 250 million	8	12	20	40
Total number of companies	9	17	26[a]	52[a]

[a]Sales data missing for two companies in the food and beverages industry.

In other words, manufacturing, sourcing, and distribution management have different meanings in these three distinct industries.

Our hypothesis is that these contextual differences have some effect on the supply chain organisational structure. Although we acknowledge that companies within the same industry do not necessarily follow the same (competitive) strategy, the specific contextual characteristics of an industry do have an important impact on the eventual strategy. Porter for instance refers to the importance of what he calls generic industry environments or even more directly to the importance of certain common industry characteristics such as the growth rate of demand, the structure of the suppliers' industry, the nature of the product and process technologies in shaping the strategy of the firm (Porter 1980, p. 142). Based on these observations, we could assume that in this research, industry differences will lead to different strategic choices and industry similarities will lead to similar strategic choices.

We received 52 responses from the 100 supply chain managers. Of these 52 supply chain managers, 36 managers reported to be the highest ranked supply chain manager in the company or business unit. Table 1 provides an overview of the number of respondents per industry and the size of the business unit studied. In all three industries, the majority of the companies are fairly large, with annual sales over € 250 million.

4. Results: How companies organise their supply chain function

In this section, we summarise the findings from the survey research, for each of the research questions.

Research Question 1. How do companies define SCM in terms of scope? Which activities lie within the responsibility of the supply chain function?

In our discussion of the scope of responsibilities within the function of the supply chain manager, we will first focus on the core supply chain areas, i.e. planning and management of the functional areas (procurement, manufacturing, and distribution). We then study to what extent the supply chain department is involved in activities with other departments, and with suppliers and customers.

The scope of supply chain responsibilities within the function of the supply chain manager has been operationalised using the Supply Chain Operations Reference (SCOR) model as a conceptual framework. The SCOR model is a framework that is well known and widely accepted in the supply chain community. It has been developed and endorsed by the Supply Chain Council to describe the business activities associated with all phases in the supply chain (see http://www.supplychain.org/ for the most recent version of the SCOR model). The SCOR model basically aggregates the major SCM tasks into four categories or SCM subfunctions: 'Source', 'Make', and 'Deliver' refer to the three functional areas, i.e. procurement, manufacturing, and distribution; 'Plan' refers to the overall planning of these three functional areas (Supply Chain Council 2008).

Table 2. Responsibility of the highest ranked supply chain manager by industry.

	Pharmaceuticals (%)	Chemicals (%)	Food and beverages (%)	Overall (%)	Industry effect (significance level)[a]
Plan	71.4	90	100	*92*	$p < 10\%$
Source	28.6	60	63.2	*56*	n.s.
Make	28.6	20	68.4	*47*	$p < 5\%$[b]
Deliver	100	90	94.7	*94*	n.s.

Note: Significance level, n.s., not significant at $p = 10\%$ level.
[a]Chi-square test comparing across the three industries.
[b]The null hypothesis that the occurrence of the 'Make' responsibility is independent of the industry is rejected (chi-square analysis, $p < 5\%$).

Respondents were asked to indicate whether they were ultimately responsible for decisions and actions related to 'Plan', 'Source', 'Make', and/or 'Deliver'. Table 2 shows, for each of these four subfunctions, the percentage of the highest ranked supply chain managers who reported to be responsible for that subfunction. These statistics are provided for each industry, as well as in total. We observe that almost all of the highest ranked supply chain managers (92%) report to have 'Plan' as one of their responsibilities, next to a mix of the three functional responsibilities. 'Deliver' activities fall under the responsibility of most of respondents (94%), but a substantial lower proportion has 'Source' in their scope (56%) and even less had the 'Make' responsibility (47%) under their control (Table 2).

Table 2 also shows that the frequency of occurrence of these four subfunctions as an area of responsibility of the highest ranked supply chain manager differs across the three industries. This is especially the case for the 'Make' subfunction, for which the frequency differs significantly across the three industries (chi-square significance level <5%). We find the widest scope of the supply chain function in the food and beverages industry, where it typically includes the three functional domains ('Source', 'Make', and 'Deliver') as well as planning. Companies in the chemical industry hold a middle position, where the scope typically includes 'Deliver' and 'Source' but does not include 'Make'. In the pharmaceutical industry, both 'Make' and 'Source' typically are outside the scope of the highest ranked supply chain manager (Table 2).

In order to test to what extent the organisation structures are integrated – that is, to what extent they group the three functional responsibilities in a single function – we investigated the combination of the functional responsibilities in the function of the supply chain manager. Table 3 shows the number of managers for each of the possible combinations of the three functional responsibilities. We identified three dominant profiles, which together represent 80% of the supply chain managers

Table 3. Functional profile of the supply chain manager.

	Number of supply chain managers	Number of highest ranked supply chain managers
No functional responsibility	4	0
Source	1	0
Make	1	1
Deliver	20	13
Source and Make	1	1
Source and Deliver	8	6
Make and Deliver	4	2
Source and Make and Deliver	13	13
Total	*51*[a]	*36*

[a]Data missing for one respondent.

Table 4. Responsibility of the highest ranked supply chain manager by industry.

	Pharmaceuticals (%)	Chemicals (%)	Food and beverages (%)	Overall (%)
Deliver	58	30	32	36
Source and Deliver	14	50	0	17
Source and Make and Deliver	14	10	58	36
Other	14	10	10	11
Total	*100*	*100*	*100*	*100*

and 89% of the highest ranked supply chain managers (Table 3): (1) distribution ('Deliver'); (2) procurement and distribution ('Source' and 'Deliver'); and (3) procurement, manufacturing, and distribution ('Source' and 'Make' and 'Deliver'). About one-third (13 out of 36) of the highest ranked supply chain managers reported to have only distribution as functional responsibility. The same number of respondents reported to have all three functional responsibilities, thus indicating an integrated supply chain structure. While 9 out of 36 cases reported to have two out of the three functional responsibilities, this usually related (6 cases) to procurement and distribution.

The preference for these three different combinations in the function of the highest ranked supply chain manager differs across the three industries,[1] as we can see in Table 4. In the pharmaceutical industry, the majority (58%) of the highest ranked supply chain managers reported a narrow functional scope; that is, they reported to have distribution as their single functional responsibility. The sourcing and manufacturing functions are typically not part of their job. The scope of the supply chain function in the chemical industry differs from the pharmaceutical industry in that 60% of the highest ranked supply chain managers report to have sourcing in combination with distribution (50% reported 'Source and Deliver'; another 10% reported 'Source and Deliver' in combination with 'Make'). In the food and beverage industry, we observe a supply chain function that is typically broader. Most supply chain highest ranked supply chain managers (58%) report to have all three supply chain subfunctions under their control: sourcing, manufacturing, and distribution. In this industry, the approach to SCM is clearly more cross-functionally integrated and process oriented than in the other two industries we have studied.

As discussed in the introduction section, SCM is not exclusively related to logistical activities. The SCM department is expected to integrate with other units, such as R&D, marketing and sales, and finance, as well as with external parties, i.e. suppliers and customers. In order to test to what extent this integration takes place, we have compiled from the literature – for the main areas with which the supply chain function is expected to interact – a set of activities that may be carried out jointly or with a high degree of involvement of the supply chain function. This list is provided in Exhibit 1. For example, we may expect the supply chain function to interact with R&D for the development and introduction of new products and/or for standardising the existing products. For

Exhibit 1. Reliability analysis for the degree of involvement in activities in other areas.

Area	Activities	Cronbach alpha
Marketing and sales	Product phase-out management; development of service policies towards customers; customer portfolio rationalisation	0.72
R&D	New product development; new product introduction; product standardisation	0.63
Finance and control	Overall profitability analysis; total cost controlling	0.76
Suppliers	Collaborative planning and forecasting; cost and cash analysis; service negotiation; price negotiation; product co-development	0.91
Customers	Collaborative planning and forecasting; cost and cash analysis; service negotiation; price negotiation; product co-development	0.74

Table 5. Involvement of the supply chain manager in other areas.

Degree of involvement of the supply chain manager with activities in	Mean	SD
Marketing and sales	3.19	0.80
R&D	3.00	0.73
Finance and control	2.91	1.02
Suppliers	3.17	1.20
Customers	2.73	0.83

each of these activities, the degree of involvement of the supply chain manager has been measured on a 1–5 scale (1 = no role; 2 = informed after decisions, during actions; 3 = consulted prior to decisions/actions, 4 = responsible for actions; 5 = ultimately accountable, individual or in team). The average score on the activities per area thus serves as a measure of the degree of involvement of the supply chain manager in that particular area. The reliability of this measure was tested by determining the Cronbach alpha for each set of items. These reliability scores are provided in Exhibit 1. The Cronbach alpha for all constructs except one exceeds the cut-off level of 0.70, indicating acceptable reliability (Nunnally 1978). The only exception is the Cronbach alpha of 0.63 for the activities in R&D. However, given that this Cronbach alpha is reasonably close to the cut-off of 0.70, we have maintained the construct in our analyses.

The average score of the degree of involvement of the supply chain manager with each of the areas is shown in Table 5.

As we can see in Table 5, the involvement with R&D, finance and control, and customers scores on average close to 3, indicating that the involvement of the supply chain manager with these areas is at least at the level of being informed after decisions and during actions, up to being consulted prior to the decision/action. The supply chain manager is more actively involved (average score >3) with the downstream marketing and sales area and with the upstream suppliers.

Research Question 2. Which integration mechanisms do supply chain managers use to coordinate with other departments within or outside the company?

As discussed in the literature section, different forms of lateral integration mechanism – off-line or on-line, formal or informal – can be used to coordinate the supply chain department with other areas within or outside the company. Building on the work of Galbraith (1973) and Martinez and Jarillo (1989), we have identified a set of 10 lateral coordination mechanisms, falling into three main categories: formal meetings and agreements, informal discussions and communication, and the use of liaison people. This list of 10 coordination mechanisms is provided in Exhibit 2.

We have measured the intensity of the use of each of the 10 integration mechanisms with other areas by asking supply chain managers to score the item on a scale from 1 to 5; a 1 indicating no use and a 5 indicating high use. The set of questions was repeated for each of the main areas: marketing and sales, R&D, finance and control, suppliers, and customers. The average score on the use of the coordination mechanisms within each category and for each area thus serves as a measure of the use of the mechanism for that particular area.

To test the reliability of the constructs for 'formal meetings and agreements' (four items) and 'use of liaison people' (five items), the Cronbach alpha has been calculated for the use of these mechanisms in the coordination with each of the areas (Exhibit 2). The Cronbach alpha for all constructs except one exceeds the cut-off level of 0.70, indicating acceptable reliability (Nunnally 1978). The only exception is the Cronbach alpha of 0.68 for formal meetings and agreements with finance and control. However, given that this alpha is very close to the cut-off of 0.70, we have maintained the construct for our analysis.

Exhibit 2. Reliability analysis for the use of coordination mechanisms with other areas.

	Cronbach alpha for coordination mechanism with				
Coordination mechanism	Marketing and sales	R&D	Finance and control	Suppliers	Customers
Formal meetings and agreements					
SLAs (rules, policies, standards, manuals)					
Formal meetings					
Task forces					
Permanent teams or standing committees	0.77	0.83	0.68	0.83	0.90
Informal communication					
Informal discussions and communication	n.a. (single item)	n.a. (single item)	n.a. (single item)	n.a. (single item)	n.a. (single item)
Use of liaison people					
Coordinator roles spending time in other units					
Job rotation between units					
Co-location of units					
Managers transferred temporarily from or to another unit					
Integrator roles with responsibilities in other units	0.85	0.77	0.87	0.78	0.80

Note: n.a., not applicable.

Table 6 lists the average score for the degree of use of each of the three categories of coordination mechanisms with each of the areas. The highest score in each of the areas is found for informal communication, which suggests that most of the coordination, irrespective of the area involved, takes place in an informal way. The more costly mechanisms, the use of liaison persons, are the least used mechanisms. We also observe that there is relatively more coordination with internal departments (R&D and marketing and sales) than with the external suppliers and customers.

Research Question 3. Which roles are played by supply chain managers in carrying out their tasks?

A specific integration mechanism is the existence of an integrator function which in some companies is precisely the role of the supply chain manager. In our study, we indeed found that the supply chain manager spends a substantial proportion of his or her time on integration. However, a supply chain manager typically plays other roles as well. We asked our respondents therefore to rate the distribution of their time over five different roles: the missionary role, the consultant, the executive, and the internal and the external integrator. These roles were described in the questionnaire as follows:

- missionary: convincing, educating, and training people in the importance of SCM;
- consultant: working on assigned projects related to SCM;
- managing executive: supervising and deploying the day-to-day activities of the supply chain department;
- internal integrator: taking responsibility for issues and relationships involving 'other', i.e. non-supply chain-related units (such as product development, sales, etc.)
- external integrator: taking responsibilities for issues and relationships with suppliers and/or customers.

Table 7 shows that on average the highest ranked supply chain managers divide their time in a fairly balanced way over the five roles. Nearly 32% of time goes into integrating with other

Table 6. Intensity of usage of lateral integration mechanisms with other departments.

Coordination with		Mean	SD
Marketing and sales	Formal meetings and agreements	3.35	0.82
	Informal communication	3.66	0.96
	Liaison persons	2.03	0.81
R&D	Formal meetings and agreements	3.42	0.94
	Informal communication	3.92	1.07
	Liaison persons	1.81	0.66
Finance and control	Formal meetings and agreements	2.80	0.81
	Informal communication	3.63	0.85
	Liaison persons	1.91	0.88
Suppliers	Formal meetings and agreements	3.15	0.91
	Informal communication	3.26	1.16
	Liaison persons	1.44	0.65
Customers	Formal meetings and agreements	3.03	0.96
	Informal communication	3.34	1.15
	Liaison persons	1.36	0.56

departments (19% internally and 13% externally), which, taken together, is nearly as much as the average time spent managing their own supply chain department, that is, the time spent in the managing executive role (36%). This highlights that the supply chain manager clearly has an integrative function and is 'building bridges' with other departments in the same organisation (internal integrator), as well as with the external partners.

We find some differences – although not significant – in the time allocation between the different industries shown in Table 7. The highest ranked supply chain managers in the food and beverages industry spend much more of their time as managing executive, and less as consultant compared with the other industries. The highest ranked supply chain managers in the pharmaceutical industry spend a lot of time as managing executive – as one would expect in a managerial function – but they also spend a remarkably high portion of their time as internal integrator. In the chemical industry, top supply chain managers spend proportionally less time as integrator, but more time as consultant compared with the other industries. As we have seen earlier (Table 4), this could be related to the range of responsibilities and hence the role of the supply chain executive in the organisation. In the food and beverages industry for instance, the supply chain manager is typically in charge of all the supply chain subfunctions and thus manages these tasks in a more 'delegating' way. The supply chain manager in the pharmaceutical sector has a more limited scope in terms of supply chain responsibilities, which implies that he/she has to spend more time integrating with other departments.

Research Question 4. What is the required skill set for the supply chain manager?

As discussed in the introduction section, we expect that the integrative nature of the supply chain function has an impact on the specific skill set requirements for the person executing this function. In particular, based on Parker and Anderson (2002), we expect that a combination of technical, business, and interpersonal skills is required.

We presented a list of skills and competencies to the supply chain managers and asked them to indicate on a 1–5 scale how important each of those skills and competencies was for their function as well as how important they expected it to be in 3 years (1 = not important; 5 = very important). Table 8 shows the average degree of importance for each of the skills and competencies, ranked from high to low degree of importance. The table also shows the expected difference in importance over a 3-year period (a positive change indicating an expected increase in importance).

Table 7. Time allocation of the highest ranked supply chain manager (% of time).

Role	Pharmaceuticals Mean (SD)	Chemicals Mean (SD)	Food and beverages Mean (SD)	Overall Mean (SD)
Missionary	10.7 (3.5)	16.0 (10.2)	11.0 (7.6)	12.5 (8.0)
Consultant	20.7 (5.3)	27.0 (22.3)	15.3 (11.1)	20.2 (15.5)
Managing executive	30.0 (7.6)	30.0 (18.1)	42.3 (17.4)	35.8 (16.8)
Internal integrator	24.3 (7.3)	15.0 (11.1)	18.7 (10.6)	18.8 (10.4)
External integrator	14.3 (6.1)	12.0 (4.8)	12.7 (8.6)	12.8 (7.0)
Total (%)	*100*	*100*	*100*	*100*

At the top of the list in Table 8, we find the people skills: communication, decision making, people management and leadership, coordination and cooperation, and negotiation are all rated as very important. The skills related to the functional expertise score somewhat lower, with the knowledge of planning and inventory management systems and logistics expertise still scoring fairly highly. Of lesser importance seems to be a set of skills that are related to the knowledge of the business context: knowledge of international business practices, and especially of law and regulations and of environmental issues scores rather low in importance.

It is striking that none of the skills is expected to decrease in importance in the near future (the last column in Table 8 indicates that for most of the skills, the expected change is significantly different from zero and positive). This suggests that the bar is being raised for the supply chain manager; the job requires ever more skills and competencies. Interestingly, the set of skills that scored rather low in importance – the knowledge of the business context – is expected to gain most in importance relative to the gain in people skills and functional expertise, which may bring these skills closer to, or even at par with, the functional expertise. This suggests that the increased globalisation and the growing awareness of sustainability issues are having an impact on the required skill set for the supply chain manager.

Research Question 5. How strategic is the supply chain function in the organisation?

In order to assess the strategic importance of the supply chain function, we studied the hierarchical position of the highest ranked supply chain manager, by asking whether he/she reported directly to the CEO, and whether he/she was a member of the board of directors. The results are shown in Table 9. Overall, across the three industries, 33% of the highest ranked supply chain managers report directly to the CEO, and 41% of them are in the board of directors. The proportion of supply chain managers reporting to the CEO differed significantly across the three industries (chi-square test; significance level $p < 10\%$): 47% of the highest ranked supply chain managers in the food and beverages industry reported to the CEO, against only 30% in the chemical industry, and no one in the pharmaceutical industry. The membership of the board also differed across the three industries (although not significantly): 47% of the highest ranked supply chain managers in the food and beverages industry were a member of the board, against only 29% in the pharmaceutical industry; the chemical industry scored somewhat in between, with 40%.

An indirect indicator of the strategic importance of the supply chain is inventory turnover. Indeed, the primary function of SCM is to match supply with demand and, as a result, to control inventories. We find that the three industries score differently in terms of the number of days of inventory (Table 10). Obviously, the high level of inventory in the pharmaceutical and chemical industry is to some extent explained by technological process characteristics that ask for large batch sizes and safety stocks. But it probably also signals that the pharmaceutical, and to some extent also the chemical, companies have not (yet) paid as much attention to inventory reduction as the food and beverage companies. In the food and beverage industry, on the other hand, the lower levels of inventory may be explained by product characteristics that impose shelf-life constraints,

Table 8. Degree of importance of skills, today and within 3 years.

	Importance today	Importance in 3 years	Change in importance	
	Mean (SD)	Mean (SD)	Mean	Significance level[a]
People management/leadership skills	4.51 (0.71)	4.55 (0.68)	+0.04	n.s.
Communication skills	4.43 (0.61)	4.67 (0.52)	+0.25	$p < 1\%$
Decision-making skills	4.39 (0.61)	4.41 (0.67)	+0.02	$p < 1\%$
Coordination and cooperation skills	4.22 (0.74)	4.57 (0.71)	+0.35	$p < 1\%$
Analytical skills	4.02 (0.63)	3.96 (0.76)	−0.06	n.s.
Negotiation skills	3.75 (0.81)	4.13 (0.73)	+0.38	$p < 1\%$
Planning and inventory management skills	3.65 (0.90)	3.78 (1.05)	+0.12	n.s.
Logistics expertise (e.g. cost analysis and budgeting)	3.49 (0.79)	3.69 (0.94)	+0.20	$p < 10\%$
Knowledge of international business practices	3.37 (0.83)	3.88 (1.01)	+0.51	$p < 1\%$
Technical skills related to product and processes	3.15 (0.77)	3.15 (0.85)	+0.00	n.s.
Knowledge of process analysis techniques	3.10 (0.91)	3.17 (0.95)	+0.06	n.s.
Knowledge on environmental issues	2.83 (0.81)	3.54 (1.03)	+0.71	$p < 1\%$
Knowledge of laws, regulations	2.82 (0.78)	3.39 (0.95)	+0.57	$p < 1\%$

Note: Significance level (n.s., not significant at $p = 10\%$ level).
[a]ANOVA test of difference between importance in 3 years and importance today.

Table 9. Position of the supply chain manager in the organisation.

	Pharmaceuticals	Chemicals	Food and beverages	Overall	Industry effect[a]
Percentage of highest ranked managers					
Reporting to CEO	0	30	47	33	$p < 10\%$
Member of the board	29	40	47	41	n.s.

Note: Significance level (n.s., not significant at $p = 10\%$ level).
[a]Chi-square test of industry difference.

Table 10. Inventory levels.

	Pharmaceuticals	Chemicals	Food and beverages	Overall	Industry effect[a]
Number of days of inventory	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Raw materials	38.4 (32.6)	35.8 (47.6)	14.3 (12.9)	24.0 (31.4)	$p < 10\%$
Work-in-process	71.4 (59.5)	10.6 (16.7)	3.3 (5.7)	14.3 (31.2)	$p < 1\%$
Finished products	67.8 (28.1)	49.4 (37.8)	18.0 (10.9)	34.1 (30.6)	$p < 1\%$
Total inventory	177 (95.6)	95.8 (64.0)	36.6 (19.2)	72.0 (68.2)	$p < 1\%$

[a]ANOVA test of industry difference, significance level.

which create pressure to minimise inventory levels. As a consequence, it is critical in this industry to match supply and demand. Hence, the higher level of strategic attention for the supply chain function in the food and beverage industry compared with the other two industries.

Research Question 6. How global is the SCM function, and what is the geographical structure of the supply chain activities?

Respondents were asked to indicate how internationally the three supply chain subfunctions ('Source', 'Make', 'Deliver') were organised. More specifically, we asked for the approximate geographical split of their sourced volume and of their sales volume, ranging from national, through continental, to global. We also asked them whether their business unit's manufacturing activities were carried out on one site, on more than one site in the same country, continentally in a

few countries, or globally in various continents. The results are shown in Table 11. For example, the average company in our sample in the pharmaceutical industry sources 30% of its volume globally, and sells 29% of its volume globally. A large majority of the pharmaceutical companies (89%) produce their products in sites in various continents. The average food and beverages company, on the other hand, sources only 17% of its volume globally and sells only 7% of its volume globally; few of the food and beverages companies in our sample (11%) have production facilities outside Europe. As we can see from the last column in Table 11, the average percentage of the volumes sourced does not differ significantly across the three industries; the average percentage of the volumes sold on the other hand does differ significantly across the three industries (ANOVA test, $p < 10\%$); The proportion of global sales is highest in the pharmaceutical industry (29% compared with 19% in the chemical and 7% in the food and beverages industry), whereas the proportion of national sales is highest in the food and beverages industry (40% compared with 25% in the pharmaceutical and 16% in the chemical industry).

Since the industry's degree of internationalisation of the manufacturing network has been operationalised by the frequency of companies in each of the four categories, a chi-square test has been carried out to test whether the frequency of the companies in the four categories per industry differed from the overall frequency in the four categories – that is, overall, 8% manufacturing at one site, 10% at more than one site in the same country, 47% at sites in a few European countries, and 35% at sites in various countries globally. The analysis indeed showed a significant difference across the industries, with a high proportion of global manufacturing in the pharmaceutical industry (89%) and a high proportion of manufacturing within Europe ($8\% + 19\% + 62\% = 89\%$) in the food and beverages industry.

This shows that, compared with the companies in the other two industries, the pharmaceutical companies have a more global supply chain. The chemical companies in our sample distribute their products predominantly in the same continent (i.e. Europe) and most of their manufacturing is continental or global. The food and beverages companies have the majority of their manufacturing and sales at the national or the continental level.

5. Discussion: no universal structure fits all organisations

As is clear from our survey results, companies organise their supply chain function quite differently. Are these differences random or is there a pattern, in the sense that certain types of organisations opt for certain structures? In other words, should we take a contingency point of view and if so, what are the contingent variables?

Responding to the last question, our analysis is suggestive of support for contingency theory, i.e. the industry seems to be an important explanatory variable. The pattern that we see appearing is that in the food and beverages industry, the supply chain manager is typically in charge of all the supply chain subfunctions and manages these subfunction areas by delegating responsibilities according to a rather hierarchical organisation model, as indicated by his dominant managing executive role (Table 6). We also recall from Table 6 that the supply chain manager in the pharmaceutical industry is more active as an integrator. He or she has a limited scope in terms of supply chain responsibilities, but manages the supply chain by integrating across various functional areas with his colleagues in the company, thus stimulating and facilitating the process view of the supply chain. The supply chain organisation in the chemical industry seems to be some kind of blend of the model observed in the other two industries.

Another factor that may explain the differences in scope of the supply chain function is the importance of the supply chain function relative to other functional areas in the company. In the pharmaceutical industry, manufacturing plays a critical role. The need for strict control over the quality of the product, the importance of getting new products to the market rapidly, and

the advanced and protected manufacturing technology all justify the existence of a separate responsibility for manufacturing that is not combined with the responsibility for procurement or distribution. In Lawrence and Lorsch's (1969) terms, there is a need for differentiation. This criticality of manufacturing can be a stimulus to design the organisation structure on a more traditional, functional basis. In the food and beverages industry, on the other hand, the tight relationship with the retail sector may explain the integrative approach to SCM. Retailers are powerful players who impose service on their suppliers and expect frequent and reliable deliveries at a low cost. In order to fulfil these requirements, strong coordination across the supply chain is a prerequisite, which creates the need for a high-level executive in the organisation who oversees all aspects of the chain.

This seems to suggest that the scope of the function of the supply chain manager may be linked to the strategic importance of the supply chain in the company. Where the supply chain is seen as a strategic weapon, we find supply chain managers with a broad, company-wide scope. If the strategic focus is on manufacturing or innovation, the supply chain gets less strategic attention, which is reflected in the more traditional, functional orientation of the supply chain manager, and consequently, in the need to use other coordination mechanisms to integrate the decision making with colleagues in the organisation.

In our research, we have found that the supply chain function was indeed positioned at different levels of strategic importance. Combining the two indicators of hierarchical position of the top supply chain manager and inventory turnover, we found that – relatively speaking – in the food and beverages industry, the strategic importance given to the supply chain was the highest, followed by the chemical and in the third place the pharmaceutical industry.

All this seems to support the view that strategic considerations may have an impact on the way firms structure their supply chain function. In Chandler's words, structure seems indeed to follow strategy.

Finally, it is interesting to note that the geographical structure and therefore complexity of the supply chain seems to differ depending on the industry. We have concluded from Table 11 that the typical company in the pharmaceutical industry sources almost one-third of its volume globally, manufactures in sites in various continents, and distributes almost one-third of its volume of end products globally. Managing such a global supply chain is a complex task. We therefore hypothesise that the combination of a global geographical scope and a broad functional scope (procurement, manufacturing, distribution) would lead to over-complexity. This motivates companies to keep the functional scope of the supply chain function rather narrow. A local or regional chain on the other hand, as we have observed in the typical company in the food and beverages industry, can more easily be supervised and managed; in such a chain, the geographical scope is not a driver of complexity, which allows for somewhat more complexity in the functional scope of the supply chain function, meaning that the functional scope can be broader.

As a matter of fact, the two factors of geographical scope and the strategic importance of the supply chain may be combined, as we have done in Figure 1, to introduce a framework for the different supply chain organisations in the three industries. We have visualised the scope of the supply chain function (Plan, and the three functional areas Source, Make, and Deliver) by using shaded text boxes; the darker boxes indicating that this subfunction is typically part of the supply chain function; the lighter boxes indicating that this subfunction is typically not part of the supply chain manager's function. The high level of strategic importance in the food and beverage industry asks for an overall responsibility of the supply chain managers. Since the supply chain is rather local, this overall responsibility is also feasible. At the other end of the spectrum, we find the pharmaceutical companies, where the complexity of the global supply chain makes it much more difficult to combine all functions into one hand. Moreover, the strategic importance of the supply chain function is lower here, making supply chain integration seem less urgent and less crucial.

This may well prove to be an interesting model, but our current research does not have the data to test it. Therefore, this is an avenue for future research.

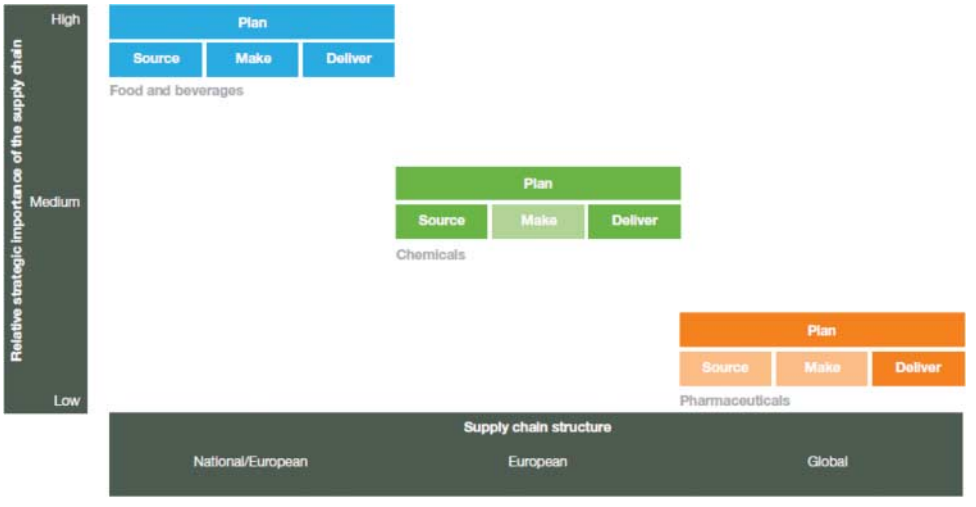

Figure 1. Potential framework for supply chain organisation for different industries.

Table 11. Degree of internationalisation of the supply chain.

	Pharmaceuticals Mean (SD)	Chemicals Mean (SD)	Food and beverages Mean (SD)	Overall Mean (SD)	Industry effect Significance level
Source: % of volume sourced					
Nationally	21.9 (19.6)	25.9 (21.1)	27.8 (27.2)	26.2 (23.8)	n.s.[a]
Continentally[b]	48.1 (23.6)	46.1 (22.2)	58.0 (27.0)	52.7 (26.7)	n.s.[a]
Globally[c]	30.0 (26.2)	27.9 (24.4)	16.7 (23.6)	22.7 (24.5)	n.s.[a]
Deliver: % of volume sold					
Nationally	25.3 (42.3)	15.9 (19.9)	40.1 (32.3)	29.4 (32.4)	$p < 10\%$[a]
Continentally	45.7 (31.0)	64.8 (20.4)	53.1 (34.0)	55.4 (30.1)	n.s.[a]
Globally	29.0 (23.8)	19.3 (16.0)	7.2 (9.0)	15.0 (16.9)	$p < 1\%$[a]
Make: % of companies with manufacturing at					$p < 1\%$[d]
One site	0	12	8	8	
More than one site in the same country	0	0	19	10	
Sites in a few countries in Europe	11	44	62	47	
Sites in various continents, globally	89	44	11	35	

Note: Significance level (n.s., not significant at $p = 10\%$ level).
[a]ANOVA test of industry difference.
[b]Excluding national.
[c]Excluding continental.
[d]Chi-square test of industry difference.

6. Concluding remarks

In this paper, we have analysed the way companies organise for SCM. Since the need to integrate is central to the concept of SCM, we have specifically looked at integration mechanisms that make up an organisational structure.

It is clear that organisations structure their SCM function in different ways, i.e. the type of mechanisms used and the intensity of their usage differ across organisations. One important characteristic is the scope of the formal supply chain department supervised by a supply chain manager. In a large number of cases, we found a completely integrated structure with all supply chain subfunctions (‘Plan’, ‘Source’, ‘Make’, ‘Deliver’) under the supervision of one manager.

At the same time, we found as many companies where the SCM department covered just the 'Deliver' function (or, when in combination, usually just with the planning function). All kinds of combinations were found in between those two most popular structures. The same variety was found in dimensions such as the position of the supply chain manager in the organisation and the distribution of this manager's time over various roles.

On the average, we found that the scope of the supply chain manager was not broader than the scope of his/her predecessor, the materials manager, in a previous study 30 years ago (Miller *et al.* 1981). What is however remarkable is that on average the supply chain manager was involved at least as an 'informed or consulted' actor in tasks which are at the boundary between his/her company and the suppliers or customers, fulfilling what has been called 'boundary' spanning functions. We also found that, on average, the supply chain manager was involved with non-traditional logistical functions in the company, such as marketing and sales, R&D, and finance and control. So our general conclusion is that companies have adopted what some people have termed a supply chain orientation in their structure (Mentzer *et al*. 2001). One consequence of this is that the most important skills of today's supply chain manager are the people skills: communication, decision making, people management and leadership, coordination and cooperation, and negotiation.

The existence of a wide diversity of structures might lead the manager to believe that there is no uniform way of organising for SCM. However, the more in-depth study in the three specific industries taught us that the conclusion should be 'it depends'. In other words, a contingency point of view should be adopted. One contingent factor is the industry. The structure of the supply chain function tends to be different in different industries. We acknowledge that differences or similarities in industries do not imply corresponding differences or similarities in strategy. Within each industry, companies can follow different (competitive) strategies. However, as we argued earlier, industry characteristics have an important impact on the possible strategies. Although in future research we should try to measure strategy more directly, we have some evidence to suggest that – as in other areas – 'structure follows strategy' in the area of SCM. Besides strategy, an alternative contingent factor is the geographical structure of the supply chain.

Finally, this research has demonstrated that although the business context-related skills are less important than the people skills and the technical skills at present, it is worth noting that they appear to be gaining in importance. One might speculate that increased globalisation and the growing awareness of climate change will have an impact on the required skill set for the supply chain manager.

7. Limitations and future research

This study is encouraging but far from complete. First of all, this was an explanatory study in which we focused on three industries in Belgium and the Netherlands, which of course limited our sample size. This quite often made statistical testing difficult if not impossible. Some of the findings need to be tested on a larger scale. Using a larger sample might help us in particular to test more rigorously the various hypotheses underlying the speculations we have made in this paper.

Secondly, rather than using industry as a proxy for strategy, we should find ways of more directly measuring strategy and the strategic context of an organisation. Similarly, we need to find ways to operationalise complexity of the supply chain better than we could in this research.

Thirdly, in this research, we followed a kind of 'evolutionary theory', implying that companies will evolve towards the ideal structure and that, if a majority of companies in a certain situation seem to adopt a certain structure, this structure is the ideal structure in this situation. It would be better if we could relate the degree of 'fit' (between structure and strategy) to an organisational performance measure. The current survey methodology was inadequate to test such a relationship between fit and performance.

Fourthly, in this study, we have not been able to study the impact of 'uncertainty' on the structure. Many organisational theorists and other researchers who have studied this domain of logistics (see, for example, Van Dierdonck and Miller 1980) have pointed to the importance of uncertainty of the information to be processed on the organisational structure. Uncertainty had been found to be related to the strategy of the organisation and the strategic context. It may be interesting to evaluate the degree of uncertainty to be dealt with in the various SCM tasks in each of our companies in the three industries.

Further research may also make it possible to evaluate the impact of information processing systems on the structure of the SCM organisation.

We leave these research challenges for future research. We hope, however, that the results of the study we have reported in this paper will provide practitioners with enough of a handhold to help them structure the supply chain organisation and help academics to understand why companies adopt various structures. We also hope that our research will stimulate them to take up some of the challenges we have identified. As Ketokivi *et al*. (2006) argued, concepts of organisational design can and should be usefully applied in an operations management context and by extension in an SCM context.

Note

1. The null hypothesis that the occurrence of the three dominant profiles is independent of the industry is rejected (chi-square analysis, $p < 5\%$).

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