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Multi-Vendor Electronic Catalogs to Support Procurement: Current Practice and Future Directions

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Abstract

Multi-vendor electronic catalogs (E-catalogs) are an increasingly important component of Internet and Intranet-based procurement solutions as they provide key support for the information-gathering procurement stage.

We provide a framework to evaluate three multi-vendor E-catalog-based procurement models: the „Do-It-Yourself“ model, where the buying firm constructs its own E-catalog, the Third-Party E-catalog Integrator model, and the Real-Time Knowledge Discovery model, where buying firms use advanced software techniques such as agents to construct E-catalogs dynamically. We discuss how these approaches might evolve and the difficulties firms may face as they transition between states. Finally, we point out that the addition of coordination pathways can extend each of the procurement models and briefly discuss the strategic implications of these extensions.

1. Introduction

Multi-vendor electronic catalogs (E-catalogs) are an essential part of electronic procurement solutions. They integrate supplier information by merging data and performing some degree of semantic reconciliation. The data is then presented to the buying firm as a centralized access point to the products and services that can be purchased via the systems. To understand more fully the role of E-catalogs in procurement, the remainder of the paper is organized as follows. In Section 2 we identify three basic categories of procurement solutions, the „Do-It-Yourself“, „Third-Party Integrator“, and „Real-Time Knowledge Discovery“ approaches. Variations of the three approaches exist. Each general solution class, however, has different implications for buyers and sellers, and different technology requirements. In Section 3 we introduce a framework to evaluate each category according to a number of variables. We then apply this framework to the three E-catalog procurement models. The last section of the paper discusses the implications of adding coordination pathways to each model.

2. Electronic Catalogs to Support Procurement – State of the Practice

There are three basic E-catalog models to support procurement. This section reviews the three types and sets the stage for Section 3 which applies an evaluation framework.

a. The “Do It Yourself” approach.

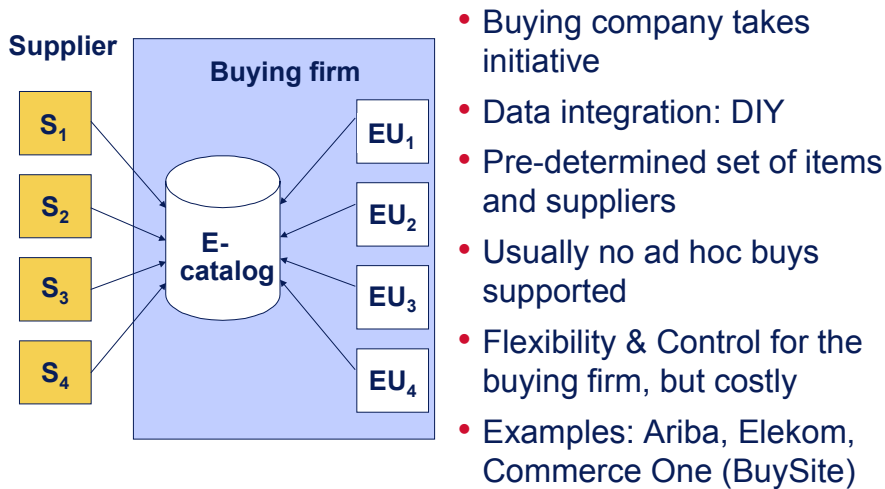
In this model, a buying firm takes the initiative to set up a catalog which comprises a fixed set of suppliers with whom close relationships are established. This is a popular

option but necessitates a high-level of in-house IT support for front-end systems development, data collating and reconciliation.

The Purchasing group is responsible for selecting the suppliers, for negotiating items prices, and for deciding according to which scheme each item is represented in the catalog. It is also responsible for the catalog design in terms of user interface, search mechanisms, and links with other applications such as accounting or human resources. Thus, Purchasing is responsible for weighing the intangibles as well as the tangibles of the suppliers' offerings. Although external support might be obtained for these tasks and for setting up, implementing, maintaining, and maybe even hosting the catalog system, the „do it yourself“ model implies that the buying company is in full control of the catalog content and system functions. Given that the participation in such a catalog project implies significant expenses, buyer and suppliers know each other well and consider their business relationships as long-term (see [Bakos, Brynjolfsson 1993] for a more formal explanation). In some cases, participation in an electronic catalog project is linked with a sole-sourcing offer, where the supplier is guaranteed to be the only source for a certain sets of items. The electronic catalog systems usually do not support for buying outside the predefined set of items and suppliers. Following the up front negotiations and system design tasks, catalog data is uploaded into the database.

Figure 1 shows a stylized view of the Do-It-Yourself approach.

Figure 1. The „Do-It-Yourself“ Approach: The Buying Firm Assembles its own In-House E-catalog



b. The „Third-party integrator“ approach.

A firm can seek help from a third party to set up a master E-catalog and then „rent“ access to parts of it, according to individual buyer firm needs. This option is chosen by firms to lower in-house IT investment with the implicit assumption that the integrator will provide a stable and trusted set of suppliers in their collated offering. This is consistent with the reduced set of suppliers predicted by Clemons et al. [Clemons, Reddi and Row, 1993] in a general outsourcing situation.

Although standards, such as the UN/SPSC codification initiative [UN/SPSC, 1998] are slowly being advanced, there is no consensus as of yet even when similar products are being merged.

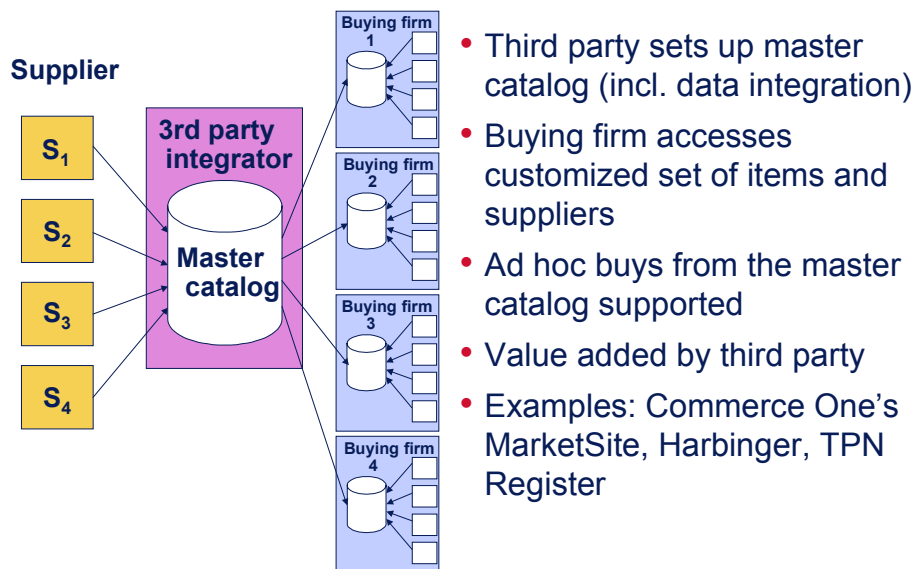
In this model, a firm seeks help from a third party to set up a master electronic catalog and then „rents“ access to parts of it, according to its individual requirements. The E-catalog integrator is thus an intermediary which performs several value-adding functions associated with generic market intermediaries [Bailey and Bakos, 1997, Bakos 1998]: it *aggregates* seller offerings to improve knowledge discovery on the part of the buying firm; it becomes *an agent of trust* as buyers implicitly trust selling firms that have joined voluntarily with the integration effort; it *facilitates* the market by reducing operating costs, and it *matches* buyers and sellers.

While the catalog or parts of the catalog can be stored physically inside or outside of the firewall of the buying company, it is important to notice that in this model, the third party is responsible for subscribing suppliers and presenting a view of the collated data

to the buying firm. Thus, it is the third party integrator who has ultimately control over the catalog content and the features of the catalog system. The integrator makes arrangements with the suppliers to participate in the catalog and manages the data uploading process. It also has main responsibility for the design and implementation of the catalog system itself, including search functionality and user interface. This is notwithstanding individual buyer-supplier agreements. Examples of integrator firms are TPN Register, Requisite, Harbinger, and Commerce One.

We diagram the general situation of the third-party integrator in Figure 2.

Figure 2. A Third-Party Integrator assembles the Master Catalog.



In the case of a firm with a centralized Purchasing authority, the use of a third-party integrator introduces an external intermediary. We can consider Purchasing as an internal intermediary; both entities sit between the Procurement end-users (buying individuals inside the buying firm) and the suppliers.

It typically acts as a filter, selecting subsets of the E-catalog to offer the end-users, such as an approved-vendor list. Value-added features such as full-text attribute search that rest on top of this catalog can be built at either, or both, of the intermediary locations.

c. The "Real-Time Knowledge Discovery" Approach.

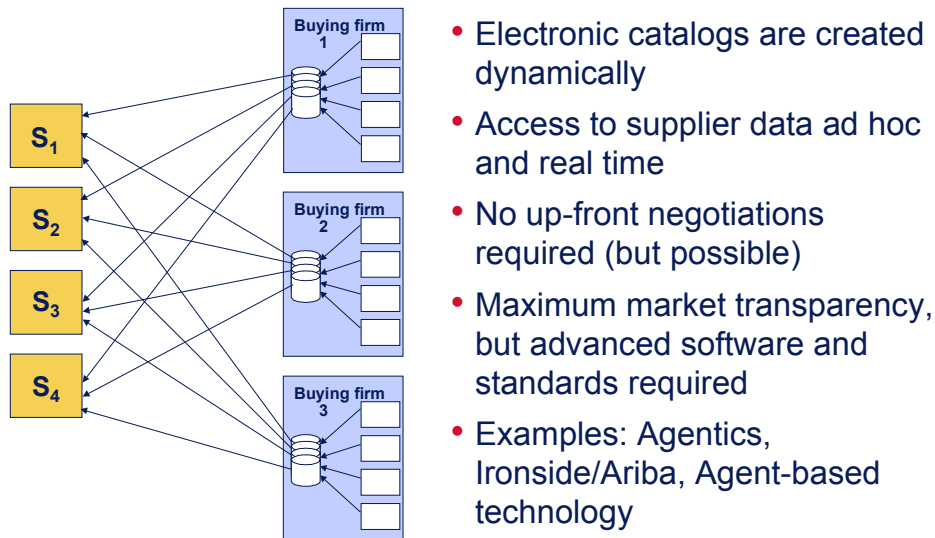
This category is actually a broad spectrum of models which represents the last step in the evolution of procurement evolution, as integrators are bypassed and buying firms rely on advanced software techniques, for example agent-based solutions, to troll the Internet and locate suitable products. A firm can use agents that create a catalog dynamically and subsequent allow access to the data in real time. It is also possible to adapt heterogeneous data sources into unified virtual schema with wrapper technology, thus creating a set of relational tables from semistructured data [Rajaraman and Norvig, 1998].

In this category, the buying firm relies on advanced software techniques, for example agent-based solutions, to troll the Internet and locate suitable products and suppliers.

Electronic catalogs are created dynamically and subsequently allow access to supplier data in real time. Examples for early stages of this model are the dynamic catalog approaches of companies like Agentics and Ironside/Ariba, and agent-based systems such as Kashbah etc. [Guttman Moukas Maes 1998, Nwana, et al. 1998]. There is no need for the suppliers to upload their catalog data into the electronic procurement systems of their customers; instead the catalogs of the suppliers are accessed as needed in any given situation. Ideally, the model does not require up front negotiations between buyers and suppliers and allows for ad hoc buys. While it provides maximum market transparency, it does rely on the availability of advanced software solutions and readily available communication protocols and product ontologies. In order to maintain control of the purchasing process and to leverage purchasing power, the model needs to provide for spending control mechanisms and access to individually negotiated pricing schemes, in addition to ad hoc access to supplier data. Agent architectures may confront unwilling suppliers, who do not wish to compete on price discovery. Software changes can be made to overcome supplier blocks, only to encounter new blocks, etc. in an iterative cycle. This game theoretic problem is modeled by Crowston [Crowston 1996]. Another obstacle to the application of technology in this model is the lack of standardization of product descriptions and inter-agent communication protocols.

Figure 3 shows the general scheme for knowledge discovery approaches.

Figure 3. In Real Time, the Buying Firms use Advanced Software Techniques to Locate, Aggregate, and Transform Supplier Data



3 A Framework to Evaluate Electronic Catalog Solutions

To compare the three approaches to E-catalog procurement identified in Section 2, it is useful to have a basis for comparison. This section introduces a framework to assess the success factors of each solution.

Each catalog model is evaluated according to eight variables, addressing its benefits, costs and underlying technology requirements. Six of the variables are focused on the buying firm, and two of them are focused on the seller firm(s) which make up the E-catalog. The eight variables are summarized in Table 1.

Table 1: Variables to Evaluate Electronic Catalog Procurement Models

Variable Name	Buyer or Seller Focus (B/S)	Function of (parameter1, parameter2, ...)
Flexibility and Control	B	$f(\text{number of intermediaries})$
Purchasing and Bargaining Power	B	$f(\text{purchasing volume, number of end users})$
Buyer Interface Cost	B	$f(\text{number of catalog partners that need a different system interface})$
Technology Cost	B	$f(\text{sophistication of solution, required technology knowledge})$
Useability	B	$f(\text{control over system interface design})$
Catalog Reach	B	$f(\text{total number of items accessible via the catalog system})$
Supplier Adoption	S	$f(\text{number of competitors included in the system})$
Supplier Interface Cost	S	$f(\text{number of partners that need a different system interface})$

We now discuss these variables in some detail and then apply them to evaluate the three major E-catalog procurement models.

1. Flexibility and Control – $f(\text{number of intermediaries})$

Different electronic catalog solutions provide the buying company with different levels of control. Differences exist regarding the level of efforts required to adjust the solution to individual needs and changing requirements. We assume that a solution that gives a buying company control over the catalog content, including the possibility to decide on the set of catalog items and suppliers, is of higher value than a solution where flexibility is low. A highly beneficial solution should provide support for changes, even if they occur on short notice. We assume that flexibility and control are dependent on the number of external third party intermediaries that are involved in setting up the electronic catalog solution.

2. Purchasing and bargaining power – $f(\text{purchasing volume and number of end users})$

Electronic purchasing solutions are often implemented not only to improve purchasing operations by automating internal workflows or external communication schemes and to improve day-to-day activities, but also to increase buys from preferred suppliers with the hope to be better able to leverage corporate purchasing power in the future. We assume that bargaining power and, thus, the success of such hopes are dependent on the intensity with which a catalog solution is used and how well it can in fact bundle purchasing power. This means that a big company with a large number of end user requisitioners whose buys are bundled with an electronic catalog system has generally more leverage than a small buyer with only a handful of end users. However, an electronic catalog solution that offers a supplier access to a large number of buyers and/or that bundles the purchases of many buyers can ultimately provide the individual buyer with significant purchasing power, too.

We assume that purchasing power is mainly dependent on the number of end users with access to a specific (individual or master) catalog.

3. Interface cost – $f(\text{number of catalog partners that need a different system interface})$

Each of the catalog models is different regarding the number of interfaces that it implies. To date, no generally accepted standards and protocols for inter-organizational communication exist. As a result, each interface is somewhat different with regards to data structure and message contents and protocols. Electronic catalog solutions have to account for these differences, which often lead to significant costs, not only to set up a solution, but also to maintain it later on. Even in cases where a buying firm is large and enjoys great buying power, effectively utilizing such power does not come without cost. In our model, we use the number of business partners that a buying company has to deal with directly (supplier or third-party intermediary), as the main proxy for the interface cost of the electronic catalog solution.

4. Technology cost – $f(\text{sophistication of solution} - \text{required technology knowledge})$

In addition to the number of different interfaces that a catalog solution requires, the systems also differ with regards to the sophistication of the underlying technology. All other things equal, self-made solutions require a higher amount of internal technical knowledge than solutions where expertise is acquired externally.

We assume that a third-party vendor providing a sophisticated catalog solution to a number of customers might in fact be able to offer this solution at relatively low cost to the individual buying company, by leveraging economies of scale. Thus, we link the technology cost to the knowledge that the buying company has to provide in order to set up and maintain the catalog solution, be it internally available or acquired from external sources. The buying firm must also evaluate the level of data aggregation offered in the procurement solution. Often, goods which are similar along several attributes can be intelligently aggregated across multiple vendors. The question then becomes whether to rely on a third party or parties to aggregate, or whether to develop aggregation strategies in-house. The question of aggregation is intimately tied to the power of the interface, as we discuss in the next point.

5. Useability – $f(\text{control over system interface design})$

From a corporate perspective, the benefits of each computer system are dependent on its adoption by the target user community. In the case of electronic catalog systems, this is a very important point, given that the intended leverage of purchasing power is depending heavily on its ability to gear purchases to the set of preferred suppliers, as opposed to other sources, including end users' friends down the street. Electronic catalog systems are usually targeting a large community of end users, each of which might use the system only very infrequently. As a result, the systems need to be designed in a way that makes their use easy, including graphical user interfaces, online help and documentation that is easy to understand, in order to assure high acceptance. Depending on the corporate culture and professional backgrounds of a user community, each firm is somewhat different when it comes to IT skills and user interface requirements. In our model, we assume that user adoption is determined by the amount of control that the individual firm has over the design of the user interface of the system. The easier it is to control a system, the easier and, as a result, cheaper it is to design interfaces that meet the requirements of an individual community and thus ensure high acceptance, even among occasional users. The importance of the interface cannot be underestimated. Recent work suggests two trends for a more powerful interface. Firstly, the interface should migrate from a generic to a personalized and onward to a community, or workgroup interface. Secondly, considering the underlying and possibly quite heterogeneous data, the interface should move from simple reporting of value-attribute pairs to *intelligent data analysis* (judgment and proprietary methods applied to the raw data) and finally to intelligent aggregation (intelligent analysis applied to aggregated data) [Kambil and Ginsburg, 1998].

6. Catalog Reach – $f(\text{total number of items accessible via the catalog system})$

Another point is relevant when it comes to determining the acceptance of user adoption of a catalog solution: the question of whether a catalog holds all the items that a user might need access to. This includes items that are explicitly included in the catalog database as well as items that a user might access relatively easily in case the database does not hold satisfying results. The higher the number of items in the catalog, the more likely it will capture everything the user needs – ideally there will be no more need to go and buy from other sources. A catalog that does not provide the „entire“ universe from the start, might still be useful by providing for access to external catalog sources. We

call this feature the knowledge discovery power of a catalog solution. It is a function of the ability of buyers/end users to locate new suppliers in real time.

As a result, we use the total number of items accessible via the catalog system as the second variable to determine user adoption of a system – it includes the items that are stored in the catalog a priori as well as the items that can be included on very short notice.

7. Supplier adoption – $f(\text{number of competitors included in the system})$

The success of each any information system is dependent on its adoption of all parties that are impacted by it. Compared to internal systems, where at least in principle top management could enforce the use of the system, inter-organizational systems rely on the acceptance of at least two autonomous decision units. Thus, in order to estimate the success of a boundary-spanning system, we need to include the perspective of the business partners and determine the likeliness with which they join the system [Buxmann and Gebauer 1999]. We can assume that supplier adoption is dependent on the benefits that a system provides to the individual supplier. In some cases, the benefits that a system holds for a supplier might be directly opposed to the benefits it holds for the buying company, leading to interesting trade-offs. One such variable is the number of direct competitors that are included in an electronic catalog system. While for the buying company, a large number of suppliers is beneficial in terms of revealing the best deals, a supplier is more likely to object to this transparency. Economic theory shows that profit margins converge toward zero in markets with perfect transparency regarding product quality, delivery terms, and prices (see [Bakos 1991], and [Bakos and Brynjolffson 1993] for a more detailed analysis of this point).

In our model, we assume that supplier adoption is inversely related with the number of competitors included in the system.

8. Supplier interface cost – $f(\text{number of partners that need a different system interface})$

Supplier adoption might also depend on the cost required to join the system.

Corresponding to the number of interfaces that a buying firm has to provide for, each model is also different regarding the efforts that it requires from the supplier side.

Again, we cannot assume that interfaces are standardized in terms of communication protocols and product ontologies. We assume that the costs of establishing electronic links with trading partners are significantly greater than zero as long as standardized interfaces are not readily available.

As a result, supplier adoption is directly related to the number of different interfaces that a system has to accommodate. These costs include the expenses to set up the technical infrastructure to link with an electronic catalog solution.

Table 2 ranks the three E-catalog procurement models with respect to the variables that we introduced in Table 1:

TABLE 2: Evaluating Three Common Multi-Vendor E-catalog Procurement Models

	1. Do It Yourself (in-house catalog, few suppliers, no ad hoc buys)	2. Third Party Integrator (catalog maintained by external party, buyer subscribes to part of the full catalog)	3. Real-Time Knowledge Discovery, e.g. Agents (inhouse catalog, many suppliers, ad hoc buys supported)
a. Flexibility and Control – f(#intermediaries)	(high/medium)++	(lowest)+	(highest)+++
b. Purchasing/Bargaining power – f(purchasing volume/#end users)	(medium)++	(highest)+++	(lowest)+
c. Cost – f(#partners)	(high)++	(lowest)+++	(highest)+
d. Technology Cost – f(internal knowledge required)	(medium)++	(little)+++	(most)+
e. Useability – f(ease of use of user interface)	(easy)+++	(medium)++	(most difficult)+
f. Catalog Reach – f(#items in catalog)	(lowest)+	(medium)++	(best)+++
g. Supplier adoption – f(#competitors)	(best)+++	(medium)++	(worst)+
h. Supplier adoption – f (#partners)	(most)+	(medium)++	(least)+++

Table 2 shows an evolutionary path from left to right. To date, most E-catalog projects fall into category one, the Do-it-Yourself approach. Typically, large corporations, often with dispersed buying communities, hope to streamline their purchasing processes and improve the leverage of their purchasing power by establishing multi-vendor catalog systems. Recently, however, the third-party integrator approach has become more popular, as renting access to parts of a master catalog is a more affordable option for smaller corporations than the costly Do-it-Yourself approach.

Over time, both weaknesses in the third party integrator model and growing ease of use of advanced internet mining techniques will give the firm incentive to switch partially or entirely to a real-time knowledge discovery model.

We will discuss this point in more detail in the next section.

4. Evolving and Extending the Multi-Vendor E-catalog Procurement Model

The do-it-yourself suffers from certain weaknesses. First of all, it is the most costly from the point of view of the buying firm. The applications developed in-house will most likely be proprietary and difficult to extend and maintain. The lack of integration of these applications spell poor coordination with third-party efforts or supplier IT systems, for example Web-based supplier E-catalogs. It also affords very little market transparency as it does not support ad-hoc buys.

4.1 Requirements for Integration and Advanced Technology Solutions

Third-party integration solution providers need to make use of, or develop, commonly accepted supplier directories, product classification scheme. And, since suppliers have disincentive to compete on product price alone [Bailey and Bakos, 1997], it is likely that the integrator will not have a high degree of overlap in the participating suppliers. Finally, as the number of supplier partners increases, the integrator must build scalable systems: search must continue to be effective, for example, as the product universe increases.

The real-time knowledge discovery approach is the most advanced and ambitious. To get there, the suppliers' resistance against too much market transparency must be overcome. We also need to fill in some missing infrastructure, such as a reliable E-commerce communication protocols between agents. This stage has the economic advantage of more efficient markets and also the potential to support automated negotiations [Gebauer Beam Segev 1998].

It is feasible, but not common, for third party integrators to offer hooks into Model 3 (real-time knowledge discovery) tools. It is more common to offer passive hooks into seller firm web sites. For example, an integrator can house collated data and include hyperlinks as well into a selling firm's Web-based product information page.

4.2 Adding Coordination to Extend the E-Catalog Procurement Models

Coordination pathways will strengthen all three E-catalog procurement models. In the simplest do-it-yourself model, we can add coordination between the end-users in the buying firm. For example, the purchasing history can be linked to post-purchase satisfaction. Thus, experiences with similar products in distributed workgroups can be stored centrally and disseminated. Merging purchasing records with post-purchase satisfaction should improve the quality of the supplier set which makes up the internal E-catalog. This will address the internal coordination problems typically seen between the

„spokes“ (end-users, or workgroups) and the internal hub, the Purchasing department. Improving the feedback between the hub and the spokes will improve knowledge discovery (supply location) and supplier selection. Another way to introduce inter-user coordination is to overlay annotation on top of a product search engine. Users can commit annotations and this can become part of the product descriptions in the internal E-catalog, thus leveraging the collective intelligence of the internal user community. This can be implemented similarly to the Intranet document annotation scheme described by Ginsburg and Kambil [Ginsburg and Kambil 1999].

The third-party integrator model can also benefit from coordination. The buying firm end-users can carry over their coordination pathways as described above; and in addition the integrator can capture product search and satisfaction measures in its integrated E-catalog. Thus, the external intermediary, by capturing user feedback across buying firms, leverages the intelligence of multiple clients and increases its value to every client.

Since the real-time knowledge discovery model is the most dynamic and ambitious, it stands to gain the most from coordination pathways. As users construct E-catalogs on the fly, search and satisfaction metadata can be merged as well. In addition, related queries or needs from similar workgroups can be displayed as a further visual aid. This kind of feedback might improve market transparency by including information about product and quality, delivery terms, and warranties etc. It might thus encourage suppliers to participate in the model, who naturally oppose a model where product prices are the only way of distinction between competitors. In principle, internal coordination (between end-users, or between end-users and the internal Purchasing intermediary) should be simpler to implement than coordination in the preceding Integrator model, which was to an external intermediary.

In general, coordination mechanisms should increase the efficiency of the buying firm solving the problem of what suppliers to include in its preferred set. End-user coordination, and end-user to Purchasing coordination, should improve the composition of the preferred supplier set and make more efficient its change over time. Starting with the small set of suppliers predicted by Clemons et al. in the move-to-the-middle hypothesis [Clemons, Reddi, and Row 1993] we can predict an oscillation around this set, as knowledge discovery feedback occurs along several paths. For example, we might have coordination between end-users (as a result of end-user product feedback, or end-user-to-Internet data mining), or improved end-user-to-Purchasing (spoke to hub) coordination resulting in Purchasing re-thinking some of its tangibles and intangibles supplier assumptions. Thus, the barriers to entry into, and to exit from the supplier preferred set, are lowered by improved coordination.

5. Concluding Remarks and Future Directions

E-Commerce presents a landscape of applications subject to high-velocity change, both technical and strategic, and the Procurement function is no exception. The framework we have presented should prove useful to evaluate a variety of multi-vendor E-catalog procurement models and pinpoint the shortcomings of some common approaches.

The coordination pathways we discuss briefly in Section 4, and their integration with the strategically key E-catalog data source, are consistent with the prediction that „Internet and related technologies will change the role of the purchasing function from a transaction-oriented function to a more managerial function focused on establishing and maintaining relationships with suppliers [Gebauer, Segev and Beam 1998]“. We plan to develop proof-of-concept implementations of end-user coordination pathways in several of the major Procurement models as a necessary step forward to evaluate their impact. In addition, work is required to model more precisely the roles of external (third-party E-catalog integrators) and internal (buying firm Purchasing department) intermediaries which separate the buyers and suppliers. And, in a related effort, we are tracking major multi-vendor E-catalog providers and buying firms in order to fit them into our evaluation framework.

References

1. Bakos, J Yannis, „A Strategic Analysis of Electronic Market Places“, *MIS Quarterly*, September 1991, pp. 295-310.
2. Bakos, J. Yannis and Erik Brynjolfsson, „Information Technology, Incentives and the Optimal Number of Suppliers“, *JMIS*, Fall 1993, Vol. 10, No. 2, pp. 37-53.
3. Bailey, Joseph P., and Yannis Bakos, „An Exploratory Study of the Emerging Role of Electronic Intermediaries“, *International Journal of Electronic Commerce*, Spring 1997, Vol. 1, No. 3, pp. 7-20.
4. Bakos, J. Yannis, „The Emerging Role of Electronic Marketplaces on the Internet“, *Communications of the ACM*, August 1998, Vol. 41, No. 8, pp. 35-42.
5. Buxmann, Peter and Judith Gebauer. „Evaluating the Use of Information Technology in Inter-Organizational Relationships“, Proceedings, *HICSS-32*, Maui, 1999.
6. Clemons, Eric K., Reddi, Sashidhar P., and Michael C. Row, „The Impact of Information Technology on the Organization of Economic Activity: The „Move to the Middle“ Hypothesis“, *JMIS*, Fall 1993, Vol. 10, No. 2, pp. 9-35.
7. Crowston, Kevin. „Market-Enabling Internet Agents“, in *Proceedings, ICIS-96*, pp. 381-390, Amsterdam, Holland, 1996.
8. Gebauer, Judith, and Beam, Carrie, and Arie Segev. „Impact of the Internet on Procurement“, *Acquisition Review Quarterly*, Spring 1998, Vol. 14, pp. 167-181.
9. Ginsburg, Mark and Ajit Kambil. „Annotate! A Web-Based Knowledge Management Support System for Document Management“, in *Proc., HICSS-32*, IEEE, Hawaii, January 1999.
10. Guttman, Robert H., and Moukas, Alexandros G., and Pattie Maes. „Agent-Mediated Electronic Commerce: A Survey“, *Knowledge Engineering Review*, June 1998, pp. 1-10.
11. Kambil, Ajit and Mark Ginsburg. „Lessons from the Internet EDGAR Project“, *Communications of the ACM*, July 1998. Vol. 41, No. 7, pp. 91-97.
12. Nwana, H., Rosenschein, J., Sandholm, T., Sierra, C., Maes, P. and Robert H. Guttman, „Agent-Mediated Electronic Commerce: Issues, Challenges and some

Viewpoints“, in *Proc. Workshop on Agent Mediated Electronic Trading* (AMET'98), Minneapolis, Minnesota, May, 1998.

13. Rajaraman, Anand and Peter Norvig, „Virtual Database Technology: Transforming the Internet into a Database“, *Internet Computing*, July-August 1998, pp. 55-58.
14. United Nations / Dun & Bradstreet Standard Products and Services Codes (UN/SPSC), available online at <http://www.un-spsc.org>.