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POSTGRADUATE PAPER

Competitive Paper

TOWARDS E-PROCUREMENT STRUCTURES IN POOLED SOURCING STRATEGIES

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INTRODUCTION TO ELECTRONIC PURCHASING CONSORTIA

Strategic management of global procurement operations has become an increasingly important issue in supply chain management. One of the main reasons is the concentration on core competencies at the company level, which led to a significant increase in sourcing activities. Therefore, procurement savings can hold significant business value and impact on profit. However, organisations can have negotiated to the lowest procurement price available according to volume. It then becomes necessary to look at other possibilities, such as forming purchasing consortia. According to Hendrick (1997), a purchasing consortium is '*a formal or informal arrangement, where two or more organisations, who are separate legal entities, collaborate among themselves, or through a third party, to combine their individual needs for products from suppliers and to gain the increased pricing, quality, and service advantages associated with volume buying'*. Essig (1999) notes that a purchasing consortium may be just one element of a supply strategy and may be combined with other effective sourcing strategies such as global sourcing, single sourcing, system sourcing, among others.

In the literature on purchasing consortium issues however, there has been little empirical research investigation focusing on a detailed analysis of ICT-based procurement strategies. Harland (1996) points out that although some research on structural aspects of supply alliance networks has been in evidence in the 1990s, little about supply alliance networks and less about strategies for their creation and management has been formulated. The strategic network theory states that the locus of value creation may be the network rather than the firm (Gulati et al., 2000). The network approach and the literature about strategic alliances have provided new insights into co-operation between actors based on a value chain, but recent research shows that relationships also develops between competitors (e.g. Easton & Arajou, 1992; Nalebuff & Brandenburger, 1996). Electronic purchasing consortia (EPC) enable purchasing organisations, to varying degrees, to electronically conduct tasks that are necessary for the management of demand aggregation of two or more legal entities, provide

efficient ICT-based communication infrastructures and rely more on electronic communication than face-to-face contact. While some researchers (e.g. Arnold, 1996; Essig, 1999; Hendrick, 1997; Quayle, 1999; Vigoroso, 1998) have explored purchasing consortia in more detail, limited attempts have been made to focus on the electronic procurement aspect in this field. Only Corsten and Zagler (1998) have proceeded with an action research project to electronic purchasing consortia and describe various tasks required for EPC management. However, their study did not include important research issues such as e.g. the empirical level of EPC adoption with regard to industry sectors' structures and anti-trust limitations, a categorisation of EPC management structures and scope, revenue models, etc. that are explained and elaborated on in more detail in the following.

THEORY BACKGROUND

Pooled sourcing strategies are not a new concept. Co-operative purchasing has been practised in non-profit institutions in the public sector for more than a century. Due to the concentration on core competencies, the trend among industrial enterprises towards the formation of strategic demand aggregation alliances started mainly in the last two decades and is described as consortium purchasing (Essig, 1999). However, the theoretical foundation for EPC is more complex, going well beyond the field of purchasing. Amit and Zott (2001) claim that no single strategic management theory can fully explain the value creation potential of e-Business. They note that rather, an integration of the received theoretical perspectives on value creation and a multi-perspective approach is needed, as '*(…) virtual markets broaden the notion of innovation as they foster new forms of collaboration among firms (rather than merely new products or production processes) and involve new exchange mechanisms and unique transaction methods'*.

An integration of strategic management theories is required to situate EPC in literature. The resource-based theory (e.g. Barney, 1991) and the positioning stream (e.g. Porter, 1985) to competitive advantage have not addressed issues where industrial firms have not as such

developed critical resources and capabilities but in co-operation with other firms. This theoretical perspective suggests that competitive advantage can also be developed through inter-firm co-operation and links. That is why the theory of strategic networks and alliances (e.g. Gulati, 1998; Jarillo, 1988), which are based on a continuum between market and hierarchy, is very relevant to EPC as a further paradigm to competitive advantage.

Corsten and Zagler (1998) state that electronic purchasing consortia may exploit synergetic potentials of economies of scale and scope (e.g. Montgomery and Wernerfelt, 1988) without the diseconomies of increased transaction and communication costs (e.g. Williamson, 1975). EPC as a hybrid co-operation form can effect economies of scale and scope and are based on the model of transaction and production cost theory. Symbiosis is the driver and a prerequisite for successful consortia (Essig, 1999). However, the effects are diminishing with increased asset specificity.

The literature review on the network and synergy concept can provide a theoretical foundation why electronic purchasing consortia are formed. Rozemeijer (2000) argues that synergy is all the new value that can be added through organisation and the structure of interrelationships between independent units. However, EPC theory requires integration of virtual structures in strategic alliance networks and virtual organisation (e.g. Bakos and Treacy, 1986; Malone et al, 1987), dis- and reintermediation (e.g. Wigand and Benjamin, 1996) as well as e-Procurement strategies (e.g. Gebauer and Zagler, 2000) to fully explain EPC. Traditionally, lack of integration and communication infrastructures were regarded as one of the biggest barriers preventing the adoption and success of purchasing consortia.

Electronic purchasing consortia, as a network enabler, can potentially offer a more efficient communication infrastructure with lower transaction costs (Corsten and Zagler, 1998). Electronic support can eliminate some inefficiency related to purchasing consortia. Metamediaries such as e-Marketplaces and procurement service providers can enable firms to adopt EPC systems. Replacing expensive EDI solutions governed by only one buyer in a

closed system, low entry costs, fast return on investment and protection of existing EDI investment, recent developments in XML-programming, are all reasons for the transformation of the supply chain into a network by Internet technologies (Richmond et al, 1998).

Knudsen (2002), however, points out that there are still some uncertainties as to how the purchasing departments' overall performance can be improved by e-Procurement. E-Procurement solutions and concepts are very diverse and have many different meanings. De Boer et al. (2002) note in that respect that the potential merit of those various e-Procurement concepts, such as e.g. electronic catalogue systems and software, electronic auctions, intelligent agent applications, electronic marketplaces, seems largely undisputed (e.g. Croom, 2000; Smelzer and Ruzicka, 2000). However, with regard to the wide range of solutions available, many firms still struggle with assessing the suitability of e-Procurement for their purchasing processes and mainly adopt a 'wait and see' approach. Moreover, there is no one best way to organise for purchasing synergy and to improve inter-organisational demand aggregation and purchasing co-ordination practices.

Approaches can range from voluntary informal EPC co-operation among purchasing firms to more formally managed co-operation structures (e.g. the laissez-faire model, in which a procurement service provider or e-Marketplace can act as a lead source for purchasing organisations and suppliers and provides e.g. product information or specifications) as well as to outsourced solutions (i.e. the mediated operating model, in which a third-party negotiates or aggregates demand on behalf of buyers or suppliers). The level of anonymity between the EPC partners is a varying parameter that is closely related to the co-operation type. When search costs, asset specificity, the level of uncertainty and the benefits from long-term relationships are low, purchasers and sellers are more likely to interact with virtual anonymity, as is the case in highly liquid commodities markets. Another classification

involves the type of EPC market mechanism and negotiation processes. It was found that several EPC trading and aggregation models exist that can range from:

- EPC with electronic requests for quotation (e-RFQ) or reverse auctions.
- Pre-production demand aggregation price curves (i.e. multiple buyers can electronically aggregate their orders around a supplier's pre-set and pre-production shipping date at the expense of additional inventory costs for purchasing organisations).
- Time limited buy-cycles (i.e. prices continually amend in pre-set increments and time-frames as new group orders are electronically placed).
- Buy-cycles with rebate schemes (i.e. a rebate is granted once the total number of purchasers has been electronically finalised).
- Pre-negotiated infomediation (i.e. EPC providers pre-negotiate purchasing prices based on aggregated demand and electronically link buyers and suppliers, but do not take ownership of products).

Full-service third-party intermediaries do not clearly fall into the EPC continuum between market and hierarchy by definition per se. At the same time, the EPC market mechanisms and adoption factors are linked to parameters, which include, but are not limited to, the level of company size, purchasing maturity, product customisation, breadth of value adding services, level of co-opetition, that require to be researched more closely in the following.

RESEARCH METHODOLOGY

The research methodology follows a positivistic approach in order to assess the overall statement: “Effective participation in electronic purchasing consortia can have the potential to enhance competitive advantage. Implementation therefore requires a clear and detailed understanding of the major process structures and drivers.” In order to better understand these variables, the authors have tested several hypotheses against empirical data (Figure 1) and transferred the variables upon the technology-organisation-environment framework

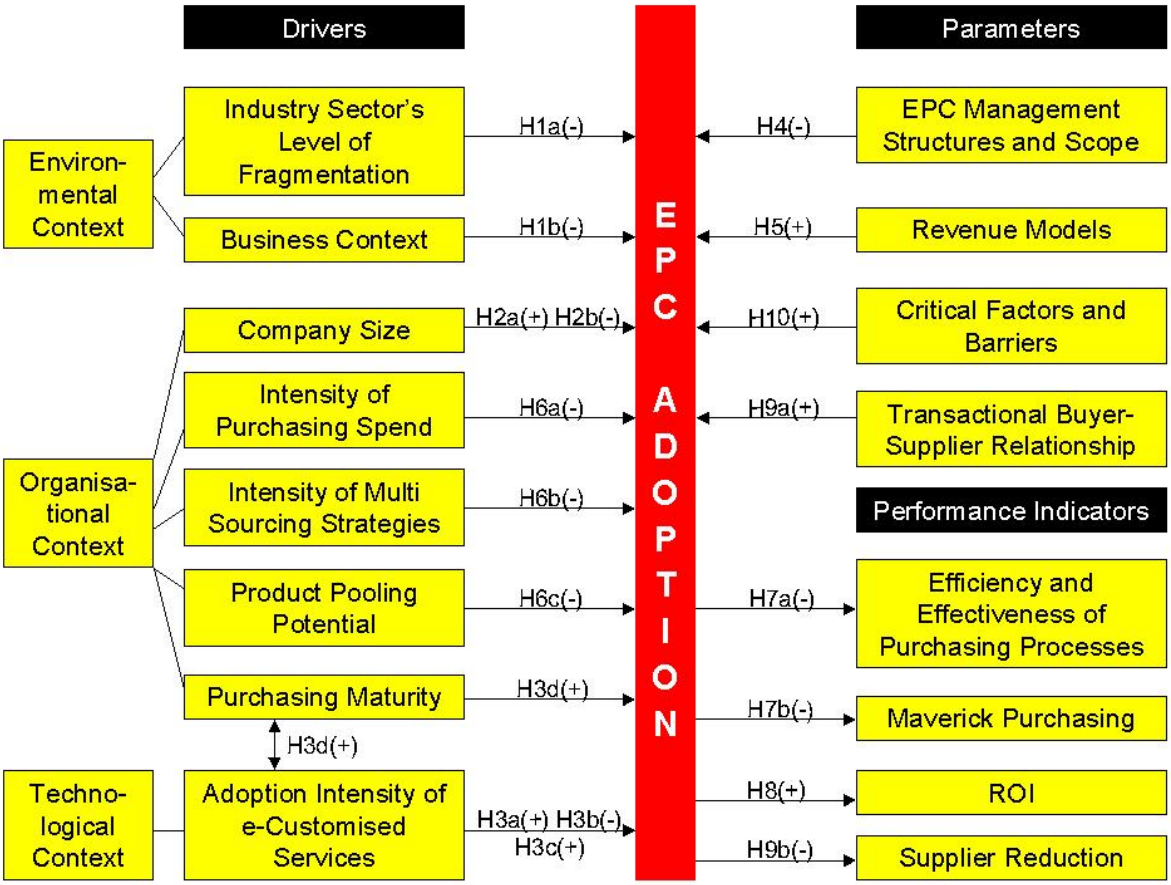
(Tornatzky and Fleischer, 1990). The framework has a solid theoretical basis and good potential of transferring it to EPC specific factors (Figure 2).

For the assessment of empirical data, an online survey instrument for e-Marketplaces and procurement service providers was implemented and pre-tested among academics and practitioners. Questionnaires were sent electronically to the population of 102 international active e-Marketplaces and procurement service providers in the automotive, electronics and closely related industries (e.g. metals, plastics). Reasons for the choice of the sectors derive from the background that both industries are pioneers and advanced in supply chain management and e-Procurement.

A final response rate of 42% resulted from the survey on e-Marketplaces / PSPs. Most questionnaires were completed by managing directors (35%) as well as marketing managers (30%). Additional findings were achieved from a survey among 400 purchasing organisations in the automotive and electronics industry in Ireland and Germany, both multinationals as well as SMEs randomly selected from established industrial databases. The response rate could be increased to 128 organisations (i.e. a response rate of 32%), which were predominantly manufacturers and processing companies. The participants have been mainly purchasing managers (40%), followed by managing directors (16%), operational managers (15%) and IT managers (13%). Both response rates can be considered as satisfactory in comparison to other survey research. For example, Bonaccorsi and Rossi (2002) specify that a response rate of 17% is very good for mail surveys in general. The survey data was tested for statistically significant differences in the responses of early and late returned surveys. No significant differences were found, suggesting that the sample is broadly representative for the population. Based on the surveys' data, the following hypotheses were tested (detailed statistical tests can be obtained on request) and modelled upon the technology-organisation-environment framework:

Figure 1. Listing Of Hypotheses	
Construct 1: Industry sectors and take-up of electronic purchasing consortia	
H1a: Industry sector's level of fragmentation is positively related to EPC offering and importance.	**Not confirmed**
H1b: Higher perceived pressures from the business context have a positive impact on EPC adoption and importance to purchasing strategy.	**Not confirmed**
Construct 2: Relationship between firm size and adoption of electronic purchasing consortia	
H2a: The size of purchasing organisation is positively related to EPC adoption, but not to EPC importance.	**Confirmed**
H2b: The size of e-Marketplace / PSP is positively related to EPC offering and importance.	**Not confirmed**
Construct 3: The level of awareness and importance of electronic purchasing consortia and further customised services	
H3a: The level of EPC implementation and further customised services is increasing.	**Confirmed**
H3b: The provision level of customised services is positively related to EPC offering and importance.	**Not confirmed**
H3c: The adoption level of customised services is positively related to EPC implementation and importance.	**Confirmed**
H3d: Purchasing maturity is positively related to EPC adoption as well as to importance of EPC and further customised services.	**Confirmed**
Construct 4: Management structures, trading mechanisms and scope of EPC	
H4: EPC are positively associated with formal third-party reinfomediation.	**Not confirmed**
Construct 5: Revenue models for electronic purchasing consortia and reverse auctions	
H5: There is a shift from the traditional total cost accumulation and equal division among members in purchasing consortia to a greater variety and mixture of EPC finance models.	**Confirmed**
Construct 6: Relationship between purchasing spend, sourcing strategies and product feasibility to EPC.	
H6a: Purchasing spend is positively related to EPC adoption and importance.	**Not confirmed**
H6b: The integration level of multi sourcing strategies is positively related to EPC adoption and importance.	**Not confirmed**
H6c: The average product pooling potential is positively related to EPC adoption and importance.	**Not confirmed**
Construct 7: Level of benefits and drawbacks of electronic purchasing consortia to purchasing organisations	
H7a: The effectiveness and efficiency level of procurement activities is positively related to EPC adoption and importance.	**Not confirmed**
H7b: The level of maverick purchases is negatively related to EPC adoption and importance.	**Not confirmed**
Construct 8: Relationship between ROI and electronic purchasing consortia / reverse auctions	
H8: The potentials of economies of scale and scope within electronic purchasing consortia can exceed the diseconomies of increased transaction and communication costs	**Confirmed**
Construct 9: Level of benefits and drawbacks for suppliers that participate in electronic purchasing consortia	
H9a: EPC are positively correlated with the arm's length (exit) buyer-supplier relationship.	**Confirmed**
H9b: Supplier reduction is positively related to EPC adoption and importance.	**Not confirmed**
Construct 10: Critical factors in creating and managing electronic purchasing consortia in future	
H10: Non-providers of EPC underestimate the importance of a critical mass of products purchased in EPC.	**Confirmed**

Figure 2. Hypotheses Modelling in Accordance to Technology-Organisation-Environment Framework



DISCUSSION OF FINDINGS

A number of environmental characteristics have been studied in the academic literature including e.g. external influence, government regulations, market uncertainty, trust, critical mass, etc. (e.g. Grover and Goslar, 1993; Tornatzky and Fleischer, 1990). The surveys focused on the following characteristics of environment context for EPC: Industry fragmentation and pressures from business context. Most empirical studies recognised competitive pressure from the business context as an adoption driver (e.g. Grover, 1993; Iacovou et al., 1995). Coming from the literature review it was assumed that pressures from the business context could have a direct effect on EPC adoption and purchasing strategy of companies in different industry sectors (or external environments). Surprisingly, pressures

from the business context (operationalised as a four-item construct with a Cronbach's alpha of 0.63) do not appear to have a significant impact on EPC adoption (F = 0.81, 1-p = 62.80%) or EPC importance to procurement strategy (R = 0.18, F = 0.41, 1-p = 61.80%)). The finding here confirms Thong (1999) that competition does not provide a direct "push" for purchasing organisations to enhance their ICT systems. While business context pressures can not be identified to significantly affect EPC adoption, Rozemeijer (2000) claims that they can still trigger changes in corporate strategy and structure, which in turn then may stimulate companies to take measures to create competitive advantage in purchasing. For example, large purchasing organisations were well aware of EPC due to reasons such as e.g. their size, high level of investment budget and market share, but EPC adoption among large firms can be limited due to anti-trust issues.

According to the trade commissions, these legal limitations are amenable to traditional anti-trust analysis whether or not competition is affected by monopsonistic or oligopsonistic buyer power (Federal Trade Commission, 2000). The further EPC extend beyond the 'safe harbour', which under EU guidelines is fixed at 15%, the greater the risk of a negative competitive effect. In the US, if less than 20 percent of a market is affected by an exclusive arrangement, it will likely avoid regulatory scrutiny because it falls within the antitrust safety zone. Therefore, the degree of industry concentration / fragmentation and external view of competition was required to be integrated into the analysis of environmental context.

Purchasing consortia can focus on both horizontal and vertical integration (in accordance with e.g. Powell, 1990). Strategic alliances are horizontal co-operation forms, whereas networks can describe both vertical and horizontal co-operation forms between companies of different tiers within the supply chain. A vertical integration of EPC network structures in terms of supply chain management (e.g. between manufacturers and first tier suppliers) can be identified in some cases from the survey data, while horizontal cross-industry EPC strategic alliances were found to be more relevant in practice. It can be argued that this is the

main reason why it could not be statistically demonstrated that EPC offering is positively associated with industry sectors‘ level of fragmentation (assessed on a scale from 1 = very concentrated to 4 = very fragmented).

Theoretically, the positioning stream would indicate a strong bond between the level of industry concentration, anti-trust legislation and EPC implementation. However, this direct link is not supported by the survey data in the automotive and electronics industry. It cannot be concluded that the level of industry concentration significantly affects EPC adoption (F = 0.01, 1-p = 12.75%) or EPC importance to purchasing strategy (corr. coef. +0.02, 1-p = 8.10%).

The surveys revealed that EPC are often designed of cross-industry collaboration structures or for products (e.g. commodities) where potential anti-trust issues are not likely to arise. Therefore, anti-trust limitations still have an impact on EPC structure in dependence of factors such as e.g. size of co-operating members and buyer power in EPC, type and level of EPC network structure and number of competitors, EPC product spectrum and market share. For example, the survey results demonstrated that none of the consortia-led e-Marketplaces / PSPs offer any electronic purchasing consortia to date. Although they would already have finished decisive EPC collaborative phases such as e.g. finding partners, building up trust and commitment among the members, getting standardisation agreements in place, demand aggregation is mainly not pursued due to anti-trust limitations (as a result of their high level of market share and buyer power).

For example, the automotive consortia-led e-Marketplace Covisint specifies on its website: *“First, Covisint will not aggregate the purchases of one OEM with those of another OEM. Second, Covisint will not offer aggregated purchasing services for any automotive-specific parts or materials. Third, Covisint's future aggregated purchases of non-automotive specific parts (such as office supplies, cleaning supplies, etc.) will always be within the applicable competitive law guidelines in the market in which the purchases are made.”*

By forming EPC within Covisint, several OEMs would dominate the automotive purchasing market share world-wide. Regulatory issues prevent consortia of automotive manufacturers from pooling their demand for production parts. Nonetheless, Covisint has taken a very conservative approach: Vertical demand aggregation between OEMs and tier 1 suppliers (for e.g. raw materials) which is common practice in the automotive industry was also not integrated. Therefore, EPC are mostly built of horizontal cross-industry collaboration structures with a relatively low level of co-opetition. EPC providers among e-Marketplaces / PSPs specified that the average number of competitors against non-competitors in EPC is 24%, while purchasing organisations identified that only 15% of EPC are made up of direct competitors.

Co-opetition seems to occur in some context in EPC; however, a majority of EPC supply networks is established among non-competitors in order to avoid anti-trust issues, among other important reasons such as e.g. the potential loss of company-specific proprietary data to competitors. Overall, a direct link between the environmental context (based upon pressures from business context and level of industry fragmentation) and EPC adoption could not be statistically supported from the surveys. However, it can be acknowledged that the environmental context and the positioning stream have an effect on the type and level of EPC co-operation and structure.

An inward focus on EPC resources and capabilities was analysed as well in terms of technological and organisational context. In literature, technology resource has been consistently demonstrated as an important factor for successful ICT adoption (e.g. Crook and Kumar, 1998; Grover, 1993; Kuan and Chau, 2001). Contrary to the organisational context and the environmental context, Tornatzky and Fleischer (1990) do not specify any particular attributes of the technological context, which facilitate or inhibit the adoption of technological innovations. The surveys focused on the overall adoption intensity of customised services (operationalised by a 11-item scale with a Cronbach’s alpha of 0.83

including services such as e.g. tracking / tracing, accounts payables and receivables processing, collaborative design) in order to represent technological context. It was learnt from the surveys that many e-Marketplaces and PSPs still lack provision of customised services to date. Gebauer and Zagler (2000) confirm that the lack of support for flexible strategic sourcing applications such as e.g. collaboration tools, complex bidding systems, multi-stage decision support or context-sensitive project-specific information systems, is a reason for frequent complaints by supply managers. The survey results revealed that e-Marketplaces / PSPs in general plan to significantly increase the offering of customised services in future in order to further complement their service infrastructure.

The adoption level of customised services among purchasing organisations is positively related to EPC implementation (F = 15.35, 1-p = 99.98%) and to EPC importance to procurement strategy (corr. coef. +0.53, 1-p = >99.99%). EPC adopters among purchasing organisations implement a significant wider breadth of customised services and enabling technology than non-adopters.

The findings coincide with the view of Barratt and Rosdahl (2001) and Wood (2000), who regard customised services such as order fulfilment and financial settlement as key areas to technology competence. The importance of having financial services is made even clearer by Keenan (2000), who suggests that in fragmented markets, e-Marketplaces and PSPs must offer a “frictionless” environment, because the parties do not necessarily have previous relationships and have therefore not built up any trust between them. E-Marketplaces / PSPs seem to have realised this potential and try to increase the offering of customised services in future. However, it could not be established that EPC providers offer more customised services than non-providers. The provision level of customised services is not positively related to EPC offering (F = 0.10, 1-p = 24.83%) and EPC importance (corr. coef -0.02; 1-p = 12.30%).

Although strategic e-Procurement and electronic purchasing consortia are still in its infancy in Ireland and Germany and only 7% of purchasing organisations have adopted EPC to date, some groundwork appears to be in place with e-Marketplaces / PSPs (i.e. 44% EPC adoption rate). Only 27% of e-Marketplaces provide EPC in comparison to 82% of PSPs. The findings suggest that e-Marketplaces generally still have potential to develop and integrate EPC. The surveys also indicated that most companies (especially SMEs) are still in the early stages of developing and implementing a strategy to e-Procurement and are still trying to understand their many options (such as EPC), weighting up the pros and cons, or holding back until more is know about this fast-changing area.

For the future, both purchasing organisations as well as e-Marketplaces / PSPs specified an increase in EPC integration. Nonetheless, only 18% of purchasing organisations plan to adopt EPC in future and therefore, EPC will not achieve a major breakthrough within the next five years. EPC are in many cases regarded by both purchasing organisations and e-Marketplaces / PSPs as an 'add-on' to other customised services. However, it was statistically proven that EPC adopters among purchasing organisations implement significantly more customised services than non-adopters and are ahead of them technology-wise. The technological context in terms of the overall adoption level of customised services could therefore be positively related to EPC adoption among purchasing organisations.

It is also important to analyse the organisational context and its impact and effect on EPC adoption. Organisational context was measured on the basis of the following specific indicators within the surveys: purchasing maturity, company size, intensity of purchasing spend, intensity of multi sourcing strategies and product pooling potential. Perry and Danziger (1980) showed that one of the most important factors in the adoption of ICT by local government was staff competence. They claim that when employees were not very well trained in using information technologies, this inadequate training resulted in resistance to change, resistance to use, and the inability to utilise information technologies to their

capacity. The survey data statistically confirmed that purchasing maturity (the level of professionalism in purchasing, which was operationalised as a five-item construct with a Cronbach's alpha of 0.65), could be identified as an important process enabler and driver to EPC.

EPC adopters are significantly more mature in purchasing than non-users (F = 17.43, 1-p = 99.99%). A multiple regression test also proved that the more mature the purchasing function, the more important are 1) EPC to procurement strategy (R = 0.69, F = 2.38, 1-p = >99.99%) and 2) further customised services to procurement strategy (R = 0.56, F = 0.22, 1-p = >99.99%). However, based on the results from the surveys, there is overall still much room for improvement in purchasing maturity among purchasing organisations, especially in the areas of EPC and e-Procurement training, development, implementation and co-ordination.

Another variable analysed within the organisational context was intensity of purchasing spend and its impact on EPC adoption. The percentage of purchasing spend is relatively high (approx. 60% of turnover, which is a result of changing business context such as e.g. concentration on core competencies, globalisation, developments in ICT) and quite even within the automotive and electronics industry sector. There is no statistical evidence for a positive correlation between purchasing spend and EPC implementation (F = 2.41, 1-p = 88.11%) and importance (corr. coef +0.12; 1- p = 82.30%).

It was statistically demonstrated that the size of purchasing organisations is positively related to EPC adoption to date (F = 6.31, 1-p = 98.72%), but not to EPC importance (R = 0.12, F = 0.82, 1-p = 54.20%). Due to their capital and skills resources, large organisations have better access to EPC adoption to date. Firm size has been consistently recognised as an adoption facilitator in academic literature. Large purchasing firms, since they operate closer to the technological frontier, are more often engaging in EPC, but also have to design, due to their buyer power, EPC structures that do not raise anti-trust issues. From the surveys it was confirmed that the size of purchasing organisations is a process driver for EPC adoption,

while the size of e-Marketplaces / PSPs is not positively related to EPC offering (F = 0.00, 1-p = 7.39%) and importance ((R = 0.23, F = 0.58, 1-p = 11.60%). The survey data indicates that other factors such as for example the business and service strategy of e-Marketplaces / PSPs can be more relevant for the decision of EPC offering.

Within the organisational context, it was also anticipated from the literature review that an important driver for EPC adoption would be the degree of product homogeneity and pooling potential. While no significance could be established that the average pooling potential of the entire product spectrum is positively related to EPC adoption (F = 0.60, 1-p = 55.24%) and importance (corr. coef. +0.15, 1-p = 88.50%), the surveys' findings revealed that there is a significant amount of products that can be potentially pooled within almost all e-Marketplaces/ PSPs and purchasing organisations. EPC providers and users still have a good potential to increase their average present pooling of products. Statistically, it was concluded that EPC initiatives are not directly linked to the homogeneity of the underlying product specifications, but to company size and purchasing maturity. Therefore, EPC suitability of products can be regarded more as a filtering rather than an explanatory variable.

Products that are characterised by a high degree of standardisation and homogeneity as well as a low level of asset specificity were identified to be well feasible for EPC. As custom products are traditionally very firm specific, not standardised and often very decisive for the overall success of purchasing organisations, EPC for custom products with high asset specificity may not have a high level of synergy potential and therefore may not result in a high level of co-operation among purchasing organisations. Complex modules with high asset specificity are more difficult to proceed by EPC because the parts are rarely sourced entirely on the basis of price, but on concept competition, supplier capabilities and in most cases single sourcing.

The survey data suggests that EPC co-operation predominantly takes place for the following spend categories: indirect materials, commoditised products in production and services.

Literature traditionally uses specialised goods as an indirect measure of high level of asset specificity of components, whereas indirect materials or commoditised products in production stand for a lower level of asset specificity (e.g. Masten, 1984). Given the very nature of product sourcing processes with low asset specificity, it is significant that EPC are perceived to be more feasible for arm's length relationships than collaborative relationships with suppliers (Chi2 = 33.35, df = 1, 1-p = >99.99%). Historically, the vast majority of buyer-supplier relationships have been conducted in an arm's-length mode. However, Clemons et al. (1993) argued that firms would move toward long-term relationships with a smaller set of suppliers. Their "move to the middle" argument emphasises that purchasing organisations tend to outsource more and reduce their number of suppliers, but develop more collaborative relationships with them.

95% of e-Marketplaces / PSPs acknowledged that collaboration between buyers and suppliers is becoming more important in future. However, there was no evidence that EPC adopters to date had a stronger tendency towards reducing their suppliers (F = 0.31, 1-p = 41.21%). A correlation test also confirms that the overall number of suppliers is not related to EPC importance (corr. coef. +0.01, 1-p = 14.60%).

The findings suggest that a combination of co-ordination mechanisms is involved, in accordance with the mixed mode hypothesis (Holland and Lockett, 1993). According to them, firms operate on a continuum between markets and hierarchies and use combinations of market and hierarchy-type relations, which they maintain simultaneously. EPC adopters among purchasing organisations mainly take advantage of demand aggregation for a small proportion of overall purchases and for products with a lower level of asset specificity, that are predominantly sourced by arm's length relationships, while collaborative hierarchical sourced products are mostly left untouched.

This conclusion is supported by the statistical analysis that the integration level of multi sourcing strategies is not positively related to EPC adoption (F = 1.32, 1-p = 74.91%) and

importance (corr. coef. -0.10; 1-p = 75.80%). This finding confirms the mixed-mode hypothesis and Sambamurthy et al. (2002) that many buyer-supplier transactions, conducted by the Internet, conform more closely to the arm's length nature of web-based relationships.

Several variables on EPC structures were also added to the conceptual framework in order to complement the findings. 44% of purchasing organisations would opt for informal EPC management, whereas 25% would require a formal third-party management by members and 31% a neutral EPC management by specialised agent. It could not be demonstrated that EPC are significantly associated with formal third-party reinfomediation (Chi2 = 1.66, df = 1, 1-p = 80.25%). EPC disinfomediation seems to occur in some context. However, it appears from the survey evidence that an electronic purchasing consortium can also well be associated with a third party organisation or infomediary that serves as a mediator between the firms in a network. Infomediaries can perform a variety of innovative services such as e.g. reverse auctions, consulting and moderation services, which are often complex, inconvenient or costly for EPC members to undertake. As a result, adaptation of metamediary roles, or EPC reinfomediation was found to be more common than disinfomediation.

The data analysis revealed that EPC providers are predominantly buyer-driven infomediaries. Whereas only few EPC providers were independent and neutral to buyers and suppliers, seller-centric providers were very rare. Procurement service providers in particular have a buy-side focus and use semi-automatic or non-electronic communications tools as well for EPC that may be necessary to gain customers' system trust to participate in electronic purchasing consortia. Virtualisation of purchasing consortia is therefore better viewed as a continuum. The majority of e-Marketplaces on the other hand, according to the survey research, focus more on automating operational purchasing instead of strategic sourcing services. PSPs, the main group of EPC providers, direct their activities more closely towards strategic sourcing and are predominantly concentrating on the buy-side.

The buy side focus of EPC providers can also be observed in the fact that they charge mainly buyers (42%) or both buyers and suppliers (53%). It appears from the survey data that there is a shift from the traditional total cost accumulation and equal division among members in purchasing consortia (Hendrick, 1997) to a greater variety and mixture of EPC finance models. EPC adopters make use of a variety of different EPC finance models, whereby fixed monthly / yearly fees, transaction costs and fees for value adding services were mostly cited in the surveys. It could not be confirmed that buyer transaction fees are the most widely accepted and dominant revenue model in EPC. Therefore, it is a significant challenge to leverage buying power while tailoring individual member's requirements, e.g. specific EPC revenue models.

The knowledge of critical factors and barriers to EPC in particular play an important role. Consortium partners have to take care to install a symbiotic system instead of commensalism or a parasite relationship. Therefore, variables to measure the EPC impacts on business performance were examined as well. Both tangible and intangible benefits and drawbacks to EPC have been identified in the surveys. The respondents indicated that the gross savings in most cases outweighed the costs related to EPC synergy initiatives.

It appears that average economies of scale and scope within electronic purchasing consortia could exceed the average diseconomies of increased transaction and communication costs. While a negative ROI occurred in some EPC context, an average positive ROI of 77% could be identified with an average net saving of 5.4% in purchasing costs. Apart from the positive ROI however, no significant correlation could be found between the overall level of efficiency and effectiveness of purchasing processes and EPC adoption ($F = 0.44$, $1\text{-}p = 48.42\%$) and EPC importance to procurement strategy ($R = 0.09$, $F = 0.15$, $1\text{-}p = 7.10\%$). This construct 'overall efficiency and effectiveness of purchasing processes' was built of a four-item scale with a Cronbach's alpha of 0.71.

It could also not be established that EPC users have a significant amount of lower maverick purchases than non-users (F = 0.13, 1-p = 28.08%). The survey data also revealed that the sharing of intangible benefits such as purchasing knowledge across businesses seems to be still rather rare.

Purchasing organisations cite barriers to knowledge sharing and demand aggregation such as a not adequate training and education in e-Procurement, a low degree of information on change management and a lack of maturity in service offerings from e-Marketplaces / PSPs. Main drivers for non-adoption of EPC further include a 'wait and see'-approach to the selection of e-Marketplaces / PSPs, security concerns and opposition to data sharing with other companies, the non-feasibility of custom-made products for pooling initiatives, a lack of standardisation, confidentiality, trust and commitment among potential members. The overwhelming concern was also a perceived loss of control with EPC and exposure to anti-trust regulations. The surveys' results confirmed that barriers were predominantly organisational or human based rather than technical. EPC providers cited critical factors for EPC such as strong management support, a high level of trust among the members and a critical mass of EPC purchases. EPC non-providers underestimate in particular the minimum needs or critical mass of EPC purchases required (F = 7.75, 1-p = 99.12%).

Most EPC adopters are quite satisfied and positive about electronic purchasing consortia and its contribution to competitive advantage and acknowledge that benefits can outweigh the drawbacks. Although there was also some scepticism from purchasing organisations and e-Marketplaces / PSPs, the overall consensus is positive that there is a wide array and potential for EPC applications in future. There is a growing realisation that over the longer term EPC can play a substantially more important role.

CONCLUSIONS

Though firms have been increasingly adopting ICT in their supply chain operations, there has been little empirical research on the adoption and diffusion of EPC, on the measurement of

key factors and structures affecting the adoption and diffusion as well as the performance impact of adoption. The findings can make a contribution to EPC theory development and indicate that EPC is a rich, multi-faceted domain. The developed framework can be a fruitful starting point for further EPC research. From the research, it is apparent that EPC, despite limitations, can be a valuable strategic tool worth consideration inside an integrated supply chain model.

The model of electronic purchasing consortia can represent a strategic procurement direction for the future in supply chain management and is developing, due to its long history, in an evolutionary rather than in a revolutionary manner. New electronic metamediaries such as e-Marketplaces and procurement service providers have the potential to interpose themselves between suppliers and buyers by taking advantage of new types of economies of scale, scope and knowledge, enabled by ICT. However, much more academic and practical work still needs to be carried out if the use of this type of electronic network is to be more widely adopted.

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