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Complexity and Commitment in Supply Chain Management Initiatives

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Abstract

While the benefits of supply chain management have been widely reported within industry, adoption of supply chain management initiatives have been slow and below industry expectations. To better understand and effectively address this problem of adoption within industry, this paper takes a closer look at the individual supply chain management initiatives to achieve a new understanding on the barriers that hamper the adoption process. This paper presents a framework that categorises different SCM initiatives according to a complexity-commitment continuum. By analysing three initiatives from the grocery industry, we argue that the inherent complexity of SCM initiatives poses barriers to adoption due to the degree of organisation commitment required.

1. Introduction

Over the last two decades, organisations have progressively moved towards establishing closer relationships with business partners to collaboratively achieve competitive advantage [1]. Several studies suggest that the scale of competition is shifting from between firms to between groups of firms such as supply chains [2] [3]. The concept of supply chain management emerged aiming at leveraging the benefits of inter-organisational partnerships through systemic thinking and integrating business processes to ensure certainty and efficiency in the flow of information and materials from upstream to downstream [4]. Although the benefits have been widely reported within academia and industry [5][6], the extent of adoption of supply chain management initiatives still falls short of industry expectations [7][8]. While many organisations have piloted initiatives such as Efficient Consumer Response and Collaborative Planning, Forecasting and Replenishment with selected business partners, there are considerably fewer examples where these initiatives have been adopted on a supply chain level involving multiple trading partners [5].

To better understand and effectively address this lack of adoption, we have to identify and understand the barriers that hamper the adoption process. Existing research tend to focus on inter-organisational barriers [9] [10] that involve trust issues, the willingness to participate, mutuality of benefits, risks and costs, as well as asymmetries in technical, organisational and cultural systems. Furthermore, barriers in the process of implementing these initiatives can be attributed to difficulties in establishing partner selection criteria [11], complexities of project management across multiple organisations and so forth. We argue that inherent complexities within specific supply chain initiatives pose an important barrier to adoption that has not been adequately addressed so far. Generally, we can distinguish between three levels of barriers that affect each other. Firstly, inherent complexities pose significant challenges for individual organisations to adopt SCM initiatives; secondly, on an inter-organisational level, existing asymmetries between organisations further challenge the adoption process. Finally, the process of implementation itself poses further challenges as it involves multi-party development projects. As the first group of barriers remains largely unaddressed so far, we believe that a better understanding of these barriers inherent to the SCM initiatives is essential for the discussion of SCM adoption.

In this paper, we argue that the inherent complexity of SCM initiatives poses barriers to adoption due to the organisational commitment that is required to address these complexities. In doing so, we will present a framework that categorises different SCM initiatives according to a complexity-commitment continuum. Using three specific SCM examples from the grocery industry, we show that newer SCM initiatives have become increasingly complex, impacting on individual organisations in terms of the required managerial commitments for the initiatives to be adopted. The next section will introduce supply chain management and our framework, followed by a section on our deductive analysis using the industry examples, and then a final discussion on the implications for further research.

2. Supply Chain Management Initiatives: A Continuum of Complexity and Commitment

2.1 Supply Chain Management: A Vision of Intra-firm and Inter-firm Synchronisation

Mentzer et al (2001) suggests that supply chain management (SCM) can be defined as:

'The systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across

businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole' [4, p.18]

Basically, SCM envisions managing and coordinating the flow of information, products, services and financial resources from upstream suppliers to downstream customers along the supply chain in order to improve customer service and ultimately supply chain profitability. To embrace the overall concept of supply chain management (SCM), individual organisations have to, firstly, adopt a systems perspective of their business, that is, an understanding of the interdependencies between individual actions and the implications of managing upstream and downstream flows of products, services, finances, and information across trading partners. Secondly, and more importantly, supply chain management requires organisations to implement this supply chain orientation involving suppliers and customers. [4, p.11]

From a strategic perspective, SCM envisions the synchronisation of supply chain activities, or processes, to compete against other supply chains [2] on a network level. In order to achieve the envisioned level of information and process synchronisation within and across organisations, organisations in various industries aim at adopting and implementing specific industry-based supply chain management initiatives.

2.2 Supply Chain Management Initiatives: Adopting and Implementing the SCM Vision

Supply chain management initiatives provide concepts to enable organisations and their trading partners to implement industry best practice to achieve the benefits of SCM. In various industries, a range of supply chain management initiatives exist that aim at orientating organisations towards achieving the ultimate SCM vision that involves the integration of all intra-firm and inter-firm policies and processes. To support our argument that new and increasingly sophisticated SCM initiatives pose inherent challenges to adoption, we will show that these initiatives cumulatively build on each other and that they vary in complexity according to the extent of intra-firm and inter-firm integration they require. Generally, SCM initiatives move beyond the traditional arms-length interaction, where organisations operate in a *laissez faire* environment and interaction is limited to transactional exchanges. As new information technology and process optimisation strategies become available and more developed within industries, new SCM initiatives propose closer, more collaborative, trading partner relationships. The following section introduces a framework to organise the different types of SCM initiatives according to their level of inherent complexity and extent of organisational commitment required.

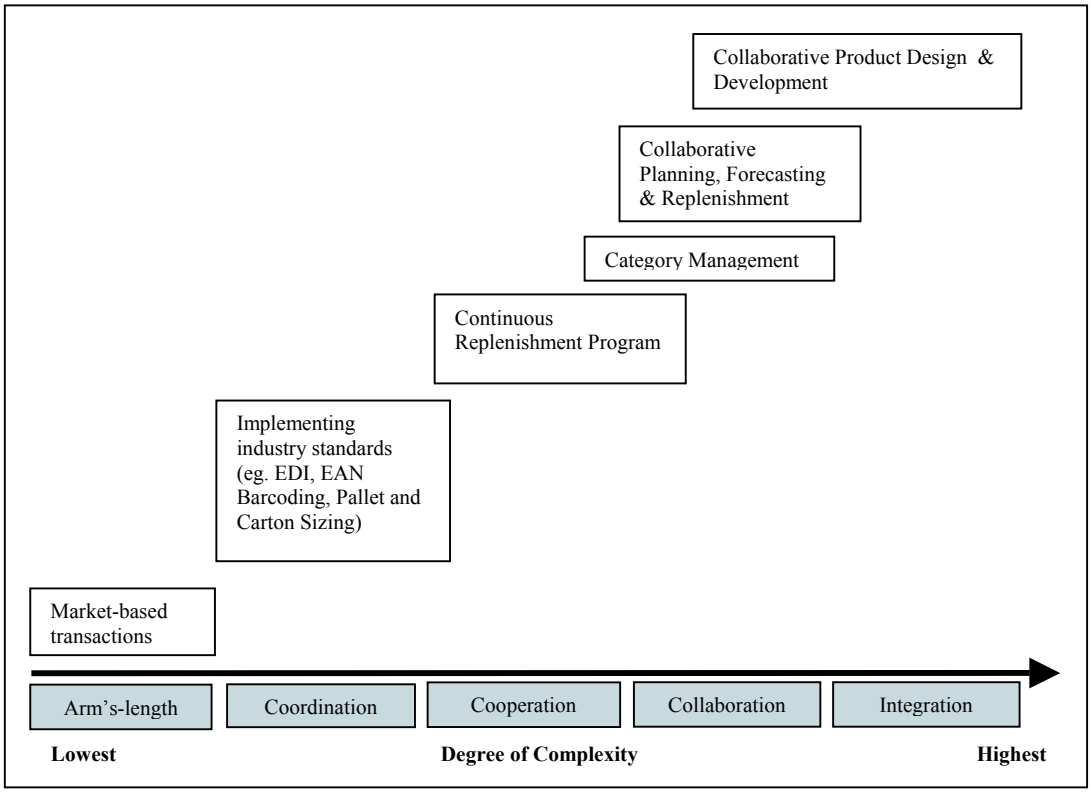

Figure 1. A continuum of SCM initiatives

2.3 The Complexity-Commitment Continuum

In his study of relational change strategies, Himmelman (1996) suggested a set of strategies that build upon each other along a continuum of commitment and complexity [12]. We have adopted this model as the basis for developing a framework in order to organise the different types of SCM initiatives according to their level of complexity and commitment accordingly. We suggest that there is an increasing complexity inherent in different types of SCM initiatives that require cumulative levels of organisational commitment as we approach a level of strategic integration among organisations. Figure 1 shows different types of SCM initiatives along this continuum of increasing complexity.

2.3.1 Different types of SCM Initiatives

Coordination Initiatives

Coordination initiatives envision organisations altering the way information is exchanged and managed and involve implementing industry data standards so that organisations can more efficiently manage the flow of information and flow of materials between organisations. However, coordination initiatives do not expect organisations to alter existing business processes. Some examples of coordination initiatives include adopting standardised messaging infrastructures such as electronic data interchange (EDI) based on EDIFACT or similar standards that might use Extensible Markup Language (XML). Apart from informational exchange capabilities, initiatives to improve the materials handling infrastructure between trading partners include product identifying standards, such as Universal Product Code (UPC) and European Article Numbering (EAN) barcoding standards, containerisation and pallet sizing.

Cooperation Initiatives

Cooperative initiatives see organisations exchanging information, altering operational activities and sharing supply chain resources. Cooperation initiatives present a series of industry process standards focused on optimising the flow of information and materials along the supply chain. The initiatives require basic coordination capabilities, as described above. More importantly, these initiatives also require organisations and their trading partners to adopt new processes for performing daily operations. Some examples include Just-in-time (JIT) delivery, Continuous Replenishment Program (CRP) and Quick Response (QR) in the electronics, grocery and textile industries respectively.

Collaboration Initiatives

Collaboration initiatives require organisations to exchange information, to alter operational and tactical activities and share resources in an extensive way. Moving beyond cooperation initiatives, they add another level of complexity by requiring organisations to align processes at the tactical level, including planning, forecasting, sales and marketing and purchasing. These initiatives also assume the existence of infrastructural and process capabilities from coordination and cooperation initiatives to effectively carry out collaboration initiatives. Some examples of initiatives include Category Management and Collaborative Planning, Forecasting and Replenishment.

Integration Initiatives

Integration initiatives suggest the next step up from collaboration initiatives and involve process standardisation at the strategic level of the organisation. Joint product development for example, requires not only alignment of strategic objectives and involvement of strategic processes such as research and development to design and develop the product concept, but also the need to be able to agree on a way to market, manufacture and distribute the product to the consumer. This requires operational cooperation, collaborative tactics and a sophisticated underlying communication infrastructure as a prerequisite to enable the exchange of strategic information, such as product designs, and joint planning and logistics processes. This implies that for integration to be achieved, all the previous types of initiatives have to be in place.

2.4 Increasing requirements for organisational commitment

Having argued that SCM initiatives become increasingly complex, we can state that this inherent complexity requires increasing organisational commitment likewise. For the purpose of our framework we distinguish four major levels of management in organisations – the infrastructure level, operations level, tactical level and strategic level. As complexity increases for each of the above initiatives, the level of commitment required by organisations in terms of time, resources and managerial attention to achieve the visions increases as we approach integration type initiatives (see figure 2). With coordination initiatives, commitment is predominantly at the infrastructure level of management. With cooperation initiatives, commitment on the infrastructure and the operations level is essential, and so forth. Finally, with integration initiatives, all management levels of the organisation are impacted and therefore commitment has to be lead by strategic management but will involve resource and managerial commitment from the infrastructure, operations and tactical level as well.

To show the validity of our framework and to ultimately support our argument that the inherent complexity of SCM initiatives poses barriers to adoption due to the organisation commitment required, we will analyse three

exemplary initiatives from the grocery industry in the following section. We will examine the level of standardisation that each initiative requires and show their cumulative nature (one initiative based on the achievements of the other). This will allow us to deduce the organisational impact of the initiatives in terms of the required managerial commitments according to the above illustrated management levels.

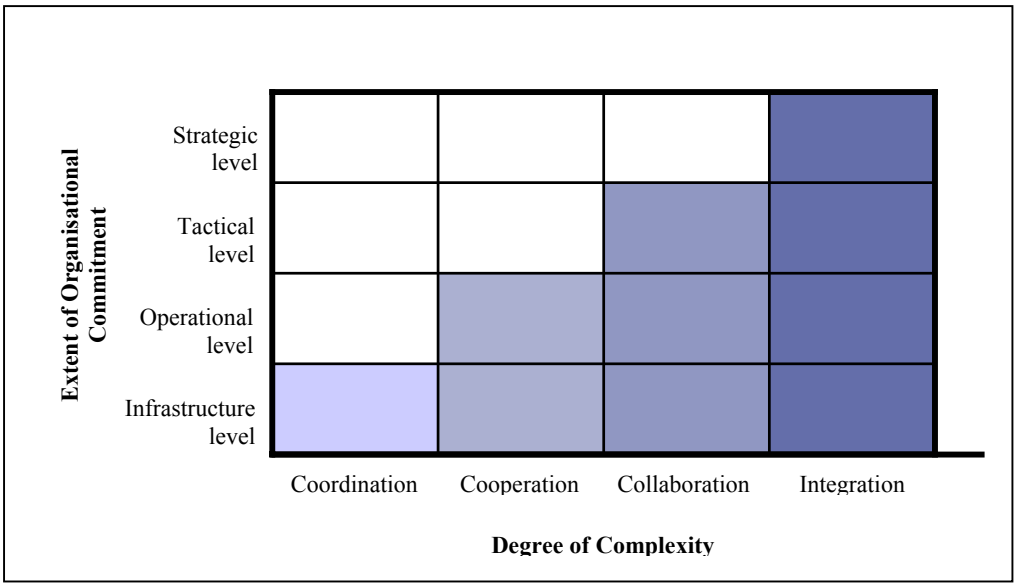

Figure 2. The Complexity-Commitment Continuum

3.0 Exploring Grocery Industry Initiatives: An illustration of the framework

3.1 Methodology

For the purpose of our analysis, we have chosen to explore three initiatives that are well known within the grocery industry – Electronic Data Interchange, Continuous Replenishment Program and Collaborative Planning, Forecasting and Replenishment. These initiatives have been chosen to illustrate the extent of organisational commitment required to achieve the envisioned level of coordination, cooperation, and collaboration respectively. For the purpose of making a clear comparison between these initiatives, we will focus our analysis on the replenishment aspect of each initiative. For each initiative, analysis will be organised in three sections: (1) review of the vision and aim, (2) description of the extent of standardisation required, and (3) description of the extent of organisational commitment required to achieve the envisioned level of standardisation.

3.2 Electronic Data Interchange (EDI)

3.2.1 Vision and Aim

Electronic Data Interchange (EDI) envisions a seamless exchange of information between two or more organisations to carry out daily replenishment operations. Taken as an initiative, EDI aims to set up an inter-organisational communications infrastructure that allows two or more businesses to electronically transmit standard transaction documents in a structured format from one company's business process application to another's business process application [13][14]. EDI's vision impacts on the replenishment process in one major way. By adopting EDI message standards, transaction documents can be recognized and understood swiftly and without unnecessary delays and errors from inaccurate interpretation and manual data entry. For example, EDI messages can be used to invoice buyers, send purchase orders, and authorise items for delivery and transfer. Shipping schedules can be transmitted directly to a shipper's computer and responded to with an electronic shipping notice more quickly than if manually processed. Because all these processes can be performed more efficiently and frequently, with fewer errors, lead times and inventory holding costs are significantly reduced [15].

3.2.2 Extent of Standardisation

Infrastructure Standardisation

EDI requires organisations to standardise the message format that is exchanged such that business applications at both ends of a transaction can transmit and receive the messages electronically. Standardisation at the data level enables organisations to transact electronically without having to implement a new system or to make major changes to existing systems. EDI standards are made up

of four major components. These include (1) transactions sets, (2) segments, (3) data elements and (4) transmission control standards [14]. Basically, an EDI transaction set identifies a standard business document (eg. Invoice document), and segments are groups of data elements identifying the details within each document (eg. Address information, supplier name, items ordered, total amount, etc). Finally, transmission controls standards apply to the secure way EDI messages are packaged for transmission. These standards ensure that EDI messages reach the intended party in the intended form.

Operations and Tactics Standardisation

There are no formal requirements within the traditional EDI vision to adopt a standardised operations process, nor standard processes at the tactical level.. This means that businesses can organise their operations functions in whichever way they deem fit as long as they can transmit and receive the necessary transactional documents in EDI format to and from another party.

3.2.3 Extent of Organisational Commitment

Primarily an infrastructure level project, resources and services of the IT function is required to implement the EDI message standards and update existing business applications to allow the output and input of messages in conformity with the chosen standard. Once the infrastructure is in place to conduct transactions via EDI, the commitment on each participating organisation is to maintain this standardised communications link, or interface. In terms of impact on organisational tasks, processes and people, EDI does not require changes to be made to existing business processes.

3.3 Continuous Replenishment Program (CRP)

3.3.1 Vision and Aim

Continuous Replenishment Program (CRP) is a major strategy under the Efficient Replenishment pillar of the Efficient Consumer Response (ECR) movement. CRP envisions suppliers, distributors and retailers cooperating towards achieving a smooth and continuous flow of product along the distribution channel, thereby, reducing channel uncertainty, inventory levels and transportation costs [16][17]. CRP encompasses three alternative replenishment arrangements – direct-store-delivery, cross-docking and flow-through [9]. The major achievement of CRP is that the stock level and order requirements at the retailers' stores are revealed and shared with the manufacturers, and manufacturers use this information to fulfill store level orders more frequently and in smaller batches. With direct-store-delivery, orders are delivered directly from suppliers to individual stores, bypassing the distributor. With cross-docking, suppliers deliver consolidated store orders to a distribution center, where they are unpacked, sorted into their store destinations and dispatched. Finally, with flow through, specific store orders are packed at the suppliers and delivered to the distribution center, checked and immediately dispatched without any sorting required. This improved flow of goods aims at eliminating buffer stock at the distribution center, reducing errors in deliveries and improving order response time, thereby, reducing out-of-stocks in stores. To achieve the maximum potential of the CRP vision, trading partners need to be able to facilitate high information coordination and be willing to align replenishment policies and operations with their trading partners' [17].

3.3.2 Extent of Standardisation

Infrastructure Standardisation

To facilitate the fast and accurate flow of replenishment information between retailer, distributor and supplier information systems, EDI is an essential enabling technology in CRP [18][19]. CRP requires stores to be able to electronically transmit information on stock levels and order requirements to a central buying office, where individual store orders are consolidated into an EDI purchase order message and transmitted to individual suppliers on a pre-agreed time schedule. Suppliers need to be able to then respond by transmitting an Advanced Shipping Notice (ASN) in EDI format either directly to the store or distribution centre to notify them of impending deliveries. Essential for enabling efficient handling of shipments and production of ASNs, suppliers need to be able to produce a bar coded serial shipping container code (SSCC) to identify shipments. Application of product identification standards, such as the European Article Numbering (EAN) system, in the form of bar codes on pallets and cartons are also essential for identifying and sorting at distribution centres. Bar codes on cartons and pallets are scanned and the data directly updated on the inventory management systems. This eliminates time consuming and error-prone manual data entry, thus, increasing the efficiency of the receiving, sorting and dispatching tasks.

Operations Standardisation

The CRP vision presents a change in the way orders are traditionally sent, received and fulfilled. Traditionally, individual store orders are aggregated at the retailer's DC and a purchase order sent to the suppliers, which then deliver a large shipment of goods to the DC. Orders are, generally, large and are sent infrequently and provide essentially no visibility of consumer or retailer ordering patterns for the manufacturers. However, in CRP, suppliers have visibility of store level requirements in their EDI orders and are expected to respond to this requirement almost immediately. This means that, firstly, suppliers must have the capability to respond to complex purchase orders that consist of many items in small

quantities and for multiple stores. Secondly, suppliers must be able to deliver these small batches of orders more frequently with a shorter lead-time (around 1 day typically).

Tactics Standardisation

In terms of replenishment processes, CRP only attempts to improve logistics and distribution operations and, therefore does not involve any processes at the tactical level of the organisation.

3.3.3 Extent of Organisational Commitment

The adoption of the CRP standard replenishment process impacts participating organisations at two levels of the organisation – the infrastructure and operations levels. At the infrastructure level, all participating firms are required to commit resources to implement a standard way of communicating messages to each other, and recognising shipments, cartons and items. In the grocery industry this is done using EDI and EAN product numbering and barcoding standards, thus, EDI and barcode compliance are a prerequisite for CRP. At the operations levels, participating retailers and manufacturers must alter the way they traditionally send, receive orders and dispatch orders. Retailers must have capabilities to send out purchase orders with individual store requirements and sort individual store order deliveries from different suppliers at their distribution centres. Suppliers, on the other hand, are required to have complex order processing capabilities to handle complex orders from retailers. Suppliers must also alter the way they traditionally dispatch orders to retailers, from large, infrequent deliveries to small, frequent deliveries. Therefore, CRP impacts mainly on the logistics and distribution functions of both supplier and retailers.

3.4 Collaborative Planning, Forecasting and Replenishment (CPFR)

3.4.1 Vision and Aim

Established in 1997, CPFR was developed to address the gaps that were present in previous initiatives, such as continuous replenishment. As such, CPFR is seen as an evolution from ECR, and more specifically, from CRP [10]. CPFR envisions two or more organisations exchanging market information to jointly develop a market-specific business plan that describes the product to be sold, the way it will be merchandised and promoted in the marketplace, and the time frame in which this happens [20]. Developed as a nine-step guideline for retailers and their manufacturers, the roadmap instructs CPFR partners to jointly develop a front-end agreement on terms of collaboration, targets and performance metrics, create a joint business plan, jointly create a sales forecast, identify any exceptions, jointly address and resolve the exceptions, generate an order forecast, and execute the order. By sharing promotion schedules, point-of-sales data and inventory data, a single shared forecast of consumer demand, at the detail of a product, is developed. The retailer and manufacturer can then base all internal planning activities relating to that particular product on the shared demand forecast, representing a major step towards value-chain integration. CPFR aims to increase visibility of demand information along the supply chain and leverage a collaboration-oriented relationship between retailer and manufacturer, to increase the flexibility of the supply chain in planning for and responding to volatile demand. This implies the need for an infrastructure that can facilitate high levels of information exchange, a sophisticated planning and forecasting system that is integrated with the production and logistics systems, and a willingness of trading partners to align planning objectives, promotional tactics, and replenishment policies and operations. The following section discusses the extent of standardisation embedded in the CPFR vision.

3.4.2 Extent of Standardisation

Infrastructure Standardisation

In terms of data and communications interfaces, EDI and product identification standards are prerequisites to achieve the level of collaboration envisioned in CPFR. The high frequency of iterative interaction between organisations while sharing sensitive information to collaboratively develop forecasts makes it even more critical for organisations to adopt data standards. Using the EDI infrastructure, organisations can transmit and receive critical data swiftly and securely while ensuring a high data integrity. Moreover, EDI can facilitate information exchange between different functional units, which under CPFR, are envisioned to collaborate closely with each other. In terms of efficient handling of goods, the requirements are very similar to CRP, thus, organisations are required to adopt the bar coding standards infrastructure for CPFR as well. This is important in CPFR because point-of-sales data is extremely valuable in CPFR for capturing consumer demand necessary to generate sales and order forecasts.

Operations Standardisation

To effectively conduct CPFR, organisations must have the capabilities to perform replenishment operations very much in same efficient way as in CRP. Therefore, the operations process standards, in terms of order receiving, sorting and dispatching, are necessary also to achieve efficient delivery execution in CPFR. However, unlike previous initiatives, inventory management is now integrated with the planning and forecasting processes [5].

Tactics Standardisation

CPFR represents a radical transformation in the way businesses plan for promotions and develop forecasts to improve their replenishment operations in response to consumer demand. Evolving from having established a shared understanding on how orders are fulfilled, as envisioned in CRP, CPFR takes process standardisation to the next level, requiring a retailer and a manufacturer to adopt a standardised way of business planning. Retailers and their manufacturers are required to share information about their business development activities for a particular product within a period of time. Based on this planning information and unprecedented access to inventory level information from Distribution Centers to stores, trading partners jointly develop and manage a forecast over this period of time. With even greater demand visibility, forecast accuracy increases and manufacturers can match production to demand and fulfil orders more effectively, reducing inventory levels along the pipeline and out-of-stocks in retailers' stores.

3.4.3 Extent of Organisational Commitment Required

CFPR requires participating organisations to adopt standard business information formats, standard replenishment policies and operations, as well as standard processes in business planning and forecasting. The extent of data and process standardisation embedded in the CPFR vision requires commitment at the infrastructure, operations as well as tactical levels within each participating organisation. At the infrastructure level, CPFR requires organisations to commit IT resources to adopt message and product numbering standards to facilitate communication of basic EDI messages and numbering and barcodes as before. Additionally, due to the iterative nature of the collaborative forecasting process, more sophisticated information technologies, such as collaborative hubs, might have to be implemented to enable real-time collaboration. At the operations level, the impact here is similar to CRP, each participating organisation must standardise the way they receive and dispatch orders, thus, impacting on the logistics and distribution functions. However, there is a new and more demanding need to standardise ways of planning, forecasting and managing product life cycles which extends the demands on companies to tactical management and longer timescales. This new level of standardisation will impact on the merchandising function (for retailers), sales and marketing function (for suppliers), and planning functions (for retailers and suppliers). More importantly, whereas previous initiatives like CRP focused on optimising individual units and not the whole process or company [5], CPFR envisions several functional units within organisations, and to some extent across organisations, to collaborate to improve the performance of the replenishment cycle.

4.0 Discussion

Through exploring the extent of standardisation required by each of the three grocery industry replenishment initiatives, we find that the level of standardisation increases cumulatively as we move from EDI to CPFR. Each initiative was observed to require the capabilities of the earlier initiatives, and at the same time, requiring new capabilities with more complex and demanding effects. As described above, EDI requires organisations to adopt a set of industry message standards. CRP requires organisations to standardise their messages as well as standardise the way orders are received, sorted and dispatched. CPFR finally requires organisations to standardise messages, standardise the way orders are received and fulfilled, and besides this, standardise the way promotions are planned, forecasts are created, and performance is measured.

Table 1: Summary of analysis

Initiative	Level of Standardisation	Impacted organisational parts
EDI	**Infrastructure**: data, communication interface	**Technical functions**: IT
CRP	**Infrastructure**: data, communication interface, product identification (barcodes) **Operational**: Order receiving, sorting and despatching processes	**Technical functions**: IT **Operational functions**: logistics and distribution
CPFR	**Infrastructure**: data, communication interface, product identification (barcodes) **Operational**: Order receiving, sorting and despatching processes **Tactical**: Business planning processes	**Technical functions**: IT **Operational functions**: logistics and distribution **Tactical functions**: sales, marketing, purchasing, planning

Hence, as the extent of standardisation becomes greater, organisations face the need to commit an increasing amount of resources and managerial attention to achieve those targets. In EDI, the focus is at the infrastructure level. Major commitments of resources have to come from the IT function only. There is little commitment necessary from the rest of the organisation. In CRP, the focus extends beyond the infrastructure level to incorporate resources and managerial attention at the operations level. This affects not only the IT function, but also the logistics and distribution functions, where orders are received, sorted and dispatched. In CPFR, the focus is extended further. Organisations must now commit managerial attention and resources at the infrastructure and operations levels of the organisation, and also at the tactical level, involving sales, purchasing, or merchandising (at retailers), and planning functions

within the organisation. Moreover, CPFR requires close collaboration between the functions at the operations and tactical level to enable a responsive replenishment cycle.

By analysing the requirements of the various initiatives, we see the level of commitment compounding as complexity increases from coordination to collaboration along the supply chain. The number of functional parts involved in operationalising the initiatives increases, implying that greater levels of commitment in terms of time and resources, and involvement of more senior management, are required by each participating organisation to manage the interdependencies of the different parts in achieving the vision.

5.0 Conclusion

This analysis supports our argument that collaborative supply chain initiatives create their own barriers to adoption because the level of complexity inherent in its vision becomes increasingly complex and expensive to implement within each organisation, and more critically, with multiple trading partners.

As supply chain initiatives become more complex due to an increasing need for standardisation, the adoption within the individual organisations is challenged by the degree of organisational commitment that is required. With more people, more organisational units and technical systems involved, the adoption respectively becomes more complex and expensive.

These barriers to adoption at the individual organisational level have to be taken into account when extending the analysis to an inter-organisational level involving multiple business partners. With these inherent complexities complementing those barriers stemming from organisational asymmetries and project management across organisations, we can begin to understand SCM adoption in a more holistic way. Just as the single initiatives have a cumulative nature of complexity and commitment it might be worth researching whether this is mirrored in the project management to implement these initiatives. Further research into the nature of projects for the implementation of SCM initiatives should aim at exploring the project management challenges that come with implementing increasingly complex initiatives with multiple trading partners.

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