



# E-COMMERCE AND THE INFORMATION MARKET

*Orchestrating online transactions between suppliers and customers, infomediaries walk a fine line creating services, controlling costs, and not winding up as order-takers for larger entities.*

**B**usiness-to-business (B2B) and business-to-consumer (B2C) e-commerce transactions could surpass \$7 trillion annually by 2005, according to Jupiter Research, exceeding the combined 2000 GDP of France and Germany. A major segment of this revenue is likely to be claimed not by end suppliers of products and services but by a new breed of company—the information intermediary, or infomediary. Infomediaries are to information markets in the electronic marketplace what intermediaries, such as wholesalers and retailers, are to physical markets in more traditional marketplaces. For the B2C segment, which could exceed \$100 billion by 2004, also according to Jupiter Research, emerging infomediaries play a special role facilitating the transformation of the traditional industrial economy to a new information-based economy.

The basic logic of infomediaries is simple [4]. In order for a large and rapidly growing consumer base and a large and rapidly growing supplier base to meet and match their common needs, an enormous amount of information has to be analyzed. Infomediaries are e-commerce companies leveraging the Internet to unite buyers and suppliers in a single, efficient virtual marketplace to facilitate the consummation of a transaction. This business model is quite different from many of the existing direct-sale business models still prevalent on the Web. If we assume that 2%–5% of transaction rev-

venue goes to the typical infomediary, the infomediary market is likely to be worth \$200 billion annually by 2005.

Infomediaries have existed in various forms, including as search engines, communities of interest, industry magnet sites, e-tailers, even individual corporate sites. However, the extent to which they provide the infomediary function varies immensely, as do the business models on which they operate. Not long ago, many observers were predicting the demise of the intermediary, as consumers increasingly found it easier to bypass them, going directly to end suppliers through the Web. While this situation continues, some intermediaries, such as retailers Best Buy and Staples, have thrived in the information economy by redefining themselves as click-and-brick operations. Here, we analyze the infomediary business model and its ongoing evolution, identifying the various types of infomediary and how they create value. We also offer data on infomediary partnerships, exploring the transition experiences of a number of them (see the sidebar “Infomediary Partnerships and Their Consequences”).

### Infomediaries Vs. Intermediaries

It is useful to contrast the role of infomediary with that of intermediary in the physical world. Intermediaries link end suppliers and end consumers, including wholesalers, retailers, distributors, and service providers (see Table 1 for some common sources of value created by both intermediaries and infomediaries).

Intermediaries provide physical infrastructure, economies of scale, and human interaction, including salespeople, useful in the distribution of physical products. In addition, intermediaries transfer information about demand patterns to suppliers for improving inventory management and sharing risk. Infomediaries may not be as well-equipped

to provide infrastructure for physical products but can focus on providing informational services to their clients. With advancing technology comes the opportunity to re-create products and services in digital form, adding value to clients at lower cost. Services include matching client needs with supplier offerings, providing content and community, reducing product complexity, protecting privacy, and providing dynamic pricing and other options difficult to replicate in the physical world. An infomediary’s success depends on many factors, including the business

**Table 1. Intermediaries and Infomediaries compared.**

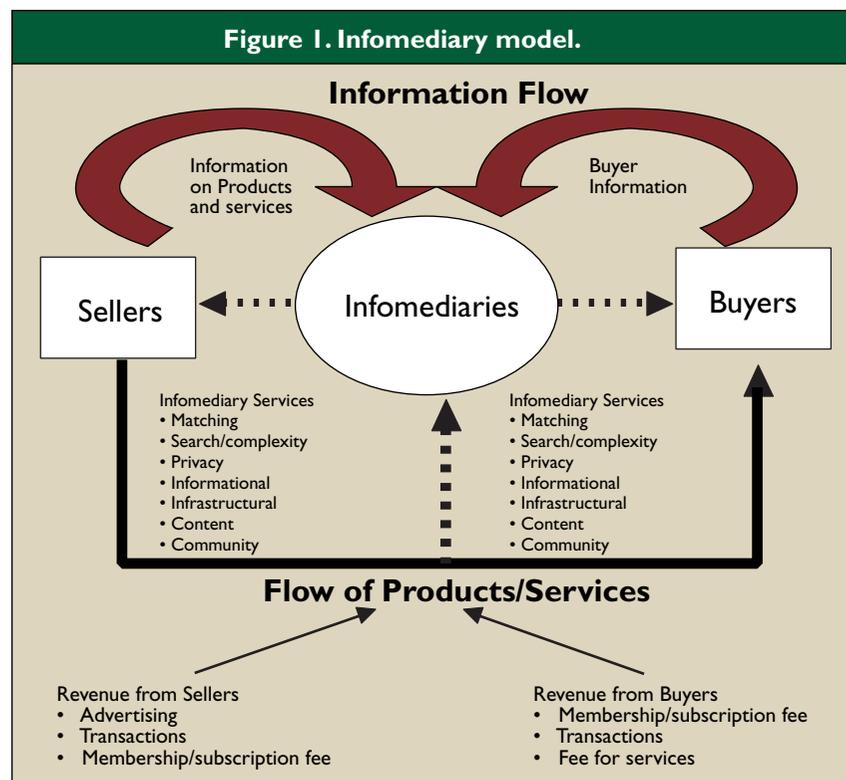
Intermediaries Provide	Infomediaries Provide
<p><i>Physical economies of scale.</i> Achieved as distributors invest in large warehousing facilities for storing and delivering products and services that might require similar handling. Passing this function to retail intermediaries might be prohibitively expensive and impractical.</p> <p><i>Reduced consumer search costs.</i> Typically accomplished when retail outlets allow customers to shop for a variety of products in one location or by creating a class of outlet, such as designer clothing, grocery, or mass merchandise.</p> <p><i>Immediacy of delivery.</i> If products are physically stored in one location, consumers get immediate delivery (when their product is in stock).</p> <p><i>Services.</i> Typically facilitates assessment of customer need and other purchasing decisions. For example, Home Depot markets its people as a source of expert assistance to help customers determine their needs. For the supply side, intermediaries provide aggregate information on product and service demand to parties in the distribution chain, facilitating better management of production and inventory.</p> <p><i>Risk sharing.</i> Consumers and producers alike face risk in transactions. Distributing the risk over the channel, intermediaries manage it for both parties by providing such services as accepting returns or refunds under certain conditions.</p>	<p><i>Search/complexity services.</i> Buyers often find it difficult to decipher complex product features, especially when suppliers make essentially identical products with seemingly distinctive designs. Infomediaries simplify the search through information, guiding buyers toward an informed choice.</p> <p><i>Matching services.</i> Leveraging advanced information technology, infomediaries economically capture information from buyers and suppliers, matching their needs with products and services in order to make the sale. Valuable for buyers who save effort searching and comparing products. Also valuable for sellers who get targeted customers for their products in an environment in which they need to sense and respond to customer need and manage their supply chains.</p> <p><i>Content services.</i> Infomediaries can provide product content on their sites, including independent evaluations, complementary products, and directory services for alternative suppliers, thus playing a pivotal role in transactions.</p> <p><i>Community services.</i> Infomediaries want to create “stickiness” between their sites and their clients. These services, which allow buyers to share information with other buyers with similar interests or problems, are valuable to the buyer and win loyalty for the infomediary.</p> <p><i>Informational services.</i> Infomediaries profile customers and source new products as demand is identified. Digital economics allow for notification services on a product, as well as dynamic pricing and negotiation.</p> <p><i>Privacy protection services.</i> For buyers, the Internet makes privacy issues an immediate concern. Environments in which buyer information is valued produce incentives for sellers to use the information in a manner incongruent with the intent during collection, sometimes further reselling the information. Buyers value infomediary services protecting their privacy and generating a reasonable return for them on their information investment in the form of personalization or matching services.</p> <p><i>Infrastructure services.</i> Some infomediaries provide infrastructure services for conducting secure transactions seamlessly, and is possibly of value to both buyers and sellers.</p>

model it adopts, the extent to which its services complement or substitute physical products, its adaptability to change, and ultimately the value it delivers.

In B2C markets, infomediaries like Amazon.com, PriceLine.com, and Expedia.com are changing the

electronic market could be another revenue source. However, more common models involve advertising revenue, whereby the infomediary accepts payments from suppliers based on advertising (screen) space, number of user page views, and transactional revenue, whereby a percentage of sales goes to the infomediary.

Buyer-based revenue sources are relatively rare but can be expected to increase over the next few years as infomediary services become valued in online shopping environments characterized by increasing choice, complexity, and information overload. Such sources could include membership or subscription fees allowing access to valued information or services, a transactional percentage, or fees based on services, such as matching a seller with a buyer and ensuring privacy protection. An infomediary front end to the Web could help insulate consumers from unsolicited mailings and confusing product selection.



way e-commerce is conducted. While “disintermediation,” or elimination of the middleman, has been touted as an inevitable result of ubiquitous open networks, it seems such proclamations might be premature. Re-mediation through infomediaries is occurring on a fairly broad scale, and where successful, these firms wield tremendous channel power.

### Business Models

Infomediaries are in the information business (see Figure 1), implying they compete on their ability to capture and manipulate information in a manner that adds value for their clients, who could be sellers or buyers. A pure infomediary provides information services by capturing information services from both sides of a transaction. They don’t own the products or services that are shipped directly from suppliers to customers. Many infomediaries today follow business models that generate revenue from the deeper pockets on the seller side. These models could be in the form of exclusive contractual arrangements whereby the infomediary is the leader in finding customers for a seller. Membership fees for participating in an elec-

value for the customer during several critical phases along the path leading from the initial search, supplier, and product comparison (requirements) to the actual transaction and ultimate product or service delivery (sales fulfillment) [5]. To support the initial phase, infomediaries leverage the power of the Internet to provide almost unlimited expansion of the search space for consumers, thus overcoming the limitation of physical space inherent in traditional brick-and-mortar operations. While conventional stores carry only the most popular items, Amazon.com offers millions of items, many sought by only a relatively few customers with specialized tastes. Buyers can certainly expand their search space through search engines, but a more organized universe provided by infomediaries is generally preferable. For example, at Yahoo.com’s Shopping area and Amazon.com’s zShops, buyers can search thousands of stores and millions of products. Aggregating a large number of suppliers, these infomediaries save buyers uncounted hours on tedious piecemeal searches through direct use of search engines. Ironically, the matching of buyers and suppliers becomes increasingly necessary as the

**Figure 2. Infomediary value grid.**

		Acquisition Costs	
		Low	High
Potential to increase navigational value <ul style="list-style-type: none"> <li>• Expanded search space</li> <li>• Organization of search space</li> <li>• Optimization of search space (matching)</li> </ul>	<b>Low</b>	<b>LL Region.</b> Emphasis on Sales Fulfillment For products and services not requiring extensive search and that are relatively easy to acquire: sales fulfillment support. <ul style="list-style-type: none"> <li>• Health and beauty supplies</li> <li>• Generic household items</li> </ul>	<b>LH Region.</b> Limited emphasis For products and services not requiring extensive search and that are bulky and relatively difficult to acquire, limited value can be provided by infomediaries. <ul style="list-style-type: none"> <li>• Lumber and bricks</li> <li>• Fertilizer</li> </ul>
	<b>High</b>	<b>HL Region.</b> Emphasis on Requirements and Sales Fulfillment For products and services requiring extensive search and that are relatively easy to acquire: full customer support, from purchasing decision to sales fulfillment. <ul style="list-style-type: none"> <li>• CDs</li> <li>• Books</li> <li>• Flowers</li> <li>• Wines</li> <li>• Insurance</li> <li>• Stocks</li> <li>• PCs</li> </ul>	<b>HH Region.</b> Emphasis on Requirements For products and services requiring extensive search and that are relatively difficult to acquire: synergy between the marketplace (purchasing decision support) and the marketplace (sales fulfillment support) <ul style="list-style-type: none"> <li>• Automobiles</li> <li>• Houses</li> <li>• Furniture</li> </ul>

search space grows larger. In this sense, infomediaries create and perpetuate their own demand.

Finally, when and where buyers make their purchasing decisions, infomediaries also provide valuable assistance by offering “suitable” suggestions. This function is supported by technology for one-to-one marketing based on online customer profiling. Amazon.com not only anticipates book-buyer demand, it facilitates the purchase decision by presenting previous buyers’ comments on the books being evaluated.

This analysis reveals how infomediaries help buyers expand, organize, and optimize their search spaces with information and information technologies. For some products, including books, CDs, and flowers that are limited in size and relatively easy to ship, infomediaries provide support through both the requirements and the acquisition phases. Thus, we identify two dimensions—vertical and horizontal—underlying the manner in which infomediaries add and create value, as represented in the form of an infomediary value grid (see Figure 2); the vertical dimension is the potential to increase navigational value; the horizontal dimension is acquisition cost.

The example products in the figure’s high-navigational value row (the bottom one) are typically information-intensive items, such as books, CDs, and houses. Flowers are not information-intensive, but infomediaries like 1-800-Flowers.com expand buyers’ search spaces by locating a florist to deliver flowers anywhere in the world on their behalf. Similarly, the search space for PCs is also enlarged, since buyers readily specify any desired PC configuration—often impossible to work out in a brick-and-mortar store.

As in Figure 2, the typical products in the HL region (lower left) represent lower acquisition costs, as they are smaller and easier to ship. A critical success factor in this cell is the quality of support and value-added services provided for requirements and sales fulfillment.

Products in the HH region (lower right), including automobiles, reflect high acquisition cost. For example, AutoByTel.com has quickly become one of the largest auto dealers in the U.S. Its customers buy cars at prices that generate only a 6% margin (rather than the more common 10%) for traditional brick-and-mortar dealers; on the Internet, customers readily compare the prices

and options offered by any number of dealers, rather than being restricted to only a few local dealers, as in the past. However, the participation of traditional (physical) intermediaries (local dealers) is needed for the eventual acquisition of the product (sales fulfillment), as well as for inevitable service and maintenance. Similarly, home buyers can also benefit from infomediaries, such as Realtor.com, to navigate the range of selections. To complete an acquisition, however, they need to work with local realtors collaborating with Realtor.com. Thus, the HH region is where companies that are not pure Internet plays can exploit the synergy between the virtual marketplace (for search) and the physical marketplace (for distribution and service). Failure to do so can be disastrous, as in the case of Furniture.com, which went out of business last year due to a lack of distributed physical infrastructure and the resulting high cost of returns (about 40% of sales).

For certain segments of the population (such as people who are just too busy), frequent trips to local stores to buy common household items and other daily necessities is inconvenient. Start-up infomediaries like Kozmo.com and Webvan.com would provide value to busy people by helping save them time doing their daily chores. Kozmo.com advertises itself by saying: “Delivery to you in under an hour.” This promise falls in the LL region (upper left) of the infomediary value grid, where the search is limited to a low-level search on cost (often automated through intelligent agents) and where the acquisition costs are not prohibitive. Infomediaries entering this region may seem to be in the delivery business, but their

operations are really based on facilitating efficient sales fulfillment, thanks to Web technology.

Infomediaries may provide significant value in all of the grid's regions, except for the LH region (upper right), where the need for search is low and the costs of acquisition prohibitive. In this region, there might be a market for certain products under certain conditions and for certain people willing to pay the acquisition cost for the convenience of a low-level search on cost and sales fulfillment through the Web.

Although most infomediaries operate in the HL region, supporting all phases of product purchase, we increasingly see newer infomediaries establishing themselves in the HH and LH regions. Two comments are therefore in order: First, it is important to observe that the grid is dynamic, as the borders between the regions may shift upward and to the right, contingent on changing technologies and related infrastructures. As the bandwidth widens and

virtual reality comes to fruition, more and more products and services will be moved from the two lower regions to the two upper regions. With the rapidly expanding capacity of delivery companies, such as United Parcel Service, as well as the U.S. Postal Service, and the emergence of those specializing in e-commerce delivery, such as Webvan.com, the expanded infrastructure will likely push the vertical grid line to the right, leaving fewer products in the LH region. Second, various synergies are possible between the physical marketplace and the virtual marketplace. Where acquisition costs are high, companies might benefit from a physical infrastructure for delivery and after-sales service. Even when acquisition costs are low, a strong physical distribution structure can cut delivery time significantly for Web orders. For example, bookseller Barnes & Noble promises one-day delivery in New York City, something a pure-play like Amazon.com can't match. Even traditional retail-

### Infomediary Partnerships and Their Consequences

**T**he evolving role of infomediary is further analyzed by examining the partnerships they've formed with one another over the past few years. We studied a sample of 67 infomediaries and their partnerships, categorizing them in terms of focus and thrust (for more detail, see [dmsweb.badm.sc.edu/grover/cacm/infomediary](http://dmsweb.badm.sc.edu/grover/cacm/infomediary)). Under "focus," we classified partnerships into three categories: those concerned mainly with commerce *per se*, that is, the actual conduct of buying and selling on the Web (category A); those focused on improving the information content of a Web site, possibly involving buying and selling (category B); and those whose major purpose is improving the technology for delivering services or products on the site (category C). A category-A partnership might, for example, be the 1999 acquisition of Movieline.com by AOL.com, enabling AOL to sell movie tickets to its millions of subscribers. The 1998 merger of Desktop Data and Individual, Inc. is in the B category, as it sought to create

improved information content for Individual, Inc., which, in this case, was the recognized leader in global news and current events awareness solutions for business. Bamboo.com developed the technology to provide 360-degree virtual tours for real estate sales applications; its 1999 merger with Interactive Pictures is classified as category C.

We further categorized the sample of partnerships according to their strategic thrusts, identifying four types of thrust:

*Type 1.* Enhance distribution channel, increasing the ability of new customers to access service. An example is the 1999 acquisition of Liquidmarket.com by Xoom.com to increase the size of its customer base.

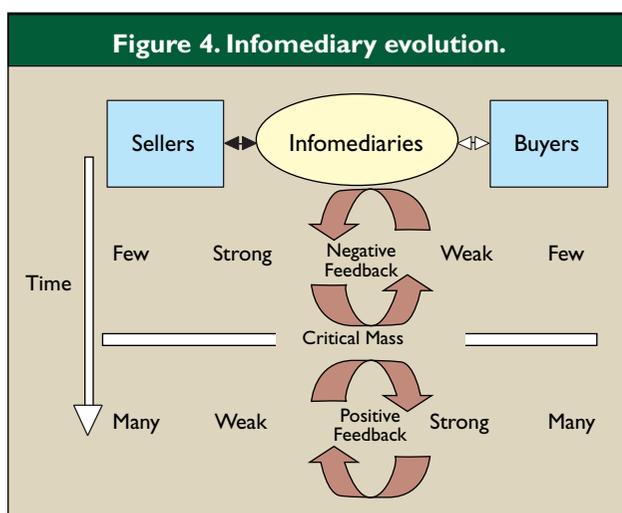
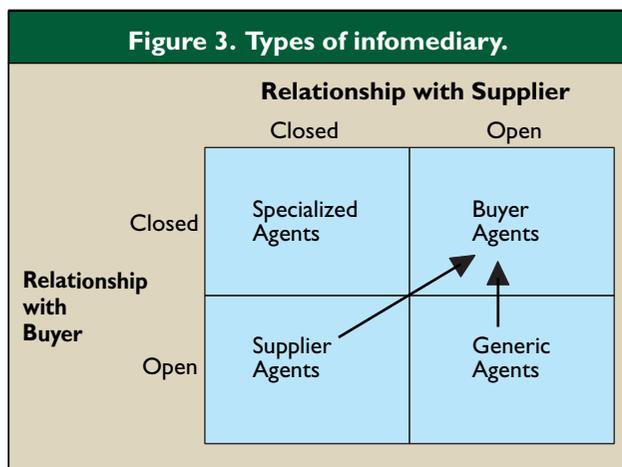
*Type 2.* Increase scope of product and service offerings. An example is AOL's 1999 alliance with Blockbuster to expand its business by providing direct access to home video and entertainment information.

*Type 3.* Enhance the depth of relationship with customers. An example is the 1999 strategic

alliance between Comtex Scientific Corp. and ON24.com.

The frequency data indicates that the predominant focus of these partnerships is commerce, that is, buying and selling on the site. For thrust, the major direction was increasing the depth of products and service offerings. In 42 cases, we found both category-A focus and type-2 thrust. AOL's partnership initiatives are typical; its alliance with eBay.com and Blockbuster, and its acquisition of Movieline and Time-Warner, all sought to expand its subscribers' online buying universe.

To provide maximum value to their customers, infomediaries seek partnerships that would expand their users' search spaces while enhancing their own navigational and customer-profiling facilities. These patterns point to an emerging trend toward the buyer-centric orientation of the B2C segment of e-commerce, generally supporting our proposition that the role of infomediaries will likely evolve into that of buyer agent. **C**



ers like Best Buy, Staples, and Wal-Mart Stores are exploiting this synergy. Typically, a customer conducts a search and places an order on the Web, while product pick ups and returns are at the physical stores.

### Types of Infomediaris

Infomediaris can be classified in terms of their relationships with sellers and buyers [1]; Figure 3 classifies four types based on whether these relationships are open (non-proprietary, giving anyone free access) or closed (proprietary, restricting access). Closed relationships imply a certain relationship-specific investment (such as membership fee), and parties making that investment expect a return. The four types are:

**Specialized Agents.** The related proprietary networks are sectioned off the broader Internet by having closed relationships with both buyers and suppliers. Entering the infomediary's domain requires a cost on the part of buyers and sellers alike, usually in the form of a fee or certifying that they satisfy a certain membership profile. These infomediaris usually manage a specialized market; their business perfor-

mance depends on their ability to deliver value through scope (sufficient numbers of sellers and buyers), specialization (a well-defined and lucrative niche), and infrastructure (a platform for transactions).

**Generic Agents.** These infomediaris maintain open relationships with both buyers and suppliers and involve no relationship-specific investment. Examples include search engines Hotbot.com and Google.com that provide open search capabilities to any buyer looking for a supplier. The infomediaris create value through their comprehensive and unbiased service, often generating revenue from advertising, which is priced based on eyeballs, or number of unique user clicks, and the value of screen real estate. Some infomediaris like Yahoo.com attempt to create additional stickiness by providing community and personalization services. Others like Bizrate.com provide customers a rating system on various e-tailers' ability to deliver promised service.

**Supplier Agents.** Many infomediaris start off in this quadrant, sponsored either by specific companies with a vested interest in selling their products or by close affiliation with a core group of sellers. Thus, they do not provide unbiased options for buyers. Major auto manufacturers, for example, host their own Web sites. Prior to offering other stock and mutual funds from a number of direct competitors, the Charles Schwab Web site started off as a supplier agent providing access to only its own products. The sustainability of these infomediaris depends on the quality of suppliers they include, benefits for buyers, and the ability to provide good infrastructure and seamless exchange platforms.

**Buyer Agents.** These infomediaris establish relationships with a core set of buyers, working on their behalf with any number of suppliers. To succeed, they must build a large base of clients while winning their trust. However, extracting valuable information and constructing information profiles deep and broad enough to create substantial value for clients is a slow process. The value for each client increases as more and more clients join the service. Since trust is often correlated with branding, and the ability to profile is the strength of some pure-play Internet companies, we are seeing alliances between branded companies like Disney and pure plays like Infoseek.com in order to create infomediaris like Go2Net.com.

### Evolution

Many early infomediaris were sponsored by a seller or group of sellers wanting to participate in the e-commerce environment, where it is in the agent's best interest to sell the supplier's products (see the

supplier agents quadrant in Figure 3). Their affiliations with suppliers are strong but weak with buyers who may not value a biased market of limited scope. Network effects work against such companies (see Figure 4); having few sellers leads to few buyers, in turn leading to even fewer sellers, as some go out of business, and consequently even fewer buyers. The negative spiral could force such infomediaries to disappear. However, an infomediary effective in providing value-added services, establishing partnerships that extend its product line, and promoting its Web site, could generate a critical mass of both consumers and suppliers sufficient to reverse the cycle of network effects from negative to positive. Positive network effects feed on themselves; greater product and service scope attracts more buyers, and in turn more suppliers.

A larger supplier base naturally reduces the affiliation of the infomediary vis-à-vis the few original sponsors. In contrast, the infomediary does not compete on margin but on its ability to deliver information and provide navigation and other value-added services to buyers. It might therefore be expected that infomediary evolution will be toward greater buyer affiliation and buyer sources of revenue, as indicated by the arrows in Figure 3 leading to the buyer agent quadrant from the other quadrants.

SABRE.com, originally a marketing arm of American Airlines, is now an independent for-profit entity providing unbiased market services to travelers for a fee. Typical of generic agents, Yahoo.com provides comprehensive search facilities for both suppliers and buyers. However, such services eventually favor buyers. For example, if you search for the Prudential Insurance Co. through Yahoo.com, you will find the company's Web address, but you will also be presented Yahoo's "Insurance Center" where you can fill out a form to get quotes from insurance companies other than Prudential. The extent to which the process for obtaining quotes is truly competitive is the extent to which Yahoo acts as a buyer agent. To be truly effective in helping clients expand, organize, and optimize their search spaces, infomediaries inevitably evolve toward the role of buyer agent.

Some infomediaries thrive in restricted-source environments, particularly where buyers value brand names (like Dell Computer) and other endorsed suppliers. Other infomediaries might evolve from being generic search engines or neutral sites to being a supplier's agent, trying to leverage their buyer base by charging suppliers for preferential display in the search engine. The sustainability of such a model is questionable, as buyers realize they are getting biased information and leave the infomediary. Reversing the

negative cycle of network effects is very difficult, as in Figure 4.

## Conclusions

We conclude that infomediaries will take a powerful position in the distribution chain of today's emerging e-commerce environment. But they are not homogeneous entities, adopting different business models and evolve from supplier, buyer, search engine, independent agency, or consortium. They can also adopt many positions over time in the value grid in Figure 2 by offering different kinds of products and services. Ultimately, however, their business models will tend to reflect those of the buyer agent. Their power will likely grow as channel drivers, as the economy evolves from one based on industry relying on traditional intermediaries into one based on networks and information relying on infomediaries to orchestrate business transactions between buyers and suppliers.

Unfortunately, the positive feedback cycle necessary for the business performance of an infomediary model makes it inevitable that a number of such companies will fail or be consolidated into larger companies. Some, like Drugstore.com, Egghead.com, Furniture.com, and Icelebrate.com, as well as many others, have already either ceased operation or face severe cash-flow problems, primarily due to the cost of customer acquisition and growth [2]. Drugstore.com spent millions on TV advertising and now uses less expensive but arguably more effective email and referral strategies. Buy.com recently reversed its strategy of selling below cost to capture new customers, making up the rest by selling ads to third parties on its Web pages. The challenge for any infomediary today is delivering value for its customers while holding down costs and generating profits.

Our analysis here does not provide the answers but raises some relevant questions all infomediaries should continue to ask themselves:

*What is the business model?* Is it supplier agent, buyer agent, generic agent, or specialized agent? Can it be sustained? How should it evolve? What changes should be made to facilitate that evolution?

*Are the services provided consistent with the value grid in Figure 2?* What opportunities emerge when the lines in the value grid move up and to the right? Can the navigational services be expanded or include new products? How should the synergy between the physical infrastructure and the virtual infrastructure be established or exploited to maximize customer value?

*How can the number of customers and suppliers be increased to exploit positive feedback in a manner consistent with the business model?* Should the busi-

ness model be changed to keep up with the changing environment? Can relationships with other companies be established to support these changes? How can value be added while managing cash flow and the costs of customer acquisition and retention?

Traditional intermediaries have evolved over centuries, creating enormous value for consumers in the traditional marketplace, culminating in creation of vast chains of discount and specialty stores. We will see even greater benefits for consumers, as infomediaries strive to take on the role of buyer agent. This role will be crucial for consumers, as infomediaries help them decipher ploys by suppliers attempting to create monopolistic power by customizing digital products [3]. Infomediaries must therefore continue to deliver value in expanding, organizing, and optimizing user search spaces.

The emerging era of e-competition will involve the battle of the infomediaries, as every company with online presence seeks to absorb more and more infomediary functions. However, the brutal economics of positive feedback will make the strong stronger and relegate the rest to the role of order-taker. **C**

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The Pacific Northwest National Laboratory (PNNL) combines the strengths of leading-edge information science with multidisciplinary capabilities from across our Laboratory to provide solutions to national problems being addressed by the U.S. Department of Energy and other government and private organizations. Our current technical focus areas in information sciences include: Information Exploitation, Large Scale Information Integration, Cyber Security Situation planning and response, Rich interaction environments

Our research and development focuses on information systems that are designed to eliminate barriers and speed the rate of scientific discovery in many fields. PNNL's information technology work also encompasses development, operation, maintenance and support of the Laboratory's information resource management systems. As steward of one of the largest parallel computing facilities in the world, PNNL has expertise that allows people and organizations to increase productivity and enhance their ability to collaborate with others in solving complex technical and scientific problems. We are in search of a Chief Architect to take information science to the next level of accomplishment. We expect the successful candidate for this position will have strong breadth of theoretical and applied knowledge of systems architecture and systems engineering, with a particular emphasis on software and applied expertise.

The position requires a technical leader who will work well with project teams on advanced information systems. The candidate must be able to effectively communicate and work with management to create the information science's architecture vision, with the project managers and staff to effectively implement the architectural concepts and with laboratory leadership to foster acceptance of systems architecture approaches in projects and initiatives. To this end, the candidate will be an evangelist for systems architecture principles and practices. The position will also require outstanding written and oral communication skills, as well as negotiation skills. The candidate must be a good risk manager. The candidate must be a leader in the systems architecture technical community, and help establish PNNL reputation in that discipline. The successful candidate will have an MS or Ph.D. with a strong Computer Science background and 10-15 years experience. The individual must have a national or international reputation in system architecture and have a good track record of publications. The experience set must include building complex architectures for large programs. PNNL is a multi-program national laboratory operated by Battelle for the U.S. Department of Energy. Located in southeastern Washington State on the last free-flowing stretch of the Columbia River, the city of Richland offers a relaxed lifestyle with easy access to recreation areas, major cities and colleges.

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