CUSTOMIZED SOFTWARE
Strategies for Acquiring and Sustaining
Competitive Advantage: A Japanese Perspective

William V. Rapp
Chair in Economic Relations with Japan
Centre for Asia-Pacific Initiatives
University of Victoria
Victoria, BC

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ABSTRACT

This paper examines the question of whether the extensive use in Japan of customized software is merely an inefficient anachronism perpetuated by large Japanese companies' investment in their existing information systems or whether it in many cases is an integral part of these companies' corporate strategies for gaining and maintaining competitive advantage. In the latter case, the apparent inefficiencies and expense of using customized software when looked at in isolation can be more than compensated for by improved productivity advantages accruing to the firm as a whole. That is, from a total cost standpoint the Japanese approach may be quite sensible and efficient. Based on the results of a larger study of the Japanese software industry, it is the author's conclusion that in fact in many industries customization does in fact contribute significant competitive and cost advantages to large Japanese users. In addition, it is a way for them to institutionalize certain tacit knowledge and organizational advantages, including incremental improvements, that is extremely difficult for competitors to acquire or emulate.

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I.   Introduction

This paper examines the proposition that customized software in the Japanese market is used by Japanese companies as an integral part of their strategies for gaining and sustaining global competitive advantage on a long term basis. It thus postulates that large Japanese customers' (purchasers of software) persistent use and development of customized software, despite its high cost, is rational and economically efficient in terms of their own industries and competitive environments. This is true even though most analysts generally see Japanese firms' extensive use of customized software as an historical anomaly that has saddled them and their managers with inefficient and technologically backward software systems.

Further, interviews with several large customers, as well as software suppliers, indicate that the high cost of converting to new systems and the slow pace of incorporating newer hardware and software technologies into their existing organizational software systems, means the extensive use of customized software by large Japanese customers will continue for some time. Therefore, the issue of economic efficiency and rationality is important for Japanese industry, their foreign competitors, Japanese software developers, MITI officials and foreign packaged-software companies. This is especially so since many industry analysts see the current system as inefficient and predict custom software's replacement by packaged software solutions, particularly open systems, as inevitable and proceeding quickly (Murchinson 1995, JISA 1993 & 1992 and Boyd 1995).[1]

The outcome of this debate is critical to the evolution of the Japanese software industry since over 85% of current Japanese software expenditures are on customized

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[1] The conclusions reached in this paper are based in part on a recently completed two year study of the Japanese software industry done under a Japan-US Friendship Commission grant. Several large users in various industries were interviewed along with industry experts, industry associations, software developers, integrated systems producers and government officials. A complete report of the research findings has been filed with the Commission and diskettes containing it are available from the author on request (Rapp 1995).

software (MITI 1993 and Boyd 1995). Indeed, an even higher percentage of large customers' software expenditures is for customized systems if their internal costs are included (JISA 1993 and Baba et al 1995). In addition, the industry has shifted from one determined by producers strategies to a user driven paradigm (Baba et al 1995 and Rapp 1995). Therefore, understanding the actual dynamics of the customization versus package software decision process is critical to any assessment of the development of Japan's software industry.

Also, the mainframe and minicomputers used by larger EDP customers are particularly wedded to customization. Since they presently account for over 80% of the software market, the persistent use of customized software will affect the trend to downsizing of computer systems and open systems too. Most PCs as well as workstations are used in offices rather than homes, and must be tied into the company's overall mainframe and minicomputer system. So their adoption becomes part of the customization framework. Because both companies and employees desire to integrate PC use with the firm's information systems, customization of even packaged PC software is actively pursued in Japan and such usage decisions by large customers influence the sale of PC software. When one considers that Toyota alone will buy 25,000 PCs for its office workers this year, almost 1% of Japan's total PC market, the customization issue for packaged software developers is clearly drawn. In sum, while Toyota and others are gradually downsizing, they also maintain their existing highly customized systems and continue to pursue customized or semi-customized solutions software across the board.

Yet large customers' apparent continued preference for customized software, even for the newer downsized systems, seems at odds with its high costs and stated inefficiencies as perceived by government officials, industry analysts and software developers, particularly foreign packaged software developers. Further, though an historical artifact and market anomaly compared to the US or Western Europe, the widespread and continued use by Japan's leading, best managed and most efficient producers raises questions concerning the actual nature of its inefficiencies and the inevitability of its elimination.

MITI, of course, correctly understands that Japanese companies' continued emphasis

on using customized software is an important obstacle to Japan's development of a globally competitive packaged software industry (Rapp 1995). However, this paper concludes that the focus on the packaged software industry and the high cost of customization represents only one dimension of a much more complex economic and competitive situation. These customized systems are an integral part of what makes Japan's leading companies competitive in producing and marketing their own products and services. From this perspective, large Japanese firms can be seen as being expert and sophisticated world class users of software, even if they are not world class developers of packaged software. In fact, they may represent the leading edge of what the U.S. International Trade Commission sees as an important new trend for the global software industry (Brown, Johnson and Warlick 1995). "Vertical market expertise is particularly important as an increasing number of clients choose to enhance competitiveness through effectively integrated information technology systems."

The higher manufacturing productivity of their lean manufacturing systems, including supporting organizational and software developments, justifies the continued use of customized software and is thus quite rational. Indeed, from both a firm and a national economic viewpoint, using customized software may be more efficient and productive than trying to use a less expensive packaged software solution that results in lower productivity in processing and manufacturing, as already documented for the automobile industry (Krafcik 1988, Womack, Jones and Roos 1990 or Clark and Fujimoto 1991). American software customers relatively greater reliance on packaged software, though less expensive at the EDP level, may sacrifice process innovation and superiority at other points in the value added chain. This would explain Japanese firms' heavy customization of packaged software to conform with their unique and proprietary software systems.

II.   User Driven Paradigm

The market for software in Japan and the continuing demand for customized software is thus being driven by large Japanese companies' perception of their software requirements as part of their total operating systems. Currently, these perceptions are being determined by three major forces: first, their own competitive evolution since the 1950s, second, the

historical development of the Japanese computer industry, and third, current technological trends in their own industries and in computers and computer software. In this sense, their decisions are path dependent.

The interview results show that software customization is, in fact, part of a system of rules and routines to which Japanese firms appear to be institutionally committed and which are thus very difficult to change, even when they may not be optimum in terms of current software and computer technology (Rapp 1992). However, in most cases, this decision on software usage and development appears related to a firm's commitment to other routines as a way to maintain its competitive advantage in its own businesses. This conclusion concerning the origins of Japan's management practices as they relate to software in turn seems important to understanding the future of the Japanese software industry as well as the user industries themselves. Other competitive or use criteria than just the price and quality of the software are generally involved in software purchase or usage considerations. These factors are frequently historically based and indicate that an evolutionary approach is likely to give the best analytical results (Nelson and Winter 1982 and Rapp 1995).

Foreign governments and industries, including the US, have expressed policy concerns whether the strategies, rules and routines that succeeded for Japanese corporations in certain industries were applicable to computer software. The global competitive success of many Japanese firms made this argument quite logical. However, the persistence of customization makes it appear that, instead, the Japanese software industry has been co-opted by the strategies of its large user industries, such as steel, automobiles and consumer electronics. Computer-related software is an essential input into virtually all forms of manufacturing and services, but in terms of cost, is usually a relatively small percentage of the total required to produce and deliver a product or service. Therefore the economics of those businesses, rather than the economics of the software industry, ultimately determines large organizations' demand for and usage of software (Baba et al 1995 and Rapp 1995). In turn, those economics continue to stimulate large customers' extensive use of proprietary software systems to maintain or improve competitive advantage. This trend is now emerging in the US. (Brown, Johnson and

Warlick, 1995). Nevertheless, because of these customers' continued commitment to customization, Japanese software suppliers have not been successful in transferring to software development Japan's successful corporate production practices based on the continuously improved production of standardized products in large volume (Imai 1986). But neither has there been a large incentive to do so.

In contrast to the 1960s and 70s, most large customers are presently buying software from multiple vendors. Large integrated systems suppliers now find that only about 10% of their customers buy exclusively from them. Thus, at one level the issue of group affiliation and historical ties appears less important in software usage than in some other industries. But at another level it has become more intense. Most large software buyers have created software development subsidiaries as a way to centralize their management and cost controls over software use and development. These subsidiaries are thus part of the parents' vertical *keiretsu*. In this respect, they try to reduce their costs per software system developed for the *keiretsu,* while maintaining their tacit expertise within the group by selling their customized software to other group members. Additionally, the subsidiaries and the companies' traditional mainframe supplier are managing the semi-customization process where outside and particularly foreign packaged technologies are heavily modified in order to work on the customer's proprietary system.

Thus, such software development subsidiaries and affiliates specialize in producing customized software or in heavily customizing package software for their parent's and group's use. These parent and group purchases account for between 50 and 100% of the software development affiliate's total sales, with the average about 70% (interviews and Baba, et al, 1995). More importantly, for the structure of the Japanese software industry and in determining future trends, the affiliates are among the very largest software companies in Japan, and serve several functions.

In addition to helping control costs, the affiliates offer careers to specialized EDP personnel outside the parent firm's personnel system. They also expand the firm's software user base to reduce the overall cost of maintaining a proprietary software system. The multi-subsidiary, as opposed to the multi-divisional, approach to Japanese corporate organization has a long history in Japan and appears to be a preferred organizational form

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when, as in this case, it meets firms' basic strategic objectives. Yet, the importance of this phenomena cannot be overestimated for Japan's software industry and large customers' software usage. These captive developers are increasing their market share while the independent developers and systems integrators are losing sales and going bankrupt in record numbers (Baba et al 1995). Indeed, five of the top ten software developers are affiliates (Rapp 1995) and 53 out of the largest 100 (Baba et al 1995).

As might be expected from this analysis, most of this customized software is for proprietary application programs (Boyd 1995). Most large customers buy their operating and middleware systems from hardware vendors or specialized software developers. They then develop their own proprietary application systems either internally or through their software development subsidiaries, rather than purchasing standardized packages off the shelf (Rapp 1995). So application software accounts for a smaller part of the packaged market than it does of the customized market. However, even when application packages are bought, they are usually extensively customized, except for simple word processing and spread sheet programs.

Results from the questionnaires and interviews indicate the cost of semi-customization usually runs about two to three times the cost of the basic package. This situation has forced most software developers and systems integrators to specialize by industry. They are then quite dependent on specific customers in those industries, each with their own large proprietary systems, thereby making software demand sensitive to developments in such customer industries. The close affiliation between software developers and specific firms has the disadvantage of limiting the former's familiarity with other software systems and has created difficulties in rewriting code for the newer open systems. It has also made large numbers of existing programmers and software engineers heavily specialized with limited skills or interest in developing more generalized packaged software solutions or learning new programming languages.

From this description it can be seen that leading Japanese software producers and most major customers have developed their software systems in an evolutionary manner to incorporate specific technologies and routines to achieve definite business purposes. These systems and routines largely determine their future software requirements. Because

of this evolution, Japan's software industry now faces some distinct competitive disadvantages relative to foreign packaged software developers that Japanese policy-makers are trying to address. At the same time, such systems appear to have created barriers-to-entry in the industries that are using them, helping to continue those industries' and their firms' global competitive advantage. Indeed, to the extent the Brown, Johnson and Warlick (1995) study is right, it may have given them a headstart in a more global trend where "spin-off firms growing out of joint-ventures are likely to emerge as competitive providers of specialized information technology services ...".

Contributing to this overall condition, is the fact that Japan's large mainframe producers are confronting difficulties in modifying their production processes to accommodate rapid changes in software technology. Their past competitive success in manufacturing and competing for market share based on distinct operating systems has hindered their adaptation to new circumstances. Further, many continue to be successful hardware manufacturers, limiting the resources they can or want to devote to software development, while applying their successful manufacturing routines to software has not developed a large user base for packaged software. Rather, it has helped them control the cost of continuing to develop customized applications, perpetuating the current paradigm. Finally, to maintain technological parity for their own and their customers' information systems, many have entered into strategic alliances with US and other foreign packaged software developers to adapt the former's advanced software technology and developments to their operating systems. This has further contributed to the custom/semi-custom approach to software usage and development by large customers.

III.   Structure of the Japanese Software Industry

The strategic objectives of the foreign packaged software developers have been neatly complemented. The heavy front-end development costs and low cost of reproduction for packaged software systems have made expanding one's user base the primary goal for foreign software producers (Rapp 1995, Steinmueller 1993). Structural differences between the Japanese and US software industries have particularly favored US producers. For example, the relative ease of completing acquisitions in the US compared to Japan, despite

some recent US Justice Department actions, gives US packaged software firms a distinct advantage in rapidly building or expanding their user base. Indeed, responding to such forces, firm expansion via acquisition appears to be a major trend in the US and Canada as witnessed by several large recent transactions across a range of software segments, e.g. IBM-Lotus, Adobe-Aldus, and Computer Associates-Legent.

Large structural and software demand differences between the US and Japan have also severely hampered Japan's expected rapid technological convergence in computer and software use with the US relative to downsizing and open systems. Thus, it is not surprising that predictions in Japan of the end of the mainframe and its inevitable replacement with network servers have proved highly exaggerated. MITI surveys that showed user interest in downsizing and open systems failed to specify the extent or degree with which such downsizing would take place or the desired continuation of customization within this framework. Therefore, corresponding predictions about the rapid growth in packaged software sales turned out to be inaccurate as well (AEA 1992 and Boyd 1995), since increased use has actually depended on their customization requirements and the ability of customers to quickly integrate the packages into their proprietary operating systems.

In sum, software system convergence is not occurring in Japan. The increased use of servers and workstations for downsizing, while progressing in Japan, is only happening at the margin. Further, even what is happening will take 10 to 20 years for many major firms to achieve. In addition, at the conclusion of their adoption plans, mainframe activities will still represent 30% to 50% of large customers' EDP expenditures. Downsizing and the shift away from mainframes is thus proceeding only very gradually in many industries and end uses. The degree of shift appears closely related to a firm's need for large data bases, security and access control, existing programming systems (i.e. installed cost), large processing or computational requirements, and high speed mission critical operations. Finally, the software to connect and operate these newer systems must still be customized or semi-customized to integrate it with the firm's overall unique proprietary software system.

From this perspective, Japanese EDP and MIS managers in leading firms seem to

be moving much more slowly than their US counterparts due to their different system and business requirements. Reliability and continuous operation appear to be more critical variables than possible cost savings or increased flexibility. However, the organizational changes required to maximize the use of such systems seem to be difficult for Japanese firms to adopt as well. Downsizing and possibly increased labor redundancy are potential negatives. In addition, customized Japanese application software in the areas of Japan's competitive strength such as steel, autos or consumer electronics production technology appears to be quite competitive on a global basis and is a key part of the foreign direct investment (FDI) in these industries (Dalton and Genther 1991, Florida and Kenney 1991 and Rapp 1993).

While MITI is concerned with the implications of this situation for development of a packaged software industry, this situation causes little stress for most large customers. In the interviews, most could not name a single major Japanese producer of packaged software other than for word processing. Yet they did not feel their dependency on adapted foreign packaged software was a business or policy issue so long as it met their requirements. Further, their continued emphasis on customization and the relatively small share (5-15% depending on the data source: MITI 1993, JISA 1993 and Boyd 1995) of packaged software in overall software use from 1991-1994 means their real dependency has also been relatively small. It is hardly surprising that MITI officials readily admit past policies have failed and that they are looking for new software industry policies (Nakahara 1993). But unlike the situation for computers and semiconductors in the 1960s and 70s, government has little influence over software as large customers and producers pay scant attention to its policies and initiatives.

The permanent employment system, often considered a plus in early high growth periods, also acts to support the current customized approach to software use and development. Software engineers and programmers feel little compulsion to leave their existing firms to start new ventures, since their skills are highly focused on the requirements of maintaining and expanding a specific company's existing large installed base and proprietary software system. The employment structure thus facilitates the extensive use of customized software and the necessary personnel resource allocation.

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Indeed, such institutional arrangements have tended to lock the EDP departments of large Japanese firms more into their software history and older programming languages such as COBOL than their US counterparts who purchase more packaged software (Steinmueller 1993). Under these circumstances, cost improvements come more from experience curve economics and subsequent manufacturing efficiencies for their products than from the user base economics that determine global competitiveness in packaged software (Cusumano 1991 and Rapp 1995).

Large integrated systems producers are no longer the dominant force shaping the software market as they have been in hardware (Anchordoguy 1989). Influence has shifted to the large systems customers. Some feel this shift has implications for Japan's entry into the Information Age as a "Supra-Industrial Society," as opposed to a "Post-Industrial Society". Some analysts have even hypothesized that Japan's transition to the Information Age will be adversely impacted by its weakness in software development (Coultas 1994). However, this paper concludes customization is simply a different path.

The research results show that Japanese weakness in packaged software is due to continued fragmentation of its industry based on customer economics, not because of any cultural advantages the US may have in writing software or US managers' ability to better or more quickly introduce new software systems as some have hypothesized (Delaney 1994). In turn, this fragmentation has perpetuated the overwhelming allocation of Japan's computer software resources to the mainframe and customized market. A cycling effect is at work, where the existing base of incompatible operating systems and installed proprietary software necessitates constant customization even of packaged products to both maintain and upgrade each customer's system. Having put in more resources, the existing commitment to the old customized system is increased, forcing the continued allocation of resources to maintain it in the future, including the training of personnel to use older programming languages. This situation is accepted due to the small impact on final product cost and perceived benefits, such as supporting superior processing technology and organization.

The resulting industry structure has facilitated foreign firms' dominance of the Japanese market for packaged software for PCs and workstations, given their large global

user bases and close relationships with the most widely diffused microprocessors and operating systems (Cottrell 1995). Their strategy of successfully developing alliances with the major integrated systems producers has proved effective as well (Rapp 1995). This is part of a a hub and spoke strategy that permits them to adapt their packages to the various Japanese operating systems and thus access the widest number of customers, expanding their global and Japanese user bases and therefore improving their cost position (Kitzmiller and Throne 1993).

IV.   Customization Commitment: An Historical Anomaly?

From this analysis, one can see that while large Japanese users' continued emphasis on customized software is part of a larger historical legacy, its continuation serves the current needs of several important industry players. Understanding the origins and development of the Japanese computer industry makes this clear. The Japanese Government's computer industry policies in the 1960s and 1970s led to multiple platforms and operating systems as fledgling Japanese computer manufacturers entered agreements with a variety of foreign producers (Anchordoguy 1988, 1989, and AEA 1992). These firms, in turn, became technologically isolated as these foreign partners were consolidated or exited the business. Further, to compete with the growing global power of IBM, the large integrated Japanese producers supported by government subsidies gave away software to lock-in their customers (Anchordoguy 1989). This "free good" combined with additional internal expenditures to greatly increase customization by these large customers (JIPDEC 1993). The installed total now amounts to billions of lines of code, with most large customers having hundreds of millions of lines of installed customized software that works and is an integral part of running their businesses.

Despite this large installed base, however, large customers support localizing and adapting foreign packaged software, together with a shift towards greater system flexibility and openness, provided these localized foreign software packages and open systems can be integrated into the customers' larger customized systems. This is called semi-customization and is currently closely associated with the growth in the demand for packaged business software and represents the high growth part of the business software

market. Costs can be kept down and yet still constantly incorporate new software technology into the existing system while maintaining the large firms' systems and computer heritages. Customers' mainframe operations are "locked-in" to their Japanese integrated systems' supplier so the systems suppliers support this trend as well. The current approach effectively manages and upgrades the multiple systems and incompatible platforms existing in Japan due to the various historical ties that have left a hardware/software environment strategically difficult to change, especially for large mainframe systems that support large firms' mission critical applications.

V.   The Size and Growth of the Japanese Software Market

These developments can be seen in the estimated size and growth rate of Japan's software industry by market segment:

Estimated Growth Rates 1990-94 by Market Segment (%)

	Custom	Packaged
Mainframe software	5.0	7.2
Mini Computer software	7.3	11.8
Work Station software	13.3	34.7
PC software	10.3	12.0

(Source - Rapp 1995 based on JISA & MITI 1993)

One can see from these figures that, as expected, mainframe software sales are growing more slowly than that for minis, work stations, or PCs. This pressures mainframe producers to strongly defend their existing customer base. Further, while the mainframe software market is very large (estimated at Y2409 billion in 1992 of which Yen 2233 billion is customized, with growth for 1991-94 estimated at 5.0% p.a.), the high growth opportunities are in downsizing and related applications, both customized and packaged.

However, it is also clear that Japanese firms are not abandoning customization and moving aggressively towards packaged software solutions as part of the downsizing and

open system process. Rather, as described above, they are quickly shifting to semi-customization, with packaged software purchases entailing substantial customization. This can be seen in the following market forecast where, because packaged software starts from a low base and customizing it runs about 70 percent of total cost, compared to customized software's current 85 to 90 percent of the market, packaged software only appears to be growing faster. Ultimately, its share will level out at twenty to twenty-five percent of the market, not including internal software development costs.

Customized & Packaged Market (Yen billions)

	1992 (Estimate)		
	Custom	Package	Total
Total	**3635**	**661**	**4296**
Mainframe	2233	176	2409
Mini	550	56	606
Work Station	545	95	640
PCs	305	336	641

VI.   Difficulties and Cost of Conversion versus the Benefits of Customization

Strengthening this trend is that the cost of converting and adapting packaged software and the new open systems, including network servers and workstations, to the installed proprietary systems is much cheaper and easier than converting the proprietary software systems to work on the new hardware and operating systems. Firms have limited numbers of programmers and system engineers familiar with the new languages and able to check the converted systems. At the same time, these individuals are needed to develop new systems or to adapt and integrate purchased programs to the corporate system. In addition, they have few incentives to learn new programming languages and systems while they are needed to maintain existing ones and monitor the overall system. Adding to this perceptual imbalance is the fact that large scale conversion programs from COBOL to C++ do not exist, while the new converted programs would in any case have to be checked and run in

parallel. Finally, the risks from a problem are of a very different scale with respect to the two approaches. Installed mission critical mainframe systems supporting data bases and key operating systems involve hundreds of millions of lines of code and work, with the risk of a failure unacceptable! On the other hand, a single new packaged program can be vetted and tested before it is installed, with little risk to the overall system.

There are the additional perceived benefits from customization too. Customized systems are seen as institutionalizing and permanently incorporating the firm's tacit knowledge and processes (rules and routines) from the shop floor and other business areas into an integrated whole, while maintaining secrecy and restricted access. Then, through the permanent employment structure, firms can realize a return on the cost of training staff in the unique features of their proprietary systems, including the operating system, without raising employee mobility concerns. This helps the large firms compensate for Japan's relatively weak education in computer science (Baba et al 1995 and Brown, Johnson and Warlick 1995) through specialization and on-the-job training in the firm's unique system for an extended period. This process includes learning to use and manage its software and EDP's finely tailored adaptation to the firm's business, processes and operating needs.

The use of dedicated software subsidiaries that specialize in developing and adapting software to the business and competitive needs of the firm and its group rather than just accommodating a purchased system is of course a key aspect of achieving these perceived benefits. It also fits well with the intra-industry strategies of the large established firms in transportation, steel, electronics, finance and power (Rapp 1992) and their historical emphasis on process versus product innovation, supported by specialized software development. Their experience and skill at adopting and adapting foreign technologies to achieve sustainable advantage makes them feel very comfortable with this strategic routine, as does the emphasis on continuous improvement (Imai 1986) in software support and the use of new technologies. Nor is a currently weak Japanese Government able to press for institutional or strategic changes in these established rules and routines as they did in the 1960s and 1970s in computers (Anchordoguy 1989 and Rapp 1995).

VII.   Persistence of Customization

Leading Japanese companies feel comfortable and committed to this process because in most of Japan's competitive industries, these leading firms have generally gained competitive advantage by adopting and improving products invented elsewhere (Rapp and Abegglen 1972, Abegglen and Stalk 1985, and Rapp 1993). They have usually done this through process innovations that have not only enabled them to acquire competitive advantage but to sustain it through their ability to do high quality precision manufacturing in volume at constantly lower costs (Imai 1986 and Womack, Jones and Roos 1990). Apparently, customized software has been a fundamental aspect of this development, especially when closely linked and integrated with corporate culture and organization. Therefore, their commitment to customization is not going to change!

Actual implementation is presently via increased semi-customization and a "three tier" hardware system where customized middleware is the element that integrates minis, PCs and workstations into the overall system managed by a mainframe. This and other adapted software is already localized for language and format as well as converted to the system suppliers' mainframe platforms before the large customer has it semi-customized for its own proprietary system to satisfy their unique processes and other business needs.

Large customers like to control this process and the system integration because they try to incorporate their tacit learning from the shop floor, their permanent employees and their captive customer/supplier base (Baba et al 1995). This enables them to maintain their special or unique system and process advantages where software is both an important input and institutional arrangement with little chance of leakage to competitors. Customized software is thus one way Japanese firms incorporate and institutionalize continuous process innovation, competitive advantages, and tacit knowledge. In this respect, software development has been a key part of a firm's competitive evolution from imported technology and products to global competitiveness, including its organization and the integration of suppliers and customers into a network. This closely links corporate culture, competitiveness and software systems. It also creates potentially large competitive barriers to entry if these systems must be copied to achieve similar productivity results. In those cases, software system barriers could affect the ease with which foreign firms can copy or emulate such practices as lean production, thus questioning an essential policy proposition

of Womack, Jones and Roos (1990). Yet, the trend towards vertical integration and specialized software in certain industries as a way to enhance competitiveness, identified by Brown, Johnson and Warlick (1995), indicates that, at least for some industries and firms, such barriers exist or can be developed. More research therefore needs to be done on this issue on an industry and firm basis to identify what the barriers are and for which industries they are most important.

VIII. Customization Costs: A Total Cost Management Approach

An important business management issue in addressing this question centers on the issue of cost. Presently, many US companies regard their EDP operations as cost centers and therefore something to be minimized. It is not seen as an integral part of their business strategy or as a way to institutionalize certain competitive practices, as their Japanese competitors do. Some representative numbers may put the reasons for this divergence in perspective. Customization in Japan costs 10 - 15 times a localized package or 20 - 30 times its import value. Even a semi-customized product is 5 - 6 times its imported value. On the other hand, a typical US firm using packaged software would expect its costs to increase only about 20% to install it. Thus, a Japanese firm expects to pay more than four times its US competitor to install a semi-customized software solution or more than twenty times for a fully customized version. The differential in software costs on a percentage basis is thus enormous. Shifting to using just a localized and installed package would reduce software costs at least 60 -70 percent. This could save Toyota, for example, about Y3500 per car or over US $150 million per year. For many US EDP managers the decision would be clear.

From Toyota's total corporate perspective, however, there is a potential cost to this conversion, i.e. reducing Toyota's manufacturing and delivery productivity or increasing its inventory and floorplanning costs to US levels (Womack, Jones and Roos 1990). Not even counting capital and other costs, an increase in assembly times by eight hours would increase labor costs alone by over two hundred dollars a car, swamping any benefits from the lower software costs. Japanese managers in steel and consumer electronics firms believe similar cost calculations apply to them. From this viewpoint, packaged solutions

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available to everyone and not tailored to the particular organization and production process could prove very costly competitively.

Examining the future competitive dynamics in software development, continued heavy customization aided by the Hub and Spoke Strategies of foreign software developers seems the most likely scenario. Large customers will assure this by maintaining and further developing their customized systems as competitive barriers to entry, including incorporation into their FDI. This may have potential adverse strategic implications for foreign firms emulating lean production or NICs following the product cycle. To further strengthen their positions, large Japanese customers and systems suppliers will push towards alliances and exclusive licensing arrangements with foreign firms in new software technologies and formats. Their goal will be both to continuously upgrade and maintain the global technological parity of their proprietary systems and to try to tie or control the entry and use in Japan of the new technology. In both cases, the objective is to improve their own relative competitive position and the firm's market advantage from a total cost or total business viewpoint.

Thus they will not just emphasize maintaining technological parity through localization, conversion, and customization of foreign software but actually will seek to improve the firm's overall competitive position in its own industry. While this process will subsidize the entry and presence of independent foreign software vendors in the Japanese packaged software market, it will also improve and maintain the competitiveness of Japan's leading corporations. Of course these large customers will try to reduce software costs, but the approach will be more to reduce costs per line of code rather than to increase revenues or the user base, especially as the latter could compromise the integrity of their proprietary system advantage. Naturally, this means the present pattern of fragmented operating systems and software applications will persist, and non-customized standard packages will not be used except for some operating and network systems for workstations and PCs.

Since the strong yen will continue and may get stronger, self development of software will be very expensive and the added cost of localization and customization will keep even converted foreign software high cost. This is another reason why Japanese

software will have to be customized and integrated by large customers into their proprietary production systems or manufacturing processes to be competitive. But because of these customers' importance to the large integrated systems producers, the latter will assist this development by providing foreign software developers with the necessary operating platform support, either directly or by entering various alliances. The government's role and influence in this process will be minimal. Overall, these developments will force the Japanese software industry in the Japanese market into a structure of profitable niche players affiliated with foreign firms or those supported by the large integrated producers and the large customer groups. Overseas Japanese software will be incorporated into the large customers' successful FDI. This is a user driven paradigm where the goal is to sustain global competitive advantage in the clients' own industries using customized software as a key element in their global strategies.

For those who wish to sell packaged software to Japanese MNCs, a strategy of localization, adaptation and semi-customization using a hub and spoke marketing approach is clear. For those who compete with the firms using customized proprietary systems, the strategic issues are more complex. These companies have seen Japanese competitors consistently improve productivity and successfully achieve their objectives of increased global market share during the postwar period in several major industries and markets. To the extent that customized software has been a key element in achieving and sustaining this situation, it becomes another aspect of Japanese business one needs to understand and manage for both policy and competitive reasons.

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