

Object-Orientation: A TOOL FOR ENTERPRISE DESIGN

Richard T. Watson
George M. Zinkhan
Leyland F. Pitt

Imagine a scenario where a startup firm with an initial investment of \$1.6 million opens its doors and immediately threatens the viability of the industry leader, a nationwide chain of 400 stores with annual sales of \$2 billion.¹ A decade ago, such a prospect would have been highly fanciful. Now, it is reality. The scenario describes precisely the emergence of Amazon and its immediate threat to Barnes & Noble in the retail book business. It illustrates a discontinuity in strategy—a breakdown in many of the old rules of business and the emergence of a new order in strategic thinking.

In the computer software industry, developers have adopted object technology in order to react to market conditions that emphasize speed and responsiveness. Strategic thinkers, facing essentially similar environments, can gain a new perspective by transferring the fundamental concepts of object technology to a business setting. An object orientation (OO) helps strategic planners to create fast-response and flexible business units. It also provides a vocabulary (using words such as encapsulation) to focus attention on fundamental design issues.

The main tenet of OO program design closely parallels the purpose of enterprise design. As Cherri M. Pancake observed:

The goal of OO design is to identify accurately the principle roles in an organization or process, assign responsibilities to each of these roles, and define the circumstances under which roles interact with one another.²

While Pancake was writing about software development, the principles described are also applicable to the design of enterprises. In his study of strategy and structure, Chandler observed that new administrative structures reflect changes in the economy, and the current design of firms is influenced by what he calls the state of administrative art.³ OO concepts enhance thinking about strategy and structure by providing managers with a coherent set of concepts for

designing enterprises in the same way that OO principles help software engineers to construct extremely complex systems. Computer operating systems are possibly the most complex systems developed by humans, with Linux having over 30 million lines of code.⁴

OO and the Network Economy and Virtual Corporations

The concepts of a network economy and virtual corporation are established metaphors for describing new organizational forms and business practices. The network economy is founded on global, highly interlinked electronic networks that exchange information and ideas real-time,⁵ and network structures are important for understanding emerging industries⁶ and the economy.⁷ Information technology has enabled the creation of products and services that can be

Richard T. Watson is the J. Rex Fuqua Distinguished Chair for Internet Strategy and Director of the Center for Information Systems Leadership (CISL) at the University of Georgia. <rwatson@terry.uga.edu>

George M. Zinkhan is the Coca-Cola Company Professor of Marketing at the University of Georgia. <zinkhan@terry.uga.edu>

Leyland F. Pitt is Professor of Marketing in the Faculty of Business Administration, Simon Fraser University, Vancouver, Canada. <lpitt@sfu.ca>

disaggregated and distributed among cooperating units, both within and outside the organization. Consequently, the most significant element of an organization's environment is the network of other organizations with which it interacts.⁸ Both the network economy and virtual corporation, in their various guises, are founded on the network elements of nodes (companies) and links

(economic, financial, and electronic associations), where nodes exchange messages via electronic links. Understanding how to exploit networks and network effects becomes critical to survival in a business environment that is increasingly based on bits, virtual integration, globally distributing activities, short-life inventories, and empowered employees.⁹ The OO approach extends the network metaphor by elaborating on the properties of a node (an object in OO terms).

Understanding these organizational networks requires investigation of the roles of the network's nodes and the interaction between these nodes. While there are various theoretical models, computer science provides a methodology that is a concise and complete set of concepts for describing how cooperating components (i.e., objects or nodes) are combined to create complex and complete systems.

Key OO Concepts

The goal of OO technology is to accelerate the building of software by enabling applications to be constructed from existing objects, in much the same way a stereo system can be created by combining items from various manufacturers (e.g., Bose speakers, Sony amplifier, Toshiba tuner, and so forth). The three major benefits of object technology are: reusability of objects, high-quality software, and lower-cost system maintenance and modification. By

TABLE I. OO Concepts

Concept	Computer Science	Organizational Strategy
Object Class	A group of objects with similar properties.	A group of firms (e.g., an industry) or individuals (e.g., eBay) with similar properties
Object	A program containing data and methods.	A firm with an organizational memory and business rules.
Message	Objects request services from each other by exchanging messages.	Firms request services from each other by exchanging messages.
Encapsulation	All processing that changes the state of an object is done within that object.	A firm is an autonomous unit.
Reuse	A new application can be built from existing objects. Code must be written to exchange messages between objects.	A new firm can be built from existing firms. Procedures must be developed for exchanging messages between firms.

using existing objects to create new applications, the cost of developing software is significantly reduced. Software built primarily from existing objects should have fewer logic errors and a better human interface. Also, objects can be modified without affecting other objects, resulting in lower maintenance costs.

Objects are self-contained units containing data describing the object and the actions (called “methods” in OO parlance) that it can perform. OO is supported by several key concepts (see Table 1).

Object Classes and Instances

An object is an instance (or occurrence) of a class, which describes a group of objects with similar properties. A class contains declarations of data that describe instances of objects along with definitions of the methods an object can perform. In computer science, all objects in a class have the same data categories and behaviors. There is absolute uniformity.

A class can be conceived of as a group of firms in the same industry or individuals with similar goals. A bank is an example of a class, and an instance of that class would be Citibank. Furthermore, this class has methods such as accepting deposits or facilitating payments. Clearly, business objects do not have the same level of uniformity as computer science objects. Nevertheless, all business objects in a class share many common features, and customers have a clear idea of what services they can expect from objects in a class.

Encapsulation

Encapsulation means that all processing that changes the state of an object (i.e., changes the value of any of its data) is done within that object. Encapsulation implies that an object is shielded from interference from other

objects; that is, an object cannot directly change any other objects. Objects are autonomous, self-contained workers.¹⁰

In organizational terms, business units are independent entities and their internal operations are hidden from others. For example, the UPS customer has no need to know how UPS moves a parcel from A to B, just that it happens within a defined period.

FIGURE 1. Encapsulation Trade-Off

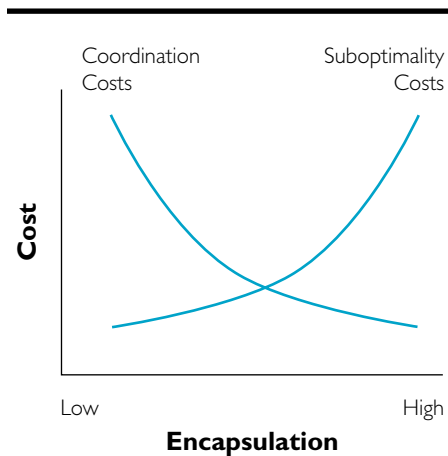
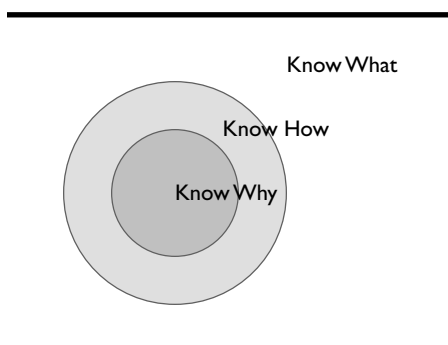


FIGURE 2. Layers of Encapsulation



In a software environment, encapsulation is the rule, but there is a trade-off. While each object may be optimal in terms of its goals, a system resulting from the combination of objects is likely to be suboptimal.¹¹ Ease of construction and maintenance are exchanged for suboptimality. If systems performance is poor, then the encapsulation rule may be waived so that pertinent objects are internally inspected and rewritten to improve overall efficiency. Encapsulation is then restored as the *modus operandi*.

Similarly, in organizations there may be occasions where the efficient operation of an enterprise requires that business objects are not autonomous and are not shielded from outside interference so that suboptimality costs are reduced. Giving up encapsulation, however, increases coordination activities. Costs are incurred in coordinating the activities of the cooperating objects to ensure that the entire operation is efficient. This trade-off between de-encapsulation (or low encapsulation) and encapsulation is captured in Figure 1.

There are layers of encapsulation, and these may be successfully penetrated to gain greater understanding of an object to improve overall efficiency, but this is countered by increased coordination costs. The levels of intellect provide a framework for understanding these layers (see Figure 2).¹²

- *Cognitive Knowledge or “know what”*—At this level, encapsulation remains intact because this is essentially knowledge about what a business unit can do—its methods. Many stakeholders (e.g., consumers, investors) interact with business units at this level. Cognitive knowledge enables consumers and firms to make use of the methods of another business unit.

- *Advanced Skills or “know how”*—Encapsulation disappears when an outside unit needs to know how another unit operates. The black box is opened for inspection. Some organizations are willing to share “know how” so that their operations can be more tightly integrated. Advanced skills enable a business to change its methods or those of its partner business units to improve its products or services.
- *System Understanding or “know why”*—When a group of business units operates as separate components in a supply chain system, understanding how the total system operates can lead to beneficial gains for each party. Systems knowledge enables a business unit to transform objects within a cooperative system of business units.

While de-encapsulation can provide benefits, it is not costless. It takes time to learn how a partner operates and even longer to understand a partner’s system. Such learning should only take place with the intention of improving the efficiency or effectiveness of the partnership. For many business units, maintaining “know what” knowledge is adequate and may be all the partner is willing to reveal. Once changes have been implemented, encapsulation is often restored. The levels of encapsulation can also be viewed as types of coordination devices, with each layer representing a more costly coordination mechanism. In other words, “know how” is more costly than “know what.”

Message Passing

Objects communicate with each other by sending and receiving messages. An object, for example, may send a message to request particular data from another object. Provided a relevant method has been established for the receiving object, the requested data are sent back to the object issuing the request. This way of communicating is usually referred to as message passing. A message can also trigger a change in the receiving object.

Message passing, in organizational terms, means that business units communicate by exchanging data. For example, a firm’s outbound logistics unit informs a parcel delivery firm to collect a parcel and provides all the necessary data to support the movement of the parcel from origin to destination. Another computer science concept, client/server, is useful for thinking about message passing. In a client/server system, one computer (the client) requests a service by sending an electronic message to another computer (the server). Sending a return message provides the results of the requested service. Thus, systems are composed of a series of objects using electronic messaging to request and provide services.

Analogously, there are client and server business objects. Clients (customers or consumers in business terms) request services from a firm. Typically, client objects outside the boundaries of a firm (i.e., they request services from the firm) are the province of marketing, and client objects within the boundaries (i.e., they request services from other firms) are handled by operations.

Reuse

When building new applications, the systems developer usually looks for existing object classes to use as building blocks. For example, in creating a drawing program, a software engineer can avoid writing a spelling checker by reusing an existing object for spell checking. This practice leads to a development strategy where recognizing and exploiting similarities in classes is a major means of increasing programmer productivity.

In terms of business design, reuse is the important OO concept to migrate. A new organization can be built by assembling existing business objects and instituting a communication system for passing messages between the objects so that the organization's goals are achieved.

The OO firm

The Internet offers entrepreneurs opportunities for innovative business designs. With relatively little capital, it is possible to form an object-oriented firm. The OO firm is one that:

- creates a core object to handle the competitive preserving methods of the business;
- leverages existing business objects by contracting out non-competitive preserving methods; and
- makes extensive use of electronic messaging to execute standard transactions.

A fundamental idea behind the OO firm is that it does not necessarily have to create, from scratch, a complete organization. Crucial parts of organizations and their functions can be contracted out. Thus, to go into business, an entrepreneur has the option of dispensing with one or more of the following functions: production, promotion (including advertising), logistics, delivery, inventory, and so forth. Of course, entrepreneurs have had the option of contracting out these services for many years. However, the evolution of electronic networks has made it much more likely that efficient alternatives can be found. From a transaction cost economics perspective,¹³ electronic networks reduce search costs as well as the costs of monitoring and controlling performance. Thus, the firm can rely on a market rather than a hierarchy to produce many services. At the same time, some traditional business functions have become like commodities and are reusable objects for assembling the elements of a new firm. These functions can be performed at a site that is far from the rest of the organization and can be shipped electronically.

It is critical for the OO firm to excel at managing information and relationships. Because electronic information flows tie together the various objects, management must create and maintain an efficient electronic network for exchanging information between the various objects. If electronic messaging fails, the firm fails. Because the OO firm contracts out many activities to other objects, the OO firm must be adept at managing relationships with these other

objects. This can mean that the OO firm is likely to be an educator (i.e., teaching some objects about the business) and learner (i.e., learning how some objects operate).

Because so many typical business functions can be contracted out, the OO firm can move very rapidly to take advantage of emerging opportunities in the evolving market environment. However, there is a potential downside associated with this ease of entry. Once an OO firm has implemented its new business, it is quite likely that others can easily copy major features of the firm. Thus, it could be quite difficult for the OO firm to maintain, over time, a sustainable competitive advantage, unless the OO firm can build long-lasting relationships with its customers that survive the imitative efforts of competitors. Once customers have *taught* a firm to serve them well, they are often reluctant to move because they don't want to repeat the lessons.

PRINCIPLE I. The OO firm can be established more easily (and imitated more quickly) than a traditional firm.

OO Concepts in Action

OO concepts can be used to explain the design of five businesses of varying size and in quite different industries: Calyx & Corolla, Amazon, John Deere's Frontier Equipment, Betfair, and Dell Computer.

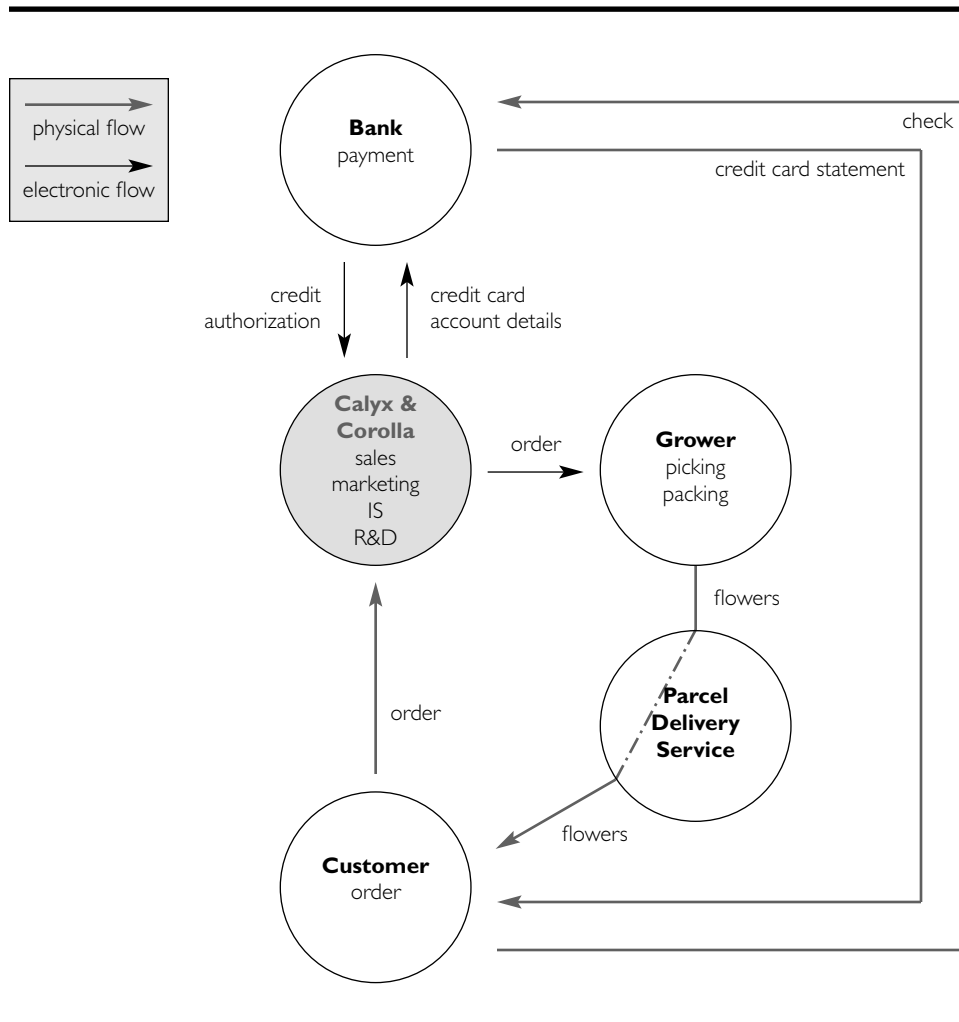
Calyx & Corolla

When Ruth Owades established Calyx & Corolla in 1988, her principle goal was to deliver flowers directly from grower to customer within 1-2 days of cutting, whereas existing sellers were usually supplying flowers that were 1-2 weeks old.¹⁴ Her core strategy was to establish strong links between Calyx & Corolla, a network of growers, and Federal Express. She said: "I envisioned a table with three legs, and Calyx & Corolla was only one of them. The second was the best flower growers available, and the third was Federal Express, the number one air carrier."¹⁵ Calyx & Corolla, using a mail-order catalog to stimulate sales, takes orders and transmits them electronically to growers, who then use FedEx to ship the completed order. See Figure 3 for an overview of the design of Calyx & Corolla.

This company's well-executed strategy resulted in annual sales gains of 30 percent in its early years.¹⁶ In 1996, Owades exchanged a 20 percent stake in the company for a nearly \$10 million investment in cash and media time from the venture-capital arm of Capital Cities/ABC (for advertising) and another 10 percent for \$5 million from an investment-banking firm (for working capital).¹⁷

"I couldn't have done this business five years ago," Owades acknowledges, because in 1988 the necessary technology was not available. Because

FIGURE 3. Calyx & Corolla Object Model



she started prior to the Web and commercial use of the Internet, Owades had to develop an infrastructure to communicate with growers and FedEx. Consequently, she spent most of her initial \$2 million in capital on the technology to create a system linking the three core objects—Calyx & Corolla, growers, and FedEx—to process orders.¹⁸ Each order is assigned a six-digit order number and a 10-digit FedEx airbill number. PCs receive orders electronically and print out order details along with a peel-off, customized Calyx & Corolla shipping label that includes a FedEx bar code, thus minimizing the paperwork for the growers.¹⁹ Calyx & Corolla does the information processing, and the grower handles the cutting and packaging of flowers.

The strength of establishing a business based on reusable objects is that the business designer can focus on what each object can do (i.e., its methods) and not be concerned with how each object does its job. This point is underscored by Abe Wynperle, the president of Miami-based Sunpetals, one of the

largest flower growers in the world: “Ruth created the relationship with FedEx, but when it comes to managing the logistics on a daily basis, she does not get involved. All Ruth wants to know is that the package got there eventually; how it gets there is my problem and FedEx’s problem.”²⁰

PRINCIPLE 2. Each object of the OO firm receives only those messages that it needs to execute its methods.

Principle 2 is a bit unusual because it goes against a key objective of marketing research: to gather and disseminate information so that managers can make better decisions. However, in an age of information explosion, Principle 2 argues that there are times when it may be beneficial to restrict the flow of messages and information. This restriction allows the objects in a business to focus their resources and to ignore methods that are not directly relevant. For instance, Calyx & Corolla is more efficient if it does not attempt to micro-manage FedEx’s logistics on a daily basis. That is, Principle 2 argues that information flow is very necessary at the planning and decision-making stages—when business practices are being designed. Nonetheless, once an efficient business design is created, then encapsulation allows the business to function in a more efficient and focused manner.

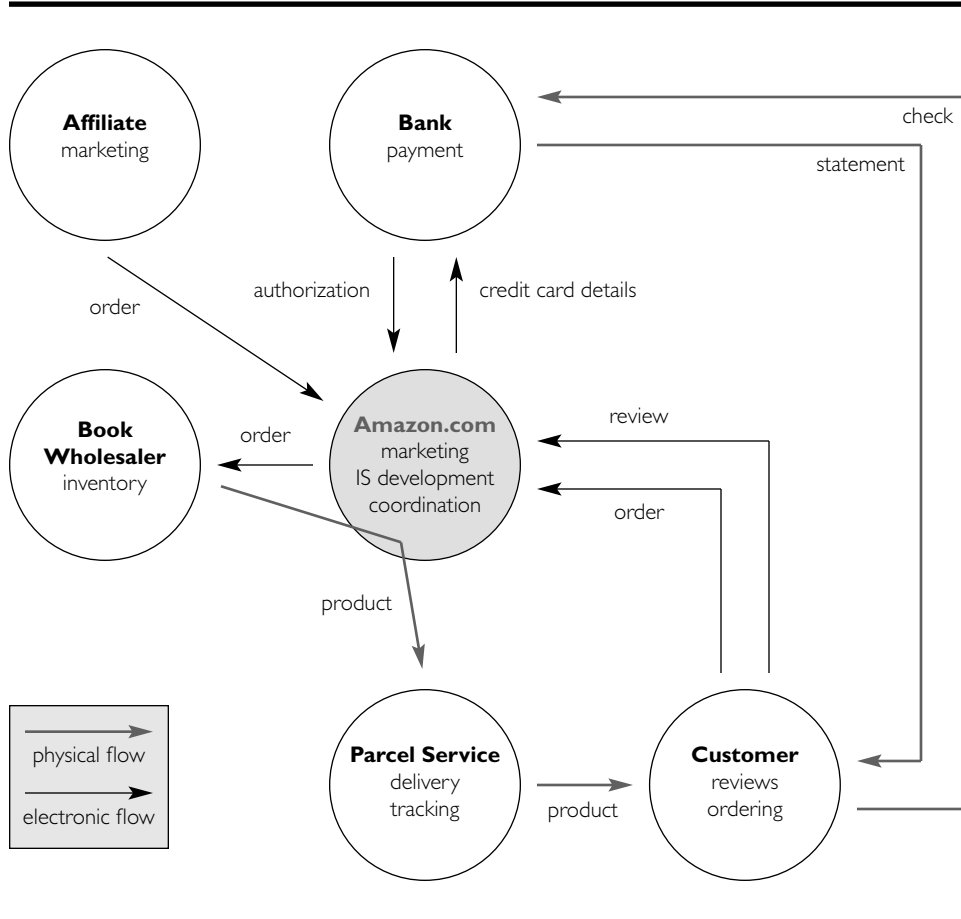
Calyx & Corolla is a marketing object heavily reliant on information processing to execute its strategy, which is why most of the initial capital was invested in information systems. It makes maximum use of existing objects and electronic message passing to weave together the elements of its business. It is the essence of an information age business—a marketing/information systems core electronically networking agricultural (flower growing) and industrial age (parcel delivery) firms. Calyx & Corolla retains some vestiges of the industrial era; it mails a catalog and accepts orders by mail, phone, or fax, as well as the Web. An information era firm transmits all routine messages in electronic format because this minimizes the cost of coordinating the objects within its network. A firm cannot reap the benefits of electronic messaging without first investing in the necessary information technology for initiating, storing, and transmitting messages between objects.

PRINCIPLE 3. OO entrepreneurs use information systems and networks to tie objects together.

Amazon

In July 1995, Amazon started business by claiming to be the earth’s largest bookstore, with 2.5 million books—ten times larger than any bricks and mortar bookstore. However, it kept only a few top sellers in stock and procured the rest from wholesalers upon receipt of customers’ orders. By April 1998, Amazon had over two million customers and repeat customer business represented more than 60 percent of orders placed. The model of Amazon’s

FIGURE 4. Amazon Object Model



operations in mid-1998, when it had not yet diversified beyond being an online bookstore, illustrates the application of OO concepts.

Amazon focused on the marketing core and cooperated with other business objects to create an OO firm, as shown in Figure 4. Amazon was primarily a marketing object, advertising and promoting the sale of books via a web site. It also built a key competitive resource—knowledge of customers’ buying patterns, preferences, and their responses to different marketing strategies. In order to preserve the integrity of the marketing object, Amazon handled order processing, the point where it captured customer data. To pass off this method to external objects would be a strategic error since the processing object could learn about Amazon’s customers. Thus, the core object must encapsulate knowledge that is essential to the competitive survival of the entity. In effect, core competency²¹ is the domain of the core object.

PRINCIPLE 4. The core object must encapsulate data and knowledge critical to long-term success.

Principle 4 is closely related to the concerns that organizations have about competitive intelligence. It is crucial to maintain the integrity of core business knowledge and practices. However, because of evolving computer technology and because of the alliances that are necessary to create an OO organization, the issue of competitive intelligence becomes much more complex. Specifically, an OO firm's alliance partners are also potential competitors. These case studies illustrate that two crucial elements are easy to copy or access: suppliers (growers or book distributors), and delivery mechanisms (e.g., FedEx and UPS). However, the customer database and extensive knowledge about customers may be a sustainable advantage. Once these companies have built their customer lists and learned what their customers need, it may be difficult for competitors to make inroads.

Bulk ordering from book distributors filled most customer requests. Indeed, one reason for Amazon locating in Seattle was to be physically close to Ingram, from whom it purchased 59 percent of its book orders in 1996.²²

Amazon's Associates program allows other web sites to sell books by linking to Amazon. Associates receive a commission. Essentially, anyone with a Web presence can become an associate by filling in an on-line form.

Amazon brings customers into the business by making them part of the order taking, advertising, and editorial methods. Customers do the order taking. They select the items and electronically complete the order form. Customers, encouraged to list their favorite books on their web site (with a link to Amazon), are part of the marketing method. Also, Amazon solicits comments from customers on the books they have read—an electronic version of word of mouth. The notion of making customers part of the business is not new. Any form of customer self-service incorporates the notion that the customer is more than just a receiver of a product or service.

The key point, however, is to realize that each customer does more than increase market size. Every new customer adds benefits to other customers because Amazon uses one customer's buying profile to suggest books to another customer with a very similar purchasing pattern or set of interests. When there are millions of customers, recommendations are more accurate because the probability of a close match is higher.

PRINCIPLE 5. Where possible, get customers to add value to other customers.

Principle 5 is based on the observation by Robert Metcalfe, the founder of the networking company 3Com, that the utility of a network is exponential to the number of nodes on the network.²³ In the case of Amazon, each customer is a node.

Authors are also encouraged to support the sales of their books by providing information about themselves through links to their web sites. Authors, thus, participate in marketing their books. Banks have existed as business objects for many years. In the case of Amazon, bank objects are responsible for verifying the credit rating of a customer, billing them, collecting the payment, and transferring funds to Amazon. Amazon does not concern itself with handling cash or checks.

Amazon lowered its capital requirements by realizing that coordinating message passing between existing objects could create value for consumers. Amazon has increased its marketing and sales force by embracing those who stand to gain from the sale of a book (associates and authors). Its marketing team is thus far larger and more skilled than that of the traditional bookseller.

Jeff Bezos, Amazon CEO, implicitly understands the principles of OO. From its initial bookstore base, Amazon has incorporated many other objects in its network. Now, many stores (i.e., objects) can be accessed from its web site. It is possible to order electronic equipment from Amazon and collect it within an hour or so from the nearest Circuit City store. Amazon understands that Circuit City is an object whose activities can be coordinated by electronic messaging. It can check any store's inventory and direct the customer to the nearest one containing the desired product. Amazon does not need to create a chain of electronic stores because such objects already exist. It just needs to establish coordination software to incorporate the chain into its business.

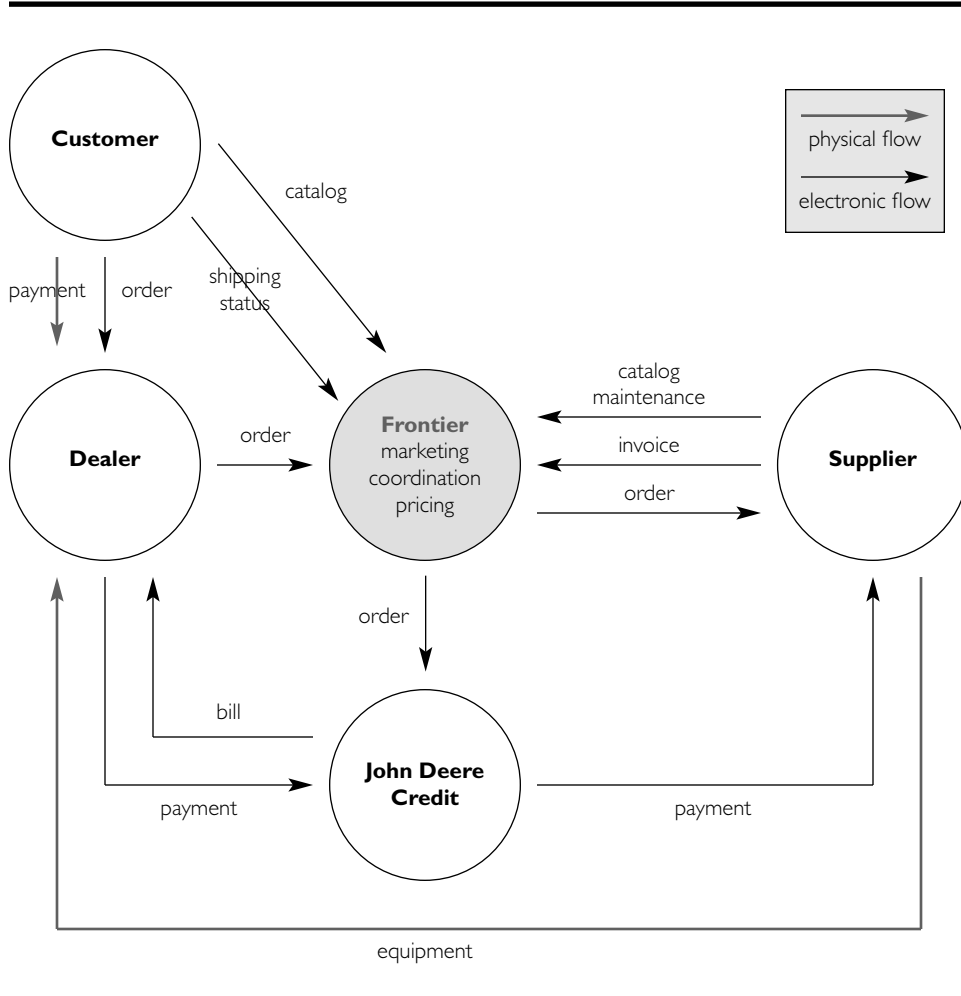
Frontier

John Deere, one of the oldest U.S. industrial companies, demonstrates that it thinks like an Internet-age maven. In August 2001, it launched Frontier, the brand name for an extensive line of new equipment to complement John Deere's products.²⁴ Frontier products appear in John Deere's catalog (www.BuyFrontier.com) and on its dealers' lots, but other firms manufacture them. John Deere implicitly applied OO concepts in creating Frontier (see Figure 5). It understands that there are many potential suppliers of ancillary equipment for its mainline products, and thus John Deere does not need to make such products but rather integrates these existing objects into its distribution channel. As a result, it can exploit its powerful brand and John Deere Credit by using the power of electronic coordination to link customers to suppliers via its existing infrastructure. Dealers can now market a wider range of products that, while not carrying the John Deere brand, inherit by association many of the qualities of the familiar green brand—as John Deere advertises, "Frontier equipment [green-with-gray trim] is designed to complement the John Deere line, at an economical price."²⁵ Suppliers get access to a global marketing system that greatly extends their market potential.

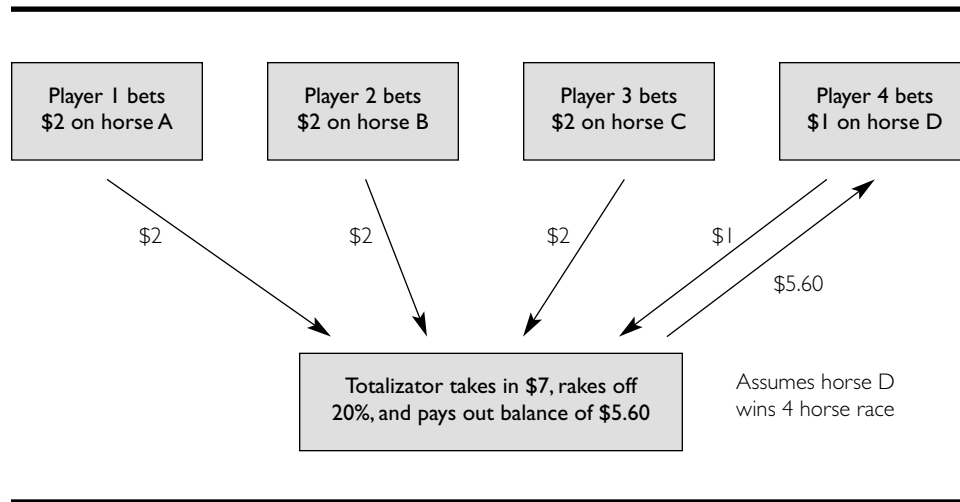
Betfair.com

Traditionally, those wanting to wager on the outcome of an event (such as the Kentucky Derby, the Superbowl, or Wimbledon) have had to resort to a

FIGURE 5. Frontier Object Model



pari-mutuel totalizator system, or a bookmaker. Pari-mutuel systems deduct a percentage of all bets (normally around 15 percent), and winners are then paid as a ratio of the remaining pool to their stake (see Figure 6). The disadvantage to bettors is that as the weight of money for their selection increases after they have placed their bet, so their odds, or potential payouts, decrease. The totalizator can never lose. It simply takes as its income a fixed percentage of all funds wagered. Bookmakers offer fixed odds on the outcome—6 to 1, for example, means that the bettor will be paid \$6 plus the original \$1 stake should the selection win the event. The advantage to the bettor is that the odds are fixed, and will not be reduced by the subsequent weight of money for the bettor's choice (although if the odds are later increased, the bettor does not benefit from this). The disadvantages to the player in this case are that bookmakers, like casinos, have a significant edge because the odds offered are shorter than true probabilities in order for them to profit in the long run—typically around 14 percent.²⁶

FIGURE 6. Pari-Mutuel or Totalizator System

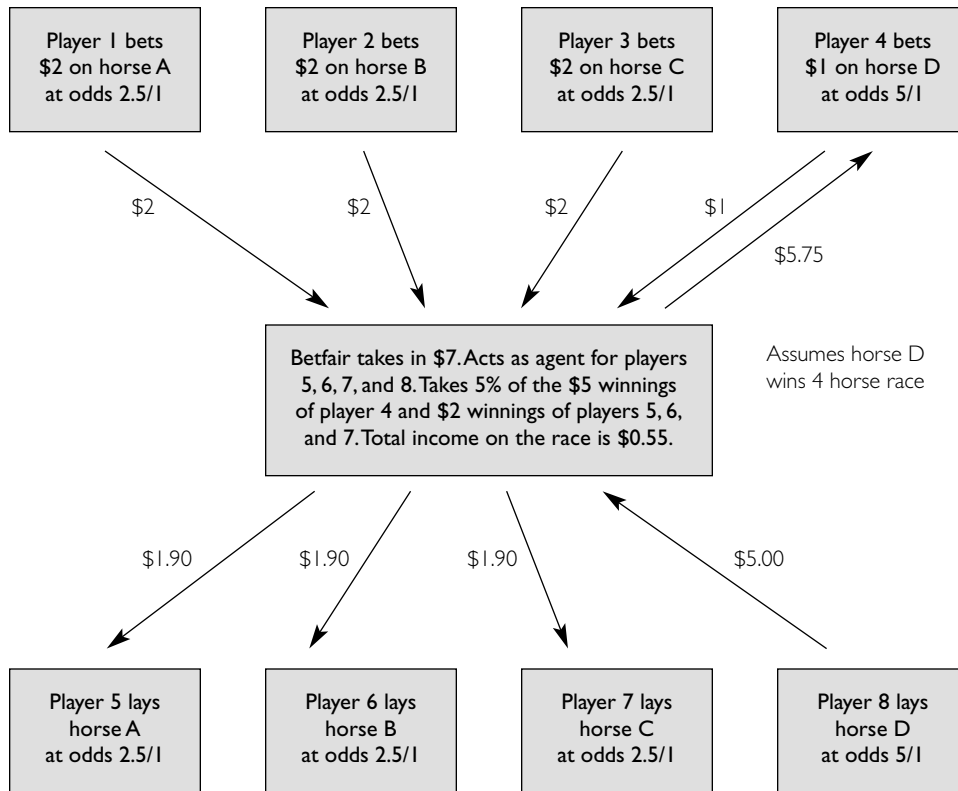
Unlike totalizator systems, bookmakers can and do lose on some events—for example, where they have misjudged the probabilities in the odds that they have offered, and where other outcomes do not attract the wagers anticipated. The basic premise of the two models is the same: Use the money taken from losing bets to pay winning ones, and allow for a percentage “rake-off” before doing so.

Just as eBay has changed the nature of auctions and C2C trade, betting exchanges are radically altering the nature of wagering, leveling playing fields for gamblers and anyone with an opinion. Rather than bet against a bookmaker, or pool their money with that of others, online betting exchanges allow gamblers to bet against each other. Therefore, they can be either bettor, or bookmaker, or both, by choosing to “take” a bet or “lay” a bet.

Betfair.com is the world’s largest betting exchange. Located in the United Kingdom, the company turned over £1.5 billion in 2002 and won a Queen’s Award for Innovation in 2003. By mid-June 2003, the site had a larger turnover on the Kentucky Derby than the track at Churchill Downs itself. More than £2 million was wagered on the U.S. Open golf tournament. The company provides the opportunity for betting on events that range from the more conventional sports (such as horseracing, football, soccer, baseball, golf, and tennis) to more exotic activities (such as hurling, darts, and snooker). There is also the opportunity for wagers to be laid or taken on non-sporting events such as the U.S. presidential elections, Big Brother competitions, and the Oscars. The company also offers a range of bets on most of the world’s major markets (turning over more than £100,000 daily simply on whether the FTSE will rise or fall).

Unlike conventional bookmakers, and like totalizator systems, Betfair is not really interested in the outcome of an event. It simply provides a market for opinions. Unlike totalizator systems, but like bookmakers, the odds offered on Betfair are fixed. Betfair doesn’t take a percentage of the money wagered.

FIGURE 7. Betfair



Rather, its income is derived from a small commission (ranging between 2 and 5 percent, depending on a player’s turnover) on a player’s net winnings on an event.

Betfair profits by taking a small percentage of winning bets and relies on massive turnover to generate income. The firm succeeds by assembling very large numbers of very small individual objects—customers—and providing a market place for them to interact. Customers place funds with Betfair by making an online deposit through a credit card or a mailed check, and Betfair then maintains the account. The balance is reduced every time a customer takes a bet (e.g., backs a horse) and is also reduced on reserve every time a customer lays a bet (i.e., incurs a potential liability by laying a horse at odds). Customers who win money or want to withdraw can at any time request to have all or part of their positive balance re-credited to their credit cards. The company will also mail customers checks or deposit funds into a bank account. Credit card companies and banks are objects in the Betfair network. A simple example of the Betfair model is shown in Figure 7.

From the size of some of the wagers at Betfair, it is evident that conventional bookmakers are using the site as a clearing market. They may be using the site to buy back (“lay off”) bets at better prices than are conventionally available. Similarly, they may be using the site as a market of last resort to lay bets that they have been unable to lay in conventional markets (albeit at better prices to the taker). In the long run, however, Betfair represents a serious threat to conventional bookmakers. While bookmakers may currently be among the “objects” assembled by the Betfair OO model, inevitably bookmakers might become vulnerable to the better prices Betfair offers gamblers.

Betfair delivers on many of the early promises made by the Internet and related technologies. Betfair offers greater information and gives better prices to all, while at the same time blurring the distinction between suppliers and customers. In short, it makes markets more efficient. Betfair has served both as a disintermediary and a reintermediary. It has allowed players to deal with each other directly, thereby making the roles of totalizators and bookmakers irrelevant. On the other hand, it has entered a channel between bookmakers and players, and it has allowed these parties to interact with each other.

Dell Computer

In an elucidating interview,²⁷ CEO Michael Dell provides many examples of OO concepts in action in a large corporation. Michael Dell, whose firm markets personal computers, recognized that in a mature industry there are many specialized firms that can provide required methods. As a result, Michael Dell states, “We concluded we’d be better off leveraging the investments others have made and focusing on delivering solutions and systems to customers.” Consequently, “There are fewer things to manage, fewer things to go wrong.” Dell’s quotes capture the essence of OO design—leverage existing objects and focus on the core competitive methods.

Dell is very adept at reallocating methods among objects. It ships computers to Sony (the monitor supplier), who then matches up computers and monitors and delivers them to the customer. During assembly, Dell will install a particular customer’s preferred set of software and place its asset tags on its computers. Dell can execute these methods, traditionally performed by the customer, at lower cost. At the same time, Dell builds stronger customer relationships.

A Business Design Methodology: A New Tool for Entrepreneurs

A crucial question in entrepreneurship is: “What is the best way to design new businesses?” An important, related question is: “What are the best sources for new business ideas?” Traditionally, it is thought that new business ideas must start with customers and satisfying customer needs; without customers, any new business will fail. Likewise, a new business will fail if it does not satisfy customers to a greater extent (or more efficiently) than existing alternatives. Despite this conventional wisdom, entrepreneurs traditionally have found new markets

for existing products, new products for existing markets, or, at the extreme, new products for new markets.²⁸ OO is a new form of entrepreneurship in that it can service existing markets with existing products by creating new organizational structures by assembling objects

The process of business design operates as follows:

- *Identify the methods the business must perform*—A business must know what methods it must undertake to meet its goals. Many of these should be obvious (e.g., process sales orders) and others may arise over time (e.g., educate suppliers). The business information analysis and integration technique (BIAIT)²⁹ and the supplementary services model³⁰ are useful starting points for systematically examining business processes.
- *Identify the competitiveness preserving methods and allocate these to the core object*—It is essential that the core object executes those methods that preserve its ability to compete (e.g., IBM outsourced development of its microcomputer operating system to Microsoft, with subsequent loss of competitiveness in the personal computing market). By focusing on a small set of key methods, the firm can become highly knowledgeable. It is focus that generates knowledge, not diversity. This notion of focusing on core skills has been frequently touted in the strategy and popular management literature (e.g., Peters and Waterman's aphorism of "stick to the knitting").³¹ In the information-age, the core object's methods are likely to include marketing and knowledge systems.
- *Identify reusable objects with competitive competency in any of the unallotted methods and allocate methods to these objects*—In most cases, organizations want to select those objects that provide superior performance; otherwise, the business's ability to perform is impaired. Calyx & Corolla clearly illustrates this concept with its use of a small number of high-quality growers. Competitive competency means that the object provides the required method at the business's price/performance mix. This is likely to require a careful screening of potential objects and possibly selecting multiple alternatives to avoid dependency. Ongoing monitoring of performance of objects is, of course, necessary.
- *Allocate remaining methods to other reusable objects or the core object*—In the case that some methods remain after the first two rounds of allocation, the business designer needs to find objects that can provide these methods, even though the price/performance trade-off is outside expectations. This is a potential area of concern because an object executing below customer's expectations can severely damage a new business because early adopters tend to be service-sensitive and price-insensitive.³² Alternatively, it may be that the firm has to undertake some methods because suitable objects are not available. There will be a consequent increase in initial capital requirements and stretching of the time to market.
- *Specify the protocol for passing messages between objects*—In order for a business to operate, messages must pass between objects. There are essentially two types of messages: operational and relationship. A framework that

identifies knowledge types can explain the purpose of these different types of messages.³³ Operational messages instruct objects to perform routine and well-specified tasks (e.g., indicate whether purchase by credit card number x for amount y should be approved). These messages should be codified and exchanged electronically. There is a standard method used to process each message. Relationship messages build and maintain relationships between objects. When Calyx & Corolla was establishing its business, considerable time was spent talking to growers and FedEx to establish an understanding of how they would cooperate. Relationship messages are typically non-routine, non-structured, and support rapid feedback (e.g., face-to-face and phone conversations). Once a business relationship is in place, operational messages are likely to predominate.

- *Examine each object to determine the level of encapsulation*—The degree of encapsulation is a design choice. High levels of encapsulation enable the executives managing the core object to remain highly focused on its methods. However, there is a danger associated with this approach. By not knowing how or why a partner object operates, the total business is potentially less efficient and effective. A compromise position is to establish a modus operandi of punctuated equilibrium. High encapsulation is the norm, but as the situation demands, the core object raises the level of relationship messaging to learn how a particular partner object operates. The objects adjust existing methods or design new ones to improve the overall system performance and then continue to operate in encapsulated mode. De-encapsulation is most likely when a new enterprise is in formation or an environmental change galvanizes action for a rapid response.

Rethinking Design

Our knowledge and theory of strategy and structure have their roots in the industrial era. Not surprisingly, Chandler's *Strategy and Structure* is based on studies of organizations of the industrial age.³⁴ Nevertheless, more recent highly influential concepts, such as core competency,³⁵ rely on industrial-era cases to illustrate the central idea. We are making the transition from the industrial to information era. As well as having a theory of management heavily based on North American experience and relatively ignorant of national culture,³⁶ we also have a theory founded on observing industrial age organizations.

One of the salient features of the information age is the deluge of information.³⁷ Information, once rare, is now abundant and overflowing. Managers can easily become disoriented by this avalanche and need to develop coping strategies. Deintegrating and outsourcing, while ostensibly strategies for increasing shareholder returns, are also ways of reducing information flow. Senior executives have fewer objects to manage and thus less data flow. When faced with an overload, people respond by:

- allocating less time to each input;
- disregarding low priority inputs;

- reducing the reception of messages by using filtering devices; and
- redrawing boundaries to shift transactions to other parties.³⁸

Organizations also must handle information overload. Galbraith conceives of the organization as an information-processing network (which is akin to the notion of the firm as a set of cooperating objects), and he asserts that a central issue of organization design is the selection of mechanisms for avoiding information overload.³⁹ He argues that when faced with information overload, the firm can reduce the need for processing information or increase its capacity to process information. Two of his design choices—creating self-contained groups or lateral relationships—are, at their core, arguments for encapsulation.

An OO design, either for creating a company or redesigning an existing organization, is a natural evolution in an ecological system increasingly overwhelmed by information. Organizations need to simplify and focus attention in order to process successfully requisite environmental signals for survival.⁴⁰ A corollary is to predict that those objects that are very adept at communicating with other objects (i.e., simple interfaces) will be more successful. For example, the adoption of no-haggle pricing by some auto retailers can be viewed as a way of simplifying the customer interface.

The Contribution of OO Thinking

The literature is replete with theories and metaphors for thinking about strategy (e.g., judo strategy),⁴¹ so what is the contribution of migrating OO concepts from computer science to strategy? The benefits include:

- OO is a concise and complete set of concepts for describing and building complex cooperating systems that exchange messages electronically.
- The network model of the organization has focused primarily on the links between organizations. The OO model forces attention on the other component of a network—the node.
- OO unites a variety of key strategic thinking notions. For example, it embraces the ideas of networks, core competency, and empowerment (i.e., encapsulation).
- OO is a tool for designing structures for ameliorating information overload, a key concern for many executives in this era of electronic mail and groupware.
- OO provides a conceptual foundation for understanding information age organizations.
- In strategic thinking, the emphasis should be on generalization,⁴² and OO is a set of generalized concepts with wide applicability.
- Executives can readily understand OO concepts and their application to organizational design.

Intra-Organizational Design

The OO designs described in this article are based on codified electronic transactions between autonomous firms. Where exchanges can be electronically codified, there are no barriers to applying the same OO principles to intra-organizational design. Indeed, firms who move in this direction will increase their shareholder value because organizational units will be more readily “plugged” into other organizations. Firms should be able to rearrange their portfolio of organizational units (objects) at a lower cost. The outsourcing of activities, such as accounting services, moves a firm closer to an OO design and nearer to the point where a unit can be sold to another firm and quickly inserted into its operations. Existing outsourced services can be transferred with the unit or new sets of services connected.

While the OO model supports an enterprise’s speed to market and agility, the system is likely to be suboptimal. Following an acquisition, the new owner might reap a quick return through rapid operational integration, but might also find it necessary to “open-up” the new object to secure system efficiency gains.

The Limitations of OO Design

OO design is limited by the extent to which knowledge needs to be shared between objects. When many of the interactions between two units can be reduced to structured electronic transactions, then OO design is feasible. However, when the mutual dependency of two units is characterized by a non-trivial learning curve and high knowledge content, information exchange is not readily codified, and OO design is inappropriate. For example, the Norwegian telecommunications company, Telenor, has recently co-located R&D and business units with the intent of accelerating the development of new products. Telenor has moved counter to OO design ideas because its senior management believes that effectiveness comes from knowledge exchange between R&D and customer-facing units.

Conclusion

The principles of OO design are appropriate when speed to market is essential and superior customer knowledge and service are the key sources of long-term success. Because an OO firm’s design is very visible, it can be readily imitated by using the same or equivalent objects. If the OO firm cannot derive competitive advantage from learning about its customers or cannot establish network effects, then it is unlikely to survive. Alternatively, if a new business venture does not present these opportunities, it is probably a poor choice for an OO design.

A core object that fails to learn rapidly from its early experiences provides an opportunity for agile-thinking second movers to catch-up. If the first mover can engage its customers and stimulate them to add value to each other (e.g., through customer’s product reviews) and thus gain the increasing economies of scale of network effects,⁴³ then the first mover creates a formidable barrier

to competitors. As well as high learning skills, the core object must nurture skills in information systems and networking technology in order to maintain and extend electronic messaging to current or new objects, process and interpret the data it gains from customer transactions, and build new services for customers.

Because the OO firm is network based, it must remain vigilant for the impact of new networking technologies. For example, a major weakness of the Internet is that customers must go to a computer to gain network access and customers cannot always be uniquely identified.⁴⁴ Third-generation mobile phone networks will support personalized and location-based services. They present an opportunity to apply the same OO design principles in a different network environment. Knowledge of OO design principles and their successful application should stimulate both scholars and managers to think creatively about successful strategies where the widespread use of electronic networks permits organizations to cooperate and coordinate to a degree not previously achievable.

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