Technical Construction Methods for E-Marketplace

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ABSTRACT
An analysis on the existing e-marketplaces shows there are seven types of technical construction methods for e-marketplaces. They are e-catalogue, e-shop, e-portal, e-hub, e-switch, e-integrator and e-merger. The quality of these e-marketplaces can be measured based on a quality matrix of accuracy, reach and richness.

Categories and Subject Descriptors
K.4.4 [**Computing Milieux**]: Computers and Society – *Electronic Commerce*. K.1 [**Computing Milieux**]: Markets. J.1 [**Computer Applications**]: Administrative Data Processing – *Business*, *Marketing*. I.m [Computing Methodologies]: Miscellaneous.

General Terms
Management, Design

Keywords
electronic market place (e-marketplace), electronic catalogue (e-catalogue), electronic shop (e-shop), electronic portal (e-portal), electronic hub (e-hub), electronic switch (e-switch), electronic integrator (e-integrator), electronic merger (e-merger), e-marketplace function, e-marketplace construction quality

1. INTRODUCTION
Electronic marketplace (e-marketplace or EMp) is an important research area in e-commerce technology. It is the infrastructure of electronic markets that enable trading partners to work together for doing business through its provided functionalities [19]. In constructing an e-marketplace, a question is often asked how an e-marketplace should be built so that its functionalities can be provided to its users. In Guo's research [19], an e-marketplace is termed as a *common business information space* (CBIS) to describe its construction. The CBIS, as an abstraction of e-marketplace, has four properties: distribution, autonomy, interdependence and emergence [19][20], which are indispensable for building an interoperable e-marketplace.

To properly maintain these properties, the interpretation work between business partners in CBIS is required for e-marketplace construction to achieve the meaning understanding between business partners. The term *meaning understanding* here is essential. It refers to reaching a certain level of semantic agreement between the known and unknown partners over disparate business systems. Its quality indicators are accuracy, reach and richness. *Accuracy* reflects the reliability of the semantic agreement between business partners. It can be measured by mutual acceptability, where *acceptability* refers to the "satisfactoriness by virtue of conforming to approved standards" (WordNet.org). *Reach* "is about access and connection" [14]. It reflects the coverage of the semantic agreement between business partners. It can be measured by the number of connected messaging systems where the population size of users could be computed. *Richness* "is the depth of the information that a business gives to or collects about its customers" [14]. It reflects the extent of functionality supported by the e-marketplace and can be measured by the number of provided e-marketplace functions, where semantic agreements exist.

This paper aims to analyze the existing technical construction methods for e-marketplaces through a literature review so that a reclassification can be properly presented to enhance our understanding on them and to guide to our future design. In the rest of this paper, Section 2 will describe the existing technical construction methods and reclassifies them based on e-marketplace functions. Section 3 will provide a quality matrix by which the quality of any technically constructed e-marketplaces can be evaluated. Finally, a brief conclusion and the future work will be provided.

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2. TECHNICAL CONSTRUCTION METHODS FOR E-MARKETPLACE
Existing technical construction methods for e-marketplaces are discussed under various notions. It is not well known yet how they are constructed and what quality matrix should be applied in their evaluation. In this Section, we conduct a brief literature review on some design-oriented e-marketplace papers by searching on the key technical digital libraries of ACM and IEEE during October-November 2008. The papers are collected based on search terms of "electronic shop", "electronic mall", "electronic markets", "electronic marketplaces", "electronic hubs", "electronic portals", "electronic exchanges", "electronic intermediaries", "information broker" and "electronic mediator". The analyzed results, shown in Table 1, are reclassified based on their similarity on e-marketplace technical construction methods, indicating their research themes and approaches to solving problems. Based on this reclassification, the required e-marketplace functions of each type are further analyzed and aligned in a functional framework, shown in Table 2.

1. E-Catalogue is a categorization web system that provides product/supplier search and electronic promotional services to buyers. It "is defined broadly to include any World Wide Web (WWW) page that contains information about the products and/or services a commercial entity offers" [42]. It is a type of primitive e-marketplace like an exhibition hall to promote products. Its research issues in technical construction are mainly catalogue user interface in the human-computer interaction for attracting potential buyers [44][45], product categorization [12], product information search, retrieval and integration [25][10][32], and heterogeneous product data interoperability [20].

Table 1: Summary of E-Marketplace Construction Methods

Method	Research Theme Examples	Example Approaches to Problem Solving
e-catalogue	Software reuse [12], survey [42], smart and virtual catalog [25], effective product selection [44], catalog design [10][32]	Categorization [12], facilitator [25] human computer interaction [44], data-driven approach [10], mediator [32]
e-shop	Shopkeeper [11], user interface [45], recommenders [4], 3D Website [8], application integration [15]	Human computer interaction [45], standardization [11], multi-agent [4], multimedia [8], Web service [15]
e-portal	Education portal [22], portal engine [27], employment portal [16], interoperability [38], portal design [17][41], SMART [1], process portal [39], search [3], e-auction [9], e-catalog [31]	Brokerage [22], web service [38], multi-agents [16][9], semantic matchmaking [1], action research [39], guided search [3], ontology approach [41], data mining [31]
e-hub	PUNCH [24], brokering strategy [43], BizTalk [28], ebXML [30], mobile agents [13], matchmaking [37][48], EDI messaging [29], medical standards [21][23]	Standard protocol approach [28][30], brokerage [43][13], matchmaking [37][48], standard-mediation [29][21][23]
e-switch	Sharing information [34], integration server [7], heterogeneous information exchange [6], interoperability [49]	Multi-broker [34], Protocol [7], argument-based systems [6], Web service [49]
e-integrator	E-catalog [25][32], e-marketplace design [5], intermediary [33], engineering services [40]	Facilitator [25], mediator [32], data-driven approach [5], multi-agents [33], project planning [40]
e-merger	design [51], intermediary [2], business process engineering [36], middle agent [50]	Standardization [51], e-intermediary [2][50][36]

2. E-shop. E-shop is a B2C web system that provides frontend electronic selling services to buyers (e.g. tesco.com) together with e-catalogues and e-payment services. In some more advanced e-shops, they may also include (1) an advertising system for advertisers to contextually advertise products [35], (2) a personalization system to deliver a personalized shop to buyers [8], (3) an auction system to enable product auction [47], and (4) a recommender for e-shop to automatically present buyer-favorite products [4]. Key problems encountered in e-shop construction are e-shop usability, backend data/application integration and accurate product recommendation. Thus, most existing researches focus on shop usability, standardization, web services, multi-agent systems for integration, and business intelligence for product recommendation.

3. E-portal is a user-oriented web system that integrates all resources and services in a backend system and is a customizable gateway to its participants. It targets at either selling or buying or both. Its key difference from e-shop is that e-portal is a central information repository for both buyer and seller, which provides more e-commerce functions such as e-procurement [46] and trust management [26]. E-portal can be a website of third-party (e.g. alibaba.com), seller-side (e.g. travelocity.com) or buyer-side (e.g. contracts.mod.uk), often following a single set of specifications. Its research issues often focus on database and/or backend application integration. There are different approaches to these issues, such as multi-agent systems [16], web services [38], semantic matchmaking [1] and ontology support [41].

4. E-hub is a homogeneous information integration web system that forwards information between information systems of buyers and sellers. It targets at integrating discrete sellers and buyers. More specifically, e-hub assumes that business partners have desires to hold their information in their local sites but not in a central repository like an e-portal. So, the task of e-hub is to design a set of specification and software, which could enable all local sellers and buyers to sell and buy and to store information in their home sites. E-hub is a decentralized system (unlike centralized e-portal), where partners' information is located and managed in local sites. E-hub does not sell or buy but only an information forwarder between sellers and buyers like a post office. The key research issue of e-hub is how to let sellers and buyers be connected from different locations. Thus, usual approaches applied are (1) to design a messaging protocol and apply it to sellers and buyers [13], and (2) to employ existing open standards to integrate sellers and buyers, such as EDI [29], BizTalk [28], ebXML [30] and MML [21][23]. Modern research on e-hub finds that simply specified protocols or standardized messaging formats do not fully solve integration problem. Buyers and sellers have different business semantics used in their delivered messages. Thus, messages, besides being delivered, must also be correctly interpreted in meaning and understood between sellers and buyers. This leads to the further study of business semantic match problem [37].

5. E-switch, which we call, is a heterogeneous information integration web system that transforms heterogeneous information between information systems of buyers and sellers without involving selling and buying. The transformation involves (1) *message structure transformation*, for example, heterogeneous message structures of a data schema or an ontology language, and (2) *semantic concept transformation*, for example**,** multilingual translation ("refrigerator" to "rèfrigèrateur"), synonym transformation (e.g. "fridge" to "refrigerator"), or heterogeneous business process patterns. Its key research issue is the semantic information interoperability between heterogeneous e-business systems and often discussed in the approaches of logical reasoning [6], service-oriented architecture [49] and semantic mapping [18]. Nevertheless, since each business system of sellers and buyers is autonomous in design and evolved over time, these approaches in general cannot accurately maintain consistency in both schematic and semantic levels between the participated business systems. In Guo's research [20], a collaborative conceptualization approach is proposed to enable semantic integration.

6. E-integrator is a service-oriented web system that forwards and/or transforms information between buyers and sellers in addition to providing B2B transaction facilitation capability (e.g. functional supports on inquiry, offer, contract, payment, shipping and insurance by users) and e-marketplace protection functionality, for example, TradeCard.com. Its research issues are: (1) how to integrate business information in both schematic and semantic levels (e.g. [20][25][32]), (2) how to support transaction facilitation (e.g. [33]), and (3) how to protect e-marketplace in both information security and legal aspects (e.g. [26]). Solutions to these issues vary and are similar to the approaches used in constructing e-catalogue, e-shop, e-portal, e-hub and e-switch.

7. E-merger, which we coin, is a fully-integrated web system that merges all functions of e-portal, e-hub, e-switch and e-integrator in addition to providing value-added and premium-charged services. *Value-added services* are the services that e-merger provides with or without a price beyond basic services, which are often used to promote the participation of e-marketplaces and to increase the subscription number. *Premium-charged services* are

bundled additional services charged with a discount. Typical e-merger can be a web system that not only integrate suppliers with buyers but also provide additional services such as spending management solutions (e.g. ariba.com) and/or directly selling or purchasing products (e.g. amazon.com). E-merger often includes B2B, B2C and e-business integration services.

Table 2: Functional Framework of Various E-Marketplace Construction Methods

Function	e-catalog	e-shop	e-portal	e-hub	e-switch	e-integrator	e-merger
Product categorization (list/search) ([10][25][32][44])	×	×	×	×	×	×	×
Usability study (look & feel) ([45])	×	×	×				×
Personalization (one-to-one) ([8][41])	×	×	×				×
e-marketing (advertise/recommend) ([4][31][35])		×	×				×
Selling products/services ([11][47])		×	×				×
Buying products/services ([46])			×				×
Value-added services (www.mobilein.com/what_is_a_VAS.htm)			×				×
Security protection ([5][26])		×	×	×	×	×	×
Legal infrastructure support		×	×	×	×	×	×
Internal database integration ([30][39])	×	×	×				×
Internal application integration ([28][29])	×		×				×
Homogeneous info. Forwarding ([21][23])	×			×	×	×	×
Heterogeneous info. Transformation ([6][18][20][37])	×				×	×	×
Heterogeneous app. Integration ([7][49])					×	×	×
Support e-marketing services (www.twx-21.hitachi.ne.jp)						×	×
Support e-contract establishment services (TradeCard.com)						×	×
Support e-contract fulfillment services (TradeCard.com)						×	×
Support e-contract maintenance services (www.twx-21.hitachi.ne.jp)						×	×

The required e-marketplace functions for each technical construction method can be allocated in Table 2. This allocation matches with the target of each type of e-marketplace.

3. QUALITY MATRIX

To evaluate the quality of a technically designed e-marketplace, a quality matrix is devised as follows.

Definition 1: *Quality of an e-marketplace (QEMp)*. The overall quality of an e-marketplace refers to the average qualities of the accuracy of meaning understanding between the exchanged information, the scope of e-marketplace coverage and the richness of e-marketplace functions developed. This definition can be formally defined in the following:

$$QEMp = 1/3\ A + 1/3\ S + 1/3\ R$$

where *A* is the *accuracy* indicator, *S* is the *reach* indicator, *R* is the *richness* indicator and "1/3" is the coefficient, which assigns the equal importance of the three indicators in measuring the quality of a constructed e-marketplace. □

Definition 2: *Accuracy of meaning understanding (A)*. The accuracy quality indicator is the ratio between the accurate concepts and total concepts within an e-marketplace. It reflects the reliability of using an e-marketplace. Here a concept is a piece of information in information exchange.

$$A = (W - IA)/W$$

where *W* refers to the *total concepts in use* such that *W = PC + DC + BC* in which *BC* is the number of basic concepts (terms) developed in a set of vocabularies such that $BC = \sum_{v=1}^{n} v \times \sum_{t=0}^{m} t$ (*v* is a vocabulary and *t* is a term), *DC* is a set of business documents such that $DC = \sum_{d=1}^{n} d \times \sum_{t=0}^{m} t$ (d is a document and t is a term), and *PC* refers to a set of processes such that $PC = \sum_{p=0}^{w} p \times \sum_{a=0}^{n} a \times \sum_{t=0}^{m} t$ (*p* is a business process, *a* is an action and *t* is a term). The *IA* is the inaccurate usage number that is not satisfied by the users when they receive the messages. □

Definition 3: *Reach (or Scope) of e-marketplace (S)*. The reach quality indicator shows the actual population size of an e-marketplace comparing with the size of a standard e-marketplace. It reflects the attractiveness of the e-marketplace.

$$S = AP/RP$$

where *AP* is the number of actual population size of e-marketplace users and *RP* is the reference population size such that $RR \geq AP$. □

Definition 4: *Richness of e-marketplace (R)*. The richness quality indicator presents the actual e-marketplace functions of an e-marketplace, comparing with a set of reference functions.

$$R = AF/RF$$

where *AF* is the number actual functions such that $\forall af \in AF$, *af* = *v* and $v \in (0, 0.5, 1)$, and *RF* is the number of reference functions for e-marketplace. □

This matrix can measure the quality of designed e-marketplaces.

4. CONCLUSION

This paper analyzed the existing e-marketplaces and showed seven types of technical construction methods for e-marketplaces: e-catalogue, e-shop, e-portal, e-hub, e-switch, e-integrator and e-merger. A quality matrix on the quality of the constructed e-marketplaces was devised based on accuracy, reach and richness.

This paper has the following contributions: (1) provided a better understanding of the existing e-marketplaces on their technical construction methods; (2) gave a clear research boundary for each technical construction method in its functional design, and (3) devised a quality matrix on measuring the quality of any technically constructed e-marketplaces.

Some issues regarding the technical construction methods on e-marketplace are still not discussed in this paper, including how to validate the reclassified methods. In future, we will make an empirical research validate this reclassification.

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