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Differences in adoption of global spare parts management in autonomous service units

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Abstract

Purpose – The purpose of this paper is to study the adoption and motivation to adopt global spare parts practices in autonomous units servicing the products of an original equipment manufacturer.
Design/methodology/approach – The methodological approach is case study investigating the reasons for different levels of use and the perceptions regarding the benefits of a centralized supply chain management in four representative service units.
Findings – Autonomous spare part units often source locally because local suppliers are easy to work with in terms of purchasing processes and have no requirements for systematic planning and control of spare parts purchases and inventory management. However, increasing the share of centrally sourced and managed spare parts in the supply chain brings advantages in terms of lower total cost and higher availability. From the perspective of individual subunits engaged in providing product support services, this advantage of relying on a centrally managed spare parts supply chain of an original equipment manufacturer is not self-evident. Autonomous units frequently choose to continue sourcing spare parts from alternative sources, undermining the economies of scale attainable through the original equipment manufacturer's supply chain. Higher levels of use are facilitated by back-office purchasing management at the unit level. The positive perceptions of centralized supply management in general – including the relationship between the supply unit and the service unit – further facilitate adoption, while local requirements and practices inhibit it.
Research limitations/implications – The study is a single case study and presents proposals requiring further study of the reasons for the observed differences in use of centralized supply chain management.
Practical implications – Centralized spare parts management service requires investment in back-office resources at the service unit level.
Originality/value – The research increases the practical relevance of existing research through an empirical investigation on the autonomous units' motivations for and perceived benefits of centralized spare parts supply.

Keywords Supply chain management, Centralization, Spare parts

Paper type Case study

1. Introduction

From the systems point of view, centralized control of the spare parts supply chain improves resource efficiency and customer service. For the delivery performance of centrally controlled supply chains to be consistently good, a manufacturer must have sufficient scale to invest in supply chain management capabilities (Cohen *et al.*, 2006a, b).

The problem faced by an original equipment manufacturer seeking to introduce a centralized spare parts supply chain is that units providing product support services to equipment owners and users for many types of spare parts also have access to alternative local sources of supply. Once the spare parts supply chain is widely in use, the benefits at the system level are substantial in terms of availability and cost. However, before reaching that stage, there are disadvantages at the level of the autonomous units, such as more complex and demanding purchasing processes, and requirements for systematic planning and control of spare parts purchases and inventory management (Huiskonen, 2001).

Previous studies have not addressed the adoption of an original equipment manufacturer's spare parts supply chain from the perspective of autonomous service units. Adoption in practice is one of three key issues firms must resolve when attempting

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change in how they manage their supply chains (Lambert and Cooper, 2000). Adoption also critically shapes the remaining key issues of processes and supply chain design. For global spare parts management the adoption in the autonomous service units determines the processes and level of integration a firm uses to manage its spare parts business. It also directly deals with supply chain design deals in that it determines the actual network structure and relationships to suppliers. As a result, the potential benefits and competitive advantage (González-Loureiro *et al.*, 2015) that can be gained from global spare parts management is achieved to a substantial degree through adoption in the autonomous service units. The purpose of this paper is to address this gap by investigating the reasons for adopting a global spare parts management service among a set of autonomous service units, and how the benefits of the service are perceived by these units.

The structure of the paper is as follows. First, previous studies related to spare parts supply chain management are reviewed, followed by a description of the methods and analysis for this study. Next, empirical results from the study are presented. Finally, the findings are discussed along with concluding notes on the contribution and limitations of the present study.

2. Literature review

The proposition that centralization of inventories and inventory control improves performance and reduces costs is explicated in inventory theory (Maister, 1976). The improvement is partly based on the reduced need for inventory when demand is met from a single location instead of many, i.e. the material flow to the point of demand is postponed until there is a demand (Pagh and Cooper, 1998). Centralized control (Cohen *et al.*, 1997, 2006b; Patton and Steele, 2003), in the right circumstances, provides a global view of multi-tier supply chains and can be used to further enhance item availability and decrease inventory commitment (Clark and Scarf, 1960; Lee *et al.*, 1997). The centralized control enables multi-tier demand-based inventory positioning, inventory pooling, real-time visibility of the system inventory, automated replenishment of forward locations, repositioning of non-moving items, system-level performance measurement, and integrated information systems (Cohen *et al.*, 1997, 2000).

After-market business has become an increasingly attractive source of revenues and profits (Dennis and Kambil, 2003; Cohen *et al.*, 2006a). However, inventory management of spare parts to service an installed base is challenging, and it is in many aspects different from the inventory management involved in supporting the manufacturing and distribution of finished products (Cohen and Lee, 1990).

There are many examples of reducing system-wide spare parts inventories through centralization reported in literature (e.g. Davis, 1993). Industry case studies have shown such spare parts supply chains to be effective (Cohen *et al.*, 2000; Lee *et al.*, 2005) from the perspective of the original equipment manufacturer. More specifically, centralizing control enables the original equipment manufacturer to use an installed database in planning more efficient responses concerning spare parts with low demand rates (Jalil *et al.*, 2010).

Implementation of centrally coordinated spare parts supply chains is challenging both for the original equipment manufacturer and for the autonomous service units. Problems regarding the design and organization of the supply chain from the perspective of the equipment manufacturer have been thoroughly addressed in the literature (see e.g. Cohen *et al.*, 2006b; Persson and Saccani, 2009). However, the adoption of the supply chain from the perspective of autonomous service units is also challenging: incompatible information systems may easily prevent an autonomous unit from joining a centrally controlled network (Hayes *et al.*, 2005, pp. 154-157), the transfer of good working practices may be undermined by the effort and resources required for learning (Hayes *et al.*, 2005, pp. 287-288), or service units may simply be reluctant to acknowledge that local practices may be inferior to available alternatives (Hayes *et al.*, 2005, pp. 305-306).

Organizational theory (Doz, 1978) suggests that implementing rationalization processes within multinational enterprises are difficult due to information difficulties (problems in acknowledging the need to centralize due to competitive pressures), structural difficulties (tight profit and loss control supporting local approaches), and power-base difficulties (reduction in the local sphere of operational control). Overcoming the difficulties heavily depends on the relationship between parent and subunits in terms of dependence, trust, and identification as well as on contextual factors, such as regulation and the knowledge, norms, and values related to the practice in question (Kostova and Roth, 2002).

From the perspective of autonomous units that already have a reliable supply, the key question for adopting an alternative is the perceived benefit of switching (Davis, 1989). The perceived benefits of centralized information systems introduced at the service unit level have been studied (e.g. Kleingeld *et al.*, 2004; Zackariasson and Wilson, 2004; Pousttchi and Thurnher, 2006), but the perceived benefits of centrally controlled spare parts supply chain management have not been studied from the service unit perspective.

3. Methodology

The study follows a single case embedded unit research design (Yin, 2009) of an original equipment manufacturer (termed OEMCo) in the process of promoting the use of a centralized supply chain (termed CMB) among autonomous service units. The case company is one of the global top five in its industry, with production facilities in North America, Europe, and Asia, and service units on all continents.

The original equipment manufacturer's products are capital goods that are purchased and installed as components of larger systems. Because the life cycle of the equipment is long and requires regular maintenance and upgrading, the after-sales business is equally as significant as new product sales. The global service network consists of more than 50 autonomous units responsible for servicing the installed base in the field. CMB was established in the 1980s as a supply unit and as an SCM service provider for service units in an attempt to rationalize spare parts management at the system level. In an attempt to streamline and harmonize operational processes across the service network, substantial investment and efforts have been made to increase the adoption of CMB by service units in the past several years.

OEMCo's spare parts delivery network under CMB's control consists of a set of suppliers and global distribution centers. CMB offers its services to units that service the equipment installed as a component of a wider system. The service units support both OEMCo's equipment and competitors' equipment. The service units are typically organized around service areas consisting of about ten technicians and one supervisor. Service units typically have their own local inventory locations, several of which can be considered as central warehouses for certain service units. In addition, basically all technicians have their own inventory in their vehicles.

Over the years, CMB has developed its service offering to service units with heavy development efforts especially in the past several years. Key milestones for CMB include the following: the introduction of an electronic ordering facility (with the share of electronic orders received from service units increasing from 0 percent in 1995 to 99 percent in 2010), establishment of regional distribution centers (currently four altogether, with the first one established in 1997), the development of an integrated delivery network with global courier and warehouse operations including automated system-to-system information links (system integration completed in 2007, along with the implementation of a new version of an ERP system), the automation of supply side transactions (i.e. virtually all purchase orders are currently processed out of the ERP in electronic format, and approximately half of all purchase orders are generated automatically), and the introduction of a distribution center inventory optimization tool in 2009. Current services to service units include integrated

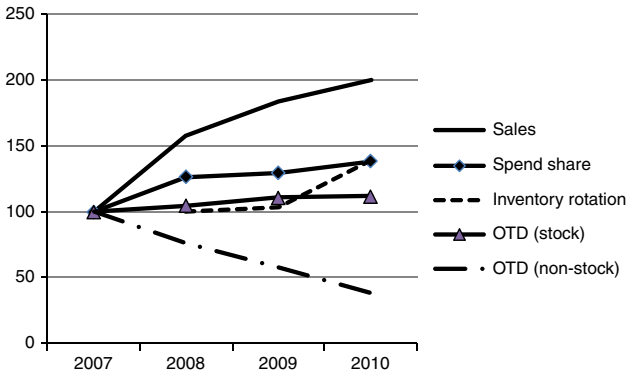
ERP-to-ERP links (orders, order confirmations, goods receipts, and invoice receipts), automated inventory-level-based replenishment of materials to technician vehicles and other local inventories, standard next-day delivery for items stocked in CMB distribution centers to preferred locations, online tracking of deliveries, automated invoicing, mobile technician PDA and a web-portal with search and materials order processing capabilities, and a web-portal where questions on technical issues (e.g. material identification queries) can be directed to the CMB technical service unit. In addition, CMB is introducing a separate inventory optimization tool for service units (aimed for technician vehicle stock optimization).

From 2007 to 2010, CMB performance development was positive with increases in sales and in the average share of all service unit spare parts spending (i.e. spend share), improved distribution center inventory rotation, improved on-time delivery (measured as actual order delivery times against requested time) for stocked items (see the development indices in Figure 1). Performance of non-stock items (i.e. items CMB orders from its suppliers against service unit order) has effectively decreased due to service units requesting increasingly shorter lead times when placing orders. In the same period, CMB has also heavily increased the amount of spare parts items on offer (both stock and non-stock).

Four service units relying on CMB to different degrees are studied. The case is selected based on its theoretical interest and its accessibility (Yin, 2009). The case company has an ongoing program to increase the use of a global spare parts supply chain management in service units. Despite CMB's significant and ongoing efforts, however, many service units continue to rely on local suppliers for spare parts. This makes the case appropriate for investigating the reasons for whether to adopt a centralized spare parts supply chain management from the service unit perspective.

The spare parts supply chain is studied on two levels: CMB; four service units, two with a higher share of CMB purchases and two with a lower share of CMB purchases. Descriptive data on the service units appear in Table I. In the table, the service material costs and the number of operatives are described using an index. Among the 27 units in the region, the unit with the highest material purchases has a material cost index of 100. A unit that spends half as much on spare parts and materials has an index of 50. Similarly, the unit with the highest number of operatives has an index of 100, and a unit with half as many has an index of 50.

The service units studied are designated with pseudonyms: Alpha and Beta (high CMB share in relative terms) and Gamma and Delta (low CMB share). Three service units are of



Notes: 2007=100, except for inventory rotation 2008=100. Spend share is the average share of all service unit spare parts spending. Inventory rotation result presented for period for which data obtained

Figure 1.
CMB performance in 2007-2010

	Alpha	Beta	Gamma	Delta
Service material spend[b]	65	65	100	52
Operatives[c]	79	55	100	70
CMB share[d]				
Rank[e]	3	6	15	22
Index[f]	97	87	65	52

Notes: [a]All values are indices: 100 = maximum value across the cases (except[f]); [b]cost of material goods needed for servicing equipment; [c]number of supervisors and technicians; [d]share of CMB from service material costs; [e]rank in terms of CMB's share in material costs among 27 OEMCo service units (on which data are available); [f]100 = maximum CMB share among the 27 service units: index range (48, 100)

Table I.
Basic data on the service units studied[a]

similar size, with Gamma being significantly larger in terms of service material costs and the number of operatives. Alpha and Beta are among the high CMB users globally. Gamma and Delta are among the low CMB users globally. Low use and high use are determined based on the share of CMB in materials used by the service units in service provision to their customers. Among the 27 units in the region, Alpha and Beta rank 3rd and 6th, respectively, in terms of CMB's share in materials supplied. Compared to the unit that purchases the most materials from CMB, Gamma purchases only 65 percent, and Delta purchases 52 percent.

The service units are all from OEMCo's major business region. The service units were studied on two levels: general management and operatives. From each service unit, a specific service area (with a supervisor and 9-15 technicians, depending on the service unit studied) is selected to complement the country-level management data. Data were collected through interviews with key informants and complemented with archival data from information systems (i.e. of both the CMB and the service units) and meetings with CMB representatives. A total of 28 people were interviewed in 22 interview sessions; 6 of the informants were from CMB; out of the 22 service unit informants, 7 worked in operative positions (i.e. supervisors and technicians) and the rest in administrative positions in service unit management.

Data were collected based on a semi-structured interview questionnaire with topics ranging from the overall business situation to the resources and processes used in spare parts management (see Appendix). The service unit's use of and perceived benefits from both CMB and local suppliers were discussed specifically in the context of its spare parts management. Interviews were digitally recorded and transcribed.

4. Analysis procedure

The spare parts operations of the service unit and its use and perceptions of CMB as a supply unit and provider of supply chain management services are analyzed. The analysis was conducted by the author who also carried out the interviews. The data were analyzed from responses extracted from the interview transcripts that describe the informant's perceptions of CMB and of the benefits of using a centralized spare parts supply chain. The analysis procedure categorized the perceptions into broader classes and compared these categories between high and low use service units.

The analysis of the reasons for the use of CMB is based on the data of informants' perceptions that were extracted from the interview transcripts. Altogether, 215 quotes describing the perceptions of informants were extracted. First, identical or nearly identical responses were grouped and labeled. Next, the labeled quotes were combined into larger categories up to the point where, based on the interviewer's best understanding of the interview transcripts, perception categories could not be further reduced without a significant risk of mislabeling the intended meaning of the informant.

A total of 19 reasons for using or not using CMB were identified through this procedure [1]. Finally, the data were classified according to reasons for using or not using CMB as cited by either all service units, only high CMB units (Alpha and/or Beta), or only low CMB units (Gamma and/or Delta). Table III shows the result of the analysis.

The analysis of the perceived benefits among the low use units followed the same procedure. Individual responses concerning the benefits of CMB were again extracted from the transcripts of interviews with respondents from Gamma and Delta – a total of 113 citations. The benefits were classified into 21 broader categories. Table IV shows the results of the analysis.

5. Results

Role of local administrative personnel

Before presenting the analysis of reasons for the use of CMB and its perceived benefits, the fulltime person equivalents required for operating spare parts management processes and for administration at the four service units are presented. The purpose is to determine whether a higher CMB share is related to a lower level of management and administrative resources in the service units. The comparison is shown in Table II.

The data indicate that a higher use of CMB is related to less resources being dedicated to spare parts management processes in the service units. On the contrary, Alpha, which is the service unit with highest CMB share, employs more persons in administration than does the unit with the least use of centralized supply for spare parts. Delta, which is the unit with the lowest share of CMB, has the lowest administrative resource input.

An explanation for the differences can be found in the way the spare part management process is organized in the different units. Both Alpha and Gamma employ the most spare parts management personnel locally and thus have a strictly centralized order management process. Operatives are not allowed to order themselves, and administrative personnel carry out the ordering processes. Gamma's need for administrative staff also stems from its lower share of CMB: purchase orders from local suppliers are managed and manually sent out by Gamma's buyers whereas purchases from CMB are automatically transmitted from the ERP system.

Delta, on the other hand, has decentralized all ordering with the only centralized personnel being deployed in material management support. The role of materials

	Alpha	Beta	Gamma	Delta	CMB
Order management	1.29	0.88	1.46	0.00	0.19
Materials management	0.17	0.00	0.81	0.93	0.12
Operative purchasing	0.50	0.00	0.68	0.00	0.19
Technical support	[a]	0.25	0.00	[a,b]	0.60
Other[c]					0.16
	–	–	–	–	–
Total	1.97	1.13	2.96	0.93	1.26 (0.66)[d]

Notes: Order management: basic intake of orders and related management (e.g. placing orders with suppliers, securing availability, informing technicians/supervisors on availability, monitoring in-bound orders, and helping in material identification). Materials management: spare parts management support functions, such as inventory management and consumption analyses. Operative purchasing: placing orders with suppliers; note that in certain service units, this is done by order management personnel whereas in other units, both the order management and the operative purchasing departments place orders (depending on the case, i.e. typically whether a purchase is from CMB or from a local supplier). Sourcing: issues such as supplier selection and performance management. Technical support: issues such as providing support on identifying materials. [a]Materials management resources provide technical support; [b]technical support resources for new product business provide help; [c]CMB management; [d]without technical support

Table II.
Comparative use of fulltime person equivalents (FTPE) in spare parts management processes

management is to control Delta's country inventories and other spare parts management support functions, such as analytics and technical support. Thus, the existence of local administrative resources with independent authority emerges as a notable difference between low and high use units. This is supported by the data from the interviews, as the following two sample responses remarks indicate:

> We [the purchasing department] control the material [spare part codes], we control the supplier, we make the link between supplier and material [in the information system] […] In our case, today we have […] percent of the market share with [CMB]. Today [Alpha has] one of the […] high[est] market share index. […] in [OEMCo] (Purchasing Director, Alpha).

> So typically, there is a PO [purchase order] management function [at service unit] taking care of ordering regardless of whether it is internal or external. In [Delta] we don't have that. We have said "no, that's overhead, kick it out". […] We have a lot of change management issues in general, we don't have a central PO function, we cannot force [the operatives]to purchase internally. Even if we said, hey guys you're not allowed, they can still go externally and say "Hey, invoice us", so we need to convince them to actually use these internal solutions, and that's a big issue (Sourcing Director, Delta).

Reasons for using and not using CMB

Next, we analyze the reasons for and against the use of CMB's centralized spare parts supply chain. Table III indicates the reasons to use or not to use CMB. The number of respondents that cite a specific type of reason to use or not to use is indicated in parentheses.

The reasons for using and not using centralized spare parts supply are similar across the units studied. In particular, all units associate using CMB with a mandate to use it (either a mandate from OEMCo to the service unit or from the service unit to the operatives). CMB is also a convenient or easy source for purchasing many types of materials.

The reasons for not using CMB are availability (e.g. spare parts for emergency repairs), and the difficulty of getting some competitor parts through the CMB system. The single most cited reason for using local suppliers is material availability, which is mainly due to CMB not having a short enough lead time on items it does not stock. Although CMB's performance with regard to material availability has improved, a centralized system cannot

Common for all[b]	High CMB unit(s)[c]	Low CMB unit(s)[d]
Reason to use[e]		
CMB use is mandated (9)	Service unit	Certain specific product types (2)
CMB as a single source of supply (5)	authority	Knowledge of CMB and its services (2)
	over operatives (1)	Part is from competitor's equipment (1)
		Reputation of CMB within the service unit (1)
		Trust on CMB (1)
Reason not to use[f]		
CMB material availability issues (15)	Distance to CMB	Relationships with local suppliers (2)
Certain specific product types (12)	distribution	Existing local practices (1)
Prices of CMB material (8)	center (1)	
Part is from competitor's equipment (5)	Service unit	
Local purchase is easy (5)	relationship	
Identifying what a part is (5)	with CMB (1)	

Notes: [a]Number of mentions in individual interviews in parenthesis (only one mention per interview counted for each category); [b]mentioned by informants from all service units studied; [c]mentioned only by informants from Alpha and/or Beta; [d]mentioned only by informants from Gamma and/or Delta; [e]other reasons to use: availability (5), CMB has improved its performance (5), service unit relationship with CMB (3), tools provided by CMB (2) prices of CMB material (3); [f]other reasons not to use: service unit authority over operatives (4), knowledge on CMB and its services (3), reputation of CMB within the service unit (3), trust on CMB (2)

Table III.
Reason for use and non-use of CMB[a]

handle all cases. Also, some specific kinds of products (e.g. consumable material) are easier to source locally. In particular, using CMB requires part identification whereas it is sufficient to remove a defective part before going to a local supplier and asking for a new identical part. The use of transfer prices between CMB and the service units also makes certain product groups uncompetitive for CMB. Furthermore, local purchasing is generally considered easier.

Two factors that distinguish the low use units from the high use units are their good relationships with local suppliers and their operatives' existing practice of sourcing locally. Furthermore, low use units see the centralized supply chain as a source for spare parts for specific product types (in this regard, OEMCo spare parts were cited as being highly available), and the availability of competitor parts. Low use units also perceive the good reputation and trustworthiness of CMB as a reason to use its centralized supply chain. This indicates that even among the operatives in the low use units, CMB is regarded as a viable supplier.

On the other hand, high use service units assess the use of CMB negatively due to their distance to the CMB distribution center (idiosyncratic factor of Beta) and their relationship with CMB. In particular, the relationship between the central unit and the service unit is emphasized. This particular issue was mentioned by an Alpha respondent who voiced concerns that CMB focuses its development work on the requirements of other service units and thus neglects the needs of Alpha. This puts Alpha's credibility to its customers at risk and thus possibly makes local suppliers more attractive to Alpha:

> [The current high share of CMB] was obtained after a lot of work with [CMB representatives] that we had, since 2007 […] meetings, conference calls, one meeting every two months […]. To maintain this position is very hard. And they [should not] forget that. I think that we work hard to be their strategic customer in order to maintain that level of service […]. [There is a risk] that they are forgetting the relationship that we have (Purchasing Director, Alpha).

In addition, the issue of service unit authority over the operatives who support CMB use emerges from the foregoing analysis.

Benefits from using CMB

Finally, we compare the perceived benefits from CMB use among the high and low use service units. Table IV shows the benefits perceived by all respondents, and the benefits perceived by respondents in the low use units. The basic finding is that the service units differ very little in their recognition of benefits. High use units differ only in mentioning three specific benefits: the better quality of spare parts, the operatives being able to focus on their main tasks, and the CMB materials being more eco-friendly through global green programs. The other benefits are cited by respondents from both high and low CMB units. These findings indicate that low CMB units are aware of CMB's potential benefits.

The benefits of centralized supply chain management at the service unit level can be seen to affect the performance of operatives. Operatives can focus on their main task, tasks related to spare parts can be automated more easily when dealing with only one supplier, searching and identifying materials can be supported, administration or process costs can be reduced, and vehicle stock composition can be improved, which reduces the need to make orders in the first place. Furthermore, supervisors who are often responsible for supervising local purchases can save time from the reduced need to approve orders and handle invoices.

As a final remark, although some of the benefits that were mentioned have been realized, only one mention of quantified benefit was observed: Alpha calculated realized savings from the use of CMB over four years (i.e. over the time when its CMB share reached its current level) corresponding to a value of around 50 percent of its 2010 total material costs:

> We made the analysis, the business case […] inventory costs, measures during delays with our clients, freight costs that we incurred, or courier cost, the process side, the personnel costs in the warehouse, the rental cost […] All this, more or less, was [in monetary units] (Purchasing Director, Alpha).

Description	Count[a]	Gamma[b]	Delta[b]
High CMB unit(s)			
Better quality of parts	3		
Operatives can focus in their main task	*2*		
Saving the environment	1		
Low CMB unit(s)			
Automation of tasks	*2*	X	
Purchasing can focus on their main task	1	X	
Benefit from specific CMB services	*1*	X	
Enables analysis of spend	1		X
Mentions from both high and low CMB units			
Benefits related to availability	*9*	X	
Faster process (e.g. order, receiving material)	*7*	X	
Easy to search/identify materials	*7*	X	X
Lower or standardized prices	*7*	X	X
Lower administration/process costs (in general)	*7*	X	X
Accurate vehicle stock composition	5	X	
Easy single point of contact	4	X	X
Savings in processing invoices	*4*		X
Better service to end-customer	3	X	
Cost savings (in general)	*3*		X
Time savings for operatives	3		X
Benefits of centralization (in general)	*2*	X	
Lower inventories/inventory costs	*2*	X	
Other non-specified benefit	2	X	

Table IV.
Classification of perceived benefits from using CMB

Notes: Italic items have been mentioned when informants were asked specifically about realized benefits. The "X" signifies that the low use unit has mentioned the benefit. [a]Number of informants mentioning the issue; [b]mentioned by Gamma/Delta respondent(s)

6. Discussion

The paper addresses the issue of centralized spare parts management from the perspective of autonomous service units. The study of adoption and motivations for adoption or non-adoption on the unit level provides important insights on how to introduce the operational practice in different types of units. In analyzing the solution design of the original equipment we have gained insight on what was actually implemented and how and when centralized spare parts management produces outcomes. This type of research is important to close the gap between promise and practice in logistics and supply chain management (Jonsson and Holmström, 2016).

In the case study, the system-level benefits of centralized spare parts control (Maister, 1976; Davis, 1993; Cohen *et al.*, 2000; Lee *et al.*, 2005) are recognized by service unit personnel. The issue at hand is not whether centralization is more effective, but how it is implementable. On the service unit level, notable benefits are possible, as indicated by Alpha, the highest user of CMB in the study. Significant productivity gains can be found at the operative level, particularly from improvements in the productivity of supervisors. The use of centralized spare parts management service at the level of autonomous business units in this study did not depend on differences in perceived benefits, but on differences in operational capabilities. All units studied recognized significant potential benefits from using CMB independent of their degree of use of CMB. Units with high and low use of centralized supply chain management differed in the level of local management resource deployed to enforce order procedures. Perceptions of availability problems for certain type of parts, relationship problems between CMB and the service unit, and existence of local ways of operating act as barriers to CMB use.

The observations on the role of back-office resources at the subunit level are an important addition to prior literature. Spare parts management is a research stream that emphasizes analytical inventory modeling (e.g. Martin *et al.*, 2010). The study indicates that sufficient back-office resources are required in global spare parts management in addition to overcoming the challenges of relationship and change management typically encountered in the transfer of operational practices within multinational corporations (e.g. Gamble, 2010; Sayim, 2010).

The practical implication of the findings is that the use of a centralized spare parts management service requires investment in back-office resources at the service unit level for the service units to obtain the potential benefits from centralized supply chain management. In addition, the study indicates that building and maintaining parent-subunit relationships as well as initiating efforts to change spare parts management at the local, operative level are important.

The limitations of the research must be noted. The study is a single case study and findings contribute to inductive theory development. The case study only proposes reasons for the differences in the adoption of centralized supply chain management. It is critical to understand the differences between high and low CMB units better. A more rigorous survey of all units would be needed to further confirm the proposals inducted in this study. Furthermore, the analysis is conducted by a single assessor. The introduction of multiple assessors and a defined analysis procedure would improve the categorization of responses and their interpretations. Furthermore, for generalizability further theory testing research is required.

To better understand the magnitude of the benefits from centrally supported systems, further research is needed to investigate the benefits for operative worker productivity. However, reliable estimates on time usage might be challenging to obtain. This would require simulation and modeling work based on models constructed from in-depth case studies, which offers another potential research area. Further research is also needed to evaluate whether the administrative resources of the service unit are essential for implementation. Could there be ways to implement a model where administration in the service unit can be kept to a bare minimum while at the same time relying on the centralized spare parts supply chain to fully benefit from economies of scale and high availability of spare parts? If so, under what circumstances?

Note

1. Two examples of how responses are categorized: "There is a lot to do, you have to use [CMB] […] we should use [CMB], so we use [CMB]" (Service director, Gamma); categorized as mandated use as the reason to use. "Special products, e.g. […] that are available from [name of a local supplier]" (Supervisor, Alpha); categorized as specific product types as the reason not to use.

References

Clark, A.J. and Scarf, H. (1960), "Optimal policies for a multi-echelon inventory problem", *Management Science*, Vol. 6, pp. 475-490, available at: www.jstor.org/stable/30046146

Cohen, M.A. and Lee, H.L. (1990), "Out of touch with customer needs? Spare parts and after sales service", *Sloan Management Review*, Vol. 31, pp. 55-66.

Cohen, M.A., Agrawal, N. and Agrawal, V. (2006a), "Winning in the aftermarket", *Harvard Business Review*, Vol. 84, pp. 128-138, doi: 10.1361/152981501770352581.

Cohen, M.A., Agrawal, N. and Agrawal, V. (2006b), "Achieving breakthrough service delivery through dynamic asset deployment strategies", *Interfaces*, Vol. 36, pp. 259-271, doi: 10.1287/inte.1060.0212.

Cohen, M.A., Zheng, Y.S. and Agrawal, V. (1997), "Service parts logistics: a benchmark analysis", *IEEE Transactions*, Vol. 29, pp. 627-639, doi: 10.1023/A:1018513900264.

Cohen, M.A., Cull, C., Lee, H.L. and Willen, D. (2000), "Saturn's supply-chain innovation: high value in after-sales service", *Sloan Management Review*, Vol. 41, pp. 93-101.

Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, Vol. 13, pp. 319-340.

Davis, T. (1993), "Effective supply chain management", *Sloan Management Review*, Vol. 34, pp. 35-46.

Dennis, M.J. and Kambil, A. (2003), "Service management: building profits after the sale", *Supply Chain Management Review*, Vol. 7, pp. 42-48.

Doz, Y.L. (1978), "Managing manufacturing rationalization within multinational companies", *Columbia Journal of World Business*, Vol. 13, pp. 82-94.

Gamble, J. (2010), "Transferring organizational practices and the dynamics of hybridization: Japanese retail multinationals in China", *Journal of Management Studies*, Vol. 47, pp. 705-732, doi: 10.1111/j.1467-6486.2009.00876.x.

González-Loureiro, M., Dabi, M. and Kiessling, T. (2015), "Supply chain management as the key to a firm's strategy in the global marketplace: trends and research agenda", *International Journal of Physical Distribution and Logistics Management*, Vol. 45, pp. 159-181.

Hayes, R., Pisano, G., Upton, D. and Wheelwright, S. (2005), *Pursuing the Competitive Edge*, Wiley, Hoboken, NJ.

Huiskonen, J. (2001), "Maintenance spare parts logistics: special characteristics and strategic choices", *International Journal of Production Economics*, Vol. 71, pp. 125-133, doi: 10.1016/S0925-5273(00)00112-2.

Jalil, M.N., Zuidwijk, R.A., Fleischmann, M. and van Nunen, J.A. (2010), "Spare parts logistics and installed base information", *Journal of the Operational Research Society*, Vol. 62, pp. 442-457, doi: 10.1057/jors.2010.38.

Jonsson, P. and Holmström, J. (2016), "Future of supply chain planning: closing the gaps between practice and promise", *International Journal of Physical Distribution & Logistics Management*, Vol. 46, pp. 62-81.

Kleingeld, A., Van Tuijl, H. and Algera, J.A. (2004), "Participation in the design of performance management systems: a quasi-experimental field study", *Journal of Organizational Behavior*, Vol. 25, pp. 831-841, doi: 10.1002/job.266.

Kostova, T. and Roth, K. (2002), "Adoption of an organizational practice by subsidiaries of multinational corporations: institutional and relational effects", *Academy of Management Journal*, Vol. 45, pp. 215-233, doi: 10.2307/3069293.

Lambert, D.M. and Cooper, M.C. (2000), "Issues in supply chain management", *Industrial Marketing Management*, Vol. 29, pp. 65-83.

Lee, H.L., Padmanabhan, V. and Whang, S. (1997), "Information distortion in a supply chain: the bullwhip effect", *Management Science*, Vol. 43, pp. 546-558, doi: 10.1287/mnsc.1040.0266.

Lee, H.L., Peleg, B. and Whang, S. (2005), "Toyota: service chain management", Stanford Graduate School of Business Case Study GS-41, Stanford, CA.

Maister, D.H. (1976), "Centralisation of inventories and the 'Square Root Law' ", *International Journal of Physical Distribution*, Vol. 6, pp. 124-134.

Martin, H., Syntetos, A.A., Parodi, A., Polychronakis, Y.E. and Pintelon, L. (2010), "Integrating the spare parts supply chain: an inter-disciplinary account", *Journal of Manufacturing Technology Management*, Vol. 21, pp. 226-245.

Pagh, J.D. and Cooper, M.C. (1998), "Supply chain postponement and speculation strategies: how to choose the right strategy", *Journal of Business Logistics*, Vol. 19, pp. 13-33.

Patton, J.D. and Steele, R.J. (2003), *Service Parts Handbook*, Solomon Press Publishers, New York, NY.

Persson, F. and Saccani, N. (2009), "Managing the after-sales logistic network – a simulation study", *Production Planning & Control*, Vol. 20, pp. 125-134, doi: 10.1080/09537280802707530.

Pousttchi, K. and Thurnher, B. (2006), "Understanding effects and determinants of mobile support tools: a usability-centered field study on IT service technicians", *Proceedings of the International Conference on Mobile Business*, *Copenhagen*, *June 26-27*, p. 10.

Sayim, K.Z. (2010), "Pushed or pulled? Transfer of reward management policies in MNCs", *International Journal of Human Resource Management*, Vol. 21, pp. 2631-2658, doi: 10.1080/09585192.2010.523580.

Yin, D.R.K. (2009), *Case Study Research: Design and Methods*, Sage Publications, Los Angeles, CA.

Zackariasson, P. and Wilson, T. (2004), "Internetworked after-sales service", *Industrial Marketing Management*, Vol. 33, pp. 75-86.

Further reading

Doz, Y.L. and Prahalad, C.K. (1981), "Headquarters influence and strategic control in MNCs", *Sloan Management Review*, Vol. 23, pp. 15-29.

Martinez, J.I. and Jarillo, J.C. (1989), "The evolution of research on coordination mechanisms in multinational corporations", *Journal of International Business Studies*, Vol. 20, pp. 489-514, doi: 10.2307/155188.

Saccani, N., Johansson, P. and Perona, M. (2007), "Configuring the after-sales service supply chain: a multiple case study", *International Journal of Production Economics*, Vol. 110, pp. 52-69, doi: 10.1016/j.ijpe.2007.02.009.

Syntetos, A.A., Keyes, M. and Babai, M.Z. (2009), "Demand categorisation in a European spare parts, logistics network", *International Journal of Operations and Production Management*, Vol. 29, pp. 292-316.

Wagner, S.M. and Lindeman, E. (2008), "A case study-based analysis of spare parts management in the engineering industry", *Production Planning & Control*, Vol. 19, pp. 397-407, doi: 10.1080/09537280802034554.

Appendix. Interview guide for service unit interviews

Name of your service unit:

Your name:

Your position and background:

Service unit overview

Organization

Please describe how your frontline/branch is organized.

Who is part of the organization?

Business overview

What is the competitive situation like?

What kind of customers do you have?

What kind of equipment do you have in your service base?

How would you describe your contract base?

How successful has your frontline been *vis-à-vis* competitors?

Spare parts management

Please describe the resources you have for spare parts management:

- Inventories
- Personnel
- Information systems
- Other resources

Please describe your spare parts management processes:

- Inventory management and replenishment

- Material identification
- Ordering processes
- Use of material codes in ordering
- Delivery processes
- In-bound delivery monitoring
- Order change management
- Invoicing process
- Supplier management
- Supplier performance monitoring
- Management of material codes
- Inventory count
- Other spare parts management activities
- Personnel time used in spare parts management (i.e. persons, time used, activities)

How well is your spare parts management functioning? (What works well? Are there any problems? Where?)
Do you measure the performance of your spare parts management? If so, how?
Do you measure the costs of your spare parts management? If so, how?
How would you like to improve your spare parts management?

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