Models of Information Markets:
Analysis of Markets, Identification of Services, and Design Models

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Abstract

The Internet reduces much of the costs of information sharing, but it does not solve information receivers' reading and interpretation limitations. Search engines ease information retrieval but do not solve the problems of specifying information needs and evaluating retrieval results. This article approaches these problems as information market problems with solutions consisting of information market service process models. These models link information suppliers and information buyers and define activities, information resources, and information flows for the information market services. The models identified may improve the quality, speed, design and realisation of information market services summary goes here.

Keywords: Internet, information market, semantics, information good, information service models.

Introduction & Research Problem

The use of the Internet for the dissemination and retrieval of information and knowledge re-sources is now common practice. Search engines have been developed to find documents that may contain the requested information, or that refer to resources (like people, organizations and information systems) that may help to solve one's information needs (Schwartz, Divitini, & Brasethvik, 2000). The problem is not the lack of supply of Internet sources that may be retrieved, but the number of supply. This number makes it difficult to substantively match supply with specific information needs. Search engines may help to cope with the number of potentially retrieved items, but they are poor media when evaluating their relevance in the context of personal semantics and use values. An important cause for this problem is the difficulty of representing an information searcher's needs completely and unambiguously.

When the information need is explicit and unambiguous, queries can be formulated which hit the desired items. This search and delivery process can be industrialized in case the information need can be well anticipated, and information products and production platforms can be specified for individuals or client groups (Meyer & Zack, 1997). Often information needs are less explicit and thus are incompletely defined and ambiguous. This less explicit information need has a lower chance of a good hit in a first retrieval. Consequently, multiple searches are required to refine the specification of information needs. The use of natural language processing search engines (Baeza-Yates & Ribiero-Neto, 2000), automatic learning facilities (like genetic programming, Fan, Gordon, & Pathak, 2000), and feedback procedures (like content relevance feedback, term relevance feedback, magnitude feedback, tactical review feedback, and term re-view feedback; Spink, 1997) have been proposed to improve the semantic relevance of information items in implicitly specified information product situations. These technologies try to solve information retrieval problems, in contexts of semantic dissynchronies (ambiguous relations between terms and meanings) on the Internet, or any other data resource. Typical for these technologies is that the semantic problems are approaches ex post (after someone has caused them). Although semantic dissynchronies are often unavoidable, they are extremely costly in an information market, and much value can be created by prevention. Technologies that aim at prevention are indexing technologies for easing the maintenance and consistency of complex storage and retrieval structures (Cleverdon, Mills, & Keen, 1966; Koch, 1997) and semantic nets that enable different user ontologies for the same data resource (Berners-Lee, Hendler, & Lassila,

2001). These technologies are instruments for a more fundamental topic: semantic synchronization among people. Synchronization of semantics among people can be realized through socialization in networks (Nonaka, 1994), through standardization via a superior authority in hierarchies (Mintzberg, 1983), or through reference to a standard or source whose meaning has become common knowledge as a consequence of market power (Hamel & Prahalad, 1994).

This article regards information supplies and demands as a market of information. Following the statements above, supply and demand do not always and not easily match, and like in material goods markets intermediate services are important. These market services can reduce search costs, transaction costs, and may increase transaction value (Gurbaxani & Wang, 1991). From this understanding of information markets, we state that an information market requires specific services, which may help (increase effectiveness and efficiency) to match supply and demand of information. This implies that information market services should be attuned to characteristics of these markets, which may be classified as pure markets (which use market power-based services for semantic dissynchrony reduction), networks (which use socialization-based services) and hierarchies (which use authority based services) (Boisot, 1998; Ciborra, 1987; Ouchi, 1980; Williamson, 1991).

Many information market services in fact already exist,

and thus the features of information market services can be detected by analyzing existing examples. A critical analysis of these examples, though, also helps to detect the design parameters of the services given the specifics of the market they want to serve. The major question in this study therefore is:

What design parameters constitute effective services for Internet information markets?

To answer this question, the paper will:

- Identify parameters of information markets, and categorize information services in these markets.

- Apply these parameters to analyze some existing information market services.

An Analysis of Information Markets

Information markets, like any market, consist of minimally one supplier and minimally one buyer. In the pure market type the number of buyers and suppliers is very large, in others this number may be moderate (networks) or very small (hierarchies). An important reason for this number is the type of information good to be traded. In pure information markets, like in other pure markets, the information good is comparable to a commodity. Information goods can, however, require intense interactions and communications to be understood (networks), or to conform to a

| | *Market type* | | |
	Pure information market	**Network information market**	**Hierarchical information market**
Number of actors	Many	Several	Few
Type of information good	Information commodities	Heterogeneous professional information and self-representing information	Asset specific strategic information and non-tradable operational information
Ownership of information	Right to sell	Right to use is shared in the group	Right to reap profits
Price mechanism	Invisible hand	Handshaking within network	Visible hand
Services	Brokers	Coordinators	Expertise centers

Table 1: Information Market Parameters

client's very specific need (hierarchy).

At information markets, information exchanges happen, which imply some kind of transfer of ownership. Following Picot et al (1997), four types of ownership can be identified: (1) the right of use, (2) the right of changing forms and structure of the transferred good, (3) the right to reap the profits of the good, and (4) the right to sell the good. For pure markets the right to sell is fundamental. In networks the sharing of information is emphasized as an important asset for the network's creative success (Liebeskind et al, 1996), implying group shared use rights. In hierarchies, information asymmetries are important elements belonging to an efficient division of labor and responsibilities (Douma & Schreuder, 1991).

Because information markets implicate the transfer of information from a supplier to a buyer, the market actors arrange some kind of payment. This price mechanism may consist of an in-visible hand (the pure market), mutual understanding and networking (the handshaking in networks) and the visible hand (in hierarchies). Because prices are hard to define in networks (Liebeskind et al, 1996), the payment for use mostly consist of invitations for collaboration on further development, and sharing profits when the information good can be sold or exploited. In the hierarchy, the most important ownership is the right to reap the profits exclusively. The sales value (right of liquidation) may be less relevant because the information in hierarchies is highly asset specific and thus it is hard to sell (Williamson, 1991).

To improve the efficiency and effectiveness of information markets, several services are needed, consisting of infrastructures, applications, and commercial actors that help supply and demand to meet (brokers in pure markets), co-ordinators who help to shake hands in networks, and expertise centers that formally institutionalize information supplies in the hierarchy. Table 1 gives a summary of the market parameters thus identified.

We describe these three market types further with a view to detect the service needs of the three market types mentioned and to operationalize some of the abstract thinking here.

Pure Information Markets

Many market actors and information commodities

Pure information markets have many actors supplying similar information, but two different kinds of information commodities:

1. Homogeneous information commodities. These commodities consist of clearly identifiable (highly codified) information products, though many similar and competing products exist, which many can supply, and which may be of interest to many actors. This is the case of books and CD-ROMs. These information commodities consist of bundled information packs, supplied at one time.

2. Data products. Many press and news agencies supply similar information about events, which may be delivered in smaller data packages, but often consists of continuously up-dated deliveries. In comparison to homogeneous commodities, these data products are more flexible in shape and may have larger opportunities of meeting specific information needs, because much of the information is unbundled. The buyers may be given the opportunity of specifying their information need, and as such create their own information bundles. Examples of this kind are the electronic publishing and market information services (such as Nielsen and news agency services).

The fundamental distinction thus is between bundled information goods versus separate information packs, and a service that bundles these information packs in one big composite or in more flexible packs, probably delivered at different moments in time (Thatcher & Clemons, 2000).

Ownership: Sales property rights

Although copyright policies may be an important measure to enable any profit in information markets, they are often ineffective. The reasons for this are the following:

1. Low costs of reproduction and the principle of give-away-and-still-have-it. In contrast to buying i.e. a car, a copy machine or printer may be sufficient to make an extra copy of an in-formation commodity.

2. Inspecting and transfer are the same. In material goods markets, a buyer may experience every user experience before buying the product, but will lose the experience when the product is not bought. Homogeneous information commodities are less sensitive to this problem, because they have a value also after the product experience (e.g. for documentation, retrieval and status). Data products, though, consist of data that are relevant at a certain moment and become obsolete after their experience. This means that payment will have to be done in advance of access to the data.

Price mechanism: Invisible hand

Although author reputation is an important determinant of price and sales volume, buyers are confronted with a large number of alternative (homogeneous) information commodities. This implies that the price is based on the working of an invisible hand. For data products this is less the case. Although there are alternative suppliers of data products, the most value is created by an effective relationship with the supplier, so that the potential information resources can be at-tuned to specific buyer needs. The homogeneous commodity requires a single buying situation, and the data products require recurrent buying by a subscription.

Services: Brokers

Even pure markets consist of more than suppliers and buyers alone. They require transportation services (i.e. roads and logistic services) and transaction services (i.e. banks). Two types of brokers exist (1) shops, who sell the bundled homogeneous information commodities, and (2) information refineries, who sell the more flexible or unbundled data packs, mostly by subscription. Brokers may behave like a cafeteria in which a buyer can pick his issues of interest, but also can navigate and arrive in areas not planned in advance. Brokers often do not own the intellectual property rights, but only own the rights to sell and reproduce, and as such are an outlet, distribution and production platform for information producers. Refineries also may supply the information requested by processing a client profile (Meyer & Zack, 1996), and as such facilitate intervention of the buyer in the actual production of the information good supplied.

Networks

Several market actors and professional information resources

The nature of professional information complicates its price formation. Mostly the number of suppliers of this information is scarce, and the information often needs a high level of customization. Consequently the price is more the result of negotiation among known actors or professional ethics, and established by handshaking. Less customized than professional information, but even as important in networks, is the provision of self-representing information, which helps professional suppliers and buyers to find each other and to realize a possible in-formation transaction.

The information traded in these markets may have a rather high codification level, though it is difficult to price, like in the case of many (semi-finished) scientific information (Liebeskind, Oliver, Zucker, & Brewer, 1996), or it may

not be economically nor technically well-codificable (like personal feelings, intuitions and self-representations). This distinction corroborates with Hansen et al (1999), who distinguish codification and personalization strategies in knowledge management. The codification strategy transfers insights to codified information published to share it with others. The personalization strategy remains keeps the insights tacit, and facilitates to share it via socialization processes (Nonaka, 1994). All the information exchanged via networks have value based on what people want to supply. High quality supply is hard to enforce, and top quality content providers often have not much time to put efforts in supply.

Ownership: Shared use rights

The professional information product transfer thus does not automatically imply the right to change (norm is to invite the original idea producer to further collaboration), exploit the profits (norm is to share profits), and sell (it is hard to sell information which is the intellectual property of someone else, plagiarism is severely punished in professional societies). Professional associations and institutes service to define and guard these norms.

Price mechanism: handshaking

Professional information is mostly scarce, but among experts differentiation may exist among tariffs on condition of production costs (such as. dentists versus general practitioners) and scarcity of effectiveness (i.e. high hour rates for certain lawyers and low for others). To avoid excessive prices and low access of scarce services, the government may take action to impose tariff ceilings (esp. in medical field). To avoid too hard competition in an oligopolistic market (very few suppliers struggling for buyers), professional associations may try to impose minimum or standard tariffs (i.e. house brokers). The self-representing information has its value based on what people want to supply. High quality supply is hard to enforce, and top quality content providers often have not much time to put efforts in supply with uncertain and unknown returns.

Services: Coordinators

The services that help to let supply and demand meet in networks are called coordinators. Two types of coordinators exist, which serve the exchange of the tacit and codified insights distinguished before respectively via (1) meeting realizers and (2) content services management.

An example of a meeting realizer is ACIB (Wijnhoven, 1998). ACIB is an office established by the Dutch government to coordinate knowledge fragment exchange on information security of Dutch official information systems.

Much security knowledge is available on many places of Dutch government agencies, but it is dispersed and therefore difficult to use in specific circum-stances. Instead of establish one expertise center on security, ACIB was established to optimize the flow of information. For this purpose ACIB organizes conferences, workshops, an intranet site, and facilitates workgroups that create information products like flyers, bulletins and manuals. A meeting realizer has the following generic characteristics, as part of the meeting realizer model.

1. Publication policies (esp. quality guidelines) control the quality of content submitted to buyers at meetings.

2. Publication goes through four stages: sponsoring (someone has to give resources to an author), reviewing, editing, making accessible to buyers. The buyer accesses the content via search (information pull) or via automatic reporting (information push).

3. Informal information exchange, in physical or virtual ways (conferences and discussion lists). The conference manager controls this process.

An example of content services management is KPN Mobile's Intranet. To increase sharing of expertise and information within its organization, KPN Mobile developed an Intranet site. Appropriate documents put on this Intranet though are hard to find. This problem of supply and demand match has been approached by the use of Life-Link® software. KPN Mobile recognized that beside of Life Link software, several services are required, consisting of technical infrastructure management, application (Life Link) management, functional content independent management, content management, and information management, which consists of the definition of goals of the system for the organization.

The content and application management services consist of the following:

1. Manual filtering and clustering of new documents, and placing high importance documents for notification on the Intranet startup page.

2. Structuring of the user startup page according to KPN Mobile's predictable information needs.

3. Document use monitoring and feedback to information suppliers and buyers.

4. Personal profiles facilities to define personal queries, personal tasks, projects involved in, personal expertise.

Hierarchy

Few market actors and asset specific information goods

In hierarchical information markets the information traded is highly asset specific, implying that:

1. Information given to people outside the hierarchy will not have any value for the receiver,

2. Or, information given to people outside the hierarchy will destroy the competitiveness of the original owner.

In the first situation we think of information given to a specific production facility, by which it is able to plan, monitor and improve effectiveness. Because production facilities may differ enormously, providing that information to another facility may be meaningless (Weick, 1985). The information supplied to operational systems is locally relevant and as such not externally tradable.

In the second situation we think of strategic information, which can be very interesting for competitors. Hoarding this information causes an information asymmetry (Douma & Schreider, 1991), which may be a major cause of strategic advantage. Information types related to this are strategic documents and specific (R&D) knowledge of products, markets, and production performance. Business intelligence is an important method to reduce competitive information disadvantage. Strategic information is highly person and situation specific. Strategic information may be required to guarantee the progress and future opportunities of the firms, and as such is nearly as valuable as the whole firm, though separate strategic information products may have this value at a certain moment only. This information has high trust demands.

Obviously, in hierarchies we recognize a distinction of information goods along the decision levels of the organization (Anthony, 1988).

Ownership: Exploitation rights

The distribution of strategic information must be well controlled and restricted. The right to modify and change is an obvious property of this information product, but most dominant are the strategic and operational exploitation rights. Some operational information may need the same distribution restrictions, though operational information may not make any sense outside the asset specific context of an operational process and thus its ownership control is not necessary.

Price mechanism: Visible hand

In hierarchies, the visible hand links supply and demand via fiat (Williamson, 1991). Similarly hierarchies create special units for business intelligence and allocate this information to specific decision-makers. Operational information supply and demand are organized via information systems and their design processes.

The price of strategic information is based on the subjective valuation of its opportunity to control some part of the business by creating information asymmetries. The price of operational information is based on its production costs and its contribution in operational decision-making.

Services: Expertise centers

Hierarchies have two types of expertise centers, one for the exchange of operational information (called information production departments here) and one for the exchange of strategic information (called business intelligence center).

1. Information production departments are responsible for the availability and quality of the information sup-

plies for operational processes. This often implies that information on human resources, production management, sales, and inventories have to be linked, to integrate use of all these resources. The information of these systems is nontradable, be-cause each production environment will be specific. These information production centers are currently often supported by enterprise (resource planning) systems.

2. Business intelligence creates information about the firm's environment. Its products are not freely available but require specific access authority, and it may use external data sources from marketing research agencies (i.e. A.C. Nielsen, http://www.acnielsen.com) and patent information publishers (i.e. www.Derwent.com) (Bogner & Thomas, 1994). They may include the opportunities of catching all kind of possibly important information and augmenting this information to relevant reports or information supplies for strategic management. The interpretation of these data requires extensive knowledge of strategic policies and the information needs of the strategic managers, or the delivery of facilities for strategic managers to define their own information needs and retrieve rele-

		Information products							
		Information commodities			Professional resources		Asset specific information		
		Data products	Homogeneous information commodities	Self-representation information	Heterogeneous professional information		Non-tradable operational information		Strategic information products
Market type	Pure	Brokers							
		Information refineries	Shops						
	Network			Coordinators					
				Content service	Meetings				
	Hierarchy					Expertise centers			
						Information production center		Business intelligence center	

Table 2: Summary of Market Services

vant data from databases (Westney & Goshell, 1994).

Summary of information market services

Following the previous arguments, we have identified two information market services for each market type. A summary of these insights is given in table 2.

Design Parameters of Information Market Services

In the design of information market services, we have to cope with several problems:

1. Many types of information goods exist and their nature makes certain market types more effective (realizing a transaction) and efficient (with minimal efforts) than others. In total we identified six information products: data products, homogeneous information commodities, self-representing information, heterogeneous professional information, nontradable operational management information, and strategic information products.

2. These information products have certain opportunities and limitations of transferring their ownership, particularly the use, exploitation and sales values. These values may be concentrated at one location or easily distributed among several owners.

3. Because of the nature of the information product and the related property right, only many or a few actors will be involved in the information market.

4. These actors, particularly the suppliers and buyers, need a certain level of semantic synchrony to understand the offerings and to realize buyer satisfaction.

5. Type of good, number of actors, type of property right transferred, and level of semantic synchronization determines the best type of information market needed.

6. These information markets require services (IT-based or human) to facilitate transaction.

The sixth issue will be further elaborated here by describing information market services models, applying the idea that each market service consists of suppliers and buyers, information resources, activities, and information flows, and process controls (Wijnhoven, 1998). We apply the following diagram objects to consistently draw these models. A box represents supplier and buyer. The left box refers to the supplier. The right box refers to the buyer. The market service is the actor between buyer and supplier

and is referred at the highest level by a large box, but at the lower level by resources, activities, information flows, and controls. An ellipse represents an activity. A circle represents a resource (store of information or processing capacity). A two-tailed arrow represents a control, where the upper resource is the controller and the lower re-source or activity is controlled. A horizontal arrow represents an information flow.

The actual information flow diagrams are given with the services as focal unit below.

A model of an Information Refinery

This archetype shows the different stages the information can be from initial supplier delivery till final presentation to the client. The product platform manages the information resources such that they can be easily produced to a pre-specified information product, or to facilities for buyers to easily create their own information product. The information product family provides facilities for buyers to pick the data products in the shape they want. The information supplier delivers elementary data to the acquisition activity of the service, and helps to fill the structure and content of the product platform. The buyer receives information packages, and submits in-formation needs specifications to the access tools and information product family resource. Information refineries have product platforms and information product families containing the management models for the control of the information flow from initial acquisition to the presentation to the buyer. See figure 1 for a diagram of the information refinery.

A model of an Information Shop

Library systems and commercial e-book stores are examples of homogeneous information commodity shops. In the era of electronic commerce and e-publishing a merger of library and bookstores is likely. Basically the information commodities of an information shop go through five stages:

1. Initial product creation. This is the writing of books, software, and videos etc.

2. Publisher activities. The publisher adds his market expertise to the product, and the author may adjust the initial product accordingly. The publisher may use the comments of potential readers and experts to evaluate the initial product.
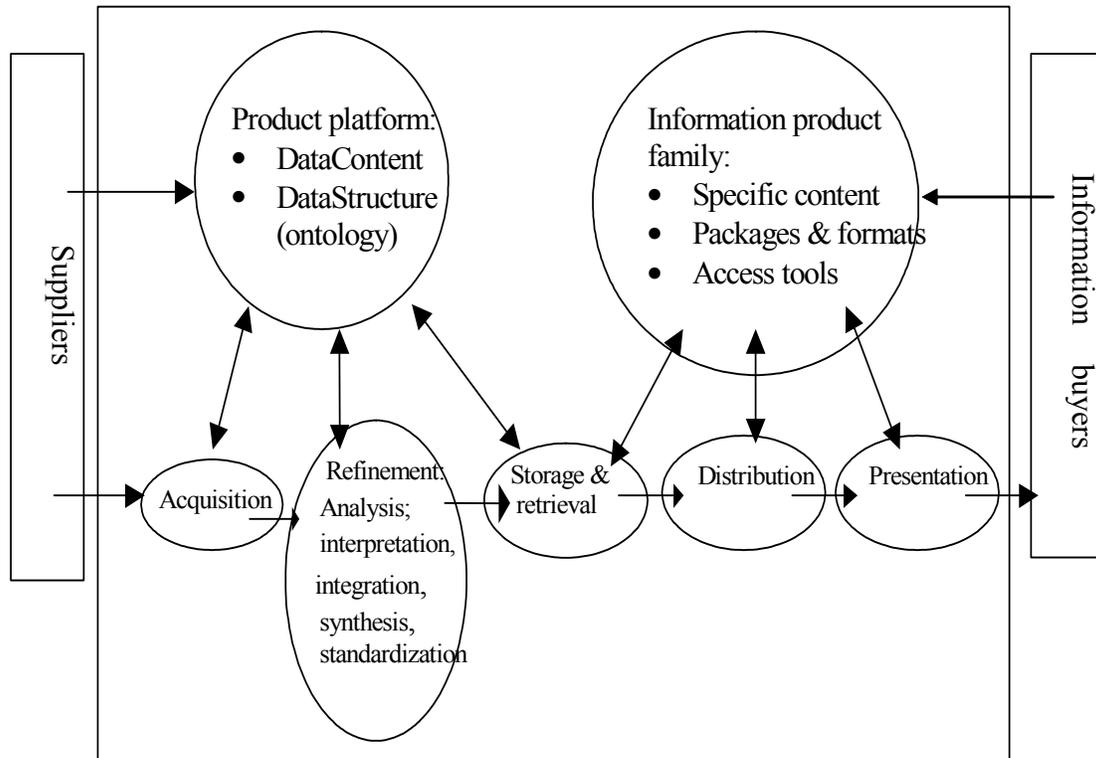
Figure 1:   Model of the Information Refinery

Based on Meyer & Zack, 1996: 47, with some modifications

3. Sales via the shop. The shop may deliver extra infor-
    mation for potential buyers, like summaries, reviews,
    news and discussion groups around the product, and
    give links to related resources and products.

4. Distribution, via physical or electronic means.

5. Buyer reading and evaluation. The buyer may submit

comments and reviews to the shop system, which may
be a source for further development of the product.

Publisher expertise and resources control the activities of
the information shop. These control activities are strongly
based on commercial information gained from buyers, and
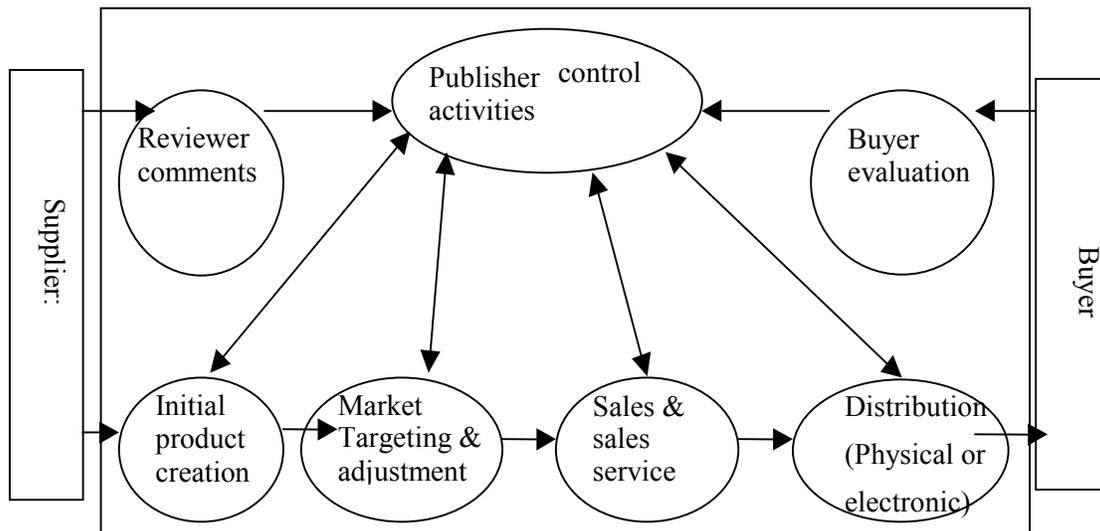quality information gained from reviewers. Figure 2 gives
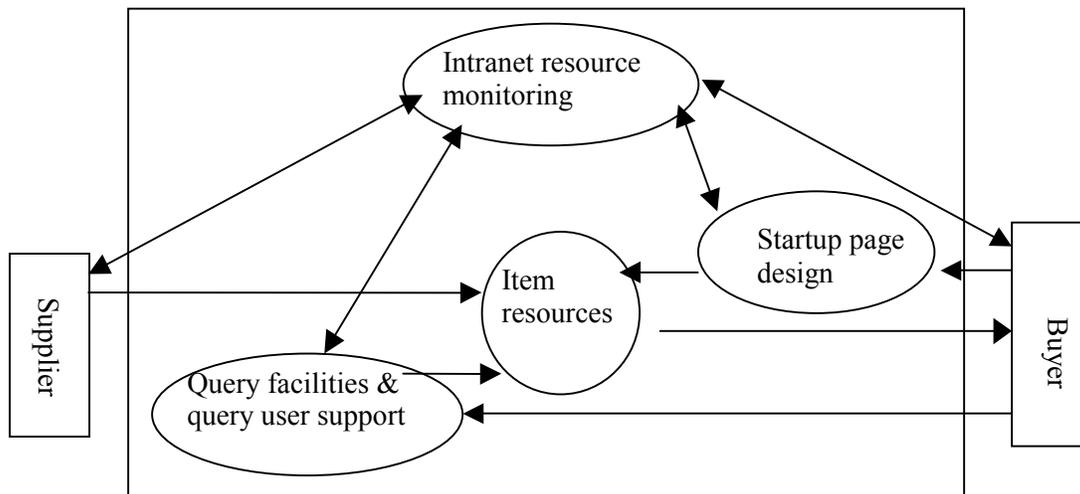

Figure 2: A Model of the Information Shop

Figure 3: The Content Service Manager

a diagram of the information shop.

A model of a Content Service Manager

To solve the many problems of receiving high quality Internet output and optimized supply utilization, the content service manager delivers the following services:

1. Start up pages, on basis of an understanding of high and repetitive user needs and related high quality supply.

2. Internet monitoring to give feedback to user needs and supply intentions.

3. Query facilities (technical tools, including personal

profile and query feedback software and user support).

A diagram of the content service manager is given in figure 3.

A model of a Meeting Realizer

The meetings are facilitated by three means:

1. Publication policies (esp. quality guidelines) control the quality of content submitted to buyers at meetings.

2. Publication goes through four stages: sponsoring (someone has to give resources to an author), reviewing, editing, making accessible to buyers. The buyer accesses the content via search (information pull) or
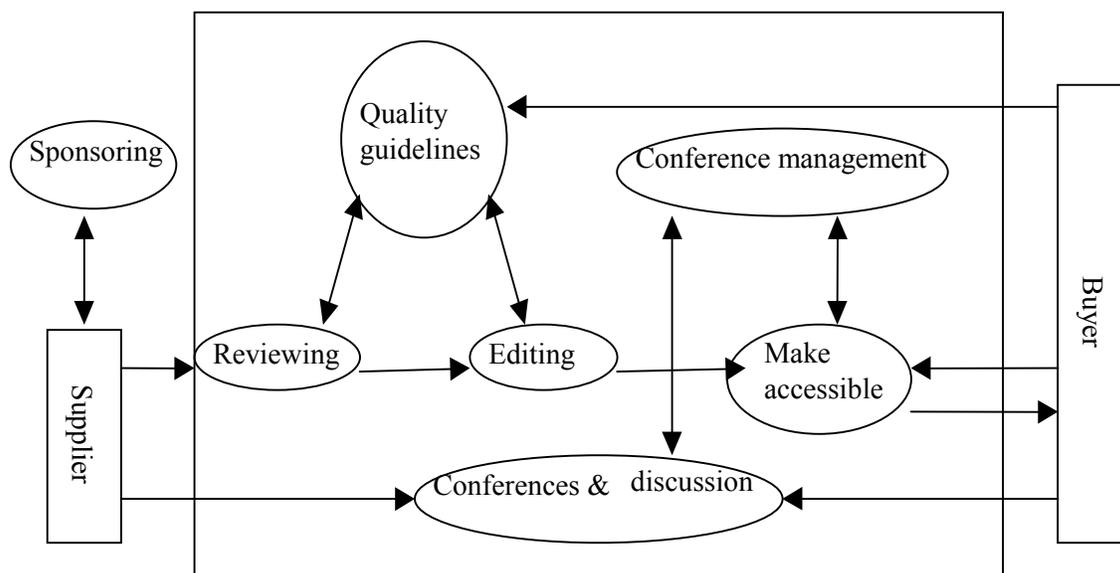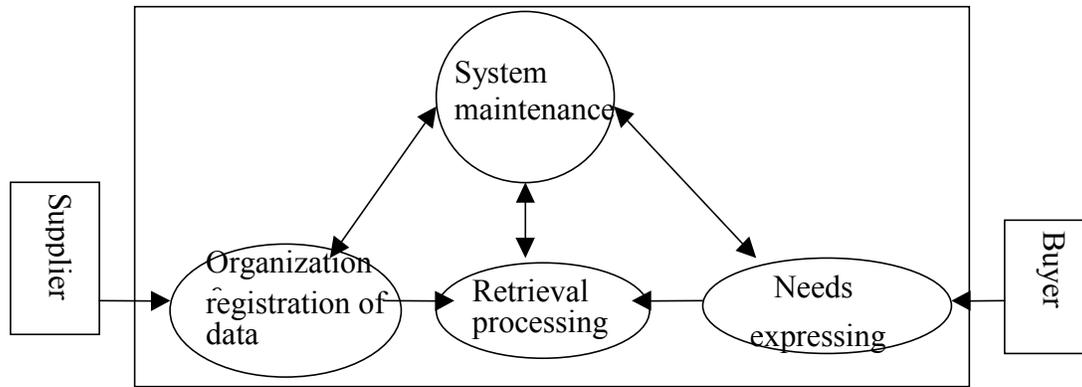
Figure 4: The Meeting Realizer

Figure 5: The Management Information Production Center

via automatic reporting (information push).

3. Informal information exchange, in physical or virtual ways (conferences and discussion lists). The conference manager controls this process.

A diagram of the meeting realizer is given in figure 4.

A model of a Management Information Production Center

The management information production center performs the following activities:

1. Catching user needs and converting these to information processing systems.

2. Development of the organization and registration of data from suppliers.

3. The development of programs to retrieve and augment these data.

4. The maintenance of this system controls that the resources stay in line with changing buyer needs.

Figure 5 gives a diagram of a management information production center.

A model of a Business Intelligence Center

The business intelligence center provides several activities to reduce senselessness for strategic management information buyers:

1. Providing an information space for different (internal) information suppliers.

2. Providing executive information systems, for flexibly analyzing the resources of the management information production center.

3. Conducting market research to create information from external sources.

4. Providing meetings to exchange informally with potential sources.

5. Contracting internal or external experts to consult in the interpretation of data gained from the information space and market research.

These activities result in the diagram of figure 6.

Discussion

This article started with the statement that technical means, search engines, are insufficient to solve the semantically rooted problems related to supplier-buyer relations in information markets. Minimally six information goods are distinguished, two for each market type. These markets provide several services to help supplier and buyer to come to a transaction, which pre-supposes some interactions (like information goods presentation and delivery customization via query tools) of supplier and buyer to synchronize semantics. These services are further analyzed to detect possible general features, which make up the information market services models. These models may be used to improve quality and the efficiency of the information market development processes. As such the article provides a structure to understand design parameters for information market services. These parameters are grouped as service contingency (information market) parameters (number of actors, type of good, property right transferred, and price mechanism), and service configuration parameters (configurations of suppliers and buyers, service controls, information flows, activities, and resources) (see tables 1 and 2 and the models). It appeared that search engines are just a few examples of a much larger collection of elements to build up information market services, and with extra facilities to improve supplier-buyer semantic synchronization.
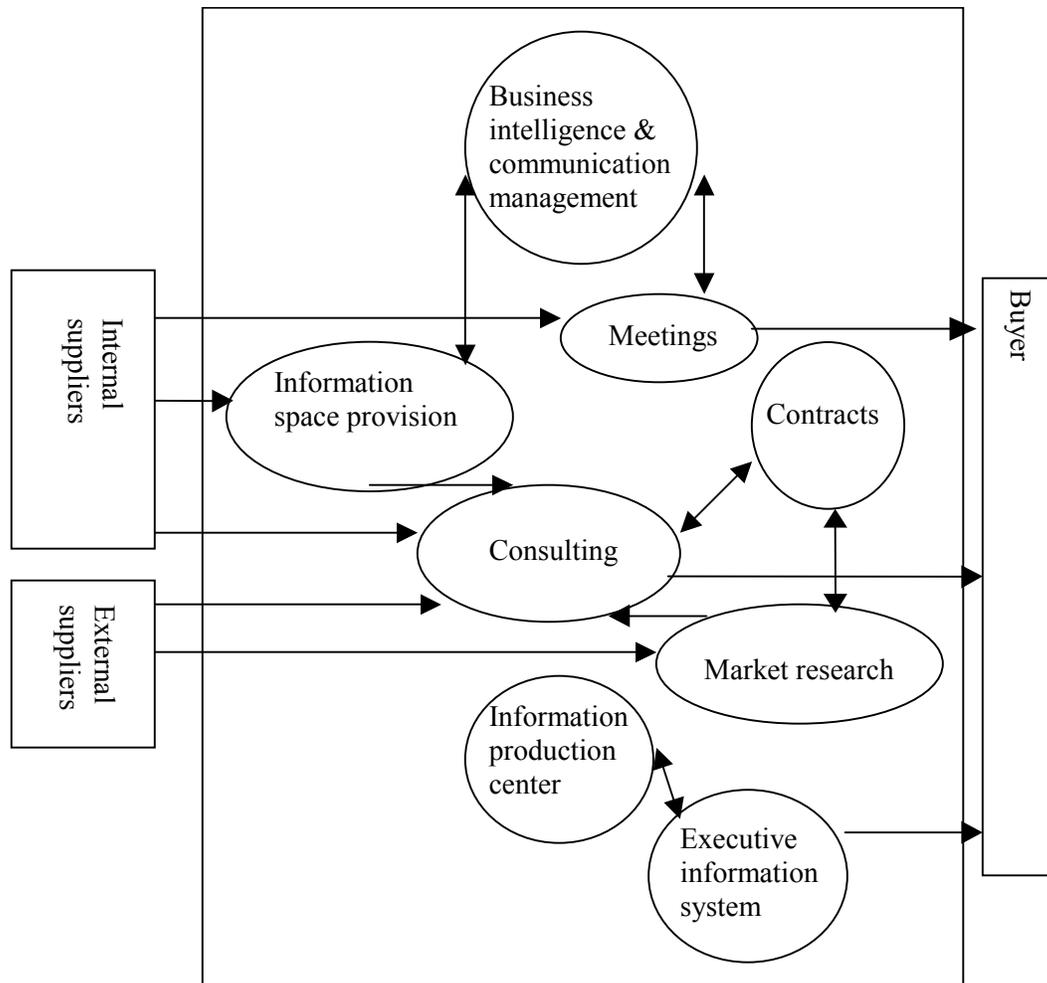
Figure 6: The Business Intelligence Center

However, there are some fundamental limitations to this study:

1. Though for each market type different services are detected, we do not yet have the theoretical maturity to check the completeness of possible services. Further exploration in the theory of information economics and markets may be welcome here.

2. No design method or work-breakdown structure has been given for information services development. The development of such a methodology may be welcome to put the concepts presented here into practice by realizing more detailed designs. Anticipating on this practical use, we expect that often a combination of services will be needed to solve a practical problem perception, resulting in configurations of services.

3. It may be important from an academic and professional viewpoint, if the ambitions of se-mantic synchrony problems reduction and improved design

efficiency are actually achieved. This is worth another study.

This study also may be a fruitful extension of electronic commerce, which at the moment mainly is occupied with very rigidly defined commodities, and has problems of coping with the less precise nature of information commodities and data products.

This article was not intended to describe the practice of the integration of economic, organizational, and information technological elements of information markets. The article's contribution is a framework for analysis, and a classification of services and parameters for de-sign purposes. The actual realization of these concepts requires a further understanding of the actors involved, and thus a further breaking up of the black boxes of suppliers and buyers. Finally, practice with these concepts will lead to further understanding of the project activities and man-

agement problems in realizing and exploiting information markets.

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Biography

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