

"EVOLVING MANUFACTURING STRATEGIES IN
EUROPE, JAPAN AND NORTH-AMERICA"

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EVOLVING MANUFACTURING STRATEGIES IN EUROPE, JAPAN, AND NORTH AMERICA

Our survey of nearly 1000 manufacturers in Western Europe, North America and Japan in the last two years (see Appendix) indicates intriguing similarities and differences in the manufacturing strategies of the companies in these regions. Around the world, manufacturers are placing an overwhelming emphasis on new products and quality. The use of computer power in manufacturing, and continued efforts to reduce headcounts in manufacturing operations are also common themes in Japan, the U.S. and Europe.

The differences between these companies in different parts of the world far outweigh the similarities however. Some of these differences, especially with respect to the Japanese, are in the strategic orientations of the business units with respect to manufacturing. But, there are even greater differences in the way companies from different parts of the globe seek to attain their strategic objectives in manufacturing. These differences in action plans can be explained by fundamental differences in viewpoint, local concerns and problems, culture, and history.

In broad and relative terms, most European manufacturers appear to be preoccupied with a reexamination of some of the structural elements of their manufacturing systems. The Americans are experimenting with a very broad range of new ideas, but seem to be focusing on sophisticated computer-based information systems. The Japanese are focused on the development of unique production processes and technologies.

Our analysis is based on the data we have collected through our "Global Manufacturing Futures Survey" and is presented in four parts: First, we describe the differences that we observe in the pattern of strategic directions and priorities for the manufacturers in each region. Second, we discuss how the companies in each region are implementing their manufacturing strategies. Third, we discuss the vulnerable elements in the pattern of dominant manufacturing strategies which we observe in each region. Finally, we look into the implications of all this for individual manufacturers in each region.

COMPETITIVE PRIORITIES

The primary function of a manufacturing strategy, as suggested by Hayes and Wheelwright (1984), is to guide the business in putting together the manufacturing capabilities that will enable it to pursue its chosen competitive strategy over the long term. Examining the competitive priorities which manufacturers are setting for themselves, therefore, provides a clue for understanding the pattern of manufacturing capabilities that are being developed. These competitive priorities—or using Skinner's (1969) term, "manufacturing missions"—are what the company strategy demands from manufacturing.

Table 1 shows the rank ordering of these priorities in each of the three regions studied.

As Table 1 shows, the Japanese are most different in their priorities from the Europeans and Americans. Consistently in the last two years, they have emphasized the ability to offer low prices and the capability to deal with rapid design changes. The Europeans and the Americans, however, in almost perfect agreement, have been placing high priority on their abilities to offer high quality products and to make dependable delivery promises. Quality scores high also with the Japanese, but not as high as it does with the Americans and Europeans.

The convergence of answers within each of the three regions, and especially in Japan, is rather remarkable: Almost every Japanese manufacturer in our sample considered the ability to offer low prices to be highly important for competing successfully in the next five years; only about three out of five European and North American manufacturers in our sample did so. (Note that in post survey interviews most Japanese manufacturers said that they did indeed weight most highly the ability to offer low prices, but that they would prefer to have the low costs consistent with this emphasis, and the highest prices possible. In other words, their real priority was in low cost, not low prices). Four out of five Japanese manufacturers considered the ability to make rapid design changes to be highly important; again only about three out of five Europeans and Americans did so. On the other hand, almost every American manufacturer and nine out of ten European manufacturers considered the ability to offer consistent quality to be of the highest importance competitively; seven out of ten Japanese agreed. And slightly more than eight out of ten Americans and Europeans considered the ability to make dependable delivery promises to be highly important; less than seven out of ten Japanese did so.

The overall picture which emerges is that the European and Americans seem to be striving for better quality and delivery performance, and the Japanese for better cost and flexibility. One interpretation of this picture is that the Americans and the Europeans are aiming at overcoming what they perceive to be the relative deficiencies of their manufacturing compared to the Japanese, whereas the Japanese, having been relatively successful in both quality and delivery management, are now aiming at developing a new competitive edge which combines flexibility with low cost manufacture. We think this is a reasonable interpretation as it fits the other signals (described later in this paper) which we discern from our data. This interpretation raises the prospect of North American and European firms finally meeting the Japanese threat in terms of quality and delivery, at some time in the future, only to then find a new "flexible manufacturing" threat before them.

The strategic manufacturing priorities of these producers must be interpreted in terms of their overall strategic directions. Table 2 depicts these directions in terms of eight characteristics in rank order of their importance as indicated by survey respondents. Four of these characteristics relate to product-market relationships. On these four, there is no statistical difference between the manufacturers in the three regions. As we said before, the strategic directions of these firms are much the same. They aim foremost at increasing their shares in existing markets with new products.

But with respect to the last four of the eight characteristics, the Japanese seem to again stand apart from the Americans and the Europeans. The Japanese are emphasizing both backward and forward integration much more than their European and American counterparts, and are relying much less on quantum changes in their business, through either acquisitions or divestitures, over the long term.

More upstream integration normally increases the role of the manufacturing function in the competitive strategy of the company. Less emphasis on divestiture and acquisition can also be interpreted as greater commitment to existing businesses. Together, this finding indicates a pattern which is in agreement with the proposition that the Japanese, more than the Americans or the Europeans, focus on the enhancement of the existing capabilities to develop competitive advantage. Especially with respect to the manufacturing function, this proposition has been cogently argued by many observers, such as Moritani (1982), Hayes (1981), and Schonberger (1982).

IMPLEMENTING STRATEGIES

How are these strategic directions and competitive priorities translated into specific programs and action plans in manufacturing? Examination of the concerns of the senior manufacturing managers responding to the survey provides a first clue. In our survey we gave each respondent a choice of 32 different items related to various aspects of manufacturing management, and asked them to indicate the extent to which they were concerned about each item. Table 3 shows, for each region, a list of the top ten items (in rank order) which have been rated to be of most concern.

It is remarkable that consistently over the last two years all three regions expressed concern over producing to high quality standards. The message from the competitive priorities -- which as mentioned above indicated a high emphasis on competing on the basis of quality -- has clearly been received by manufacturing. The Japanese, again very consistently in the last two years, follow this with an almost equally high concern over improvement in yield and reduction of rejects. The Americans seem to have started to pay

Table 1

COMPETITIVE PRIORITIES

<u>EUROPE</u>	<u>NORTH AMERICA</u>	<u>JAPAN</u>
CONSISTENT QUALITY (1)	CONSISTENT QUALITY (1)	LOW PRICES (1)
HIGH PERFORMANCE PRODUCTS (3)	HIGH PERFORMANCE PRODUCTS (2)	RAPID DESIGN CHANGE (2)
ON TIME DELIVERY (2)	ON TIME DELIVERY (3)	CONSISTENT QUALITY (3)
LOW PRICE (4)	LOW PRICE (6)	HIGH PERFORMANCE PRODUCTS (4)
RAPID DESIGN CHANGE (5)	RAPID DESIGN CHANGE (7)	ON TIME DELIVERY (5)
FAST DELIVERY (6)	FAST DELIVERY (4)	RAPID VOLUME CHANGE (6)
RAPID VOLUME CHANGE (7)	AFTER SALES SERVICE (5)	FAST DELIVERY (8)
AFTER SALES SERVICE (8)	RAPID VOLUME CHANGE (8)	AFTER SALES SERVICE (7)

() Rank in the 1983 Survey

Table 2

STRATEGIC DIRECTIONS

Europe	North America	Japan
NEW PRODUCTS/EXISTING MARKETS (4.2)	NEW PRODUCTS/EXISTING MARKETS (4.0)	NEW PRODUCTS/EXISTING MARKETS(4.3)
MARKET SHARE/EXISTING MARKETS (4.0)	MARKET SHARE/EXISTING MARKETS (3.8)	MARKET SHARE/EXISTING MARKETS (4.1)
NEW MARKETS/EXISTING PRODUCTS (3.7)	NEW PRODUCTS/NEW MARKETS (3.4)	NEW PRODUCTS/NEW MARKETS (3.9)
NEW PRODUCTS/NEW MARKETS (3.5)	NEW MARKETS/EXISTING PRODUCTS (3.3)	NEW MARKETS/EXISTING PRODUCTS (3.2)
GROWTH BY ACQUISITION (2.8)	GROWTH BY ACQUISITION (2.5)	BACKWARD INTEGRATION (3.0)
WITHDRAWING FROM BUSINESS (2.5)	WITHDRAWING FROM BUSINESS (2.4)	FORWARD INTEGRATION (2.3)
FORWARD INTEGRATION (2.2)	FORWARD INTEGRATION (2.4)	GROWTH BY ACQUISITION (1.4)
BACKWARD INTEGRATION (2.1)	BACKWARD INTEGRATION (2.1)	WITHDRAWING FROM BUSINESS (1.2)

Footnote: Average weight on a scale from one to five where one is no emphasis and five is critical emphasis over the next five years.

Table 3

CONCERNS

(Ten Highest Rated Among 32 Choices)

<u>EUROPE</u>	<u>NORTH AMERICA</u>	<u>JAPAN</u>
1.PRODUCING TO HIGH QUALITY STDS (2)	1.PRODUCING TO HIGH QUALITY STDS (1)	1.PRODUCING TO HIGH QUALITY STDS (1)
2.HIGH/RISING OVERHEAD COSTS (1)	2.INTRO. NEW PRODUCTS ON SCHEDULE (4)	2.YIELD PROBLEMS/REJECTS (2)
3.LOW INDIRECT LABOR PRODUCTIVITY (3)	3.HIGH/RISING OVERHEAD COSTS (2)	3.AVAIL. OF QUALIFIED SUPVSRS (3)
4.INTRO. NEW PRODUCTS ON SCHEDULE (5)	4.LOW INDIRECT LABOR PRODUCTIVITY (5)	4.INTRO. NEW PRODUCTS ON SCHEDULE (4)
5.HIGH/RISING MATERIAL COSTS (4)	5.YIELD PROBLEMS/REJECTS (10)	5.FALL BEHIND IN PROCESS TECHLGY (5)
6.LOW DIRECT LABOR PRODUCTIVITY (7)	6.HIGH/RISING MATERIAL COSTS (7)	6.AVAIL. OF QUALIFIED WORKERS (10)
7.POOR SALES FORECASTS (6)	7.POOR SALES FORECASTS (8)	7.LOW DIRECT LABOR PRODUCTIVITY (8)
8.AVAIL. OF QUALIFIED SUPVSRS (11)	8.EXCESS MFG. CAPACITY (3)	8.INABILITY TO DELIVER ON TIME (7)
9.HIGH/RISING INVENTORIES (9)	9.FALL BEHIND IN PROCESS TECHLGY (12)	9.LOW INDIRECT LABOR PRODUCTIVITY (12)
10.INABILITY TO DELIVER ON TIME (17)	10.LOW DIRECT LABOR PRODUCTIVITY (9)	10.HIGH/RISING MATERIAL COSTS (5)

() Rank in 1983 Survey

more attention to the yield and reject problems (moving from the tenth place in their 1983 list of concerns to the fifth place in 1984). But concern over yield and rejects is not in the forefront of attention of most European manufacturing managers. (It moved up from the nineteenth place in 1983 to the eleventh in 1984.).

The Europeans and Americans, on the other hand, seem more concerned with costs and productivity issues: High or rising overhead and material costs, as well as low direct and indirect labor productivity, are higher on their lists of concerns than for the Japanese. They are also more concerned with the accuracy of the sales forecast (an item which is remarkably low in the Japanese list). We interpret the repeated references to cost concerns by the North Americans and Europeans to signify that in total, costs are an equal, or even greater overall worry than meeting quality standards for them..

Another similarity among the three regions is in their concern with introducing new products on schedule. The manufacturers in all three regions indicate that the average life cycle for their products is decreasing, and that they (and particularly the Japanese) expect their products to be more customised in the next five years. It is therefore reasonable to see the regions being highly concerned with introduction of new products on schedule.

A major concern in Japan is with falling behind in process technology. Many of the Japanese companies in our survey are generally regarded as technological leaders in their fields, yet, consistently last year and this year, we find the typical Japanese manufacturing manager being highly concerned about this issue. We find this significant and we shall return to it later. The Japanese are also concerned about the availability of qualified supervisors — a concern somewhat shared by the Europeans but not as much by the Americans — and the availability of qualified workers — a rather low concern to the Europeans and a very low concern to the Americans.

The overall picture which emerges shows considerable similarities in the concerns of the manufacturing managers in the three regions. However there are also telling differences among the three regions. "Telling", because they are indicative of the motivation for action on various issues. If we only look at the differences, we find the American and the European manufacturing managers relatively more concerned with cost related issues, and the Japanese managers relatively more occupied with quality at several levels. This picture raises a question about the consistency between the concerns of the Americans, the Europeans, and the Japanese manufacturing managers, and their competitive priorities. Are the relatively high concerns over costs expressed by the Americans and Europeans justified when as a competitive priority the ability to offer low prices is below a number of other factors? Conversely, if the Japanese are putting the ability to offer low prices high on their list of competitive priorities, why do they seem to be relatively less concerned with the cost related issues?

Our data provide no direct answers to these questions. Our interpretation of the data, backed up by interviews with a number of managers, is that in America and Europe, almost regardless of the competitive priorities set for the company, the manufacturing managers continue to be under direct and short term pressure to perform well on costs. The Japanese, on the other hand, seem to consider that costs will be reduced in the long term if they concentrate on quality improvement, process technology, and finding qualified supervisors and workers to run their operations. This interpretation suggests that the time frames and indeed the basic paradigms for strategic planning and action in Japan and in the West are substantially different.

The way these strategies are being implemented in different parts of the world becomes clearer when we examine the specific actions of manufacturers over the last several years. In our survey we asked for information on the specific improvement efforts relating to the management of manufacturing that had been undertaken in the company. Table 4 shows the programs most frequently undertaken by manufacturers in each region over this period.

Again there are many similarities among the three regions: Three out of five manufacturers in each region have been working on their production and inventory control systems; two-thirds of American and European manufacturers and half of Japanese manufacturers have focused in reducing the size of their workforce; three-fifth's of the Americans and about half of Japanese and Europeans have been working on programs for motivating the direct labor force; and so on. But the examination of the differences is again more revealing.

Seven out of ten Japanese manufacturers have put efforts into Quality Circles; only half the Americans and a third of Europeans did the same. About half the Japanese have been broadening the scope of their workers' jobs; only one-third of Europeans have done the same. More than half of the Americans have been working on changing the labor-management relationship; less than one-fifth of the Japanese have done the same. About half the Americans have worked on computer-aided-design (C.A.D.) and computer-aided-manufacture (C.A.M.) only about a third of Europeans and Japanese have done the same. Almost half the Japanese have worked on reducing set up times; only a third of Americans and a fourth of Europeans have done the same. The list is quite long.

Table 5 shows the improvement efforts planned for the future in each region. The Japanese clearly are putting an increased emphasis on automation. Quality Circles are still receiving attention, but they are being surpassed in popularity by efforts to develop flexible manufacturing systems, to automate jobs, and by efforts to improve production and inventory control systems. The other most frequently mentioned future plans include computer-aided design (CAD), computer-aided manufacture (CAM), the integration of manufacturing information systems, and office automation--which together with the rest are indicative of an aggressive drive towards adoption of the

Table 4

RECENT IMPROVEMENT EFFORTS

(Ten Most Frequent Among 39 Choices)

<u>EUROPE</u>	<u>NORTH AMERICA</u>	<u>JAPAN</u>
1.REDUCE SIZE OF WORKFORCE(*)	1.PRODUCTION/INV.CONTROL SYSTEMS(1)	1.QUALITY CIRCLES (1)
2.PRODUCTION/INV.CONTROL SYSTEMS(1)	2.REDUCE SIZE OF WORKFORCE(3)	2.AUTOMATE JOBS(2)
3.TRAIN SUPERVISORS(3)	3.TRAIN SUPERVISORS(2)	3.PRODUCTION/INV.CONTROL SYSTEMS(12)
4.AUTOMATE JOBS(2)	4.MOTIVATE DIRECT LABOR(7)	4.NEW PROCESSES FOR OLD PRODUCTS(3)
5.MAKE EXIST.SYSTEMS WORK BETTER(*)	5.NEW PROCESSES FOR NEW PRODUCTS(15)	5.MOTIVATE DIRECT LABOR(7)
6.REORGANIZE MFG.(4)	6.WORKER SAFETY(6)	6.REDUCE SIZE OF WORKFORCE(4)
7.NEW PROCESSES FOR OLD PRODUCTS(6)	7.INTEGRATE MFG.INFO.SYSTEMS(4)	7.BROADEN WORKERS TASKS(8)
8.INTEGRATE MFG.INFO.SYSTEMS(9)	8.REORGANIZE MFG.(13)	8.WORKER SAFETY(5)
9.MOTIVATE DIRECT LABOR(7)	9.QUALITY CIRCLES(6)	9.REDUCE SET-UP TIMES(13)
10.NEW PROCESSES FOR NEW PRODUCTS(12)	10.NEW PROCESSES FOR OLD PRODUCTS(8)	10.EXPAND CAPACITY(11)

() Rank in the 1983 Survey

* Not Included in the 1983 Survey

Table 5

FUTURE PLANS

(Ten Most Frequent among 39 Choices)

<u>EUROPE</u>	<u>NORTH AMERICA</u>	<u>JAPAN</u>
1.MOTIVATE DIRECT LABOR(2)	1.NEW PROCESSES FOR NEW PRODUCTS(6)	1.PRODUCTION/INV.CONTROL SYSTEMS(2)
2.NEW PROCESSES FOR NEW PRODUCTS(3)	2.PRODUCTION/INV.CONTROL SYSTEMS(1)	2.AUTOMATE JOBS(1)
3.TRAIN SUPERVISORS(6)	3.INTEGRATE MFG.INFO.SYSTEMS(3)	3.FLEXIBLE MFG. SYSTEMS(6)
4.INTEGRATE MFG.INFO.SYSTEMS(7)	4.TRAIN SUPERVISORS(2)	4.QUALITY CIRCLES(4)
5.INTEG.INFO.SYS.ACROSS FUNCTIONS(11)	5.MOTIVATE DIRECT LABOR(4)	5.OFFICE AUTOMATION(3)
6.REDUCE LEAD TIMES(15)	6.C.A.M.(5)	6.NEW PROCESSES FOR NEW PRODUCTS(5)
7.OFFICE AUTOMATION(9)	7.AUTOMATE JOBS(11)	7.REDUCE LEAD TIMES(18)
8.MAKE EXIST.SYS.WORK BETTER(13)	8.C.A.D.(12)	8.C.A.D.(19)
9.C.A.M.(4)	9.INTEG.INFO.SYS.ACROSS FUNCTIONS(10)	9.C.A.M.(21)
10.REORGANIZE MFG.(12)	10.NEW PROCESSES FOR OLD PRODUCTS(6)	10.INTEG.MFG.INFO.SYSTEMS(12)

() Rank in the 1983 Survey

new technologies in manufacture. In fact, the Japanese showed a more aggressive profile than the Americans and Europeans for nearly every one of the process technology oriented action plans covered by the survey (only the top 10 items are shown here). The reason for the emphasis on automation seems clear, these new technologies are the ones that promise to provide the capability to deliver low costs with a high degree of flexibility, the foremost priorities of the Japanese.

The Americans, and to a large extent the Europeans, also seem to be converging on new technologies at a fast pace, but in different ways. The Americans, for example, seem to be framing most of their programs for technological improvement in terms of information systems (software) rather than in terms of process technologies such as FMS, robots, etc. (hardware), like the Japanese. This is seen by the high frequency with which American (and European) firms are working on integrating information systems both within manufacturing and across functional boundaries, and by their relatively high degree of focus on CAD/CAM. We believe it is significant that the Americans seem to be most aggressive in developing new process technologies that are specifically focused on new products.

Last year two-thirds of European and American and half of the Japanese manufacturers reduced the size of their workforce. Substantially fewer in all three regions are planning to do so in the next two years, even though reductions in the workforce had the highest frequency of being named as "the single most effective past improvement effort" by manufacturers in all three regions. The Europeans, in particular, have replaced the reduction of the workforce as the most common past effort (Table 4), with programs for motivation of the workforce as the most frequently mentioned future improvement plan (Table 5). This suggests fewer layoffs and more attention to the remaining workforce.

Further insights into the action plans of manufacturers are provided when one examines the list of future programs which managers in each part of the world feel are most important (as opposed to most used). In Japan, flexible manufacturing systems were identified by over 13% of the sample as being most important. No surprise here. In the U.S., developing new processes for new products, followed closely by a host of information system projects were identified as being most important. Again, we see the emphasis on software. In Europe, the most important single future activity involved developing a new manufacturing strategy, followed by work on improving labor/management relationships and reorganizing the manufacturing function. This data, in combination with that shown in Exhibit 5, suggests that European manufacturers are in the midst of restructuring the basic foundations of their manufacturing infrastructure, to a far greater extent than their American and Japanese counterparts.

DOMINANT MANUFACTURING STRATEGIES

To get an overall idea of how the manufacturers in these three regions are acting out their manufacturing strategies, one needs to put together all that we have gleaned from the data on concerns, priorities, and future plans. Any attempt at encapsulating these findings in one or two short sentences carries the risk of oversimplification or, worst, superficiality. Nevertheless, to make our points in the rest of this paper clearer, we take this risk.

Our overall interpretation is that a large number of the Japanese manufacturers are banking on aggressive deployment of technology to achieve economic flexibility in manufacture. In terms of Hayes and Wheelwright's (1984) structure, they seem to be focused as a group on developing a "breakthrough" that fundamentally changes the way manufacturing is done. The breakthrough they appear to be seeking is the development of flexible process technologies which will yield both low costs and flexibility. This technological thrust appears to focus on process development as viewed more from the perspective of the manufacturing engineer, rather than from the view point of the computer scientist. Their highest ranked projects for the future are framed in terms of physical process models such as FMS, rather than in terms of information flows. These efforts seem to be entirely consistent with their competitive priorities, and their major concerns.

The European and American manufacturer's competitive priorities appear to be focused on doing the fundamental things better, especially with respect to the quality and dependability of their processes and deliveries. Overall, costs appear to be viewed as a major problem area (they're too high) rather than as the centerpiece of a fundamental long range competitive strategy. This puts these firms in the position of trying to simultaneously do everything well within the context of their existing operations. We see both the Americans and the Europeans planning on broad portfolios of future actions, ranging from quality circles to technological development to improving their human capital. In contrast to the Japanese, the technological thrust of these firms seems to spring more from the framework of the information systems specialist than from that of the process engineer. Between the North Americans and the Europeans, the major difference appears to be in the extent to which their planned activities focus on these information technologies as opposed to activities which develop their people and organizations. The Americans are much more heavily focused on the former, and the Europeans on the latter.

Viewed from the perspective of time, our data suggests that the actions and competitive priorities of the Japanese on one hand, and the North Americans and Europeans on the other, are beginning to converge. In the three years we have done the survey, for example, the results have shown that the

Americans have tended to rank price as being a much more important competitive ingredient (Americans rated price 4th on the list of priorities in 1984 versus 6th in 1983). Similarly, we have seen the Americans plan on an increasing amount of process development from 1982-84, while the Japanese are increasing the extent of the software development (information systems) component of their plans. To us, it is clear that the major international players in the manufacturing game are influencing one another.

VULNERABILITIES

The dominant manufacturing strategies in each region have, like any strategy, their vulnerabilities. The issue is to identify the weaknesses and to see how the risks which they pose are being managed.

The Japanese seem to be taking potentially large technological risks. To develop unique capabilities in flexible manufacture, they must develop a good part of the technology in house. They are already doing that. Our data shows that for their production process technology, the Japanese tend to look much more internally (i.e., inside the company) than externally. American and European firms are more likely to look to outside suppliers for their technologies.

But what if the technological problems that they have to solve turn knotty and intractable, and entangle their companies in difficult situations? Unlike when their manufacturing strategy was to a large extent based on worker-initiated careful, meticulous, and continuous improvement in the management of production, this strategy can lead them into uncharted waters. We believe, however that the Japanese are quite conscious of these risks. They pay considerable attention to process development and seem to be committed over the long term to their goals. Furthermore, they can reduce their risks if they manage to simultaneously simplify product and production process designs (at which they have proved to be quite good in the past) while they deploy their new technologies.

A second area of vulnerability for the Japanese is suggested by the similarity of their responses to the survey, and in subsequent interviews. In contrast to the rich diversity of strategies and action plans in North America and Europe, the similarity in the approaches of the Japanese firms in our sample is striking. They run the risk as a country of having all their eggs in one basket. As individual firms, they run the risk of losing opportunities to differentiate themselves from one another, and to exploit important market niches.

If the Japanese are successful in their attempts at a breakthrough, they will aggravate the vulnerability of the dominant manufacturing strategy of the

Americans. With their focus on sophisticated information systems, despite their acknowledged abilities in these areas, the Americans run the risk of overlooking simplification of the production process itself. The competitive value of a complex system for the management of manufacturing evaporates as the production process is simplified beyond a certain point. Changing the production process in the direction of "repetitive manufacturing" (even with no change in aggregate output) may be more effective than designing sophisticated information systems for managing a "job shop." In short, because of their ability to design and operate complex systems, and because of their openness to new ideas and fast adoption of them, the Americans run the risk of leaving their manufacturing processes more complicated than they need to be, or of, in fact, increasing rather than decreasing the level of capacity.

A second area of vulnerability for the typical North American manufacturer is suggested by the conflicting goals they seem to be trying to achieve. The North American's chief concerns seem to be focused on cost, while their strategic priorities are on quality. It is difficult to conceive of cost oriented actions which will improve quality (despite efforts to circumvent this by focusing on the "cost of quality"). The Japanese goals on the other hand, are much more internally consistent. They have proved that they can reduce costs by focusing on quality first, and that is what they do. Whether or not the Americans can make a "breakthrough" in terms of reconciling the cost/quality conflict to the extent required competitively remains to be seen.

The problem for the European manufacturers is difficult. The European emphasis on people and organization calls for change: change in the size of organizations, workforce, technology, and other parameters of manufacture. How long will it take to implement these changes and marshal all the resources required to reach clear objectives in terms of manufacturing capabilities? The European manufacturers are probably burdened with more external obstacles in moving fast in their intended directions. Varied but entrenched cultural values, deep industrial traditions, complex industrial relations, and other similar factors have so far tended to hinder change.

One area of vulnerability facing the Japanese and the North Americans and Europeans is the shortage of people with the skills required to move to new technologies. Today's "smart" technologies require a combination of the skills of the process engineer and the MIS specialist. How far can the Japanese get with the best process engineers with limited MIS skills? How far can the best MIS specialist in Europe or North America get without understanding process design? What kind of manager is needed to manage operations based on such different talents?

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CONCLUSION

The manufacturing strategies of the companies in each of the three regions examined here are influenced by the competition and markets each firm faces, by their individual strengths, weaknesses, and biases, and by the local environment within which each operates. The differences in manufacturing strategy within each region are extensive. Our goal has been to examine the differences and similarities in manufacturing strategy across regions however. And we have found that these inter-regional differences are substantial. The Europeans seem to be concentrating on redesigning and rebuilding their manufacturing infrastructure; the Japanese on developing new flexible, low cost processes, the Americans on better software and information systems.

Where these strategies will lead these manufacturers is open to question. On the one hand, there is a trend toward convergence. Perhaps more than at anytime in the past, manufacturers are looking outside of their own companies, and countries, to learn how they can improve their effectiveness. Some of the best ideas are being imported/exported, and this has resulted in an increasing similarity in the pattern of manufacturing strategies being utilized. On the other hand, each region will be likely to persist in building on those capabilities where they have unique strengths. Certainly, each will continue to be subject to local forces and concerns.

As these strategies evolve, we believe that there are several important developments to monitor in each region we have examined:

- How quickly can the Japanese "break through" the technological problems involved in developing flexible, low cost process technologies? To what extent must they move more rapidly to develop their "software" capabilities? What are the competitive implications of the high degree of similarity in Japanese goals and plans?
- How quickly can the European manufacturers complete the restructuring of their strategies and infrastructures? To what extent will this focus on restructuring retard the development and use of new technologies?
- Will the American focus on information systems turn out to be a source of competitive advantage, or will it result in overly complex and ineffective systems and organizations? Can the Americans effectively reconcile their strategic focus on quality from a financial planning framework?

These and other issues will be monitored through the Global Manufacturing Futures Survey in the future.

APPENDIX

THE MANUFACTURING FUTURES SURVEY

The Manufacturing Futures Survey was initiated at Boston University in the Summer of 1981. Over 160 business units of major North American firms participated in the first survey effort which was completed in the winter of 1982. The objectives of the survey were to gather and analyze information on the current practices, concerns, and of most importance the plans of these business units, to improve their operational effectiveness. The results of that survey were reported in several Boston University publications.

It became apparent from the first survey results that manufacturers are indeed managing through a turbulent era; an era in which global competition is forcing many firms to rethink their approach to manufacturing, and an era in which plans were rapidly changing. For these reasons, the four of us decided to join our efforts, working through our respective Universities, to develop and implement a new Manufacturing Futures Survey for 1983. The survey instrument which was designed was translated into 6 languages, and administered in the U.S., Canada, Japan, Ireland, Great Britain, France, Sweden, Germany, Belgium, Denmark, Spain, the Netherlands and Italy. Senior Manufacturing managers from over 600 business units around the globe participated in this expanded survey in 1983. Another 600 or so business units were surveyed in 1984. The majority of these respondents also participated in the 1983 survey. The results of these later two "global" surveys form the basis for this report.

The purpose of this report is to provide an overview of the common themes that emerge when one takes a broad perspective that cuts across all manufacturing environments in each of three major areas of the world surveyed: North America, Japan, and Europe. The advantage of this perspective is that it provides a way of isolating the issues, concerns and priorities that were important to most, if not all, of the survey respondents, and that it offers a way of understanding the general directions in which respondent firms in each part of the world are headed. This perspective is taken in the hope that it will be of some value to managers who want to understand "what others are doing." It is anticipated that it will also be useful to educational institutions, like Waseda, INSEAD, and Boston University, which are seeking to train managers and do research relevant to a broad variety of industries and settings. There are disadvantages to this perspective however. The analysis and interpretation based on the mean responses of the respondents from each part of the world can obscure important information about what is going on in particular industries, or with particular types of companies, or strategies. Further analysis of the data is already underway to explore the "manufacturing futures" of particular industries.

Enclosed is a summary of the actual responses to the survey in the three parts of the world in 1984. The respondents to these surveys were senior manufacturing executives, usually holding the title of VP or Director of Manufacturing.

We owe a great debt to the many people who made this work possible. First and foremost, we would like to thank the manufacturing executives who volunteered a significant portion of their time in responding to the survey. Clearly, without them, we would have nothing to say. We are also indebted to the many executives who worked with us in smaller working groups and who provided financial support and encouragement - the Manufacturing Roundtable in the U.S., the Waseda University advisory group in Japan, and the INSEAD Advisory Group in Europe. Our colleagues and research assistants at our respective institutions also played important roles in developing and implementing the survey, and to them we owe a debt of gratitude. Professor Arnaud De Meyer played an especially important part in developing and implementing the European Survey in 1984. Finally, we would like to acknowledge with gratitude the financial support and encouragement of the heads of our respective organizations - Dean Henry Morgan of the Boston University School of Management, Mr. Toshio Harada, Head of Waseda Universities Systems Science Institute, Deans Heinz Thanhelser and Claude Rameau of INSEAD.

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GLOBAL MANUFACTURING FUTURES PROJECT
SURVEY INSTRUMENT

BUSINESS UNIT PROFILE

KEY: NA = North America; J = Japan; E = Europe.

1. Principal product(s) manufactured by the business unit:

See Exhibit 1 for a distribution list of responses to this question.

2. Which category best describes the products/markets of the business unit?

	Capital Goods (equipment used by other busi- nesses)	Consumer Goods (products for use by general public)	Industrial Goods (components, supplies, etc., used by other businesses)
No. America	[35.4%]	[21.2%]	[42.4%]
Japan	[35.2%]	[30.1%]	[34.7%]
Europe	[34.2%]	[30.3%]	[35.5%]

3. Check the box which best describes the business unit:

	Plant	Division	Group	Entire Company	Other
No. America	[7.5%]	[47.2%]	[15.6%]	[28.8%]	[0.9%]
Japan	[62.9%]	[10.7%]	[2.6%]	[21.8%]	[2.0%]
Europe	[20.4%]	[27.6%]	[9.2%]	[41.4%]	[0.7%]

- 4.. What were the approximate sales of the business unit in the last fiscal year?

No. America	\$922,960,000 (mean)
Japan	
Europe	681,100,000

5. What were the total operating assets of the business unit in the last fiscal year (cash, receivables, inventory, plant and equipment, real estate)?

No. America	\$757,386,000 (mean)
Japan	1,642.8*
Europe	

(*in 100 million yen)

6. What was the overall net profit before tax as a percent of sales (last fiscal year) for the business unit?

	<u>negative</u>	<u>0-10%</u>	<u>11-15%</u>	<u>16-25%</u>	<u>Over 25%</u>
NA	[36.6%]	[38.5%]	[12.2%]	[9.4%]	[3.3%]
J	[7.2%]	[82.1%]	[8.2%]	[1.5%]	[1.0%]
E	[23.0%]	[59.2%]	[9.2%]	[3.3%]	[0.7%]

7. What was the approximate average annual growth rate of sales (in units) in the last three years for the business unit:

	<u>negative</u>	<u>0-5 %</u>	<u>6-10%</u>	<u>11-15%</u>	<u>16-20%</u>	<u>21-25%</u>	<u>26-30%</u>	<u>over 31%</u>
NA	[34.3%]	[28.9%]	[10.8%]	[8.8%]	[6.4%]	[3.9%]	[2.0%]	[4.9%]
J	[11.8%]	[39.0%]	[22.6%]	[14.4%]	[8.7%]	[1.5%]	[0.5%]	[1.5%]
E	[16.4%]	[34.2%]	[23.0%]	[7.9%]	[9.2%]	[2.6%]	[4.6%]	[0.7%]

o PLACE AN X ON THE FOLLOWING SCALES TO INDICATE THE POSITION OF THE BUSINESS UNIT.

8. Overall, how well do the top functional managers of the business unit (Finance, Manufacturing, Marketing, etc.) cooperate?

	<u>Very un-cooperative</u> 1	<u>Somewhat un-cooperative</u> 2	<u>Neutral</u> 3	<u>Somewhat cooperative</u> 4	<u>Very cooperative</u> 5
4.20 NA	1.9%	1.4%	7.6%	56.2%	32.9%
4.2 J	0.0%	4.1%	9.1%	47.2%	39.6%
E	%	%	%	%	%

9. Overall, how would you characterize the decision-making style of the general manager of the business unit along the following dimension?

	<u>Very auto-cratic</u> 1	<u>Somewhat autocratic</u> 2	<u>Neutral</u> 3	<u>Somewhat par-ticipative</u> 4	<u>Very par-ticipative</u> 5
3.74 NA	3.3%	17.1%	8.1%	49.5%	21.9%
3.2 J	2.6%	28.4%	27.9%	27.9%	13.2%
E	%	%	%	%	%

10. Check off the 3 functional areas serving the business unit that are most likely to get the projects they propose approved:

<u>No. America</u>	<u>Japan</u>	<u>Europe</u>	
[20.9%]	[41.1%]	[39.5%]	Data Processing
[30.8%]	[2.5%]	[17.1%]	Finance/Control
[75.8%]	[60.9%]	[71.7%]	Manufacturing
[52.6%]	[11.2%]	[44.7%]	Marketing
[9.5%]	[6.1%]	[9.9%]	Personnel
[67.3%]	[79.2%]	[57.2%]	R & D/Engineering
[16.1%]	[72.1%]	[23.7%]	Process Engineering
[25.6%]	[17.8%]	[25.0%]	Sales

11. Place an X on the following scales to indicate the degree of importance of each of the following to the business unit in competing successfully in the next 5 years.

Mean Response		No effect 1	Small importance 2	Moderate importance 3	Very important 4	Very critic 5
3.73 NA	a) Ability to offer	0.5%	7.5%	29.7%	44.3%	17.9
4.8 J	low prices	0.5%	1.0%	2.6%	13.2%	82.7
3.84 E		2.0%	6.0%	28.7%	48.0%	15.6
3.62 NA	b) Ability to make	1.4%	13.3%	26.1%	44.5%	14.7
4.3 J	rapid design changes	1.5%	4.1%	11.8%	25.7%	56.9
3.74 E	or introduce new products quickly	1.3%	13.3%	20.0%	48.7%	16.7
3.28 NA	c) Ability to make	1.4%	22.4%	32.4%	37.1%	6.7
3.9 J	rapid volume changes	2.5%	3.0%	25.4%	37.6%	31.5
3.52 E		4.7%	11.4%	33.6%	34.0%	15.6
4.50 NA	d) Ability to offer	0%	0%	4.2%	41.5%	54.3
4.1 J	consistent quality	0%	0%	25.8%	30.4%	43.8
4.21 E	(reliability)	0%	2.7%	12.0%	58.7%	26.7
4.13 NA	e) Ability to provide	0.5%	1.4%	18.0%	46.0%	34.1
4.0 J	high performance	0.5%	4.2%	22.6%	31.8%	41.1
4.11 E	products	0.7%	4.7%	16.0%	51.3%	27.1
3.58 NA	f) Ability to provide	0%	6.6%	42.0%	41.0%	10.4
3.6 J	fast deliveries	3.1%	11.8%	30.2%	28.7%	26.3
3.67 E		2.7%	8.1%	33.8%	41.2%	14.3
4.05 NA	g) Ability to make	0%	0.5%	18.9%	57.1%	23.5
4.0 J	dependable delivery	1.5%	4.1%	27.9%	23.9%	42.1
4.11 E	promises	0.7%	2.7%	15.0%	60.5%	21.1
3.57 NA	h) Ability to provide	1.9%	16.1%	26.5%	36.5%	19.0
3.5 J	after-sales service	1.0%	13.8%	32.8%	31.8%	28.1
3.43 E		7.4%	16.2%	19.6%	46.6%	10.0

12. Place an X to indicate the degree to which the business unit will emphasize the following strategic directions in the next 5 years.

Mean Response		No emphasis 1	Small emphasis 2	Moderate emphasis 3	Significant emphasis 4	Critical emphasis 5
3.82 NA	a) Increasing	0.5%	4.7%	22.3%	57.8%	14.7
4.1 J	market share in	2.1%	2.1%	10.5%	35.3%	50.0
4.00 E	existing markets	0.7%	4.7%	18.2%	60.1%	16.3
3.31 NA	b) Entering new	3.3%	19.0%	33.2%	36.0%	8.5
3.2 J	markets with	4.7%	14.2%	35.3%	32.6%	12.2
3.70 E	existing products	4.1%	9.5%	26.4%	43.9%	16.0

12. Continued

Mean Response		No emphasis 1	Small emphasis 2	Moderate emphasis 3	Significant emphasis 4
2.39 NA	c) Withdrawing from certain businesses	16.1%	46.0%	23.2%	14.2%
1.2 J		78.0%	16.1%	4.8%	1.1%
2.46 E		25.9%	32.0%	24.5%	15.6%
3.98 NA	d) Developing new products for existing markets	0.5%	5.7%	14.6%	55.2%
4.3 J		1.1%	2.1%	4.7%	29.5%
4.16 E		0.7%	4.1%	14.9%	50.7%
3.40 NA	e) Developing new products for new markets	6.6%	18.0%	22.3%	37.9%
3.9 J		4.2%	6.8%	16.8%	25.6%
3.47 E		6.8%	17.7%	27.9%	29.3%
2.45 NA	f) Growing by acquisition	22.9%	36.7%	19.5%	17.6%
1.4 J		60.8%	32.8%	4.8%	1.6%
2.80 E		24.7%	25.3%	14.4%	26.7%
2.38 NA	g) Forward integration	28.5%	28.5%	26.0%	14.5%
2.3 J		29.4%	24.1%	26.2%	16.0%
2.23 E		34.7%	32.6%	17.4%	12.5%
2.10 NA	h) Backward integration	32.3%	29.4%	21.2%	5.6%
3.0 J		8.0%	21.8%	29.8%	30.3%
2.09 E		37.8%	35.0%	17.5%	8.4%

SECTION B

MANUFACTURING PROFILE

1. What were manufacturing costs (material, labor, energy, manufacturing overhead) as a percent of total sales (last fiscal year) for the business unit

	<u>Under 25%</u>	<u>25-40%</u>	<u>41-55%</u>	<u>56-70%</u>	<u>Over 70%</u>
NA	[22.5%]	[10.3%]	[12.7%]	[27.2%]	[27.2%]
J	[1.6%]	[7.2%]	[7.7%]	[21.1%]	[62.4%]
E	[%]	[%]	[%]	[%]	[%]

2. Estimate the current structure of manufacturing costs for a typical final product:

<u>No. America</u>	<u>Japan</u>	<u>Europe</u>	
[52.0%]	[61.2%]	[51.0%]	a. Material
[15.0%]	[14.6%]	[18.7%]	b. Direct Labor
[6.0%]	[5.2%]	[6.6%]	c. Energy
[27.0%]	[19.5%]	[23.8%]	d. Manufacturing Overhead

3. Estimate the current structure of manufacturing assets:

<u>No. America</u>	<u>Japan</u>	<u>Europe</u>	
[37.0%]	[25.1%]	[31.6%]	a. Inventories
[20.0%]	[16.1%]	[26.3%]	b. Real Estate and Plant (Book Value)
[34.0%]	[23.4%]	[33.7%]	c. Equipment (Book Value)
[9.0%]	[37.4%]	[8.5%]	d. Other (specify)

4. What has been the trend in utilization of manufacturing capacity in the last five years?

	Substantially decreased 1	Somewhat decreased 2	Remained about the same 3	Somewhat increased 4	Substantially increased 5
3.08 NA	18.0%	15.6%	19.9%	34.6%	11.8%
3.4 J	9.7%	12.7%	22.5%	40.3%	14.8%
3.19 E	9.9%	21.1%	27.6%	28.9%	12.5%

5. Overall, how extensively are products customized in the business unit?

	Highly customized 1	Somewhat customized 2	Standard with custom options 3	Somewhat standardized 4	Highly standardized 5
2.84 NA	16.4%	29.6%	23.5%	18.3%	12.2%
2.9 J	6.3%	40.3%	19.9%	17.8%	15.7%
3.28 E	10.6%	21.2%	28.5%	15.9%	23.8%

6. How extensively do you expect them to be customized in the future (next few years)?

Mean Response	Substantially less 1	Somewhat less 2	About the same 3	Somewhat more 4	Substantial more 5
3.21 NA	0.9%	10.3%	60.1%	26.3%	2.3%
4.2 J	0.0%	0.5%	10.3%	42.8%	46.4%
3.41 E	3.3%	7.3%	48.0%	38.0%	3.3%

7. Indicate the degree to which this business unit looks to internal as opposed to external sources for its process technology. Internal sources would include the company's own process or industrial engineering staff (external sources would include capital goods suppliers, licensing arrangements, etc.

	100% external 1	75% external 2	50/50 3	75% internal 4	100% internal 5
3.64 NA	1.9%	13.6%	21.6%	47.9%	15.0%
4.2 J	0.0%	2.5%	12.8%	43.9%	40.8%
3.48 E	2.7%	18.1%	27.5%	40.9%	10.7%

8. How would you rate management-labor relationships in your business unit?

	Highly adversary 1	Somewhat adversary 2	Neutral 3	Somewhat cooperative 4	Highly cooperative 5
3.97 NA	0.5%	12.2%	11.3%	42.3%	33.8%
4.6 J	0.0%	0.5%	5.6%	27.9%	66.0%
4.09 E	0.7%	8.0%	13.3%	45.3%	32.7%

9. In 5 years, the production process in this unit will be best characterized

	One of a kind 1	Small batch 2	Large batch 3	Repetitive/semicontinuous 4	Continuous 5
3.13 NA	2.4%	40.1%	17.5%	29.2%	10.3%
2.4 J	15.5%	48.2%	19.7%	10.9%	5.7%
3.17 E	5.3%	31.6%	24.3%	23.7%	15.1%

10. For the typical product of the business unit, a unit forecast six months in the future is inaccurate by approximately:

	<u>0%</u> 1	<u>25%</u> 2	<u>50%</u> 3	<u>75%</u> 4	<u>100%</u> 5
2.09 NA	22.3%	60.2%	10.9%	6.2%	0.5%
2.3 J	4.7%	64.8%	20.7%	8.8%	1.0%
2.09 E	22.7%	55.3%	15.3%	5.3%	1.3%

11. Indicate how often someone breaks into scheduled production for an expedited order:

	Almost never 1	Once a month 2	Once a week 3	Once a day 4	Several times a day 5
3.06 NA	12.5%	16.3%	38.5%	21.6%	11.1%
2.8 J	6.9%	31.2%	38.1%	13.2%	10.6%
2.84 E	14.9%	22.0%	36.9%	24.8%	1.4%

12. To what extent do you feel that the current manufacturing capabilities fit with the competitive strategy of the business unit?

	Very poor fit 1	Somewhat poor fit 2	Neutral 3	Somewhat good fit 4	Very good fit 5
3.83 NA	0%	10.8%	12.3%	60.4%	16.5%
3.7 J	0.5%	9.8%	14.9%	59.3%	15.5%
E	%	%	%	%	%

13. How often are engineering (product design) changes authorized for products produced by the business unit?

	Once a year 1	Once a quarter 2	Once a month 3	Once a week 4	Once a day or more 5
3.48 NA	10.1%	13.6%	24.1%	26.6%	25.6%
2.5 J	27.6%	21.0%	21.5%	14.4%	15.5%
2.74 E	25.6%	19.4%	22.5%	27.9%	4.7%

14. What is the approximate number of engineering (product design) changes in a month for the business unit?

No. America 113 (mean)
Japan 52
Europe 1

15. Place an X in the box or boxes that describe production in the business unit

	<u>No. America</u>	<u>Japan</u>	<u>Europe</u>
Make to stock	[49.8%]	[39.8%]	[55.6%]
Make to order	[64.8%]	[50.0%]	[44.1%]
Assemble to order	[27.7%]	[10.2%]	[27.6%]

16. Place an X to indicate the degree to which each of the following is of current concern in the business unit:

Mean Response		No concern 1	Small concern 2	Moderate concern 3	Significant concern 4	Critical concern 5
3.08 NA	a) Low direct	2.8%	26.3%	37.1%	30.0%	3.8%
3.7 J	labor product-	2.0%	9.2%	27.1%	36.7%	25.0%
3.37 E	ivity	4.0%	17.2%	31.1%	39.7%	7.9%
3.44 NA	b) Low indirect	1.4%	13.1%	32.9%	45.5%	7.0%
3.6 J	labor product-	0.5%	6.6%	37.2%	38.3%	17.4%
3.57 E	ivity (includ- ing white collar)	2.0%	15.4%	28.2%	38.9%	15.4%
2.51 NA	c) Availability	16.4%	39.4%	29.6%	11.7%	2.8%
3.8 J	of qualified	2.0%	7.1%	27.1%	39.3%	24.5%
3.04 E	workers	9.9%	27.0%	27.0%	27.6%	8.6%
2.87 NA	d) Availability of	6.6%	29.7%	39.2%	20.8%	3.8%
3.9 J	qualified line	1.0%	7.2%	15.9%	52.3%	23.6%
3.28 E	supervisors	7.3%	18.7%	34.0%	26.0%	14.0%
3.98 NA	e) Producing to	0%	7.0%	19.7%	41.3%	31.9%
4.4 J	high quality	0%	2.0%	8.7%	35.7%	53.6%
3.82 E	standards	2.6%	17.8%	11.8%	34.2%	33.6%
2.92 NA	f) Impact of gov-	7.5%	33.3%	25.4%	28.2%	5.6%
2.7 J	ernment reg-	12.4%	25.9%	39.4%	16.1%	6.2%
3.08 E	ulations	7.2%	27.6%	32.2%	21.1%	11.8%
3.13 NA	g) Excess manu-	11.3%	23.0%	22.5%	30.5%	12.7%
3.0 J	facturing	12.4%	19.6%	32.4%	22.7%	12.9%
3.15 E	capacity	8.6%	25.8%	25.8%	30.5%	9.3%
3.28 NA	h) Yield problems,	1.9%	20.3%	34.4%	36.8%	6.6%
4.1 J	rejects	1.5%	5.6%	17.3%	33.7%	41.9%
3.17 E		4.0%	28.0%	32.0%	27.3%	8.7%

16. Continued

Mean Response		No concern 1	Small concern 2	Moderate concern 3	Significant concern 4	Critical concern 5
3.11 NA	i) Falling behind in process technology	5.7%	21.7%	39.2%	26.4%	7.1%
3.8 J		1.0%	5.6%	28.6%	39.3%	25.5%
3.16 E		4.6%	27.8%	32.5%	26.5%	8.6%
3.56 NA	j) Introducing new products on schedule	2.8%	15.6%	23.1%	41.5%	17.0%
3.9 J		0.5%	9.7%	21.6%	33.8%	34.4%
3.44 E		2.0%	23.2%	24.5%	35.1%	15.2%
2.73 NA	k) Too broad a product line	11.8%	32.1%	34.4%	19.3%	2.4%
3.4 J		7.1%	11.2%	30.1%	32.7%	18.9%
2.83 E		8.6%	33.8%	35.8%	15.9%	6.0%
3.23 NA	l) High or rising material costs	4.7%	15.0%	41.3%	32.4%	6.6%
3.6 J		2.5%	11.2%	28.1%	33.2%	25.0%
3.41 E		1.3%	21.1%	31.6%	34.9%	11.2%
2.91 NA	m) Aging plant and equipment	8.9%	30.0%	31.5%	23.0%	6.6%
3.4 J		3.6%	17.4%	28.2%	32.3%	18.5%
3.04 E		5.3%	30.9%	32.2%	25.7%	5.9%
1.96 NA	n) Insufficient manufacturing capacity	44.1%	31.8%	15.2%	8.1%	0.9%
3.1 J		5.7%	19.7%	37.3%	23.3%	14.0%
2.31 E		32.5%	33.8%	15.2%	14.6%	4.0%
3.55 NA	o) High or rising overhead costs	1.4%	9.9%	31.9%	48.4%	8.5%
3.6 J		0.5%	10.7%	31.6%	36.2%	21.0%
3.78 E		1.3%	4.6%	28.5%	53.6%	11.9%
2.76 NA	p) Ineffective materials control system	10.4%	37.4%	26.1%	22.3%	3.8%
3.0 J		4.6%	26.2%	37.9%	22.6%	8.7%
3.13 E		7.3%	24.5%	31.1%	27.2%	9.9%
2.90 NA	q) Unreliable vendor quality	4.2%	33.8%	39.0%	19.2%	3.8%
3.4 J		5.1%	11.3%	37.4%	28.2%	18.0%
2.97 E		7.4%	31.8%	33.8%	16.9%	10.1%
2.83 NA	r) Unreliable vendor lead times	4.2%	39.0%	36.2%	15.5%	5.2%
3.1 J		9.8%	15.5%	37.6%	24.7%	12.4%
3.05 E		4.7%	30.4%	34.5%	20.3%	10.1%

16. Continued

Mean Response		No concern 1	Small concern 2	Moderate concern 3	Significant concern 4	Critical concern 5
3.00 NA	s) Long lead times	3.3%	33.0%	29.7%	28.8%	5.2%
3.3 J		5.2%	15.5%	31.4%	33.0%	14.9%
3.12 E		8.2%	22.4%	32.0%	29.3%	8.2%
3.02 NA	t) High or rising inventories	7.5%	24.9%	34.7%	28.2%	4.7%
3.6 J		6.2%	12.3%	24.6%	29.7%	27.2%
3.24 E		6.6%	16.6%	39.7%	29.1%	7.9%
2.64 NA	u) Incorrect inventory information	10.9%	40.3%	28.4%	16.1%	4.3%
2.9 J		9.3%	22.7%	37.6%	20.6%	9.8%
2.89 E		9.2%	33.6%	28.9%	21.1%	7.2%
2.90 NA	v) Inability to deliver on time	7.5%	35.2%	29.6%	19.2%	8.5%
3.7 J		4.1%	10.3%	22.5%	31.8%	31.3%
3.23 E		5.3%	24.5%	32.5%	23.8%	13.9%
3.16 NA	w) Poor sales forecasts	2.8%	25.1%	35.1%	29.4%	7.6%
3.4 J		5.7%	12.8%	28.2%	37.4%	15.9%
3.31 E		3.3%	20.5%	36.4%	26.5%	13.2%
2.76 NA	x) Too many engineering changes	10.8%	35.4%	27.4%	23.6%	2.8%
3.3 J		5.8%	13.1%	35.1%	28.2%	17.8%
2.78 E		12.6%	29.8%	35.1%	19.1%	3.3%
2.01 NA	y) Voluntary direct labor turnover	28.2%	53.1%	14.1%	4.7%	0%
1.9 J		44.4%	30.4%	17.0%	4.1%	4.1%
2.15 E		31.3%	38.1%	22.4%	7.5%	0.7%
2.70 NA	z) Communicating needs to top management	7.1%	37.3%	40.1%	14.6%	0.9%
2.7 J		9.4%	29.2%	37.5%	20.3%	3.6%
2.89 E		6.7%	31.5%	38.9%	17.4%	5.4%
2.36 NA	aa) Large and complicated plants	19.8%	43.4%	24.5%	9.9%	2.4%
2.2 J		28.6%	34.4%	26.0%	8.9%	2.1%
2.48 E		23.3%	34.7%	22.7%	18.0%	1.3%
2.25 NA	bb) Direct labor absenteeism	18.3%	50.7%	23.9%	6.6%	0.5%
2.2 J		35.4%	28.2%	24.1%	7.7%	4.6%
2.77 E		9.9%	39.1%	25.8%	20.5%	4.6%
2.52 NA	cc) Inability to respond to rush orders	10.4%	47.2%	26.9%	15.1%	0.5%
3.0 J		10.3%	21.0%	34.3%	27.7%	6.7%
2.88 E		9.3%	31.3%	34.7%	18.7%	6.0%

16. Continued

Mean Response		No concern 1	Small concern 2	Moderate concern 3	Significant concern 4	Critical concern 5
2.82 NA	dd) Communications	6.6%	30.8%	40.8%	20.4%	1.4%
J	with other	%	%	%	%	%
3.02 E	functions	6.7%	25.3%	37.3%	28.0%	2.7%
2.70 NA	ee) Poorly articu-	8.0%	41.3%	27.7%	20.2%	2.8%
J	lated goals/	%	%	%	%	%
3.05 E	strategies	6.0%	28.7%	34.7%	22.7%	8.0%
2.36 NA	ff) Aging	19.7%	43.7%	24.4%	10.3%	1.9%
J	workforce	%	%	%	%	%
2.61 E		12.7%	36.0%	38.7%	9.3%	3.3%

17. What has happened to the length of the product life-cycle during the last five years?

Mean Response	Substantially decreased 1	Somewhat decreased 2	Remained about the same 3	Somewhat increased 4	Substantially increased 5
2.71 NA	8.1%	33.2%	43.6%	13.3%	1.9%
2.5 J	16.4%	40.8%	28.6%	7.1%	7.1%
2.55 E	5.3%	28.9%	40.8%	7.9%	6.6%

18. What has been the trend in research and development expenses directly related to this business unit over the last five years?

	Substantially decreased 1	Somewhat decreased 2	Remained about the same 3	Somewhat increased 4	Substantially increased 5
3.56 NA	4.7%	10.8%	24.1%	46.2%	14.2%
4.1 J	0.0%	2.5%	18.3%	50.8%	28.4%
3.64 E	3.9%	9.9%	23.0%	42.8%	17.1%

19. Which of the following best describes the changes you plan to make in the business unit's production capacity? (Check one.)*

<u>No. America</u>	<u>Japan</u>	
[28.4%]	[4.2%]	An increased percentage of our production will be done in foreign plants.
[11.8%]	[85.3%]	An increased percentage of our production will be done in domestic plants.
[59.8%]	[10.5%]	The percentage of foreign/domestic production will remain the same.

* Not included in European survey

20. Which of the following best describes the changes you anticipate in your sourcing patterns.*

No. America Japan
 [33.6%] [5.7%]

An increased percentage of our purchases will
 from foreign sources.

[7.1%] [74.5%]

An increased percentage of our purchases will
 from domestic sources.

[59.2%] [19.8%]

The percentage of foreign/domestic purchases
 remain the same.

* Not included in European survey

21. Compared to marketing and finance, to what extent are senior manufacturing executives involved in strategic planning for the business unit?

Mean Response	Substantially less 1	Somewhat less 2	About the same 3	Somewhat more 4	Substantially more 5
3.10 NA	4.7%	20.3%	47.6%	19.8%	7.5%
3.3 J	3.1%	19.4%	38.2%	25.0%	14.3%
3.16 E	3.9%	21.7%	41.4%	22.4%	9.2%

22. Place an X in the box which best describes who understands the goals, strategy, and overall business plans in the business unit.

<u>No. America</u>	<u>Japan</u>	<u>Europe</u>	
[7.5%]	[1.0%]	[16.4%]	Top management only
[25.4%]	[24.3%]	[38.2%]	Top and some middle management
[54.0%]	[44.2%]	[46.1%]	Top and most middle management
[10.3%]	[24.9%]	[9.9%]	Every manager and supervisor
[2.8%]	[5.6%]	[2.0%]	Every manager, supervisor, and worker

23. The following is a list of information systems which are important to the management of manufacturing. Place an X to indicate the degree of emphasis the business unit will place in the next 2 years on better integration of each of the following systems with one or more of the others.

Mean Response		No Emphasis 1	Small Emphasis 2	Moderate Emphasis 3	Significant Emphasis 4	Critical Emphasis 5
3.53 NA	a) Master	2.4%	12.4%	25.7%	51.4%	8.1%
3.9 J	Production	1.6%	7.8%	17.2%	39.1%	34.3%
3.61 E	Scheduling	4.8%	9.0%	25.5%	53.8%	6.9%
3.53 NA	b) Materials	2.4%	13.2%	25.9%	47.2%	11.3%
3.6 J	Requirements	3.1%	11.9%	28.0%	29.5%	27.5%
3.68 E	Planning	2.7%	8.7%	28.0%	50.7%	10.0%
3.62 NA	c) Inventory Status	0.9%	8.5%	27.5%	56.4%	6.6%
3.5 J		5.2%	10.3%	28.5%	31.1%	24.9%
3.67 E		2.0%	10.1%	27.7%	49.3%	10.8%
3.49 NA	d) Shop Floor	2.4%	13.5%	29.0%	46.9%	8.2%
3.9 J	Control	1.0%	5.2%	20.6%	42.8%	30.4%
3.55 E		1.4%	14.1%	31.7%	43.7%	9.2%
3.36 NA	e) Purchasing	1.9%	13.7%	36.3%	43.9%	4.2%
3.5 J		2.6%	9.7%	37.4%	33.9%	16.4%
3.62 E		1.3%	11.3%	32.7%	43.3%	11.0%
3.38 NA	f) Design	2.4%	18.2%	29.7%	43.1%	6.6%
3.6 J	Engineering	1.6%	10.9%	30.5%	33.2%	23.8%
3.40 E		6.8%	16.9%	25.7%	41.2%	9.4%
3.46 NA	g) Manufacturing	1.9%	10.2%	35.0%	47.6%	5.3%
3.5 J	Engineering	1.0%	8.9%	38.5%	32.3%	19.3%
3.62 E		4.0%	8.0%	30.0%	49.3%	8.8%
3.26 NA	h) CAD	11.7%	16.5%	23.3%	36.4%	12.8%
3.4 J		11.5%	13.5%	17.2%	27.6%	30.5%
2.97 E		18.1%	18.8%	27.1%	29.9%	6.5%
3.30 NA	i) CAM	8.7%	18.0%	24.3%	36.4%	12.6%
3.3 J		12.0%	15.7%	18.3%	25.7%	28.3%
3.24 E		12.9%	16.3%	24.5%	38.1%	8.0%
3.49 NA	j) Process	1.9%	14.5%	31.9%	38.2%	13.4%
3.8 J	Control	2.6%	6.8%	25.0%	34.4%	31.2%
3.42 E		4.1%	17.9%	28.3%	39.3%	10.0%

23. Continued

Mean Response		No Emphasis 1	Small Emphasis 2	Moderate Emphasis 3	Significant Emphasis 4	Critical Emphasis
3.91 NA	k) Quality Control	0.9%	5.7%	20.4%	50.7%	22.3
4.0 J		1.5%	1.5%	25.8%	30.5%	40.5
4.07 E		0.7%	6.0%	14.6%	50.3%	28.9
2.95 NA	l) Maintenance	5.7%	23.8%	44.3%	25.7%	0.5
2.9 J		12.0%	16.2%	41.1%	22.9%	7.1
3.34 E		1.3%	18.0%	37.3%	38.7%	4.9
3.15 NA	m) Cost Accounting	2.4%	21.9%	38.6%	34.3%	2.1
3.9 J		2.1%	4.2%	21.2%	40.9%	31.7
3.56 E		2.0%	7.9%	39.1%	41.7%	9.1
3.21 NA	n) Financial Performance Reporting	1.0%	19.6%	42.6%	33.0%	3.1
2.9 J		9.1%	17.1%	41.2%	23.0%	9.8
3.50 E		2.7%	11.3%	32.7%	45.3%	8.2
3.12 NA	o) Budgeting	1.9%	21.4%	45.7%	27.6%	3.1
3.4 J		6.3%	6.8%	34.7%	35.3%	16.1
3.56 E		3.4%	8.1%	30.2%	50.3%	8.3
3.46 NA	p) Strategic Planning	1.9%	16.2%	31.9%	37.1%	12.5
3.5 J		5.8%	13.1%	25.1%	30.9%	25.1
3.89 E		2.0%	6.7%	18.8%	50.3%	22.1
3.11 NA	q) Order Entry	4.8%	21.5%	38.3%	39.7%	5.1
3.0 J		8.6%	16.7%	37.6%	23.1%	14.0
3.40 E		3.5%	19.7%	30.3%	33.1%	13.4
3.30 NA	r) Sales Forecasting	4.2%	16.0%	34.0%	39.6%	6.1
3.2 J		9.1%	11.7%	30.3%	33.5%	15.4
3.80 E		1.4%	7.6%	24.8%	49.0%	17.2
3.31 NA	s) Sales Planning and Analysis	2.9%	14.5%	36.7%	42.0%	3.9
3.1 J		11.6%	11.6%	30.7%	33.3%	12.8
3.71 E		1.4%	9.6%	27.4%	47.3%	14.4
2.86 NA	t) Physical Distribution	13.2%	22.4%	36.6%	25.4%	2.4
3.2 J		8.4%	14.7%	31.1%	31.6%	14.1
3.34 E		6.3%	19.7%	26.1%	36.6%	11.1
2.97 NA	u) Market Research	7.3%	22.8%	41.3%	24.3%	4.1
2.9 J		12.1%	20.0%	29.5%	27.4%	11.0
3.54 E		2.8%	12.4%	33.1%	38.6%	13.1

SECTION C

RECENT EFFORTS TO IMPROVE MANUFACTURING EFFECTIVENESS

1. During the last year, have you sought significant improvements by focusing on any of the activities, tools, or programs listed below? If yes, place an X in the appropriate spot. If no leave blank. (Items have been listed by the percentage of respondents indicating they have taken this action.)

	<u>No. America</u>	<u>Japan</u>	<u>Europe</u>
a) Giving workers a broader range of tasks	[43.0%]	[48.2%]	[34.9%]
b) Giving workers more planning responsibility	[26.8%]	[25.9%]	[19.1%]
c) Changing labor/management relationships	[52.1%]	[17.3%]	[42.1%]
d) Direct labor motivation	[59.6%]	[53.3%]	[48.7%]
e) Manufacturing reorganization	[53.1%]	[45.7%]	[54.6%]
f) Worker safety	[55.9%]	[48.2%]	[42.1%]
g) Quality circles	[52.6%]	[72.1%]*	[30.3%]
h) Automating jobs	[50.2%]	[66.0%]	[55.9%]
i) Supervisor training	[63.4%]	[35.5%]	[59.2%]
j) Improved maintenance	[37.1%]	[20.8%]	[30.9%]
k) Zero defects	[25.4%]	[14.2%]	[15.8%]
l) Production inventory control systems	[66.2%]	[61.4%]	[60.5%]
m) Lead-time reduction	[46.9%]	[41.1%]	[42.8%]
n) Purchasing management	[42.3%]	[24.9%]	[42.1%]
o) Vendor Quality	[50.2%]	[35.5%]	[30.3%]
p) CAM (Computer-Aided Manufacturing)	[46.0%]	[20.8%]	[34.2%]
q) CAD (Computer-Aided Design)	[49.3%]	[28.9%]	[26.3%]
r) Reducing set-up time	[37.6%]	[47.7%]	[28.3%]

*For Japan, Statistical quality control for both Process and Product are included in Quality Circles

1. (continued)	<u>No. America</u>	<u>Japan</u>	<u>Europe</u>
s) Value analysis- Product redesign	[33.8%]	[42.1%]	[32.9%]
t) Group technology	[26.3%]	[14.2%]	[20.4%]
u) Reducing size of workforce	[64.3%]	[50.8%]	[67.8%]
v) Capacity expansion	[25.8%]	[45.7%]	[30.9%]
w) Reducing size of manufacturing units	[23.0%]	[25.9%]	[17.1%]
x) Plant relocation	[15.5%]	[15.2%]	[17.8%]
y) Developing new pro- cesses for old products	[52.6%]	[56.9%]	[52.6%]
z) Developing new pro- cesses for new products	[58.7%]	[43.7%]	[48.7%]
aa) Narrowing product lines/standardizing	[27.2%]	[27.4%]	[32.9%]
bb) Focusing factories	[30.0%]	[23.6%]	[19.7%]
cc) Defining a manu- facturing strategy	[52.1%]	[24.9%]	[40.8%]
dd) Integrating manu- facturing information systems	[54.5%]	[25.9%]	[50.0%]
ee) Integrating infor- mation systems across functions	[43.2%]	[11.7%]	[40.8%]
ff) Office automation	[45.1%]	[34.0%]	[46.1%]
gg) Making existing systems work better	[52.1%]	[22.3%]	[55.9%]
hh) Training in pro- duction/inventory control systems	[41.8%]	[17.3%]	[35.5%]
ii) Education in manu- facturing management	[39.9%]	[33.5%]	[35.5%]
jj) Reconditioning physical plants	[34.3%]	[31.5%]	[28.3%]
kk) Introducing robots	[30.0%]	[33.5%]	[23.0%]
ll) Flexible manu- facturing systems	[31.5%]	[34.5%]	[25.7%]

1. (continued)	<u>No. America</u>	<u>Japan</u>	<u>Europe</u>
mm) Closing plants	[28.6%]	[4.1%]	[19.7%]
nn) Statistical quality control (Process)	[39.4%]	[%]	[24.3%]
oo) Statistical quality control (Product)	[32.9%]	[%]	[34.9%]
pp) Other	[3.3%]	[2.0%]	[%]

2. Of all the activities took and programs listed above, which was the most emphasized?

North America

	<u>% of Respondents</u>	<u>Activity</u>
1.	[7.6%]	Reducing Size of Workforce
2.	[7.6%]	Production/Inventory Control Systems
3.	[5.9%]	Changing Labor/Management Relationships
4.	[5.4%]	Manufacturing Reorganization
5.	[4.9%]	Quality Circles
6.	[4.9%]	CAM (Computer-Aided Manufacturing)
7.	[4.9%]	Developing New Processes for New Products
8.	[4.9%]	Integrating Manufacturing Information Systems
9.	[4.3%]	Direct Labor Motivation

Japan

	<u>% of Respondents</u>	<u>Activity</u>
1.	[10.0%]	Developing New Processes for Old Products
2.	[9.4%]	Quality Circles
3.	[8.8%]	Automating Jobs
4.	[8.2%]	Flexible Manufacturing Systems
5.	[7.1%]	Production/Inventory Control Systems
6.	[6.5%]	Lead-time Reduction
7.	[5.9%]	Reducing Size of Workforce
8.	[4.7%]	Capacity Expansion
9.	[4.7%]	Developing New Processes for New Products

Europe

	<u>% of Respondents</u>	<u>Activity</u>
1.	[13.8%]	Reducing Size of Workforce
2.	[7.2%]	Manufacturing Reorganization
3.	[5.3%]	Production/Inventory Control Systems

3. Which was most effective?

North America

	<u>% of Respondents</u>	<u>Activity</u>
1.	[8.0%]	Reducing Size of Workforce
2.	[6.4%]	Changing Labor/Management Relationships
3.	[5.3%]	Direct Labor Motivation
4.	[5.3%]	Quality Circles
5.	[4.8%]	Manufacturing Reorganization
6.	[4.8%]	Production/Inventory Control Systems
7.	[4.3%]	Worker Safety
8.	[4.3%]	CAD (Computer-Aided Design)

Japan

	<u>% of Respondents</u>	<u>Activity</u>
1.	[11.7%]	Reducing Size of Workforce
2.	[9.4%]	Developing New Processes for Old Products
3.	[8.2%]	Quality Circles
4.	[7.0%]	Automating Jobs
5.	[7.0%]	Lead-time Reduction
6.	[6.4%]	Production/Inventory Control Systems
7.	[5.3%]	Capacity Expansion
8.	[4.7%]	Value Analysis/Product Redesign

Europe

	<u>% of Respondents</u>	<u>Activity</u>
1.	[12.5%]	Reducing Size of Workforce
2.	[6.6%]	Developing New Processes for New Products
3.	[5.3%]	Production/Inventory Control Systems
4.	[5.3%]	Manufacturing Reorganization

4. Which was least effective?

North America

	<u>% of Respondents</u>	<u>Activity</u>
1.	[6.3%]	Direct Labor Motivation
2.	[5.7%]	Changing Labor/Management Relationships
3.	[5.7%]	Quality Circles
4.	[5.1%]	Vendor Quality
5.	[5.1%]	Narrowing Product Lines/Standardizing
6.	[4.6%]	Production/Inventory Control Systems
7.	[4.6%]	Making Existing Systems Work Better
8.	[4.0%]	Reducing Set-Up Times

4. Continued

Japan

	<u>% of Respondents</u>	<u>Activity</u>
1.	[6.7%]	Production/Inventory Control Systems
2.	[6.7%]	Office Automation
3.	[6.7%]	Flexible Manufacturing Systems
4.	[5.9%]	Direct Labor Motivation
5.	[4.4%]	Manufacturing Reorganization
6.	[4.4%]	Vendor Quality
7.	[4.4%]	Developing New Processes for New Products
8.	[4.4%]	Narrowing Product Lines/Standardizing

Europe

	<u>% of Respondents</u>	<u>Activity</u>
1.	[5.3%]	Production/Inventory Control Systems
2.	[5.3%]	Lead-time Reduction
3.	[5.3%]	Integrating Manufacturing Information Systems

SECTION D

FUTURE EFFORTS TO IMPROVE MANUFACTURING EFFECTIVENESS

1. Place an X by those activities, tools or programs the business unit is planning focus on during the next 2 years to improve operations (including those that will be initiated but not completed). Note: Items have been listed by the percentage of respondents indicating they plan to take this action.

	<u>No. America</u>	<u>Japan</u>	<u>Europe</u>
a) Giving workers a broader range of tasks	[42.5%]	[34.0%]	[32.2%]
b) Giving workers more planning responsibility	[31.3%]	[15.7%]	[26.3%]
c) Changing labor/management relationships	[41.4%]	[6.6%]	[40.8%]
d) Direct labor motivation	[57.0%]	[31.5%]	[63.2%]
e) Manufacturing reorganization	[30.4%]	[36.0%]	[44.7%]
f) Worker safety	[41.1%]	[31.5%]	[23.0%]
g) Quality circles	[46.3%]	[50.3%]*	[40.1%]
h) Automating jobs	[54.7%]	[57.9%]	[44.1%]
i) Supervisor training	[59.8%]	[19.8%]	[53.3%]
j) Improved maintenance	[38.3%]	[22.3%]	[32.2%]
k) Zero defects	[31.3%]	[8.6%]	[22.4%]
l) Production inventory control systems	[61.7%]	[59.4%]	[43.4%]
m) Lead-time reduction	[44.4%]	[47.7%]	[48.7%]
n) Purchasing management	[38.8%]	[25.4%]	[32.2%]
o) Vendor Quality	[50.9%]	[33.5%]	[30.3%]
p) CAM (Computer-Aided Manufacturing)	[57.0%]	[43.9%]	[45.4%]
q) CAD (Computer-Aided Design)	[54.7%]	[46.2%]	[34.2%]
r) Reducing set-up time	[45.3%]	[40.1%]	[34.9%]

* Includes the responses for Statistical quality control for Process and Product

1. Continued	<u>No. America</u>	<u>Japan</u>	<u>Europe</u>
s) Value analysis- Product redesign	[33.2%]	[34.5%]	[31.6%]
t) Group technology	[31.8%]	[13.2%]	[17.8%]
u) Reducing size of workforce	[30.4%]	[38.6%]	[42.8%]
v) Capacity expansion	[23.4%]	[30.5%]	[20.4%]
w) Reducing size of manufacturing units	[13.6%]	[25.5%]	[11.2%]
x) Plant relocation	[8.9%]	[3.1%]	[10.5%]
y) Developing new pro- cesses for old products	[50.9%]	[40.3%]	[40.1%]
z) Developing new pro- cesses for new products	[62.6%]	[48.0%]	[55.3%]
aa) Narrowing product lines/standardizing	[28.5%]	[31.1%]	[32.2%]
bb) Focusing factories	[26.2%]	[17.9%]	[18.4%]
cc) Defining a manu- facturing strategy	[50.5%]	[32.7%]	[35.5%]
dd) Integrating manu- facturing information systems	[61.2%]	[41.8%]	[52.0%]
ee) Integrating infor- mation systems across functions	[51.4%]	[20.4%]	[49.3%]
ff) Office automation	[41.1%]	[48.5%]	[48.7%]
gg) Making existing systems work better	[50.5%]	[16.8%]	[46.1%]
hh) Training in pro- duction/inventory control systems	[37.4%]	[15.3%]	[36.2%]
ii) Education in manu- facturing management	[43.5%]	[17.3%]	[43.4%]
jj) Reconditioning physical plants	[25.2%]	[13.8%]	[23.0%]
kk) Introducing robots	[38.8%]	[32.1%]	[36.2%]
ll) Flexible manu- facturing systems	[41.6%]	[50.5%]	[36.8%]

1. Continued	<u>No. America</u>	<u>Japan</u>	<u>Europe</u>
mm) Closing plants	[10.3%]	[%]	[9.2%]
nn) Statistical quality control (Process)	[43.0%]	[%]	[27.6%]
oo) Statistical quality control (Product)	[42.1%]	[%]	[34.9%]
pp) Other	[7.0%]	[1.5%]	[%]

2. Of all the activities, tools and programs listed above, which is the single most important in your plans for the future?

North America

	<u>% of Respondents</u>	<u>Activity</u>
1.	[9.8%]	Developing New Processes for New Products
2.	[6.3%]	Other
3.	[6.3%]	Production/Inventory Control Systems
4.	[5.7%]	CAM (Computer-Aided Manufacturing)
5.	[5.7%]	Statistical Process Control
6.	[5.2%]	Defining a Manufacturing Strategy
7.	[4.0%]	Automating Jobs
8.	[4.0%]	Integrating Manufacturing Information Systems
9.	[4.0%]	Flexible Manufacturing Systems

Japan

	<u>% of Respondents</u>	<u>Activity</u>
1.	[%]	Flexible Manufacturing Systems
2.	[%]	Integrating Manufacturing Information Systems
3.	[%]	Production/Inventory Control Systems
4.	[%]	Developing New Processes for New Products
5.	[%]	Developing New Processes for Old Products
6.	[%]	Defining a Manufacturing Strategy
7.	[%]	Lead-time Reduction
8.	[%]	Automating Jobs

Europe

	<u>% of Respondents</u>	<u>Activity</u>
1.	[6.6%]	Defining a Manufacturing Strategy
2.	[5.3%]	Changing Labor/Management Relationships
3.	[4.6%]	Manufacturing Reorganization
4.	[4.6%]	Developing New Processes for Old Products
5.	[4.6%]	Developing New Processes for New Products

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