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GAINING AND SUSTAINING LONG-TERM ADVANTAGE USING INFORMATION TECHNOLOGY: EMERGENCE OF CONTROLLED PRODUCTION

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Abstract

This paper summarizes case studies comparing leading Japanese and US firms’ use of software to gain competitiveness. It concludes several Japanese firms are world-class information technology users, sometimes ahead of US counterparts. Further, these Japanese and US users do not reorganize or reengineer to employ software. Rather, they enhance existing core competencies, organizations, and strategies. To control this, they avoid outsourcing or enterprise management systems and pursue limited goals per project in an evolutionary manner. Finally, they represent a new production paradigm, “controlled production”, where software helps control all aspects of production and delivery, including influencing external environments.

Introduction: Objective and Status of this Study

Objective

This paper summarizes the results of case studies comparing Japanese and US companies in various industries. The project’s purpose is to examine through these case studies how US and Japanese firms who are recognized leaders in using information technology to achieve long-term sustainable advantage have organized and managed this process. The industries and firms examined cover finance, retailing, semiconductors, automobiles, pharmaceuticals, and steel.¹

The cases researched so far² support an initial hypothesis that while Japan is competitively behind in producing most software, especially packaged software, some Japanese firms in key industries are very sophisticated users. These firms have integrated software into their management strategies and use it to institutionalize organizational strengths and capture tacit knowledge on an iterative basis. Previously this strategy involved heavy reliance on customized and semi-customized software (Rapp 1995), but is changing towards a more selective use of package software managed via customized systems. Interestingly, their US counterparts, who generally have relied more on packaged software, are doing more customization, especially of systems needed to integrate various software packages into something closely linked with their business strategies, markets, and organizations.

¹ Columbia-Yale Project: Use of Software to Achieve Competitive Advantage. Industries examined include food retailing (Ito-Yokado and H. E. Butts), semiconductors (NEC and AMD), pharmaceuticals (Takeda and Merck), retail banking (Sanwa and Citibank), investment banking (Nomura and Credit Suisse First Boston), life insurance (Meiji and USAA), autos (Toyota), steel (mini-mills (Tokyo Steel and Nucor) and integrated mills (Nippon Steel)), and apparel retailing (Isetan and Federated). The case writers and research team wish to express their appreciation to the Alfred P. Sloan Foundation for making this work possible and to the Sloan industry centers for their invaluable assistance. For completed cases, see Cabolis (1999), Amari (1999) and Amari (1999a).
² This refers to firms for which interviews are complete. So excludes AMD, H. E. Butts, Nucor, Isetan, Federated, USAA.
Thus, there is some convergence in the approach of these leading software users in the US and Japan, though they are coming from different directions.

**Status**

These cases therefore confirm what some other analysts have hypothesized, that a coherent business strategy is a necessary condition for a successful information technology strategy (Wold and Shriver 1993). However, contrary to what such analysts might have expected, these successful business and information strategies have not led to or emerged from a change in corporate culture. Rather, the software and information technology strategies pursued have codified and institutionalized existing cultures, core competencies and organizational structures. Further, these strategies and cultures have been positively oriented towards using technology to improve product or service development and delivery. These results seem at odds with some major tenets of reengineering which hypothesize that the successful use of information technology (IT) requires substantial corporate reorganization to achieve significant improvements in productivity. It also indicates that learning to use IT to enhance existing competitive advantages has for these companies itself become an important core competency.

In sum, these leading Japanese and US firms seem to be moving positively towards a similar strategic and operational balance point with respect to using software to improve competitiveness even if coming from opposite directions. In this approach, they both appear to reject reengineering or any major corporate reorganization as part of their strategies. Similarly, they have elected to retain control over software purchasing and development and have avoided outsourcing except for certain low technology, low priority tasks such as payroll because of the perceived benefits of controlling the integration and use of information technology in their basic business and organization. Further, they indicate industry-specific vertical application software is increasing in importance globally as these firms develop and integrate information systems specific to their industry and competitive situation. They thus confirm another research hypothesis that some firms consciously and successfully use software to pursue competitive advantage.

Implementation and design of each company’s software and software strategy seems unique to each firm, its competitive situation within its industry, and its strategic objectives. These factors influence how they choose between packaged and customized software options to achieve specific goals as well as how they measure success. Thus, NEC (Cabolis 1999) sees semiconductors as global and highly price competitive, especially in commodity products such as DRAMs. Thus, they need total flexibility to introduce the latest production or design software packages. Because these are generally English language based and their production base is global, all software and supporting systems use English since this gives them the most flexibility to introduce improvements and control costs. Localizing software takes time and increases cost two to three times (Rapp 1995).

Alternatively, Meiji Life relies on a localized and then customized version of Windows-NT. However, their competition is entirely within Japan and their new software delivery system through a network of laptops carried by 40,000 agents depends for its success on the agent and customer easily understanding the information presented. Thus, the software must be in Japanese. In addition, these laptops must be able to receive and send information to Meiji’s network servers and mainframes that use heavily customized systems, also Japanese language based.

As part of the strategic integration noted above, these and the other leading software users interviewed have also linked their software strategies with their overall management goals through clear mission statements that explicitly note the importance of information technology to firm success. In turn, they have coupled this with the active participation of the CIO (Chief Information Officer) and
their information technology support group into the firm’s business and decision making structure. Thus for these firms the totally independent Management Information Systems (MIS) department appears a thing of the past. This may be another reason why outsourcing for them is generally not a viable option. However, it is also clear these firms’ successful performance is not based solely on their software.

Though software is an integral element of their overall management strategy and plays a key role in serving corporate goals such as enhancing productivity, improving inventory management or strengthening customer relations, these systems must be coupled with an appropriate approach to R&D, manufacturing and marketing. A key aspect of this is that the firms interviewed had a clear understanding of their business, their industry and their firm’s competitive strengths. This clear vision enables them to select, develop and use the type of software they require for each business function and to integrate them into a total support system for their operations to achieve corporate goals. Since this clarity of vision impacts other corporate decisions, it is hardly surprising firms who are good at using software have good human resource and financial characteristics (Rapp 1999).

At the same time, while the mix and emphasis on certain software and information technologies are unique to each firm, industry and country, the cases indicate some common themes. Some are similar across a range of industries in both countries, others across a range in one country, and some within an industry in both countries. One theme common to all the cases is the creation of large proprietary interactive databases that promote the automatic feedback between various stages and/or players in the production, delivery and consumption process. For example, Ito-Yokado uses a sophisticated real time interactive database to predict luncheon purchases at its various stores and restaurants by time of day and day of the week, helping to reduce inventory costs and wastage while improving customer service. Reduced inventories and improved control of the production process are also common to both countries and all the firms interviewed. For example, even a service company like Meiji Life as a direct result of its new system expects to substantially lower paper and storage costs through reducing the number and size of its branches as well as the number of copies of each document it must retain for its records.

Organization and Loops

We also found that organizationally and competitively successful software users are able to build beneficial feedback loops that increase productivity or decrease costs in areas as different as R&D, design and manufacturing, and production and delivery. For example, integration of marketing, design and production have enabled NEC (Cabolis 1999) to more accurately forecast demand through designing products more in-tune with market requirements. This enables manufacturing to schedule production more efficiently, reducing in-plant inventories and cycle times while improving on-time delivery. Improved cycle times reduce costs but also increase the reliability of their forecasts since they need to cover a shorter period. Customer satisfaction is also improved through on-time delivery. Therefore, software inputs can be critical factors in overall business strategies, with strong positive implications for competitiveness of those who do it well and potentially negative implications for competitors.

An important consideration in this respect is the possible emergence of a new strategic production paradigm. In the same way mass production improved on craft production through the economies of scale and using standardized parts and lean production improved on mass production by making the production line more continuous, reducing inventories and tying production more closely to actual demand (Krafcik 1988 and Womack, Jones, & Roos 1990), what might be called “controlled” production significantly improves productivity through monitoring, controlling and linking every
aspect of producing and delivering a product or service including after sales service and repair (Rapp 1999). However, because this is an evolutionary process, lean manufacturers retain these characteristics when they are cost effective just as they retained the scale effects of mass production when they remained cost effective. Nor have they changed their accelerated model developments, parallel engineering, and improved organizational integration of design through marketing. What has qualitatively changed, though, is their ability to precisely monitor and control these different aspects of their business. This has in turn introduced both greater flexibility and greater control just as a numerically controlled machine tool has improved the scope and precision of what that tool can do leading to flexible manufacturing systems.

Furthermore, in some cases such controlled production has even impacted the firm’s external business environment, such as the greater automation and integration of clinical trials and the new drug application process (Merck - Amari 1999). Therefore, as detailed below, in its use by firms who are not lean and in its impact on particular processes, it is different than the lean production described by Womack et al (1990). At the same time, such controlled production is only possible by actively using information technology and systems to continuously monitor and control what had previously been a rather automatic system response to changes in consumer demand. These firms’ proactive use of IT has thus provided them with a clear and continuing competitive advantage.

This conclusion is partially indicated by the fact that all these firms are successful competitors relative to peers in terms of standard industry measures such as market share, growth and profitability per employee or relative to assets employed. But further, in most cases, their skillful use of IT is seen by themselves and industry analysts as important to this success. Still, from the cases examined so far, software seems most likely to contribute to enhanced competitiveness when it is integrated with the business from both an operation and organization standpoint, reflecting the firm’s overall business strategy and clarity of competitive vision. Their software and systems development departments are part of the decision making structure while the system is integral to delivering and supporting the product and/or service, thus the name “controlled” rather than “lean” since IT was not integral to Toyota’s production system (TPS) as it evolved in the 1960s.

Differences

This difference was perhaps most clearly delineated for Merck and NEC where the systems development personnel are part of the decision team on all allocations of resources from plant expansion to semiconductor and drug design while their systems are integral to those same operations and decisions. In other words, leading American and Japanese firms who successfully use software systems and information technologies to improve competitiveness integrate them into their business strategies through incorporating them within their decision-making and operational structures where they are used to monitor, link and help control the overall process. This includes the development of large data bases that track after-sales service and performance, facilitating product improvements and demand forecasts.

An interesting change this process has brought to the normal lean production cycle is the break in the production line for many “controlled” producers and their increased in-process inventory, a seemingly radical departure from “lean” manufacturing principles (Krafck 1988 and Womack et al 1990). These manufacturers found certain points in the assembly line had limited potential for improved productivity. These then limited the possibility of substantial improvements in a continuous manufacturing system. However, by breaking the line and having small buffer stocks, some parts of the line could be improved, freeing labor for other plant operations while the next subassembly line
continued to operate. Monitoring and controlling these buffer stocks at points in the manufacturing process is done using software and information technology (Cabolis 1999).

A Watershed

Therefore Seagate Technology seems correct when the state (1997 Annual Report) “We are experiencing a new industrial revolution, one more powerful than any before it. In this emerging digital world of the Third Millennium, the new currency will be information. How we harness it will mean the difference between success and failure, between having competitive advantage and being an also-ran.” This view is also supported by Mr. Okuda, president of Toyota, in a presentation (Yale 1998) on “When the Ground Rules Change.” He states: “I now have discussed three watersheds in the history of the automobile industry. Each time, a new business model changed the ground rules for the industry. Each time the new model seemed invincible. And each time, it gave way to changing circumstances and a new business model. ... Our old business model is breaking down for four main reasons. One, we need to decentralize our manufacturing and R&D activities ... Two, the product and process paradigms that Henry Ford established are themselves breaking down ... Three, information technology is transforming the inner workings of the automobile. It is also transforming the way we develop and make and sell our products. And four, the changing product paradigm and the growing role of information technology will open our industry to a vast array of competitors.”

The impact of information technology as an agent of change is therefore clear. How some leading US and Japanese users are managing this change represents the remainder of this paper. To stay leading edge, the firms interviewed have decided to develop some customized software, generally to link packaged software together and adapt it to their existing organizational structures. They have usually not tried to adapt the organizational structure to the software. Even though Meiji Life uses a standard localized Windows-NT package to link their unique organizationally oriented agent software together, what they and the other leaders have done is at some critical point in the information chain they have developed customized software that differentiates them from competitors. This usually is where they feel organizational value added is required to achieve a competitive differential and where there is no suitable leading edge software product available to place the company on this competitive frontier. Given this perspective, both functional and market gains are used to justify the additional expense incurred by customization, including the cost of integrating customized and packaged software into a single system.

Still, even Japanese firms are relying more on packaged or semi-customized software to reduce costs compared to three years ago (Rapp 1995). The most aggressive in this regard is NEC (Cabolis 1999) due to the intense global competitive pressures in semiconductors. Yet they too use customized software to tie their operations together. Given this mixed software strategy, where the appropriate software for each situation is selected on a case by case basis, these leading software users questioned the benefits of the general and extensive outsourcing of software technologies currently pursued by many US firms. They believed that firms who focus heavily on outsourcing are overemphasizing the cost side of software investment rather than analyzing the possible organizational and operational benefits and especially its role in enhancing core competencies. While they will adopt the information systems used by their competitors if there is no business advantage to developing their own, they reject the view that information systems are generic products best developed by outside vendors who can achieve low cost through economies of scale and who can more afford to invest in the latest technologies. Instead, these leading users select their packaged software themselves, do their own packaging and systems integration, and add value at the critical strategic junctions for their specific business through some customization and semi-customization (e.g. Amari 1999 and 1999a). They
reject the notion it is OK to buy a package if it delivers 80\% of the functionality (Track 1998) needed by the firm’s users since the extra 20\% may be what achieves an advantage.

This research result was not surprising with respect to Japanese firms since an earlier study (Rapp 1995) indicated Japanese firms have generally viewed software as an integrating element in their production and delivery of a good or service for some time. For them cost has been balanced against overall long-term productivity gains. However, the research team was surprised to see how adamant the leading US software users were that if the increased cost of customization results in competitive benefits, developing and using customized software makes sense. They thus assign positive value to improved integration and enhanced control (from an intellectual property and management perspective) gained from customization. They are thus loathe to yield responsibility for this benefit to a third party driven by different objectives such as cost and general technical improvement.

Merck (Amari 1999) and Citibank in particular believe customized software and its close organizational integration have helped them to capture and perpetuate more consistently certain tacit knowledge and unique corporate features that account for their continued success. Consistency, reliability and repetition are important elements in their thinking. They stated extensive outsourcing would surrender these strategic options since they feel systems service companies have an incentive to develop increasingly standardized products to improve their operational efficiencies. Outsourcing also puts the firm one step removed from the market which means they lose many of the beneficial loops discussed above. In addition, they question the outside firm’s knowledge of their industry or organization and its ability to design and integrate the software into their basic business to enhance competitiveness. Given their clarity of vision, this seems a legitimate concern. (See Appendix on Common Case Methodology.)

**Using Software to Improve Competitiveness in an Industry Context**

**Software Strategies**

As noted above, a number of Japanese firms in key industries are very sophisticated software users who have integrated software into their management strategy and use it to institutionalize organizational strengths and capture tacit knowledge on an iterative basis. Historically, this strategy has involved heavy reliance on customized and semi-customized software. Conversely, their US counterparts generally have relied more on packaged software with an increasing number of US firms outsourcing software design and development. Further, industry-specific vertical application software and embedded software are increasing in importance within the global software industry and in some cases are being strategically integrated too. A firm may thus embed software into its production and delivery processes as well as its products.

Other strategies involve creating large interactive databases to allow automatic feedback between stages or players in the production and delivery process. They can also tie software with high speed telecommunications technology. Yet, precisely how firms decide, design and implement such software strategies, how they measure success, and how they choose between packaged and customized software options for achieving specific goals vary by firm and its particular competitive situation and the business strategies they have developed to achieve competitive success. There are related differences in how they actually link their software strategies with overall management goals, though it is clear that high performance firms do not succeed solely on the basis of software. Instead, software is an integral element of an overall management strategy, adapted to a particular industry and competitive situation. Nevertheless, not all firm strategies involve the retention of proprietary data.
Some, for example, have established data banks on the Internet to which they contribute data and then encourage others to add. What is common to these approaches is IT is used to enhance and improve the way a firm implements its strategy and achieves its goals as shown in the examples above and illustrated later in this summary.

At the same time, in talking with users and developers, it is apparent while software offers unique opportunities and benefits in terms of enhancing core competencies to achieve strategic objectives, it poses risks too. That is, a firm can successfully introduce innovation through software to gain first mover advantages. Using software effectively can enable it to build beneficial feedback cycles that increase productivity, reduce cycle times and defects, and integrate production and delivery. Software may also be a way to capture externalities or to exercise greater flexibility and control over certain business processes. However, when used ineffectively - with insufficient attention to training or systems and organization integration, for example - software can confound seemingly routine operations.

In sum software can be a critical factor input to overall business strategies, with both positive and negative implications for competitiveness. It was to shed light on the dynamics of such software utilization this project was undertaken. In exploring the role and impact of software as a tool of competitive advantage among a group of leading Japanese and American software users, some key issues are outsourcing, selection criteria, customization, beneficial loops, innovation, reliability, organizational integration and management. As explained above, the firms examined so far support the hypothesis that being competitively behind in producing most software, especially packaged software, has not prevented some Japanese firms from being sophisticated users by successfully integrating software into their management strategies and using it to institutionalize organizational strengths and capture tacit knowledge.

But whereas previously this strategy has involved heavy reliance on customized and semi-customized software, it appears to be shifting towards a more selective use of package software managed by customized systems, including customized middleware. Conversely, their US counterparts, who have relied more on packaged software, are doing more customization, especially of systems needed to integrate various packages into something more closely linked to their business strategies, markets, and organizational structure. Thus, there is some convergence in approach, though in both situations a coherent business strategy is a necessary condition for a successful IT strategy. By way of example, some of these strategies are outlined below for particular firms in specific situations. These examples in conjunction with those noted above indicate how the various cases contribute to the research project’s overall results and conclusions.

**Enhancing Core Competencies**

These examples show how these firms, who are considered leaders in using software to improve competitive position, do this by developing software and IT systems that enhance core competencies, including improving organizational performance and strategy implementation. So though the specific competencies and organizational structures needed to succeed vary by industry and country, the logic of using IT to improve them cuts across firms and industries.

For instance, a key core competency for Merck is its ability to efficiently manage clinical trials and the FDA approval process (Amari 1999). However, they have been restricted in the number of drugs they can handle due to the number of drugs their top managers have been able to manage at any one time. Historically, this has averaged about 18 drugs in the pipeline. However, they have now revised the way their IT systems gather and organize clinical data so their managers can handle 24 or 25 drugs in the pipeline. Since each drug costs about $350 million to develop and generates billions in
revenues, this increase in a core competency represents a tremendous increase in their business potential. It has also allowed them to sell their interest in the joint venture with Dupont for over $4 billion since one reason for entering that venture was to expand their ability to conduct clinical trials and the FDA approval process across another organization.

Similarly, Nippon Steel is currently enhancing their core competency in managing the production schedule for their steel mills, a very complex task since each order represents a slab of steel with its own unique specifications as to amount, coating, thickness, composition, end use, etc. They are doing this in conjunction with IBM Fishkill which has developed a new mathematical algorithm because Fishkill believes NSC is one of the few firms in the world that can both introduce the system and use it. The results for NSC could save tens of millions of dollars in process inventory while complementing their e-commerce and data base co-operation projects with the trading and auto companies as explained below.

A related finding to enhancing core competencies has been that these firms do not reorganize themselves to use available or new software technologies. Indeed, they generally reject concepts of outsourcing or re-engineering, though their cultures are technology oriented. For example, both Takeda and Merck have elected to use SAP systems (Amari 1999), but they have not adopted SAP’s entire integrated system which would have required substantial reorganization. Rather, they each selected only a piece of SAP’s system that they thought would be useful and cheaper and which in turn they could adapt to their existing systems in a cost effective manner. In effect they purchased and adapted a particular software package that was cost effective and then integrated into their system while rejecting SAP’s total electronic management response.

This approach to software selection and IT development is one reason for the finding described above concerning the partial convergence in the degree of customization by leading Japanese and US software users. That is, leading US firms are doing more customization to enhance particular core competencies while the leading Japanese firms are using more packaged software when they can adapt it to their highly integrated overall system. These firms are thus gaining increased control over their use and development of information technology. But they are using specific criteria to make these selections between packages and customization. In this regard they are not wedded to either packages or customization for their own sake but rather to what works and is cost effective.

Generally, they will employ a package that is sufficient and cost effective in terms of adaptation and system integration. However, in terms of determining what is cost effective, these firms will not sacrifice user functionality or revenue enhancement merely to use a package and reduce costs. For these companies, this approach to evaluating software has in turn generally established beneficial loops where enhanced core competencies and successful strategies have led to better business performance and further software improvements, leading to better performance, etc. For example, as described above Meiji Life uses Windows NT as the inter-communication operating system for its new laptop based marketing system. But the program incorporates Meiji’s proprietary life cycle model tied to specific life insurance products which is totally proprietary and customized (Program on International Financial Systems 1998). This model has resulted in greater sales consistency across their 40,000 representatives while reducing paper costs and branch office expenses as the representatives can now communicate directly with the corporate mainframe.

These leading users thus have clear criteria related to their business strategies for selecting software that do not include using the latest software or IT technologies for their own sake. Rather, business, organizational and in turn software strategies are driven by a firm’s competitive position. Therefore, when evaluating new integrated business systems such as SAP, as noted above they do not buy the whole system but rather purchase pieces they feel can do a specific job more cost effectively.
than a customized package. They then adopt and integrate this into their overall system. As noted by both Nippon Steel and Toyota, a major reason for this decision is the systems these leading firms have developed over several years involve hundreds of millions of lines of code and are so complex and tightly integrated with their organization, that these new enterprise software packages just cannot replicate the benefits and functionality of these firms’ current systems.

This organizational comprehensiveness is reflected in these firms’ software strategies which extend from mainframe through PCs. Further, because software is related to the firm’s organization and business strategy, it is not easily emulated by outside competitors. It can thus establish a competitive barrier, especially if it involves hundreds of millions of lines of code and mainframes are used for distributed processing since such programs are not easily transferred. All the firms are quite conscious of this competitive benefit. However, Toyota is probably the most articulate about it since they have seen the problems GM has had in implementing the TPS (Toyota Production System) system even though GM has had access to it and have been able to observe it working at the Fremont plant in California for almost fifteen years.

Naturally, this software often involves mission critical systems that support major data bases and key operating systems. Therefore, these systems must work, and the risk of a failure is unacceptable! This drives a rather conservative risk averse incremental approach for all the firms with respect to adopting new technology to support core competencies and is another reason they reject enterprise system solutions. Toyota and Credit Swiss First Boston (CSFB) both typify this approach. The latter particularly notes that their trading and investment business is generally client, transaction and product specific. Thus, in addition to capturing contextual specificity, there is confidentiality and fiduciary responsibility which force a risk averse approach to developing and adding software. Thus, system changes for these firms are evolutionary not revolutionary (Nelson and Winter 1982).

**Evaluation Systems**

To insure that this approach is consistently implemented, most of these leaders in using software have set up evaluation systems to ensure the cost of customization or a new system is really paid for through benefits such as reduced cost, improved inventory management, lower cycle times, better market information, or consistent organizational performance. They track this through cross functional approval and review committees. NEC (Cabolis 1999) and Merck (Amari 1999) are particular examples of this. NEC has committees of managers and engineers that examine and review the software used in each part of the design and production process. This is a critical function as the software controlling each machine in the production process is constantly being upgraded and NEC cannot afford to fall behind a competitor in production efficiency. At the same time, they do not want to upgrade if another package is better or if the benefit of an upgrade or change is marginal. They thus look carefully at cost, functional benefit, and the elapsed time to full efficiency improvement. Merck has cross functional committees involving top managers as well as people from manufacturing, R&D, finance, IT, and marketing. These committees then examine each dollar of IT investment using the same return criteria demanded by Merck of a dollar invested in drug development, including the application of their business financing option concept. The latter criteria forces committees to examine the potential cost of not making or delaying development of a new system relative to the cost and benefits of proceeding. This option model also considers the likelihood of technology advances during development that could improve results.

While there are differences between firms, industries and countries as to the critical competitive variables and resulting business strategies and core competencies which use IT, there do not seem to be systematic differences among these factors. All Japanese firms do not pursue a particular approach
such as customization nor do all US firms have the same view towards using IT. Similarly, while all manufacturing firms are conscious of controlling inventories, so are many service firms, e.g. Meiji Life and CSFB respectively try to control document storage and the securities held in their trading or commercial paper portfolios. Further, inventory control is not done blindly since as we noted in the case of Toyota and NEC, buffer stocks have been increased to improve line efficiencies coupled with a decrease in raw material and finished inventories. Rather, the common theme among the firms examined is using IT to improve competencies and results with specific outcomes.

Managing IT

Because of this close integration of strategy, organization and IT, the CIO (Chief Information Officer) within these firms is usually in senior management and from a value adding part of the business. In some cases, they are responsible for embedded software too which requires combining product and software knowledge to enhance a firm’s product. Product data is then interlinked with data base management. In this way IT adds value to product and service; not just cost. There is thus no truly independent Management Information System (MIS) department in these firms. Rather they maintain and integrate systems and computer heritage with management strategies to capture tacit knowledge and support institutionalized organizational strengths on an interactive and iterative basis. For these firms using IT is subject to the principles of Kaizen or continuous improvement (Imai 1986).

They do this by constantly introducing innovations and new developments incrementally with organizational evolution, all driven by the sharp clarity of their business/industry vision. Software is thus adapted to business and competitive needs rather than to accommodate a purchased system or just to introduce the latest technology. These firms generally recognize that packaged solutions available to all cannot improve competitive advantage unless linked to part of a larger proprietary system that contains benefit features that act as barriers to entry or enhance performance. The current CEOs of Ito-Yokado and Citicorp are probably two of the most prominent examples of this phenomena as both come from a technical part of the business and built their reputations on the application of systems to improve business performance. Mr. Suzuki, President of IY, rose from Ito-Yokado’s convenience store business, 7-11, and John Reed, Chairman of Citicorp, rose from being head of global retail banking.

Furthermore, these leading software users are employing information technology to monitor and control all aspects of their business including certain aspects of their external business environment. This has led us to postulate a new production paradigm called “Controlled Production”.

Controlled Production

Controlling Business Functions

Since for these firms controlling production (CP) is not just a way to reduce costs but to improve business performance and organizational effectiveness, it differs from mass production which achieved economies through scale using standardized parts or lean production which reduces costs through more continuous manufacturing processes and reduced time and waste in all business functions. This is not to say “CP” ignores the benefits of scale or “lean” production and design. Indeed, for firms such as Toyota, it builds on and extends these competitive benefits. But “CP” goes beyond “mass” and “lean” by seeking business improvement through using IT to control all aspects of delivering a product or service including the external environment such as after sales service and repair, supplier relationships or industry standards.

Thus two of Nippon Steel’s current major IT efforts involving hundreds of millions of dollars
are i) working with the trading companies who control the order flow to all Japanese steel companies to put the entire order system on-line instead of using faxes (e-commerce), and ii) working with the auto companies to develop a model that can anticipate the requirements for replacement part steel since currently the steel companies must carry almost one month inventory for each model of car. Similarly, Merck is gathering after sales information about patients to anticipate both drug reordering requirements and potential adverse side effects (Amari 1999).

In these firms, therefore, suppliers and customers are linked to systems and these links can extend into both the past and future aspects of the relationship. In addition to Merck’s gathering of prescription data after drug sales have begun and Nippon Steel’s attempt to understand auto demand for replacement parts, there is First Boston’s desire to track option performance to adjust future pricing or to close out risky positions. Also, Toyota is gathering information on warranty claims to adjust their production and design of cars while Ito-Yokado has included its suppliers and delivery contractors in its systems development plans so they can more effectively do their jobs of meeting Ito-Yokado’s requirements.

Users’ process and systems integration thus try to incorporate and build tacit learning from the shop floor through to the customer/supplier base, maintaining special or unique system and process advantages where software is both an important input and an institutional arrangement that creates barriers to entry. Some specific cross industry, cross country, cross firm commonalities include inventory control, interactive data base management to improve product performance, integration of telecommunications and organizational structure, linking product or service R&D with production, marketing, delivery and after sales service. This can be seen in several of the examples already mentioned. For instance NEC has determined that some aspects of the initial IC production process are common across a range of products (Cabolis 1999). They thus have increased their buffer stock (in-process inventory) at this point, a complex IT exercise, while reducing front-end inventories. This allows them to respond more quickly to shifts in market demand by switching output more rapidly than competitors. This allows them to get to market more quickly and ahead of falling prices.

Perhaps, the most interesting and potentially most important aspect of the “Controlled Production” paradigm is how these firms are using IT to control and influence their external environment.3 This is because such control and influence can potentially redefine the normal microeconomic relationships we assume among firms, their suppliers and their customers. In addition, by capturing and sharing previously unexploited externalities, these firms can improve their competitiveness and increase their market shares, establishing beneficial loops that can alter current competitive relationships. These changes may create ripple effects impacting customers and suppliers and in turn their customers and suppliers. Further, to the extent such systems, software or IT is protected by copyright or is subject to user base economics (Rapp 1998) where high development costs per unit are continuously reduced by adding users (customers, employees, or suppliers), these firms approach a Microsoft competition model (Aley 1996). Here a beneficial loop emerges such that expansion and usage lower unit costs, increase market share and user benefits, and thus expand the user base. For this reason, I shall present below some more detailed explanations of how these firms are using IT in this manner.

Nippon Steel

Currently, large Japanese trading companies control Japan’s steel ordering system. These major

trading companies receive orders by fax for particular types and quantities of steel from their customers such as auto producers, ship builders and large construction firms. They then bundle this demand and order the steel by fax from the steel producers. Nippon Steel and other Japanese steel makers then place the orders for the steel with their different mills through a complex production allocation system. The orders are then tracked through the production process, their shipment and billing to the end customer. Since each order represents a separate slab of steel with its own dimensions, thickness, weight, coating, purpose, customer, etc., tracking and managing this production process is a complex task lasting as long as three months. Receiving and monitoring the order for the trading company and its customer is also complex, especially as each trading company's ordering system is somewhat different. Thus to facilitate the ordering and allocation of the steel among its different mills, Nippon Steel has developed an e-commerce system where all trading companies' orders are received electronically using a consistent and common format. This has reduced errors while permitting NSC and the trading companies to track the order without requiring time consuming faxes or phone calls. Further, NSC can now more easily adjust its production schedule to respond to changes in customer priorities. In this way, NSC has used IT to extend its control over the ordering system outside the firm to its and their customers' advantage. The e-commerce system also supports their auto replacement parts project.

That is, they have also been working with the trading and auto companies to reduce their single biggest inventory expense, the finished steel they must keep for auto replacement parts. This is because every car model has its own unique steel requirements in terms of various steel characteristics such as size, thickness, and coating. In turn, the stock of each car being driven in different countries determines the replacement parts related to accidents and other repairs. Yet, it is a customer given that no car owner will wait three months for a replacement part. So the steel must be on hand, but the actual amount needed varies depending on the number of cars produced, where they were sold, how fast they have been scrapped, what parts need replacement, accident rates, etc. This information is only available to the auto companies and has not been systematically gathered. NSC is therefore now working with them to understand the real amount of steel needed for on-hand inventory. This analysis requires a complex software and data management program that will arrive at a better evaluation of the inventory needed for different steels for replacement parts with NSC and their customers sharing the cost benefits. This is a clear and explicit example of how one IT leader is using IT to extend its influence beyond the firm for its and its customers' benefit. At the same time, it is tying its customers more closely to its steel production strategy since once an auto company has integrated its parts replacement strategy with NSC's production and inventory strategy the ability of the auto producer to switch steel suppliers is substantially reduced.

**Merck**

The most expensive and time-consuming aspect of managing the drug pipeline is clinical trials, especially phase III involving human subjects. Merck has undertaken several IT related initiatives to extend its influence outside the firm to improve its efficiency in managing this process (Amari 1999). Since it now feels it can manage 24 or 25 drugs in the pipeline due to improvements in managing clinical trials, this and other efforts have paid big dividends in potential growth as well as the number of therapeutic areas in which it can work. First Merck has developed a medical term dictionary that it has made available to all doctors involved in clinical trials for Merck or anyone else. Their belief is that if one can improve the consistency and meaning of terms used by researchers in reporting their observations during clinical trials, Merck will need to spend less time rewriting, checking or interpreting various results. It will also mean they can better understand the results of trials undertaken
by competitors in related drugs. They are similarly using such an open system to influence external behavior patterns affecting the firm by establishing and maintaining a free library on genetic material where people can post and obtain information, thus reducing anyone firm or scientist’s ability to patent and monopolize a particular research result.

The medical dictionary facilitates and contributes to another big IT initiative outside the firm as well, which is automating the stage III clinical trials in terms of reporting to the FDA and other countries’ approval agencies relative to applications for the approval of new drugs (Amari 1999). Merck has been a leader in helping draft the common automated application guidelines and the way the supporting data from the clinical trials should be gathered and reported. Given their resulting familiarity with the guidelines and the ability to use their own experience and competencies to support their views, they have effectively developed an interactive systems-based approach which translates into faster approvals, reduced costs, and more drugs in the pipeline. Finally, they have extended this concept to gathering prescription-related data at the pharmacy level. This has given them the ability to respond more quickly with lower inventories to patients’ needs for prescription refills. Indeed, one unanticipated benefit of this system has been to reduce the unmonitored switching between similar drugs that pharmacists did automatically when a Merck product was not in stock. Another important benefit is that this data collection system will improve early warning of potential side effects in new drugs that only emerge after the drug has been approved for widespread use. Given the potential liabilities associated with unexpected side effects, the ability to closely monitor after sales information at the pharmacy level is an important strategic and competitive benefit.

**Toyota**

The concept of having one’s own product or system accepted as the industry standard is frequently recognized by executives and business analysts as an important competitive advantage. The firm knows this standard better than its competitors and can introduce changes and modifications so as to favor its products or services. Certainly this has been part of Merck’s strategy in making its medical term dictionary widely available or Hewlett Packard’s approach to printer system interfaces. Interestingly, Toyota is taking the same approach to ITS (Intelligent Transportation System). This is a sophisticated information technology system combining a computer in the car with a navigation system and a computerized highway. Under ITS one could enter a highway, indicate via your car computer where you wanted to exit, and the highway’s computer would then use your computer to control your car and drop you at the appropriate exit. You could rest or play cards during this part of the trip. While US manufacturers see this development as speculative and several years away and Toyota’s Japanese rivals do not have the resources to support the required R&D effort, Toyota is funding it in Japan and expects to have a pilot project operating there in about five years. Then through the international forum on ITS, it will work to have its functioning system adopted as the international standard. Since Toyota believes that in any case a single on-board computer will soon have to replace the various microprocessors that currently run a car’s independent functions such as brakes, fuel injection or suspension, they see a convergence of ITS, embedded software and the automobile’s technological evolution towards more electronics. Through ITS they are influencing this external development which they expect to increase the demand for their cars as well as to increase IT related revenues as other auto manufacturers license their system. This is the Microsoft model (Aley 1996) aggressively applied to automobiles.

Other ways they are using IT to extend their influence beyond Toyota and to capture potentially beneficial externalities include the replacement parts requirements for steel noted above. They are also further extending this idea to develop a database on repairs that may ultimately be tied to information
stored in the on-board computer for each car. This information and the related system are strategically important because repairs related to warranties are a rising expense for auto producers. To the extent Toyota can use this data to improve design or production of its cars to reduce warranty claims or recalls, it will increase long-term profits. It can also use this situation to improve its prices and/or its warranty relative to competitors. Related to this is Toyota’s ability to influence their repair system by alerting mechanics to potential problems before they occur reducing the cost of very expensive recalls in a way similar to Merck’s desire to anticipate adverse drug side-effects. Finally, like Ito-Yokado, Toyota has given its suppliers more access to its IT system so they can improve their production and delivery scheduling. This is an important switch in their approach from when they were interviewed in 1994.

**Ito-Yokado (IY)**

As noted above, Ito-Yokado is particularly aggressive in tying its suppliers, contract warehouses, and trucking companies into its IT network. This is because in their business strategy they not only want to keep inventories low relative to sales but assets to sales generally. They have thus systematically and increasingly outsourced such functions as warehousing (which uses land) and trucking while making sure suppliers have the data needed to carry or produce just the amount IY requires. They thus help all these firms to become part of the IY network. By making their suppliers more efficient in their relationship to IY, they lower their own costs. Simultaneously, they are tying their suppliers more tightly to IY and are impacting their external environment in that given the benefits the suppliers receive from being part of IY’s network they will demand similar data from other customers.

**Meiji Life**

Japan is now facing its own Big Bang that will allow all financial firms to compete across business segments. This means every financial company is facing a wide range of new competitors. But they will also have the chance to offer new products to existing customers even with no special competitive strength in that product or service. To sell these new products and services where they have no traditional strength but to existing customers where they do have influence, Meiji Life has developed a life cycle profile. This profile of their customers’ life-long financial requirements they demonstrate and deliver through a network of laptops carried by their 40,000 agents. Their strategy is thus dependent for its success on the agent and customer easily understanding the model and the information presented. Therefore, a key aspect of the system is having the customer develop an appreciation of and interest in their life cycle financial requirements and the role Meiji can play in satisfying those needs. The latter is done through presenting a range of products that includes those that Meiji has not previously been allowed to offer. At the same time, training and using the new system help their salesforce to learn, accept and market these new products and services. To the extent they are then successful in getting the customer to accept their view of the customer’s future requirements and Meiji’s ability to meet them on an integrated basis, they will create competitive barriers to competing firms with a different approach. As part of their effort to educate their customers to the benefits of the new environment and Meiji’s products, they also have had to get the customer to

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adjust to less paper. They have done this by showing them the benefit and convenience of more customized policies adjusted and printed directly from their representatives’ laptops. Finally, since individual life insurance products account for about 80% of Meiji’s profits even though only about half the insurance in force (the balance is group life insurance), the importance of this approach has a clear business basis. It is an interesting illustration of how the “controlled production” model can extend beyond manufacturers to a service company.

**NEC**

In the semiconductor industry NEC believes the key to their competitiveness is their ability to respond quickly to changes in demand while keeping production costs low and production technology at the leading edge (Cabolis 1999). This view requires them to introduce changes in the systems controlling production equipment on a timely basis. Since much of this equipment is controlled by software written in English by the companies who produce the machinery, to effectively tie the equipment producers into their production paradigm on a timely low cost basis NEC must be able to adopt this software quickly. Therefore, they have decided their semiconductor division will operate totally in English, including their own production information system. In this way they have changed and extended their organization and how it creates and uses software to affect their ability to work with suppliers to introduce periodically improved software systems controlling production equipment. In turn, by increasing the integration with equipment suppliers, NEC has more effectively utilized their equipment and its related software improvements while being able to influence such developments as well. This approach is integral to the flexible production system and buffer stock strategy explained above since this permits them to respond more quickly than competitors to the rapid changes in demand characteristic of the semiconductor industry. Because of this ability to quickly shift production, in 1996 they were the only profitable Japanese semiconductor producer when demand for DRAMs dropped precipitously (Cabolis 1999).

**Takeda**

Like Merck, Takeda has had to develop software systems that can manage and interact with the new international standard application process and more automated phase III clinical trials. Otherwise it could not sell its drugs globally. Yet global sales are critical to spreading the high cost of developing new ethical drugs over the largest possible market. Additionally, to reduce inventories and better match production with sales, Takeda has moved to improve information flow with Japanese drug wholesalers. It has thus organized the other Japanese pharmaceutical companies and Japan’s drug wholesalers to develop an integrated industry-wide inventory and order system in conjunction with SAP. In this way by influencing sales and after-sales support in Japan, Takeda has extended its influence beyond its boundaries through organizing an integrative IT initiative from which it will benefit (Amari 1999a).

**Citicorp**

Citicorp has established itself as the leader in international retail banking that has required development systems support on a global basis across a range of services including credit cards and ATMs. Their desire is to extend these into industry standards worldwide. They have started this process by initiating alliances with major credit card and ATM providers in various countries. These alliances not only tie these financial service providers into Citicorp’s network but allow Citicorp to offer their upscale retail customers in other countries easy access to a worldwide ATM and credit card network so customers suffer no loss of convenience and service domestically while global benefits are
enhanced.

Nomura

The securities industry is highly regulated in Japan as in many other countries with many reporting requirements. Thus understanding and complying with regulations is critical to firm success. Nomura has influenced this process by developing and maintaining the standard software for reporting securities trading. Because its program is accepted by the MOF as the standard, other firms find it less expensive to buy Nomura’s program than to develop and maintain their own. This has enabled Nomura not only to create the standard but to convert a cost into a revenue stream. As reporting requirements and technology change, Nomura benefits from being able to work with the MOF prior to those changes being implemented. Its revenues then increase as other firms must upgrade to the new system. The Big Bang will only enhance this benefit as more financial firms feel the need to offer securities and related products in addition to other services as part of their comprehensive life cycle package.

Sanwa Bank

Due to Big Bang pressures, the decline in corporate lending and the entrance of all Japanese citibanks into retail banking, Sanwa has been forced to develop a different approach to the retail banking to differentiate itself both from other banks and new competitors such as life insurance and securities companies. Their strategy has emphasized automated branches to deliver an expanding range of services related to their life cycle model of customers’ requirements which is analogous to that used by Meiji Life. To differentiate their strategy from competitors, Sanwa depends on three basic elements 1) their retail banking infrastructure, including branches and information network; 2) their retail marketing strategy; and 3) their evaluation of people’s lifestyles or pattern of personal development throughout their lives. Though difficult, they make a special effort to manage and analyze data related to items two and three. This is because they currently envision their customers as having an evolving and growing set of financial needs that change over their lives. When they are young and starting to work, their need is likely to be for credit cards and consumer related financial products. When they marry, they need debt products such as mortgages for an apartment that expands to a house and life insurance as they have children. Then there are savings products for college, weddings and retirement. The question is how to track, market and deliver these products on a timely basis as well as to assure product development evolves in an way responsive to changes in lifestyle and technology. Another important issue is how valuable on a discounted basis the typical consumer is and how easily can a firm retain them throughout the cycle? Further, what is the appropriate time to start marketing, how much investment should be made per customer and what is the most effective way to both market and deliver a special product or service?

To address these and related strategic issues, Sanwa has developed a matrix identifying different customer groups and their banking needs according to lifestyle. They cross match this with a set of products for which they carefully control costs. Their primary target is young people just starting their careers who are the fastest growing retail market segment in Japan with the greatest long-term potential. However, they are expensive to service via traditional branch banking but can be efficiently serviced electronically via automated branches, telephone and the Internet. Sanwa’s plan is appeal to this market segment’s greater acceptance of technology and to then follow these individuals as they progress through their lives, their earning power grows and their financial needs expand by offering them new products tailored to their changing financial needs.
By getting them acquainted with automated banking at an early date and by constantly increasing the number and quality of services offered through their automated branches that are much cheaper to open and maintain, Sanwa hopes to improve customer contact, reduce customer migration and keep cost low. They now have over 1000 automated branches, more than any other bank. By targeting and reinforcing the technological bias of this group, they are thus using IT to influence customer behavior, tie them to Sanwa on an interactive basis, and grow an increasingly profitable customer segment. But for the strategy to work, Sanwa must gather and manage a range of information about this client base so they can offer products in a personal and timely way while constantly improving the efficiency and user appeal of their systems. Interestingly, this approach avoids the problem of some US banks that have unsuccessfully tried to change existing client behavior to force them to use electronic systems. Rather, Sanwa’s view is to match products and delivery systems with the targeted customer segment. In this way stay truly customer oriented since they continue to serve traditional clients through their branch network. In sum, Sanwa has studied each segment and knows what products and services it wants and how it wants them delivered. It uses IT to monitor these and keep the information in service delivery loops so when a customer event occurs they can solicit related business. This reinforces customer acceptance of the life cycle approach.

Comparison US and Japanese firms: IT and Organization

All our leading software users in the US and Japan face environments where they must justify using their products or services to increasingly cost conscious customers in terms of improved performance and benefits while developing new products and services that are more complex and often more expensive. Yet, they recognize only by developing and marketing their products in such a manner can they grow and prosper. Further, these products, especially manufactured goods, must often be sold on a global basis to amortize high development costs or the cost of continual improvements. To do this efficiently requires sophisticated techniques to acquire and manipulate large amounts of data in a standardized manner at several levels, including development, production, marketing, delivery and after sales service or performance. Therefore successfully using systematically gathered data as well as sophisticated analytical methods in their decisions is critical to their business and future growth.

However, even though the need to use IT in this manner is clear, the leading users believe the purpose of these systems is to improve their firms’ existing decision-making skills which is what has been responsible for their success. Therefore, using IT systems should not result in automatic managerial decisions but should rather improve the quality of the firm’s decisions by enhancing a manager’s experience and judgment. Thus, even though one important use of software is to facilitate better communication, these firms still use face-to-face communication among managers in formulating strategies and making decisions, including those related to IT.

At the same time, they do not believe the more information everyone has the better, i.e. that all information should be freely shared among everyone in the firm. They consciously try to create some barriers among employees to limit information flow to those with some need to know. Still using software enlarges and extends employees’ knowledge domains. So particularly highly qualified representatives generally have full access to such information since it is most valuable when those with good judgment understand and use it.

Nevertheless, these firms’ basic approach of using IT to enhance and improve existing core competencies avoids many organizational dilemmas since people can see their effectiveness and the company’s competitiveness is improved without the need for substantial reorganization and its
accompanying disruption. This strategy contrasts with companies such as Bayer that use a minmax approach to software use and development (Track 1997). This is because such an approach focuses on achieving maximum user functionality for the least cost. Under these systems, a firm uses low cost software packages if they achieve 80% of the functionality users request without evaluating whether the additional 20% of functionality represents a critical added value or is important to maintaining a core competency. Also, this approach stresses centralized IT control more to facilitate upgrades than to develop strategies and allocate resources. Thus firms using the minmax strategy do not support certain functions even when the user may require them to efficiently utilize an historical database or certain programs which may only be available for a MAC or VAX system. Further, the minmax strategy is typically supported by a review process with a check list of 20 to 25 benefits that are evaluated for each IT project. This procedure makes it difficult to isolate and value one or two key business factors in terms of IT integration or the enhancement of core competencies critical to the business (Track 1997).

The press and various reengineering specialists have stressed that one outcome of improved information systems is a flattened organization because it is easier for top management to communicate with lower levels, and middle management is no longer required to process information or to manage and set objectives for smaller units. Being able to eliminate middle managers saves money and is thus cost efficient. But the leading users examined in this study did not generally note these benefits and when they mentioned them felt any such effect from the increased use of IT has been indirect, i.e. they have flattened their organization first to prepare for future competition and make each person’s responsibilities clearer. They had to become slimmer because their competitors did.

Rather from these firms’ perspective, the role of IT has been to assist each person to be more productive in their defined responsibilities. Easier monitoring of subordinates via improved information systems has not been a reason for moving to a flatter organization. This result is similar to other responses from these companies that indicated the role of IT has been to enhance and extend existing strategies and core competencies rather than to restructure or change the organization. At the same time, through a creative mix of customized, semi-customized and packaged software, these firms have created information systems and organizational supports for these systems that have significantly improved their competitiveness in several areas. An important aspect of this development has been the interactive linking and control of various functions that previously were relatively separate within the organization such as R&D, manufacturing, marketing, sales and after-sales service.

Thus, one important common organizational aspect of the “best practice” firms is the integration of IT into their organizational structures through the extensive use of cross functional groups and committees to organize and monitor IT activities. In this manner marketing, production, etc. are all involved in assessing and managing different software projects giving them a better appreciation of the interlinks between the firms’ different functions and the role of IT in assisting this process as well as in enhancing various business capabilities. This has then facilitated implementation of IT strategies and these firms’ ability to capture beneficial feedback at different points in their overall business, demonstrating the competitive power of “controlled production”. These results are consistent with Professor Harker’s study (Wharton 1998) of call centers that indicates a proper balance of human organization and the IT system is critical to success since customers impose limits on the system’s complexity and employees’ ability to understand and manage it.\(^5\) He concludes, as do we from our case

studies, that: “IT spending alone does not correlate well with improved performance. ... the key is ‘smart design’ and paying attention to process impact.”

**Theoretical and Research Extensions of Case Study Results**

These case studies appear to support certain current theories regarding innovation and strategy while rejecting others. In particular, these leading US and Japanese firms seem to have specific rules and organizational routines for managing IT both generally and in terms of innovation. These rules and routines seem to regulate and limit the number of variables to be changed at one time and specify how the results of the changes are to be measured. This process would therefore appear to support evolutionary theory in terms of organizational approaches to innovation (Nelson and Winter 1982). Thus, best practice in using IT evolves and is path dependent with competitive advantage accumulating over time.

Further, because for these firms best IT practice is used to enhance existing core competencies, these cases support the strategic literature (Teece, Pisano, and Shuen 1990) which stresses that firms compete by constantly modifying and extending existing core competencies. At the same time, these firms’ success in using IT to improve competitiveness means they have added “using IT” to their existing core competencies and made it a fundamental part of their business strategies and the way they develop their organizations. But while the cases contribute to both the literature on evolutionary growth and core competencies, they also raise interesting new strategic and competitive issues that extend into other areas of research. One such area of course relates to “controlled production”.

“Controlled production” raises the possibility that certain firms use IT to influence their external environments or to establish a sustainable competitive advantage. One way they seem to do this is that by making IT competitively important, systems’ development time, organizational integration and IT development costs become important competitive variables. Since such systems are subject to copyright law that can extend intellectual property protection indefinitely (Rapp 1998), the possibility for very long-term monopoly profits (rents) becomes both an important policy and competitive issue. It also means the Microsoft model of increasing returns to scale (Aley 1996) can be extended to more traditional industries where in these cases systems costs get spread over more and more customers via their purchase of cars, steel or financial products. It would be logical that the greater the importance of software either organizationally or embedded within the product or service, the greater the possibility of increasing returns and the impact of user base economics (Aley 1996 and Rapp 1998). Both these developments argue for greater industry consolidation. This certainly has been a factor in retail banking mergers but may extend to pharmaceuticals, steel, and autos as well.

When the concept of increasing returns and path dependency in terms of best practice are combined with continuous intellectual property protection, many of our classic concepts of competition and the global competitive environment are challenged. It becomes difficult in such industries for firms to catch the leaders by leaping to best practice as we hypothesize in a perfectly competitive neo-classical environment or even in a perfect oligopoly. Not everyone has access to the same production function and markets. This is true organizationally, economically and legally.

In this kind of competitive environment, there will be a premium on firms using IT to develop and enhance alternative approaches to each industry’s worldwide competitive environment. In this respect the case studies show there are several paths that can be pursued to competitive success as long as firms recognize their existing strengths and their actual competitive situation. Hopefully future case studies and research will therefore focus on the existence and interplay of these issues as well as the
way different firms in various industries approach these problems. The results are bound to be interesting.

Appendix: Common Case Methodology and Questions

Methodology

These cases have been developed using a common research approach that examines cross national pairs of firms in key industries in the manufacturing and service sectors. In principle, each pair of case studies focuses on a Japanese and American firm in an industry where software is a significant and successful input into competitive performance. The firms examined are ones recognized by the Sloan industry centers and generally by the industry as ones using software successfully. To develop the studies, we have combined analysis of existing research results with questionnaires and direct interviews. Further, to relate these materials to previous work as well as the expertise located in each industry center, we have held working meetings with each center. We have also coupled the new questionnaires with the materials used in a previous study to either update or obtain a questionnaire similar to the ones used previously. This has enabled us to relate each candidate and industry to earlier results. We have also worked with the industry centers to develop questions related to a firm’s business strategy and IT’s role within that. Some questions address issues that are relatively general across industries such as inventory control. Others such as managing the drug pipeline or pricing derivatives are more specific to an industry. The focus has been to establish the firm’s perception of its industry and its competitive position as well as its advantage in developing and using a specific IT strategy and approach. The team has also contacted customers, competitors, and industry analysts to determine whether competitive benefits perceived by the firm are recognized outside the organization. These sources have provided additional data as well on measures of competitiveness and on industry strategies and structure.

The case studies are therefore based on interviews by the project team on software’s use and integration into management strategies to improve competitiveness in specific industries, augmenting existing data on industry dynamics, firm organizational structure and management strategy collected from the Sloan industry centers. In addition, we gathered data from outside sources and firms or organizations with which we worked in an earlier project. Finally, the US and Japanese companies in each industry who were selected on the basis of being perceived as successfully using software in a key role in their competitive strategies in fact saw their use of IT in this manner while these competitive benefits were generally confirmed after further research.

All firms selected are large and significant competitors in their respective markets and use software, both innovative and packaged, synergistically with their business and organizational strategies to achieve competitive advantages. Furthermore, we believe the way these firms use IT and integrate it with their organizational and business structures to efficiently manage increasingly complex businesses, including learning from mistakes, should help other managers improve the consistency of their performance in terms of increased productivity, greater profitability, and better quality. We wish to thank the many Sloan industry research project teams who have cooperated with this study. These include the computer and software center at Stanford, the semiconductor and software centers at Berkeley, the financial services center at Wharton (University of Pennsylvania), the pharmaceutical and auto centers at MIT, the steel project at Carnegie-Mellon and the food services project at the University of Minnesota.

Questions
In undertaking the studies, the project sought to answer a set of key questions while recognizing firm, country and industry differences. Several of these were discussed above. Also, during our research and interviews, other important issues were raised that we tried to clarify for each firm and its use of IT to achieve competitive advantage. The questions are broken into the following categories: General Management and Corporate Strategy, Industry Related Issues, Competition, Country Related Issues, IT Strategy, IT Operations, Human Resources and Organization, Various Metrics such as Inventory Control, Cycle Times and Cost Reduction, and finally some Conclusions and Results. They cover a wide range of issues from direct use of software to achieve competitive advantage, to corporate strategy, criteria for selecting software, industry economics, measures of success, organizational integration, beneficial loops, training and institutional dynamics, and finally inter-industry comparisons. A detailed list of questions is available or see Rapp (1999), Cabolis (1999), and Amari (1999 & 1999a).

References


