Just-in-Time Research: Reducing Cycle Time in Achieving Research Results for Business Practice

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Executive Summary

Innovations that affect business practice, particularly those in information technology, are occurring at an increasing rate. For example, the time between major innovations in information technology has decreased from between four and five years in the 1970s to mere weeks in the 1990s. The problem for business executives is getting solid information on which to base technology adoptions, business process designs, and business strategy. The basic information needed is not usually proprietary; it is advanced knowledge of what will be known by everyone when the innovation is in widespread use. This advanced knowledge allows early innovation, reduces expenditures on obsolete technology and practices, and allows the organization to capture benefits earlier than competitors that wait for general knowledge and acceptance of changes.

The normal cycle time of research on business practice is too long for organizations that want to be on the forefront of innovation. Much more rapid results about new technologies and new practices are needed. The research results should be available at the time innovation decisions are being made. In other words, just-in-time research is needed.

The method of just-in-time research in business practice proposed in this article combines case studies, a panel of expert practitioners, and academic or consultant facilitators to achieve research conclusions. The case studies document early experimentation. Using several case studies allows the innovation to be seen as a general phenomenon rather than an isolated instance. It also allows for concept or technique to be supported by a preponderance of evidence. Using only one case study can be misleading. The experienced practitioners discuss the case studies and evaluate the value of the innovations. Each practitioner obtains insight for his or her organization, both from the case studies and from the discussion. The discussion allows general principles to emerge. These principles provide a framework for individual organizational decisions and actions. The academic or consultant facilitators assist in extracting generalizations from the cases and practitioner responses. They also assist in avoiding narrow groupthink, in which everyone becomes enthusiastic and tough questions are not asked.

The process of just-in-time research and the benefits to be obtained are illustrated by three examples involving recent innovations in information technology: client-server, object-oriented programming, and electronic commerce.

Introduction

Chief Information Officer, John Erikson, faced some tough decisions regarding innovations in the way his organization designed and implemented information system applications. Last year, Erikson's organization invested heavily in technology and training for client-server applications. Now some of the staff are saying they should be using object-oriented methods. If they
are right, the sooner the decision is made, the better. The cost of obsolete technology and training would be avoided. Delays mean newly-developed systems would incur conversion costs. On the other hand, enthusiasm by a few gurus and early adopters must be discounted, because they often let their zeal obscure real problems and hidden costs. Erikson needs solid evidence from the early innovation results plus the kind of evaluation of the evidence that provides insight into the general problems and business benefits. He also needs to be able to translate the general problems and insights into specific decisions for his company.

This problem is often very serious. Decisions for early use of innovations may have large benefits and large costs. The executive making the decision may be “betting the budget” on the decision. Career opportunities may be gained or lost.

Difficulties with the Research Results on Early Innovation

When a new innovation enters the marketplace, a large number of descriptive articles explaining the innovation and speculating about its benefits are available. Such articles are useful for becoming aware of new technologies and business practices. However, they rarely have solid evidence of impact or perceptive evaluations of principles to guide implementation and use.

Case studies may appear detailing, one at a time, the experiences of early innovators. These case studies frequently have a bias toward the benefits of the innovation and understate the problems. They are typically published so soon after the new technology or practice is implemented that many important effects are not reported.

For example, a very innovative expert system for configuring computer systems was reported in case studies. These case studies failed to report the under-use of the system after the initial enthusiasm had subsided. This fact was due to the time required for the system’s use and the lack of incentives for its use. The persons who “paid the price for use” were not compensated for it nor penalized for failure to use.

Delphi studies asking practitioner opinions on various aspects of the innovation (including estimates of benefits and risks) can be valuable. However, the studies tend to respond to what each person thinks rather than generating new insights through group interaction. Also, the opinions tend to be abstract and not grounded in reported experiences.

Focus groups are useful to get reactions to proposals and products. However, they tend to be used more for marketing decisions.

Rigorous academic research based on studies of the innovation over time or based on experiments to test some of the assumptions provide excellent evidence, especially if several such studies are evaluated. The problem is that often they appear too late for the decision maker.

Just-in-Time Research for Business Practice

Just-in-time research is designed to provide a basis for business innovation decisions to be made when evidence is limited and the consequences are significant. The method should have the following characteristics:

- Reflect the lessons from early innovation, even though the evidence may be incomplete.
- Reflect the diversity of insight that comes from a group of practitioners from different organizations and backgrounds.
• Actively involve executives who will have to make the decisions for their organizations.

• Assist executives to both generalize the issues and to identify the lessons learned that are dependent on the characteristics of the adoption and the adopting organization.

• Reduce opportunities for overlooking serious defects and for enthusiasm to cause groupthink.

This method combines many characteristics of existing research methods. However, it is designed to provide results in time for decisions. The steps are:

1. Assemble a group of executives with responsibilities for making the innovation decisions being discussed. A group of 10 to 30 people should provide sufficient diversity and opportunity for interaction.

2. Have two or three facilitators who have the ability both to discussion and also to identify generalizable insights from the discussion. Such facilitators may be found in universities and in consulting firms.

3. Have several case studies on the same issue. The case studies describe “real-world” experiences of organizations. They demonstrate the dynamics of the innovation. They may be incomplete but will generally allow some general lessons to be identified.

4. Have the group of executives discuss the cases, identify issues from their perspectives, and draw tentative general conclusions. Votes may be taken to quantify the strength of conviction about the conclusions. This idea is analogous to accepting or rejecting research hypotheses. Convergence may emerge but the process should also document concerns, risks, and differing opinions.

5. Each executive participating in the process obtains general insights regarding problems and issues. In this process, the executive can begin to relate the case study results and the discussion insights to his or her own situation. Questions and discussion based on individual situations are encouraged because they often lead to additional insights.

The result of this process is both quantitative and qualitative. There are measures of confidence from the group relative to issues, principles, and insights. The quantitative results are of limited use without the qualitative insights that arise from the discussion of the cases and from the comments of individuals with diverse backgrounds. Executives who participate are able to evaluate the resulting conclusions because of their participation within it. The insights for the individual organization are captured by the organization’s executive, both by extending the general principles to the organization’s situation and by identifying specific elements.

An issue related to this method for business practice research is the involvement of executives from different organizations. The group may include executives who work for (or may in the future work for) competitors. Will competitive advantage opportunities be lost? Probably not—the innovations are known. Even after the discussions, the real competitive advantage comes from making the innovation specific to the norms, culture, and processes of an organization. Making an insightful decision is critical and the research method assists with it. This decision must be followed by implementation; if two competitors make the same adoption decision, the competitive advantage of early adoption goes to the organization which can implement the decision well.

Application of Just-In-Time Research

The authors have applied the proposed research method to investigate technological and organizational innovations such as object-oriented programming, rapid cycle-time systems
development, self-directed teams, and client-server technology. In this article we provide an in-depth report on the results of the just-in-time research from the client-server study conducted two years ago. The report is followed by a summary of the results of just-in-time research on object-oriented programming conducted a year ago, and electronic commerce conducted this year.

For those readers not versed in the field of information technology, these illustrations may occasionally discuss technical issues in more detail than is familiar. Please don’t get concerned if that should happen. These examples are provided for illustration purposes to demonstrate the nature of just-in-time research. For readers whose work is related to information technology, the research results should be of direct interest.

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Client-Server Background

Client-server has captured the imagination of senior executives because of its potential for reducing the costs of information processing while increasing processing flexibility. Executives can understand client-server and fit it to their business model more easily than they can a mainframe approach. Ironically, our findings suggest that while the impact on costs remains clouded, there is little argument for increased flexibility. Yet, the proper way to install and manage client-server computing has remained elusive in the years since client-server architectures emerged. The advent of client-server presented such a stark contrast to existing mainframe-centric computing styles and skill sets that it provided an ideal test ground for the just-in-time research process.

There are many variants for client-server computing, including having only the presentation logic on the client, having presentation and application logic on the client, splitting the application logic between the client and the server, and having presentation and application logic on the client with database processing on the server. Each of these variants poses different challenges on existing skill sets and the underlying technical infrastructure. Computational complexity and the need to integrate with legacy systems are two additional complications.

Tools are another deployment issue. While new client-server tools come to market regularly, there is an explosion of interest in the Internet, which promises in some cases to bypass client-server networks entirely. It is very easy to immerse oneself in the technical characteristics of tools and technologies and miss the true business impact.

Our research in client-server, originally undertaken in 1993, provides a good illustration of the just-in-time research technique, due in part to the fact that sufficient time has passed to weigh the accuracy of the insights gained. Other examples will be provided later in this article.

Just-in-Time Research Design

To get better insight into the deployment and managerial issues of client-server technology, a group of 55 information systems vice presidents and systems development directors were gathered for a two-day research project. Participants came from 55 Fortune 500 companies located in North America. The organizations represented could collectively be making at least $10 billion worth of decisions on client-server technology during the next five years. Clearly the need for good information would be helpful.

Six case studies of early adopters were presented to the group prior to the real time "hypothesis" discussion. The early adopters described in the case studies were AT&T Global Information Systems, two health care suppliers, USWest, International Flavors and Fragrances and American Airlines. The six case studies are summarized below.
Case-Studies on Client-Server

Case Study 1 — Accelerating Product Development at AT&T Global Information Systems

AT&T Global Information Systems (GIS) was driven to client-server technology by virtue of a fast-changing and increasingly competitive marketplace (the competitiveness of this market was borne out by the subsequent decision by AT&T to, in effect, divest itself of its GIS unit). Customer loyalty, enforced in the past through vendor lock-in due to architectural incompatibilities, has since evaporated due to increased mobility. Plus, cycle time has become an absolute premium in the fast-changing computer industry. AT&T GIS saw client-server technology as a way to maximize its potential for maintaining its customer base while increasing its ability to deliver products in a timely manner.

In order to maximize time-to-market, AT&T GIS attempted to leverage the best of all available sources, including purchased applications, end-user tools and developer’s tools. With this multi-tool strategy in place, AT&T GIS discovered that most changes to legacy systems that were responsible for agonizing maintenance procedures could instead be made with end-user tools. Consequently, the move to client-server actually improved the ability to deliver high-impact applications. For example, a new collection process enabled the company to reduce outstanding receivables by 42 percent with a significant reduction in paper costs and numbers of collectors. More importantly, customer satisfaction rose.

AT&T GIS’s experience with client-server emphasized how the inherent integratability (although not without hard effort) and scaleability make it a more flexible approach than monolithic, mainframe-centered computing. These benefits come at the added cost of a more intensive applications design process, in which many decisions regarding the distribution of functions must be made and the ideal technical enablers of these distribution decisions must be identified.

AT&T GIS’s 10 years of experience have identified several keys to success in client-server development.

- Establish an information technology review board.
- Develop a concise hardware/software architecture.
- Define responsibilities and new job descriptions.
- Develop a standard products list.
- Establish an enterprise-wide infrastructure.
- Designate key shared resources and services.
- Establish relationships between use and information systems (I/S) representatives.
- Establish operational and enforcement procedures.

Case Study 2 — Launching a New Business at US West

To launch a new business line for data communication products, US West needed to build a new service center—fast. In just four months, US West built the center’s information systems using a client-server architecture to meet the company’s time-to-market needs. The system was ultimately finished on time and under budget. The system operates across 14 states and has 60 users; it consists of 12 local applications that access over 50 legacy applications throughout the company.

Driving the decision to use client-server was the tremendous speed required and five other high-level requirements: a need for greater flexibility, better communications between different work groups, the ability to evolve with new business needs, common access to information by US West employees in a 14-state marketplace, and 24 hour, seven-days-a-week availability.

Because of the severe time-to-market pressure, the development strategy was to use an existing intelligent workstation application as the core of
the systems and off-the-shelf applications to support the new products and services. Because the applications were from a variety of vendors, US West adopted a multi-vendor architecture using common standards wherever possible. Like other regional Bell operating companies, US West had many legacy systems to interface with the new system.

There were several keys to success in US West's development approach. One of the most important was Time-Box Decision Making. US West identified what it could deliver each month and adhered to that schedule. Application selection was governed by the 80-20 rule: if an application met 80 percent of the user criteria, it was selected on the theory that such inexpensive software is almost disposable because better functionality will come later. The development approach minimized code writing and maximized reuse whenever possible. There was a high assembly-to-build ratio.

There were a number of management and technical challenges in the project, not the least of which was physical logistics. The service center was in Minnesota, the lab was in Colorado, and the vendors were in several states. Coordinating procurement and generation cycles was tricky at best. Other key challenges included managing client expectations, managing vendors and their ongoing support, and generally managing a project with an extremely fast pace. There were no special incentives for the team, which was highly self-motivated. The key success factors of the project included:

- a shared, articulated vision,
- strong partnerships,
- a highly skilled team, and
- commitment by team members.

Case 3 — Supporting Customer Requirement Through Flexible Client-Server Applications at International Flavors and Fragrances (IFF)

IFF, the world's largest manufacturer of flavors and fragrances, undertook the move to client-server with considerable care. IFF's experience demonstrates how a well-chosen pilot project, in this case an Executive Information System, is key to conveying the power of client-server, particularly in a traditional processing environment. The IFF case, which describes the evolution of IFF's three client-server applications, illustrates important unanticipated business benefits from the initiative. The case also points out the management and cultural changes that must be propagated throughout the organization as client-server and the transition to teams takes hold.

Due to IFF's need to rethink its business processes and provide flexible systems at lower cost, a decision was made to pursue all new developments in client-server. Consultants were called in, and an infrastructure and tools were chosen. When the time came to select a pilot program, an initial suggestion for a flavors/fragrances sample system for sales people was rejected because of the wide area network requirements (sales people were in New York City headquarters; samples were in New Jersey). However, a second suggestion for an order-bookings decision support system for senior management met the selection criteria.

The system gave senior management a high-level pictorial view of the company's order position for a given month. Management could use this information to balance orders from month to month, for example moving larger orders from the next months into the current month if the current month's orders were relatively light. One of the most striking team experiences was realizing the new skills needed. Team members needed to have a broader set of skills, including a better understanding of the business and stronger interpersonal skills. The most important skill was a capacity for learning. The customers reviewed the prototype at the end of the two-week effort but were not initially involved.

The application has been successful, spawning two unanticipated benefits. First, it is now easier to share information globally due to the flexibility and low cost of the client-server environment. Because of its success, client-server has since
caught on in other IFF applications. IFF’s experiences suggest that developers must be seen as working for users, not I/S management. Developers must be delivering value to the business. It is the organizational issues, not the technological issues, that pose the greatest challenges.

Case Study 4 — Enhancing Decision-Making at American Airlines with Client-Server

American Airlines has been using client-server for over six years to run one of its most critical business functions—pricing and yield management. Applications in this area are large-scale, mission-critical systems operating in a highly dynamic environment. This case study examines how two applications, the Pricing Decision Support System and the Critical Flight Analyzer, helped American Airlines restructure business functions, cut costs and respond more rapidly to marketplace changes.

Pricing and Yield Management (PYM) is a revenue-generating arm of American Airlines. The objective of PYM is to maximize total passenger revenue for a given flight. Given that price times quantity equals revenue, the price portion of the equation includes restrictions and fare levels. The quantity, or yield management, portion of the equation includes number of passengers (under- or over-bookings), allocations (the numbers of seats to sell in each price/discount category) and traffic flow management (which routes should have discount seats at all).

Due to the complexity and sophistication of PYM’s business needs, PYM requires enormous amounts of data. Pricing analysts must analyze and process vast quantities of fare information in order to maintain American Airlines’ competitive position. American Airlines has roughly 313,600 fares in over 12,000 domestic markets, with an average of 26 fares per market (a market is a city pair, like Tulsa-Los Angeles). The daily fare change rate is 18 percent (i.e., 55,000 fare changes daily); the average life of a fare is 6 days.

Yield management analysts process both pre- and day-of-departure information in order to attain the highest revenue from each airline seat. With approximately 4,000 daily flight departures, each averaging seven classes of service (e.g., first class, business class, coach), the analysts manage some 28,000 separate “inventories.” Both the volatility of the industry and the necessity for strategic and tactical planning require superior ad hoc analysis capabilities. Immense amounts of data on advanced bookings (which may be made up to 330 days into the future), market share, scheduling, traffic, and revenue are accessed.

In 1989 SABRE Computer Services, the information systems arm of AMR Corporation, American Airlines’ parent, was a predominantly mainframe shop. However, by this time it had become evident that mainframe development methods were too slow. The company needed automated analysis tools and standard data access and presentation capabilities. This ideal would improve decision-making by reducing the time needed to collect and analyze data and by providing more accurate and timely data for better-informed decisions. The goal, from a systems perspective, was to have as many fully automated decision support systems in PYM as possible (e.g., domestic pricing, international pricing, domestic yield management, international yield management).

Prior to client-server, approximately 50 PYM analysts managed fare changes on a daily basis. The analysts’ job was manually intensive, with large volumes of data that changed daily to process. The pricing analysts submitted fare changes on paper to implementation analysts, who reviewed the changes and prepared instructions about them for ATP (Airline Traffic Publishing Company), the clearinghouse for all airline fares. ATP would process the changes and transmit all fare changes to all carriers and travel agents. At that point the new fares would be loaded into SABRE for American Airlines.

With the introduction of a client-server Pricing Decision Support System (PDSS), this process was streamlined considerably. PDSS automated filing fares to ATP, completely eliminating the implementation analyst function. PDSS
automated data collection and fare monitoring and provided automated analytical tools for fare recommendations. For example, it provided policy-based pricing (e.g., a rule could be set up that if a competitor’s fare changed by $10, American Airlines would match it), revenue impact worksheets, and market share analysis.

Prior to client-server, analysis was cumbersome and there were problems when trying to analyze all flights. Over 50 yield management specialists reviewed and adjusted flight booking levels for all flights over multiple days. As with pricing, large volumes of historical data were needed to effectively manage booking levels.

The client-server Critical Flight Analyzer (CFA) system made analysis simpler and more effective. CFA provided a critical flight identifier, so that only those flights flagged as critical (i.e., had reached a certain booking level, either high or low) were analyzed. The system displayed historical information and provided what-if analysis capabilities. With the CFA system, the number of yield management specialists was reduced to 20.

But the benefits were not without challenges. The development team faced a number of obstacles along the way, including unfamiliarity with the leading-edge platforms, insufficient support expertise and the huge data volumes that came later during the fare wars.

Today, the team has learned to assess and manage risk and customer expectations better, and it has added data management and network expertise. Development is moving towards AI-based systems, including neural networks and other capabilities. This fact opens the door to object orientation and a host of new tools and techniques. So while many organizations are still moving to client-server environments, American Airlines already has legacy client-server systems.

**Case Studies 5 & 6 — Addressing High Transaction Requirements in Health Care**

Two examples of large-scale client-server applications, a health care claims system (decision support) and a customer billing system (transaction processing) were reported to highlight some of the challenges that client-server technology had to overcome in high-volume transaction environments. These cases, both at the same health care provider, underscore the need to establish an underlying foundation for handling client-server applications, sometimes at enormous cost and expense.

Both case studies dealt with health care claims systems that are processed monthly. Provisions to handle the high “surge” amounts, along with the need to support up to two years of historical data, made client-server a challenging proposition. Data architecture needs were also significant. The time needed to support loading of the database for backup and recovery was too long, and excess reliance on vendor-supplied database management systems (DBMS) features to solve these issues had led to additional delays. In effect, the health care provider had to build a new solution while pressuring its vendors to undertake some of the underlying enabling technology. The case studies underscore the fact that despite wrenching technical obstacles, the move to client-server was the correct decision from a business perspective.

**Summary of Case Studies**

The six case studies presented represent diverse industries, applications, and technologies. The next task in the just-in-time research was to formulate generalizable “hypotheses,” principles, or rules of thumb that would be useful to organizations making client-server decisions.

This process involved the consultants formulating “hypotheses” that were presented to the group.
From a research perspective, the group could be viewed as a panel of experts for discussion, modification, or rejection of hypotheses. Additions were also allowed. To be accepted as a finding, a unanimous vote or a very strong consensus was required. The statements accepted by the group provide the basis to make their client-server decisions. The reflection and conclusions drawn by the group are as follows.

**Just in Time Research Conclusions**

A number of conclusions were formulated based on the discussion of the case studies on client-server. A summary of these is listed below.

**Strategic/Managerial**

- Client-server is attractive to senior management. Therefore, successful client-server projects will reflect well on I/S.
- Client-server provides a “CE0 connection”—an opportunity to talk with the CEO about a transformational technology.
- Client-server has attractive advantages in functionality, although it presents a mixed picture in terms of price/performance.
- Good places to start with client-server are supporting niche applications, giving existing systems a facelift, or providing decision support for low-volume, static environments.
- Designers should cluster on enterprise, group, and individual levels as they formulate a client-server architecture.
- I/S must balance business benefits and client-server technology strengths.
- Architecture, business principles, capacity performance, and recovery planning are critical components of a client-server strategy.

**Organizational/Behavioral**

- Stars (gurus) are critical to help jump-start the development team.
- I/S must use virtual teams, augmented by support functions, that are empowered and operate with a shared vision.
- Ironically, though client-server may start out in the user community, it can end up back in I/S. The new “glass house” is a room full of servers.
- “Once a convert, always a convert.” Once mainframe programmers experience client-server and graphical user interfaces (GUI), they are reluctant to go back to mainframe programming.
- The mindset change involved in moving from mainframe to client-server is easier than the one involved in moving from mainframe to object-oriented programming. One migration approach is to move from mainframe to client-server to object-oriented programming.
- It is easy to be seduced by client-server’s upside functionality (e.g., GUIs) and not see the downside performance issues (e.g., volume, security, backup, recovery).
- Client-server favors creative people who can deal with ambiguity.

**Methodology and Tools**

- Function should drive tool selection.
- The development tool strategy should minimize the number of tools and maximize interoperability, within the context of architectural considerations.
- The development approach should follow the Lego paradigm (plug-and-play software components that “snap” together).
- Developers should watch for surprises by examining what the tools are really doing (i.e., demystify the buzz words).
- Volume is risky in client-server.
- Methodology always lags technology. Methodology can help prevent a major mistake but doesn’t guarantee success.
• Prototyping is a way to solve problems in a client-server environment quickly and help achieve business (and therefore I/S) success.

Discussion of Findings

The just-in-time research findings, though generalizable, are quite specific and practical. They provide a basis or guideline for making critical decisions.

Although these findings are qualitative in nature, participants rated the value they perceived they had received using a 5-point scale where 5 indicated extremely useful and 1 indicated little value. The score for the research effort was 4.8—a strong support of value added. Not only did these insights provide immediate value to participants, but they have also endured over time as useful principles for organizations beginning the transition to client-server technology today.

As further demonstration of the utility of the just-in-time research technique, additional areas of investigation were pursued. These included object-oriented technology, fast-cycle development approaches, and most recently, the prospects for electronic commerce over the Internet. For the sake of brevity, individual case history examples are omitted. A discussion of the findings for each area follows.

Just-in-Time Research Findings on Object-Oriented Programming

Together with client-server technology, object-oriented programming provides the best potential for a quantum leap in performance in systems delivery. Although object-oriented software construction principles were first laid out more than 25 years ago with the development of Simula, the first object-oriented language, the object-oriented approach is only now catching on among a broad base of commercial implementers. Our interest in object-oriented programming is ongoing in light of the rapid evolution of object-oriented technology. Consequently, a series of two separate just-in-time research studies were performed, based on a total of seven case studies. In fact, one of the initial findings was rejected in the second study, which illustrates the importance of performing just-in-time research on longitudinal basis using new case studies to evaluate the strength of the initial findings. Examples of some of the initial findings include:

• Mentoring is an essential part of an object-oriented training program.

• To attract the best personnel, object orientation must be applied to a meaningful project.

• Ideal opportunities for the introduction of object-oriented technology include domains that have not been addressed successfully in the past, or where there has been a long history of failure. This approach is likely to resonate with senior management better than migrating to object orientation for its technical superiority.

• To sell object orientation internally, an approach that recognizes the need to foster change from the top down and bottom up will yield the best results.

• Productivity comparisons of object-oriented projects versus traditional projects can quickly devolve into “apples and oranges” comparisons.

• For full-scale object orientation, technology and standards are not now on the critical path. What is on the critical path is the organization’s willingness to invest in and develop a proper business object model.

• In object-oriented modeling, it is useful to delineate inflexible structure from flexible elements, just as is true in conventional modeling.

• Good design is essential to success with object-oriented systems. The better developers are, the less they will subscribe to “religious” language debates.
Effective planning is required if object-oriented development is not to result in chaos.

Infrastructural planning is key.

Management buy-in for an extensive object-oriented infrastructure is difficult to achieve.

While exponential is definitely too strong a term to describe today's productivity gains, over time, improved reuse will yield substantial progress. In any event, reuse requires significant amounts of administration and planning.

The potential for reuse of existing software components—allowing software components to be built and recombined as though they were standard machine parts—was among the primary factors propelling interest in the object-oriented paradigm. However, subsequent to this initial meeting, the field experience of object-oriented implementers strongly suggested that initial expectations for reuse in object-oriented development were overstated. Consequently, among other recommendations having to do with technical object-oriented infrastructure, object-oriented training and mentoring and object-oriented modeling, the following insights regarding object-oriented reuse were made during our second session on object-orientation.

Reuse may be a good by-product, but it should not be the primary objective of object orientation. In any event, end users are unlikely to care much about it.

Practitioners are discovering that the object is not necessarily the ideal unit of reuse. Instead, less granular constructs such as the class or even application templates may be more amenable to reuse.

Regardless of the reality of reuse, management is expecting some positive impact on reuse due to previous market education about objects. Object-oriented developers must help readjust expectations.

These insights suggest that the use of just-in-time research on a repeated basis can be extremely useful for particularly rapidly evolving technologies as a way to hone insights further after the initial application of the just-in-time technique.

Just-in-Time Research Findings on Electronic Commerce

More recently, a group of approximately 50 information systems vice presidents and directors of systems development and systems delivery managers attended a forum on prospects for electronic commerce, which is an extremely fast-evolving subject that changes virtually daily. As was true in the client-server example, five case studies were presented by early implementers of electronic commerce strategies. Among the insights gained from the just-in-time research process were the following:

- There may not yet be a competitive advantage to have a home page on the World Wide Web, but there is definitely the fear of being at a competitive disadvantage by not having one.

- The success or failure of electronic shopping will depend on its ability to replace the human touch now critical in face-to-face and mail-order commerce.

- Except for brand identity, there is no sure way to verify that an electronic merchant is a legitimate entity.

- Because electronic commerce is not for all consumers, corporations will have to support dual infrastructures for electronic and traditional markets.

- Technical choices regarding infrastructure and communications between enterprises and between enterprises and their employees are not value-neutral—Architecture is politics.

- There is equal, if not greater, value in collaborating with firms NOT in one's
industry for electronic commerce initiatives. The primary reason is that people in the same industry tend to have the same strategic point of view. If their point of view goes unchallenged, they might get blindsided by an innovation they had not considered.

- To prepare for electronic commerce, organizations should develop clear policies about privacy.

These recommendations support the view that just-in-time research is ideal for tracking up-to-the-minute developments while laying the groundwork for taking effective first steps.

Conclusions and Recommendations

The just-in-time research method proposed offers utility for drawing initial conclusions about new organizational/technological phenomena. We were focusing on information technology, which could be used for any new technological or organizational phenomenon.

As mentioned in the introduction, the authors have used the research method successfully to assess a number of new technologies. In the case of object-oriented programming, the authors incorporated a longitudinal dimension by having a follow-up just-in-time research session, which allowed an adjustment to be made in one of the findings. Reliability was quite good. Only one finding required adjustments (i.e., initial productivity increases were adjusted downward.)

As for recommendations, the just-in-time research method could be enhanced by using Group Decision Support Software. Also, the findings generated from just-in-time research should be a good source of researchable issues using more traditional field and laboratory experiments and research designs.