Process Integration and Web Services

A Case of Evolutional Development in a Supply Chain

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Abstract. Many situations of rapid emergence of a phenomenon are characterised by the fact that a lot of what is written and said is based on ideas, though the discussion may be flavoured by hype rather than anchored in reality - at least in the beginning. Still, there are also situations that constitute real changes. Extensive experiences from spare parts logistics at Volvo are the basis for an up-to-date view of development and use of web services.

This paper provides results and experiences from implementations of advanced web service solutions. The origin of these solutions is a desire to improve process integration between supply chain actors. Therefore, the context for business-to-business process integration between suppliers, manufacturers, dealers and customers is also presented. Focus is made on how the usage of IS/IT and management concepts can give extended reach and create closer customer relationships. It is an evolutional development that has often exploited existing strengths and timing of opportunities provided by linking technology and organisational conditions between different actors.

The case gives a perspective of Volvos global supply chain, aspects

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of its evolution and findings concerning timing, culture, installed base and stakeholder relations. The paper provides a general case to the discussion of process integration and in particular, it shares experiences and results from implementation of advanced web services.

Key words: process integration, web services, implementation, case, evolution, supply chain management

1 Introduction

New technology has always been used in order to achieve business impact, that is, to increase efficiency, enable strategic imperatives and extend reach and scope for products and services. At the same time new management concepts are continuously presented to achieve the same objectives. Some become larger in significance or faster in speed of change in the business context. Classical examples are the introduction of the power loom, the railroads, the telephone and the Internet as well as concepts and thoughts like Scientific Management, JIT (Just-in-Time), BPR (Business Process Re-engineering) and SCM (Supply Chain Management).

However, there are many situations with rapid emergence of a technology or management concept that are characterised by the fact that a lot of what is written and said is based on ideas, though the discussion may be flavoured by hype rather than anchored in reality—at least in the beginning. Still, there are also situations which constitute real business impact.

This paper focuses on process integration with development of web services in general and illustrates a case from spare parts logistics at Volvo in particular. It illustrates how the interplay between management and technological opportunities can be seen as an evolution within a large organisation. With in-depth experiences and results from the implementation of advanced web services two intertwined issues underlie this research:

- Characteristics of process integration
- Influence of the historical and concurrent context on the supply chain actors

The objective is to contribute to a better understanding of how development and usage of web services are placed into a practical context. This context can illustrate how prior integration efforts relate to each other and that it is not a case of ‘one solution for everything’. Furthermore, in order to enrich the case,

a historical background is provided. The background illuminates the influence of stakeholder relations and installed base. By sharing details and width the case presents how actors in the supply chain relate to each other and to the usage of web services, thus providing insights into current discussions in this area.

The paper will first introduce a view on technology and management, web services and spare parts logistics. Then the need for this research will be motivated and followed by a presentation of the research method. The case will initially provide a historical background that highlights parts of the evolution for integration. Then web service implementations will be discussed and analysed in relation to each actor in the supply chain. The paper ends with concluding remarks and further research.

1.1 Technology and Management

Current technology provides new possibilities for networks, the distribution of information and the design of business logic. An array of digital products and services is brought into the markets. This is combined with an increasing use of the Internet, more open standards and new mobile web technologies. The trends of globalisation and deregulation are equally important. The recent commercial behaviour has commonly been referred to as an era of "e-" where e-business, e-procurement and e-logistics often implie quite radical changes (Kalakota and Robinson 1999; Bayles 2001). Competition drives resource optimisation and standardisation for economies of scale on one hand. On the other hand, business innovation contributes to differentiation. Managers need to confront both of these and have to consider several critical factors, for example if new concepts and/or technologies can actually be utilised with effect or if they are more temporary (Holmqvist and Enquist 2003). This may be difficult since new trends and technologies are often presented with a lot of hype and simplifications, especially in terms of their implementation, e.g., BPR and PC-introduction (Strassman 1990; Hammer and Champy 1993).

Web services are currently being widely presented and to give a universal definition of web services is not easy. This paper draws upon the W3C technical reports from 2001 and joint presentations of Microsoft´s Bill Gates and IBM's Steve Mills (17 September 2003) where web services are used: "For specifically distributed services that process XML encoded SOAP messages, sent over HTTP, and described using Web Services Description Language (WSDL)" (Christensen et al. 2001; Ferguson et al. 2003). Though the objective of this paper is to share experiences rather than to sharpen technological

definitions, figure 1 below depicts a good view of current areas of interest for advanced web service development.

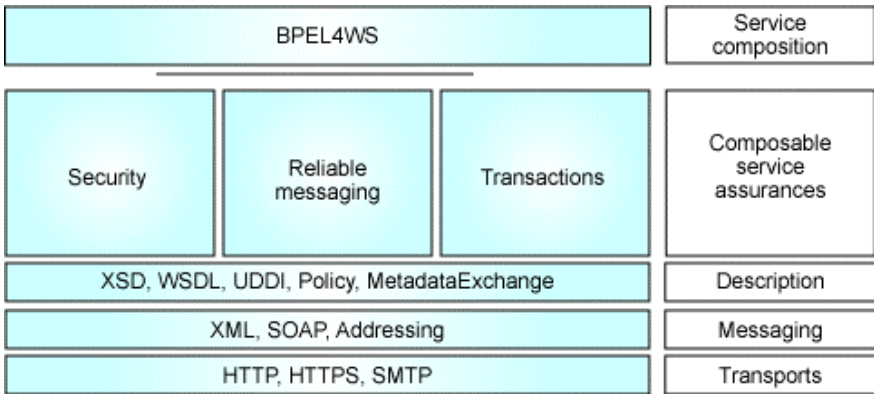

Figure 1. Web service groupings (Ferguson et al. 2003)

Web services deliver message interoperability and interface exchange. It may be simple, stand-alone connectivity or complex transaction chains that need to address security, reliability, versioning and business process activities. The composition of services provides interoperability between software components and support integration activities. In one way it is a collaborative result of underlying concepts that date back to the 1970s, when the thoughts of boundaries around software and providing access to that software only through well-defined interfaces arose (Jackson 2003). This concept of encapsulation can now use guidelines of web services to develop, deploy and maintain a service oriented architecture that fits in loosely coupled and ever changing business conditions.

Speed of change is important and Orlikowski (1993) discusses types of changes as: “Incremental change represents an extension of the status quo, that is, adjustments or refinements in current products, practices, relationships, skills and norms. ... Radical change goes beyond augmenting the status quo, requiring a shift to fundamentally different products, practices, relationships, skills and norms” (p. 331). In operations with an installed base of IS/IT-intensive operations, such as logistics, it takes time to change existing structures and it may be risky (Henderson and Venkatramen 1993; Lumsden 1998; Ciborra and Hanseth 1998; Holmqvist et al. 2001; Howard et al. 2001). Therefore, it is worthwhile to review events in this specific context in order to illustrate how management concepts and technologies have been applied.

1.2 Spare Parts Logistics

Large vehicle manufacturers have traditionally come to play a major role in the after market supply chain (Jones et al. 1990). The role originates from the control of product development and sourcing as well as influence upon the distribution network, dealers and customer offer. This has contributed to a two-fold perspective of Inbound and Outbound logistics and an urge to integrate partners along the value chain in order to reach efficiency (Porter 1985; Motwani et al. 2000). The vehicle manufacturer has led the development and been seen as the major hub of the supply chain—controlling the flow of goods, information and financials towards suppliers on one hand and towards customers on the other. Not least, the complexity of the products and a lack of information transparency have contributed to a situation with stable relationships between different actors in the supply chain (see figure 2).

From the perspective of the Vehicle manufacturer, the Parts manufacturer represents the supplier from which spare parts are bought. Equally, Dealers have been the actor that buys spare parts from the Vehicle manufacturer and then sells them on to vehicle owners. Therefore, vehicle manufacturers refer to vehicle owners and operators as End-Customers.

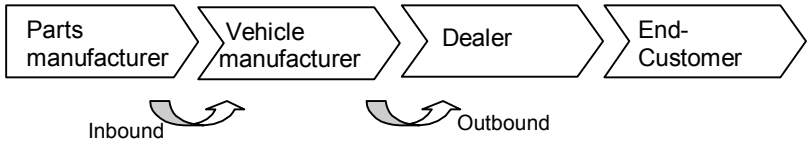

Figure 2. Current supply chain actors.

The fierce competition in the transport sector pushes business-to-business relations to focus on bottom-line results in a reality of diminishing margins. This at the same time as exploiting core competencies and finding new business propositions seem even more important. With high volume flows of physical goods as well as many stakeholders of information, logistics is by many means growing into one of the most complex business functions (Ericsson 2003; Lumsden 1998). The rise of the Supply Chain Management area, systems and consulting is one example of this development.

To out-line strategies which involve highly dynamic factors is difficult, management must often act in a situation where control of operations and technology is drifting (Ciborra 2000). Multiple interrelations on one hand and significant differences between actors on the other hand are a common situation in the field of logistics. ‘Agile logistics’ is a concept that has been used to

describe as a strategy to meet this situation by introducing some slack to increase flexibility (Christopher and Towill 2000; Ericsson 1996; 2003). In this sense there is a similarity and natural attraction to the loosely coupled architecture that surround web services.

1.3 Justifying a Practical Case

This paper is anchored in the business context of spare parts logistics at Volvo and one of its objectives is to describe the case environment. With results and experiences from the implementation of web services the importance of relationships between actors are highlighted. An extensive practical case may illustrate how both management and IS/IT issues as well as the operational context play an important role for integration. In many ways we need better explanations, as Monteiro states: "A more satisfactory account to the interwoven relationship between IT and organisational transformation is lacking. More specifically we need to learn, not just that this interplay exists, but how it works" (Monteiro 2000, p. 74). Most theoretical frameworks (independent of whether they contain detailed or broad argumentation) deal with issues like implementation or integration quite commonly without providing examples and insights from a context where these issues are confronted.

In a special edition of MIS Quarterly this discussion is highlighted at length and for example does Tom Davenport together with Lynne Markus argue that more case material is essential to make IS/IT research more accessible to professionals (Davenport and Markus 1999). There is little literature on IS/IT in logistics and even less in the field of spare parts, despite the facts that it constitutes a major share of transactions in the automotive industry (Tilanus 1997; Bayles 2001).

Actual implementation experiences and results from advanced web services are so far scarce. The commercial value and interest is vivid. An example is that IBM is using one of the implementation projects that is included in this research as a 'Case study' for Web Services as well as presenting it in the 'Company of the month' section[1]. Still, in many ways it presents a simplified and commercialised view of the objective, the implementation and not least the origin. This paper provides a background that may illuminate how recent results are part of an evolutionary development of integration while it also presents specific characteristics of web service implementation, for example where in the supply chain it can be most appropriate to develop web services.

1.4 Research Method

The Volvo case environment has characteristics in terms of size, scope and content to become relevant (Yin 2003). Through in-depth knowledge and open access the aim of this research is to share context in order to contribute to a discussion on IS/IT-management issues. The first author of this paper has an extensive background within Volvo and may thus enhance the relevance to practice. There is a main advantage to have extensive access to the case context, something that is crucial when studying complex situations that need comprehensive descriptions.

There are basically two parts of this research: one part provides a historical view of the development at Volvo from a perspective relating to IS/IT usage and process integration, and one part based on a case study that has been conducted in conjunction with specific implementation projects with web services.

The objective with the historical view is to share the context and show how general developments of IS/IT and management concepts have been applied by Volvo. This is made in alignment with the contextualisation principle of Klein and Myers: "The contextualisation principle requires that the subject matter be set in its social and historical context so that the intended audience can see how the current situation under investigation emerged" (Klein and Myers 1999, p. 73). The historical view was created through interviews and collaboration with six key people. All together these six people represent more than 200 man-years of Volvo experience.

They represent the management positions of: CIO, Warehousing, Strategic management, Distribution, Finance (four are today active, two are recently retired but active in teaching at the IT-University in Göteborg). Section 2 of this paper was, prior to submission, also 'proof-read' by these six people. There have been no objections, which would indicate that the description of the context environment would impact the research rigor, instead the objective is to enrich the case (Yin 1984; Applegate 1999). Furthermore, reviews of company documentation validate descriptions of especially ERP and Importer integration efforts, e.g. white books and operational guidelines.

The second part of this research concerns the study of four implementation projects:

1. Establishing platform and approaching Truck Dealers and End-Customers in selected European markets.
2. Refinements for Bus Key Customers and stand-alone Truck importers.
3. Developments for Truck Dealers and End-Customers in Asia and East Europe.

4. Single Order Interface for Construction Equipment Dealers.

The first specific web service implementation project for this case originated in late 2001 and the latest implementation (4th project) was deployed September 2003.

The methodology basically involves interpretive case study (Walsham 1995), where in-depth access to the case has been facilitated through the IS/IT manager position that the first author has at Volvo. Walsham has described how the topic of interest is in focus for exploration (In this paper: process integration and web services) and applies appropriate methods for conducting a research project based on this. In this case the data collection has mainly been carried out through observations, semi-structured interviews and workshops with stakeholders, decision makers and designers/developers.

All implementation projects have involved interviews with the Steering Group chairman, the Project Sponsor and the person in charge of the pilot site (these represent the CIO, the After Market management, the Dealer principal or equivalent). On several occations other representatives have been interviewed in order to include all supply chain actors. User feedback from each implementation project has been collected and analysed. As projects have been deployed, the first structured feedback has been conducted via a user satisfaction survey after three months and then continuously executed. Specific user interviews, phone interviews and user group workshops have been conducted (for example on: Access and Security with Single Sign-On and Application-to-Application services; Multi-language standards and Service design). Two master thesis studies have also contributed with user impressions from three of the projects.

It may be argued that case studies in general lacks replicability, that generalisations are difficult to make, that self-critisism is omitted and that the research rigor may be easy to question.

However, the main objective of this case is to increase the understanding of process integration and web service implementation by sharing experiences of a practical context. The research in this paper is based on collaborative involvement and together with a rigorous process the objective is to provide contributions to both organizational development and scientific knowledge (Braa and Vidgen 1999).

This paper will now provide a view of the evolution of integration through the Volvo spare parts supply chain. Thereafter, the paper presents current developments and web service implementations together with a discussion. The paper elaborates upon experiences and implementation results before concluding remarks are presented.

2 Case History: Evolution towards End-Customers

Volvo is a world-class provider of transport solutions, services and products. With global presence and sales exceeding 185bn Sek its more than 75.000 employees focus on business-to-business operations in the areas of Trucks, Buses, Construction Equipment, Marine Engines and Aerospace. Spare parts logistics is a complex operation characterised by intensive information exchange between several stakeholders, in the case of Volvo 1.000s of suppliers and 10.000s of distribution points towards 100.000s of end-customers. Every day ('365&24/7') around 70.000 order lines are handled towards more than 185 markets. The industrial product families contain 100.000s of parts, which demand both a long-term service responsibility and management of complicated supersession chains. The "parts" also increase in complexity, as they are no longer just physical but also digital as well as part of service arrangements and wider business solutions.

In many ways any case description of the context for global business-to-business spare parts logistics is doomed to be a shortcoming. Nevertheless, table 1 is just an initial view, while elaboration below may illustrate the continuous development of integration and expansion of operations.

	1970s	*1980s*	*Early 1990s*	*Late 1990s*
Example of change at Volvo	Automating stock control	Establishing market set-ups	Consolidating accounting	Reaching End-Customers
Base of change (Volvo/Actor)	Integration within Headquarter	Integration with Importers	Integration with Dealers	Integrated supply chain towards End-Customers
Volvo characteristics (change driver, culture and organisational focus)	Get statistics to secure quality, Central logistics function, Founder management	Growth and cooperation with Renault and others, Conglomerate business, Strong CEO	Consolidation, Back to core competence, EDI with suppliers, VMI with dealers	Merger expansions, Centres of excellence, Value added services

Table 1. Volvo historical case characteristics and context

Logistics focus	Production	JIT	3PL outsourcing	"e-logistics"
Management trends	Automation, origin in Scientific Management	Internationalisation and decentralisation	Business Process Reengineering	Globalise and customise SCM, CRM
Technology	Mainframe	Client/Server	ERP modules	www / "e"
Macro environment	Oil crisis, restrictions, GATT rise	Boom, deregulation, Japan productivity increase	Recession in estates, Europe's common market	Boom, Merger & Acquisitions, Innovation and mobile communications

Table 1. Volvo historical case characteristics and context

2.1 The Seventies

Volvo had more than 40 years of experience of manufacturing vehicles when, during the 1970s, the use of information systems started to evolve. The after market population, both in terms of population size and range, was considerable. Hence, as computerisation possibilities emerged, one of the first areas to reap benefits was the control of stock balances in order to maintain quality. The management was still much influenced by the two Swedish founders and managed from its original domains dominated by production facilities. A clear break-point for the development was the introduction of mainframe technology, however, limited to a certain area. What was really achieved was automation, instead of keeping logbooks, doing manual recounts, awaiting status etc the first computer could programmes released resources at the headquarter giving possibilities for further expansion and internationalisation.

A former CIO, working with stock balance administration in 1977, recalls that: "The introduction of 'Quantities On-hand' made it possible to re-organise a whole working group, a basic sales support was built-up."

In the beginning, importers were mainly ad hoc set-ups of an entrepreneurial spirit, which helped establishing market presence. These have then transformed into sophisticated systems for after market services. Of course, this was due much to utilising technology that it became possible (from the headquarter's perspective) to embrace and integrate information further out in the supply chain, i.e., as close as possible to the original information provider.

2.2 The Eighties

Fast build-up and international establishments created diversity and decentralisation. This happened although management trends of JIT advocated coordination and Client/Server technology could have provided central control. JIT influenced the production systems at Volvo but as spare parts logistics is dominated by higher volatility new system functionality focused on handling of further volume increases and the establishment of importer systems. The Operational Guide from 1986 describes VIPS (Volvo Parts Importer System) as: "VIPS manages the parts business and warehouse administration of the market company/importer. It is built on modern client/server technology. The applications are continuously developed, improved and maintained in order to support the distribution structure as well as business- and service level demands. The systems are extensively integrated with central functions and support warehouse." This highlights the process integration between the headquarter and importers.

Overall, the Volvo Group expanded and at times the group was a wide-ranging conglomerate with Pehr Gyllenhammar as a strong CEO. Some grand attempts, like VIS (Volvo Integrated Systems), were started with the objective to deliver very comprehensive process integration but simply had to be abandoned due to a lack of relations between actors as well as due to technical incapabilites. However, relationships grew stronger between spare parts importers and the headquarter, which was a pre-requisite for gradual system and supply chain integration.

2.3 The Early Nineties

During the early 1990s, fast growth together with a tougher business climate had made times right at Volvo for greater rationalisations and improved control. Furthermore, the ERP (Enterprise Resource Planning) and BPR trends were dominating the scene. However, neither has given that radical 'business impact' that it was often labelled with. At Volvo, it is possible to show that both ERP and BRP have rather been used only in certain areas. Of course, some internal pre-studies as well as management consultants suggested complete changes of the systems structure and radical redesign of processes.

Nevertheless, considering the amount of stakeholders, the amount of transactions, the wide-spread and in many areas decentralised functionality that made up the Volvo after market it would have been a too large area to change all at once, not the least because there were serious considerations about the business risks. Furthermore, ERP and 3PL (3rd Party Logistics for outsourc-

ing) providers were at this time not able to support the special characteristics of state-of-the-art spare parts logistics.

Instead, it was in one of the non-core processes, accounting, that the ERP modules from SAP R/3 were introduced. At the same time as international relations were maturing towards the importers, there were also opportunities for both rationalisation and improved control. Common ways of working could be introduced with one system consolidating the whole chain, however, just with regard to financial transactions. Even if it was limited to the accounting area the Volvo Group ERP project was still one of the largest projects in the administrative area with both pros and cons among the lessons learned. Characteristically, an extensive white book (internally published with paper back) relates to "… integration work during the implementation phase required 30% more than estimated. Several times it could possibly have been better to scale down the ambitions. The scope was sometimes so large that it was difficult to comprehend and implement good solutions." Still, as mentioned, this ERP project was only concerned with the financial modules.

At the same time, after market management drove both overall business consolidation and system integration with suppliers as well as emerging towards dealers. With suppliers it was mainly EDI but with dealers thoughts and practice of the extended enterprise grew, for example through the introduction of VMI (Vendor Managed Inventory).

2.4 The Late Nineties

Seen as a whole and over a 30-year period one can discern a large difference, with a much larger, international company, with growth phases leading to diversification but in certain areas again becoming centralised. It is a perpetual and incremental shift towards End-Customers, accomplished when culture is ready and technology available. The late 1990s has been characterised by further globalisation and mergers together with an upswing in innovations and utilisation of communication technologies. In the case of Volvo, cooperation with Mitsubishi, Schmitz and Renault/Mack has either been intensified into mergers or dis-invested. Better process understanding and established relations as well as the *de facto* spread and adoption of web technologies have provided opportunities for further integration along the supply chain. However, challenges in terms of scale and scope of operation have been larger than any technical obstacle.

Consequently, the largest transformation demand has concerned adaptations within existing legacy systems. Again, these practical restrictions have only made gradual changes possible.

To address the organisational complexity one step that facilitated a comprehensive overview (during a growth period) was the creation of a centre of excellence for spare parts logistics. Furthermore, value added services such as call centres and diagnostics with the help of telematics have been recent examples from Volvo in the process of evolving towards End-Customers.

2.5 Thirty Years of Evolutional Systems Integration

Given a brief historic view of the integration efforts at Volvo, section 2.5 will summarise parts of this evolution of developments. This will provide a basis for the discussion and analysis of web services implementation projects that will follow in section 3. With this span of time it is essential to both depict unquestionable facts and interpret the stories that the organisation culture shares through artefacts (Dahlbom et al. 2002). Consequently, it is essential to be aware of the fact that the case can only convey simplified parts as illustrative explanations. It has been an evolution especially by means of an increasingly integrated supply chain as conceptually illustrated in figure 3 and described below. It depicts how Volvo has evolved focusing on the outbound relations. Of course, inbound relations towards suppliers have also developed, with more than 80% of purchase value being handled electronically already in the 1980's and currently reaching above 95%.

The system platform originally handled only internal transactions, exemplified as; "once shipped to France, it became the problems of the French importer". However, during the "era" of client/servers, importers were integrated into the in-house developed logistics systems platform through implementation of local systems connected to the central platform. Coinciding with this technology shift was a time of general internationalisation and decentralisation (Johansson and Vahlne 1977). Even though it was decentralised in many ways it became possible for Volvo headquarters to capture the information and over time build-up a knowledge that could influence the importers in a new way.

To refer to an "era" of technology may be misleading and it is important to bear in mind that it is equally adequate to refer to: an affordable cost for development of systems, the possibility to provide tools such as Terminals/PCs or that the introduction of new technology not exclusively replaces the existing technology. It is also relevant to see what sort of architecture and what possibilities there are for change (Magoulas and Pessi 1998). And not least important is the ability to extract as well as to understand the value of integrated operations through a common platform.

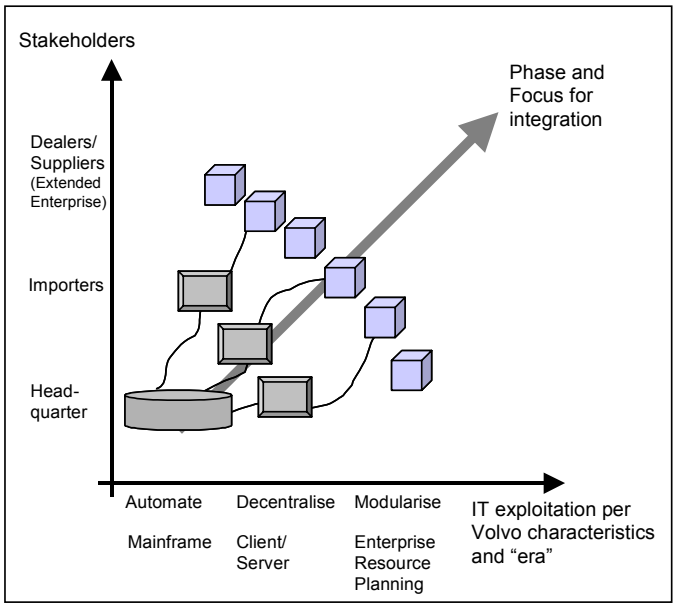

Figure 3. Evolutional systems integration

Alongside with growth of ERP providers, modularisation and customisation have been driving forces for further integration. The use of standard packages may reduce the need for in-house development and resources can be used for other purposes or with the objective of saving costs. There are advantages of integration and enterprise wide collaboration as well as inter-organisational cooperation for example with 3PLs, however, the lock-in effect, risks and conflicts in business interest is also considerable (Ciborra and Hanseth 2002; Holmqvist and Enquist 2003). The boundaries of the organisation have become more fuzzy and in some ways the term Extended Enterprise is relevant as parts become not only out/in-sourced but advanced forms for business transactions have evolved gradually as relations mature (Malone et al. 1998; Slywotzky et al. 2000).

In section 3, figure 3 will be further expanded to incorporate the integration towards End-Customers as a way of introducing specific experiences from web service implementation projects in relation to the supply chain actors.

3 Case Analysis: Implementations, Web Services and Relations

Currently, there are relatively affordable, transparent, simple-to-access and real-time on-line solutions. Management concepts suggest that Supply Chain Management is about seamless links and collaborative replenishment. Web service technology delivers a more loosely coupled integration form than earlier integration architectures. In highly heterogeneous distributed environments this is beneficial but also provides new challenges.

This section will first outline a conceptual view of the integration process within Volvo after market and then focus on experiences from four web service implementation projects. These will be discussed together with main issues and alternatives by presenting the context for each actor in the supply chain. This will provide integration process characteristics as well as present how each supply chain actor has been influenced by the context.

3.1 Integration towards End-Customers

Figure 4 builds upon figure 3 and embraces the reach towards End-Customers. In order to benefit from improved order behaviour in the supply chain as well as to reduce inventories it is necessary to have relevant information from the supply chain actors (Holten et al. 2002). However, it still takes a long time to build relations with trust enough to let partners control stock levels and reach agreements on how to handle shortages as well as surpluses. Similarly, no matter how quick XML and WSDL standards are to comprehend and set-up, different parties must still decide upon how to work and how real-time access is to be supported by underlying data input (Weitzel et al. 2000). Nevertheless, a main feature that is challenging the existing structures is a shift from major cost focus towards higher flexibility and increased networking. There is a need to change from solely focusing on lean resource utilisation to becoming agile, since the further out in the supply chain one reaches the higher the volatility (Ericsson 2003). Individual order volumes also become smaller closer to the End-Customers, since the former consolidations of volumes (buffer stocks) are eliminated.

Expectations from End-Customers have grown with improved access and information availability, caused by the broad reach and the universal usage of Internet. New requirements upon support and response occur, for example End-Customers more commonly expect round-the-clock service. As opportunities increase in terms of availability new demands are created for scalability.

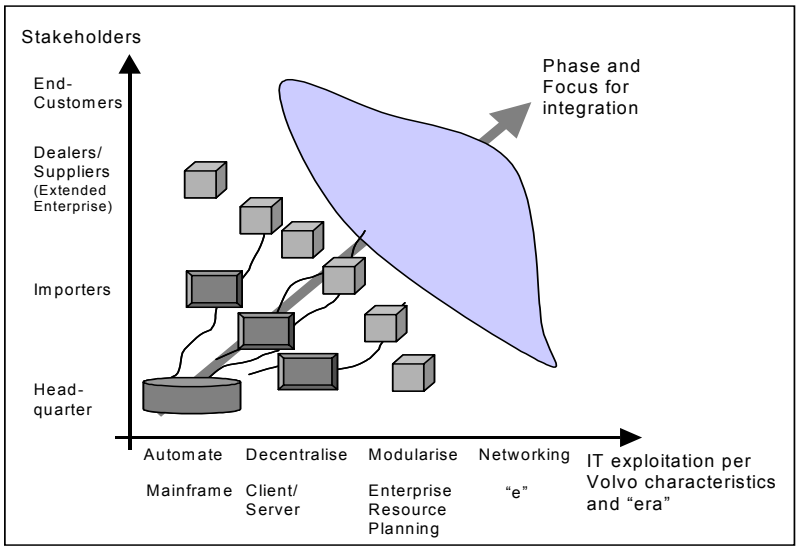

Figure 4. Integration towards End-Customers

Even if there are de facto standards and transparency between platforms there are also a number of practical obstacles in distributed technologies. The opportunities of getting the customer order point closer to the source give rationalisation gains through placing information input at the source which in turn allows automatic inquiry possibilities (self-service). However, obstacles that were formerly eliminated through central (and time-consuming) roll-outs now re-occur as End-Customers may experience problems due to differences in process and activity design, message broker and browser engines, character recognition, security protocols, connection speeds and ISP of various quality.

Volvo has been working on implementing concept offers and web services in accordance with creation of value chain scenarios as outlined in (Holmqvist et al. 2001) in order to meet different requirements thus being able to differentiate the level of integration depending upon relationship. The existing business context consists of four rather clear-cut organisational relations, which have also created the set-up of current logistics solutions (As seen in figure 2 and 3). However, this structure is challenged in several ways, for example by its actors, management consultants and by opportunities in technology. This section will discuss implementation characteristics per supply chain actor. It

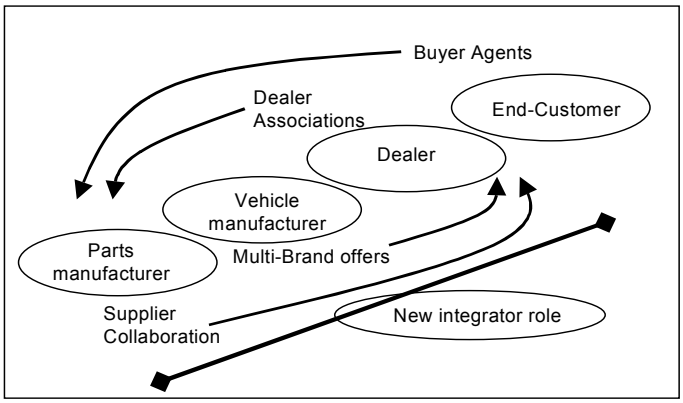

Figure 5. Supply chain actors and alternative relations (building on figure 2)

will also outline integration efforts and relations between actors in the supply chain (see figure 5 as building on figure 2).

The stability between the existing players also opens up large opportunities for a new integrator role that can exploit the situation. It could be set-up by an existing player or by a new entrance, independent or in alliance, "e-Mediator.com" (EIS Survey 1999). A start-up, in the form of an e-Mediator, provides an opportunity to exploit selected segments and focus on attractive high-margin services (Rayport and Sviokla 1995). It can also start with state-of-the-art technology, web service compositions and design processes without any heritage from installed base or inflexible legacy systems. However, it is not possible to neglect the strong requirements that End-Customers have in order to optimise their operations. To a large extent those requirements connect to physical locations and objects.

Major issues relate to; Requirements upon availability of spare parts that optimise service level and costs, Requirements upon service points that are "on the way" hence creating large variations in the flows due to mobility (since vehicles may break down anywhere), Requirements upon tools that can handle the increasingly complex trouble-shooting to find problems in vehicle configurations, Requirements upon highly-skilled technicians that can optimise vehicle productivity and provide professional as well as flexible administration dependent on the terms of interaction. Finally, it would also require a substantial purchase volume before a new actor would get actual discounts on purchase from parts manufacturers. Existing initiatives, in form of basic spare parts web portals, have so far not impacted the market in a considerable way

and there have been no practical interactions in the web service solutions, which has been implemented so far.

3.2 Parts Manufacturer

The circumstances, which make it worthwhile for parts manufacturers to restructure the existing supply chain relationships, relate to their ability to join together to form attractive offers for End-Customers by for example creating supplier portals enabling integrated relationships. Their objective would be to exploit higher margins by reducing the number of actors in the supply chain for after market products. Vehicle manufacturers are increasingly placing their product development at system suppliers (i.e., systems in the sense of a complete axis, air condition etc.) rather than development and supply of isolated parts. This has created different perspectives upon and possibilities for sourcing.

Suppliers are becoming large, consolidated, global and increasingly interested in getting closer to the Dealers and/or End-Customers of their products. Nevertheless, it would be a tremendous change to transform into managing interactions and operations with 100.000s of End-Customers compared with the current situation of a small number of vehicle manufacturers. Furthermore, such a transformation may risk the existing relation with vehicle manufacturers. Introductions of Key Customer Accounts and support from CRM techniques would be pre-requisites for adaptation of the logistical set-up.

However, there is a very heterogeneous structure and multiple segments among the parts manufacturers that need to join together and meet comprehensive End-Customer requirements in logistics (1.000s of different suppliers to the after market for each product family). The experiences of supplier collaborations are so far relatively scarce. There have been contacts in the last implementation project with selected suppliers to provide web services for Direct Deliveries. However, the current results are excluded from presentation in this research. Nevertheless, as opportunities emerge vehicle manufacturers need to also consider in which way supplier relations will exist with End-Customers.

3.3 Vehicle Manufacturer

One of the main strategic choices for a vehicle manufacturer concerns the possibility of providing after market offers for other than their own manufactured brand, in other words, to become a multi-brand provider. These opportunities are increasing as the number of standardised spare parts are growing (ie same spare part fits to several brands). In the USA, multi-brand transactions already

constitute a large share of the business. In the EU there are recent legal changes, regarding Block Exemption regulations, that promote similar conditions to those that exist in the US market[2].

Segmentation of the range of service and parts is a key issue in terms of providing comprehensive logistics and probably the best opportunities are to exploit high-frequent, easy-to-fit and fits-all parts.

The most probable change of the existing supply chain is that a vehicle manufacturer takes on a new integrator role for multi-brands in order to serve more dealers and End-Customers. However, there are also risks with a venture that would alter existing stability, such as brand image impact. There is also increased complexity in handling multi-brand due to wider information and product distribution. Current implementation projects have directly avoided deploying web services that include multi-brand capabilities but have readiness to exploit possible business opportunities.

The implementation projects at Volvo have developed web services for a service oriented architecture providing 'publish-and-subscribe' possibilities for different actors based on business roles and relations. The Volvo implementation projects have used web services for interface exchange and interoperability. This has started with simple, ad hoc application services and ranged into large-scale efforts that manage complex transaction chains. The latter focuses on business process activities with major issues on: versioning, security, reliability and synchronisation. Concurrently, web portal services are providing user interfaces into different business portals. An example of a screen shoot is attached below, see figure 6.

The web services that currently exists in the area of spare part logistics can be divided into three main categories: Find parts, Order parts, Use parts. These categories contain multiple services and service compositions for example: Find part in catalogue, Get customer status, Place order, Get order status, Get order status part detail, Parts master and Supersession master, Invoice workflow set-up and Vendor Managed Inventory set-up.

3.4 Dealer and End-Customer

The decreasing barriers of entry, in terms of access to information and collaboration costs, enable dealers to form associations and directly approach suppliers in order to cut layers in the supply chain. Dealers own much of the End-Customer relation and have local presence as well as the competence to provide service. However, the traditional barriers of entry tend to be lower the further out in the supply chain one gets due to lower operational complexity as well as lower capital requirements. Consequently, there is an over capacity in

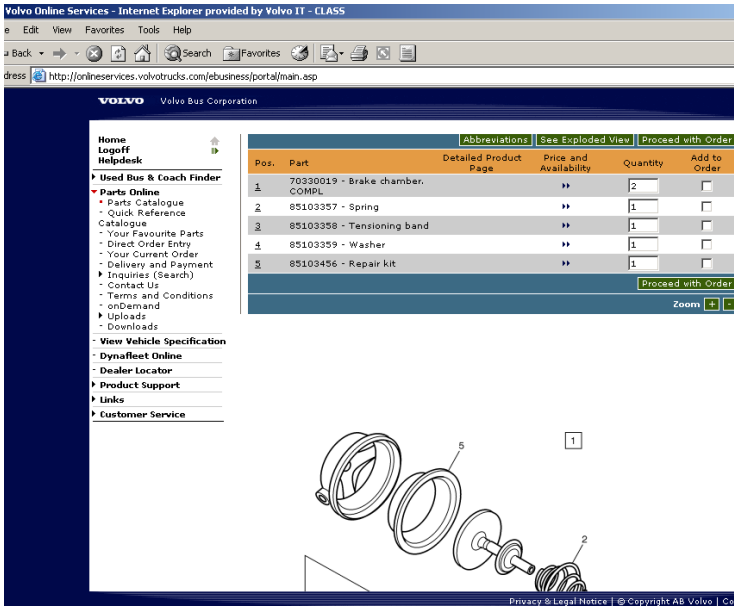

Figure 6. Example of web portal screen

the dealer structure, fierce and heterogeneous competition, and this results in lack of cooperation together with financial weakness. This makes it less probable that dealer associations will become a dominating force of development. On the other hand there has been a great interest and appreciation for the web service initiatives that Volvo has introduced. Especially among technology mature dealers there has been efforts to meet up and make adjustments to benefit from integration of the services. As opposed to earlier solutions it is not 'all or nothing', the flexibility has proven to be a good enabler for faster roll-out with focus on roles and relations (See figure 7 as an example from internal Volvo presentation). The largest obstacles among dealers have been in terms of competence, financial capability and time/priority for these activities in relation to daily operations.

In the same way, the probability of effective formations of End-Customers into buyer agents directly approaching suppliers is less likely to happen than other scenarios.

This is mainly due to the existing heterogeneity, fierce competition and the domination of small-scale operations. Consequently, End-Customers are more frequently users of web portal services. The exception is, of course, mega-cor-

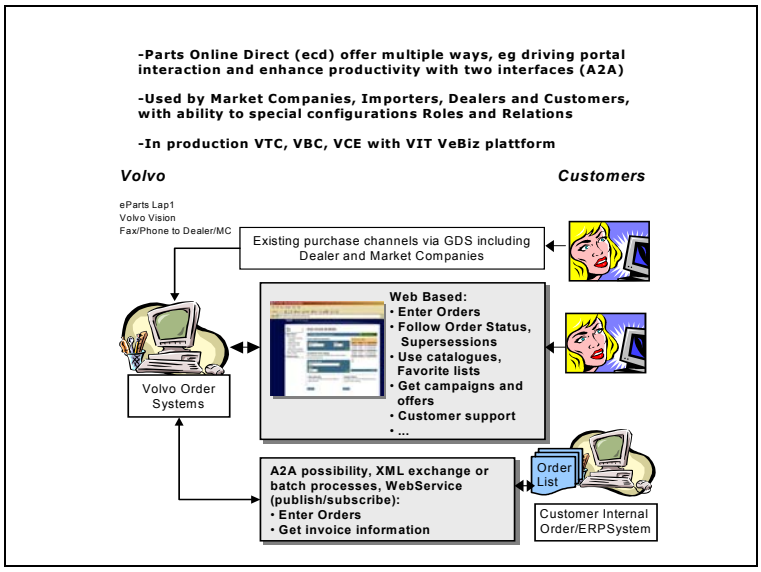

Figure 7. Example from Volvo internal presentation of web services.

porations (such as Key Customers) that already largely influence the logistic set-up and relations within the generalised supply chain described above.

Key Customers represent an important part within the End-Customer segment. Several Key Customers have been interacting intensively in the web services area. Sometimes they have their own initiatives to which Volvo has adapted, sometimes they participate in partnership developments (delivering e.g., invoicing flows and advanced application-to-application features) and sometimes they enter as subscribers when the services have been deployed. The second implementation project focused on Bus Key Customers and confronted many of the challenges with the synchronisation of processes. Bus Key Customers are often very large organisations with operations in many fields and an installed base of legacy systems.

Furthermore, in the fourth implementation project (the first in the construction equipment area) there has been a build-up of experience to confront a very complex and heterogeneous business structure. Consequently, the scope of web services for the construction equipment set-up initially excluded catalogues and invoicing services and focused on providing process integration into a Single Order Interface (See figure 8).

The Single Order Interface has capabilities to synchronise order process events though underlying legacy systems may have very different restrictions,

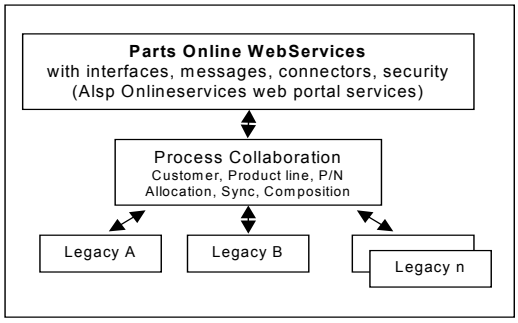

Figure 8. High-level structure for Single Order Interface and process collaboration

for example in terms of warehouse allocation, freight conditions, order priority handling, service composition etc.

This case has also gained commercial recognition by for example IBM (as referred to earlier, e.g. presented as 'Company of the month') but this would not have been possible without prior platform and project implementations.

To conclude this section table II below gives a high-level overview per implementation project. It shows the lead-time, development efforts, result achieved, target groups and services for each project. The development efforts (cost, resources, competence etc) are expressed in relative size compared with the first implementation project, i.e. the platform project. Results achieved are expressed as the relation between expected and delivered business value.

This means what has so far been achieved in relation to the expectations on what the project should deliver, for example: building the platform was more difficult than expected and the number of End-Customers that would connect was over estimated—Project 1 (0,5). East Europe roll-out resulted in a very quick, simple and beneficial adoption, thus delivering much more value than expected—Project 3 (2). Simplified one can say that the first project under-delivered relative to its expectations, and the third project over-delivered. The

target groups and main service content and functionality are also outlined in a summarised view.

Implementation project #	*Lead time*	*Development effort*	*Result achieved in relation to expectations*	*Target group*	*Services (content and functionalities)*
1	>1 yr	1	0,5	Selected Truck Dealers and End-Customers in some EU markets (small vol/site)	Establishing platform. Mainly web portal services; • Catalogue • Price & Availability • Order parts • Order history
2	6 m	1/5	1	Bus Key Customers and stand-alone Truck importers (large vol/site)	Many catalogue selections Publish/subscribe of web services; • Invoice • Order handling
3	3 m	1/20	2	Truck Dealers and End-Customers in Asia and East Europe	Service composition; • Advanced supersessions • Importation data • Service instructions
4	6 m	1/5	1	Construction equipment Dealers	Mainly web service development; • Single Order Interface • Allocation rules • Process synchronisation • Security

Table 2. High-level summary according to implementation project

4 Concluding Remarks

The objective of this paper is to contribute to a better understanding of how the development and use of web services are placed into a practical context. The practical context can illustrate how prior integration efforts influence each other and that it is not a case of 'one solution for everything'. In a way, integration has always been on the agenda in spare parts logistics and in the case of Volvo the last 30 years can be seen as an evolution.

The case illustrates the need for installed platforms to build further development upon. This implies that initial efforts are mainly establishing a base that further implementations can utilise. The integration process is characterised not only by a technical platform but also by a basic understanding for and handling of relations between different supply chain actors. It seems to a large extent to be a question of relation timing, i.e. to match management ideas and technology and continuously assess risks. It is clear that the further out in the supply chain, the more heterogeneous conditions are. The loose coupling of web services has therefore shown to be beneficial. So far the implementation of web services has proven to be fruitful in several integration efforts, but it is not less crucial to assign competence, have financial capability and work gradually.

Global spare parts logistics with large volumes, a considerable installed base and a dependence on economies of scale have provided a pressure to improve performance as well as to be innovative. Still, despite this, in the light of industry maturity and competition, it is difficult to achieve radical changes. Instead, it is important to apply opportunities where they fit and are applicable rather than to believe that there are 'everything/everywhere solutions'. Development projects need a size that is possible to comprehend and in that way increase possibilities to influence implementation results. This may especially be the case since scope may drift due to different objectives among the supply chain actors.

An integration process that is characterised by several implementation projects where each one has clear target groups and can re-use the platform and web services is clearly beneficial. Initial work with scenario development may prove more fruitful than trying to make detailed development plans. Large leverage of results can be achieved through a sequence of tight follow-on projects, rather than having single and large-scale projects with larger scope. Evolutionary development seems to require persistence and an ability to handle mismatch between IS/IT and business structures. Even with an awareness of that it takes time to change, it is equally important to regard and assess how different actors can act upon available opportunities.

The influence of the historical and concurrent context on the supply chain actors plays a vital role. It seems as though the Vehicle manufacturers will still dominate the scene for spare parts logistics although there is no clear evidence. Consequently, they will continue to drive how web service developments are applied in this sector. At the same time, it will depend on their continuous ability to deliver operational excellence and superior information availability, since supply chain actors are challenging current relations. However, strong End-Customer requirements and complex product and business structures make it less likely that a completely new actor will enter the scene to successfully take on an integrator role. It does not seem likely that such actors will become strong enough to influence the forms for web service content and functionality.

Parts manufacturers are likely to be active in the after market, not least in examples of direct deliveries to Dealers and End-Customers. Dealers and especially large End-Customers will continue to be important actors, mainly as subscribers of web services. Integration with smaller End-Customers has been more difficult than originally estimated.

Finally, considering the characteristics of the integration process in large-scale spare parts logistics changes will not take place in any radical way. Overall integration takes time, often longer than expected. It is a question of how valuable improvements can be made and how integration may change relations influenced by management and technology. Current use of web services has proven to be successfully applied in supply chain areas that are close to End-Customers, but less used for internal applications. By sharing actual case characteristics the aim is to contribute to discussions and further research as well as spread an interest for research to practitioners.

Notes

1. http://www-306.ibm.com/software/ebusiness/jstart/casestudies/volvo.shtml.
2. http://europa.eu.int/comm/competition/antitrust/legislation/.

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