Cooperative Advantage and Vertical Information System Standards: An Automotive Supply Chain Case Study

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Abstract
Development, implementation, and effective use of interorganizational information systems (IOS) remain an elusive goal for many companies, despite growing complexity in supply chains and evidence that the lack of interoperable information systems results in enormous costs. We use the both collective action theory and a pie sharing framework interfirm collaboration to explore potential factors influencing adoption of industry standard IOS. We present an in-depth automotive industry case analysis that highlights explanations for difficulties in achieving acceptance of proprietary IOS within an auto supply chain, as well as the potential benefits of using an industry standard approach. Our case analysis suggests that an auto manufacturer-centric approach with a focus on information systems as a source of competitive advantage, will likely fail to achieve either private or collective benefits. Evidence from a pilot study of a new standards-based effort suggests that a cooperative approach to IOS in the supply chain may have a better chance to enhance prospects for both firm and industry profitability. We conclude with a series of propositions to guide future research on adoption of industry wide IOS standards.

1. Introduction
An enduring narrative in the information systems (IS) literature emphasizes the role of information technologies as a tool for competitive advantage, especially when used to connect with external stakeholders such as suppliers and customers via interorganizational information systems (IOS) in order to reduce the costs of transactions (Bharua et al., 2004; Clemons, 1986; Porter & Millar, 1985). Although this narrative has been under considerable scrutiny by those who see information technologies as commodities that are easily obtained and copied (Carr, 2003), the many cases in which information system innovations have enabled dramatic improvements for companies – either in terms of cost reductions or the differentiation they help achieve in products and services – suggests continued growth in efforts to implement IOS.

Despite noteworthy successes, many companies have not achieved the full potential of IOS (Markus, 2005). Markus (2005) observes that less than successful IOS implementations often include only a subset of trading partners, usually the largest ones, and even then only for a limited set of business transactions. In some cases, this may be due to the complexity of IOS technologies, such as EDI.

Many analysts believe that the additional benefits to be gained from expanding the deployment of IOS are vast. A 2004 US National Institute of Standards and Technology (NIST) report documented huge opportunity costs associated with inadequate IOS in the automotive and electronics industries: “We estimate the total annual costs of inadequacies in supply chain infrastructures to be in excess of $5 billion for the automotive industry, and almost $3.9 billion for the electronics industry. These figures represent about 1.2% of the value of shipments in each industry.” (White, O’Connor & Rowe, 2004, p. ES-1).

Emerging technical and industry developments such as XML, web services, and standardization efforts like RosettaNet promise to reduce the costs of IOS, thereby potentially enabling use of IOS to be expanded to new partners and transactions, enhancing IOS benefits (Markus, Steinfield, Wigand & Minton, 2006). Standards-based IOSs may offer an alternative approach to achieving widespread interoperability across trading partners, although successful diffusion of standards once developed is by no means guaranteed (Markus et al, 2006).

In this paper, we explore the juxtaposition of these trends – the vast potential savings from IOS implementation among a larger share of trading partners, the lack of success that many companies have experienced in the past, and the emergence of industry-wide IS and IT-enabled business process standards efforts using lower cost Internet technologies – within the context of an automotive industry supply chain case study. In particular, we ask why past efforts at implementing IOS in one automotive manufacturer's supply chain have not succeeded, and investigate a promising new approach.
for IOS implementation that has important lessons for information systems theorists as well as management executives.

2. Conceptual Framework

Strategic and operational benefits of interorganizational systems (IOS) and electronic data interchange (EDI) have been observed in companies such as McKesson (Clemons & Row, 1988), Baxter (Short & Venkatraman, 1992), Brun Passot (Jelassi & Figon, 1994), Chrysler (Mukhopadhyay, Kekre, & Kalathur, 1995), Japan Airlines (Chatfield & Bjorn-Andersen, 1997), FedEx (Williams & Frolick, 2001), Sabre (Christiaanse & Venkatraman, 2002), and Enterprise Rent-a-Car (Premkumar, Richardson, & Zmud, 2004), among others. Survey research shows that IOS can benefit customers (Mukhopadhyay & Kekre, 2002) and suppliers (Lee, Clark, & Tam, 1999; Subramani, 2004). In addition, customer-side IOS initiatives have been shown to lead to better financial performance, and supplier-side initiatives support IOS on the customer side (Barua, Konana, & Whinston, 2004).

Despite these successes, many efforts to implement IOS yield little benefit. Segev, Porra, and Roldan (1997) noted that EDI has been adopted by only a tiny fraction of the world’s businesses. Few small organizations have adopted EDI, and usually only when required to do so by their partners (Iacovou, Benbasat, & Dexter, 1995; Tuunainen, 1998). Markus (2005) further argues that small organizations resist EDI because they generally do not benefit from its use. Reasons for this include 1) high costs, 2) few partners and transactions, mitigating potential savings, 3) a lack of knowledge as well as the resources to implement EDI, and 4) limited ability to reuse EDI investments with other partners, because of the lack of standards (Chen & Williams, 1998; McGrath & More, 2001; Tuunainen, 1998). Although EDI-over-Internet is bound to increase the use of EDI, web-based EDI is far from an ideal solution and is thus unlikely to catalyze widespread adoption of IOS (Beck & Weitzel, 2005; Juul, Andersen, & Korzen-Bohr, 2004).

The difficulties that companies have faced in including smaller trading partners into EDI-based IOS directs our attention to the incentives that organizations face in deciding whether to participate. As Clemons (1986) observed more than two decades ago, successful and sustainable IOS efforts are characterized by the fact that the trading partners of the firm driving system development experience strong gains from system use. As we show in our case study of efforts to integrate IOS throughout one automakers supply chain, this has not generally been the case in the past.

From a competitive advantage point of view, adopting a standards-based IOS can be thought of as inferior to implementing a proprietary system. By design, standards-based IOSs can be implemented by competitors, negating any competitive edge that the IOS may have brought to an adopting company. Using a resource-based view of the firm (Wernerfelt, 1984), the literature on collaborative advantage and pie sharing (Dyer & Singh, 1998; Jap, 1999; 2001) views the collaboration as a system that creates value that is difficult to imitate. This is because the unique combination of resources arising from the “idiosyncracies of the interfirm relationship,” along with the inability for competitors to observe the system, makes imitation difficult (Jap, 1999, p. 463). A proprietary IOS that is not observable by competitors would thus be more likely to provide competitive advantage than a standards-based one by this logic.

However, such an approach can also result in collective action problems (Markus et al., 2006), exposing the need for a multi-level perspective that examines the aggregate consequences of firm and dyadic level decisions. For example, if partners in dyadic collaborations implement proprietary IOS, then it is likely that firms will need multiple systems to the extent they must do business with partners outside the dyad. Then, the lack of integration across multiple systems can be costly, negating any benefits otherwise stemming from the adoption of a proprietary IOS.

Efforts by a dominant player to impose an IOS across a supply chain are unlikely to succeed, then, if supply chain partners need to engage in transactions with other buyers, as it creates inequities in benefits from investments. The focal manufacturer may benefit, but supply chain partners experience higher costs due to the need for multiple systems. Instead of expanding the benefit pie and encouraging collaboration (Jap, 1999), such an approach can result in asymmetric benefits and resistance by potential IOS partners (Markus, 2005).

Adopting an industry standard IOS gives firms a way out of this collective action dilemma. If the standard experiences widespread adoption, then it makes it easier to engage in electronic transactions with new trading partners. Even large manufacturers who may have the market power to impose IOS systems can benefit since the use of a standards-based IOS reduces resistance by smaller suppliers who do business with other buyers. Even though other competitors can potentially achieve the same
benefits, the resource-based view would still argue that competitive benefits may arise due to other idiosyncratic aspects of interfirm relationships (Jap, 1999). This integration of resource-based views on collaboration, competitive advantage perspective, and collective action theory leads to our fundamental research question:

RQ: Under what conditions will firms adopt industry standard interorganizational information systems as opposed to proprietary systems?

3. Methods

We explore our research question through a detailed case study of the development and implementation dynamics of an IOS standard within the automotive industry. In particular, we provide a brief history of efforts by one automotive manufacturer (we refer to as AutoInc) to connect electronically with its supply chain, and contrast these past efforts with new work being completed by the Automotive Industry Action Group (AIAG) to define standards for long distance automotive supply chains. AIAG is a not-for-profit industry association founded in 1982 whose members include automotive manufacturers, parts suppliers, technology vendors, and other service providers. Its charge is to promote standards development and harmonized business practices in the automotive industry (www.aiag.org). Our work with AIAG is one component of a project funded by NSF exploring the diffusion of industry-wide information systems standards.

Data sources for the study include a dozen in-depth interviews conducted with automotive industry and AIAG representatives starting in late 2007 and continuing into early 2010; essentially throughout the history of the AIAG standards-making effort. We also reviewed numerous documents provided by the AIAG working group as well as by other interviewees. Among the interviewees were a former director of logistics at AutoInc, several AIAG staff members working to support the standards effort, a representative from the Original Equipment Suppliers Association (OESA), the major association representing automotive industry suppliers, the CEO of a logistics software technology firm participating in the AIAG working group, and representatives from the National Institute of Standards and Technology collaborating on the AIAG effort.

All interviews were recorded and transcribed, and served to inform us of key events and insights regarding past and present efforts to establish an interconnected supply chain. Our analysis is based on a single case study, and we use it to help build theoretical insights for further empirical investigation. The historical comparison of past efforts by AutoInc to implement proprietary systems to current experiences participating in the development and pilot testing of an industry-standards based system are used to develop propositions to guide future research.

4. Case Results: Efforts to Implement IOS in the Long Distance Automotive Supply Chain

The specific focus of the AIAG effort we studied is on long distance supply chains, defined as supply chains that encompass overseas suppliers shipping parts to the automotive manufacturer via ocean freight. AIAG began the Materials Offshore Sourcing (MOSS) project in 2006 following requests from major manufacturers for help in improving communication efficiencies in their growing global supply chain.

4.1. The growing need for IOS in the global supply chain

Two detailed studies conducted by NIST researchers identified the costs arising from lack of adequate interoperability in data exchanges in the automotive supply chain. Brunnermeier & Martin (1999) initially estimated that the lack of such interoperability resulted in $1.05 billion in annual costs in the U.S. automotive sector. A later NIST study (White et al., 2004) found that the U.S. automotive sector wasted more than $5 billion annual due to shipment delays, order cancellations, and forecast revisions. Continuing reliance on the use of telephones, faxing, and email, manual rekeying of information from one entity to another, and the fact that trading partners each had their own proprietary information systems were considered the primary causes contributing to a lack of real time information sharing in the supply chain.

Further indicators of the scope of the problem were identified in survey of trans-ocean shipping practices in 210 companies commissioned by AIAG in 2005 and conducted by AMR (Comerford & Denno, 2007). Eighty-seven percent of the responding companies felt that they lacked visibility in the supply chain, while 91% reported problems emanating from use of phone, fax, and email. A full 79% reported rekeying shipment data multiple times into trading partners' proprietary systems. At the same time, reliance on overseas imports grew 52% in
the five years preceding the survey. In total, respondents estimated that 15% of in-bound shipments experienced delays due to incomplete data. As a result, respondents resorted to maintaining excess transit and safety stock inventory, and were forced to pay higher costs for expediting shipments when delays were intolerable. Incomplete information also put shipments out of compliance with U. S. Customs and Border Protection, leading to additional delays.

The increasing reliance on overseas imports presents a daunting problem for supply chain information systems integration. In addition to the challenges of lack of adequate data network infrastructure in some overseas locations, full integration is all the more difficult to the number of participants in any long distance supply chain. Participants can include the manufacturer, suppliers, third party logistics providers (3PLs), freight forwarders, customs brokers, customs agents, ocean carriers, and others. In AIAG research as part of their analysis for the MOSS project, they identified 30 different documents containing in excess of 400 data elements (AIAG, 2009). It is not surprising, then, that there was so much inefficiency in communications in global automotive supply chains. As stated by one interviewee:

"The more global you get, the more transparency you lose in your supply chain, and the more you don't know what's going on..." [AIAG representative, January, 2008].

4.2. Past efforts at IOS in the automotive supply chain

During the course of our case analysis, several major efforts by one automotive manufacturer (to establish electronic integration with its supply chain were described. Table 1 highlights four of these efforts, some of which were outright failures and others exhibiting modest success.

Interviews with suppliers as well as logistics managers underscored the difficulty of overcoming barriers to electronic integration in the supply chain. Autolnc's early failures in creating their own proprietary system were described by one interviewee as follows:

"[Autolnc] spent $5 million on [their system]. It was a point-to-point system designed to get the right data entered, but it was not truly end-to-end.”

"The costs were to be borne by all the users. Freight forwarders were asked to use system to enter their data, this was costly to them in terms of people and training -they asked for funding from [Autolnc] - didn’t get it so the system died in its tracks.” [Autolnc Logistics Director, October, 2009].

| Table 1. History of efforts by Autolnc at electronic integration of its supply chain |
|-----------------------------------------------|-----------------------------------------------|
| Early 1990s | Developed an in-house point to point system that required supply chain partners to enter data in the Autolnc system. It was resisted by supply chain partners due to high labor and training costs and failed. |
| Post (9/11) | Autolnc participates in the National Customs Automation Program (NCAP) and the Free and Secure Trade (FAST) initiative led by US Customs. Advance electronic shipping data shaved hours off truck transit time at Canadian and Mexican border crossings. |
| 2000 | Autolnc joins with other automotive manufacturers to create Covisint, a B2B electronic marketplace linking auto makers with suppliers. The marketplace fails in part because it is viewed by suppliers as a means of forcing down prices. |
| Early 2000s | Autolnc attempts to consolidate logistics with an outsourced solution, establishing a company in partnership with a global logistics provider. Ultimately, this effort does not yield expected benefits, and the logistics operation is reintegrated into the company in 2007. |

Sources: Interview with former director of Autolnc logistics, October, 2009 and Howard et al., (2003).

Another interviewee from the supplier's association underscored the difficulties in developing true electronic integration in the supply chain, noting:

"I think this kind of served to underscore the fact that developing standards, or harmonized standards, for electronic transactions in this industry is a huge challenge. I mean we saw a lot of plans fall apart and we saw a lot of companies waste a lot of money.” [OESA representative, October, 2007]

In addition, even when a system is implemented by mandate, adoption may be only superficial, as evidenced by this supplier's comment:

"I know a lot of people still who get the electronic stuff and they type it into their own Excel spreadsheets and they use that to run the manufacturing side of their
business.” [OESA representative, January, 2008].

Three common themes are evident in these earlier efforts. First, there are repeated instances of efforts to establish proprietary systems aimed at building a competitive advantage. It was not clear in these instances how supply chain partners benefited from use of the proprietary system. Here we are reminded of Clemons (1986) observation that unless all parties in an IOS benefit, it is not likely to yield a sustainable advantage. Second, in each effort, supply chain partners were not at all involved in the development of the system, diminishing the likelihood that it would adequately address any of their unique needs. Finally, in most cases, the method of promoting adoption of the system by supply chain partners was coercion, which has been shown to result in less than optimal interorganizational electronic exchange relationships (Hart & Saunders, 1997).

4.3. The Materials Off-Shore Sourcing Project: An alternative standards-based approach

In stark contrast to earlier, proprietary efforts, our case analysis revealed initial signs of success in a recent pilot implementation in one AutoInc supply chain using the MOSS standards developed in conjunction with AIAG and NIST. AutoInc joined with other manufacturers, IT and logistics service providers, suppliers, US customs representatives, and NIST to work on an industry-wide solution to the problem. Although results are preliminary, after conducting a pilot test in one AutoInc trade lane with a Korean supplier of battery parts, the supplier was not only willing to continue and extend the pilot program, it offered AutoInc improved terms of trade.

The MOSS project has progressed through several major stages, including analysis of baseline metrics, development of process diagrams and use cases, creation of data tables, a lab-based proof of concept, and the actual pilot test in a field setting. Following the pilot test, project leaders developed a detailed cost-benefit analysis, and are currently preparing a detailed set of implementation guidelines (AIAG, 2009).

Among the more interesting baseline metrics was a finding that helped to illustrate the potential payoffs from MOSS. In the 30 odd documents used for overseas shipments, 92% of the information contained in them is known at the start, while only 8% is generated en route (AIAG, 2009). Baseline data on average transit and dwell times at various points in the shipping process also helped to identify the potential savings that would result if elimination of data re-entry, and earlier provision of shipment data decreased dwell times (Table 2).

| Table 2. Baseline Measures of Transit and Dwell Times in Long Distance Supply Chains |
|-----------------------------|-----------------------------|
| Transit Route               | Days                       |
| Transit from supplier to consolidator | 3.78                      |
| Dwell at consolidator       | 7.38                       |
| Transit from consolidator to port of departure | 1.12                      |
| Dwell at port of departure  | 7.49                       |
| Transit from port to port   | 10.09                      |
| Dwell at port of entry      | 4.39                       |
| Transit from of entry to final destination | 4.62                      |
| **Total Transit Time**      | **36.02**                  |

15.8% of shipments took over 45 days
Range: 20 to 64 days

Source: AIAG. Based on 526 data points

The Proof of Concept was a lab test focusing on a subset of the full set of supply chain transactions that had been identified. The analysis focused on 75 data elements used between the supplier, 3PL, freight forwarder, ocean carrier, customs broker, and buyer. Approximately 80% of these items could be input once and reused in subsequent invoices and customs documents (AIAG, 2009).

In order to enhance visibility across the supply chain, the MOSS team made two technology decisions. First, they relied on UN eDocs – existing global EDI standards for invoices onto which the identified data elements were mapped. In order to minimize the cost and complexity of these EDI-based documents, the team decided on a cloud-based architecture with a “software as a service” (SaaS) solution (Figure 1). As each participant enters data, it instantly becomes available to the whole supply chain, depending on the business rules defined for each type of document. Each participant’s documents can then be pre-populated with previously entered data, and participants are notified when shipping events improving their ability to forecast shipment arrivals. Multiple software providers were included in project, and NIST developed conformance tests to ensure that any software was in compliance with the standard.
Figure 1. A cloud-based architecture for a supply chain IOS (Source: AIAG)

The vendor selected for the pilot test brought a unique approach to pricing of the project. They charged a fee only to the importer of the parts for use of the system – it was free for all the other parties. The following quote from the CEO of the software provider illustrates his rationale – that those who benefit the most should pay for the service:

“… our pricing model typically with our customers is based on a transaction fee. It will be free for [the different parties]. They will not be paying anything for that at all. …The benefit is to improve the [AutoInc] supply chain network, and today if there is any delay [AutoInc] will pay for any expedited service. [AutoInc] gets the benefit and should pay per transaction.” [CEO, Logistics Software Company, January, 2009].

Smaller companies in the supply chain can use a simple browser to access to data, or install a software client application, minimizing their costs for participation.

4.4. MOSS pilot results

From May to July 2009, a pilot study was conducted in a US-Korea trade lane. The pilot involved purchases of battery parts from a Korean supplier, which were shipped to a warehouse in Kansas City. This trade lane executed 1379 shipments worth $55 million. The scope of the pilot included ordering, transport, and customs processes, but not payment (AIAG, 2009). The MOSS system operated in parallel to the existing systems, enabling a comparison of system performance.

At the conclusion of the pilot, a detailed cost-benefit analysis was completed, estimating the potential savings that would have been realized had the MOSS trade collaboration system been deployed.

Among the key findings from the pilot was the fact that 100% of the data entered at the outset of a shipment was able to be reused at a later point. In contrast, using the current system, only 21% of the data was re-used. Nearly half of the data (49%) was entered more than twice during the shipping process by different parties.

The AIAG Cost Benefit Analysis (AIAG, 2009) provided a range of labor, time, and cost savings in the pilot. There were reductions in the number of tasks that needed to be performed from 26 to 9. A potential reduction in shipment dwell time at ports was estimated at 4.85 days. AIAG estimated that the buffer inventory needs could be reduced by 7 days. Based on this level of buffer inventory reduction, MOSS leaders estimated that .71% of the value of imports in this particular trade lane could be saved, which amounts to approximately $392,000 annually. They then extrapolated these savings to other trade lanes within the AutoInc organization, which led to an estimated annual savings of $50 million. Finally, the AIAG cost benefit analysis estimated that the entire industry could save $1.7 billion annually using the MOSS standards in their supply chains (AIAG, 2009).

Other benefits observed in the pilot included improved visibility, error detections, better conformance with new customs regulations, and efficient use of resources. The visibility in the supply chain allowed participants to engage in better planning and forecasting. Error detection was best illustrated by one event that took place during the pilot test. Workers at the receiving warehouse in Kansas City had long assumed that each pallet from the Korean supplier held 32 batteries, and reorders were made based on the assumed level of inventory in the warehouse. Only when they sent the faulty received shipment data via MOSS standardized documents back to the supplier were they made aware that, in fact, each pallet held 42 batteries. This error had led to a tremendous excess supply of batteries in the warehouse, estimated at 2 years' worth of supply by one interviewee (AutoInc Logistics Manager, October, 2009).

Because of the MOSS standard was designed with new US Customs and Border Protection rules in mind, shipment data in compliance with new security requirements was virtually guaranteed, eliminating costly delays at the port of entry. A quote from one of
the MOSS project participants who worked with a global logistics services company illustrates how customs regulations were baked into the standard:

“We are not going to get into making any recommendations to change any of the customs standards because it would take too long -- their messages are very stable. We are, however, building in ... customs initiatives, particularly the importer’s security filing...What the DHS and customs in the US is requiring is that every importation by ocean into the United States... that a security filing has to be received by customs 24 hours prior to the lading of the goods on the foreign vessel...We’re cognizant of that -- we’re building that into the MOSS solution.” [Global Logistics Services Company Representative and MOSS Participant, September, 2009]

A fourth set of benefits involved the ability of intermediate transportation providers to make more efficient use of their transportation assets. Because trucks and containers can be moved more quickly through the process, they can be redeployed for use with other customers to generate revenue.

As a result of the trial’s success, the battery supplier was enthusiastic about continuing with use of the MOSS standard, and even proposed new, more favorable payment terms to AutoInc. They offered to be paid on receipt of goods at the warehouse, rather than paid on shipment – terms that would result in improved cash flow for AutoInc.

5. Discussion

The MOSS approach shows great potential for solving the automotive industry’s supply chain visibility problem. How was this achieved, and why was the supplier response to the MOSS pilot so different from earlier efforts by AutoInc to establish an IOS with suppliers? What are its prospects for long term success? Our case study reveals a number of enabling factors in the MOSS approach that were not present in AutoInc's prior efforts to build an in-house system. We highlight insights suggested by this case below, followed by propositions that emerge from our discussion. We use these propositions to illustrate the value of the case for helping to build a theory of the adoption of industry-based IOS, derived from our collective action and pie sharing conceptual framework.

5.1. Broader participation by supply chain parties in system development managed by a neutral third party

Most of the participants in the supply chain do business with other buyers than AutoInc, and hence would be reluctant to invest in a system that only worked with one buyer. In addition, past efforts to build an in-house system and force suppliers to use it created trust problems. By outsourcing the development of a standard to a neutral third party, AIAG, which represents many different interests in the industry, some of these trust problems are mitigated, and AIAG and NIST participation added legitimacy to the effort. As stated by one of the MOSS participants working for a global logistics services company:

“But at an independent company, people are not going to change their system. It has to be an industry standard. That's why if it's published by AIAG, it's an industry standard now and individual companies will subscribe to that standard.” [Global Logistics Services Company Representative and MOSS Participant, September, 2009]

As noted in earlier studies of user-based standards development (Markus et al., 2006), including parties from across the chain of activities ensures that different types of users' needs are considered, so that the eventual standard stands a greater chance of benefiting each participant. This is a markedly different approach than former efforts to build competitive advantage through proprietary systems. Rather, cooperative advantage across the supply chain is stressed, yielding both private benefits to AutoInc and its partners, as well as providing the potential for public benefits to the industry at large. Prior attempts to coerce supply chain partners to use proprietary systems led to resistance and lack of use, depriving AutoInc of any private benefit.

The following propositions summarize the theoretical insights from this case study finding:

P1: To the extent that supply chains in an industry are interconnected (that is, suppliers to one buyer also supply other buyers), a standards-based IOS will experience less resistance to adoption by supply chain partners than a proprietary IOS.

P2: Standards-based IOS developed by a neutral third party in an industry will experience less resistance to adoption by supply chain partners than if developed by the dominant buyers in the industry.

P3: The greater the inclusion of supply chain participants in the standards development process, the
less the resistance to adoption to a standards-based IOS.

5.2. The choice of a "software as a service" solution with a pricing model that reflects the distribution of benefits arising from the IOS

A second major difference between the MOSS trial and AutoInc's prior IOS efforts is found in the technical design choices made by the working group. The decision to use a cloud-based, software as a service solution made it easier for the smaller and less technologically capable participants to participate in the IOS. This approach was chosen to purposefully minimize cost and complexity, as illustrated by the following quote from the software vendor:

“The real reason, besides cost, was just added complexity … How could you make not only that investment in the actual cost of the software and the transactions, but then the additional investment in the training, the additional investment in the time that it takes to do and maintain all that stuff?”

Additionally, the proposed pricing model further recognized the differing motives and incentives that IOS partners bring to a collaborative system. As noted by the interviewees, most of the benefit would accrue to AutoInc, mainly in the form of reduced delays and avoidance of expedited shipping costs. Hence, AutoInc incurs the fees, while the software service is free to the supply chain partners. In this way, the SaaS approach can help overcome problems arising from asymmetric incentives and resources among the different organizations in the supply chain. It also makes it easier for supply chain partners to rationalize using the new IOS even if they have legacy systems. The cost is not zero, since implementing any new system, even a software based service that is free, involves some costs such as training. However, the low cost, when combined with the fact that MOSS is an industry standard that increases the likelihood of being able to use the system with other buyers, may overcome the resistance that even free proprietary systems can generate.

This discussion can be summarized by the following propositions:

P4: Benefits from the use of an IOS in the supply chain are not evenly distributed across participants

P5: The more that costs of implementing an IOS in a supply chain reflect the distribution of benefits, such that those who benefit more, incur higher costs, the less the resistance to adopting an industry-standard IOS.

5.3. Prospects for later adoption are enhanced by steps taken in the standards development phase

Because true visibility in the supply chain can only be achieved when all participants adopt a common IOS, attention has to be paid to the prospects for widespread adoption. Achieving widespread adoption requires efforts that begin early in the development of the IOS, rather than waiting until after it is completed and rolled out to trading partners (Markus et al., 2006). The first step as noted above was clearly recognizing that an industry-standards approach would yield more success than a proprietary one. Once the decision to outsource system design to a neutral third party was made, the project attempted to incorporate a set of participants that reflected the eventual population of future adopters in the standards development effort.

Our case study revealed additional steps taken by the MOSS project that recognized that later adoption would be filtered through decisions by individuals, companies, and communities. More specifically, the development of the detailed cost benefit analysis appeared designed to give future adopters the ammunition needed to convince decision makers in their companies of the need to adopt. Among the mechanisms associated with adoption of innovations, one of the most powerful is social learning, where adopters view the successes achieved by comparable organizations and see how they can apply the innovation to their own organization (Rogers, 2995; Young, 2006). Relating the success stories, not only for AutoInc, but for the supplier and other channel partners promotes this social learning diffusion mechanism.

Another important step aimed at minimizing future adoption costs is the development of a best practices implementation guide that reflects a wide range of potential use cases (AIAG, 2009).

Finally, the publication of an open standard, the inclusion of multiple vendors in the standards-development effort, and the development of conformance testing all are designed to help to ensure that vendors have the ability to build the standard into their products and services. These steps can facilitate future adoption by ensuring adequate competition among vendors to avoid monopolization and high prices.

This discussion can be summarized by the following propositions:
P6: The more visible the successes from IOS implementation are, the more widespread the adoption.

P7: Low or near zero purchase prices for an IOS are necessary but not sufficient to stimulate adoption by supply chain participants. Reducing the organizational costs of implementation, including identification of use cases will improve adoption.

P8: The easier the standard is to incorporate into vendors’ software solutions, the greater the benefits in terms of price and features from competitive supply of standards-based IOS software.

6. Conclusions

Our case study of the MOSS project illustrates an alternative approach to the establishment of an IOS – in this case in an automotive supply chain. This alternative approach emphasizes cooperative development of a solution that enables a more equitable distribution of costs and benefits than former proprietary approaches imposed on supply chain participants. In particular, the standards-based approach is more likely to be adopted than proprietary solutions that impose costs onto supply chain partners for systems may not be used with other buyers.

Of course, such a cooperative approach involving a public standard implies that an individual company may not achieve the kind of sustainable competitive advantage that companies experienced in the past through proprietary systems that competitors are unable to copy. However, the case study suggests that past efforts by the focal firm in this study to achieve an IOS in the automotive supply chain also failed to provide any form of competitive advantage, since channel partners had few incentives to join.

The case study reveals many public and private benefits from the cooperative approach. It may also be that sustainable advantage can occur due to the unique complementary resources that adopting companies bring to the process – an outcome that would be consistent with resource-based views of information technology impacts on performance (Bharadwaj, 2000).

A single case study is not adequate to generalize these findings more broadly. However, it contributes to our development of propositions for further empirical testing, and for further developing theories that can explain the diffusion of vertical information system standards in particular contexts such as industry supply chains.

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8. References


