Communications of the Association for Information Systems

Volume 35 | Article 9

11-2014

Supply Chain Resource Planning Systems: A Scenario of Future Enterprise Systems

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Abstract:

To envisage possible future enterprise systems, we describe four scenarios that all respond to the increasing need for better supply chain-wide coordination of resource allocation decisions. We use two drivers to derive these scenarios; namely "normal form of providing corporate computing resources" and "stance of regulators towards explicit forms of industry-wide coordination", the latter of which includes cooperation among competitors. While three of our scenarios are familiar to contemporary readers, the fourth, supply chain resource planning (SCRP) systems, marks a radical break with current practice. We describe the operating principle of SCRP systems and discuss possible governance structures for organizations supporting SCRP systems. We hope to encourage discussion about the future of enterprise systems that moves beyond extrapolating past and current trends. The paper concludes by outlining four areas for promising future research.

Keywords: Supply Chain Integration, Enterprise Systems, ERP, CPFR, Inter-organizational Information Systems.

Volume 35, Article 9, pp. 173-190, November 2014

The manuscript was received 12/09/2012 and was with the authors 11 months for 4 revisions.

Communications of the Association for Information Systems

I. INTRODUCTION

How will enterprise information systems look in 10 years from now? While such a question certainly cannot be answered in a definitive manner, it seems worthwhile to explore possible future courses of development and think through the implications of these several possibilities in terms of capabilities required, opportunities opened up, and risks to be guarded against. With these considerations, companies, policy makers, system vendors, and service providers may thus be able to prepare themselves for the future and engage in actively contributing to a desired future.

Markus, Petrie, and Axline (2000, 2003) proposed the same question ten years ago. They suggest that currently dominant enterprise resource planning (ERP) systems may be replaced by a centralized supply chain management system. These authors argue, as we do, that the future may be discontinuous in the sense that it cannot be predicted by extrapolating current trends. Therefore, they propose juxtaposing a "discontinuity" view against a "continuity view", the latter of which extrapolates current trends with regard to enterprise integration. In the continuity view, enterprise integration is based on ERP systems that are connected across supply chains through dyadic electronic data interchange (EDI) links. In the discontinuity view, intermediaries facilitate enterprise integration by hosting ERP-like functionality and data needed for supply chain cooperation. Daniel and White (2005) have proposed a related idea, "industry resource planning system", which manages stocks and flows for a whole industry rather than for a single company. As such, we (1) specify the conditions under which such a discontinuity scenario could come to pass, and (2) specify an implementation process and a governance structure that could make this scenario a reality. We believe that the idea of a centralized supply chain management system, which was presented in the context of electronic marketplaces that were mushrooming around the year 2000 only to implode together with the dot-com bubble, is worth revisiting. On the one hand, the idea has not been elaborated; Markus et al. (2000, 2003) do not offer much detail about how such a system would work, be implemented, be governed, or under which conditions it would be feasible and sustainable. Moreover, Daniel and White's (2005) description of an industry resource planning system is even more limited. On the other hand, the framing of the idea as an instance of an electronic market implied that the idea lost credibility when electronic marketplaces fell out of favor. In contrast, we re-frame the idea by discussing it in the context of the need for closer supply chain collaboration that originates in the ongoing globalization and deregulation of markets.

To explore the conditions under which a centralized supply chain management system outlined by Markus et al. (2000, 2003) may be feasible and sustainable, we follow the scenario approach that Gray and Hovav (1999, 2007) introduced to the IS literature. Specifically, we define two main drivers that significantly affect the future of enterprise information systems: "normal form of providing corporate computing resources" and "stance of regulators towards industry-wide coordination", including cooperation among competitors. We then use these two drivers to construct four scenarios of feasible and possible future forms of enterprise information systems. We briefly describe all four scenarios and their associated forms of enterprise information systems, then focus on one scenario that corresponds to the idea of a centralized supply chain management system. We call this scenario the supply chain resource planning (SCRP) scenario, named by drawing together elements of both names that Markus et al. (2003) and Daniel and White (2005) suggest; namely, "centralized supply chain management system" and "industry resource planning system" respectively.

The continuity view that Markus et al. (2003) describe is the dominant view in the literature (for a synopsis, see Sinke, 2008). Specifically, the evolution of enterprise information systems is portrayed as a steady functional extension of initially limited and isolated information systems (Markus et al., 2003). In this vein, Moller (2005) characterizes the evolution of enterprise information systems through five stages, with each stage dominating one decade beginning with inventory control systems (1950s) and continuing with material requirement planning (MRP) systems (1960s), manufacturing resource planning (MRP II) systems (1970s), computer-integrated manufacturing (CIM) systems (1980s), and culminating in ERP systems in the 1990s. Extrapolation of this development predicts that ERP systems will continue to grow in their reach and scope. For example, de Búrca, Fynes, and Marschall (2005) characterize extended ERP systems as including "additional modules such as CRM, supply chain planning, integrated e-commerce, sales force automation, decision support and human resources to the core foundation modules of internally focused established ERP systems" (p. 428). Moller (2005) sees ERP systems at the center of extended ERP II with newer components arranged in concentric circles. Similarly, Jaiswal and Kaushik (2005) see extended ERP systems as hubs that are, however, connected to systems of other organizations (e.g. through EDI-links), which thus increases their reach. While these authors do not claim to predict the future of ERP systems, their descriptions indicate how one would likely predict future enterprise information systems if one extrapolated from past and present experiences.

We do not deny that future enterprise information systems may be extended versions of today's ERP systems. However, we submit that the future may also look radically different. For example, enterprise integration may be facilitated by intermediaries who operate centralized supply chain management systems, which Markus et al. (2003) suggest in their discontinuity view. While Markus at al. developed their discontinuity view by constructing a counter-image to the presently dominant view, the continuity view, we take as our point of departure a discussion of supply chain-wide coordination to better understand the conditions under which such a scenario may be feasible and sustainable. Supply chain-wide coordination became an issue in academia when Lee, Padmanabhan, and Whang (1997) described the bullwhip effect, which results from rational actions of companies in a supply chain that conspire to produce unintended and undesired effects at the supply chain level. We associate this phenomenon with a concept that Emery and Trist (1965) proposed almost half a century ago: turbulent fields. By arguing that the bullwhip effect that Lee et al. (1997) identified can be interpreted as an instance of a turbulent field, we prepare the ground for our discussion of possible governance structures for SCRP systems as a specific type of organized collective action at the industry level described by Trist (1983) under the name of "referent organization". In between, however, we develop our scenario space by distinguishing the two drivers mentioned above, which yields four scenarios that we briefly describe. Against this scenario space, we then elaborate on one scenario, the SCRP scenario. Subsequently, we propose an implementation process through which companies in an industry can transition from a traditional, ERP-centered form of enterprise integration to an SCRP-based form. As part of this description, we introduce a new type of intermediary, called SCRP agency, which operates an SCRP system. Finally, we return to the concepts of turbulent fields and referent organization to describe a possible governance structure for SCRP agencies as a feasible solution to the complex governance problems associated with an industry-wide supply chain resource planning system. We conclude by proposing four promising areas for future research.

II. THE EMERGENCE OF TURBULENT FIELDS IN SUPPLY CHAINS

Emery and Trist (1965) describe four types of organizational environments that impose a growing need for coordination and collaboration among organizations as the environments in which they operate display increasing rates of change and unpredictability. The first two types of environments concern organizations in environments that are largely devoid of other organizations. Instead, the environments consist entirely of useful and required resources (as seen from an individual organization's perspective) that may be distributed in different ways. In the simplest case, resources are distributed randomly so that organizations do not need special skills for navigating in such environments; as long as they continue to "move" they will encounter useful and necessary resources. Only when resources are distributed non-randomly (i.e. when they show some clustering pattern) will organizations have to develop "strategies" that direct them to large clusters and help them to avoid unpromising ones. However, organizations do not have to cope with other organizations and thus the need for coordination or effective competition has not yet arisen. These two types of environments correspond to the textbook economic cases of perfect and monopolistic competition, respectively (Emery & Trist, 1965), and largely serve a didactical purpose when viewed against the other two types .

The third type that Emery and Trist (1965) describe, called disturbed-reactive, may be related to the textbook economic case of oligopolistic competition. Here, an organization's main environment consists of other organizations with which it is interlocked through strategic interdependence. Trist (1983) further elaborates this case as typical of large, multi-national and multi-divisional bureaucratic organizations that have developed sophisticated marketing strategies that have co-evolved with those of competitors. While companies have to cope with a significant amount of uncertainty resulting from strategic interdependence, they have developed skills and techniques that provide adequate responses to the degree of uncertainty associated with such environments. Here, competing firms, suppliers, and customers are tied together through complex but manageable links (Trist, 1983; Astley & Fombrun, 1983).

The capability to manage complexity resulting from strategic interdependence is lost in the fourth case. Here, the actions of other organizations conspire to create unintended and undesired effects that organizations, acting individually, cannot anticipate and prepare for any longer (Emery & Trist, 1965; Astley & Fombrun, 1983). However, organizations can effectively cope with these environments, called turbulent fields, through collective action (Trist, 1983). In contrast to the third type, change in turbulent fields does not only result from other organizations' predictable actions, but also from interactions between organizations themselves; these become so complex and multi-faceted that organizations can no longer predict the eventual outcomes. To cope with these effects, collective action has to normatively stabilize the environment (Trist, 1983). We return to this argument later. Here, we want to point out the striking parallel that exists between the concept of turbulent fields and the bullwhip effect that Lee et al.

(1997) describe to motivate our choice of Emery and Trist's model as a theoretical foundation for our discussion of alternative scenarios for IS-based coordination in supply chains.

In their seminal paper, Lee et al. (1997) describe distortions in a supply chain resulting from un-coordinated resource allocation decisions within the individual companies constituting the supply chain. Specifically, they argue that sequential demand forecast updating, order batching, price fluctuations, and rationing behavior may induce companies to make wrong resource allocation decisions. For example, sequential updating of demand forecasts often causes each company in a supply chain to add a safety margin to their planned order and/or production quantities. Similarly, order batching may be misinterpreted to signal an increase in demand and thus erroneously lead companies to increase planned output volumes. Promotional price discounts (price fluctuations) may lead companies to build up stock in components and materials, and thus, again, signaling increased demand when demand has actually not changed. Rationing of goods in short supply can have the same effect as companies artificially bloat order quantities when they know that orders will be filled only partially.

Individual companies' strategies to properly anticipate changes in their environment and to respond adequately can conspire to create unintended and undesired effects at the whole supply chain level. Lee et al. (1997) noticed such effects when they compared the movement of inventory levels in a supply chain. Specifically, they found that small upward or downward changes tend to increase as they propagate upstream in a supply chain, similar to the movement of a bullwhip when excited, hence the name "bullwhip effect". We interpret the bullwhip effect as an indication of the presence of a turbulent field since companies' individual strategies no longer result in adequate responses to environmental uncertainty; rather, these strategies become themselves the major source of environmental uncertainty, a telltale characteristic of turbulent fields.

Lee et al. (1997) offer a number of remedies such as sharing of demand data across the whole supply chain, virtual integration through vendor managed inventory (VMI) and continuous replenishment programs (CRP), and dis-intermediation, shortening of lead times, reduction of order lot sizes, refraining from promotional price discounts, and changed rationing practices. These diverse tactics share the need for action at the supply chain level to make them effective. (Note that measures such as reduction of lot sizes, avoidance of promotional price discounts, and so on are only effective if applied across the whole supply chain.) Thus, the proposed remedies further justify our characterization of supply chains displaying the bullwhip effect as turbulent fields since action at the collective level is recommended as a solution rather than improved strategies at the level of individual companies. In sum, we argue that both the increased volatility of the environment due to strategic interaction and the need for action at the collective level to stabilize the environment provide a strong indication that supply chains exposed to the bullwhip effect are instances of turbulent fields as Emery and Trist (1965) describe.

III. DEVELOPMENT OF A SCENARIO SPACE

While the framework that Emery and Trist (Emery & Trist, 1965; Trist, 1983) develop outlines a broad direction for coping with turbulent fields, there are various ways in which organizations can act jointly to stabilize their environment. Thus, even when assuming that supply chains will be characterized by increased turbulence in the sense of Emery and Trist and, further, when assuming that companies in supply chains will act collectively to address such increased turbulence, one still cannot confidently predict or prescribe the type of enterprise information system that will come to pass in the future. Gray and Hovav (1999, 2007) have introduced the use of scenarios to the IS field to address such uncertainty. Specifically, they argue that scenarios provide a legitimate and practical "way of communicating about the future" (1999, p. 15). Scenarios are not to be confused with predictions; rather, they help managers and politicians to understand the assumptions and implications of various possible courses of actions and thus to prepare for the future without having to predict it (1999, p. 15). We follow Gray and Hovav by developing four scenarios that we consider to be possible, plausible, and internally consistent (Gray & Hovav, 1999, p. 16) responses to increasingly turbulent supply chains. We believe that one or more of these scenarios will be observed in the next ten years.

We follow Gray and Hovav's (1999) recommended procedure by (1) defining the domain of the future to be modeled, (2) creating a scenario space through identifying key drivers and specifying our assumptions, and (3) creating a set of scenarios to communicate with decision makers (Gray & Hovav, 1999, p. 16). Our domain are turbulent supply chains as described above. To create a scenario space, Gray and Hovav (1999) recommend identifying two or more drivers that are believed to shape the future and which, in combination, result in distinct scenarios. Gray and Hovav (1999) have used the "social acceptance of IT" and the "state of telecommunications" respectively as their drivers; they slightly renamed these drivers in their updated version published in 2007. By distinguishing two values for each dimension, Gray and Hovav obtained four scenarios, which they call utopian, dystopic, status quo, and technology. Of these, they describe only the first two in detail. For reasons discussed in what follows, we chose more specific and narrow drivers; namely, "stance of regulators towards industry-wide coordination" and "normal form of providing corporate computing resources".

Enterprise systems have been shaped by what companies do with IT and how companies organize the provisioning of IT services. We use these two influences to derive drivers for constructing our scenario space. The organization of IT services has varied over time; however, the internal provisioning of IT resources is traditionally accepted as normal and exceptions have to be specifically justified, even though more and more functions (e.g., software implementation and development) formerly performed by internal IT departments are now provided by specialized firms. However, some authors believe that most IT resources will be provided externally in the future. Such external provisioning of IT resources is variously labeled as outsourcing (McFarlan, 1995), software as a service (Turner, Budgen, & Brereton, 2003), utility computing (Carr, 2005), grid computing (Foster, Zhao, Raicu, & Lu, 2008), and, most recently, cloud computing (Armbrust et al., 2010) or cloudsourcing (Clarke, 2013). Common to these concepts is that core IT functions and data are hosted and managed by specialized service firms, as described by Nicolas Carr (2005) who compares the provisioning of IT services to that of power and gas. In contrast, critics of Carr may prevail because companies may insist on managing their data and IT functionality internally: they may rely on increasingly standardized hardware, software, and service components but integrate these into internally managed information infrastructures (see for example Clarke, 2013). Internal provisioning of IT functionality does not preclude the use of external services. However, outsourcing IT functionality might be considered only for particular applications such as provisioning email services or supporting business functions with suitable characteristics such as customer relationship management. If, in contrast, IT functionality is predominantly provided as an external service, most business applications, including core data and functions for production and distribution planning and operations, will be procured as a service while certain applications considered to be particularly sensitive may continue to be provided internally.

Which form of organizing the provisioning of IT resources will dominate in the future depends on many factors such as costs, security, and reliability of data communication, wages of IT personnel, energy costs, legal requirements, and so forth. Moreover, the concrete form of organizing corporate IT resources will vary across firms. However, such variation will occur against a general understanding of what will be considered to be the normal organization. For example, Carr (2005) argues that external provisioning of IT resources will be considered to be the normal form of organizing IT resources in the future, whereas internal provisioning of corporate IT resources was considered to be norm in the past. We therefore argue that future enterprise systems will be constructed on the basis of such a general understanding. If external provisioning of corporate IT resources is considered to be normal, then IT managers will have to build a convincing business case if they want to provide IT resources internally. Conversely, the term “outsourcing” suggests that the normal way of providing IT resources is through corporate IT departments, which now have to render control over some aspects of corporate computing to external service providers if a suitable justification is provided. In this vein, the early discussion of IT outsourcing was dominated by whether companies should outsource all IT services, so-called total outsourcing, or only parts of the IT portfolio of services, so-called selective outsourcing, which was generally recommended (Lacity, Willcocks, & Feeny, 1996). We therefore define, as our first driver, the general understanding of what constitutes the normal form of organizing IT resources and distinguish between two values; namely, internal and external provisioning of IT resources.

Regarding the use of corporate IT resources, we assume that the trend towards integrating ever more segments of supply chains, reaching beyond the boundaries of companies, will go on. However, we propose that the process through which such integration is obtained will vary in a significant way. Specifically, as integration transcends company boundaries, cooperation among several companies will be required. Such cooperation involves suppliers and customers. In addition, as the automation of information exchange between suppliers and customers is made easier through common standards, cooperation among competitors may be efficient to jointly negotiate such standards (Reimers & Li, 2005). The extent of such cooperation depends on two factors: the ability of companies in an industry to act collectively, and the constraints imposed by regulators on collective action, especially among competitors. Of these two possible drivers of future enterprise systems, we believe that the stance of regulators towards industry-wide collaboration is more useful for our purpose. We argue that the ability to overcome various problems of collective action (Olson, 1965) varies significantly across industries so that it would be difficult to generalize our findings if we chose to drive our scenario space through this factor. In contrast, for the reasons given below, we believe that the stance of regulators toward industry-wide coordination tends to become more similar across countries so that this driver offers a more robust basis for generalization. However, our findings are limited by the fact that we do not consider the ability of industries to act collectively, which may be important as we discuss in Section 7.

Traditionally, politicians and regulators, following Adam Smith who famously claimed that competitors rarely meet without conspiring against the public (Smith, 1994, p. 145), adopt a hostile stance towards cooperation among competitors. However, the stance of governments and economists has also varied over time in this regard (Dilorenzo & High, 1988; Stigler, 1982). For example, after World War II, the U.S. Government has actively encouraged the formation of trusts (Dick, 2008). In spite of the presently predominantly hostile stance towards cooperation among competitors, most countries provide the legal means for such cooperation in clearly defined boundaries. For example, German law allows for so-called “rationalization cartels”, which are routinely granted in some industries such as banking (Emmerich, 2012). Empirically, industries display significant differences regarding the extent to which mechanisms for industry-wide coordination have evolved (Kenworthy, 2000). Moreover, countries may also be classified according to the degree to which collective bargaining mechanisms are tolerated or encouraged (Hall & Soskice, 2009).

Yet, we believe that changes in the stance towards industry-wide coordination will, to some degree, display some global homogeneity. On the one hand, the economic discourse on proper regulation and efficient forms of organization of economic activities is increasingly global in nature. On the other hand, a global regulatory regime is shaping up (e.g., as manifested in the institutions of the World Trade Organization, the European Union, and other forms of regional regulatory consolidation observed in the Americas, Africa and Asia), and there is a lively debate whether and to what extent antitrust policy should be incorporated into such multilateral international trading systems (Hoekman & Holms, 1999; Hoekman, 2003).

As requirements for coordinating operational processes across firm boundaries increase, the currently predominantly hostile approach towards increased forms of cooperation among competitors may change, resulting in more flexible regulation and the broadening of areas where competitors can legally cooperate. This may result from an increased emphasis on efficiency through coordination rather than through competition in the public and academic debate. Such a trend could also result from changed patterns of consumer behavior, which may favor novelty over affordability as societies become generally more wealthy. Finally, increasing “informatization” of production and distribution processes may not only offer new opportunities for better coordination, but also increase transparency and thus offer better tools against anti-social behavior of firms.

We distinguish between a friendly and a hostile approach, with the currently predominantly hostile stance serving as a reference. Thus, our scenarios are built on the assumption that the current stance either will not change significantly or that it will become significantly more friendly towards industry-wide coordination of production and distribution processes.

IV. FOUR SCENARIOS OF FUTURE ENTERPRISE SYSTEMS IN TURBULENT SUPPLY CHAINS

From our two drivers “normal form of providing corporate computing resources” and “stance of regulators towards industry-wide coordination”, with each adopting two possible values, we construct four scenarios, which Table 1 shows. We briefly describe those two scenarios that, subsequently, we do not consider further in this paper; namely, “regulated IT services facility” and “hierarchically integrated supply chains”. By doing this, we demonstrate that the drivers used for creating the scenario space are valid in the sense that they suggest four distinct scenarios that are all internally consistent and plausible. Subsequently, we focus on the remaining two scenarios because we can identify these with the continuity view and the discontinuity view that Markus et al. (2003) describe.

Table 1: Four Scenarios for Managing Turbulence in Supply Chains

	Hostile attitude to industry-wide coordination	**Friendly attitude to industry-wide coordination**
External provisioning of IT resources seen as normal	Regulated IT services facility	Supply chain resource planning systems (SCRP)
Internal provisioning of IT resources seen as normal	Collaborative planning, forecasting, and replenishment (CPFR)	Hierarchically integrated supply chains

Regulated IT Services Facility

This first scenario envisages that enterprise systems will be provided as an external service to corporate customers. Moreover, such systems will be highly standardized to facilitate easy connectivity between the various instances of the software that hold the business data of customer firms so that data exchange between these instances supports supply chain-wide coordination. As the provisioning of such services will involve significant economies of scale, the supply side will see a strong trend towards the emergence of monopoly structures. We believe that this scenario is likely in a world in which external provisioning of IT resources is seen as normal while regulators adopt a hostile stance towards industry-wide coordination. In such a world, companies will have limited scope for industry-wide cooperation to support supply chain wide coordination through integration of their systems. To meet the increasing need for supply chain coordination, IT service providers will offer easy connection of systems through standardized interfaces. In effect, supply chain firms will accept IT service providers as standard setters. Such practice, however, will reinforce the development of supply-side monopoly structures. In this scenario, regulators will allow monopoly to emerge but then tightly regulate it. The reason is that regulators, while they are keen to prevent anti-competitive behavior, recognize that centralized provisioning of IT services may be efficient since such services form a so-called natural monopoly, a situation in which a market is best served by a single supplier (Baumol, 1977). Thus, the establishment of a a tightly regulated monopoly will be seen as a second-best approach. Such efforts are already to be seen in the market for operating systems such as when Microsoft found itself at loggerheads with regulatory authorities, and in markets for IT services such as iTunes's and Amazon's cloud services (Liebowitz & Margolis, 2001; MacLean & Gullo, 2011; BBC News, 2013; The Economist, 2013).

Hierarchically Integrated Supply Chains

In a world where regulators increasingly favor effectively coordinating production and distribution activities over maintaining a strictly competitive environment (and in a world where firms are hesitant to rely on external IT and data services), companies may find it easier to coordinate supply chains and the requisite investments in IT infrastructure internally (Williamson, 1987). Thus, our second scenario envisions that supply chains will be coordinated through internally managed enterprise systems. This will become a possibility because dominant firms will either own increasing portions of their supply chains or rely on their bargaining power to integrate supply chains electronically, a form which might be called quasi-integration (Makadok & Coff, 2008). Regulators will not rein in such practices because they favor efficiency through better supply chain coordination over enforcement of anti-trust policies. We can see examples in the IT industry where large firms such as Dell, Intel, and Apple use their market power to dictate IT standards and, to some extent, work to streamline processes across the whole supply chain (e.g., Rivkin & Porter, 1999).

Because hierarchically integrated supply chains operate under a single authority, the source of turbulence described by Emery and Trist (1965) is effectively removed. Such turbulence results from the interactions of autonomous organizations that, attempting to anticipate environmental changes and respond accordingly, are the very source of the uncertainty that the organizations intend to guard against. By negating autonomous decision making on the level of operational units in a supply chain, such turbulence is avoided. In sum, legally integrated and quasi-integrated supply chains solve the problem of supply chain turbulence by cutting out the main source of that turbulence while, at the same time, offering a transaction cost-efficient governance structure for integrating information systems at the operational level.

Collaborative Planning, Forecasting and Replenishment (CPFR)

The CPFR scenario represents the status quo. It is based on the existing IT infrastructure of companies, mostly ERP systems connected through EDI links; in contrast to current practice, it calls for more extensive integration of enterprise resource planning processes across company boundaries to cope with increasingly turbulent supply chain environments (Sherman, 1998). However, such inter-organizationally integrated planning is currently being implemented by advanced companies (VICS, 2010). We associate the CPFR concept with a scenario in which external provisioning of corporate computing resources is accepted only for niche applications and in which possibilities for industry-wide cooperation, especially among competitors, are limited because of a hostile stance of regulators towards such cooperation. These conditions are characteristic of the present corporate world in which the CPFR concept has arisen. Specifically, CPFR assumes that companies operate enterprise systems (which are connected through electronic data interchange (EDI)) internally; it also limits cooperation to adjacent supply chain companies (i.e. cooperation among competitors is not envisioned as part of the concept).

A major problem in implementing the CPFR model consists in what might be called a recursive relationship between two planning levels: the enterprise level and the supply chain level. Enterprise level planning usually starts with forecasting demand on which basis resource allocation decisions are made. However, assumptions made on this level about future demand may become invalid as companies engage in CPFR. Specifically, the basis on which company-wide plans have been made may be undermined through a joint (collaborative) demand-forecasting process. Moreover, joint (collaborative) resource-allocation decisions on the level of a supply chain may alter the input parameters on which company-wide planning is based.

Based on these insights, the industry group acting as a curator for the CPFR concept—Voluntary Interindustry Commerce Solutions (VICS)—has proposed the integration of supply chain-wide CPFR with company-wide sales and operations planning (VICS, 2010). Their analysis shows that a weakness of the traditional approach to CPFR lies in a specific solution to the problem of the recursive relationship between the two planning levels. Specifically, companies have integrated these two planning levels through staggered planning horizons: company-wide sales and operations planning has a long-term time horizon, the outcomes of which are then used as input values for short-term CPFR. Naturally, reversing resource allocation decisions on short notice often becomes infeasible or prohibitively expensive (VICS, 2010). As a consequence, traditional CPFR's benefits are limited.

To remedy this situation, a maturity model has been developed that distinguishes four stages (VICS, 2010). The first stage, called unlinked, describes an arm's length relationship between two adjacent firms; communication occurs only in the form of placing orders and sending invoices. In the fourth stage, called strategic, planning is integrated across all levels, from joint short-term demand forecasting to collaborative planning of new product launches (VICS, 2010). Likewise, members from all hierarchical levels are involved in the collaborative planning process, from operators to executives (VICS, 2010). VICS claims that no pair of companies has yet reached the level of collaborative strategic planning, with most companies found to be in the second stage, called basic, and just a few having reached the third stage, called collaborative (VICS, 2010).

In sum, CPFR, including advanced versions described by VICS (2010), is based on a distributed computing architecture and a collaborative planning approach limited to supply chain partners, which may include strategic planning. In contrast to hierarchically integrated supply chains, CPFR does not imply or recommend that a company surrenders its autonomy; even on the highest level of the VICS maturity model, companies maintain their internal identity and decision making authority; the model assumes that the companies engaged in CPFR have roughly equal bargaining power or, if this assumption is not justified, that the more powerful company abstains from leaning on the weaker party to impose its own plans. This also means that CPFR most likely works in a bilateral relationship; importantly, the concept does not require or recommend that competitors engage in a joint planning effort. This distinguishes the CPFR scenario from the SCRP scenario that we now describe in more detail.

Supply Chain Resource Planning Systems

The fourth scenario corresponds with the discontinuity view that Markus et al. (2003) describe. External provisioning of corporate computing resources will be considered normal and firms will have ample scope for industry-wide collaboration to address increasing turbulence in supply chains because regulators emphasize the benefits of such collaboration over possible disadvantages through anti-competitive behavior. Enterprise systems will be offered as a service by external providers. However, in contrast to the regulated IT services facility scenario, enterprise customers can pool their data to create a common and shared data resource that is then used to provide an aligned demand forecast distributed across the whole supply chain because regulators perceive such sharing of data and forecasts to do more good than harm. This, in turn, effectively eliminates the main source of turbulence in supply chains; namely, uncertainty about demand assumptions made by other supply chain members. We elaborate these two aspects of the scenario—sharing of data and forecasts respectively—in turn.

The first aspect characterizing SCRP, the sharing of business data, may be usefully elaborated by comparing the scenario with the concept of hosted ERP systems, known as application service provisioning (ASP). According to the ASP model, companies do not install an ERP system on their premises but access a system remotely installed on the premises of a service provider. In addition, the licensing model is varied in that users often pay based on a monthly rate or on the actual volume of use rather than based on a fixed number of users as is typical for standard ERP licensing arrangements (Seltsikas & Currie, 2002). Thus, the ASP model can be seen as an instance of the external provisioning of corporate computing resources. Adoption of the ASP model has remained far behind original expectations (Seltsikas & Currie, 2002) although it was praised as an attractive alternative especially for small and medium-sized firms. A likely reason is that small firms are often pressured by their large business partners to adopt the same system that the large firms use internally (Benders, Batenburg, & van der Blonk, 2006). In any case, the advantages of the ASP model are limited to cost savings (in the form of lower licensing costs and more efficient system operation) when compared to standard ERP deployment. Moreover, the ASP model also does not tap the potential for increased efficiency through providing a higher level of data and planning integration across a whole supply chain.

If the SCRP scenario was limited to supply chain-wide data sharing (analogous to the (logically) single, integrated database of an ERP system), its only advantage would also consist in cost savings. Specifically, the costs of interfacing independent and often incompatible ERP systems through EDI-type linkages would be eliminated (as is the case for the regulated IT services facility). However, the main advantage of the SCRP scenario is associated with a new approach to supply chain-wide planning. The shared database provides a basis on which a consistent demand forecast for a whole supply chain is created. Thus, the second aspect of the SCRP scenario, a shared sales forecast, is most usefully compared to the CPFR scenario. Both scenarios aim at integrating demand forecasting at the supply chain level. In the CPFR scenario, the planners of the involved companies jointly develop a sales forecast. In contrast, in the SCRP scenario, a third party provides a demand forecast for all participants in a process described in more detail in Section 5. Thus, the SCRP scenario promises significant benefits through better coordination across a whole supply chain, which is analogous to the CPFR scenario.

In contrast to hierarchically integrated supply chains, companies in the SCRP scenario retain full autonomy over resource allocation decisions. In hierarchically integrated supply chains, a central authority creates a demand forecast and plans resources across the whole supply chain accordingly. Input and output quantities are assigned to each company or subsidiary. In the SCRP scenario, a third party creates a shared sales forecast, which companies use as an input into their own planning process. In turn, their planning data feed into preparation of the demand forecast. In contrast to the CPFR scenario, a large number of companies will be involved, including competitors. Moreover, in the CPFR scenario, demand planning is done collaboratively; that is, all involved parties combine their views and attempt to achieve a consensus view. In contrast, in the SCRP scenario, the demand forecast is created by a third party, based on inventory, order, and plan data of participating companies, and broadcast to all participants in the system. Table 2 highlights the differences between the CPFR and SCRP scenarios.

Table 2: Comparison of the CPRF and SCRP Scenarios

	CPFR	SCRP
Business data are managed by ...	... supply chain companies	... a third party
Data integration is achieved through ...	... electronic data exchange between corporate enterprise systems	... a shared data base across the whole supply chain
Production planning is based on ...	... corporate demand forecasting, amended through collaborative planning rounds	... demand forecast prepared by a third party and distributed across the whole supply chain

In sum, the SCRP scenario involves cooperation among companies related through customer-supplier and competitive relationships for which a shared demand forecast is developed in an iterative process. Thus, extensive industry-wide coordination takes place, including explicit coordination among competitors, which is only possible in a scenario in which regulators have adopted a more friendly stance towards such cooperation. The scenario is further based on a shared data architecture that enables and facilitates this iterative planning process. This requires that companies have entrusted their data and the management of their systems to an external service provider (i.e. external provisioning of corporate computing resources has become an accepted mode of operating corporate computing resources). In Section 5, we describe this scenario in more detail.

V. IMPLEMENTING SCRP

So far, we use the term “SCRP” as a designation for one of our scenarios. In doing so, we foreshadow and outline an SCRP system architecture that we now make more concrete by describing a possible process of implementing such a system. An SCRP system is an instance of an enterprise system feasible in an SCRP scenario. We have also referred to a third party that maintains the common database and prepares demand forecasts to be shared across the whole supply chain. We designate this third party as an SCRP agency but, in this section, refer to it only in functional terms. In Section 6, we further elaborate on the governance structure of that agency.

We use a distinction between three different types of business data as our main, admittedly highly simplified, analytical tool: order/delivery data, inventory data, and production and distribution plan data. Implementing an SCRP system can then be thought of as proceeding in three stages, with each stage sharing one more data type. Thus, the first implementation stage consists of sharing order/delivery data across the whole supply chain, the second of sharing inventory data, and the final one of sharing production and distribution plan data.

Sharing order/delivery data across the supply chain suggests itself as a first stage of developing an SCRP system because companies often already engage in similar practices in the form of electronic data interchange (EDI). While the Internet provides a basic means of exchanging such data, companies still frequently rely on so-called value added network services (VANs) to provide additional security, traceability, and accountability (Wareham, Rai, & Pickering, 2005). Thus, order and delivery data are often already stored in the systems of VAN providers, albeit only temporarily. Using such data for creating demand forecasts therefore may appear as a natural extension of these practices, provided that suitable measures against misuse and theft of these data have been adopted, an issue which we address in Section 6. Moreover, in the absence of suitable external data, companies usually rely on order data for estimating future demand volumes, which Lee et al. (1997) have identified as a major source for increased turbulence in supply chains (see Section 2). By sharing order and delivery data at the level of a supply chain, demand forecasts can be significantly improved (Lee et al., 1997). Demand forecasts are prepared by the SCRP agency for each supply chain stage and shared across the whole supply chain. Thus, companies will not create their own demand forecasts, but will still have to decide which share of the predicted demand they intend to fulfill in view of their competitive situation and strategy. In the rather unlikely case that each supply chain stage comprises only one company, the forecast demand is identical with the total demand that each supply chain company needs to fulfill. In any case, companies will have to prepare a sales plan that reflects that company’s competitive situation and strategy and the predicted demand.

In the second stage, the SCRP agency manages all inventory data in the supply chain (in addition to order and delivery data, both of which are used as an extended basis for creating demand forecasts). Inventory data can actually be built from delivery data collected over a sufficiently long period of time. A delivery can be seen as a deduction of the supplier's inventory and a corresponding increase in the customer's inventory. Thus, adding inventory data to the SCRP system seems to be a natural second step. Availability of inventory data to the SCRP agency helps to improve the accuracy of demand forecasts because inventory data can be used as a gauge to assess the effects of competitive strategies that are manifest in order data. For example, aggressive pricing may result in increased order volumes because companies may be led to overstock because they perceive lower prices as temporary. Conversely, artificially bloated orders resulting from supply bottlenecks can be more easily detected. Both these effects significantly contribute to the bullwhip effect (Lee et al., 1997).

In the final stage, data about production and distribution plans will be integrated into the SCRP system, which, again, extends the basis on which demand forecasts are created. It is possible that production plan data will be extracted from existing ERP systems to be automatically processed into the SCRP system. This allows for the parallel existence of ERP and SCRP systems. The SCRP agency may then begin to offer ERP software as a service, initially by offering advanced or industry-specific functions not available in standard ERP systems. Such a trajectory may allow companies to gradually migrate their data and IS functionality to the SCRP system. The availability of production plan data in the SCRP system makes an iterative planning and forecasting approach feasible. Specifically, participants can adjust their production plans based on demand forecasts. The forecasts prepared by the SCRP agency may then, in turn, be updated according to the modified production plan data. These iterations can be continued until demand forecasts and production plans have sufficiently converged. Table 3 synthesizes the three implementation stages discussed so far.

Table 3: Possible Gradual Implementation of an SCRP System

	Role of SCRP agency	Enabling condition	Unresolved problem
1st stage	Prepares demand forecast based on order/delivery data	Electronic order/ delivery data are already sent through a third party	Order/delivery data do not fully reflect actual demand situation
2nd stage	Prepares demand forecast based on order and inventory data	Inventory data can be cumulatively built from order data	Plan data are not considered in demand forecast
3rd stage	Prepares demand forecast based on order, inventory, and production plan data	Production plan data are extracted from ERP systems; ERP functionality is complemented by SCRP system	Iterative planning and forecasting process may not lead to convergence

For illustrative purposes, we can further elaborate the working principles of an SCRP system as outlined above by comparing them to those prevalent in the CPFR scenario on the one hand, and to those prevalent in hierarchically integrated supply chains on the other. In contrast to the CPFR scenario, demand forecasts are not created collaboratively but through a third party. Moreover, this third party, the SCRP agency, has real-time access to business data that document resource commitments made by member companies, while, in the CPFR scenario, this common data basis has to be created ex post after resource allocation decisions have been made in (company-level) ERP systems. Further, and in contrast to the highest maturity level presented in VICS (2010), the SCRP scenario does not assume that member companies engage in joint financial planning nor that they need to coordinate their resource allocation decisions directly. Rather, such coordination comes about through multiple planning rounds that are moderated by the SCRP agency. A third critical difference with the CPFR scenario is that the number of companies involved is much higher in the SCRP scenario and involves both competitive and collaborative relationships. In contrast, the CPFR scenario is generally limited to cooperation between companies that occupy adjacent positions on a supply chain, with typically not more than two companies involved in the arrangement.

A crucial difference with a vertically integrated firm is that the SCRP agency has no goal of maximizing profit across the whole supply chain. Rather, financial planning remains strictly bounded by company boundaries, while the SCRP agency aims to stabilize expectations about total demand across the whole supply chain and facilitates the coordination of resource allocation decisions under the constraints of—company-wide—profit maximization. Moreover, the SCRP scenario implies a higher level of supply chain wide integration because, ideally, there is only one SCRP agency for every industry (which we describe in Section 6), while there will be several competing hierarchically integrated supply chains in the latter scenario among which no explicit coordination will take place.

VI. GOVERNANCE OF SCRP SYSTEMS

So far, we describe SCRP systems as one possible solution to the increasing turbulence in supply chains that may arise in a scenario characterized by the broad acceptance of external provisioning of corporate computing resources and a friendly stance towards industry-wide explicit coordination that includes cooperation among competitors. From an economic perspective, the costs of such systems need to be addressed, too. Since an SCRP system can be seen as a specific form of governance, we begin by analyzing the costs of SCRP systems from a transaction cost economic perspective, the predominant framework for studying governance structures.

Transaction costs arise because parties to a contract need to mutually guard against opportunistic behavior in the face of uncertainty (Williamson, 1987). The most extensively studied situation concerns the relationship between a customer and a supplier of a product, which is produced more efficiently if the supplier invests in specialized equipment or other forms of assets, the value of which is tied to the identity of the customer, a property called asset specificity (Williamson, 1987). Thus, the customer can threaten to sever the relationship in order to obtain a better price once the supplier has made the investment. Various solutions are offered by transaction cost economics including safeguards, dedicated governance structures such as arbitration arrangements, and unified ownership (Williamson, 1987). An SCRP system is similarly exposed to the threat of opportunistic behavior predominantly by the SCRP agency on the one hand and the participants in (users of) the system on the other hand.

One source of transaction costs through opportunistic behavior arises from the handing over of systems operation to a third party. For example, the third party may fail to properly protect the data of the participating companies against misuse and theft or it may fail to update system functionality according to the requirements of the participating companies. Both problems arise because neither data nor software are sufficiently standardized to allow for easy switching between vendors or service providers. Such problems, however, have been addressed in the outsourcing literature (Swann, 2010; Aubert, Rivard, & Patry, 2004). In addition, operation of the SCRP system is now under control of the SCRP agency that provides additional services at the supply chain level; namely, the preparation of demand forecasts derived from data available in the SCRP system. This effectively locks participants into a fixed relationship with a particular SCRP agency since switching to another SCRP agency is now hampered not only by proprietary data formats and software but also by the need for tightly coordinated action among all participants who would have to switch simultaneously.

One feasible way to guard against this threat appears to be unified ownership. To be consistent with the SCRP scenario, unified ownership implies that the SCRP agency is jointly owned by the participants of the system; in contrast, if participants are owned by a central authority the autonomy of participating companies is destroyed, which is characteristic of the hierarchically integrated supply chain scenario. Thus, the SCRP agency needs to be owned and governed by its members to guard against the SCRP agency's opportunistic behavior and to be consistent with the very concept of an SCRP system. This is, in fact, the solution that Trist (1983) proposes for organizing collective action in turbulent fields, which he calls a referent organization. The most critical aspect of the referent organization is that it is governed by its stakeholders. It establishes a domain of common concern through appreciative acts, described as "a complex perceptual and conceptual process which melds together judgments of reality and judgments of value" (Trist, 1983, p. 273). While the concept of a referent organization requires that member organizations surrender portions of their decision making authority to the referent organization, it does not display a hierarchical structure; rather, order emerges through mutual adjustment of the stakeholders (Trist, 1983, p. 271). Trist further describes the referent organization as a "different logical type" based on a shared understanding of the need for collaboration and "adaptive cultivation of interdependence" (Trist, 1983, p. 273). The referent organization has three functions; namely, regulation, appreciation, and infrastructure support; the latter includes information sharing (Trist, 1983, p. 275). Moreover, Trist sees "interactive planning" as an extension of the regulation function.

This description seems to offer a good fit with our concept of an SCRP system, which is based on cooperation among a large number of companies, some of which are competitors who agree that such cooperation is required to stabilize their increasingly volatile environment (i.e., come together in a joint act of appreciation). They stabilize the environment through a joint, iterative, and interactive planning process that involves both regulatory and information sharing elements. Therefore, we propose that the concept of the SCRP system can be seen as an instance of a referent organization described by Trist (1983), just as we propose that the bullwhip effect can be seen as an instance of a turbulent field in Section 2.

Trist (1983) distinguishes referent organizations along four dichotomies: constituent/representative, emergent/established, voluntary/mandated, and single/multiple. A constituent referent organization is formed by an existing member of the domain, whereas a representative form is specifically created by the members. Established referent organizations tend to focus on preserving certain practices, while emergent forms are more future oriented; there might be cases in which a referent organization is mandated (e.g., in the field of healthcare), while most forms are based on voluntary membership; finally, occurrence of more than one referent organization in a domain indicates that the domain has not yet settled and is without a clear normative orientation.

We propose that the ideal form for an SCRP agency is a referent organization that is representative, voluntary, emergent, and singly occupies a particular supply chain as a domain. A constituent referent organization will tend to evolve into a (quasi-) integrated supply chain because a single company will organize and regulate information systems and operational processes across the whole supply chain and thus undermine the autonomy of participant companies. In contrast, a representative form requires that specific membership rights and obligations are specified, which is an occasion to clarify potentially contentious issues or, alternatively, to establish procedures for how to deal with conflicts as they arise. Specifically, a referent organization explicitly addresses normative issues such that the identity of member organizations is preserved and the type of aspired behavior in the domain is defined. The SCRP agency should also be based on voluntary membership because, otherwise, incentives for rent seeking in the organization may undermine its beneficial effect (Milgrom & Roberts, 1990). Because the SCRP agency addresses novel problems, it should not be created through extending established organizations such as trade associations who often have a conservative, status-quo-preserving agenda. Finally, it is desirable that a single SCRP agency exists for a particular supply chain (i.e. for all companies that contribute to a product or service in a clearly defined and bounded market). In contrast, the co-existence of multiple SCRP agencies in a single industry would severely limit the potential for providing a reliable planning framework and may even contribute to the turbulence in the field through undesired interactions between the several agencies who are likely to compete for members. Table 4 summarizes this characterization of an SCRP agency.

Table 4: Ideal Properties of an SCRP Agency

Possible characteristic of referent organization		SCRP agency should be ...
Constituent (existing member of the domain becomes the referent organization)	Representative (referent organization specifically created by the members)	... *representative* to avoid being dominated by one supply chain company
Emergent	Established	... *emergent* to avoid that it preserves existing practices
Voluntary	Mandated	... *voluntary* to avoid that it is manipulated through rent seeking
Single (only one referent organization per domain)	Multiple (several referent organization per domain)	... *single* to ensure that demand forecasts are complete

While an SCRP agency that conforms to these recommendations seems likely to address the governance problems inherent in the SCRP concept, successfully creating and operating of an SCRP system is by no means guaranteed, even under the favorable conditions associated with our SCRP scenario, friendly attitude towards industry-wide coordination, and broad acceptance of external provisioning of corporate computing resources. In other words, the SCRP scenario provides the necessary conditions for an SCRP system to emerge but is, in itself, not a sufficient condition. Specifically, there are significant costs, uncertainties, and complexities associated with creating an SCRP system. On the one hand, there are significant costs associated with running an SCRP agency. These include costs through opportunistic behavior that may be minimized but cannot be completely eliminated through an appropriate governance structure. Next, the management of an SCRP agency itself requires resources that will have to be provided by member organizations. Finally, the surrender of sovereignty with regard to demand forecasting may impose significant opportunity costs especially for those potential members who have developed sophisticated systems for demand forecasting that afford a competitive advantage.

These costs have to be compensated for through the benefits made possible by an SCRP system, which mainly consist of stabilizing the environment and thus allowing for better matching of supply and demand, which, in turn, lead to reduced waste and fewer lost opportunities. Evaluating the overall benefits against the total costs of an SCRP system will not be easy. Moreover, the net benefit of participating in an SCRP system will vary across companies so that participation may seem worthwhile for some members of a supply chain but not for others. Complicating matters, the potential benefits offered by the system will increase with the number of participants, which causes complex problems of collective action even before the SCRP agency is available to coordinate collective action at the domain level. Thus, the SCRP agency may remain elusive even in cases in which, individually, net benefits of the SCRP agency would be positive for all potential participants. We address some of these issues in Section 7, in which we will outline promising areas for future research.

VII. DISCUSSION AND CONCLUSION

In this paper, we envision one possible future of corporate information infrastructures by using the scenario approach that Gray and Hovav (1999, 2007) introduced into the IS field. Among four scenarios, we focus on one scenario, called the SCRP scenario, which is characterized by a significantly more friendly stance towards industry-wide coordination, and which includes cooperation among competitors and the broad acceptance of the external provisioning of corporate computing resources. We envision that, in this scenario, a novel way to manage enterprise data and processes and supply chain-wide resource planning will become feasible. Specifically, all corporate data and information systems will be hosted as a service that facilitates much tighter integration of data and processes across a whole supply chain, similar to the benefits of data and process integration at the company level enabled by enterprise resource planning systems. Moreover, based on the central availability of such integrated data, a new planning approach will become possible, which aims to provide a shared demand forecast across a whole supply chain and thus significantly stabilize the planning environment for company-wide resource planning. In an advanced stage, supply chain-wide demand forecasting and company-wide resource planning are integrated in an iterative and interactive planning process. The overall objective of such a system is to stabilize increasingly volatile supply chains whereby this increased volatility results from the interactions of the supply chain companies itself. By embedding these interactions in a structured and controlled process that works at the supply chain level, this volatility is significantly reduced. A supply chain resource planning system will have to be governed by a stakeholder-owned organization, similar to the concept of the referent organization that Trist (1983) describes, which effectively addresses the problem of opportunistic behavior among participants and by the SCRP agency. Yet, the balance of potential costs and benefits of such as system will vary across industries and national contexts so that its emergence cannot be taken for granted. Moreover, creation of such a system has to overcome tricky problems of collective action, which may result in the failure of creating such a system.

In this paper, we broadly outline the SCRP system, but the concept needs to be worked out in much greater detail before it can be considered for implementation in practice. We hope to encourage other researchers to comment on, critique, and extend the concept in a joint academic effort so that we can determine whether this concept is feasible and viable. Concluding our paper, we present four problems that we deem to be especially promising for future research about SCRP systems.

The first concerns the problem of firms that operate in multiple supply chains. If they want to move from ERP to SCRP systems, they would have to use multiple SCRP systems, too. Thus, better integrating data and processes at the supply chain-level would go hand in hand with fragmented data and information systems at the company level. One possible solution to this problem is that such companies continue to operate ERP systems in parallel to their participation in an SCRP system. We describe this possibility in Section 5, where we show that this is a feasible solution if SCRP and ERP systems are integrated. While such integration may require the development of various interfaces, data-mapping tools, and so on, such bilateral integration is already wide-spread in existing supply chains when (usually weaker) supply chain companies are asked to support system interface and data standards used by their more powerful customers (Webster, 1995; Reekers & Smithson, 1996; Gerst & Bunduchi, 2005). As there are potentially fewer supply chains than supply chain partners with whom a particular firm will have to build such interfaces, participation in SCRP systems might still be preferable even when companies continue to operate internal ERP systems.

From a more theoretical perspective, however, an interesting question concerns the boundaries of companies. So far, organizational theory still maintains the idea that companies have a clearly defined boundary. To cope with exposure to multiple, often conflicting environmental demands, companies have developed complex organizational structures and processes such as the M-form (the multi-divisional firm) and matrix structures (Chandler, 1980; Galbraith, 1971). How will companies be structured in the future when the requirements for supply chain-wide coordination have grown much more demanding? The invention of the M-form indicates a significant loosening up of internal processes and structures such that divisions can respond more freely to market demands. Corporate units regulate the behavior of divisions mostly by setting standards and supervising financial performance. Participation in an SCRP system will add a further layer of complexity. How will regulation through corporate headquarters and SCRP agencies be aligned with each other? Is such alignment possible at all or will one have to yield?

A second promising area for future research concerns normative theory. Participating in an SCRP system requires that companies make a difficult decision by trading off possible gains resulting from better supply chain management and possibly lower costs of systems operation against the costs of participation. While there is a substantive literature on the possible gains of better supply chain management, often framed in terms of the “value of information sharing” (Lee, So, & Tang, 2000; Cachon & Fisher, 2000; Lee, Pak, & Lee, 2004), and on the potential gains of external provisioning of corporate computing resources (Boillat & Legner, 2013), the literature on which one can draw to estimate the costs of participation in an SCRP system is much more limited. These costs include the relatively more limited control firms have over the design and operation of essential information systems and the costs associated with the surrender of aspects of planning authority to the SCRP agency. While the former type of cost is, to some extent, addressed in the literature on IT outsourcing (Ketler & Walstrom, 1993; Aubert, Patry, & Rivard 1998; Aubert et al., 2004; Chow et al., 2009), the latter poses an open research problem. Some studies have addressed the relationship between companies and industry associations (Eising, 2004; Astley & Fombrun, 1983; Pfeffer & Salancik, 1978). But there are no normative models available that guide companies in making the decision to join such collective self-regulatory initiatives. Some ideas may be drawn from the literature on standardization processes (Reimers & Li, 2005). Another possible source of inspiration is the team theory of the firm that, from a strictly rational behavior perspective, explains the emergence of a firm as an act of self-regulation among a team of co-workers (Marshak & Radner, 1972). However, to be practically useful, a normative theory addressing voluntary surrender of decision making autonomy would probably have to be more specific. For example, it would have to cope with the increased complexity that results from delegating the task of predicting demand to a collective body: what are the risks associated with such delegation? What new capabilities and resources are required if companies engage in collective forms of supply chain planning? How do the costs of participation in collective supply chain planning vary with company size, supply chain position and other company characteristics? How does the design of the SCRP agency, especially members' rights and obligations, affect the costs of participation?

A third promising area for future research concerns the operational aspects of an SCRP system, especially with regard to the iterative planning approach that we describe in this paper. The underlying theoretical problem concerns the integration of two planning levels: the enterprise and the supply chain level (Stadler, 2005). Current approaches for solving the problem either rely on privileging one level over the other or on simultaneously addressing both planning levels by combining enterprise-level and supply chain-level planning into one process (VICS, 2010). In contrast, the planning approach that we outline in this paper proposes an iterative coupling of these two levels. Supply chain-level demand forecasts are shared across the whole supply chain, which may lead to adjustment of enterprise-level production plans. These are then fed back into the supply chain-level forecasting process and so forth. We have optimistically suggested that such iterations are continued until both enterprise- and supply chain-level planning processes have sufficiently converged. However, it is not clear what that means in practical terms; specifically, what constitutes a sufficient degree of convergence is not clear. Moreover, it is also an open question whether, indeed, these two processes will converge under all conditions. Thus, addressing this two-level planning process would seem to be a practically relevant and theoretically interesting field for future research.

A fourth promising area for future research concerns the influence of institutional structures on the feasibility of implementing the SCRP scenario. While we have considered the stance of regulators towards industry-wide coordination as one of our two major drivers, we have not considered possible problems of collective action at the industry level because such problems are likely to vary across industries and national contexts. Specifically, the latter issue seems to be an interesting and relevant problem for further exploration. For example, the willingness of firms to surrender aspects of their planning authority to a third party may be related to aspects of national culture, such as the acceptance of relatively greater power asymmetries (Hofstede, 1991). In the same vein, so-called "collectivism" as a trait of national culture (Hofstede, 1991) may positively or negatively influence the ability to act collectively at the industry level to establish SCRP systems (Manske & Moon, 2005). Similarly, the move to an SCRP scenario may threaten valued bilateral relationship and thus be opposed on these grounds (Hsiao, 2001; Marble & Lu, 2007; Martinsons, 2008). Another possible influence may be related to a preference for or against the use of intermediaries. Because the SCRP scenario requires the establishment of a new type of intermediary, a preference of the use of intermediaries may positively affect the likelihood of implementing the SCRP scenario. For example, Martinsons (2002) has argued that adopting electronic business in a Chinese context is shaped by intermediaries.

Finally, we should note our paper's possible research problems. Counterfactually, our scenario approach implicitly includes the solutions to these problems, but we need to specifically address them in order to implement the SCRP scenario. Regarding the lock-in problem, our scenario assumes that appropriate solutions to the problem of vendor lock-in have been found (e.g., in the form of wide-spread data and software standards, so that companies can relatively easily switch between vendors). Otherwise, it is unlikely that the external provisioning of corporate computing resources will be broadly accepted as our scenario assumes. Similarly, legal problems resulting from cooperation among competitors are unlikely to be as constraining as in today's business environment because regulators will be much more welcoming towards industry-wide coordination. However, SCRP agencies are likely to become very powerful organizations, comparable to credit card organizations, which were often founded by banks to serve a collective operational need and who are now known for some heavy handed practices against banks and merchants, and it is not clear what appropriate means are available to prevent misuse of such power outside the realm of anti-trust law. Lastly, we assume that the scope of an SCRP system can be clearly delineated. However, supply chain structures are likely to overlap and to vary over time. Thus, in order to realize the SCRP scenario, it will become necessary to develop a boundary criterion that helps managers and entrepreneurs to define efficient or, at least, feasible system boundaries.

ACKNOWLEDGMENTS

This research has been supported by the National Natural Science Foundation of China (grant numbers 71110107027 and 70972029).

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Communications of the Association for Information Systems

ISSN: 1529-3181