Factors affecting the execution of supply chain management – an international view

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Abstract

This paper discusses factors affecting the execution of supply chain management and presents a conceptual model and six hypotheses based on such factors identified in the literature. The model was tested in two European country-specific cases using structural equation modelling. Findings in both cases confirm the hypothesized hierarchical order of three proposed antecedents: 'internal SCM conditions' affect 'joint SCM conditions' which in turn influences collaborative 'SCM-related processes'. Managerial implications are that firms in both countries should adopt these hierarchical steps to ensure a rigorous and appropriate approach to achieving full and integrative SCM.

Keywords: Demand network management, Supply network management, Supply chain management execution

Introduction

Today's competition is not among individual companies it is among networks of organizations that are known as supply chains (Corbett et al., 1999; Christopher, 2000). The need for an organization to manage its supply chains stems from the market, which expects both product and service customization and optimal utilization in a global environment (Cousins and Menguc, 2006). Through the installation of co-operative relationships, organizations are able to achieve distinct competitive advantages (Langfield-Smith and Greenwood, 1998) as the adaption and execution of such networks help to reduce operating costs and maximize the effectiveness of the organization (Mason and Leek, 2008).

Supply chain management (SCM) is defined as the internal and external integration of a firm's supply and demand management with an objective to replace the view of operations from a single isolated unit to the whole supply chain, spanning from raw material suppliers to the final customer (Frohlich and Westbrook, 2001; Heikkilä, 2002). Integration goes in a forward as well as a backward direction (Cousins and Menguc, 2006), and the set of SCM business practices aims to add customer value and optimize the whole entity instead of single parts (Cooper and Ellram, 1993; Cooper et al., 1997; Heikkilä, 2002). It is the power behind such business process integration that allows companies to exploit the advantages of SCM and thus achieve better performance (De Treville et al., 2004; Mitra and Singhal, 2008).

There is now general acceptance that the application of SCM allows firms to work in a seamless manner and that SCM is a strategic weapon which helps to improve significantly the performance of businesses (Dierickx and Cool, 1989; Narasimhan and Das, 2001). Research on a conceptual and qualitative level has shown that the level of integrated business processes depends on specific antecedents or competences (Mason and Leek, 2008) but that such collaborative alliances are difficult to organize (Boddy et al., 2000). Langfield-Smith and Greenwood's work (1998) demonstrated how Toyota developed co-operative partnerships with their suppliers.

Building on these concepts we were interested to see to what degree a firm has integrated their internal and joint business processes with customers and suppliers, i.e. the execution of supply and demand management, and how levels of integration or the application of SCM, are affected by a certain set of collaborative business practices that in turn are affected by a particular internal and joint organizational antecedents, i.e. internal and joint conditions. As antecedents very likely vary across different SCM settings, we also investigated country-specific heterogeneity within in our empirical investigation. We focused on the following research question: *What factors affect the execution of supply chain management?*

The remainder of the paper is as follows. We first consider the theoretical background for such applications and propose a concpetual model and six hypotheses positing various relationships among the sets of factors. Then, we report on an empirical study testing the model in two different country case settings to see whether there were homogeneous and/or heterogeneous effects that may affect SCM in global supply chains. Next, we present a critical discussion of findings with regard to practical implications. Finally, we conclude the paper by discussing limitations and providing an outlook for future research.

Literature review and conceptual model

The installation of co-operative relationships with suppliers and/or customers certainly has its origins in the automotive industry where Toyota has proved the power of supplier collaboration (see the discussion of supplier buyer relationships models by Langfield-Smith and Greenwood, 1998). When making the transition from adversarial to more co-operative relationships companies are advised to consider: (a) similarities between industry and technology of supplier and buyer firms; (b) prior experiences of employees; (c) two-way communication and information sharing; and (d) experimental learning. These factors, according to Langfield-Smith and Greenwood (1998), affect the willingness and ability to accept change for the organizations involved.

Further, Lambert and Knemeyer (2004) argued for a comparison of various cooperation expectations between the supply chain partners, which was also discussed by Boddy et al. (2000), who see mismatches in the expectations of the partners towards a co-operative alliance as one of the most important hurdles to the successful implementation of collaborative programmes. Such implementation of collaborative alliances in the form of close supply chain partnering requires interpersonal relations, which facilitates more co-operative behaviour (Boddy et al., 2000).

The cooperation content agenda should include business processes, financial resources, technology, structure, culture, power, people and business processes and, through an interactive approach, the process of supply chain network integration may be initiated. Building integrative supply and demand networks is also a question of transferring inter-firm knowledge and inter-firm routines (Mason and Leek, 2008).

The drivers for integrative supply and demand management are, according to Mentzer et al. (2001), certain 'soft factors' such as mutual understanding, trust or commitment. Joint organizational antecedents with a positive effect on the installation of the processes, as well as through the implementation of SCM, also refer to long-term relationships, shared visions and goals, shared controlling systems, joint project groups, trust, information sharing on forecasts, inventory status, product development, leadership, organizational culture, mutual dependency and profit and risk sharing (Bechtel and Jayaram, 1997; Cooper et al., 1997; Fawcett and Magnan, 2001; Mentzer et al., 2001; Droge et al., 2004; Cousins and Menguc, 2006; Das et al., 2006).

However, Lambert (2004) suggested firms should check their internal requirements or conditions first. Such factors include top management support, willingness to share and change, internal controlling systems, guidelines for information exchange, internal education and the dedication of financial and human resources (Fawcett and Magnan, 2001; Mentzer et al., 2001; Narasimhan and Das, 2001; Droge et al., 2004; Das et al., 2006; Mason and Leek, 2008). This means that internal conditions impact on joint organizational antecedents, as well as forestall the establishment of collaborative business processes through the integration of supply and demand management.

Co-operative behaviour, which is the result of positive interaction between internal and joint organizational preconditions, leads to the installation of collaborative business processes, where the direction of their flows is both downstream (forward towards the customer) and upstream (backward towards the supplier). Such processes, which are required to manage integrative supply and demand management, can be broken down into the following eight processes (Cooper et al., 1997; Croxton et al., 2001; Lambert et al., 2005):

1. Customer Relationship Management, i.e. development and maintenance of relationships with customers;
2. Customer Service Management, i.e. single source of customer information and key point of contact for administering the product service agreements;
3. Demand Management, i.e. balancing the customers' requirements with supply capabilities;
4. Order Fulfilment, i.e. all necessary activities to define customer requirements;
5. Manufacturing Flow Management = all necessary activities to obtain, implement and manage manufacturing flexibility and move products through the plants in the supply chain;
6. Supplier Relationship Management, i.e. development and maintenance of relationships with suppliers;
7. Product Development and Commercialization, i.e. development and market introduction of new products together with suppliers and customers;
8. Returns Management, i.e. all activities with regard to returns, reverse logistics and avoidance.

The outcome of these processes is the interconnection of supply and demand management within and across organizations, which means that these processes have a positive impact on the execution of SCM. Summarizing these contributions we propose effects between the following four dimensions: 1) internal organizational antecedents; 2) joint organizational antecedents; 3) collaborative business processes; and 4) integrative supply and demand management. The resulting six hypotheses that are consequently labelled by path coefficients (γ_n) are as follows:

- H_1 (γ_{21}): Internal SCM conditions (ξ_1) positively impact joint SCM conditions (ξ_2).

- H_2 (γ_{31}): Internal SCM conditions (ξ_1) positively impact the adoption of SCM-related processes (η_3).
- H_3 (γ_{32}): Joint SCM conditions (ξ_2) positively impact the adoption of SCM-related processes (η_3).
- H_4 (γ_{41}): Internal SCM conditions (ξ_1) positively impact the execution of SCM (η_4).
- H_5 (γ_{42}): Joint SCM conditions (ξ_2) positively impact the execution of SCM (η_4).
- H_6 (γ_{43}): The adoption of SCM-related processes (η_3) positively impacts the execution of SCM (η_4).

Our overall research objective was to gain an insight into how these dimensions are interrelated and how the various condition and process variables impact significantly on each other. To allow for simultaneous testing a structural equation model with latent variables was developed that comprises all six hypotheses (or proposed effects). The indictors standing behind the latent variables are based on literature and can be seen from the appendix.

The model indicates that SCM may not only be affected directly (γ_{41}, γ_{42}, γ_{43}) but also indirectly by the two types of organizational conditions (γ_{31}, γ_{32}), whereas the internal conditions impact on the joint ones (γ_{21}). We noted above that internal and joint conditions are antecedents of collaborative business processes which, in turn, affect the application of integrative supply and demand management.

Methodology

The framework was tested in two different country case settings, Austria and Denmark. The investigations in these two case countries, which have similar size and economic characteristics, were enabled by available research funding and allowed us to heed a call for critical replications in research studies (Neuliep, 1991; Evanschitzky et al., 2007). Both investigations used a structured self-administered questionnaire in postal surveys.

A back translation procedure was applied to ensure linguistic equivalence of the two instruments (Behling and Law, 2000). Senior managers of large companies in manufacturing, trade and service industries were selected as the most competent informants regarding the topic. A tailored design method (Dillman, 2007) was used and generated usable responses of 100 in the Danish case and 174 in the Austrian case.

In the Danish case the majority of respondents (70%) represented manufacturers while the rest were either service (17%) or trading (13%) companies. In contrast, a smaller share of manufacturing companies (39%) was represented in the Austrian case whereas the share of trading company respondents was higher (29%). The rest of the Austrian case was split among the service, building and energy sectors.

Empirical Findings

Modeling Results

To analyze the proposed effects between our four reflective latent constructs in both case settings, we used partial least squares path modeling (Wold, 1975; Lohmueller, 1989; Chin, 1998; Tenenhaus et al., 2005) using the software SmartPLS (Ringle et al., 2005). This was motivated by the less strict requirements of the PLS procedure in terms of sample size, level of measurement and multinormality (Fornell and Bookstein, 1982; Chin and Newsted, 1999).

The analysis contained two parts: (1) we first evaluated the measurement or outer models, i.e. the sets of constructs with the observable items standing behind them; and (2) we subsequently investigated the proposed effects between the latent constructs within the structural or inner models.

Measurement model

Regarding both the Austrian and the Danish cases all *t*-values of the factor loadings prove to be highly significant ($p<.001$) (see appendix). All loadings exceed the suggested size of 0.7 (Hulland, 1999). The internal consistency can also be considered to be satisfactory for all factors (Cronbach Alpha; $\alpha>.7$) (Nunnally, 1978) and the composite reliability (ρ) of all factors meets the requirement to be above 0.7 (ρ; Fornell and Larcker, 1981). The degree of the convergent validity proves to be acceptable with the average variances extracted (AVE) in the range of 0.5 or higher (Baggozzi and Yi, 1988). With regard to the constructs' discriminant validity, it can be said that the AVE is larger than the highest squared intercorrelation with every other factor in the measurement models (Fornell-Larcker-Ratio; FLR<1; Fornell and Larcker, 1981). Overall, the local fit of the measurement models proved to be satisfactory.

Structural model

Following Chin (1998) we evaluated the structural models by using the coefficients of determination (r^2), the size, signs and significance of the single path coefficients ($\pm\gamma_n$, $\pm\beta_n$) and the effect sizes (f^2) as shown in Table 1.

Table 1 – Structural Model Results

		Endogenous factors								
		Execution SCM(η_4)					Adoption of SCM-related processes (η_3)			
Exogenous factors		Direct effects (γ)	Med	Indirect effects	Total effects		Direct effects (γ)	Med	Indirect effects	Total effects
Internal SCM conditions (ξ_1)	γ_{41}	A:.218$^{*(w)}$ D:.221$^{***(w)}$	ξ_2, η_3	A:.302 D:.459	A:.520*** D:.680***	γ_{31}	A:.055$^{n.s.(w)}$ D:.523$^{***(m)}$	ξ_2	A:.351 D:.186	A:.406*** D:.709***
Joint SCM conditions (ξ_2)	γ_{42}	A:.216$^{*(w)}$ D:.510$^{***(m)}$	η_3	A:.138 D:.033	A:.354*** D: .543***	γ_{32}	A:.435$^{***(m)}$ D:.259$^{***(m)}$	--	--	A:.435*** D:.259***
Adoption of SCM-related processes (η_3)	β_{43}	A:.317$^{***(m)}$ D:.130$^{*(m)}$	--	--	A:.317*** D:.130*	--	--	--	--	--

Captions: A, based on the Austrian case (n=174); D, based on the Danish case (n=100); Effect size (see f^2-values): --, not proposed or N/A; w, weak effect, m, moderate effect; s, strong effect; direct effects between ξ_1 and ξ_2 not shown (direct (=total effects) $\gamma_{21,}$ A:.806$^{***(s)}$, D:.719$^{***(s)}$

Notes: *t*-values calculated by applying a bootstrapping procedure with 1,000 sub-samples (Chin, 1998); r^2-Values: A: $r^2(\xi_2)$=.650; $r^2(\eta_3)$=.232; $r^2(\eta_4)$=.391; D: $r^2(\xi_2)$, .517; $r^2(\eta_3)$, .535; $r^2(\eta_4)$, .613$^{(s)}$; f^2-values: A: $f^2(\gamma_{21})$>>.35; $f^2(\gamma_{31})$, .004; $f^2(\gamma_{32})$, .088; $f^2(\gamma_{41})$, .027; $f^2(\gamma_{42})$, .025; $f^2(\beta_{43})$, .123; D: $f^2(\gamma_{21})$>>.35; $f^2(\gamma_{31})$, .273; $f^2(\gamma_{32})$, .063; $f^2(\gamma_{41})$, .044; $f^2(\gamma_{42})$, .293; $f^2(\beta_{43})$, .087

In the *Austrian case*, the *t*-values of five path coefficients prove to be significant ($p<.05$) and all coefficients have a positive sign as proposed. Only the internal SCM conditions do not significantly affect SCM-related processes. By interpreting the size of effects according to the notions of Cohen (1988) based on f^2-values, we see that the strongest or most considerable effect ($f^2>.350$) is between the internal SCM conditions and the joint SCM conditions. Furthermore, moderate effects ($f^2\sim.150$) were identified between the joint SCM conditions and the SCM-related processes (γ_{32}) and, finally, the processes and SCM (β_{43}). All other effects turned out to be weak ($f^2\sim.020$).

Finally, we tested the goodness of fit of our data by interpreting the r^2-values. From there we see that in terms of ξ_2 the share of explained variation is high and in terms of η_2 and η_3 it is moderate compared to the total variation of these constructs (Chin, 1998).

In total, it can be said the goodness of fit of the data from the Austrian case is acceptable with respect to the presented indices and supported all hypotheses except H_5.

If we focus explicitly on the moderate and strong direct effects within our model, a chain or hierarchy of effects can be revealed. It can be seen that the internal SCM conditions directly affect the joint conditions. In turn these joint conditions influence the SCM-related processes significantly. Ultimately, execution of SCM is only affected by the SCM-related processes. Finally, by interpreting the total effects towards the endogenous construct execution of SCM, and thus taking the direct and indirect (mediated) effects into account, we see that the most considerable (total) impact on execution of SCM stems from internal SCM conditions, followed by joint SCM conditions and finally SCM-related processes.

In the *Danish case,* we see similar results. With respect to the *t*-values of the path coefficients they are all significant at the 5% level. All path coefficients show a positive sign. Again, the highest f^2-value can be detected for the effect between the internal and joint SCM conditions. With the exception of the small effect between the internal SCM conditions and execution of SCM, all other effects proved to be of moderate size. The goodness of fit turned out better than in the Austrian case. All r^2-values are above 0.5 which means that more than half of the variations of the constructs ξ_2, η_3 and η_4 are explained by their influencing constructs proposed in the model. Overall, all six hypotheses are supported in the Danish case.

Again we identified a chain of effects similar to the Austrian case, but in addition there are moderate effects between internal SCM conditions towards SCM-related processes and joint SCM conditions towards execution of SCM directly. Finally, by focusing on total effects internal SCM conditions turn out to be the major antecedent for execution of SCM, closely followed by joint SCM conditions. Remarkably, SCM-related processes have a comparably low impact.

Discussion

Taking into consideration the different SCM cases and the heterogeneity between our two groups of firms, represented by our respondents, we found remarkably homogenous results. Overall, both investigations have provided empirical proof for our suppositions regarding the order and type of antecedents for integrative supply and demand management or execution of SCM.

We found that collaborative business processes were identified as the core antecedent that directly drives execution of SCM. Further, internal and joint organizational conditions play a significant but not substantial role in changing the application of integrative supply and demand management directly. As a consequence, the work from Boddy et al. (2000) and Mason and Leek (2008) can only be partly confirmed.

The work of Langfield-Smith and Greenwood (1998), Boddy et al. (2000), Mentzer et al. (2001) and Lambert (2004) can be confirmed with respect to the importance of setting up the internal organizational conditions first, i.e. before entering into a supply chain partnership. This factor proved to be of highest total importance in both settings and thus can be seen as the first order antecedent of SCM execution. The second most important antecedent are joint organizational conditions, which also have a remarkable high total effect on SCM execution, whereas the collaborative business processes are of direct significant, but comparably low importance.

As a second major finding, we reveal the indirect importance of preliminary factors, i.e. internal and joint organizational conditions (Mason and Leek, 2008). Although — particularly in the Austrian case — both of them are of no direct relevance, they are of substantial indirect importance with regard to influencing the application and execution of SCM. This calls for a stronger consideration of interdependencies between all factors and consequently the items or variables that set into operation the drivers of integrative supply and demand network management.

Limitations and future research agenda

A limitation in this study is the empirical setting of our conceptual framework. Other country and industry specific conditions may limit the joint validity of our results and the transferability of our result to other markets. However, by heeding a call from Neuliep (1991) and Evanschitzky et al. (2007) for critical replication studies in the social sciences, we have demonstrated a rationale for empirically applying this model in other contexts and thus future application of this model should be tested in other country cases.

The study results also reflect the views of large organizations in the two cases since the execution of SCM is more an issue for such supply chain partners. Further research should extend this view towards smaller organizations such as small and medium-sized enterprises (SMEs) and test the model with respect to their role in supply chain partnerships.

The findings reflect an aggregated view comprising the responses from diverse kind of supply chain partners. This neglects, for example, the heterogeneity of responses from sets of respondents representing different groups of supply chain partners. As a next step, moderators which influence the effects can be considered. Such moderators account for the affiliation to particular supply chain stages and industries, or to the size of supply chain partners.

Finally, our endogenous factors are only explained to a certain degree (see r^2-values in Table 1).This calls for an extension of the model regarding other influencing factors, reflecting soft dimensions of supply chain partnerships such as trust or power.

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Appendix

		Measures/Indices			
		Austria (n=174)		Denmark (n=100)	
Latent construct Indicator/item (*"to what degree…"*)		λ_n	α/ρ AVE/FLR	λ_n	α/ρ AVE/FLR
Internal SCM conditions (ξ_1)					
x_{11}	Personnel / human resources made available for SCM issues?	.863***		1.082***	
x_{12}	Are financial resources made available for SCM issues?	.892***		.976***	
x_{13}	Does top management of your company support SCM issues?	.937***		.944***	
x_{14}	Were internal goals set up before SCM projects were launched?	1.069***		.979***	
x_{15}	Are employees able to use IT systems for SCM issues?	1.006***		.816***	
x_{16}	Does your company have IT systems capable of processing data from other SC members?	.974***	.940/.985	.999***	.920/.966
x_{17}	Is there an agreement on guidelines with respect to the exchange of information with other companies in the SC?	.927***	.841/.772	.800***	.696/.742
x_{18}	Are employees trained in order to contribute to SCM projects?	.938***		.806***	
x_{19}	Does your company have project groups consisting of people from different functional areas?	.946***		.776***	
x_{110}	Is there the necessary expertise in your company to set up and maintain SC relationships?	.683***		.648***	
x_{111}	Is your company is willing to integrate with other SC members?	.814***		.562***	
x_{112}	Is the cross-functional execution of internal business process important within your company?	.530***		.609***	
x_{113}	Are SC processes evaluated within your company?	1.170***		.642***	
Joint SCM conditions (ξ_2)					
x_{21}	Are SC processes evaluated together with other SC members?	1.013***		.726***	
x_{22}	Is there an agreement on collaborative goals with other SC members?	.976***		.907***	
x_{23}	Are there SC project groups in place with other SC members?	1.033***		.782***	
x_{24}	Is your company aware that its decisions may affect other SC members?	.830***		.901***	
x_{25}	Is your company willing to trust other SC members?	.810***		.665***	
x_{26}	Does your company have long-term relationships with other SC members?	.783***		.457***	
x_{27}	Is there an equal distribution of power among all members in your SC?	.573***	.933/.971	.455***	.870/.916
x_{28}	Is the distribution of risks and benefits even between your company and other members in your SC?	.605***	.716/.808	.451***	.463/.811
x_{29}	Is there mutual dependency between your company and other members in your SC?	.708***		.247***	
x_{210}	Does your company exchange information regarding stock levels with other SC members?	1.136***		.902***	
x_{211}	Does your company exchange forecasting information with other SC members?	.989***		.796***	
x_{212}	Does your company exchange product development information with other SC members?	.761***		.839***	
x_{213}	Is your corporate culture similar to other SC members?	.699***		.452***	
x_{214}	Is your corporate decision-making similar to other SC members?	.696***		.482***	

	Latent construct Indicator/item (*"to what degree…"*)	Measures/Indices λ_n	 α/ρ AVE/FLR	 λ_n	 α/ρ AVE/FLR
Adoption of SCM related processes (η_3)					
y_{11}	Is your company capable of processing orders according to agreement with customers in terms of quantities and times?	$.248^{***}$		$.539^{***}$	
y_{12}	Is your company capable of forecasting future customer demand?	$.385^{***}$		$.528^{***}$	
y_{13}	Is your company capable of adapting production capacity according to customer demand?	$.567^{***}$		$.506^{***}$	
y_{14}	Is your company capable of informing customers about the current status of their orders?	$.621^{***}$	.748/.836	$.746^{***}$	.809/.877
y_{15}	Is your company capable of intergrating key accounts and suppliers into the product development process?	$.798^{***}$	.515/.793	$.755^{***}$	.483/.8116
y_{16}	Is your company capable of dealing with returns and returned packaging?	$.587^{***}$		$.612^{***}$	
y_{17}	Is your company capable of intergrating key accounts in the development and implementation of marketing programmes?	$.898^{***}$		$.733^{***}$	
y_{18}	Is your company capable of building up multiple cooperations with important, strategic suppliers?	$.784^{***}$		1.001^{***}	
Execution of SCM (η_4)					
y_{21}	Has your company integrated sourcing, logistics, marketing, product development and other areas with your suppliers?	$.963^{***}$	.780/.961	1.116^{***}	.773/ .962
y_{22}	Has your company integrated sourcing, logistics, marketing, product development and other areas with your customers?	1.057^{***}	.894/.415	$.938^{***}$	.897/.628
y_{23}	Has your company internally integrated its sourcing, logistics, marketing, product development and other areas?	$.798^{***}$		$.751^{***}$	

Caption: y, indicator or manifest variable; η, factor or latent (endogenous) variable: λ_n, factor loadings; α, Cronbach's Alpha; ρ, composite reliability; AVE, Average Variance Extracted; n, sample size

Notions: Ratings based on a 5-point scale, verbally and numerically anchored (1, to a very low degree; 5, to a very high degree); Cut-off values for measurement validity: α>.7; ρ>.7; AVE>.5 (Fornell and Larcker, 1981; Baggozzi and Yi, 1988);