Analysis of the Role of e-Business in the Emerging Software Component Markets

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INTRODUCTION

Reuse of standard software components is a contemporary trend not only in the software industry, but also in many other industries that make use of software in their systems and products. For example, modern automation, telecommunication and electronics products are based heavily on software. A software component can be defined as a piece of reusable and independent computer program that is accessible through specified interfaces [e.g. Szyperski 1997]. Due to their reusable and independent nature, software components are expected to make software development more effective by offering cost and time savings and quality improvements.

The idea of large-scale reuse of standard software components was introduced as early as in the late sixties in a workshop organized by NATO, but rather little has happened during the past thirty years when it comes to systematic reuse of commercial software components. However, intra-organizational software reuse has emerged quite rapidly in the nineties, based on proprietary software architectures and platforms. Moreover, many software products can be seen as "large" components and platforms on which different applications are being built. The best known examples of the latter include not only Windows and other operating systems, but also databases, communication protocols and user interface software packages.

Commercial software component business in the sense of recognizable markets consisting of customers and sellers is still at its early stage of development, although the impact of software components on industrial software development is already evident. Some of the likely problems are the lack of understanding of how software components produce value for their buyers, and how component sellers and purchasers could interact, in practice. These questions are addressed in this paper, taking a view that buyer value creation is a key driving force for the use of

commercial software components, and that the interaction between sellers and buyers can vary from distant and occasional market transactions to close collaboration.

Especially the former type of interaction strategy can be supported by e-commerce solutions, but also the latter may benefit from electronic assistance. Moreover, in addition to software component development and delivery time buyer-seller interaction strategies, a third approach based on electronic access to operational software is emerging.

We have been carrying out several empirical studies in the software and other industries to see how commercial software component markets and supplier-customer business relationships are unfolding. Formation of the markets is especially important from the viewpoint of companies that have built systemic products in which software has not had any distinct role. Many of these companies have been accustomed to subcontract software development services, rather than to buy commercial-off-the-shelf (COTS)[1] software components or even modified-off-the-shelf (MOTS)[2] software components. Moreover, it is very likely that some of these companies will not only become software component and product buyers, but also sellers, which will shake the traditional industrial boundaries.

The contemporary trend of e-business is going to have its own influence on the changes of the traditional industry structures, while offering new opportunities for the companies to organize their activities and manage their supplier-customer relationships in software component businesses. In this working paper we will discuss some of the basic aspects of e-business in the context of software components, referring to the results of already accomplished studies, but emphasizing the fact that we are still in the middle of an ongoing research process.

PROBLEM RECOGNIZATION AND COLLECTED RESEARCH DATA

During the last eighteen months we have collected both primary and secondary data related to a broad range of issues in software components, from pure COTS to heavily tailored software components, from technical to commercial topics, and from the supplying software industry to several possible customer industries. Secondary data has been collected mainly through Internet, by analyzing e.g. white papers on software components and home pages of companies that are involved in the emerging software component markets.

[1] COTSs are standardized software components, with any or little modifications done for the customer

[2] MOTSs are software components that are modified for the customer either by the supplier or as in a cooperation (cf. Original Software Component Manufacturing, OCM) with the customer.

However, the main body of our research data originates from several interviews that we have been carrying out among industrial professionals working in software supplier and buyer companies. The interviewed companies include not only potential software component buyers (i.e. customers) but also component sellers (i.e. suppliers) and companies who can act as an intermediaries in the software component markets. Most interestingly, many of the interviewed companies are not able and willing to work only as component buyers, but also as component developers and sellers. Thus, even the future roles of each actor are not specified yet in the emerging software markets. Information about intermediary software component brokering companies could not be acquired through interviews conducted in Finland – there are no domestic component traders available yet. Instead, such secondary data sources as the Web sites of the big American software component market places (www.flashline.com, www.componentsource.com) were used.

We have chosen to look at the emerging software component markets especially from an original equipment manufacturer's (OEM) point of view. Here, the OEM stands for a company that buys both hardware and software components in order to build an operational systemic product for further sales. The OEM may be a pure systems integrator (SI) that only does the assembly work and manages the end-customer interface. However, it can also be a company that has its own product development activities, too, besides of the pure assembly work and ownership of the end-customer interface. In our research, the studied OEMs represent automation, telecommunication and electronics (ATE) industries, while the software component suppliers can be classified more or less as representatives of the pure software industry.

From the chosen view-point of OEM companies in the ATE industries, we are interested in finding answers to the following research questions:
What kinds of supplier-customer relationships are involved in software component businesses?, and
Which kinds of e-commerce solutions can be used to manage these relationships?

This paper provides for working answers to these questions, although it is clear that the answers will change during the coming months due to the rapid technological evolution of e-commerce solutions. More importantly, the viability of certain types of relationships to certain companies is likely to change. For example, a software component seller may become a component broker, as the service aspects of the business are maturing.

CONTEXT OF THE RESEARCH

Customer-supplier relationships play an important role in the emerging software component business. The importance of being able to recognize and manage successfully relationships that are forming around software component business was evident in the empirical data. Figure 1 illustrates customer-supplier relationships both from the viewpoint of OEMs, and stressing the fact that sellers may be "vertical"

(customer-application oriented, providing MOTS components or fully tailored software solutions) or "horizontal" (seeking for generic COTS-based business opportunities).

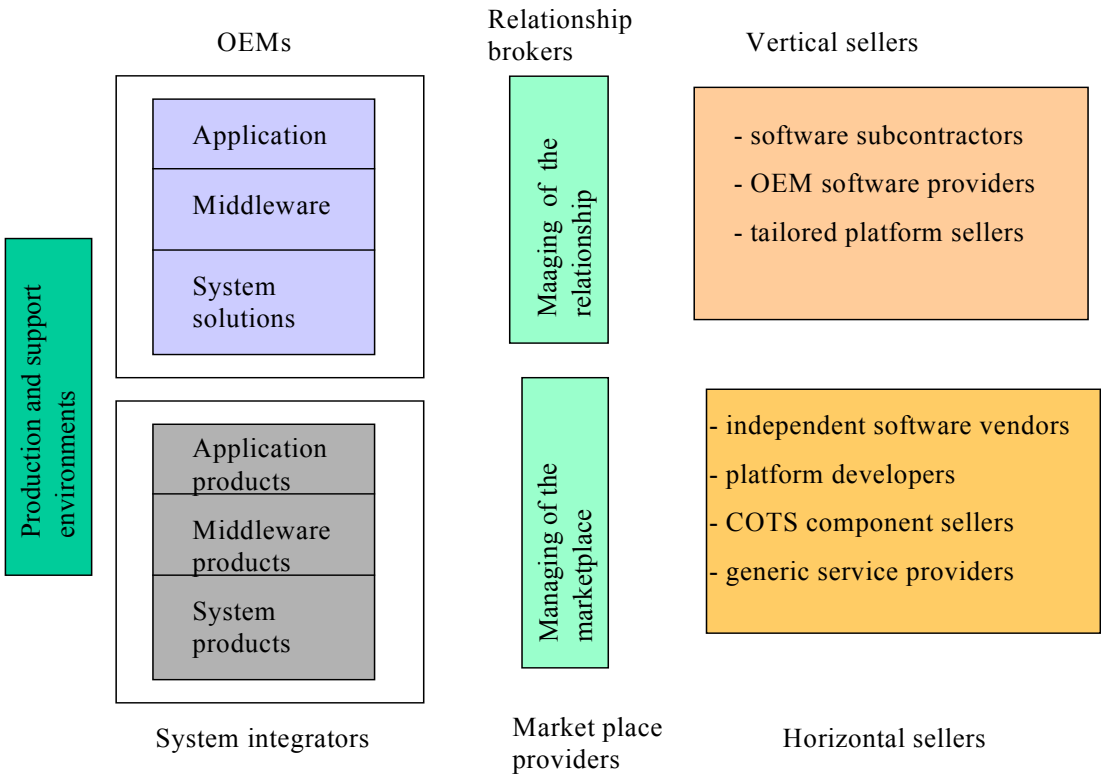

Figure 1. Context of software component business from OEM's point of view.

In all, the context of software component business is divided in Figure 1 into three areas: buyers, intermediaries and sellers. The buyers are considered either as system integrators or OEM companies depending on the visibility and modifiability of the purchased components or software products, the sellers as vertical or horizontal. The intermediaries are characterized as relationship brokers that serve mainly vertical sellers or market place providers that focus on horizontal sellers.

The buyers' needs are viewed through a three-tier product architecture, supplemented with the systems that are needed to build products, such as software development and testing environments. The "small" or "large" number of software products or components to be exchanged has a key effect on all the three types actors. In the buyer's side the corresponding effect could be emphasized further by using the concepts of a production company (small number of purchased parts) and an assembly company (large number of purchased parts), but this has been omitted from the figure.

In Figure 1 two kinds of software component buyer-supplier relationship types are depicted: *partner relationships* and *market supplier relationships*. These types of relationships differ from each other, for example by the closeness of supplier-customer interaction, by the nature of the provided software components and by the role of the supplier in the customer's product development process. However, the relationship types represent more like two alternative opposites in a relationship continuum than only two possible alternatives.

Although the two relationship types can include service aspects, a third type of buyer-supplier relationship, *pure service relationship* can exist. This is a pure service relationship in the sense that software component is not sold for the customer, but instead the customer can use the component for its operational needs by acquiring its usage rights from the supplier. The so called Application Service Provisioning (ASP) is a very good example of this kind of relationship.

Although the three relationship types differ quite much from each other, they have one common factor: the growing importance of e-business in offering modern ways to build and manage the relationships. In the following, we will discuss the relationship types based on our preliminary empirical findings, and considering e-business solutions as relationship accelerators.

E-BUSINESS SOLUTIONS AS ACCELERATORS FOR SOFTWARE COMPONENT BUYER-SELLER RELATIONSHIPS

When considering automation, telecommunication and electronics industries as potential software component buyers, an important question is the need for product customization. Such final products as industrial machinery, telecommunication network equipment and process control systems are usually customized, but the components of the products do not necessarily have to be customized; they can also be standard ones, but including a wide range of options and variants [Lehtinen 1996].

Usually the computing infrastructure (cf. "system solutions" and "system products" in Figure 1) on which the products are based is built of rather standard hardware and software parts, depending on the need of integration – for example most handheld electronic devices include also customized application-specific components. In telecommunication products also the communication protocol platform may be standardized to a large extend. Such applications as automated control of production processes is often a mixture of customized and standard solutions. A good example of a standard part of many applications is a database management system needed to store and manage application-related data. These kinds of software components and products can usually be acquired from a quite distant software component suppliers, probably utilizing an electronic market place as a component broker.

However, in most of the cases some components of the final ATE products have to be customized due to the changing needs of end-users. Often this is done by following some sort of a product family approach based on software, because it is the

most malleable part of the whole product (cf. [Sääksjärvi 1998]). For successful customization, close communication and interaction is needed between the suppliers and the OEMs; usually this favors direct distribution channels between them. As a result, the supplier relationship is more likely to include explicit characteristics of partnerships. Another question however is that whether the OEM software component supplier interact also with the end-user of the product, i.e. with the OEM's customer. This question is dependent not only on the buyer's purchasing policy, but also on the use of the component in the end-product.

Besides of the question of customization, there are also other software component related characteristics that have an influence on the OEM's supplier relationship portfolio. One relevant criterion is the importance of the component in the whole systemic product. It can be argued that the more important part of the whole product the component is, the more important the supplier is for the OEM company, too. This importance of the specific component can increase the dominance of the supplier compared to the OEM company.

The size of the component is another criterion for categorizing components, but usually it is quite closely connected to the importance of the component. Both of these questions can have a major impact especially on what kind of license agreements the supplier and the OEM company should make. Besides of these two criteria, also the price of the software component has an impact on the relationship parties. If the price of the component is "low", the OEM company should buy it in such large volumes that it is profitable for the supplier to tailor it for the buyer.
If there is no need for tailoring of the component and the supplier can sell the same component also to many other customers, the question of buying volume is not that important. However, the basic question is whether there is any point to even consider the tailoring of cheap components. It is possible that tailoring expenses are greater than profits per component. The price issue affects license agreements, too. It can be argued if is it reasonable to license "small" components with "low" prices, at least if the selling volume is "low".

Based on these criteria, it is clear that OEMs are going to have at least the two different kinds of supplier relationships pointed out above, partner relationships and market supplier relationships.

Partner relationships

Usually the relationship between supplier and the OEM company is rather close, due to the need of component tailoring and shared product development process. The closeness of the relationship can bring many advantages that include, for example, reduction of overlapped functions and new product innovations. However, the close relationship also requires a lot from the relationship parties; building a successful relationship needs many investments in the relationship and most of all, it requires commitment. This kind of commitment can be a risk for both parties, because by committing to certain a supplier or customer, a blocking of other potential partners may result. For example, commitment may require taking in use proprietary e-

business solutions by the dominating party, or the two parties may need to invest jointly in such a solution.

The question of commitment is thus even more important to the less powerful party of the relationship than to the dominant parties. Both the supplier and the OEM company can be the dominant party, however, depending on in which markets they operate. For example, if the OEM company is a domestic company buying from a global supplier, it can be possible that the OEM supplier is larger and more dominant. However, usually the OEM companies are larger than their suppliers are.

In more general terms, partner relationships require open information sharing based on person-to-person and electronic information sharing. The relationship involves a high level of trust, commitment over time, long-term contracts, joint conflict resolution, and the sharing of information, risks, and rewards. Such collaboration affords many of the benefits of vertical integration without the attendant loss of strategic flexibility.
In contrast, adversarial or transactional buyer-supplier relationships are characterized by sourcing from multiple suppliers, the use of competitive bidding, fully developed bidding specifications, and short-term contracts to achieve a low purchase price. [e.g. Spekman 1988, Ellram 1990, Heide & John 1990].

Supply chain management (SCM) is a way of deepening the cooperation of suppliers and the OEM, in practice. SCM is a loosely defined concept that lacks a universal definition, both in terms of depth and breadth of SCM strategies and processes. However, one common theme in the literature is that SCM, in its basic form, proactively plans and coordinates the flow of products, services, and information among a connected series of firms that range from final customers to raw material providers. Effective SCM may positively affect cost, quality, flexibility, and innovation performance [Scannell et al. 2000].

Although successful SCM needs to be more like a way of thinking that is adapted both by the OEM and the suppliers, in practice there is also a need of utilizing e-business solutions or at least the possibilities offered by the Internet. Electronic SCM systems control everything from sketching and color boards, product development, and order booking and accounting systems to electronic purchase orders, scheduling and plant loading, and sales and production. In other words, electronic commerce is a significant aspect of cutting costs out of the supply chain [Hill 2000], and can be managed by an intermediary party (cf. “relationship broker” in Figure 1).

Market supplier relationships

Market supplier relationships can be described as arm’s length relationships, based on occasional transactions between the OEM and its supplier. Based on our empirical findings, these kinds of supplier relationships are going to occur especially in such cases, where the acquired component is quite standard one. Moreover, in these kinds of supplier relationships, the use of electronic market place as an intermediary is

likely to occur. Thus, the role of electronic commerce solutions is remarkable in the market supplier relationships.

The idea of component trading (cf. “component market places” in Figure 1) is that standard COTS or MOTS components could be marketed to other companies with similar needs [Hoch et al. 1999]. There already exists a few virtual software component marketplaces in the Internet. Their purpose is to facilitate component supply and to provide a reliable and branded channel to sell and buy software components, i.e. to facilitate the acquisition and support processes of software components. [Sprott 2000] Component buyers will need, for example, information about purchase and license conditions, the functionality of the components, interfacing and performance issues - such as the execution time and minimal memory size required by the components, etc. [Aoyama and Yamashita 1998]

At a more general level, brokers can create value both to component producers and buyers through a variety of services. These include, for example, market-based services, requirements-based services and negotiation-based services. In market-based services the intermediary can create value by providing customers with specialized knowledge of the market. Such knowledge includes qualities and quantities of available components and consumers. In requirements-based services the broker can create value by providing clients with feedback on interactions among their requirements and how the market might meet them. Lastly, in the negotiation-based services the intermediary can create value by interacting with customers to create mutually acceptable deals. In some cases the intermediary can, for example, create a packaged deal which matches a number of customers and component producers. [Robinson 1997]

In the following, two electronic software component market places are briefly presented as they appeared in the Web pages of the market places during the empirical study in the turn of 2001.

http://www.flashline.com/

Flashline is one of the biggest software component market places in the Internet. The basic functions provided by the site are the following: Extend Your Component Development Expertise, Developer Links, See How It Works, Register as a developer, Search through Requests, View your Developer info and Need a license agreement. A component design manager is provided for software suppliers. The basic procedure to become a software component supplier is the following:

”1. Developers register with Components by Design, and create an online profile identifying areas of interest and expertise. Registered developers receive an email notification when a request that matches their qualifications is entered into the system.
2. Anyone can view requests in the system, but only registered developers can ask questions during the Review phase, or participate in bidding. Bids can be edited or withdrawn at any time during the bidding phase.

3. Each developer that bids on a request receives an email notification when a bid is accepted.
4. The developer and requester then communicate directly with one another to bring the project to a close".

For the software component buyers the procedure is as follows:
"1. Companies complete the "Component Request" form, which includes the component specifications, due dates and other requirements, such as testing and documentation. An email is sent to qualified developers notifying them of a new request.
2. The request then enters a Review period, during which developers have an opportunity to ask questions about the project, and requesters can refine the component specification.
3. After the review period, developers place online bids. The requester can view the bids and developer information. In addition, Requesters can categorize and rank the bids.
4. Once the winning bid is selected, the requester states the reason, and an email notification is sent to all bidders.
5. The requester and developer then communicate directly with one another to bring the project to a close".

Flashline also provides for software component certification, by "verifying the availability of critical documentation and by disclosing test results". Additionally, Flashline offers component testing services, provided by Flashline's QA Lab. Tests can be executed during all stages of development. Three separate sets of tests are available: Pass 1: Code Structure and Design Analysis; Pass 2: Component Performance and Efficiency; and Pass 3: EJB Load and Performance. Flashline markets testing and certification outsourcing as one of its key services associated with the component market.

http://www.componentsource.com/

Componentsource is another software component marketplace, but with a focus on business-related. The site markets especially the opportunity for software developers to encapsulate "existing knowledge" into components than can be sold in the marketplace: "Do you have expertise in a specific area or vertical market?, Do you have existing applications with "locked in" functionality?, Do you have plans to build a new product - that will be built using components?, Do you know Visual Basic, Java, Visual C++ or Delphi? If you can answer 'yes' to any of the above questions you can start building business components now".

The procedure for component developers to follow would be: "Identify the components that you can build, To get more ideas read our case studies or visit our Component Request Center to see a list of components in demand, Read our White Papers (These will tell you about how to create and price your components), Send your components to us, We can review the components, test them and give you feedback prior to you offering them for sale".

The component marketplace is characterized as a means for ”Open Market Component Based Development” that offers buying companies the ability to choose COTS software components for any platform from multiple component authors and combine them with their own in-house components to build applications. Components for the open market ”should ideally be built for deployment on one of the following platforms”: Microsoft Component Object Model (COM), Sun Enterprise JavaBeans (EJB) and Object Management Group (OMG) Common Object Request Broker Architecture (CORBA).

However, there are other aspects to building open market components that are necessary regardless of the platform, such as utilizing security certificates, providing adequate documentation such as help files, and installing the components. Security certificates allow developers to digitally sign their components, insuring their authenticity and preventing them from being altered.

Discussion

Based on the empirical data and utilizing the relationship connectors identified by Cannon et al. [1999], the basic characteristics of the partner relationship and market supplier relationship are summarized in Table 1.

The two relationship types are not only compared by the factors - information exchange, legal bonds, operational linkages, closeness and dominance – that illustrate the nature of the relationship, but also by the factors – generality and adaptability – illustrating the nature of the component.

Table 1. Comparison of the Partner and Market Supplier Relationships

Characteristics	Partner Relationship	Market Supplier Relationship
Nature of Relationship		
Information Exchange	More open sharing of information, e.g. future product development plans	Standard and narrow information exchange
Legal Bonds	”Handshake” agreements preferred, IPRs shared or buyer owned	Standard legal agreements, mostly license based trade, seller owned IPRs
Operational Linkages	Operational linkages exist a lot, e.g. in terms of shared product development	Indirect operational linkages, mainly concentrated on selling and purchasing activities
Closeness	Close cooperation, including shared risks and mutual adjustments	Arm’s length relationship, lack of direct contacts, utilization of an intermediary
Dominance	Possibility of occuring buyer’s dominance, although balance would be preferred	Relationship is quite balanced
Nature of Component		
Generality	Mostly application domain specific components	Mostly general components

Adaptability	MOTS, modifying and tailoring done in cooperation	COTS, standardized components, narrow possibilities to have tailoring
Importance	Usually quite critical for the buyer, e.g. important piece of the final product	Not so critical and important parts, at least not closely related to the buyer's core competence area

From the viewpoint of e-business solutions, the nature of the relationship (information exchange, legal bonds, operational linkages, closeness and dominance), are likely to have the greatest effects. In other words, they should be considered as the factors through which e-business solutions can, in practice, accelerate the emergence of software component markets and businesses. Vice versa, if some solution can offer only weak electronic support for the tight operational linkages characteristic to partner relationships, it is doomed to fail. What would be too "weak" support depends, of course, on the situation, but an example could be that the parties product development environments cannot directly exchange software component specifications, designs or test data.

Pure service relationships

Although partner relationships and market supplier relationships can include some aspects of services, a yet another relationship type that contains pure service aspects can be identified. Software provisioning through Internet, i.e. ASP, is one good example of pure service relationships.

The definition of the concept of ASP is not very clear yet; it has been used in a variety of meanings in different contexts. However, one common interpretation for an ASP is that it is any company, which offers access to application programs on a network basis [Anon. 2001]. It can also be said that ASPs typically allow businesses to offload their application maintenance needs, including staff and equipment, for a monthly or usage based fee that covers a rental of expensive software applications that, for example, many small businesses could not otherwise afford [Grice 2000]. Therefore, the basic business idea of an ASP model is to rent application programs to other companies using the web as a distribution channel.

ASPs offer an alternative, when companies are deciding if they should outsource applications or maintain – and even build - them in-house. It can be said that acquiring of a piece software from an ASP company to use becomes an outsourcing situation. The ASP model should allow the customer companies to get their applications installed and running for their own customers faster than by using the more traditional channels. Moreover, the customer organizations should avoid the complexity and cost of establishing an infrastructure on which to base the application and to have an organization to manage it – just by avoiding the staffing costs the customers can save a lot of money. A yet another important business driver is the fact that at the very best an ASP company can provide an "end-to-end solution" for the customer, in other words they can provide a comprehensive, integrated, one-source offering. [Blackwell 2000] As a conclusion, the ASPs create value to the

customers by offering faster and easier way to install and update their software applications [Paul 2000].

The lack of tailoring possibilities and the need of developing necessary interfaces are issues that may prevent or at least slow the utilizing of ASPs as an intermediary in the OEM business. This is due the fact that in many cases the OEM relationship is characterized by tailoring of the supplied components and products at least to some extent. In the case of software components the ability to use them as parts of the overall rental applications of the ASP company by the end-users is central.

Sound Consulting has listed factors, which are converging to drive the new ASP market forward. These factors are technical, financial and market dynamics. Figure 2 illustrates these dynamics that are fueling the ASP market. For example, financial factors affect the ASP market because reach of new customers will become easier and less expensive through the Internet and because the ASP model helps to avoid the costs of application maintenance. On the other hand, the market factors affect the rise of the ASP market mainly because of the difficulty for companies to obtain IT staff. What comes to the technology dynamics, one significant factor is the technologies that allow traditional client/server applications to be accessed in a hosted environment. [Anon. 2000]

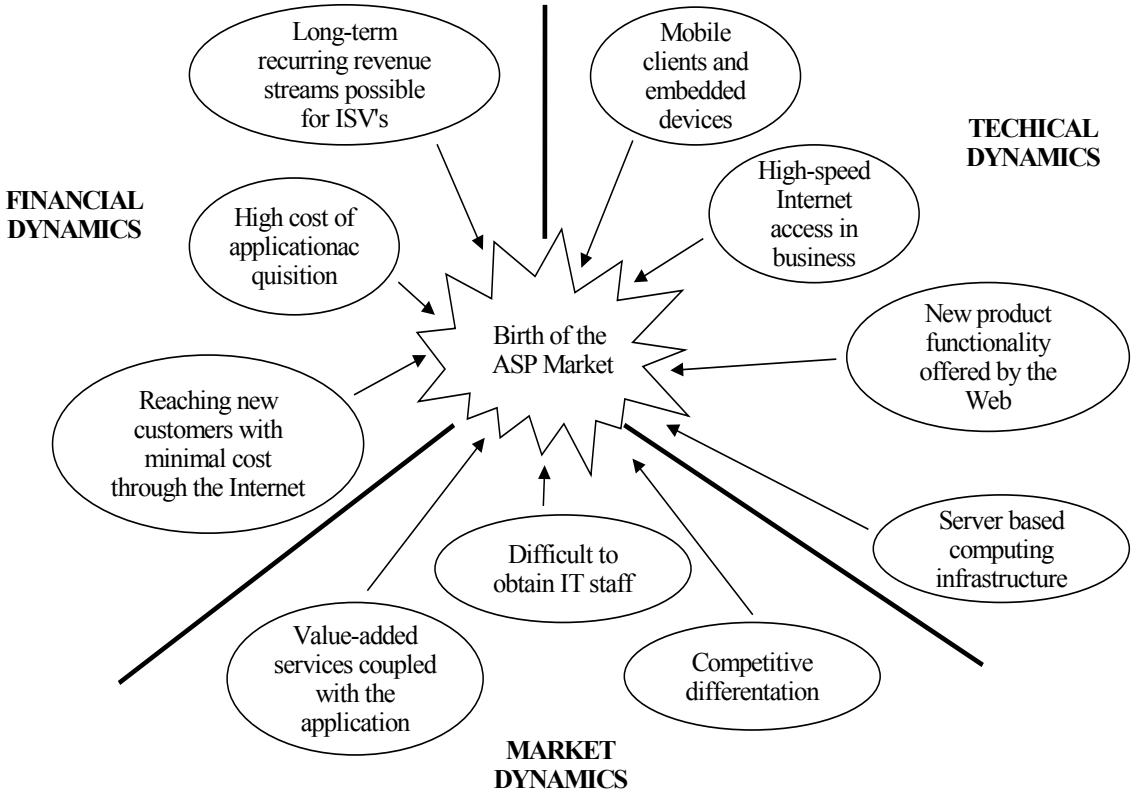

Figure 2. ASP business fueling factors. [Anon 2000]

Considering ASPs as possible intermediaries of an OEM relationship, one major problem is the question of whether it is reasonable to rent software components via Internet. The price of buying rather than renting such components may not be that high, at least in the case of "small" components. In this situation the costs of renting and licensing component may not differ considerably. Furthermore, the question of IPRs can prevent the emergence of ASPs as intermediaries in the OEM software business.

One could expect that only if both the OEM company and the component suppliers make use of the ASP model through the same service provider, the question of IPRs becomes irrelevant. In this case the roles of the parties become, however, closer to another type of a business web than a supply chain. [Tapscott et al. 2000] In all, it is reasonable to argue that ASP will change the traditional way to see value chains. In the traditional value chain -manufacturer-retailer-wholesaler-customer- the participants of the chain only operate with the previous and following link of the chain. In the ASP model everybody can co-operate with everyone and the value chain consists of value-added and supporting services. Every company can offer various services and thus participate in one or several stages of the value chain. Figure 3 illustrates the different stages of the ASP value chain.

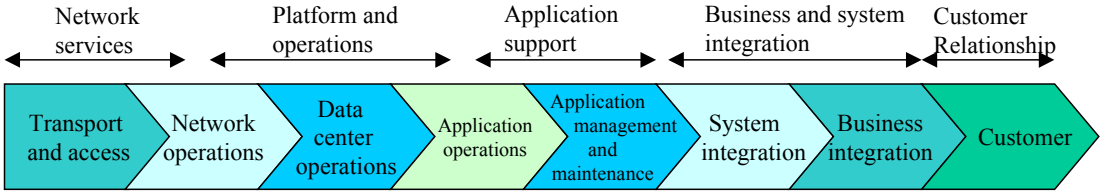

Figure 3. ASP Value Chain [modified from Fitzgerald 2000]

From an OEM point of view, renting software components for a product that goes further to an end- customer may in fact lead into a situation where the component developer can directly rent the needed component for the end-customer and the OEM company itself may end up of loosing its nodal role in the value chain related to that specific component.

CONCLUSIONS

The different types of software component buyer-supplier relationships can be positioned by their occurring closeness and dominance in Figure 4. The partner relationships can be positioned in the middle of the relationship continuum based on how close cooperation the supplier and the OEM are emphasizing. However, in the same time this kind of relationship leaves space for the dominance of the other party of the relationship. Based on the empirical data, it can be argued that in most of the cases the OEM is going to have more dominant position than the component supplier. However, especially in cases where the acquired component is large or

critical for the OEM, the component supplier may grow its dominance in the relationship, too.

The market supplier relationship can be positioned in the leftmost side of the competition-collaboration continuum; in these relationships there usually aren't any remarkable cooperation objectives and the relationship is rather transaction based. However, both the supplier and the OEM have usually quite free will to choose with whom they do business and this prevents any dominant positions for both of them.

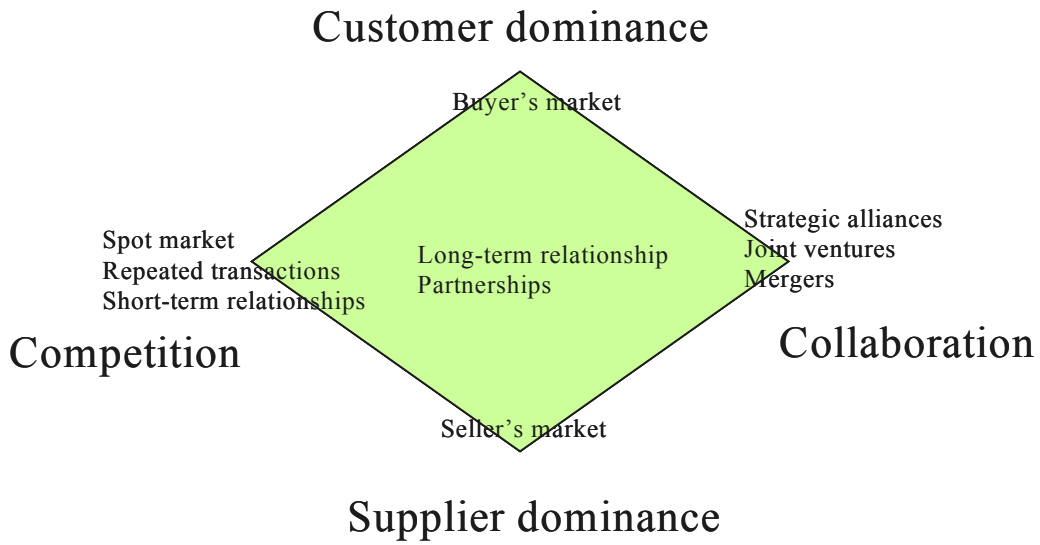

Figure 4. Buyer-seller relationship continuum (modified from [Alajoutsijärvi 1996] and [Webster and Frederick 1992]).

Most interestingly, pure service relationships should in principle be located in the right-most side of the competition-collaboration continuum, i.e. to help to reduce both customers' and suppliers' dominance. Software components are taken in use only as needed, the buyer pays only for the usage, and the seller earns profits based on the value created by the actual need of the component. In practice, the ASP company that logically corresponds to the two other kinds of intermediaries depicted in Figure 1, needs to assemble an extensive value chain (cf. Figure 3), whose management may appear as very difficult.

It is apparent from the discussion presented in this paper that the research needs to be continued. Although we have been able to identify the three types of seller-buyer relationship and have recognized some of the basic needs of e-business solutions for accelerating the emergence of software component businesses revolving around these types of relationships, it is for example still unclear how various actors in the software and other industries will position themselves wrt. the emerging markets. Therefore, an automation company may after all need to establish its own software

component market place, instead of taking in use a supply chain management system together with its OEM software component suppliers!

Acknowledgements

The research described in this paper was generously supported by VTT Electronics (www.ele.vtt.fi).

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