

The Unit of Analysis in E-Commerce Studies

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Abstract

In this paper, we raise the issue of the appropriate unit of analysis for e-commerce studies. Once it is acknowledged that the unit of analysis in e-commerce studies should comprise more than one firm, the question is, which organizations should be included, i.e. how to bound the unit? We discuss the e-commerce literature with regard to the implicit or explicit unit of analysis adopted there and then extend the literature review to include other concepts from industrial organization and economic sociology. In total, fourteen concepts are discussed and none is found to be sufficiently broad while at the same time also being amenable to bounding. We introduce a new approach based on the notion of the industry life cycle. The main proposition of our concept is that the unit of analysis should be defined differently for each life cycle stage. We also indicate how this could be done theoretically and empirically. There are, however, several open issues of this approach which need to be addressed by future research.

1. Introduction

Electronic commerce is a disruptive technology not only for practitioners but also for theoreticians. For practitioners, the question of identifying the right ‘business model’ is probably the most pressing one. This question is fundamental because the configuration of value activities might be affected rather than just the organization of individual activities. Thus, the forms of value creation will probably change including the forms of revenue collection.

For theoreticians, the problem is equally fundamental. First, the phenomenon of electronic commerce exposes the weaknesses of the traditional separation between the domains of company management and market analysis which are dealt with by the academic disciplines of organization theory/management science and economics respectively (Reimers and Li, forthcoming).

Second, and even more fundamental, the question of choosing the appropriate unit of analysis comes to the fore. Organization theory and management science take the existence of organizational boundaries for granted, although the question of appropriate delineation of organizational membership is sometimes explicitly addressed.

Similarly, economists assume that bounded markets or industries can, in principle, be identified although problems may emerge when delimiting concrete markets as evinced in the discussion about ‘relevant markets’ in industrial organization theory.

However, these difficulties seem marginal when limiting the analysis either to internal organizational issues or external market issues. They become central issues when discussing electronic commerce though.

The main benefit of electronic commerce stems from integrating operational processes across organizational boundaries. Thus, it will be necessary to extend its analysis beyond organizational boundaries too. But then the question is: how far? Would it be sufficient to include the immediate suppliers and customers of a ‘focal’ organization? But then these suppliers and customers will have links to other companies as well (notably competitors) which will certainly have an impact on the direct relationships with the ‘focal’ company with regard to setting up and operating an e-commerce system. Also, the notion of ‘supply chain’ indicates that it might not be sufficient to analyze direct customer-supplier relationships under conditions of time-based competition (Lee et al., 1997); rather, the customers’ customers and the suppliers’ suppliers need to be included as well.

Moreover, the institutional context of commercial relationships matters when considering the establishment of electronic commerce (Monse and Reimers, 1995). Thus, there should be a place for trade associations and other regulatory bodies (public and private) in the unit of analysis. But how to decide which institutions should be considered part of the unit of analysis and which should be considered as part of the external environment or the institutional context? Certainly, national lawmakers should be considered part of the institutional context, or should they?

This paper will address the question of how to delimit the unit of analysis in e-commerce studies. Specifically, it will try to assess possible systematic errors resulting from the choice

of different units of analysis implicitly or explicitly used in the literature and discuss an alternative unit of analysis which potentially avoids these problems. Also, implications for further research are outlined.

In the next section, the unit of analysis in e-commerce studies (explicit or implicit) will be discussed. Next, we will broaden the scope of our literature review to discuss potential theoretical approaches with regard to their implicit or explicit definition of the unit of analysis comprising economic and sociological theories. Finally, we will introduce our own proposal based on the industry life cycle concept to deal with the challenges posed by the phenomenon of electronic commerce regarding the definition of a unit of analysis which is broad enough to capture the complexities of this new phenomenon while also amenable to being bounded.

2. The unit of analysis in the e-commerce literature

Although not being representative, Table 1 has been compiled from a broad set of e-commerce studies and we believe that the list of units of analysis derived from this selection is complete with respect to the units of analysis mentioned in the e-commerce literature. However, the frequency counts implicit in the column listing of e-commerce studies as examples for the units of analysis listed in column 1 should not be interpreted as the set of studies used for compiling this list has not been drawn randomly.

Table 1: Units of analysis in the e-commerce literature

<i>Unit of analysis</i>	<i>Used in ...</i>
Transaction	Steinfeld et al., 1995; Clarke, 1993; O'Daniel, 2001
Supplier-customer relationship	Riemer et al., 2001; Johnston and Lee, 1997*; Whiteley, 1996; Reekers and Smithson, 1995; Cameron and Clarke, 1996
Supply chain	Klein, 2000; Klein and Schad, 1997; Lee and Whang, 1998; Markus et al., 2002; Pires et al., 2001; Kim and Umanath, 1999; Hawkins and Verhoest, 2002
Focal company	Johnston and Lee, 1997*; Andersen, 1999; Chan and Swatman, n.d.; Dai and Kaufman, 2002
Market	Kubicek, 1992; Alt and Klein, 1998; Tomak and Xia, 2002; Lee and Clark, 1996; Esbjerg, 1999; Salmi and Tuunainen, 2000
Industry	Christiaanse et al., 1996; Johnston and Gregor, 2000
Economy	Lucking-Reiley and Spulber, 2000; Son et al., 1999; Kshetri and Dholakia, 2002; Coppel, 2000
EDI initiative	Damsgaard and Lyytinen, 1998; Henriksen, 2000; Cassivi et al., 2002
Inter-organizational system	Kumar and van Dissel, 1996; Christiaanse and Huigen, 1997; Holland and Lockett, 1993; De and Ferratt, 1998; Swatman and Swatman, 1992; Boddy, 2000; Cash, 1985; Allen, 2000

* Study uses two units of analysis in is therefore mentioned twice in this table.

The entries have been loosely ordered from 'narrow' to 'broad' (with regard to the number of types of organizations included in each unit of analysis). The last two entries (EDI Initiative and Inter-organizational System), however, do not fit into this scheme and are thus appended at the end of the list. We will discuss each entry in sequential order.

Transaction

Choosing the transaction as the unit of analysis in e-commerce studies has the advantage of focusing on the most basic unit of any commercial activity. In addition, it is a rather easily observable unit (thus lending itself to quantitative analysis) and there is a broad consensus on a classification of transaction phases which would support studies of how e-commerce affects individual transaction phases differently. Also, it might be possible to classify different types of transactions and correlate them with types of e-commerce according to criteria of efficiency, effectiveness, or costliness. This, in turn, would allow for predicting the success of e-commerce initiatives or, alternatively, the prescription of types of e-commerce systems with regard to desired outcomes.

On the negative side, it might be very difficult to bound this unit since single transactions are usually elements of an ongoing business relationship. On the one hand, it is often not clear if and when a transaction has been finally settled. After-sales services and warranties render many transactions a pending issue for a potentially very long time. Similarly, determining the point of initiation could be close to impossible since a transaction starts with an act of the will on the side of the buyer or the seller. Also, in business relationships the de jure initiation of a transaction by sending a purchase order might be a routine or even automated process embedded in a long-term business relationship which might not be codified and the beginning of which might have to be traced back to early events in the history of an organization.

This problem of diffuse boundaries indicates a more fundamental one, namely the tendency of most transactions to be embedded in long-term business relationships. Thus, it would seem that choosing the long-term business relationship as a unit of analysis is more in line with real business behavior (including consumer behavior which is often characterized by long-term loyalty to brands).

A similar argument could be made with regard to the theoretical treatment of transactions in Commons' (1990) analytical framework who is well known for having proposed to establish the transaction as the unit of analysis in institutional economics (rather than the firm or the market). However, careful reading of his writings leads us to the conclusion that, in fact, he uses the notion of the Going Concern as his basic unit of analysis with a Going Concern defined as the expectation of an ongoing business relationship.

Thus, we conclude that choosing the transaction as the unit of analysis in e-commerce studies will create two problems: (1) It will be difficult to bound this unit in a concrete empirical context; (2) the nature of individual transactions might not be explicable without also considering the underlying, potentially long-term business relationship as a whole. Therefore, the latter would seem to be a more appropriate unit of analysis in e-commerce studies when compared to the transaction as a potential unit of analysis.

Business relationship

In contrast to a transaction a business relationship is less easily observable as a unit of analysis. Although there might be some proxy measures such as length and frequency of transactions, extent to which transactions are concluded without formal documentation, and existence of private activities among the parties involved in the relationship, it is the intention

of each party to continue the business relationship and the expectation that the other party will continue the relationship which constitutes a business relationship (Commons, 1990).

Once a business relationship has been identified empirically, however, it is more easily bounded than a transaction as a unit of analysis since the parties to a business relationship can be clearly identified.

As with the transaction, it is possible to identify different types of business relationships, such as collaborative relationships among SMEs (Cameron and Clarke, 1996) and correlate these with different types of e-commerce for predictive or prescriptive purposes.

However, a similar problem to that discussed with regard to the transaction emerges with respect to the business relationship as a unit of analysis, albeit on a higher level, namely that business relationships are affected by the network of all direct and indirect relationships each party entertains. Thus, the network of business relationships is to the individual business relationship what the individual business relationship is to the transaction as a unit of analysis. Specifically, often the main problems of establishing electronic data interchange do not stem from difficulties of adapting systems and procedures between the parties involved in a bilateral business relationship, but from the fact that, at the same time, other business relationships require different systems and processes which are costly to maintain simultaneously (Reimers, 1995).

As with respect to the transaction as a unit of analysis, a business relationship does not include the effects and requirements emanating from the linkages between the suppliers' suppliers and the customers' customers, i.e. from the increasing importance of considering processes across whole supply chains.

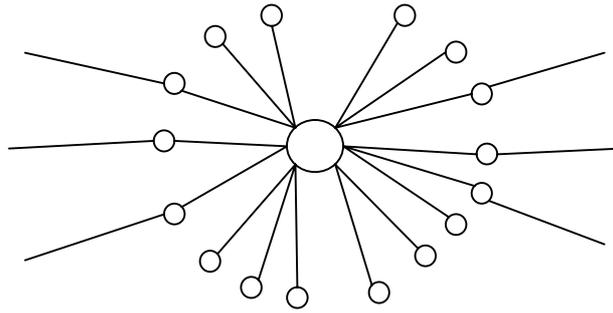
These two problems are partly addressed by the concepts of the focal firm and the supply chain to which we now turn.

The focal firm and the supply chain

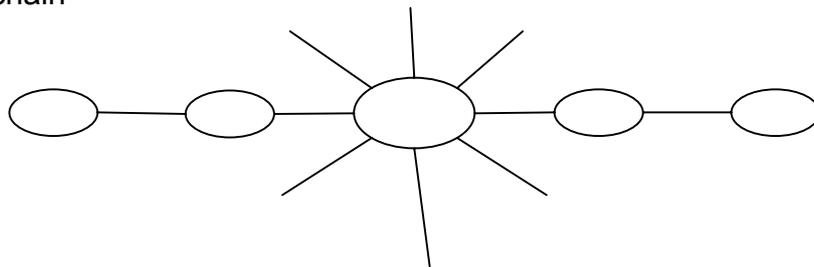
Both units solve, to varying degrees, the problem of mutually embedding business relationships, i.e. the fact that each business relationship provides (part of) the context of all other business relationships of one "organization" (firm, division) while, at the same time, all these other relationships form its context. Thus, these alternative units build on and extend the concept of the business relationship.

The differences between these two units stem from different degrees of extending the business relationship as a unit of analysis. The concept of the focal company uses the boundaries implicit in the concept of "an organization" (a firm or division) to delimit the range of business relationships by only including direct supplier-customer relationships in the unit of analysis (see Figure 1a). The concept of the supply chain extends this unit by also including indirect supplier-customer relationships, i.e. the relationships between the customers' customers and the suppliers' suppliers. However, the semantics of a 'chain' indicate that only a core set of relationships is considered on each production/distribution stage which reduces complexity (see Figure 1b).

a: Focal firm



b: Supply chain

**Figure 1: Focal firm and supply chain**

However, these units still do not address the problem of conflicting relationships which would only become visible when also considering business relationships of suppliers and customers with competitors, i.e. when extending the unit of analysis to the business or “inter-firm” network. As this concept has not yet been used as a unit of analysis in e-commerce studies, we will relegate its discussion to the next section. Suffice to say here that an important element would be missing in e-commerce studies when excluding conflicting business relationships from the unit of analysis while, at the same time, the task of bounding the unit of analysis becomes much harder when allowing for conflicting relationships to be included in the unit of analysis. With respect to further characteristics of these two units of analysis, we can refer to the discussion of the business relationship as a unit of analysis since these two concepts are simply extensions of that one.

Industry, market, and economy

As with the units discussed so far, the three units of industry, market, and economy can be understood as a series of stepwise extensions. The difference with the previously discussed units consists in the way of grouping of economic units (such as firms or households). Whereas the units discussed above (transaction, business relationship, focal organization, supply chain) were grouped along transaction relationships, the three units to be discussed here (industry, market, economy) are grouped by the criterion of similarity.

An industry consists of a group of firms using either similar type of main input material, similar production technology, or producing similar type of main output (product). A market extends the concept of an industry by including the group of either buyers or suppliers of an industry’s main type of output or input. Thus, a market is defined as a set of buyers and

sellers that are similar with respect to a particular type of input/output material. Note that a market is not defined along existing transactions or business relationships as it also includes potential participants (consider also the notion of “anonymous markets”). An important exception concerns the concept of “markets as networks” which will be discussed in the next section.

An economy consists of all producing and consuming units within a geographically or politically delimited entity. The similarity here consists of a similarity of geographical and political affiliation respectively. Again, the grouping of organized units is not done according to actual business relationships. For example, a national economy may be defined to include manufacturing plants that import all inputs and export all outputs.

The last unit (economy) is most easily bounded as decisions regarding the appropriate affiliation of an organized unit (such as a firm) with a political or regional entity only occasionally raise some problems. Delimiting industries and markets in terms of group membership, however, frequently creates significant problems as firms usually participate in more than one industry and one market as defined by main input and/or output characteristics.

Grouping by similarity facilitates statistical analysis. Also, national accounting systems have been established which enable easy access to data about all three units. Also for this reason, all three units lend themselves to statistical analyses such as impact studies. For example, the number and average size of firms in an industry might be associated with the use of e-commerce technologies.

However, as e-commerce technologies, by their very nature, always affect at least two firms at the same time that entertain a business relationship, it seems highly likely that e-commerce will grow along established relationships and networks. Thus, all effects detected in such studies are likely to be weak as they are mediated by existing structures of business relationships as long as these are not explicitly modeled. This, then, would lead to a different unit of analysis similar to those discussed above, i.e. the individual business relationship, a focal firm (and its supplier/customer network) or a supply chain.

Thus, we can summarize that the three units discussed here support a statistical analysis of e-commerce impacts or preconditions (so-called critical success factors) which, however, are likely to discover only weak associations as business relationships will mediate any such association.

EDI initiatives and Inter-organizational Systems

Analyzing an Inter-organizational System in its operating stage or during its genesis (in which case it would be called an IOS or EDI initiative) seems to be a natural choice for studying e-commerce, especially when adopting a case study method. Such a unit is readily bounded as only users of the system or participants in the initiative would be included in the unit and it also contains the business relationship as an elementary unit since an IOS will be laid over existing business relationships rather than new ones. Also, the unit can be observed almost physically as an IOS also consists of a technical layer in addition to its organizational features.

However, the decision not to participate in/use an IOS will be systematically excluded from analysis. Thus, one of the most important issues in e-commerce studies will be excluded too. For this reason, this unit seems not appropriate for e-commerce studies except for purely exploratory purposes. Any attempt to include non-users in the unit would raise the problem of how to bound this extended unit which would put us back to the beginning of our discussion.

3. Alternative units proposed in organization theory

The following concepts suggested in diverse literatures will be discussed here as alternative possible units of analysis in e-commerce studies:

- Markets as Networks
- Inter-firm Networks
- Alternative industry concept
- Organizational Fields and Innovation Communities
- Industrial Clusters

Markets as Networks

Beije and Groenewegen (1992) have suggested the concept of Markets as Networks. They review a diverse set of literatures from mainly European authors and contrast these with the view of the 'American Institutionalists' (mainly Oliver Williamson) who have also departed from the neo-classical concept of perfect competition and anonymous markets.

The main idea is to view markets as networks of mostly personal (socially embedded) relationships rather than an anonymous mechanism. Some efforts at refinement have been made, for example the proposal to analytically distinguish between actors, relationships, and resources, but the approach is mainly descriptive. It seems that there are no normative intentions (regarding regulation or welfare analysis) other than providing an alternative to the mainstream approach (with its inherent assumptions of free competition and self-regulation as the normative default rules).

The main problem with using this concept as a unit of analysis for e-commerce studies is that it cannot be bounded. In an open economy, a network of relationships can be extended without limit since there will always be a business relationship pointing to an organization not yet included in the group of organizations under consideration.

Inter-firm Networks

Sydow and Windeler (1998) have proposed a related concept, Inter-firm Networks, which, however, provides a way of bounding a network. To achieve this, they suggest that only those firms are included in the concept which entertain a special kind of business relationship with one another. The characteristics of this kind of business relationship are reciprocity and reflexivity.

Although this method clearly succeeds in bounding the unit of analysis, it seems not appropriate for e-commerce studies because it would be overly restrictive for this purpose. Reciprocity requires that firms mutually depend on each others' output; reflexivity means that they are aware of this mutual dependence. E-commerce seems to be useful also in cases where these two criteria are not met, for example in the case of an automobile supplier network in which the car manufacturer unilaterally depends upon the output of its suppliers.

In addition, this concept would exclude the dynamic aspect of business relationships. Specifically, a business relationship may evolve over several stages with only one of these being characterized by reciprocity and/or reflexivity. This dynamic characteristic of business relationships may be important for understanding or designing e-commerce systems.

Johnston and Gregor (2000) have also used the characteristics of a business relationship between firms to define an alternative concept of an industry. As Sydow and Windeler, they use the criterion of reciprocity. In addition, they also draw on the theory of structuration by Anthony Giddens to delimit their unit of analysis. According to this idea, only those entities are included in the unit which contribute to the structuring of its institutional environment. If the institutional environment of an organizational entity is not affected by this entity's behavior, it is part of the "remote environment" and thus excluded from the unit of analysis; otherwise, it is part of the "immediate environment."

However, the authors themselves acknowledge that these boundaries might be difficult to draw. Relationships within an industry might not be reciprocal and boundaries between the remote and the immediate environment may be blurred. By trying to link the concepts of Industry and Inter-firm Networks, both become diffuse. Therefore, we conclude that this alternative concept of an industry is too diffuse to function as a unit of analysis in e-commerce studies.

Organizational Fields and Innovation Communities

DiMaggio and Powell (1983) define an Organizational Field as "those organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products. The virtue of this unit of analysis is that it directs our attention not simply to competing firms ... or to networks of organizations that actually interact ..., but to the totality of relevant actors." (DiMaggio and Powell, 1983, p. 148).

Thus, the idea of an organizational field significantly extends the concepts of Markets as Networks and Inter-firm Networks by including the institutional dimension. This idea, however, does not only extend the concept, but also bounds it. The boundaries of the unit are determined by the area which is "recognized" in an institutional sense, i.e. legitimized and taken for granted (Aldrich, 1999). Thus, by choosing a "recognized area of institutional life" the researchers can bound their unit of analysis.

However, the advantage of using an institutional definition of the unit of analysis lies not only in the possibility to bound an otherwise unwieldy network of relationships but has also a potential theoretical benefits. Establishing an e-commerce system often resembles the creation of a collective good. Thus, the institutional structure of the unit of analysis in e-

commerce studies is likely to be of great importance. Using an institutional definition to define the unit of analysis provides easy access to the analysis of its institutional structure.

Empirically, Powell and DiMaggio suggest that an organizational field must be identified in an ongoing manner, i.e. it cannot be identified *ex ante*. Only as information about actors accumulate can it be decided which actors have to be counted as members of a specific organizational field and which must be excluded.

Still, the concept lacks a ready way of operationalization as it is not quite apparent what a “recognized area of organizational life” would be in the field of e-commerce studies.

Lynn et al. (1996) have explicitly identified the problem of bounding the unit of analysis in studies of inter-organizational phenomena and suggest to use an “innovation” as a delimiting device for their unit of analysis, the Innovation Community. However, by its very nature, an innovation is not institutionalized. Rather, the process of diffusion of an innovation is characterized by increasing levels of institutionalization. As soon as an innovation is fully institutionalized, it ceases to be an innovation and becomes part of a recognized area of institutional life. Therefore, an innovation cannot be used to define a recognized area of institutional life. This problem can also be seen from the circular fashion in which Lynn et al. link the problem of delimiting their unit of analysis and the purpose of their analysis: only those organizational entities shall be included in an Innovation Community which significantly contribute(d) to the underlying innovation; but the purpose of the analysis is to determine the significance of individual organized entities for the innovation under consideration.

Industrial Cluster

According to Porter (1998), “[a] cluster is a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities” (p.4). Thus, he enriches the concept of a network of business relationships by embedding it in its institutional context. In addition, he also heavily draws on the dimension of reflexivity as he emphasizes the moment in which actors become aware of them being participants in a cluster and the ensuing institutionalization of the cluster via, for example, business associations. However, it should be pointed out that Porter does not use an institutional definition of his unit of analysis. Rather, the boundaries around this unit of analysis are drawn according to a geographical entity (such as a region or a city) and only those institutions which are associated with this geographical entity are included in the unit of analysis.

Nevertheless, he follows Powell and DiMaggio with regard to the method of empirically identifying the unit of analysis and even goes so far as to suggest that actors might determine themselves whether they are part of the cluster or not. However, “[a firm’s] importance to productivity and innovation determine the ultimate boundaries [of the cluster]” (p. 6).

Thus, among the units discussed so far, this one seems to be the broadest while also being clearly bounded. However, again it would seem overly restrictive to use this unit in e-commerce studies since e-commerce might also be important outside and beyond the boundaries of one or several clusters. The task is to define a concept which is equally broad

as that of a cluster and equally bounded as a cluster while being more generally applicable to other productive configurations.

4. A New Proposal for the Unit of Analysis in E-commerce Studies

When considering a new way to define the unit of analysis specifically for the purpose of e-commerce studies, the most important requirement is to appropriately take into account patterns of cooperation and competition among companies that are expected to be, directly or indirectly, involved in an existing or future e-commerce infrastructure. Patterns of cooperation and competition represent the most powerful force for as well as constraint on developing a joint e-commerce infrastructure (Christiaanse and Huigen, 1997). This is, at least, our guiding principle for making a proposal for a new unit of analysis in e-commerce studies.

By now, there is considerable evidence for the claim that patterns of cooperation and competition among firms shift over time in a predictable way. Specifically, the concept of the industry life cycle has been broadly supported by empirical studies (Klepperer and Graddy, 1990; Anderson and Tushman, 1990; Utterback and Suárez, 1993; Filson, 2002). Depending upon the theoretical models used to explain the industry life cycle, two, three, or four distinct phases are distinguished (cf. Utterback and Suárez, 1993; Klepperer and Graddy, 1990, and de Jong, 1986 respectively for examples of each). For our purpose, we chose the model of Utterback and Suárez who, in turn, build their model on the work of Utterback and Abernathy (1975). This model distinguishes between two phases which are separated by the emergence of a dominant design. The first phase is launched by a technological breakthrough or 'discontinuity' after which a small number of firms start to experiment with the new technology and try to find a way to transform it into a sellable product or service. Once some of these experiments prove to be economically viable, more and more firms are attracted to the emerging industry that will continue to modify product designs in order to differentiate themselves. Thus, the main form of competition is based on product innovation leaving entry barriers low.

However, once these several product designs converge into one, the dominant design, the nature of competition shifts dramatically. As companies can no longer demand a premium over costs via product differentiation, they need to cut costs in order to maintain profit levels. Thus, competition shifts away from product innovation to process innovation. As the latter typically involves the substitution of machines for manual labor, economies of scale emerge driving out smaller companies from the market and steadily increasing entry barriers. As a consequence, the number of companies drops sharply until a few large companies are left. These then consolidate their market shares which tend to remain stable until a new cycle begins.

Our main proposition is that the unit of analysis for e-commerce studies should be defined differently for each of these two phases since the patterns of cooperation and competition are fundamentally different between them. In addition, e-commerce is likely to play very different roles in each phase and the range of organizations to be included in the unit of analysis varies significantly across phases. Also, the ways of empirically identifying and bounding the unit of analysis are different for the two phases.

In the initial phase, companies are engaged in a 'friendly' form of competition since a specialized supplier industry does not exist yet so that complementary non-generic components can only be provided either internally or via alliances with (potential) competitors (Gemser et al., 1996). Also, regulatory authorities are unlikely to step in as firms are small and/or market shares have not yet stabilized.

The role of e-commerce in this constellation will mostly be to facilitate novel (potentially experimental) ways of packaging/combining technical features and service components into a product. It would resemble more a collaboration tool than a tool for supply chain management.

As no dedicated supply industry or channel system has, in this phase, yet emerged the unit of analysis can be limited to the participants in that industry. Also, the industry is not yet institutionalized, i.e. companies have not yet established industry associations and the like which would have to be included in the unit of analysis as these organizations are likely to play active roles in the establishment and operation of any e-commerce system.

The most appropriate way of empirically identifying this unit of analysis would be the 'ongoing' method suggested by DiMaggio and Powell (1983) and Porter (1998) with regard to their respective concepts, organizational fields and industrial clusters (see Section 3), i.e. one would start to interview an initial set of industry participants and ask these which other participants exist. This process will be continued until no significant new mentions are made. As competition is mainly based on product innovation and differentiation, industry participants are likely to know each other, i.e. their relationships are reflexive in the sense of Sydow and Windeler (1998) and Porter (1998) (see Section 3). Thus, the criterion for inclusion/exclusion in the unit of analysis is the awareness of other participants.

In contrast, companies in the second phase are engaged in a form of 'hostile' competition (called Bertrand competition in economic theory) initially characterized by the struggle for sheer survival and later on for market share (once the number of companies has stabilized). This makes horizontal cooperation among competitors very unlikely (Gemser et al., 1996). At the same time, companies will try to cut costs not only by making processes more efficient internally, but also with respect to their suppliers and customers. This should encourage cooperation along the supply chain. One expression for this quest for efficiency is the development of a dedicated supply and channel structure. More and more components procured by suppliers (or made internally if firms integrate vertically) will be specifically designed and made for the industry and channel systems will become more and more specialized to accommodate the requirements of the industry.

Accordingly, the role of e-commerce in the second phase will be predominantly to integrate internal and external logistical processes. In terms of technology, systems for the exchange of standardized business data are more likely than collaboration tools supporting the exchange of unstructured design data.

The unit of analysis in e-commerce studies of industries that have reached the second phase of their life cycle should include the suppliers and the customers and their suppliers and customers in so far as they have invested in specialized products or processes, apart from industry participants themselves. In addition, the unit should include organizations that have emerged in the institutional context of the industry such as industry associations and standardization bodies.

The empirical identification of this unit of analysis will be aided by the existence of formal documents such as membership lists, industry statistics, and SIC codes. The criterion for inclusion/exclusion is whether a specific organization contributes to the reproduction of the dominant design. This might be difficult to assess but as an indicator it could be sufficient to ask whether a certain organization's survival would be threatened if that dominant design were to disappear.

The usefulness of this proposal crucially depends upon the existence of an unambiguous way to empirically discriminate between the two phases. Theoretically, the emergence of a dominant design is the watershed between the two phases. However, as Anderson and Tushman have observed, the emergence of a dominant design becomes apparent only with hindsight (1990, p. 614). Thus, it is necessary to find another way.

Utterback and Suárez have demonstrated for seven industries that the emergence of a dominant design coincides with the peaking in the number of firms in an industry. They also show that the characteristic peaking of the industry does not occur when no dominant design emerges. Thus, time series data about the number of firms in an industry seem to provide an easy and handy way of determining the industry life cycle stages of a particular industry. However, these results are not unambiguous. Specifically, time series data provided by Filson (2002) about the development of the PC industry seem to contradict this finding (although this is not discussed by Filson).

The data provided by Filson show that the number of firms in the (global) PC industry peak around the year 1991/2 while it is generally accepted that the dominant design, in the form of the IBM PC standard emerged in 1981 (Langlois, 1992). This seeming puzzle indicates two open issues not yet addressed in the discussion of industry life cycles to which we now turn.

5. Open Issues

The concept of dominant design has so far been described from a purely technical point of view. Although Utterback and Suárez claim to also include the customer view, this is done only in so far as customer preferences place a constraint on the technical choices leading to a dominant design.

However, when really looking at dominant designs from a customer perspective, it becomes apparent that the technical configuration of a certain product or service only forms part of the total set of features important for the evaluation of the product/service. A distinctly different feature regards the way how the product/service is delivered since only a delivered product or service will be of any use to the customer.

Even after the bursting of the 'dot-com' bubble, the concept of 'business models', which gained wide-spread currency in its wake, has proved to be rather persistent. We want to use this notion here to describe the way a product or service is delivered to the ultimate consumer. A *dominant business model* then would indicate a dominant mode of delivering a certain product or service to the consumer.¹

¹ This choice was inspired by discussions with Stefan Klein and Andreas Voss.

When going back to the puzzle posed by the example of the PC industry in the data provided by Filson, Filson himself argues that after IBM's introduction of the PC standard, new entrants were attracted to the industry by the possibility of providing cheaper IBM 'clones'. As IBM assembled the PC from readily available components, other firms could do the same (Langlois, 1992). After IBM had used its muscle to establish the industry standard, the standard thus became a collective good significantly lowering entry barriers and leading to a continued increase in the number of industry participants.

One interpretation of this process is that IBM had unwittingly introduced an open standard which changed the way microcomputers were delivered. Rather than in one assembled system, computers could now be pieced together by consumers according to their individual needs (Langlois, 1992). Thus, it may be said that the emergent dominant business model was the customized computer assembled from standardized components. This strategy was later emulated by the industry leaders IBM and Compaq who had discovered that their internal production costs were higher than purchasing prices for components due to external economies of scale (id.). Coincidentally, this change in strategy was implemented in 1991 in both companies (id.) marking the year of the peaking of the industry in terms of participant numbers. We therefore tentatively conclude that in this year the dominant business model of the PC industry had been established. However, clearly more research is required to confirm this claim.

This example shows that, depending upon the production/distribution stage one chooses to investigate, a dominant design may come to resemble a dominant business model and vice versa. Generally, one would expect that the notion of a business model is more appropriate in the field of distribution while the notion of a dominant design would be more appropriate in the field of production. However, the concept of dominant business models could also prove to be helpful in another respect. Preliminary findings of a study of e-commerce in China indicate that regulatory events could start an industry life cycle just as well as a technological breakthrough. In that case, the technology standards were already established when the life cycle commenced. Thus, the concept of a dominant design is not very useful in differentiating between cycle phases. The concept of a dominant business model, however, would be applicable and useful.

This discussion leads to a second question, namely how to determine the 'right' stage of production/distribution when trying to identify the dominant design or the dominant business model? On the one hand, different descriptions of dominant designs/business models might result from this choice which could well be arbitrary. On the other hand, the more fundamental question is how a specific dominant design or business model reverberates across the whole production/distribution system. In the data presented by Utterback and Suárez (1993) there are some indications that a dominant design emerges first on the assembled goods stage and then, with a delay of several years, moves upstream. Thus, the question arises if there is an 'epicenter' in the whole production/distribution system where the dominant design/business model appears first and from which it then spreads up- and downstream?

These question merit further research and indicate the necessity to refine the concept for a unit of analysis introduced in this paper. However, we still think that it will be a first important step to distinguish between the two phases described by the concept of the industry life cycle and define the unit of analysis accordingly. It might still be the case that upstream or downstream industries have significant interdependencies with the unit thus defined. But

the same holds true for studies of the industry life cycle in particular industries. Nevertheless, these studies still provide valuable insights. However, we think that for the purpose of using the notion of the industry life cycle for defining the unit of analysis in e-commerce studies, the concept of dominant business models should complement the concept of dominant design even though, up to now, we do not really understand how these two concepts are related.

6. Conclusions

In this paper, we have discussed fifteen possible definitions for a unit of analysis in e-commerce studies, nine used in the e-commerce literature, five from a broad array of the organizational research literature, and one newly introduced in this paper.

We conclude that the fourteen concepts taken from the existing literature are not suitable for e-commerce studies because they either do not sufficiently take into account the networked character of business relationships characteristic of e-commerce or, if they do, are bounded in a way which would exclude important aspects of e-commerce.

We do not claim to have exhausted all possible concepts which describe inter-organizational relationships suggested in the literature. However, we do believe that we have discussed all concepts explicitly or implicitly used in the e-commerce literature and that we have selected those concepts from the broader organizational research literature which are the most relevant for explaining and designing e-commerce systems. Nevertheless, there is the possibility of having overlooked an important and relevant concept which might serve as a unit of analysis in e-commerce studies. Thus, one purpose of this paper is to stimulate the search for such a concept in the existing literature and the discussion of its merits and drawbacks for being used as a unit of analysis in e-commerce studies.

We have also introduced a new concept which might be used as a unit of analysis in e-commerce studies. This concept builds on the notion of the industry life cycle and solves the problems identified in the earlier studies. It includes the notion of a network of business relationships while being bounded. Our main contribution in this paper is the suggestion that the way of bounding the unit of analysis should depend upon the life cycle stage of an industry.

There are three open issues which need to be addressed in further studies. The first regards the applicability of the concept of dominant design. We have argued that this concept is too narrow and needs to be extended or complemented and proposed to complement it by the concept of dominant business models. However, this proposal needs much more refinement. The second issue concerns the question how dominant designs/business models on different stages of the whole production/distribution system are related to one another. It seems likely that the processes of emergence of a dominant design/business model are linked to one another but it is not clear how. We have suggested that the relationship might be characterized as a movement from a center to a periphery like an earthquake or the rippling of the water surface after a stone has been thrown into a pool but there are no real data to support this or any other such hypothesis as of yet. Clearly, this question merits further research.

Finally, the criterion used for bounding the unit of analysis of studies concerned with industries that have progressed into the second phase of their life cycle, whether or not an organization contributes to the reproduction of the dominant design/business model, needs further theoretical and empirical work. This criterion draws on the theory of structuration which is still in the early stages of its development. So far, there has not yet emerged a clearly defined way of describing and delimiting the process of reproduction. Giddens himself (1984) offers only vague hints and much remains to be done. We think that the criterion is reasonably clear to start with but needs to be refined in the process of applying this concept to e-commerce studies. For example, when a supplier invests in specialized machinery to produce a component specific to a certain dominant design it clearly commits itself to that design which could be considered as a reproductive process since this supplier signals that it will support the concept. Similarly, a governmental organization issuing and enforcing standards regulating a product or a production process of a product which represents a certain dominant design signals that this agency endorses the design and thus contributes to its reproduction. However, it needs to be clearly spelled out what constitutes a reproduction process and what doesn't.

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