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Business-to-business electronic market place selection

J. GUO*

Department of Computer and Information Science, University of Macau, Av. Padre Tomás, Pereira, S.J., Taipa, Macau

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There is an increasing demand for doing business online, which calls for higher business interoperability on business-to-business (B2B) electronic market places (EMp). This drives the development of integration technologies for improving B2B electronic market (EM) functions on EMp. This paper argues that with the development of integration technologies companies will use more private, community and public EMp and select their proper type of EMp when comparing the function–cost ratios of business interoperability on different types of B2B EMp. This argument has been validated through the case studies against a method of historical event analysis. In this shift, four integration factors of standard flexibility, enterprise integration, service provision and semantic integration are constantly improving EMp functions, which lead to an overall reduction of interaction cost for business interoperation on all types of EMp. This will change business behaviour and corporate strategies of most firms, and have important implications for firms to make strategies of how to select EMp to increase business interoperability for higher competitiveness.

Keywords: Electronic market place; Electronic commerce (e-commerce); Electronic business (e-business); Enterprise information integration (EII); Enterprise information systems (EIS); Enterprise integration; Inter-and intra-organizational information systems; Inter-enterprise interoperation; Interoperability models; Inter-organizational enterprise systems; Supply chain; Standard

1. Introduction

In the past two decades, business integration technologies have undergone a drastic transition from internal functions integration within a firm to external market place functions integration between firms (Matz 2004). These innovations have radically reduced the cost and time of business interoperation within and between firms required for information sharing, exchanged data understanding and underlying systems integration (E-Business Watch 2005). This, in turn, brought many changes in the ways electronic market places are built and used. Underlying these changes are more fundamental changes in how firms adopt their electronic market place patterns to connect with each other for rebuilding value-added chains online. In this paper, we address the more basic issue of how advances in integration technologies,

*Email: jzguo@umac.mo

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developed in the context of e-commerce, are affecting business interoperability in electronic market places and discuss the options these changes present for e-commerce technology research and corporate strategies.

Electronic market (EM) inherits the notion of the traditional 'market' encompassing the behaviour of the exchange of goods and services. In the traditional perfect market, the business information necessary for transaction is assumed to be conveyed by price, and the price mechanism achieved by 'invisible hand' (Smith 1976) is the most important instrument for co-ordinating and allocating business information (Milgram and Roberts 1992). Here price information exchange is implicitly implemented through the pervasive mailing systems, face-to-face contacts or any other means that can quickly disseminate information. However, in EM this is explicitly implemented by a certain technical system (e.g. information exchange system) underlying the EM. If the use of exchanged price information as a price mechanism is a type of EM behaviour, then the information exchange system that supports this behaviour should belong to another system, i.e. the electronic market place (EMp). Pricing behaviour in markets as a whole are invisible and formed by many anonymous and/or named market participants. Studying pricing behaviour (or more broadly market behaviour) is attributed to EM and falls into the economic category. In contrast, an EMp originated from the traditional 'market place' as a physical gathering place (e.g. a bazaar or an exhibition centre), is a visible technical system in which pricing behaviour happens. It focuses on business information exchange and is in the technological category. In this sense, an EM is a superstructure of an EMp, while an EMp is an infrastructure of an EM.

Electronic market place (EMp), in the above sense, is an outcome of Internet computing technology and is one of the quickest development areas in e-commerce. It is a common information space, where e-business information exchange is enabled to allow B2B EM functions to be presented with certain information exchange efficiency and/or financial cost in use (Guo and Sun 2004). With a historical perspective (Guo and Sun 2004), the development of B2B EMp was highly related to the development of integration technology (Warfield 2007), from an intra-enterprise EMp (e.g. a traditional ERP system integrating discrete departments to enable better information exchange), to an inter-enterprise EMp (e.g. a community-oriented SCM system integrating heterogeneous firms for inter-enterprise information exchange (Beheshti *et al.* 2007)), and to a regional or a global EMp (e.g. a global trading system like Alibaba.com integrating unknown firms to enable irregular international trade). Integration technology here can be defined as any type of IT technologies that enable better business information exchange on the Internet between any business entities. Speaking from the level of integration, these technologies can be the enablers of business concept exchange, business document exchange and business process matching between either homogeneous or heterogeneous business applications or systems belonging to discrete business entities. It is obvious that the purpose of developing integration technologies is to provide a better business information exchange system; that is, a common business information space in terms of an EMp. Furthermore, the achievement of a better EMp is to improve the ability of business interoperation between any business entities, or in other words the business interoperability that can be defined as the capability of business collaboration between business partners for the fulfilment of certain business functions at certain cost and efficiency. More specifically, business interoperability (I) can be computed

in a formula of the ratio between the number of effective EM functions (F) and the co-ordination costs (C) such that $I = F/C$. Thus, a logical sequence can be found that improves integration technology so as to formulate a more cost-effective EMp and finally to increase business interoperability.

In this paper, we argue that new integration technologies lead to an overall development of all B2B EMp in terms of public electronic market places (public EMp run by an independent third-party), community electronic market places (community EMp run by an industrial consortium), and private electronic market places (private EMp run by a single buyer or seller). In this development, the cost reduction and the increase in EM functions constantly happen in all types of EMp and lead to an overall improvement of business interoperability. Thus, there is a general shift towards more use of all types of EMp, transferring more firms from traditional markets to EMp. Here EMp participants refer to both EMp facilitators (Guo and Sun 2004) and EMp users as sellers and/or buyers.

In this shift, the specific selection of a type of EMp is dependent on the business interoperability presented on that EMp. Some innovative firms will become public EMp facilitators but not EMp users, and some business giants will create more industry consortiums to form community EMp and they themselves act as either buyers or sellers. A few financially and technically strong firms will become both the facilitators and single sellers or single buyers of the private EMp, tightly integrating their own business partners for exchanges. Most firms will benefit from the emergence of the new integration technologies for better business interoperability by joining in the existing EMp types.

The analytical framework on which our argument is based follows the transaction cost theory (Coase 1937, Williamson 1981, Malone *et al.* 1987), which is useful in explaining the EMp business interoperability changes brought by the development of integration technologies, as well as predicting the consequences of the changing business interoperability. The past two decades provide some clue of integration technologies for us to understand how they impact on the changes of cost and efficiency of EMp construction and hence possibly change people's attitude on selecting and using different types of B2B EMp.

2. Business motivation of selecting business-to-business electronic market places

Business people are motivated to chase more profit during business operations. A precondition of online business for more profit is how to establish and use an electronic channel (Schlueter-Langdon and Shaw 2002) between business partners. Researches (Lee and Clark 1996) show that the cost and efficiency of establishing and using electronic channels determine the business interoperability, and ultimately in reverse determine the selection of electronic channels by business people. Business interoperability is tightly related to integration technology and can be described in three levels:

i. technical interoperability from technical integration,
ii. business interoperability from technical integration, and
iii. business interoperability from business integration.

Technically, 'integration' is a collaborative process for seamless convergence of technical structures, concepts, services and applications between disparate business systems. Commercially, 'integration' means superstructure change of organization and strategy by restructuring and transforming (e.g. vertical integration and strategic alliances) towards either an electronic hierarchy or an electronic market (Malone *et al*. 1987). The term 'interoperability' implies 'integration' results for the technical capability of working together between business systems and business capability of efficiency increase and cost reduction of organizations. Clearly, integration determines interoperability and interoperability asks for integration. In this paper, we focus on technical integration that achieves business interoperability in terms of the formula $I = F/C$.

A glance at the literature will show that electronic channels can often be found in the research context of B2B EMp such as e-portal (Thompson *et al*. 2006) (e.g. Amazon.com, CTrip.com and Dell.com), e-hub (Rossen 2001) (e.g. Tradecard.com and Alibaba.com), or simply an Internet-based software package sold to firms to form supply chain (i.e. the so-called e-package, e.g. SAP SCM systems or global trading systems (GTS)). A further investigation on these EMp forms finds that the topic of business interoperability on these EMp is often emphasized with the measurement of the cost and efficiency of business functions provided for interoperation between trading partners; for example, the interoperation functions of matching buyers and sellers, facilitation of transaction, and institutional infrastructure (Bakos 1998).

It is very clear that the motivation of B2B EMp is to increase business interoperability and the primary task of an EMp is to provide more mature EM functions with lower costs. To achieve it, a B2B EMp plays the role of a common business information space (CBIS) to support cost-effective EM functions between millions of distributed enterprise systems (Guo 2007). What EM functions should an EMp provide? Bakos (1998) listed the three categories of functions for a B2B EMp, which are matching buyers and sellers, facilitation of transaction, and institutional infrastructure. The matching of buyers and sellers refers to the business interoperability that provides the searchable and interoperable electronic catalogues for quick searching products, buyers and sellers, discovering prices, and matching offers with purchases (e.g. Alibaba.com as a meeting place). The facilitation of transaction asks for a broad functionality such as trust and credit query, bidding and negotiation, contract and order processing, product quality inspection service, insurance service, shipping service, payment service, and after-sale support (e.g. the international trade payment services from Tradecard.com). The institutional infrastructure means that the cross-firm legal systems are built to enable the legal contract validation, digital signature verification, and trade laws and regulation conformance (e.g. AliPay.com's conformance to China Digital Signature Law). These three aspects constitute the business interoperability requirements for building any type of electronic market place. Similar functionality categorization can be found in some other research references such as in the work of Wang and Archer (2004, 2007), which classifies EM functions on EMp into market-oriented functionalities (i.e. aggregation and match-making) and collaboration-oriented functionalities (i.e. functions at the transaction level and functions at the strategic level). Given a price tag for each of the above EM functions, it is quite obvious that

the reduction of the cost and time in building and using these EM functions will attract more firms to have their e-business systems to participate in B2B EMp.

3. Business criteria of selecting business-to-business electronic market places

It is interesting to know what the business criteria are for selecting a B2B EMp. Following the transaction cost theory of economics (Coase 1937, Williamson 1981, Malone *et al*. 1987) this section proposes an analytical framework to understand the behaviour of B2B EMp participants in selecting a specific EMp for increasing business interoperability. Before we discuss this analytical framework, we first classify B2B EMp into private, community, and public EMp with definitions, and provide a criterion to judge the type of EMp.

3.1 *Definitions of private, community and public electronic market places*

B2B EMp has three basic forms for achieving business interoperability (Nøkkentved 2000):

i. *public EMp* or many-to-many public exchanges,
ii. *private EMp* or one-to-one/one-to-many private exchanges, and
iii. *community EMp* or few-to-many community exchanges.

Public EMp refers to a business information exchange mechanism that provides the business interoperability between firms' e-business systems. It is run by an independent B2B EMp facilitator, such as a third-party dot-com firm (e.g. tradejango.com or plasticsnet.com), to orient towards a perfect market for a group of buyers and sellers, with the emphasis typically on the unbiased base. It strives to reach industry- and market-based efficiency through managing interactions among exchange participants. Facilitators (Guo and Sun 2004) of public EMp (e.g. vertmarkets.com or marchex.com) are owners, vendors or licensers of the EMp and determine the provided exchange functions based on the market demand, legal environment, profitability and maturity of EMp technologies. Firms joining in the public EMp as EMp users could compare the cost and benefit of the available EM functions between all public EMp and choose the one that is best appropriate to them. The major thought of joining in a public EMp by firms for business interoperability is that, by means of building a closer external partner relationships through service outsourcing, firms (e.g. the users of plasticsnet.com or the users of alibaba.com) can be reconstructed as a light-weight organization and thus decrease the management overhead.

Private EMp, on the other hand, refers to a business information exchange mechanism for business interoperability within a firm (i.e. a firm acting as both EMp facilitator and a sole EMp user either in the form of a single seller or a single buyer) by means of merging more and more external business information exchange relationship (e.g. supplier.dana.com/www2.dana.com, bluescopesteel.com.au or 30030.com). The private EMp is often driven by a single firm acted as either a seller or a buyer, and typically involves a firm automating its own supply chain and/or demand chain where participation is generally open to specific and trustful suppliers or buyers of the firm. It is often promoted through a participation

invitation process campaigned by the owner of the private EMp. In practice, firms that have perfected this model include Dell, Cisco, and Wal-Mart. Single buyer or seller oriented supply chains also fall in this category (e.g. cat.com). The philosophy behind it is that the excellence of management technique can make business interoperation more efficient by building a self-owned EMp rather than the external joining in one or more third-party EMp, because the cost and time of co-ordinating external technical, social and legal relationships could be minimized through establishing a set of corporate rules. In addition, customer loyalty and trusted partner relationships can be maintained. For example, Amazon can be largely regarded as a private EMp, where the seller–buyer relationship is one-to-many (i.e. Amazon-to-consumers, which is a B2C EMp not discussed in this paper) or many-to-one (i.e. suppliers-to-Amazon, which is a B2B EMp), in which these two relationships are often separated; that is, consumers and sellers do not contact directly.

While the public EMp and the private EMp are two extremes of EMp patterns, there is a type of EMp between them, called community EMp. The community EMp (e.g. exostar.com) refers to a business information exchange mechanism for business interoperability within a tightly related value chain such as the purchasing-oriented supply chain and the selling-oriented demand chain. Often this EMp has a few-to-many or many-to-few seller–buyer relationship with the primary motivation of chain co-ordination and optimization. Its build is often initiated by a consortium where few firms come together to form the EMp. Usually the consortium consists of members in the same industry. When only a very few big competing firms vote to manage the consortium and form the community EMp (e.g. covisint.com), it has the possibility, but not necessarily, to seed an oligopolistic electronic market for grabbing extra profits (Lücking 2001) (e.g. the FTC's anti-trust investigation on Covisint.com (FTC 2000) and the European Union's anti-trust investigation on MyAircraft.com (Bicknell 2000) show this concern). For example, the Covisint eMarket place was initiated by automobile manufacturer giants General Motors Company, Ford Motor Company, and Daimler-Chrysler in early 2000, and since then has expanded to include several other automobile manufacturers. In Covisint, small automobile parts suppliers are dependent, where Covisint represents the voice of the car manufacturers rather than that of the suppliers (Koch 2002). Covisint experiences show that oligopoly-styled community EMp may have problems of internal competition and distrust between the few consortium initiators (Konicki 2000). It is also observed that, when an industry consortium is initiated by few big non-competing or complementing firms, the formed community EMp is more like a supply chain and therefore easier to be successful. For example, exostar.com is a community EMp where the participants are different strategic business units along the supply chain.

Variants or different naming of the three pure forms for business interoperability exist (e.g. auctions, vertical and horizontal exchanges, e-portals, e-hubs and community exchanges), but can usually be categorized into the above three forms. In general, when a technically and/or financially strong firm is a dominant seller or buyer in a specific industry, it tends to increase business interoperability through self-building a private EMp, for example, the case of Boeing Company (Sommer *et al*. 2002). On the other hand, when a firm is both financially and technically weak such as small- and medium-sized enterprises (SMEs), it often selects

the public EMp (e.g. thousands of SMEs in Alibaba.com) to increase business interoperability, because this form offers more opportunities for finding potential buyers and creditable sellers. When an industry has only a few business giants, they may compromise to form a community EMp to grab oligopolistic profit, or when some industry-related buyers and sellers share common interests along a value chain, they may form a value-chain based community EMp.

Nevertheless, while the above general situations may apply, the availability of EM functions is important and will limit firms to select a specific EMp. For example, Alibaba.com only has limited EM functions in searching, matching and negotiation. Firms which require more transaction facilitation functions, such as placing orders and trade payments, will not join in Alibaba. Instead, they may select TradeCard.com for electronic international trade payments. Thus, firms will select an EMp based on the formula of $I = F/C$ by comparing the available functions and the relevant costs.

3.2 *Criteria for judging public, community and private electronic market places*

Given the above definitions of private, community and public EMp, there is a straightforward criterion to judge whether a B2B EMp is more like a public EMp, a community EMp or a private EMp. This criterion is:

> *The neutrality* (*or independence*) *of the owners of the electronic market place on its business operation*

This criterion is critical and determines the characteristics of the electronic market (EM) built on the given EMp. The neutrality refers to the attitude of EMp owners, whether they will lean more towards the interest of buyers or sellers, or even become the whole or part of buyers or sellers, or just remain independent of the interest of buyers and sellers. It is the criterion to determine whether the EM built on the given EMp will possibly be a perfect EM, an oligopolistic EM or a monopolistic EM. Figure 1 depicts the relationship between the electronic types determined by this criterion that is used to judge whether an EMp is a private, community or public EMp. In the figure, the triangle reflects the relationship between neutrally independent EMp and biased seller or buyer EMp. The general rules are:

1. If the EMp owner is neutral and independent of sellers and buyers, then this EMp creates a perfect electronic market.
2. If the EMp has several influential sellers or buyers, which are also the owners of the EMp or represent the EMp owners' interests, then this EMp may create an oligopolistic electronic market.
3. If the EMp is owned by a single buyer or a single seller, which also acts as the buyer or the seller, then this EMp may create a monopolistic electronic market.

In the above three types of electronic markets, the normal situations are: the public EMp creates the perfect electronic market, the community EMp creates the oligopolistic electronic market, and the private EMp creates the monopolistic

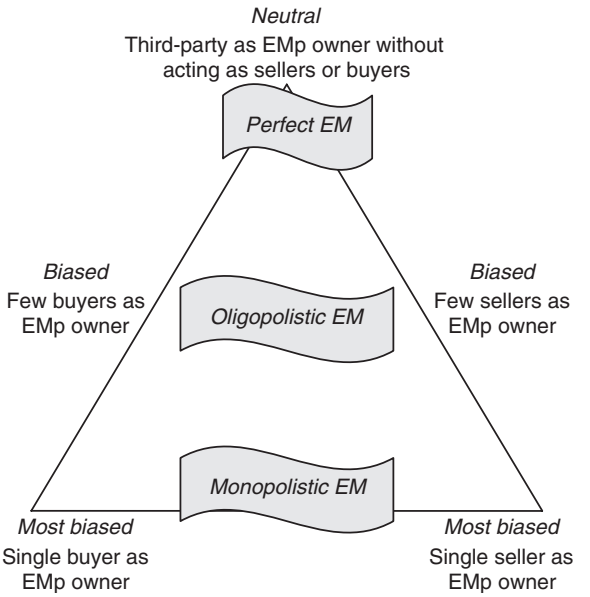

Figure 1. Criteria for judging the type of electronic market places.

electronic market. However, it must be noted that to be an oligopolistic EM on community EMp or a monopolistic EM on private EMp is only a possibility. Since each EM built on an EMp is one of the numerous EM on numerous EMp in the context of the large world market, an oligopolistic EM on a community EMp or a monopolistic EM on a private EMp may face fierce competition from many other EM built on other EMp. Thus, although current EMp integration technology still cannot integrate all types of discrete and fragmented EMp, the overall market force in a large sense may drag the EM that have monopolistic and oligopolistic possibilities back to the perfect competition orbit.

3.3 *Factors affecting selection of public, community and private electronic market places*

A distinction between private EMp, community EMp and public EMp is not our ultimate goal. The purpose of such distinction is to understand the relationship between private EMp, community EMp and public EMp, and to investigate what will affect the selection of self-building private EMp, joining-in private EMp, self-building community EMp, joining-in community EMp and joining-in public EMp.

Following the transaction cost theory (Coase 1937, Williamson 1981, Malone *et al*. 1987), 'a transaction occurs when a good or service is transferred across a technically separable interface' and transaction cost is 'the economic counterpart of friction' (Williamson 1981). The analysis of this 'friction', i.e. transaction cost analysis, examines 'the comparative costs of planning, adapting, and monitoring task completion under alternative governance structures' (Williamson 1981). According to Williamson (1981), a firm has its efficient boundary, which serves as a technically separable interface to market. Thus, there are two basic types of governance

structures: firm and market, where 'the crucial issue is how the choice between firm and market governance structures for decisions' of 'make-or-buy'. Central to this issue is the trade-offs between production cost economies and governance cost economies, which determine whether some products or services should be made within firms or buy in markets.

A B2B EMp is a firm but more as a place that supports an EM. It does not include 'make' (i.e. producing products) decision, but only consists of decisions of how to buy (i.e. self-building EMp or joining-in EMp) and where to buy (i.e. which EMp). (To simplify the discussion, this paper assumes an EMp does not include any production activities such as digital production of e-books, music and videos. This assumption establishes if we define digital producers as e-firms that will again either self-build or join in any EMp.) Therefore, private EMp, community EMp and public EMp are three types of pure market governance structures, where the transaction costs involved are only 'coordination costs' similar to Malone *et al.*'s descriptions, which 'take into account the costs of gathering information, negotiating contracts, and protecting against the risks of "opportunistic" bargaining' (Malone *et al.* 1987). To opt for the discussion context of this paper, we redefine co-ordination costs to consist of two stages of costs as management costs and interaction costs. The management costs refer to the first-stage costs of creating and maintaining the availability of business interoperability services (i.e. EM functions) of an EMp, while the interaction costs denote the second-stage costs of consuming the available business interoperability services from EMp. The former includes the costs of the setup, maintenance or joining-in of EMp for enabling business interoperability such as the functions of search, matching sellers and buyers, negotiation, e-payment, e-logistics, and electronic after-sales services. The latter includes the costs of consuming the existing available EM functions of EMp, such as time and money used in business information systems integration between firms and EMp, searching of products and customers, negotiation of contracts, and e-payment processes. The management costs are often tangible, yet the interaction costs involve not only tangible and calculable costs (i.e. integration costs) but also intangible costs occurred between EM trading partners who are subject to bounded rationality that Williamson discussed as one of the two behavioural assumptions of transaction cost analysis (Williamson 1981). Nevertheless, as discussed in section 1, EMp and EM are two separate concepts on two different levels, where EMp is the infrastructure of EM and studies the business information exchange mechanism for delivering EM functions for transactions. This mechanism is technical oriented and thus does not involve human behaviours of organizations; whereas EM is the superstructure of the EMp and has the behavioural models between trading partners (Guo 2007). In this paper, we assume that the behavioural models of EM over all types of EMp fall in the research field of EM, thus bounded rationality is excluded in the discussion of EMp and its associated transaction cost is also not discussed. In this sense, the differences of interaction costs between different EMp are only the integration costs occurred during integrating buyers' or sellers' e-business systems into the different EMp.

Adopting the comparative advantage theory (Torrens 1815, Ricardo 1912) often used in economics for trade analysis, a general statement can be derived such that trade-offs exist between different EMp with regard to the management costs and interaction costs, assuming that the equal EM functions are achieved by

Table 1. Relative cost for private, community and public EMp.

	Characteristics	Management cost	Interaction cost
Private EMp self-building	A single firm self-builds EMp and acts as a single buyer or seller	Highest	Lowest
Private EMp joining in	Join in private EMp by following its joining-in instruction	Uncertain	Uncertain
Community EMp self-building	Several firms self-build EMp and act as few buyers or sellers	High	Low
Community EMp joining in	Join in community EMp by following its joining-in instruction	Uncertain	Uncertain
Public EMp joining in	Join in third-party public EMp	Lowest	Highest

different EMp. The comparison between the two types of the costs is opportunistic, which determines the intent of a firm on selecting between self-building or joining in a private EMp, self-building or joining in a community EMp, or joining in a public EMp. Table 1 summarizes the statement relevant to our argument.

In table 1, the 'lowest', 'low', 'high' and 'highest' give a relative comparison of management cost and interaction cost between private EMp, community EMp and public EMp. The 'uncertain' refers to the EMp cost level depending on the joining-in policy of the EMp owner, the software requirements for joining in and the system integration conditions. They reflect the comparative advantages and disadvantages of each specific EMp. When assuming that all types of EMp provide the same EM functions, the trade-offs between different EMp simply become the evaluation of management costs and the integration costs (which is the part of interaction costs that exclude the costs occurred by bounded rationality). For self-building private EMp, a firm builds an EMp by itself for use. Hence, the management costs are highest but the integration costs are lowest. The advantages are that a firm has no need to purchase the membership of an EMp for EM functions and spends any money to integrate its own e-business systems into the EMp systems. The disadvantages are that a firm bears all the costs of the EMp setup and maintenance. For self-building community EMp, few influential buyers or sellers self-build an EMp and invite many others to join in as either sellers or buyers. The management costs here are high but the integration costs are low with the considerable community standardization costs. The advantages are that a firm can share the cost of EMp setup and maintenance with some other EMp founding firms and has no need to purchase the EMp services from external EMp. The disadvantages are that it should share the EMp building and maintenance cost and may also have some business strategic conflicts with other EMp founders in building EMp. For joining in public EMp a firm does not involve any EMp creation, but subscribes to the available EM functions from an EMp. In this alternative management costs are lowest, but integration costs may be highest because if a firm has legacy e-business systems it has to put more effort into integrating its legacy systems into the EMp systems. The advantages are that a firm has no need to cost its own to setup and maintain

a specialized EMp for business interoperation. Its disadvantages are the firm's costs of purchasing the EMp services and integrating its e-business systems into the subscribed EMp. For joining in private EMp and community EMp, the advantages and disadvantages are uncertain. It depends on the EMp joining-in policy of the EMp owners and whether the joining-in requires the purchase of the proprietary software and systems.

Table 1 illustrates the trade-offs between management costs and interaction costs for business interoperability in different types of EMp. In this analysis, the choice between self-building or joining in private EMp, self-building or joining in community EMp, and joining in public EMp depends on the cost by comparing the management costs and interaction costs between the three EMp. If an EMp has lower cost than another for the same EM functions after the evaluation of the trade-offs between management costs and interaction costs, it would be selected by the related firms.

There are many factors that affect the transaction costs (here the co-ordination costs in terms of management costs and interaction costs) hence the choice between private EMp, community EMp and public EMp for business interoperation, such as information security, customer loyalty, trust relationship, market power of major business partners, financial strength and technical ability, legacy e-business systems and their processes in buyers and sellers, and the maturity of EM functionality. It is worth noting that, among the above factors, market power, legacy systems and maturity of EM functionality are important. When a firm has significant power in buying or selling, it may select the private EMp type. For example, Wal-Mart has a strong tendency to build a private Wal-Mart B2B EMp (i.e. an EMp between Wal-Mart as a single buyer and Wal-Mart product suppliers as many sellers). Due to Wal-Mart's strong market position, Wal-Mart will not do business with any company that does not agree to adopt Wal-Mart's business rules. The same happened to Amazon B2B private EMp. Amazon's suppliers have to agree with Amazon's web service specification to join in Amazon EMp. Other similar cases can be found in travelling industries such as Expedia.com and CTrip.com where small hotel suppliers have to comply with the predefined private EMp specifications (Luo and Guo 2007). However, while the market power of a firm has a significant impact on SMEs, legacy business systems become the obstacles for medium- and large-sized enterprises (MLEs) to join in an existing EMp. For example, TradeCard.com is a well-known international trade e-payment EMp but its development is slow because many MLEs are reluctant to adopt the proprietary TradeCard XML specifications as interfaces to their legacy systems. (TradeCard is a hybrid of private and public EMp because for some business TradeCard works as a third-party yet for some other business it is like a single seller.) In contrast, Bolero.net presents an open and transparent BoleroXML specification, SWIFT message structures compatible, to interface to various MLEs' internal systems for international trade e-payment. The compatibility of legacy business systems through SWIFT makes Bolero work better as a B2B public EMp. The maturity of EM functionality also impacts the selection of EMp types. For example, although Alibaba.com is evolving with a history of constantly improving its EM functionality, it only provides limited EM functions and thus prevents MLEs from joining in (Guo *et al*. 2006). On the other hand, the B2B community EMp of exostar.com developed very fast with a growing number of MLE suppliers in aviation industry when Exostar constantly improved its

EM functionality (see figure 3 later). The similar case can be found in Covisint.com (see section 5.2.2).

All things being equal, two factors play an important role in comparing co-ordination costs in terms of management costs and interaction costs between different EMp. They are business standard flexibility and business concept complexity. The issue of business standard flexibility has been discussed in the researches of standard integration (Bergamaschi *et al.* 2002, Leukal and Maniatopoulos 2005) while the reduction of business concept complexity has been investigated in an ontology-based approach (Lee *et al.* 2005, Hepp 2006), community-based/usage-centric technique (WebCatalogPers) (Paik *et al.* 2002), and collaboration-based/concept-centric approach (CONEX) (Guo 2004).

3.3.1 Business standard flexibility. Business standards can be classified as international standards (e.g. UNSPSC.org), *de facto* industrial standards (e.g. ebXML.org), enterprise standards (i.e. used within a firm), and non-standards that most SMEs adopt. Business standard flexibility refers to the application ability of a standard from a given scope to another scope. It is the ability to integrate the internal legacy business systems into the external heterogeneous systems. Its opposite term is business standard rigidity, which focuses on the exchangeability of electronic data on Internet. The exchangeability refers to the ability of syntactically and semantically reading and writing the same piece of business information between any two different e-business information systems that are in communication, but may be homogeneous or heterogeneous. When the rigidity of business standards becomes higher, the exchangeability becomes lower. Business standards are the most important building blocks of EMp for business interoperability such that one business system can interoperate with another by following the same standards. However, business standard rigidity becomes an issue, because the desired increasing business interoperability asks for the more and more flexibility of business standards to adapt to a wider scope of integrating more distributed and more heterogeneous e-business systems.

For the above reason, a firm may achieve business interoperability by self-building a private EMp if it has a set of rigid enterprise-wide business standards and depends on these legacy standards. This is because the change of existing rigid business standards in use will pay a higher interaction cost for e-business systems integration than management costs for self-building and maintaining an EMp. In contrast, firms may achieve business interoperability on public EMp if they have flexible business standards or they are less dependent on these legacy standards; for example, most SMEs. This is because the cost paid to integrating their e-business systems into the public EMp is less than the cost of building their own private EMp for the same level of business interoperability. If firms are in an industry that has a widely used industrial standard but not flexible enough to be compatible with the standards of external industries, they tend to adopt community EMp. This is because firstly these firms may only be specialized in the business of the industry and secondly the cost of participating other industrial communities' standards may incur a high cost.

Business concept complexity refers to the amount of effort for representing and using the syntactically and semantically interoperable business concepts. A business

concept denotes a broad business connotation including the representation and use of a business vocabulary, a business document, a business processes and even a whole business service (Guo 2006). For example, a business process is a conditional sequence of operation concepts operated on a set of business documents that are in exchange. A business document is a set of business terms and values. All these business processes, documents, terms and values are business concepts.

Other things being equal, a firm may achieve business interoperability on self-building private EMp if it is able to reduce the business concept complexity by turning the systems of complex concept representation and use into the systems of simpler concept representation and use. This is because a simpler system, which can maintain the same EM functions, is less in management costs and makes the total co-ordination costs (management costs and interaction costs) less. For example, if a firm like Boeing (Sommer *et al.* 2002) can force its business partners to adopt a uniform business concept representation system that is consistent with its legacy business systems (i.e. simplify the overall system in the eye of Boeing), there is no doubt that a private EMp will be selected by Boeing. In contrast, a firm may achieve business interoperability by joining in public EMp if it is unable to handle the business concept complexity or there are no legacy business concept representation systems. This is because the management cost of complex business concepts is much higher in self-building and maintaining a private EMp than simply joining in a ready made public EMp. For instance, SMEs have non-standard business concept representation systems, which are most complex in business concept integration. They are also technically and financially weak in self-building private EMp for handling complex business concepts. What's more, they are less influential in forcing its business partners to join in their private EMp if any. Thus, SMEs, in general, seek to join in public EMp to achieve their business interoperability. Besides the above two extremes, many firms are industrial firms that have complex business concepts that are standardized in certain industrial communities. They may either self-build or join in community EMp to enable business interoperability.

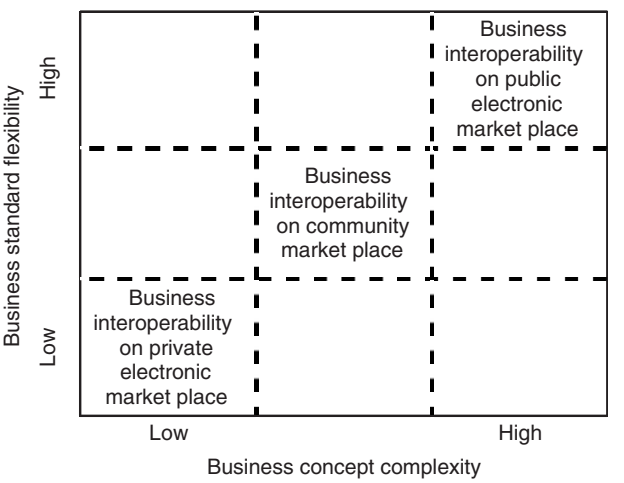

Figure 2. Factors affect EMp selection.

Figure 2 shows that when a firm has more flexible business standards and is more difficult in reducing business concept complexity by itself, it tends to join in public EMp for business interoperability if the public EMp can resolve the concept complexity issue. In contrary, when a firm has more rigid business standards of its own and is able to reduce business concept complexity by forcing other firms to use them, it tends to self-build private EMp for business interoperability. Between the two extremes, when few firms have identified a set of rigorous industrial standards shared between them and are difficult to reduce business concept complexity for higher business interoperability by the aid of external public EMp, they tend to self-build their own community EMp.

3.4 *A remark on asset specificity and complexity of product descriptions*

The two factors of business standards flexibility and business concept complexity affect the selection between self-building or joining in private EMp, self-building or joining in community EMp, and joining in public EMp. These two factors are somewhat inspired by the Malone *et al.*'s work on the asset specificity and the complexity of product descriptions (Malone *et al.* 1987), but they are not comparable due to the following reasons:

1. Business standard flexibility and business concept complexity are discussed in the context of various types of EMp while asset specificity and complexity of product descriptions are discussed in the context of electronic hierarchies and electronic markets. A superficial comparison between electronic hierarchies and private EMp is that electronic hierarchies are similar to private EMp. However, a full investigation into electronic hierarchies finds that electronic hierarchies were developed from traditional hierarchies, which are production-oriented firms, including the study of production costs. Whereas, private EMp are market-oriented firms excluding the study of production costs. Thus, trade-offs exist between electronic hierarchies and electronic markets by evaluating production costs and co-ordination costs. In this paper, trade-offs only exist between private EMp, community EMp and public EMp by evaluating management costs and interaction costs, which are all co-ordination costs where management costs focus on how to make the EM functions available and interaction costs focus on how to make the available EM functions usable through technical integration.
2. Business standard flexibility and business concept complexity only investigate on the Internet phenomena happened in EMp. They exclude two categories of concerns on off-Internet or physical product move and on human behaviours occurred in using EM functions supported by EMp. The first exclusion adjusts the discussion of this paper only towards electronic business while the second exclusion divides the traditional electronic markets into two layers of EM and EMp, where EM studies the EM behaviours and EMp studies the EM functionality provision within a secure and integrated environment. This exclusion effectively limits the task of this paper only in the aspect of EMp but not EM.

One should say that the asset specificity and the complexity of product descriptions are not appropriate factors that affect the selection between private,

community and public EMp. First, asset specificity can arise in any of several ways: site, physical, human, dedicated and brand-name specificities (Williamson 1981, 2002). This is largely related to 'specialization by proximity', physical product manufacturing methods, 'firm-specific training or learning by doing', dedicated investment made, and 'brand-name capital' (Williamson 2002). For site and physical specificities, they should be studied in the domain of traditional markets. For the human, dedicated and brand-name specificities, they should be discussed as the aspects of both traditional markets and EM, which are more relevant to the contractual relationship between firms and their staff and between firms. Confusion here is often the unclear distinction between traditional markets, electronic markets (EM) and electronic market places (EMp), thus wrongly applies asset specificity to EMp, where an EMp is only a 'space' or a business information exchange mechanism that enables the exchanges of products and goods in an electronic manner (Guo 2007).

Second, complexity of product descriptions is over simplified if we use this concept as a factor that affects the selection of different types of EMp. Classically, Malone *et al.* thought 'products with complex descriptions are more likely to be obtained through hierarchical than through market coordination for reasons centering on the cost of communication about a product' (Malone *et al.* 1987). In our understanding, in a given industry (e.g. automobile), the complexity of product descriptions will not be changed whether this industry builds a private, community or public EMp. Thus, there is no proof that the above statement of Malone *et al.* could be established. A possibility, on which an EMp type is more likely to provide the information of 'products with complex descriptions', is that this EMp type has better functionality for exchanging complex product information between this EMp and its customers. Hence, it is the EMp's technical integration ability of product information exchange functions that determines which EMp is better for handling more complex product descriptions.

The above remark shows that electronic hierarchies and electronic markets, proposed by Malone *et al.* (1987), involve too many contents of traditional markets and have no distinctions between electronic markets (EM) and electronic market places (EMp). Their key affecting factors of asset specificity and complexity of product descriptions, cannot thus be applied to the research of private, community and public EMp. This is because these types of EMp are fully classified in the e-business boundary on the Internet, which only discusses the business information flows on the Internet but not the physical movability of products, human and investments and the human behaviours that may be uncertain.

4. Technical driving force of business-to-business electronic market places

The development of integration technology on Internet is changing the factors of business standard flexibility and business concept complexity, which affect the opportunity cost for choosing between public EMp, community EMp and private EMp for achieving business interoperability. This reflects in four aspects of the development of the flexible standards, the evolution of enterprise integration, the evolution of service provision, and the emergence of semantic integration, which are shown in tables 2–5.

4.1 *Development of flexible standards for business-to-business electronic market places*

Table 2 shows that EMp standards for integration are moving from proprietary standards to open standards. This trend signifies that the standards are becoming more and more flexible. It implies that various e-business systems are easier to be integrated on EMp with less cost and time for interaction. This is because the open standards have proved their advantages in reusability and easy deployment (E-Business Watch 2005).

In the examples of table 2, early proprietary standard of EDIFACT is very rigid and the private EMp, on which it is built, is very restrictive. It requires firms to invest a large amount of money to join in the value-added network (VAN), which builds a private EMp for business partners. With the development of open standards (e.g. XML, SOAP and WSDL) and integration technology, even the traditional EDI systems can be accessed via Web-based EDI (e.g. covalentworks.com). The consequence is that not only large companies but also small and medium sized enterprises (SMEs) can access various corporate EDI systems in a very low cost (e.g. just via a single networked PC) through a Web-based EDI public EMp that provides EDI services.

4.2 *Evolution of enterprise integration in business-to-business electronic market places*

Table 3 shows the evolution of enterprise integration technologies from enterprise resource planning (ERP), to extended resource planning (XRP), to enterprise application integration (EAI), and to electronic market place (EMp). This evolution states that enterprise integration technologies are reducing the cost of a firm from within a firm to between firms and finally in EMp. It implies that a firm can lower cost and increase time-to-market efficiency by adopting more technology of enterprise integration.

In table 3, we can see that the primary force of enterprise integration is the reduction of cost of a firm. This force initially happens within a firm when people find that business information between departments are not interoperable. This triggered the ERP development (roughly 1960s to 2000s). Later, people found that the implementation time and cost of ERP was long and high, which is prohibitive for many small businesses to adopt ERP. To overcome such weakness, XRP (roughly 1990s to 2000s), e.g. supply chain management systems (SCM) and customer

Table 2. Development of flexible standards for EMp.

Evolving stage	Proprietary standard	Open standard
Characteristics	Proprietary, rigid, pre-designed	Open, statically pre-designed
Examples and cases	EDIFACT (www.unece.org/trade/untdid)	UNSPSC, ecl@ss, etc. for business, and ebXML, SOAP, WSDL, BPEL etc. in interoperability services
Cost and time	High cost in design and long time to deploy	Less time in design and less cost to deploy and reuse

Table 3. Evolution of enterprise integration.

Evolving stage	Enterprise resource planning (ERP)	Extended resource planning (XRP)	Enterprise application integration (EAI)	Electronic market place (EMp)
Characteristics	• Inter-department integration • Planning 4M of money, man, material and manufacturing	• Inter-enterprise integration • Integrated value chain between firm and its suppliers and customers • Supply/demand chain plan	• Application independent • Business process oriented • Integrate heterogeneous applications of enterprises and inter-enterprises	• Online intermediary • Aggregating offerings • Matching buyers and sellers, transaction facilitation • Market places integration
Examples and cases	• ERP vendors, e.g. SAP, Oracle, ssaglobal.com	• XRP vendors, e.g. SAP, Oracle	• EAI vendors, e.g. IBM, NEON, BEA	• EMp vendors, e.g. Ariba, I2.com, Sterling Commerce
Cost and time	Cost reduction within a firm	Cost saving between firms	Reduce re-use cost	Reduce market place cost

Table 4. Evolution of service provision in EMp.

Evolving stage	Electronic connection and EDI	Application service provision (ASP)	Web service (WS)
Characteristics	• One-to-one connection • Trusted partners on VPN • Data transaction on ANSI X12 and EDIFACT for inter- and intra-industry • Connectivity with trade documents • Governed by standards of specific industry consortium	• One-to-many connection • Trusted partners on proprietary network • Data transaction on proprietary standards • Connectivity with trade documents • Governed by standards of vendors	• Many-to-many connection • Dynamically joined partners on Internet • Data transaction on XML SOAP in WSDL • Connectivity with application-to-application • Governed by standards of W3C, OASIS and WS-I
Examples and cases	• Electronic connection, e.g. American Hospital Supply Corporation (AHS) to many hospitals (1970s) • Built-in house EDI, e.g. Tradenet/Tradacom (Ghobadian *et al.* 1994)	• Web EDI (outsourcing), e.g. covalentworks.com, dicentral.com, datatrans-inc.com, pscommerce.com • Outsourcing enabled application, e.g. ariba.com, Autodesk.com, Salesforce.com	• WebserviceX.net • Oracle: www.oracle.com/technology/tech/webservices; IBM: www-128.ibm.com/developerworks/webservices; Microsoft: msdn.microsoft.com/webservices
Cost and time	• High cost in installation and maintenance • Time-consuming for deployment	• Configurable cost by outsourcing • Less time in deployment	• Low cost in deployment • Less time in maintenance through increased re-usability

Table 5. Emergence of semantic Integration on EMp.

Evolving stage	Keywords	Metadata	Ontology	Collaborative concept
Characteristics	• No semantic conflict resolution	• Pre-designed semantic consistency on meta-data level	• Pre-designed semantic consistency for all terms in one or several integrated ontologies	• Collaboratively designed semantic consistency for all concepts
	• Semantic consistency depends on the hidden meanings	• Semantic conflicts on data level	• Concept and concept value are not separated	• Partially resolved semantic conflicts for concept values
				• Separate concepts from concept value
Examples and cases	• Search engines, e.g. Yahoo.com, Google.com, Microsoft.com, Altavista.com	• Organize resource and specify search, e.g. CERES/NBII (ceres.ca.gov/thesaurus/), MMUG (marinemetadata.org)	• Ontology management: AlphaWorks (www.alphaworks.ibm.com/tech/snobase)	• Collaborative concept creation systems, e.g. CONEX (www.sftw.umac.mo/~jzguo/pages/ConexDemo/index.html
			• Ontology editing, e.g. protege.stanford.edu	
Cost and time	• Additional cost and time for resolving semantic conflicts from hidden meanings	• Additional cost and time to maintain semantic consistency between metadata and resolving data-level semantic conflicts	• Additional cost and time for integrating heterogeneous ontologies and resolving semantic conflicts from monolithic terms	• Distributed cost in collaborative concept design
				• Lower cost and less time for maintaining semantic consistency between heterogeneous concept systems

relationship management systems (CRM), was promoted to increase connectivity to external firms for suppliers and customers to optimize supply chain performance and increase customer loyalty. However, the process of integrating external firms are not smooth, because there are many heterogeneous enterprise applications that had already used in firms, this again motivated many firms to look for EAI (roughly 1990s to 2000s) to integrate the heterogeneous intra- and inter-enterprise heterogeneous applications to improve the application re-use and achieve real-time business processing. The EAI development has summarized many important integration experiences such as service level messaging and component design. These further encourage the connected firms to form new types of electronic EMp to reduce market place cost in marketing, procurement and customer support.

4.3 *Evolution of service provision in business-to-business electronic market places*

Table 4 shows that the evolution of service provision from the cases of early rigid and non-reusable EDI systems to the open and highly reusable web services (Chen *et al.* 2003). These evolving stages have proved that acquiring services from B2B EMp (e.g. EDI systems, ASP networks, and Web service oriented integration systems) is becoming easier and easier with less cost and time. It implies that B2B EMp participants can find more desirable B2B services (i.e. EM functions) for business interoperability through the service outsourcing in public EMp and community EMp, and it is less necessity to design and self-build private EMp by their own.

More investigation through table 4 indicates that the B2B service provision has exactly experienced three important stages. They are electronic data interchange (EDI), application service provision (ASP), and Web services (WS). These stages have their own characteristics and their changes signify the path of integration technology development. For traditional EDI service (roughly 1970s to 1990s), due to the constraints of network technology and the rigid and proprietary EDI standards, they are limited to private EMp for large firms with high cost in investment. The issue of traditional EDI encouraged people to find out how to support SMEs for electronic connection for business interoperability.

Influenced by the IT philosophy of 'software as service', ASP (roughly 1990s to early 2000s) was a product of IT outsourcing technology driven by the development of the Internet. It included a large scope of technology-based services such as hosting service providers (HSP), data centre service providers (DSP), management service providers (MSP), storage service providers (SSP), integration service providers (ISP), security service providers (SSP) and network service providers (NSP). It was targeted at most SMEs, which did not have the potential to invest in major systems like ERP and CRM, and so SMEs naturally became a key target for service provision vendors. The large number of SMEs made analysts very optimistic about the growth of business. Following this trend, many private EMp (e.g. Compaq, Dun & Bradstreet, and Office Depot) (Gilbert and Mateyaschuk 1999), community EMp (covisint.com and exostar.com) and public EMp (plasticsnet.com and VertMarkets.com) were created with the technical support by ASP. In this stage, some important EMp solution vendors are Oracle.com, Ariba.com and CommerceOne. (CommerceOne was bankrupted and its historical data can be found in http://web.archive.org/web/*/

http://www.commerceone.com for understanding the representative public EM functions provided by an EMp facilitator in the early of 2000s.)

However, except for some successful ASP models such as grid computing and utility computing, ASP retains many problems. The falls of ASP in early 2000 (Vassiliadisa *et al*. 2006) showed that

a. ASP technology is not ready to integrate SMEs,
b. ASP technology lacks of standardization and difficult to integrate numerous heterogeneous applications, and
c. the changes of ASP vendors causes new integration issues.

All these increase the cost of ASP application deployment and stop SMEs from participating B2B EMp.

Web service with service-oriented architecture (SOA) (roughly late 1990s to now) is a reaction to, and a rethinking of, ASP technology. It has improved integration technology for business interoperability in all B2B EMp. In private EMp it improves the private supply chain between the buyer and suppliers (e.g. amazon.com's web services). In community EMp it enhances the collaboration between the involving partners (Eijk 2007) (e.g. covisint.com). In public EMp, numerous SMEs are able to connect to public EMp through the reusable Web service components. The actual effect of Web services is that the overall integration costs are reduced in participating in EMp.

4.4 *Emergence of semantic integration in business-to-business electronic market places*

Table 5 shows that the emergence of semantic integration technology on EMp has characterized a path that the difficulties of business information exchange between heterogeneous e-business systems, or their conflicting business understanding, are gradually reducing. The overall cost and time of processing the business concepts with the same complexity is decreasing. This implies that the interaction costs between EMp participants are lowering.

Details of table 4 have illustrated an important development in the aspect of semantic integration technology from keywords, metadata, to ontology and collaborative concepts. This corresponds to people's understanding of the EM functions that are required. For example, the early interests in building an EMp was to provide the search ability of products, buyers and sellers. This drove people to study how to use keywords to find what people need. The search engine EMp (e.g. Yahoo and Google) can be seen as a product of this research path. Investigation on keywords reveals many problems of keyword use, e.g. no semantic conflict resolution for synonyms, homonyms and hidden meanings of keywords. This encourages people to study the explicit meanings of keywords through metadata (i.e. data about data) and use metadata (e.g. thesaurus) to classify products and business documents in electronic catalogues for browsing products, sellers and buyers.

However, besides the search, a new requirement for EMp approaches, which is the exchange of product information between sellers and buyers situated in heterogeneous business systems. The metadata, developed as a kind of informal vocabulary within a system, attempted to resolve the issue but cannot satisfy the requirement. This is because heterogeneous business systems have their own contexts

to develop their own metadata. This makes metadata not interoperable. Ontology is a reaction on such limitation. It is designed as a kind of formal, explicit and shared vocabulary of a domain. Through providing the inference rules between different ontologies, heterogeneous business systems can talk with each other for exchanging business product information through the given ontologies. Under this investigation (e.g. Keller 1996), some ontology-based EMp are developed (e.g. http://web.archive.org/web/*/http://www.commerceone.net).

Nevertheless, the ontology is not without its problems. With the further new requirement of EMp for facilitating transactions between heterogeneous business systems, the targets of achieving higher similarity (a target of data search) between the exchanged product data cannot resolve the semantic consistency between the exchanged business information, such as an invoice, an inquiry sheet or an order sheet. This is because a transferred order sheet cannot only be similar between the sender and receiver in semantic understanding. This problem triggers the investigation on the collaborative concept (Guo 2004), which attempts to guarantee that both senders and receivers exactly agree on the semantic concept equivalence of the exchanged documents without any legal consequences.

The above changes in standards, enterprise integration, service provision and semantic integration technologies have signified the following trends:

1. Business standards are becoming more flexible, which becomes a strong drag of EMp participants to different EMp.
2. Technical integration is moving fast from intra-enterprise to inter-enterprise towards EMp.
3. Complex business concepts are becoming easier and cheaper to be processed and integrated in EMp because of the new way of service provision and semantic integration. The previously non-interoperable EM functions, such as searching, matching buyers and sellers, contracting, e-payment, and e-logistics, are becoming more and more integrated. Thus, all types of EMp are becoming larger and larger.

These three trends support the argument that firms will make more use of EMp for achieving business interoperability with the development of integration technology. Their specific selection of a particular type of EMp will be determined by their individual evaluation on the trade-offs between private EMp, community EMp and public EMp with regard to the management costs and the interaction costs that are involved.

5. Case studies on business-to-business electronic market places

In this section, we hypothesize that firms are increasingly using various types of private, community and public EMp for business interoperability with the development of integration technologies. To validate this hypothesis, we make some case studies to investigate whether firms are using these types of EMp more with the development of integration technology, assuming other factors such as information privacy, customer loyalty, trust relationship, market power, financial strength and technical ability remain unchanged for the studied cases. If this hypothesis is established through our case analysis, we can then conclude that the

function–cost ratio of the business interoperability formula ($I = F/C$) is increasing in all private, community and public EMp as the development speed of integration technology quickens. This will be apagogic to our argument.

5.1 *Methodology*

We employ historical event analysis to conduct our case studies. With this approach, we first carefully select the cases we want to study and then discover in chronological order the important events that have happened around each case's website as an EMp. Finally, we analyse how the events reflect any clues for the development of the studied case. The cases we study are selected according to the following criteria:

- *Originality of the source*. The selected case is a historically recorded case by a convincible and robust historical website, which records the original and real past of the cases without any modification.
- *Repeatability of the verification*. The selected case can be repeatedly verified by other researchers as we do in our approach.
- *Representability of the case*. The selected case is about B2B EMp, which is well known by most e-commerce researchers and practitioners. This ensures the representability of the case study.

With the above methodology and case selection criteria, we adopt Wayback Machine (www.archive.org) as our history Web archival website, because we believe this website is well known and has been pretty robust in recording Web history since the mid-1990s. Whereas the real history of EMp is as short as the Web development history, the most recorded Web pages in archive.org are sufficient to represent the whole picture of EMp development.

5.2 *Case analysis*

For the particular case studies, we select boeing.com, covisint.com and alibaba.com respectively to analyse the development of private, community and public EMp. These three cases are suitable because they all satisfy the criteria of originality of the source and the repeatability of the verification. In archive.org, their historical information is properly recorded and repeatedly verifiable. The boeing.com as a private EMp is representative because

a. Boeing individually owns boeing.com,
b. Boeing.com serves an EMp where Boeing as a single buyer to purchase various aviation supply parts (in B2B aspect) and as a single seller to sell its Boeing gifts and used products (in B2C aspect), and
c. Boeing is influential in the aviation industry as a buyer in its private supply chain supported by boeing.com

The covisint.com as a community EMp is representative because

a. the covisint.com is one of the largest community EMp and was initiated and is owned by the automobile firms of General Motors, Ford Motor Company, and Daimler-Chrysler (later adding a few other leading firms),

b. the firms in the owner group of covisint.com are influential in industries as buyers or sellers, and
c. the covisint.com has provided EM functions that enable other business partners to join in the covisint.com.

The alibaba.com as a public EMp is representative because

a. alibaba is the owner of the alibaba.com that is the largest public EMp in terms of the user number (Guo *et al.* 2006),
b. it acts as neither a seller nor a buyer in alibaba.com and thus is independent of the interests of the buyers and sellers in alibaba.com, and
c. the alibaba.com facilitates as an online meeting place before 2004 and gradually adds transaction facilitation functions after 2004. These are all EM functions that are preferably provided by a public EMp.

These historical sites are analysed through the investigations on (1) whether the historical events reflect the increased EM functions, or (2) whether the historical events show the increased number of joining in the investigated EMp. Based on the formula of $I = F/C$, if the number and/or quality of EM functions (F) increases, we could infer that business interoperability is increased and thus firms use more of EMp, assuming that the total costs of EMP building, subscription and integration remain unchanged. If the number of EMp participants increases, we could infer that the firms are driven by higher interoperability on EMp and thus use more of EMp. According to the formula $I = F/C$, if I is increased, then it is either F increased or C reduced, or both F increased and C reduced. The increased business interoperability will imply that integration technologies are the technical driving force that either reduces total coordination costs or improves EM functions on EMp.

5.2.1 Boeing.com. Boeing is an aerospace company specializing in aviation technology and products for passenger planes, helicopters, warplanes and missiles, satellites and spacecraft. It is one of the largest aerospace companies in the world, with headquarters in the USA, and has been in existence for more than 100 years. Its journey of e-commerce and electronic market place started nearly as long as the Internet history under the name of boeing.com.

Historical event analysis. Historical event analysis on boeing.com based on table 6 in the Appendix shows that Boeing started its building and use of private EMp from the middle of the 1990s. Initially, it was merely a corporate website for product promotion, and then quickly shifted to online sales and supplier supports. With the development of EDI, SCM, standardization and Web technology, it soon developed more EM functions of e-marketing and business community services and supplier chain management.

Figure 3 shows that Boeing has improved the EMp functions in its own boeing.com private EMp, but also as one of the founders of the community EMp of exostar.com where the EMp functions have also constantly improved. The Boeing case shows that Boeing has consistently used both the self-building private EMp and the self-building community EMp to constantly improve their EM functions. Assuming that the total costs to join boeing.com remain unchanged, we would say

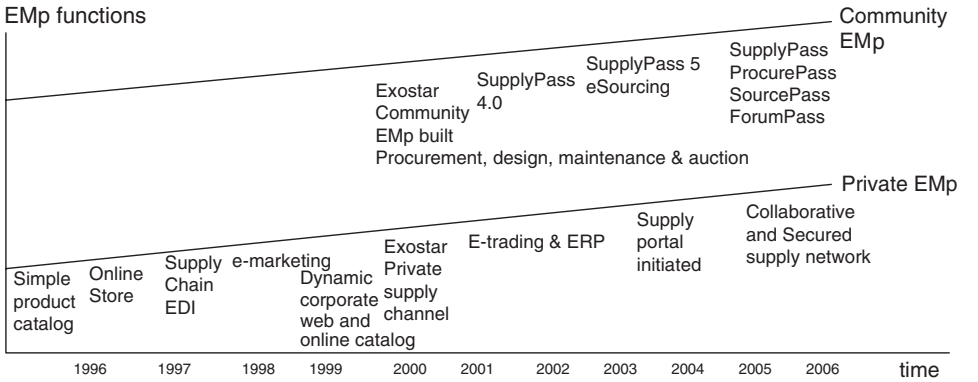

Figure 3. Development of both private and community EMp (sources: Table 6 and http://web.archive.org/web/*/http://www.exostar.com).

that business interoperability has been increased in boeing.com by the inclusion of Boeing's business partners.

5.2.2 Covisint.com. Covisint is a leading e-market place that provides interoperability solutions for the automobile, healthcare and public sectors. It was founded in 2000 by leading automobile firms General Motors, Ford Motor, and Daimler-Chrysler, all based in the United States.

Historical event analysis. Table 7 in the Appendix shows the historical events of covisint.com from its establishment to today. Our analysis found that EM functions in Covisint were constantly increased. From supply chain, procurement and product development, to supply network, content personalization, application integration, and supply chain execution applications, and finally to integration framework. This included: virtual project workplace, auctions, catalogues, quote manager, asset control, fulfilment, supplier connection, quality planner, problem solver, portal, integration, and finance service, on Covisint specialized industry operating systems with standardized message structures and services to care for more SMEs.

Figure 4 illustrates that in the automobile industry the numbers of registered suppliers and active users increased, respectively, from 250 in 2001 to 30 000 in 2005 and from 78 000 in 2003 to 266 000 in 2005. From then onwards the numbers stabilized. This may be explained by the fact that the automobile industry is rigid in its market size. The new introduction of healthcare and public EM sectors from 2006 may indirectly imply that Covisint realized the market size problem. By speculation, if more industries are supported to increase the total market size, covisint.com will be gradually evolved from a vertical EMp to a horizontal EMp. Another interesting point is that the number of owners of covisint.com increased from four in the automobile industry to 12, including five in the non-automobile industry sector. One may speculate that if the owner number of Covisint continues to increase, the feature of community EMp will gradually fade and finally Covisint will be evolved into a public EMp, because more owners distributed in different industries means the end of the control of

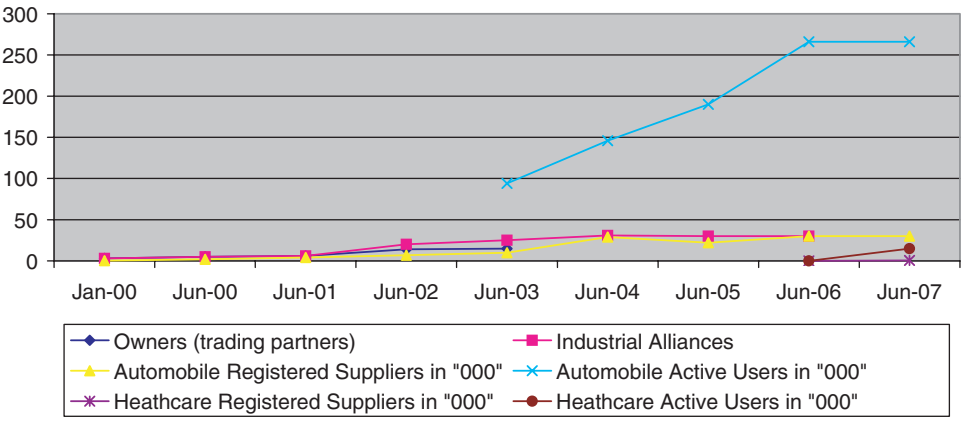

Figure 4. The evolution of Covisint community EMp (source: http://web.archive.org/web/*/http://www.covisint.com).

the community EMp by a few influential firms. This speculation may be verified by another phenomenon; that is, the competing automobile companies as industrial alliances are also gradually joining covisint.com slowly, but limited to the large automobile companies in the world.

Whatever happens, the total number joining covisint.com is increasing. Since covisint.com was obviously improving its quality and number of EM functions (F), we can infer that the overall business interoperability of covisint.com was increasing, based on the formula of $I = F/C$, with the decreasing co-ordination costs in covisint.com.

5.2.3 Alibaba.com. Alibaba.com is a wholly-owned subsidiary of the Alibaba Group, China. It is the world's largest online B2B market place for global and domestic China trade. With members in more than 200 countries and territories, Alibaba.com is the number one destination for businesses to find volume buyers and suppliers from around the world. The Alibaba.com public EMp includes two interrelated market places, which are Alibaba International (www.alibaba.com) and Alibaba China (china.alibaba.com).

Historical event analysis. Alibaba.com's development, shown in table 8 of the Appendix, signified a public EMp development path from having simple EMp functions of electronic product catalogues to including buyer-seller interaction, to personalization of corporate portal, to credit management and fraudulence prevention, to e-marketing of online trade show, to real-time communication, to online inquiry, to escrow services, to customer management, and finally to online negotiation. These can be seen as a kind of improved understanding of EM functions on EMp.

Figure 5 shows Alibaba's increasing numbers in product listing, selling offers and buying inquiries. However, while selling leads drastically increase, the buying leads and registered companies was staggering from 2004 to 2007. This phenomenon may imply that the actual sales revenue was increasing in a very hard way in Alibaba International, though it has a large increase in total EMp

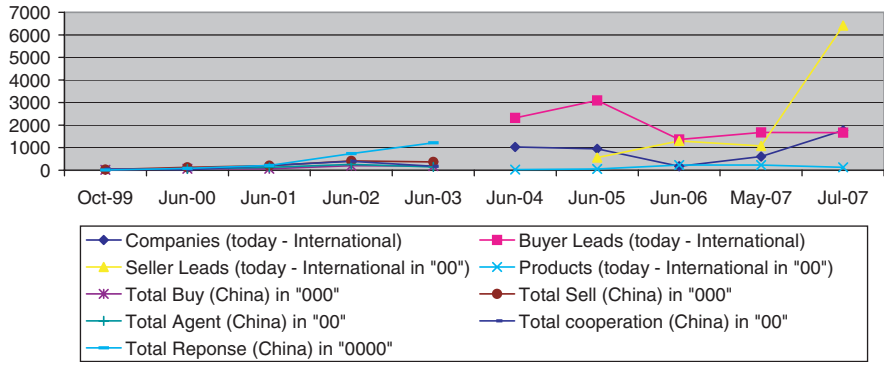

Figure 5. The evolution of Alibaba public EMp (Alibaba International).

joining-in number. Comparing with Alibaba China (see http://web.archive.org/web/*/http://china.alibaba.com), especially years 2005–2007, the speed of providing more EM functions to Alibaba International largely lagged behind Alibaba China. This difference meant that Alibaba China had much quicker development than Alibaba International (e.g. in Alibaba China, there are 55 millions visits/day, 11 millions buyers, and 80% of online transaction market share of China). There are two possible explanations:

1. Alibaba knew the Chinese market better than the international market and so it had more flexible and personalized public EMp construction in Alibaba China than in Alibaba International.
2. Integration technology was easier to apply in Alibaba China than in Alibaba International, because in China, its TrustPass, TraderManager, AliAssistance, and AliPay could easily work together to satisfy SMEs.

However, in Alibaba International, Alibaba lacks effective integration technology to solve the problems of integrated credit management, international trade e-payment, logistics and shipping, and even inspection services.

5.3 *Results of case analysis*

Some conclusions can be made based on the above three case studies:

1. All three EMp of boeing.com, covisint.com and alibaba.com will surely become larger and larger in terms of the numbers of EMp participants. Particularly:
   - Boeing as a large influential firm in the aerospace industry tends to self-build larger private EMp by improving EM functions to attract more business partners. This tendency can also be seen in the Ford Motor Company in the automobile industry, Wal-Mart in retail industry, and Amazon in the book industry, where the number of firms joining these private EMp has increased a lot over the last 5 years.
   - Boeing, similar to some other large influential firms, also has a tendency to jointly self-build a larger community EMp with other leading firms for

an increasing number of suppliers to join in. Such examples can be seen in exostar.com community EMp that is jointly self-built by BAE Systems, Boeing, Lockheed Martin, and Raytheon, and in covisint.com community EMp that is jointly self-built by General Motors, Ford Motor Company and Daimler-Chrysler.
- Alibaba.com as a third-party public EMp has an increasing number of SMEs' joining in its public EMp. Similar examples can be seen in the public EMp of globalsources.com.

2. EM functions have been improved in both quality and quantity since 2000 in boeing.com, covisint.com and alibaba.com. This is because of the rapid development of integration technology and the drastic increase of EM functionality provision. This has motivated many firms (both LMEs and SMEs) to make more use of private (e.g. Boeing), community (e.g. Covisint) and public (e.g. Alibaba) EMp.

These results indicate that, while Boeing, General Motors, Ford, DaimlerChrysler were self-building their private and community EMp, most firms were more likely to use the existing EMp provided by different types of EMp like Boeing, Covisint and Alibaba to increase business interoperability. The particular selection of any type of EMp—public, community or private—is dependent on the specific evaluation of business interoperability on each type of EMp, which is determined by the increasing EM functions and/or the decreasing total co-ordination costs.

6. Impact of increasing use of business-to-business electronic market places

The result of case analysis has proved the argument that firms will make more use of various types of EMp based on their particular evaluation on the co-ordination costs and the EM functions. This may result in several important impacts on corporate behaviours and strategies.

1. If they are not large firms like Boeing or Ford companies may gradually abandon the practice of the full purchase of high cost hardware and software to install a private EMp. Instead, they may outsource EM functions from community or public EMp, because this will save them money.
2. More than ever before strategic alliances will be formed between firms, because the purchase of non-core EM component services from strategic alliances will be comparatively cheaper than self-development in house, and it will also increase the speed of time-to-market and thus beat the market competition.
3. Collaborative design of various types of things such as business knowledge, products, processes and services will become popular, because the semantically integrated and enlarged EMp provides an unprecedented, global, collaborative and virtual space for firms to work together.
4. More firms will participate in various types of EMp based on their evaluation of provided business interoperability (i.e. $I = F/C$). It will be easier for SMEs, which previously had no way of joining EMp in order to share in the benefits of business interoperability, to join existing EMp because the entry fee for

joining EMp is gradually reducing (either free to join in or paid with subscription fees).

Exceptions will continue to existing during the above shift. Some firms, which still rely on traditional transaction means, will still stay in traditional markets.

7. Conclusion

The integration technologies are proving more and more important for increasing business interoperability on EMp. The framework we have developed in this paper helps explain this importance. We have seen that integration technologies have evolved along four major directions in standardization, enterprise integration, service provision and semantic integration. This evolution results in more flexible business standards, and cheaper handling of complex business concepts in all types of EMp. Such changes lead to fewer co-ordination costs and improved EM functions. These changes signify a trend of increasing business interoperability on EMp, which will lead to increased use of various types of EMp.

This shift has several implications for practitioners and technology developers:

1. Public or community EMp will not fail as in the case of CommerceOne (Gilbert 2002). Most firms should realize the emerging business opportunities on community and public EMp brought by the fast development of integration technology.
2. Most firms should consider certain forms of strategic alliances to benefit from the new advances of service provision supported by all types of EMp.
3. Most firms should be aware of the power of collaboration on EMp to increase corporate productivity.
4. SMEs should seize the new opportunities by subscribing to EMp for increasing their business interoperability.

In short, the development of integration technology, especially standardization, enterprise integration, service provision and semantic integration, will lead to an overall increase of business interoperability on EMp, making it more efficient and less costly for companies doing e-business on EMp. The case studies on Boeing, Covisint and Alibaba have showed that with the development of integration technology, firms are increasingly using various types of EMp to increase business interoperability according to each firm's evaluation on the co-ordination costs and EM functions between different EMp.

Appendix

Table 6. Historical event analysis on Boeing.com.

Time	Event	Source	Interpretation
19/10/1996	Product introduction	~19961019182651/http://www1.boeing.com	Online product booklet
22/12/1996	Detailed firm and product introduction; open gift store	~19961222072537/http://www.boeing.com	Online store; simple product catalogue
			Private EMp created
15/04/1997	Doing business with Boeing	~19970415121138/http://www1.boeing.com	Supply chain initiated
10/12/1997	Search function introduced	~19971210100850/http://www.boeing.com/	Intra-firm search engine; EDI for SCM and standardization initiated
	EDI implementation guide		
01/1998	Boeingmedia.com launched	~*/http://boeingmedia.com/	Boeing e-marketing initiated
02/12/1998	Dynamic website started and multi-media introduced	~19981202051209/http://www.boeing.com/	Dynamic corporate Web
			Dynamic electronic product catalogue
29/02/2000	Exostar channel initiated	~20000229191243/http://www.boeing.com	Boeing private supply channel
28/03/2000	Boeing, BAE, Lockheed Martin and Raytheon announced open global trading exchange	~20001015100834/www.boeing.com/companyoffices/doingbiz/supplier/global_trad_message.html	CommerceOne.com MarketSite Portal solution to enable community EMp for supply chain management
10/05/2000	Customer LOGON enabled	~20000510132318/http://www.boeing.com/	Web customization supported
	Boeing community established		E-Portal initiated
16/08/2000	Connexion by Boeing created	~20000816025420/http://www.boeing.com/special/connexion/	Boeing business community formed to strengthen private EMp
16/11/2000	Exostar.com jointly launched as per 28/03/2000	~20001116214300/www.exostar.com/index_nf.asp	Boeing community EMp formally built for global trading exchange
17/11/2001	Boeing e-business launched	~20011117173851/www.boeing.com	e-trading and ERP
12/02/2003	Supplier introduction added	~20030212162908/www.boeing.com	Supplier portal initiated
To present	More improved in SCM, CRM and corporate governance	~20070518150433/http://www.boeing.com	Improved e-portal with collaborative and secured supply network

Note: ~=http://web.archive.org/web/

Table 7. Historical event analysis on covisint.com.

Time	Event	Source	Interpretation
25/01/2000	General Motors, Ford Motor Co. and DaimlerChrysler planned it	~20001019015239/www.covisint.com/info/about.shtml	Plan a single global portal for B2B trading exchange in automobile industry
14/04/2000	Renault, Nissan joined	~'same as above'	Planned EMp owner group enlarged
16/08/2000	Product lines:	~20001110100900/www.covisint.com/procurement/;	
	• Procurement	~20000816024305/www.covisint.com/supplychain/;	• Procurement (auction, catalogue, quote management)
	• Supply chain	~20000816024311/www.covisint.com/productdev/;	• Supply chain (collaborative forecasting and planning, material flow management; coordinated transportation and trade management)
	• Product development	~20001027222421/www.covisint.com/info/pr/covisint_selects_nexprise.shtml	• Product development (in-formation services, knowledge exchange, collaborative product design)
19/10/2000	Technologies of NexPrise and Engineering Animation Inc. (EAI) adopted for integration		
21/11/2000	Supplier network created to create global e-marketplace for B2B e-commerce	~20001121083200/http://www.covisint.com	Concept of supplier network, with the cycle of plan, design, purchase, build, use and dispose
12/01/2001	• Formal establishment; Oracle and CommerceOne joined;	~20010124045900/www.covisint.com/info/pr/covisint_becomes.shtml;	• Changed EMp owner structure
	• Select Documentum for content management		• Having 250 suppliers across two continents, mostly tier-one suppliers

(*continued*)

Table 7. Continued.

Time	Event	Source	Interpretation
		~20010124050700/www.covisint.com/info/pr/covisint_documentum.shtml	• Content personalization enabled
21/01/2001	Board of Directors selected	~20010407091307/covisint.com/info/pr/board_of_directors.shtml	12 from automobile industry and 5 from non-automobile
01/03/2001	Selected Mercator software	~20010301232430/http://covisint.com	Application integration
31/03/2001	Selected supply solution	~20010331004600/http://www.covisint.com	SC execution applications
13/07/2001	Selected Web methods	~20010713080526/http://www.covisint.com	Built integration framework
29/11/2001	New solution suites:	~20011129120749/http://covisint.com	Solutions suites were selling:
	• Collaboration	~20011212094837/covisint.com/solutions/collab	• Virtual project workplace
	• Procurement	~20011211210406/covisint.com/solutions/proc	• Auctions, catalogues, quote manager, asset control
	• Supply chain	~20011211212802/covisint.com/solutions/sc/	• Fulfilment, supplier connection
	• Quality	~20011211212000/covisint.com/solutions/qlty	• Quality planner, problem solver
	• Corporate	~20011211205315/covisint.com/solutions/corp	• Portal, integration, finance service
05/03/2002	Trading partners increased to 14	~20020305223108/portal.covisint.com/public	Community EMp enlarged
27/03/2002	100 million transactions/month; 2000 suppliers and automakers	~20020405135819/www.informationweek.com/story/IWK20020225S0010	Community EMp joining in member number and value increased
26/05/2002	New languages available	~20020526092819/http://www.covisint.com	8 language Covisint available
18/02/2003	Restructured website; focused on members and alliances, services, press media	~20030218033349/http://www.covisint.com	Over 8000 registered customers, 78 000 active users, over 3300 online bidding, over 435 online catalogues—EMp enlarged
24/12/2003	Automobile industry operating system; Covisint Connect;	~20031224095319/http://www.covisint.com	• Special Ind. OS
	Services:		• Offered messaging on both standard XML and EDI
	• Connect		• New vision of services
	• Communicate		
	• Collaborate		

05/02/2004	Over 25 000 registered customers, 135 000 active users in 96 countries	~20040205202539/http://www.covisint.com	Community EMp enlarged
24/06/2004	Over 29 000 registered customers, 146000 active users in 96 countries	~20040624001013/http://www.covisint.com	Community EMp enlarged
23/07/2004	Over 20 000 members, 155 000 active users	~20040723062948/http://www.covisint.com	Adjusted EMp size statistics
23/05/2005	Announced Covisint Healthcare	~20050323032226/http://www.covisint.com	New EMp scope introduced
24/09/2005	Web-based EDI; demand-driven interoperability	~20050924173127/http://covisint.com	Paid attention on SMEs and integrated SCM
29/10/2005	266 000 users 30 000 companies 600 applications	~20051029093847/http://www.covisint.com	Community EMp enlarged
01/11/2005	Business now released	~20051101214429/http://www.covisint.com	Extended ERP to Covisint portal
05/12/2006	Link to public sector community New solution visions: • Portals • Collaboration suite • Global B2B messaging • Virtual fax services	~20061205054656/http://covisint.com	• Community EMp scope enlarged • Emphasized corporate portal, collaborative business process, global standard messaging, SMEs
09/07/2007	EMp size: automobile 266 000 users, 30 000 companies in 96 countries Healthcare: 15 000 users, 450 companies in North America; 600 applications	http://www.covisint.com/about, accessed on July 9, 2007.	Community EMp steadily enlarged in the aspect of new industry of healthcare

Note: ~=http://web.archive.org/web/

Table 8. Historical event analysis of Alibaba.com.

Time	Event	Source	Interpretation
1999	Basic manufacturer directory services, buy and sell posting, BizExpress, Firm List, Add Your Company, My Sample Room, View Sample, Join Free, Help; Parallel sites: China, Global Chinese		Initial framework of Alibaba public EMp with major EMp functions of electronic catalogues
08/02/2000	BizMail, BizClub added	~20000208125348/http://www.alibaba.com	Increased buyer-seller interaction
10/05/2000	BizService added	~20000510084810/http://www.alibaba.com	Improved EMp logistics services
11/06/2000	BizNews added	~20000611045243/http://www.alibaba.com	Improved trade information channel
02/12/2000	Included My Alibaba, Forum, My Company, Business Center	~20001202085200/http://www.alibaba.com	Start EMp personalization for trade activity, and social networking
30/01/2001	Included Business Information and Services	~20010130091900/http://www.alibaba.com	Provided deal analysis, credit report, supporting tools, and supplier clubs
04/04/2001	Included Customer Service, For Buyer, For Seller, Trade Site, China Supplier	~20010404235147/http://www.alibaba.com	Concept of customers segmentation, introduced individual corporate portals
22/09/2001	TrustPass introduced	~20010922183341/http://alibaba.com	Credit service started
21/01/2002	TrustPass community added	~20020121173807/http://alibaba.com	Increased trade opportunities for TrustPass members
22/07/2002	Promotion Center added	~20020722224617/http://alibaba.com	Increase user confidence on Alibaba
Late 2002	Gold Supply product introduced	http://www.alibaba.com/aboutalibaba/index.html	Provide better e-marketing

2003	Chinese TradeManager added	http://www.alibaba.com/aboutalibaba/index.html	For real-time trade communication
03/02/2004	Inquiry basket appeared	~20040203114549/http://www.alibaba.com	Enable online inquiry
20/05/2004	Fraud email added	~20040520060746/http://www.alibaba.com	Introduced anti-fraudulence
02/07/2005	English TradeManager introduced	~20050702073536/http://www.alibaba.com	For real-time trade communication
05/04/2005	Included Chinese keyword bid, auction, pay with Alipay, free C2C e-shop	~20050409034442/http://china.alibaba.com	Add means of e-marketing; Increase trade means with auction; Escrow service for China trade
12/05/2006	Chinese Customer Management System introduced	~20060512000800/http://www.china.alibaba.com	Alisoft started to integrate Alibaba EMp resources into a SCM system
01/03/2007	New TradeManager including mobile TradeManager	~20070301105335/http://china.alibaba.com	Improved online negotiation in both desktop and mobile phone
10/07/2007	Introduced industry-based EMp	www.china.alibaba.com accessed on 10/07/2007	EMp market segmentation

Note: ~=http://web.archive.org/web/

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