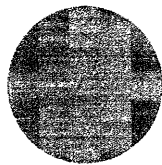


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**MANAGING R&D
WITH CONSTRAINED RESOURCES IN
JAPAN'S HIGH TECHNOLOGY COMPANIES**

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MITJP 93-05

Center for International Studies
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1.0 Introduction

In the 1980's, R&D spending in Japanese high technology companies grew seemingly exponentially. Fueled by an evolving domestic technological capability, high quality manufacturing, an export boom, and relatively cheap capital, R&D spending grew to reach up to a reported 13% of sales in some companies. Compounding this threat, in the eyes of US competitors, was not only that sales were so high, but that they were also growing at such a fast rate, so that Japan's technological lead seemed to be becoming unassailable. In Fujitsu Limited, one of the "Big Six" electronics companies, for example, the reported annual increase in R&D spending reached almost 30% in 1988 alone. Much of this increase in expenditure on R&D was used to fund a move into more basic, longer-term research, in what amounted to a basic research boom in Japan in the mid-1980's.

From 1989, however, the overseas markets of Japan's high technology companies began to be adversely affected by recession. By 1990, sales in Japan's domestic consumer markets had also begun to slow. The picture had changed dramatically from the early and mid-1980's. The challenge for the managers of Japanese high technology companies' R&D operations rapidly changed from one of managing an ever expanding R&D budget, to one of adapting to a new environment of constrained resources.

This process was further complicated by geopolitical change. The collapse of the Soviet Union and the end of the Cold War meant that the US defense establishment was no longer willing to make the same commitment to more basic, or fundamental research, from which both Japanese and US high technology companies had benefited in the previous two decades, and which had fueled their applied research efforts. So, by 1990, Japan's high technology companies had to reorient their R&D strategies, and to adjust to the reality of fewer resources, while recognizing the heightened importance of their growing commitments to basic research.

The research presented in this paper looks at some of the ways in which this reorientation has occurred, by focusing on the impact of constrained resources on aspects of the Japanese corporate R&D system. Based on analysis of a number of structured interviews and a set of questionnaire responses, some important conclusions about the R&D systems in Japan's leading high technology companies are reached. The conclusions tell of R&D organizations

that have, on the whole, adapted effectively to the new environment of constrained resources. More important, the new organizational structures being developed seem capable of further, rapid adaptation to any economic upturn that may come, as well as to the need for research of a longer time horizon than has traditionally been the case. This should be a source of additional competitive advantage over European and US technology driven companies, to the extent that each national system presents different sets of organizational capabilities, with different "organizing principles of work" (Kogut, 1991).

Finally, this research was motivated by a desire to investigate some of the myths that have come to surround the R&D systems of Japan's high technology companies. On March 22, 1992, *Fortune*, for example, reported that:

"...many of [Japan's electronics makers] are beginning to look a lot like IBM - too fat, slow-footed, and cautious for their own good. They are finding that it is much easier - and cheaper - to copy and improve old technologies than to invent new ones. They are discovering, much as Big Blue has, that protecting established lines of business instead of quickly embracing new technologies is a dead-end strategy."

The image presented by this article is a picture that needs little elaboration or deconstruction. Its significance, however, is quite high if, for example, it forms a basis for competitive response by European or US competitors, or policy makers. So, it is important to ask whether Japanese high technology companies really are becoming "like IBM," in the ways depicted. The new era of constrained resources provides an excellent vantage point from which to see how Japanese high technology companies have adapted to a change in their environments. My research suggests that the portrayal by *Fortune* is a myth, and a myth that needs exposing.

2.0 Background

Whichever list of key technologies is used, whether one reads lists drawn up by Japan's MITI, the US Department of Commerce, private industry pressure groups, or by other state or quasi-state institutions, there is a near consensus on the technologies which will be important future sources of corporate and national competitive advantage. Tyson (1992) notes that all studies generally reach the same general conclusions, that the number of technologies in which the US has a clear lead has decreased over time, such that the US now lags Japan significantly in many areas. The reasons for this are much debated in the literature (e.g. Nelson, 1990), but the pattern is distinct.

In a 1988 White Paper entitled "Trends and Future Tasks in Industrial Technology," Japan's MITI showed how the comparative standing of the US in 16 selected technologies, mainly in electronics and materials science, had weakened between 1983 and 1988, as measured by level of technology and technical development capability. In none of the 16 technologies had there been a shift to the US in comparative standing of measures of either level of technology or technical development capability between 1983 and 1988, and there were gains for Japan in nine of, and ten of, the 16 technologies for the two measures, respectively.

In 1990, in a report entitled "Emerging Technologies: A Survey of Technical and Economic Opportunities," the US Department of Commerce Technology Administration similarly concluded that, whereas in 1989, the US was ahead of, or even with, Japan in seven of 12 important technologies, the US would lose status and its leadership position to Japan in many of these by the year 2000. In the same year, the Computer Systems Policy Project, a US computer industry pressure group, projected that the US computer industry would lose its position in 14 of 16 key computer technologies between 1990 and 1995.

It is in Japan's largest electronics companies where many of these technological capabilities are being developed. The research reported here, therefore, has focused on these companies, and has sought to gauge their responses to the more difficult economic climate of the past four years. It sought answers to questions prompted by reports such as the *Fortune* description of the companies as "too fat, slow-footed, and cautious for their own good." It is clear that the answers will have an important bearing on whether Japan, as a nation, can keep on track the technological leadership that so many reports attribute to it.

3.0 Myths and Research Questions

If the *Fortune* 1992 article depiction of Japan's electronics companies is a myth, it is only one of a number of related, institutionalized myths which exist. Other myths, with important potential consequences for those whose actions should be based on a more accurate understanding, are typified by the following:

- That the Japanese R&D system is inflexible - the "life-time" employment system means high fixed costs. Accordingly, whereas US and European companies have responded to a period of constrained resources by cutting back through layoffs, early retirement programs, and in other broad areas, Japanese high technology companies have only been able to cut in mainly peripheral areas (such as travel budgets, social outings).

- That US companies are at an advantage, in that they are able to adapt more easily, clinically and decisively, to changed economic circumstances, so preserving financial strength with which they can compete more effectively in the future.
- That the internationalization of R&D by Japanese companies will be seriously curtailed as they focus more on their home base.

To reveal the actual changes taking place in the companies where interviews were carried out, a questionnaire was devised to answer a number of questions, including the following:

- What is the overall impact of the global recession on technology development within technology-driven Japanese companies?
- In what specific ways are Japanese technology-driven companies adjusting to new financial constraints?
- What has been the impact on technology strategy - in the short and long term?
- How have R&D programs been affected?
- What does the experience of Japanese companies tell us about the Japanese R&D system?
- What will be the impact on the internationalization of R&D?
- What are the implications of this for technology decision makers?

4.0 Research Method

The results presented in this paper are based on a questionnaire survey completed by 25 R&D managers and planners based at the corporate R&D organizations of five of Japan's largest high-technology companies. Four of the companies are part of Japan's "Big Six" electronics companies, and the fifth, although formally listed as in precision instruments, in fact has electronics technology as a core to its major business focus, that of office automation.

The five companies are collectively, and some individually, involved in the entire set of technologies which have been the subject of the cross-national comparisons highlighted above, with the exception of biotechnology. This includes, therefore, all technologies in semiconductors, computers, software, consumer electronics, and infrastructure electronics

such as power generation and telecommunications equipment. No amendments were necessary to the list of companies selected for the questionnaire survey, as all companies showed complete cooperation and gave the required access for the research to take place.

Respondents were asked for, and often stressed that they were giving, personal rather than official responses to the questions, which is considered to have improved the quality of the quantitative data. Nevertheless, the sample size is not large enough to provide statistical significance. To offset this, several days were spent in various locations in each of the companies obtaining qualitative data from interviewees from different business areas, so as to provide a context within which to interpret and assess the responses.

The questionnaire asked respondents to rank on a scale from one ("Not Very Important") to seven ("Extremely Important") the importance of specific adjustments to managing R&D in the recent economic climate of constrained resources. The questionnaires were completed during January and February, 1993. The results were recoded for the purpose of analysis and interpretation, with responses of one or two being regarded as "Not Important," three or four as "Somewhat Important," and five, six or seven as "Very Important." The data was analyzed using frequencies, cross tabulations, and variance analysis techniques.

The result is a set of data that suggests some important trends, and is consistent with the qualitative data obtained.

5.0 Results

The first table presents the results of questions on the significance of reductions in R&D budgets in each of the financial years 1991/2, 1992/3, 1993/4, and after this.

TABLE 1 ABOUT HERE

It shows that the most important budget reductions occurred in the previous, and in the current year, when 68% of respondents noted that this was a very important factor at these times. From the next full financial year (1994/5) onwards, however, the importance of budget reductions becomes smaller. Given that the decline in overseas markets began in 1989, and that the Japanese domestic market began its decline in 1990, the figures suggest a lag before reductions in budgets occurred, which is perhaps why the companies were characterized by *Fortune* as being "slow-footed." However, this conclusion ignores other changes that were occurring in the companies in 1991/2, if not earlier, and implies that R&D expenditure should fluctuate more-or-less in tandem with the business cycle.

An analysis of variation among and within company responses shed some light on the budgeting process over time. In 1991/2, there was a large difference *within* companies in terms of R&D budget reductions, relative to differences among companies. Consistent with other data, this suggests that 1991/2 was a period of strategic technology reorientation within companies, in which priorities and plans were being reassessed.

From 1992/3 on, however, in each year the difference in expected R&D budget reductions was much greater *among* companies compared to within companies. This suggests that, within the new strategic framework set in the previous year(s), some companies were more active in cutting costs than others, but that the budget allocations and policies were consistent within the companies - there was a general agreement as to how the impact of budget reductions was being felt within each company as a whole.

Turning to budgetary changes, there is a most interesting result. Whereas a shift in funding sources for R&D has occurred, almost entirely from the corporate level to the divisions, this has not been accompanied by the same degree of shift from long- to short-term time horizon. The movement in budgets to shorter-term projects was only held to be very important by 36% of respondents, whereas 59% of respondents noted a very important shift in the funding source for R&D between the corporate and divisional levels. The reason for this is that the divisions are also concerned with the long term in those technologies that directly relate to the products and businesses that they are engaged in. The qualitative data consistently bore this out, especially for those technologies in which the company was a leader, either alone or in competition with others. In such cases, there were occasions when the time horizons of the corporate and divisional levels were almost indistinguishable.

This is a different result than that which might typically be expected from a European or US company, for example, in which a shift in funding source to the equivalent of the Japanese corporate divisions might be expected to result in a marked shift in technology and project time horizon to the short term.

Almost all of the corporate R&D managers and project leaders in the Japanese companies reported spending much more of their time building relationships with the divisions, relationships that were obviously more distant before the need for funding shifted. However, bridging the gap between the corporate laboratories and the laboratories carrying out shorter term development, or design, risked distracting researchers from longer term projects. Therefore, the need for enhanced communication between the corporate and divisional levels sometimes involved the establishment of laboratories specifically set up for this purpose -

effectively "technology transfer laboratories," skilled in understanding the needs of both the corporate laboratories and the divisions, and at communicating between them. These technology transfer laboratories would assume responsibility for technology relationships between the corporate laboratories and the divisions, among the divisions (e.g. between materials, devices, and systems), as well as for longer term development work than the divisions would otherwise carry out. This also freed up the corporate R&D laboratories, which had more time for longer term research work.

Other than the refocused, internally commissioned research system, and the establishment of intermediate laboratories, there was an emphasis on other methods of improving communication between the corporate R&D laboratories and the business divisions, or groups. These included regular meetings to discuss strategic issues, "open houses" (annual company-wide R&D exhibitions), setting up core technology forums, and interdivisional projects. These latter projects span the corporate and divisional levels, and are designed to build both cooperation and to more actively promote R&D achievements to a wider internal audience.

In all these specific activities, as in the formulation of other responses to the new environment of constrained resources, there was a sense that the process itself was important. The process appeared, moreover, participative and democratic. Nonaka (1988) has described the "middle-up-down" management system in Japanese companies, as a method of information creation, in contrast to the "top-down" and "bottom-up" management styles depicted by American scholars, which center of information flow and information processing. It was evident in a number of the companies that this researcher visited, that the process of R&D planning, both in relation to formulating specific responses to an environment of constrained resources, as well as more generally, drew heavily on the ideas of middle managers and more junior researchers.

Turning to technology strategy, the responses to the questionnaire revealed a much greater focus on core technologies.

TABLE 2 ABOUT HERE

However, whereas 96% of respondents noted that the greater focus on core technologies was very important, less than one third (32%) of respondents said that adopting less ambitious strategic objectives for technology was very important. This is supported by other evidence which shows that, in many areas, the perspective of Japanese high-technology companies

has become more long term. Reasons for this include the reduction in US longer term research support, as defense technology expenditure has been cut back, and a greater confidence from the successes that have been achieved to date in research by Japanese companies.

Also shown is the increased willingness to engage in joint, or alliance, R&D. While this has been a contentious issue (e.g. Reich and Mankin, 1986) from the perspective of which party has gained more from such alliances in the past, the motivation of the companies that participated in the interviews was to share costs and risks in research into new technological areas.

The mean square variation (0.05) between company responses as to the importance of increasing the external acquisition of technology was much smaller than the difference within the companies (0.32). This may reflect a number of different factors, but is consistent with a strategic reorientation focusing on core technology, and a greater reliance on external sourcing for non-core, or more peripheral technologies. Additionally, as in semiconductor research, the costs of research may be so high as to prohibit internal R&D in strategically important areas.

Despite more constrained resources, only 28% of respondents indicated that reduced R&D expenditure outside Japan was a very important consequence. This was supported in the interviews, in which internationalization was linked directly to technological development and organizational needs, rather than to any short-term, cost-driven imperative. A more significant, and negative, impact on internationalization might also have been expected to have come from the additional emphasis being placed by companies on building integrated researchers, and on the strengthening of ties between the corporate laboratories and divisions. In interviews, all companies indicated a need for better integration, and more effective communication between the corporate and divisional levels, as well as among different technologies, where there might be future synergies, or where joint projects required knowledge in two or more areas - such as in material science and electronics. While this might have been expected to be more consistent with a strengthening Japan home base in R&D, the development of an international R&D capability nevertheless remained a strategic priority in many technology and product areas, as well as for the companies as a whole.

Turning to the effect on R&D programs, all of the approaches mentioned were of some importance to the companies, although the adoption of more stringent requirements for program continuation stands out.

TABLE 3 ABOUT HERE

This should not, however, be confused with a shift to the short-term, so much as an increasing concern with measuring R&D effectiveness. Other data suggest that programs that were running into funding problems and had to be curtailed, or canceled, were those that relied on funding from the divisions, and that either did not relate to existing or projected business areas, or were those in fields in which a company's immediate or prospective leadership was uncertain. There was also considerable variation among companies in the extent to which they were slowing the pace of some programs.

The personnel system in the companies had various ways of adapting, which were distinct to Japanese companies.

TABLE 4 ABOUT HERE

Instead of focusing on the number of layoffs that had resulted from the new economic order, as would be expected in a European or US company, this research tried to look at some of the measures of change more appropriate to the Japanese personnel management model. While, based on analysis of data over the period 1975-1978, Koike (1987) has concluded that redundancy is not rare in large Japanese firms, it is also not usual. Instead, the Japanese R&D system has a number of other short-term adjustment mechanisms, such as internal transfers (*shukkō*).

Yet for the respondents, more important than internal transfers were reductions in overtime (very important for 76% of respondents), and a reduction in short-term or contract workers (very important for 62% of respondents). These had less impact on receiving organizations of transferred workers, and indicate the degree of flexibility built in to the Japanese corporate R&D system. Questions such as these are far less relevant to European or US R&D organizations, but are important aspects of the Japanese personnel management system. Other research, that has concluded that Japanese organizations are responding to the current economic situation of constrained resources by merely cutting peripheral costs, has failed to ask questions about adjustment mechanisms other than layoffs, thereby ignoring the importance of differences between the Japanese and US organizational models. Research needs to be sensitive to the local institutional environment.

Table 4 also shows that there has been a shift to internal training programs. This may, however, be as much due to increased capability in research, as for cost-saving reasons. None of the interviewees, for example, indicated that visits to, or sponsored seminar

programs at, overseas universities would be curtailed on account of cost alone. The continuing development of external networks was, in fact, considered essential.

Focusing more closely on effectiveness, there has been a tightening up in a number of ways.

TABLE 5 ABOUT HERE

Tighter measurement (e.g. staff numbers), stronger accountability (e.g. supervision), and a stronger link to profitability (whether short or long term), were all important.

In terms of other general expenditure adjustment mechanisms, the questions elicited expected responses on the importance of reduced equipment purchases, the consolidation of R&D facilities, and cutbacks in travel.

TABLE 6 ABOUT HERE

These have, of course, also been important in European and in US companies' R&D operations. There was some evidence in this research, however, that there were other motives that were equally important. Two of the companies, for example, explained that they were simplifying the formal organization of their laboratories, so as both to improve the possibilities for moving researchers between different technology areas, and to manage the relationship with between the corporate and divisional laboratories in a more coordinated and structured way.

The dividing line between the corporate and divisional laboratories was obviously marked in some, but not all, instances. One corporate R&D research manager, for example, referred to hand-off to the divisions as being "dirty work." While the curtailed corporate funding was probably the single most important and successful mechanism for improving the corporate and divisional R&D relationships (see above), formal organizational adjustment, such as reductions in numbers of laboratories at the corporate level, but not in their locations, made an additional contribution. The simplified laboratory organizational structure also made the task of the personnel managers easier, as it was often mentioned that it was far easier to transfer researchers between different technological areas if they were, at least, within the same organization. Building "the truly integrated researcher" was a high priority for many companies.

On the redefinition of "R&D" to include other expenses, while the responses were not as marked as for other adjustment mechanisms, nevertheless nearly half of the respondents

mentioned that this was very important. It is important to recognize that R&D in Japan is accounted for differently than in the US, in a way that makes cross-country comparisons difficult to make. These differences are both specific to R&D, and result from more general differences, such as in the rules concerning consolidation. It is beyond the scope of this paper to evaluate all this in more detail, but the differences are certainly of sufficient magnitude to render simple international comparisons of declared amounts misleading.

Within R&D itself, some of the differences include the opportunity to amortize R&D expenses over five years in Japan, compared to the requirement for full expensing as incurred in the US. There may be more flexibility as to what may be included as R&D in Japan than in the US. The inclusion of expenditure in R&D rather than as a product cost, for example, would seem to offer the double advantage of increasing product profitability and keeping the R&D figure at a desirable level.

6.0 Conclusion

Based on the results of the data analysis, a number of conclusions may be drawn by way of broad generalization, including the following:

- The Japanese corporate R&D system is responding to the changed environment of more constrained resources in ways that reflect the premium placed on technology throughout the company.
- The adjustment mechanisms are different from those in the US, and not always so visible. It is unusual to read of changes such as reduced overtime, reductions in numbers of contract workers, and personnel movements, in the press. The research shows the importance of asking locally appropriate questions according to research location.
- While there was a lagged reduction (by some three years) in R&D budgets in response to the first signs of product market declines, in 1989, this measure ignores other changes, such as strategic reorientations within companies, which appear to have taken place in 1991/2, if not earlier. This could hardly be considered being "slow-footed," both given the long-term nature of many R&D projects, and relative to the actual experience of many European and US companies.
- The strategic technological reorientations that have taken place have taken into account a recognized need by the companies to continue to develop a longer-term basic, or more fundamental, research capability. As a response to this, in most companies, there has

been a lengthening of research time horizon in important technology areas. Other responses have included a greater willingness to engage in joint research.

- Collaborative research efforts, as private sector initiatives, are usually with companies with a home base outside of Japan. The lengthening of research time horizon for such collaborative efforts is leading to newer, particular forms of "corporate" relationship between multinational companies with different home bases. These are different to special purpose collaborative arrangements, in that the relationships are not hostage to the outcomes of particular research projects. This imposes a higher, moral responsibility on the partners of specific projects, and may result in a more equal sharing of research knowledge jointly developed. Also, in these 1990's relationships, the typologies of collaborative arrangements that were written about in much of the 1980's literature on joint ventures (e.g. Contractor and Lorange, 1988), in which relationships were categorized according to content of legal agreements or extent of ownership (e.g. 75:25, or 50:50 arrangements), are of less significance compared with the overall corporate relationships, in which trust is increasingly important.
- The shift in funding of corporate R&D to the divisions is being accompanied by an increased emphasis on enhancing communication, both within the corporate level (across technologies), as well as between the corporate level and the divisions.
- Internationalization is not a prime casualty of constrained resources. Rather, internationalization continues to be driven by the same set of factors identified by Westney (1991), namely science and technology, market, state and regulatory, and competitive factors. Recession or no recession, lead users may remain outside Japan, standards setting has not shifted to Japan, the shortages of specific scientific and technical labor have not disappeared in Japan, and so on. Internationalization is still dependent on technological and competitive actions and responses, and on organizational capability, rather than driven by resource availability.
- In comparing R&D measures among companies in countries with differing accounting regulations and practices, such as between Japan and the US, it is important to recognize that numbers (such as the amounts expended on R&D) or ratios (such as R&D as a percentage of sales) are not directly comparable. More research is needed on this issue, given the extent to which some companies appear to make more-or-less superficial cross-company (and cross-national) comparisons.

- A number of the changes instigated by the companies interviewed at, as responses to a period of constrained resources, indicate some potential sources of future competitive advantage. These include the following:
 - The relative ease with which the companies may be expected to respond to the availability of more resources for R&D, given both the speed with which they have adapted to a period of constrained resources, and the nature of the particular adjustment mechanisms. It is, for example, easier to increase overtime than to rehire and retrain a laid off workforce.
 - Many of the companies have developed improved tools for project management and cost accounting purposes, traditionally a relative strength of the US corporate system.
 - Efforts to improve communication between the corporate research laboratories and the divisions, as well as among laboratories at each level, will be an enduring feature of the R&D systems.
 - The democratic process by which responses to a period of constrained resources have been formulated may be expected to enhance employee commitment, both to the decision outcomes of the process, as well as to the company as a whole. This is in contrast to the more top-down management style of some European and US companies.

Most of these sources of competitive advantage are organizational, rather than technological. If US companies see competition in terms of technology, for the Japanese companies which were the subject of this study, technology is more an outcome of their organizational capability. There was a strong relationship between the results as a whole among the companies, suggesting a country dimension to the organization of R&D, and highlighting the importance of the institutional context, and organizational principles, of Japan.

As a final note, evidence from the organizational responses to a period of constrained resources suggests that Japanese and US companies would mutually benefit from engaging in constructive dialogue. Mutual benefit would include, for example, what US companies can learn from their Japanese counterparts about how to achieve a commonality of technology vision, and what Japanese companies might learn from the US, in terms of tighter and more rigorous controls on programs. There are many areas of mutual interest. To exchange such ideas and knowledge requires, however, at the very least the clarification of our myths of the

Japanese corporate R&D system. This paper has tried to expose some of these myths, by focusing on specific reactions by Japanese high technology companies to a changed environment, an environment of less munificent resources. These reactions were complicated by a strategic shift to more fundamental, or basic research, in the companies that kindly participated in the study.

TABLE 1: R&D BUDGET CHANGES

SIGNIFICANCE OF REDUCTION IN R&D BUDGET				
	NOT IMPORTANT	SOMEWHAT IMPORTANT	VERY IMPORTANT	TOTAL
YEAR 1991/2	20%	60%	20%	100%
YEAR 1992/3	4%	28%	68%	100%
YEAR 1993/4	4%	28%	68%	100%
AFTER THIS	4%	56%	40%	100%

BUDGETARY CHANGES				
	NOT IMPORTANT	SOMEWHAT IMPORTANT	VERY IMPORTANT	TOTAL
REDUCING OVERALL R&D BUDGETS	20%	28%	52%	100%
REDUCING BASIC R&D EXPENDITURES	28%	48%	24%	100%
MOVING BUDGETS TO SHORTER-TERM PROJECTS	8%	56%	36%	100%
LESS EXTERNALLY FUNDED R&D	24%	44%	32%	100%
CHANGES IN FUNDING SOURCES FOR R&D (E.G. BETWEEN CORPORATE, DIVISIONS)	6%	35%	59%	100%

TABLE 2: TECHNOLOGY STRATEGY

TECHNOLOGY STRATEGY	NOT	SOMEWHAT	VERY	TOTAL
	IMPORTANT	IMPORTANT	IMPORTANT	
LESS AMBITIOUS STRATEGIC OBJECTIVES	28%	40%	32%	100%
GREATER FOCUS ON CORE TECHNOLOGIES	0%	4%	96%	100%
INCREASED EXTERNAL TECHNOLOGY ACQUISITION (INSTEAD OF INTERNAL INVESTMENT)	8%	72%	20%	100%
MORE EXPLOITATION OF EXISTING TECHNOLOGIES	16%	32%	52%	100%
INCREASED JOINT /ALLIANCE R&D	4%	20%	76%	100%
REDUCED R&D EXPENDITURE OUTSIDE JAPAN	20%	52%	28%	100%

TABLE 3: R&D PROGRAMS

R&D PROGRAMS	NOT	SOMEWHAT	VERY	TOTAL
	IMPORTANT	IMPORTANT	IMPORTANT	
MOVEMENT OF PROJECTS TO SUPPLIERS	20%	60%	20%	100%
STRICTER CRITERIA FOR PROGRAM START UP	8%	40%	52%	100%
MORE STRINGENT REQUIREMENTS FOR PROGRAM CONTINUATION	4%	24%	72%	100%
SLOWING THE PACE OF SOME PROGRAMS	12%	36%	52%	100%
REDUCTIONS IN NUMBERS OF TECHNOLOGIES / PRODUCTS /PROCESSES SUPPORTED	8%	36%	56%	100%

TABLE: 4 PERSONNEL, EDUCATION AND TRAINING

PERSONNEL CHANGES	NOT	SOMEWHAT	VERY	TOTAL
	IMPORTANT	IMPORTANT	IMPORTANT	
MOVEMENT OF PERSONNEL TO SUBSIDIARIES	38%	29%	33%	100%
MOVEMENT OF PERSONNEL TO SUPPLIERS	36%	48%	16%	100%
EARLY RETIREMENT PROGRAMS	37%	42%	21%	100%
REDUCED OVERTIME	4%	20%	76%	100%
REDUCED SHORT-TERM OR CONTRACT WORKERS	21%	17%	62%	100%
SALARY REDUCED, FROZEN, SMALLER INCREASES SMALLER UPWARD ADJUSTMENTS	32%	32%	36%	100%
REDUCED RECRUITMENT INTO R&D	20%	44%	36%	100%
EDUCATION AND TRAINING				
	NOT	SOMEWHAT	VERY	TOTAL
	IMPORTANT	IMPORTANT	IMPORTANT	
REDUCED INTERNAL COMPANY TRAINING	52%▲	36%	12%▼	100%
REDUCED EXTERNAL EDUCATION IN JAPAN	44%	28%	28%	100%
REDUCED EXTERNAL EDUCATION ABROAD	38%	29%	33%▼	100%

TABLE 5: EFFECTIVENESS

EFFECTIVENESS	NOT	SOMEWHAT	VERY	TOTAL
	IMPORTANT	IMPORTANT	IMPORTANT	
TIGHTER MEASUREMENT (E.G. STAFF NUMBERS)	0%	32%	68%	100%
STRONGER ACCOUNT ABILITY (E.G. SUPERVISION)	4%	20%	76%	100%
STRONGER LINK TO PROFIT ABILITY	0%	24%	76%	100%
INCREASED USE OF AUTOMATION AND OTHER NON-HUMAN RESOURCES	24%	36%	40%	100%

TABLE 6: GENERAL EXPENDITURE ADJUSTMENTS

GENERAL EXPENDITURE ADJUSTMENTS	NOT	SOMEWHAT	VERY	TOTAL
	IMPORTANT	IMPORTANT	IMPORTANT	
REDEFINITION OF "R&D" TO INCLUDE OTHER EXPENSES	24%	28%	48%	100%
REDUCTIONS IN ENTERTAINING EXPENSES	20%	32%	48%	100%
REDUCED EQUIPMENT PURCHASES	4%	32%	64%	100%
CONSOLIDATION OF R&D FACILITIES TO SAVE OVERHEAD COSTS	8%	24%	68%	100%
CUT BACKS IN TRAVEL	4%	28%	68%	100%

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