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Organizing For the Effective Diffusion of Corporate Information Systems: Manage Project Scale and Scope

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Abstract

Incremental innovations reinforce the capability of established organizations, while radical innovations cause firms to develop new technical and commercial skills. In this paper, we will present the results of an exploratory study examining the technology diffusion process associated with eleven different systems initiatives in eight organizations and suggest that, in addition to the important distinctions the technology life cycle model provides, another useful perspective is that one differentiates the innovation based on its scale and scope. We will present the findings of this exploratory research and suggest that to successfully diffuse projects of different scale and scope requires the building of differentiated project selection processes and criteria, organizational structures and management involvement. As a first step in this process, we propose classifying R&D initiatives based on scale and scope and suggest that this classification will enable managers to identify and establish appropriate managerial and organizational processes that will facilitate the technology diffusion.

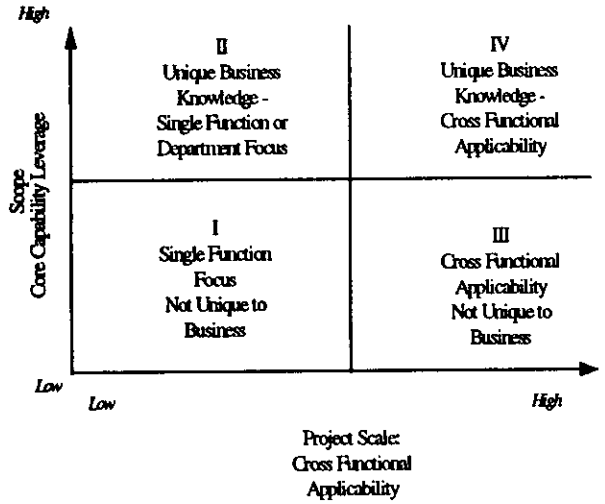
1. INTRODUCTION

The diffusion of a new technology is a complex process that has been usefully described applying a life cycle model to track the stages of the innovation's development, growth, maturity and eventual decline (Rogers and Shoemaker 1962). An outgrowth of the life-cycle model has been the differentiation of innovations based on whether they represent a radical new idea, and thus a new life-cycle, or whether an innovation is an incremental improvement building on existing technology (Henderson and Clark 1990). The motivation for distinguishing between radical and incremental innovation has been the clear evidence that the organizational capabilities required for each differ sharply (Nelson and Winter 1982; Mansfield 1977; Utterback 1994). Incremental innovations reinforce the capability of established organizations, while radical innovations cause firms to develop new technical and commercial skills.

In this paper, we will present the results of an exploratory study examining the technology diffusion process and suggest that, in addition to the important distinctions the technology life cycle model provides, another useful perspective is one that differentiates the innovation based on the dimensions of scale and scope. Drawing on the work of Leonard-Barton (1988) and Katz and Shapiro (1986), we use *scale* as a measure of the multi-department applicability of an innovation as well as a measure of the technology's "network externality" (Katz and Shapiro 1986), that is, the degree to which an organizational subunit's benefit is dependent on adoption throughout the organization. We use *scope* as a measure of strategic focus (Porter 1990; Quinn 1992) and the degree to which the innovation leverages the unique core competency of the firm. We have applied these two parameters to construct a conceptual framework to guide this exploratory research (see Figure 1). Our findings suggest that the organizational capabilities required for successful technology diffusion are strongly influenced by the scale and scope of the innovation just as they are by its life cycle stage.

We began our investigation of technology diffusion strategies by studying eleven different systems initiatives in eight organizations. The sample was drawn by convenience and the research undertaken through the cooperation of academics and practitioners who focused on the problem of identifying organizational processes and procedures that would promote technology diffusion.

In this paper we will present the results of the research and a synopsis of three case studies that represent the range of different initiatives that we examined across the two parameters of scale and scope. We will then map the case studies onto this conceptual framework and attempt to address some of the issues associated with choosing an appropriate technology transfer strategy within the constraints of the technology's characteristics and the organizational context.



Dimensions Defined:

Scope

1. Core Business Knowledge Leverage: Does the application support unique business capability? Or does it support a core competency or strategic purpose (Porter 1990; Quinn 1992)?

Scale

2. Cross Functional Applicability: Does the application affect multiple functions or business units (Leonard-Barton 1988)? Or does a major benefit of the innovation derive from use by other subunits or network externalities (Katz and Shapiro 1986; Fichman and Kemerer 1993)?

Figure 1. Defining the Dimensions of Scale and Scope

2. BACKGROUND RESEARCH

Building on the work of several researchers (Rogers 1983; Kimberly 1981) who noted the distinction between understanding the technology transfer and diffusion process within organizational settings and the process of technology adoption by individuals, Leonard-Barton examined the implementation characteristics of various technologies and the impact of these characteristics on the implementation strategies available to managers. She noted that "within an organization, individuals' innovation responses are highly influenced by the way that implementation is managed. However, managers operate within parameters set by the technology's implementation characteristics." Her findings indicate that an innovation's complexity as measured by "the number of people affected by the introduction of an innovation and the number of different organizational subunits that the innovation cuts across" increases the challenges faced by managers in choosing an implementation strategy.

Fichman and Kemerer (1993) used similar distinctions when describing the process of technology transfer for software process innovations. They note that researchers have typically studied the adoption decision of individuals or organizations without taking into account the network effects of process innovations that cut across organizational boundaries or require the coordination of many subunits. Such innovations are frequently subject to the phenomenon described by economists as "network externalities" or "increasing returns to adoption:"

> Increasing returns to adoption means that the benefits of adopting an innovation largely depend on the size (past, present, and future) of the community of other adopters...(the classic example here is the telephone network). [Fichman and Kemerer 1993]

In such circumstances, the attributes of the innovation, however preferable, may not be enough to guarantee its diffusion. Fichman and Kemerer, drawing on the work of Arthur (1987) and Farrell and Saloner (1987), suggest that the introduction of a new technology can overcome this impediment through strong sponsorship.

> Sponsors can tip the cost benefit equation in favor of the new technology by actively subsidizing early adopters and by setting standards that ensure that a single network will emerge around the new technology instead of a pastiche of smaller, potentially incompatible networks.

Sponsorship is defined by economists as "making investments in the form of penetration pricing to establish technology so that such investments can later be recouped by pricing in excess of marginal costs" (Katz and Shapiro 1986). Leonard-Barton notes that sponsorship requires the "concentration of power necessary for breaking stalemates among the various subunit participants."

3. CLASSIFYING INFORMATION SYSTEMS PROJECTS FOR EFFECTIVE TECHNOLOGY TRANSFER STRATEGIES

In this study, we wanted to determine if organizations used identifiably different technology diffusion strategies based on the complexity of the innovation which we measured using the scale and scope variables as previously defined. To address this issue, we framed the following two research questions:

1. Do technology transfer strategies coalesce around systems initiatives based on determinants of scale and scope?

2. For process oriented technologies that have the potential to affect multiple business units or are likely to benefit from increasing returns to adoption, is there an observed behavior of strong sponsorship?

We examined eleven unique information technology initiatives focusing on the process of technology diffusion in eight different organizational settings. We developed case studies using structured interviews as well as more open-ended discussion questions. In each of the cases, a face-to-face or telephone interview was conducted with at least two participants. The interviews and subsequent analyses were extensively reviewed for accuracy and inclusiveness. The methodology was chosen as most appropriate for gaining rich information on dynamic processes. As Yin (1984) noted, "The ability to conduct six to ten case studies arranged effectively within a multiple-case design is analogous to the ability to conduct six to ten experiments on related topics." The methodology also directly builds on the work of Leonard-Barton, who studied fourteen cases in examining implementation characteristics of various technologies within organizational settings and the impact of these characteristics on the diffusion strategies available to managers.

The following section presents a summary of three cases that exemplify the differences that we found both in the scope and scale of the projects and in the technology transfer processes and structures embedded in the organization.

4. THE CASE STUDIES

4.1 Case #1 — Trading Partners Inc.

The Application: Trading Partners Inc., an international brokerage house, began in 1988 with the vision of one of the senior traders to make voice recognition a modality for data entry for trading applications. The first prototype was developed in January of 1988, and installed in the Fixed Income area. After some additional modifications, the technology was successfully deployed using handsets on traders' desks.

Project Selection Process: Trading Partners Inc. has a formal project selection process that begins with soliciting project ideas from line managers. These ideas are then evaluated using the following criteria.

1. Invest in technologies that are somewhat later than "emergent" in their life cycle when a demonstration prototype can be built.

2. Move quickly to develop a working prototype that can be put out in the business to provide feedback on what real problems are occurring and how they might be solved. If it can't be used in a year, it is abandoned as too immature or not appropriate for the environment. (Handwriting Recognition is an example of a technology that was evaluated as too immature to be effectively deployed within a 12 to 18 month time frame.)

3. Develop in-house technical expertise so that proprietary knowledge can be retained in-house and not reside with a vendor or consultant.

4. Work with analysts and modelers during the process so that hand-off to operations can be accomplished more easily. The system must be able to be supported within the existing infrastructure.

5. Focus on the specific needs of the business and what makes money within 12 to 18 months for an operating unit. A review committee composed of senior managers reviews project proposals and makes the final selection.

Structure of IS and Line Management Interaction: At Trading Partners Inc., IS is housed within the Trading Services Group which supplies a range of operational, technical and systems support to specific line departments within the company (see Figure 2). This represents a "grouping by customer" (Nadler and Tushman 1988) approach that fosters a close working relationship between line managers and the IS group.

Process of Deployment and Technology Transfer: Because of the customer focus grouping of the IS function within Trading Services, members of the project team described themselves as having "two bosses" on any given project, the senior vice president for the business unit (e.g., Fixed Income) and the senior vice president of Trading Services. Because the project selection criteria emphasize choosing a low risk technology (i.e., the technology can not be "emergent") with a relatively quick payback (return on investment within 12 to 18 months), the technology transfer process occurs quickly and within a specified period of time. In terms of the framework, Trading Partners' technology diffusion process focuses on supporting those innovations that are narrowly focused in terms of scale and also in terms of scope. That is, the project selection criteria emphasize choosing a technology that directly leverages the core competency of the firm and is not dependent on cross departmental implementation or a standardization of platform in order to realize benefit. The project selection process, the structure of the MIS/line relationship and the technology hand-off to the operating department all work together to insure success in developing, transferring and deploying this particular type of focused information technology initiative. The diffusion process is largely driven by the innovation's ability to demonstrate a business benefit in a fairly short period of time.

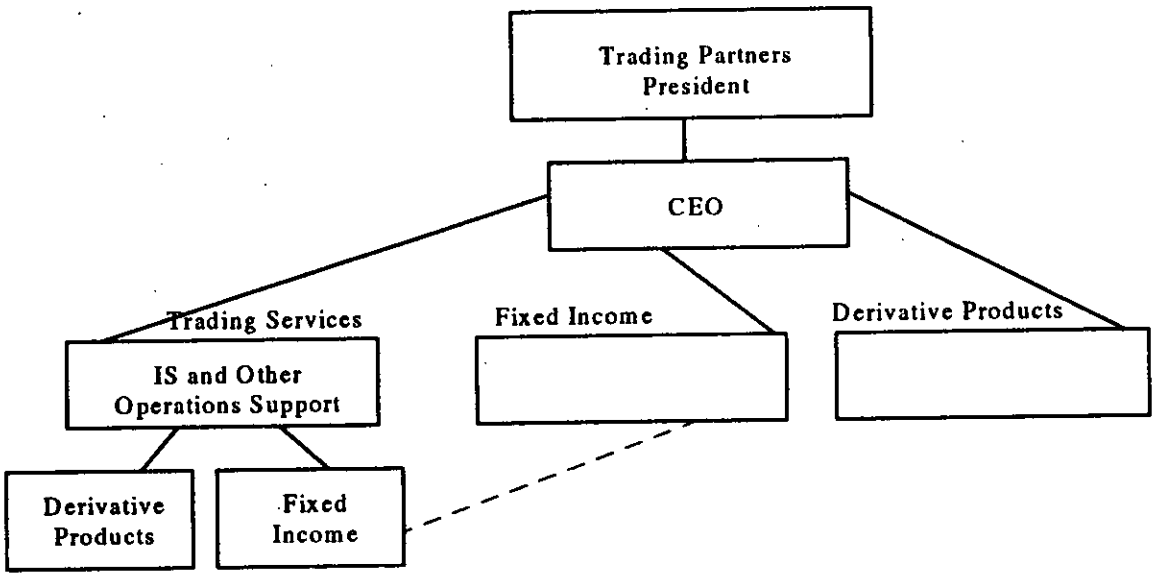


Figure 2. Trading Partners Inc. Organizational Structure

4.2 Case #2 — Connecticut Mutual Life Insurance Company

The Application: The Connecticut Mutual Life Insurance Company embarked on a major business reengineering effort enabled by the creative use of information technology including image processing, expert systems and networking. Beginning in July of 1990, the company articulated a vision that Connecticut Mutual would present "one image" to clients, agents and associates through the use of a "command center" workstation that would provide on-line access to customer-based rather than product-based information.

The Project Selection Process: The primary objectives of Connecticut Mutual's top management were reduction of operating expenses and improvement of service. The goal of the MIS area was to shift the focus from system maintenance to system development while reducing response time and cost to the users. The senior VP of Individual Life Insurance was the sponsor of the One Image project and described the situation at Connecticut Mutual this way:

> Life insurance products were becoming increasingly complex to administer. The fact that we are in a business with shrinking profit margins required us to find a better way to do business. Automating existing processes just doesn't achieve permanent savings. We had to rethink the way we do business. The other reason was that we decided that we really wanted a customer focus and to look like one company, not fifteen little separate ones to our customers.

Structure of IS and Line Management Interaction: Implementing the One Image project required changing the structure of the IS organization. The first step was to consolidate all the software programmers, architects and developers into one division called Business and Technology Solutions. By taking this action, Connecticut Mutual created a core of technically skilled people who could build expertise and reinforce each others' learning as the company began its reengineering effort and the process of uniquely combining imaging, databases and networking into the information systems architecture. In Nadler and Tushman's terminology, this was "grouping by project" where individuals with a variety of technical skills were brought together to focus on creating the technical backbone of the One Image project. At the same time, management created cross-departmental project development teams staffed with both business and IS professionals whose job was to focus on the business and systems requirements to reengineer particular business processes: "grouping by process."

Process of Deployment and Technology Transfer: The first step in planning the reengineering effort was to establish a cross-functional committee of senior executives who met at least twice a week for two hours to set policies and make decisions around business goals and areas of responsibility. One Senior Vice President described the importance and necessity of this initial step:

> The horizontal changes required by a reengineering effort are cross functional and cross departmental and for them to be successful, an attitude of cooperation among the heads of the departments was required. If

> we have a problem, the three of us [Senior VPs] discuss it and are willing to give up a territorial attitude so that problems can be resolved. For example, we had to decide whether we wanted reinstatements as part of pre-sale or post-sale support, that is whether it would be the responsibility of customer service or of the underwriting departments. Currently both departments are doing reinstatements, and they will be combined. It means that people have to give up the traditional view of themselves as getting promoted by virtue of how many people they have reporting to them.

The initial objective was to fully implement command center functionality in one department and have a quick success. It was decided that the installation should take place in a department that was highly visible and critical to the servicing of clients. An early analysis of business processes identified the Check Services Department for the first installation. The Check Services Department is where payments for policies can be made automatically using electronic funds transfer from the client's checking account per written authorization from the client. The impact to the client and unit cost reductions were the basic criteria for the selection of this department as the first site.

The success of this system was dramatic: reducing the backlog from three weeks to two hours and greatly improving the quality of customer service. The success in Check Services created pressure to expand the new system, since other non-image departments were no longer able to share documents with the Check Services Department. The result was the beginning of re-engineering in five business groups almost immediately after the Check Services Department installation started.

In this case the technology diffusion process began with organizational restructuring. Business returns required that a critical mass of users be established and, as Fichman and Kemerer suggested, this required strong sponsorship, with a "concentration of power required to break stalemates" (Leonard-Barton 1988). This was accomplished through the establishment of the cross-functional committee of senior executives who met on a weekly basis. In terms of the framework, this innovation affected multiple departments and, as the Check Services example demonstrates, major benefits were to be derived from the networking and standardization that would occur as the initiative spread throughout the company. This was an innovation that we ranked highly on both scale and scope measures: it is very high in supporting the core competency of the business and very high as an increasing returns to adoption innovation.

4.3 Case #3 — Worldwide Mutual Funds

The Application: Worldwide Mutual funds is a diverse financial services company. The company's key competitive strengths are an expertise in investment management and solid customer service within a context of prudent cost control. This case describes a customer service initiative called the "audio response system" which provides customers with touch tone access to information about account balances and daily price closes and allows them to execute transactions on their accounts. The system's objective is to help automate some of the customer service functions previously handled by customer service representatives. By integrating Worldwide's "800" telephone system with a sophisticated computer system, the company supplied customers with information automatically. The system allowed easier access to information and the convenience of twenty-four hour service while enabling customer service representatives to spend more time with individual customers addressing more complex account needs.

The Project Selection Process: Worldwide's strategy is to be customer rather than technology driven. Their technology strategy is to be a "fast follower" rather than a leader in their use of technology, preferring to evaluate the success of new technology initiatives in other companies before investing. Accordingly, project selection criteria reflect the company's desire to implement technology solutions that are late enough in their life cycle for outsourcing to be a viable option while still providing a return on investment. Worldwide's project selection criteria in terms of business benefit and time frame were very similar to those used by Trading Partners.

Structure of IS and Line Management Interaction: The in-house IS organization at Worldwide consists of one manager and eight professionals who work closely with line managers in helping them define their technology needs. As in the Trading Partners case, the IS function is also part of a larger organization called Mutual Funds Services which provides a wide variety of operational and technical support to Customer Service and Mutual Funds managers. However, because of Worldwide's technology strategy to be a "fast follower," the company has concentrated its resources on identifying and managing the integration of outsourced systems rather than on developing in-house expertise in specialized areas of application development and support.

Process of Deployment and Technology Transfer: The Audio Response system was developed for Worldwide by an independent vendor who provided a turnkey solution for Worldwide both in terms of hardware and software. The system provided an "800" number with an audio response for customers desiring answers to simple inquiries regarding fund prices and yields. Customer adoption was overwhelming. Within a month, Worldwide doubled call handling from 5,000 to 10,000 calls per week. Customers enjoyed the simplicity of the system and the availability of twenty-four hour service (see Figure 3 for a schema of the system).

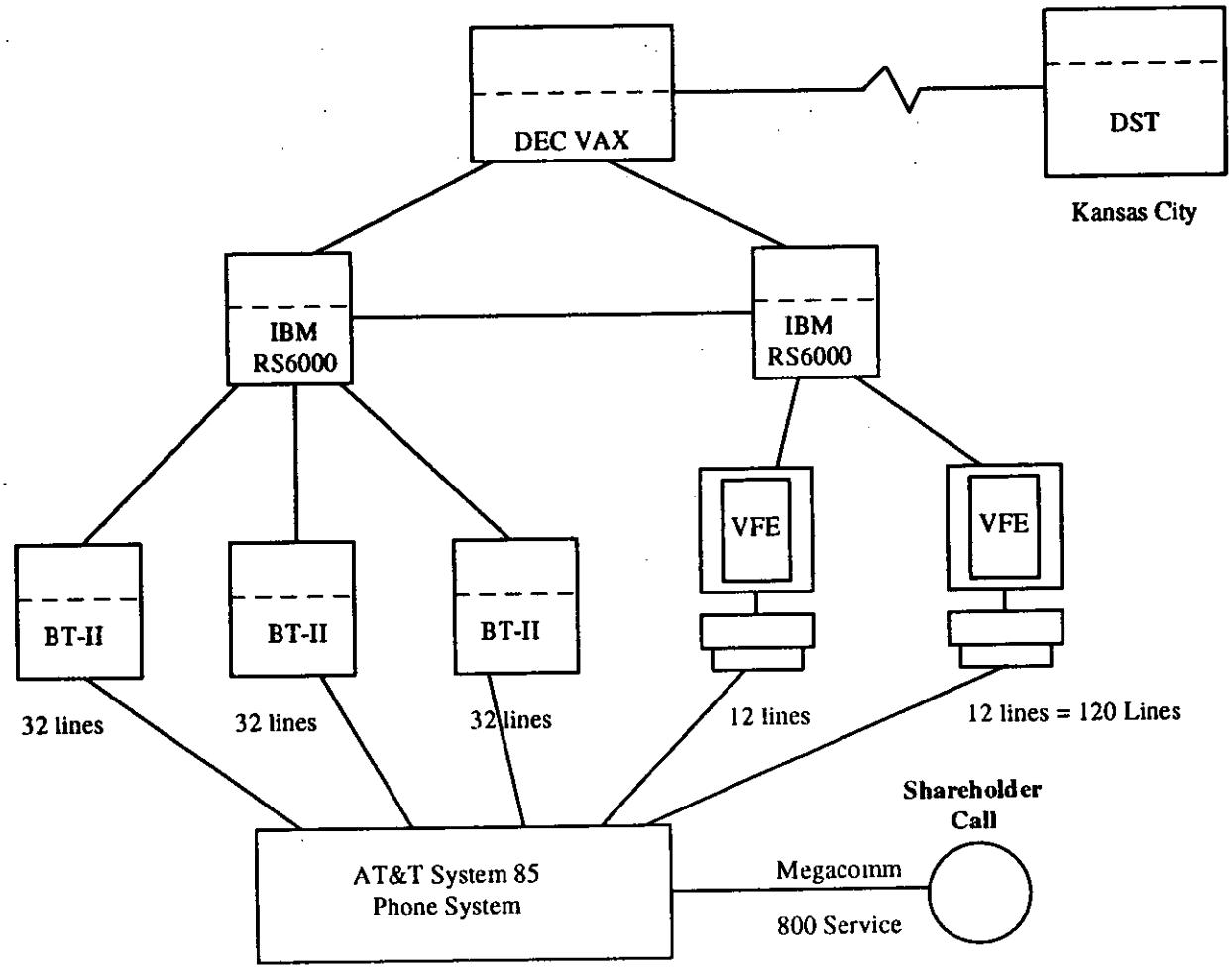


Figure 3. Audio Response System at Worldwide

This was an initiative that had potential for "increasing returns to adoption" in that the company's several different mutual funds would likely have benefited from an integrated audio response system while the management of such a system would have been facilitated by standardization. Yet there was no evidence of strong top management sponsorship or aggressive technology push activities such as those described in the Connecticut Mutual case. Worldwide's technology selection criteria and its diffusion process more closely mirrored that found at Trading Partners.

Three principal characteristics differentiated Worldwide's infrastructure investment from that of Connecticut Mutual. First, the audio response system was late enough in its life cycle that industry standards had been established and the development of an integrated network was possible even if initiatives in other sections of the business were launched separately. Second, and partly due to the existence of such network standards, the audio response system could be implemented in a piecemeal fashion that allowed for a smaller scale trial of the technology. This characteristic of "divisibility," which includes the ability to implement a technology in stages or segments each of which delivers some benefits, even if no further segments are adopted, was found to offer greater opportunities for effective implementation design and was highly correlated with successful technology transfer in Leonard-Barton's study. Third, the audio response system was not at the core of Worldwide's business and thus while it offered opportunities for improved customer service, it was not part of a larger organizational change effort and did not require the level of sponsorship found at Connecticut Mutual.

5. MAPPING THE CASE STUDIES TO THE FRAMEWORK: EXAMINING THE RESEARCH QUESTIONS

Applying the scale and scope measures, we mapped the various technology initiatives onto the framework to construct the quadrants shown (see Figure 4) and to use these as groupings in assessing the original research questions. (A brief description of the eight other case studies not detailed in the body of this paper is included in the appendix). To address these questions, we constructed the following tables listing some of the principal project implementation characteristics.

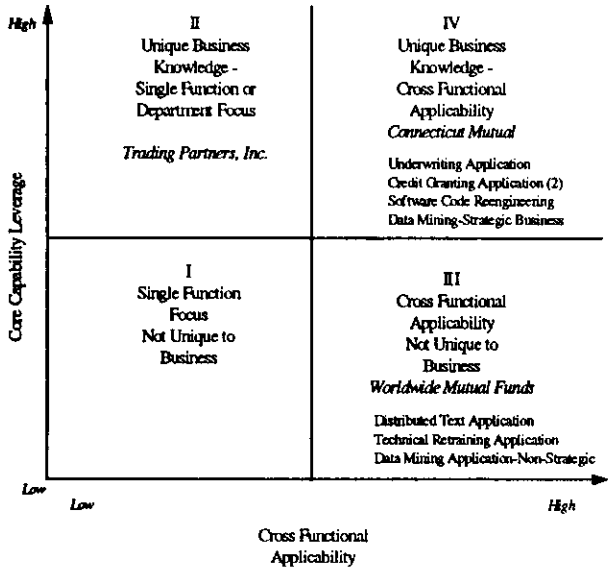


Figure 4. Classifying Information Systems Initiatives: The Case Studies

The project selection criteria and the estimated time for project completion (Time Frame) were obtained from the project request proposals in all cases except for Connecticut Mutual and Lincoln Underwriting, where the criteria and time frame were obtained from conversations with project managers and systems users. The technology initiatives were judged as having increasing returns to adoption based on the original proposal's justification and the belief of project managers that funding for an initial pilot would provide the basis for future implementation efforts in other units of the organization.

In assessing the stages of diffusion completed, we drew on the work of Rogers and Shoemaker to define the stages of implementation as shown in Figure 5. Agreement on these definitions and the level of diffusion success for each of the initiatives was obtained through discussions with business unit managers, technology managers and in some cases corporate funding managers. In cases where assessments of diffusion success differed, these were noted as "mixed reviews."

In identifying the principal diffusion strategy for each of the initiatives, we categorized the "organizational pull" strategy as one where adoption of the technology beyond a pilot stage is dependent on the individual adoption decisions of other business unit managers who perceive a strong enough comparative advantage over existing technology to invest in the innovation. This is the classic diffusion of innovation model and mirrors the S-curve adoption function tracked by sociologists (Rogers and Shoemaker 1962) and shown in Figure 4. In addition, we noted another diffusion strategy "parallel development," where two or more business units were given funding to develop technologies and adapt them to a particular organizational setting. The parallel development strategy enabled a sharing of costs and risks and was undertaken in cases where it was assumed that a number of business subunits would benefit from the adoption experiences of more than one unit. In addition, we observed some cases where a diffusion strategy included setting up a separate group or spin-off company to focus on the project exclusively.

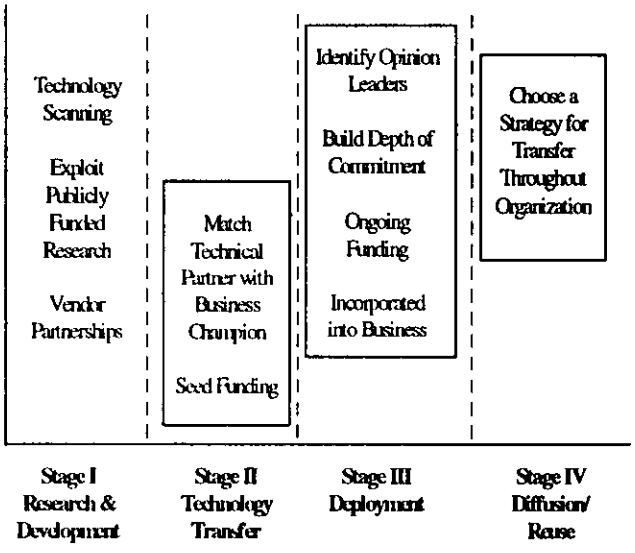


Figure 5. Stages of Internal Technology Transfer, Deployment and Diffusion

Finally, we examined the organizational structure and reporting relationships of IS professionals within each of the projects and mapped how these fit into the overall implementation strategy of each initiative. The tables on the following page show the results of this mapping.

6. EXAMINING THE RESEARCH QUESTIONS

1. Do technology transfer strategies coalesce around systems initiatives based on determinants of scale and scope?

What do the research findings tell us about technology diffusion strategies? First since this was an exploratory research study with a limited sample size, our findings must be viewed within the context of hypothesis generation rather than traditional hypothesis testing. Given this caveat, our results do point to patterns of organizational structure, project selection criteria and management behavior that appear to be associated with the definitions of project scale and scope developed from the literature. Our research would seem to indicate that firms who are successful at diffusing new technologies do apply different technology transfer and diffusion strategies based on scale and scope.

Table 1. Quadrant II Project Characteristics

System	Project Selection Criteria	Time Frame	Increasing Returns to Adoption	Diffusion Stages Completed	Diffusion Strategy	Diffusion Success	Org. Structure/ Technical Specialists
Trading Partners	ROI	12 to 18 months	No	II, III	Org. Pull	*Yes*	Group by Customer

Table 2. Quadrant III Project Characteristics

System	Project Selection Criteria	Time Frame	Increasing Returns to Adoption	Diffusion Stages Completed	Diffusion Strategy	Diffusion Success	Org. Structure/ Technical Specialists
Technical Retraining	Feasible Concept	12 to 18 months	Yes	II	Parallel Development	*Yes* — in one unit — not diffused to others — Mixed Reviews	Multi-Foci Groups
Non Mining Non-Strategic	Feasible Concept	12 to 18 months	Yes	I	Org. Pull	*No* — Not used	Group by Function
World-wide	ROI	12 months	Yes	II, III	Org. Pull	*Yes* — spread to other apps.	Group by Customer
Distributed Text	Feasible Concept	12 months	Yes	II (plans for III)	Parallel Develop.	*Yes* — to Feasibility — not diffused	Group by Function

Table 3. Quadrant IV Project Characteristics

System	Project Selection Criteria	Time Frame	Increasing Returns to Adoption	Diffusion Stages Completed	Diffusion Strategy	Diffusion Success	Org. Structure/ Technical Specialists
Connecticut Mutual	Strategic Business	Long Term	Yes	II, III, IV	Campaign Mgt.	*Yes* — multiple instances	Multi-Foci Groups
Underwriting	Strategic Business	Long Term	Yes	II, III, IV	Spin-Off Separate Co.	*Yes* — industry standard	Group by Output
Credit (1)	ROI	24 months	Yes	II	Org. Pull	*No*	Group by Function
Credit (2)	ROI	18 to 24 months	Yes	II, III	Org. Pull	*Yes* — one area — Mixed Reviews	Group by Function
Software Code	Strategic Business	Long Term	Yes	II	Separate Group	*Mixed Reviews*	Group by Output
Data Mining Strategic	Strategic Business	12 to 18 months	Yes	II, II, IV	Campaign Mgt.	*Yes* — redefined business strategy	Group by Output

The Trading Partners application is a classic example of the "organizational pull" diffusion associated with the DOI perspective described by Rogers and Shoemaker and Fichman and Kemerer. That is, a "niche" technology that is principally dependent on the attributes of the innovation for its adoption. In this case, the project selection criteria were based on screening potential technologies that were beyond the emergent stage of their life cycle and with a high probability of return on investment. The organizational structuring of the technical specialists grouped by "customer focus" was a key characteristic in successful project selection and implementation. The group by customer organization was also found at Worldwide Mutual funds where the audio response system, although an infrastructure and increasing returns to adoption initiative, was viewed as an innovation whose adoption by the organization was driven by its ability to provide a return on investment. The organizational pull approach coupled with the group by customer structure of technical was made possible by modularizing the technology and implementing it in subunit segments.

A modular approach was also chosen for other Quadrant III initiatives, but in no other case were these coupled with a group by customer organizational structuring of specialists. The "group by customer" approach would seem to be an effective organizational design for those initiatives that are viewed as traditional DOI "organizational pull" innovations. This finding is consistent with research done by Blanton, Watson and Moody (1992). They examined the long term support and maintenance of systems in operating business units and found that

> Locating IT groups that provide personalized IT support with groups that provide other types of personalized support to office workers is more effective in providing service and support than centralizing such groups within a separate department.

Project selection criteria that focus on short term and visible results are also consistent with the DOI perspective described in the literature.

Project selection criteria and the organizational structure of technical specialists was found to be very different for Quadrant IV innovations that were both at the heart of the firm's core competence and subject to increasing returns to adoption. The project selection criteria in all but two of the Quadrant IV projects was driven by an articulated strategic business need. The two Credit applications that were identified as Quadrant IV projects and undertaken with an ROI perspective were also the least successful in diffusing throughout the organization. In three of the Quadrant IV applications, Connecticut Mutual, The Lincoln Underwriting System and the Software Code reengineering project, a much longer time horizon was proposed for review of the initiative's success.

The organizational structure of technical specialists also was found to be different from those organizational pull innovations described earlier. In no case did we find the grouping by customer that facilitated the DOI innovations found in Quadrants II and III. Instead we found evidence that in the three cases where diffusion had moved into stage IV (Connecticut Mutual, Lincoln Underwriting and Data Mining-Strategic), technical specialists were either grouped by output or, in the case of Connecticut Mutual, grouped by output as well as process.

2. For process oriented technologies that have the potential to affect multiple business units or are likely to benefit from increasing returns to adoption, is there an observed behavior of strong sponsorship?

We did find evidence of strong sponsorship for those initiatives that had strategic value. We also observed two distinct types of strong sponsorship actions. The first, campaign management as described in the Connecticut Mutual case, is focused on diffusing an innovation across several business units to fundamentally change both the technical and organizational process of doing business. The second approach is illustrated by the Lincoln Underwriting case and the Software Code Reengineering project. In both of these cases, a spin-off firm was created with the idea of influencing industry standards at the same time that the innovation was being tested within the parent organization. This would appear to be an approach that allows a company to hedge its bets while still pursuing the deployment and diffusion of a process innovation that might provide substantial strategic benefits to the firm. As Fichman and Kemerer note, "the primary risk associated with early adoption of technologies is being stranded on a technological 'spur' away from the main track of technology development." The spin-off approach creates a vehicle for marketing the new idea to the industry and at the same time allows the parent company to work with its spin-off in a kind of Stage I R&D partnership, reaping the benefits of being early in the cycle while keeping an eye on how fast standards are changing within the industry so as not to be "abandoned" if the technology fails to catch on.

The "increasing returns to adoption" dimension, which is represented by our horizontal dimension "cross functional applicability" did not appear to be as dominant a determinant of strong sponsorship behavior as our vertical dimension, core capability leverage. Looking at the systems outlined in Figure 4, all those in Quadrants III and IV exhibit the characteristics of process innovations subject to increasing returns to adoption. Yet, no strong sponsorship strategy was observed in any of the Quadrant III applications. Only those applications that were viewed as contributing to the company's strategic goals merited extensive executive involvement and sponsorship. Perhaps the best example of this comes from the Data Mining case, where two business units in the same company worked together on the

development of the technology, but only one — the one that perceived the greatest competitive advantage — actually deployed and diffused the technology using a campaign management style of executive involvement and diffusion. This is consistent with other findings, specifically Leonard-Barton, who describes the failure of a gelatin processing innovation in this manner:

> Although Solagen was faster and offered superior process control and quality predictability, these attributes were not valued enough to warrant the organizational and technical changes required for implementation of the new process....the Solagen process could not be linked to any currently important programs of change.

Given the description in the Connecticut Mutual case of the depth of commitment required to replace an existing technology and business systems infrastructure, it is not surprising that companies would only engage in this level of effort to secure strategic advantage or respond to a significant threat. The Connecticut Mutual case also reveals the organizational corollary of software process innovations: the parallel need for fundamental procedural and business process redesign. This may also help to explain why seemingly advantageous process innovations, such as client server architecture or object oriented programming simply don't get the strong sponsorship required for their success. The relentless "campaign" management required to push standardized process oriented innovations across the organization is simply too costly in human and financial resources to merit investment without a perceived "blockbuster" return. In economists' terms, "making investments in the form of penetration pricing to establish technology so that such investments can later be recouped by pricing in excess of marginal costs" (Katz and Shapiro 1986). This would seem to suggest that innovations that require network externality must be intimately linked with the firm's ability to achieve competitive advantage. The exception to this is the use of a modularization strategy as evidenced by Worldwide Mutual Funds. In such instances, infrastructure investments that can be segmented to achieve benefit in one unit or phased in over time while achieving some measurable benefits at each stage offer managers a wider range of implementation strategies and options.

7. CONCLUSIONS

The technology transfer, deployment and diffusion strategies we observed differed widely even across our small sample as did the organizational structure of MIS and other technical support groups. However we did identify patterns of organizational structure, diffusion strategies and project selection criteria that were associated with the scale and scope of innovations. First, DOI perspective innovations whose diffusion is largely driven by the innovation's ability to demonstrate a business benefit in a fairly short period of time can be supported through:

1. Project selection criteria that focus on short term identifiable results and exclude very emergent technologies.

2. An organizational structure of technical specialists that is "grouped by customer" and focused on customer satisfaction rather than the building of technical expertise.

3. A project selection process that requires buy-in and budget responsibility by line management facilitates the transfer and deployment of these projects.

For those initiatives that leverage the core competence of the firm and benefit from adoption from other subunits or require network externalities, strong top management support is required and the initiative is likely to be diffused more rapidly with a "campaign management" or spin-off approach than through the organizational pull approach described for traditional DOI innovations. Because these innovations are large scale, the firm needs to organize at least some technical specialists who are focused on project outcome rather than on business unit performance. Finally, for the strategic business applications that we examined, a longer time frame for evaluation and a broader set of outcome criteria were developed than for those projects that were more limited in scope.

A strategy to combat this is divisibility. As noted from Worldwide Mutual Funds, breaking the innovation down so as to have it adopted in an organizational pull approach allowed for a less risky implementation strategy. As Leonard-Barton notes, "In the 14 cases observed, technology was more successfully transferred to users, when the potential for divisibility existed and was recognized, encouraged, and used as a foundation for implementation process design."

Organizations clearly have an interest in developing the internal capability to successfully transfer, deploy and diffuse a wide range of technology initiatives throughout the organization. Our research indicates that to do so may require the more explicit building of differentiated project selection processes and criteria, organizational structures and management involvement. As a first step in this process, we propose classifying R&D initiatives based on the scale and scope framework described in this paper and then linking the appropriate managerial and organizational processes required for effective diffusion.

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Appendix
Summary Descriptions of Cases

1. **Trading Partners Inc.** (Described in the text.)

2. **Connecticut Mutual** (Described in the text.)

3. **Lincoln Underwriting Application**: The Lincoln National Risk Management (LNRM) underwriting application is an example of an information systems initiative that lead to the development of a spin-off business. Lincoln National is one of the country's major reinsurance companies and as such has developed considerable expertise in underwriting due to the fact that they are the "insurance company's insurance firm." Lincoln National, using its underwriting expertise, considerable systems experience and the vision of its senior medical director, was able to develop an underwriting expert system and establish a separate subsidiary to market the product to other insurance companies. Rather than keeping the system as a proprietary in-house application, Lincoln launched a new business that sought to change the standards for all of underwriting within the life insurance business. In this sense, the spin-off company works with Lincoln Life as a partner in the R&D stage of the diffusion process, and has chosen to actively transfer the technology across the industry rather than focusing exclusively within their own company.

4. **Credit Granting Application (1) — Credit Authorizer:** The credit assistant (CA) application was developed using expert systems technology to incorporate key credit rules. Development required the partnering of technical and business people who were separated geographically. The geographical separation of the key units complicated the process and contributed to the difficulty of achieving a standardized development process, consistent level of support and maintenance. Additionally, the systems group did not appear to have the right mix or level of technical skills to take on the full support of the project once the application had been deployed. Organizationally, there seemed to be little incentive for systems support personnel to change in ways that would have been required to achieve the desired level of internal support. This initiative demonstrated the technical feasibility of the system, but failed to be fully deployed into the operation of the business.

5. **Credit Granting Application (2) — Credit Authorizer New Accounts:** New Accounts is an R&D project currently at the deployment stage. The time frame for the project has been approximately one year. Part of the development success of this project is attributed to the fact that the interested parties were co-located within the same city. The development people have been eager to acquire new skills and have received the support of their managers to change. Such line management support and a willingness to fund the project has led project managers to be hopeful that, as the project progresses toward full deployment, the internal systems group will be ready to step up to the challenge of ongoing support and maintenance.

6. **Software Code Reengineering:** The overall goal of this project is to replace the existing computing infrastructure and put in place a new architecture that will allow the company to be more responsive to customer's needs for tailored services and at the same time reduce the cost of processing.

   The Software Code Reengineering Project consists of two main components. The structural component entails changing the actual configuration of the computer/information system(s). The software component addresses the shift from having programs and utilities written in procedural languages (specifically COBOL) to those generated by CASE tools in object-oriented languages/environment.

   Ultimately, systems programs and utilities will be designed and implemented using CASE tools. In the meantime, existing programs and utilities in the "old" system will be ported over to the "new" system through the use of Reverse Code Engineering. This company has considered, if the project is successful, creating a spin-off company to sell this process within their industry. Throughout the development phase, a special unit has been organized and "grouped by outcome" to focus solely on getting this project completed. Progress has been slow, however, and the project has fallen behind schedule several times.

7. **Technical Retraining:** Originally, retraining efforts across the various business units of this multinational company focused largely on enrolling staff in classes in new technologies rather than transitioning information systems professionals from traditional mainframe systems development to a distributed environment. However, it soon became apparent that workforce

retraining required an approach that would go beyond specific training classes to support continuous learning for personal and professional development. Within this context, the retraining team focused on creating a skills development methodology that could be applied across technology platforms and business units.

The "Retraining Strategies R&D Project" was jointly funded by corporate R&D budgets and four operating units. The project had two distinct phases. Phase I focused on the development of a widely applicable retraining methodology; Phase II concentrated on testing the methodology within the context of improving distributed systems skills. Phase I was completed and one operating unit has been testing the methodology.

8. **Distributed Text Management Systems:** The Distributed Text Management System R&D Project was spearheaded by one business unit with the participation of two others. The project spanned fifteen months beginning in 1992 and was just completed in March of 1993. The main objective of this project was to develop a distributed text management capability that could be used to link field and home offices. This objective was clearly met. The project team was able to integrate existing, albeit new, software from outside vendors to provide this capability. Feasibility was demonstrated and the next phase of the project involves deploying within the separate business units.

9. **Data Mining: (1) Non-Strategic Business Application:** "Prospect Modeling in Parallel" is the name given to the research and development project designed to utilize neural networks in conjunction with massively parallel computers as a means of improving target marketing and enhancing prospect modeling. Prospect models are used to determine potential purchasers of goods and services from a prospect list or data file. This project was designed as a marriage of two complementary technologies into a single competitive marketing product. The project was developed using resources from two business units and rapidly moved through the feasibility stage and into the transfer state. However, only the business unit (described below), who saw the application as contributing to a strategic advantage moved aggressively to fully deploy and diffuse the technology. In the "non-strategic" business unit, the technology was never implemented.

10. **Data Mining: (2) Strategic Business Application:** With the assistance of a partnering business unit, the "Prospect Modeling in Parallel" was demonstrated as a viable concept. The CEO of this business unit was at first very skeptical, but once he saw that this technology could provide his company with a strategic advantage in garnering customers, he quickly moved to fully deploy and diffuse the technology throughout the business. This unit is now enjoying a price premium in its market due to this technology.

11. **Worldwide Mutual Funds** (Described in the text.)