MANUFACTURING PRIORITIES & ACTION PROGRAMMES IN THE CHANGING ENVIRONMENT: AN EMPIRICAL STUDY OF INDIAN INDUSTRIES

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Working Paper

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INTRODUCTION

The Indian industrial environment has been traditionally identified by its regulative and protective characteristics for investments by foreign manufacturers and for import of goods into the country. The restricted industrial licensing policy by the Government of India had resulted in a closed internal competitive environment without an easy access to foreign goods. However there has been a distinct realisation on the part of the Indian companies since 1991 - when the country opened up for outside direct investments and goods due to economic liberalisation policy of the Government of India - that the manufacturing in India has to compete with outside companies to be competitive even in the domestic market.

Study of Indian manufacturing practices at this crucial juncture is likely to be of great interest to the international community because of current interest in India. Foreign companies especially multinational corporations (MNCs) have been excited about the prospect of investing in India which has a huge potential market and relative advantages over China [1]. According to a recent Ernst & Young survey, U.S. based MNCs cite India as one of their top priorities for foreign investment[2]. This widespread interest is evident from the actual foreign investments made so far and number of proposals for Foreign Direct Investment (FDI). Between 1991 and 1995, investment

proposals worth US $15 billion were cleared by Government of India, and 50% of these were approved in the year 1994-95[3]. Actual foreign investments since 1991 is of the order of US $7 billion. Leading international companies including major American corporations such as General Electric, IBM, Pepsico, Coca Cola, Enron Corporation, Digital Corps and Kellogs are investing in a wide range of projects from processed foods and software development to engineering plastics, electronic equipment, power generation and petroleum exploration. Some of the international companies like General Motors have already started sourcing some components from the Indian companies for their global requirements.

The studies on manufacturing practices specific to some countries have been reported in literature. Some of the coutries for which the manufacturing practices have been studied are Sweden[4], USA and Japan[5], Belgium[6], Singapore[7], and USA and Europe[8]. An attempt has been made to benchmark global manyfacturing practices by comparing the manufacturing priorities and action programmes of companies in American, European and Pacific Rim countries[9]. Some of the recent studies have focused on only one aspect like quality[10,11] and on productivity[12]. Identification of various barriers to the management of international operations have also been studied[13].

In our knowledge there is no systematic study on the manufacturing objectives and practices pursued by the Indian

companies towards understanding these competitive issues at the micro level. Hence a survey on Indian manufacturing practices was carried out in the year 1994-95 among the discrete manufacturing companies to take stock of the present situation in terms of their objectives and action programmes in the emerging competitive environment. The study was designed to capture the behaviour of manufacturing in these companies in the previous three years and their planned action programmes in the coming three years. The purpose was also to understand as to how the manufacturing functions in the Indian companies are reacting and gearing towards these objectives in terms of the action programmes for achieving them.

These manufacturing objectives and the emphasis given to action programmes were also compared with that of other developed and developing countries in the world to get an idea about the difference in emphasis by the companies in the various countries.

METHODOLOGY

The approach was based on a mailed questionnaire survey and structured interviews. The questionnaire was designed using the literature available about similar studies being done in other countries [9] and our knowledge of Indian manufacturing. Pilot testing of the questionnaire was done with senior manufacturing executives of two leading companies.

The study was designed keeping in view the problems of using questionnaire survey method for the purpose of obtaining data in the field of manufacturing in the Indian corporate environment. Indian experience in the area of mailed survey by taking random sample from an industrial database has not been encouraging. The problems are more serious in the field of manufacturing as the companies are usually reluctant to share data as it is considered to be confidential. About 100 companies were sent the questionnaire. The sample included companies with whom the authors had relationships based on earlier interactions, to improve the response rate for the survey. A total of 38 usable responses from diverse group of industries were finally obtained. The respondents were senior executives incharge of manufacturing function in their respective organisations which ensured the the validity of the data.

It was decided to take Strategic Business Unit (SBU) of a company as a unit of analysis because a company operating in diverse product market situations is likely to follow different manufacturing strategy in each of the product market situations.

The process industry was excluded from the study as it was felt that clubbing process industry and discrete unit manufacturing industry in the study would not lead to meaningful results.

The sample profile using various classification scheme was as follows:

NATURE OF BUSINESS

Industrial Products	32
Consumer Products	6

TYPE OF INDUSTRY

Electronics	11
M/c Tool	7
Others	20

TYPE OF PRODUCTION PROCESS

Job-shop (low volume, high variety)	13
Batch-flow (mid volume, mid variety)	15
Flow-shop (high volume, low variety)	10

SIZE OF UNIT

Turnover in million Rs (US $32,000)

Small	< 100	8
Medium	100 - 500	15
Large	> 500	15

The analysis carried out provides an overall understanding of the Indian manufacturing practices.

MANUFACTURING OBJECTIVES

The objectives were based on the criteria prevalent for the competitiveness of the manufacturing organisations viz Cost, Quality, Delivery and Flexibility as emphasised in the literature on the industry competitiveness [14]. These four broad objectives were further divided into 10 subcomponents wherever relevant to get a better understanding of the priorities for specific objectives.

The scale used to develop the scores ranged from 1 to 5 on the Likert Scale.

1	2	3	4	5
not important				very important

The mean scores for the importance on the above scale for the 10 objectives identified are as follows.

	Objectives	*Mean score*
	COST	
C	Reduce unit cost	4.55
	QUALITY	
Q1	Improve performance of the products	4.47
Q2	Reduce rejection / rework rate	4.14
	DELIVERY	
D1	Increase delivery speed	4.32
D2	Increase delivery reliability	4.16
	FLEXIBILITY	
F1	Improve ability to make rapid changes in product-mix	3.53
F2	Improve ability to make rapid volume changes	3.32
F3	Increase variety of products	3.05
F4	Improve ability to change product design to customer needs	4.00
F5	Reduce lead-time for introduction of new products	4.05

The objectives which have been considered very important are

i. Reduce unit cost

ii. Improve performance of the products and

iii. Increase delivery speed

This shows that the three dimensions viz., Cost, Quality and Delivery find place on the top of the importance in that order. But there is a preference for a particular aspect of these dimensions by the manufacturers, like increase speed in delivery than reliability and improve performance of the product rather than reducing rejection rate. It is interesting to note that the other two criteria in the top half of the importance are again the aspects related to Delivery and Quality contributing to the confidence of the customers and the reduction of cost. The pursuing of these objectives will also help the manufacturers in terms of better inventory management at WIP and other stages.

All the five dimensions related to Flexibility have appeared in the bottom half of the importance of the list. The flexibility dimensions reflect the ability of the organisation to adapt to the changes in the environment and are unlikely to give the benefit on a short term as compared to the other criteria. It appears that the manufacturers preference is towards those aspects which can give immediate returns though it could be on a short term basis. It is also possible that manufacturers have still not felt the need for rapid response to the environmental changes.

This analysis was also carried out on the following:

(i) nature of businesswise between industrial products and consumer products

(ii) type of industrywise : between electronics and machine tools

(iii) type of production processwise : between job shop, batch flow and flow shop

(iv) size of unitwise : between small, medium and large companies

The details of these analysis are shown in the Appendics I to IV . The analysis has not shown any significant differences in the above discussed priorities.

The self assessment of the performance by the companies in terms of the achievement of objectives has shown that

(i) majority of the companies are happy with their performance on the quality front

(ii) there is a mixed reaction about performance in cost and delivery and

(iii) a general disappointment and even frustration about the speed of introduction of new products by the companies.

Among the 38 companies 23 mentioned that they have a written manufacturing strategy. However some of the organisations have a perception that the translation of marketing plan to a manufacturing plan is synonymous with manufacturing strategy.

An attempt was made to understand the difference between Indian companies and companies in other parts of the globe in terms of importance given to various manufacturing objectives. Table 1 compares top three manufacturing objectives, in the order of importance, pursued by companies in five of the representative countries / regions of the world and in India. This comparison with Korea and Mexico is of specific interest in the context of

India having to compete for foreign investments with similar countries.

Table 1. Comparison of Manufacturing Priorities

The comparison brings out clearly that countries in the various stages of development pursue different priorities. For example Indian and Mexican companies which have been working by and large in the protected markets in the past are pursuing cost reduction as the most important manufacturing objective while their other counterparts in the developed countries do not consider cost reduction as a priority area. One can also conclude that as country moves up on the development ladder, cost becomes only a qualifier criterion but quality and delivery become order winning criteria. This comparison would also help in sensitising Indian manufacturing companies to the fact that manufacturing priorities are dynamic in nature and that they should be proactive in revising the same over a period of time.

MANUFACTURING PROGRAMMES - Present

All the possible action programmes that could be initiated by a company towards meeting the above objectives were identified and total of 44 such programs were listed with the relevant programmes under each objective. An overall objective in terms of "improving overall manufacturing capabilities" was added to the above list of objectives.

These action programmes were identified on the basis of literature survey for similar studies [9] and a series of discussions with the top level and operating executives in the manufacturing areas of the companies helped in modifying the list to be relevant to the Indian situation.

The respondents were requested to indicate the emphasis given for the programme on a 3-point scale of `no emphasis' `normal emphasis' and `great emphasis'. The degree of emphasis reflects the importance given by the companies in terms of the resources deployment for the respective programme. [List of action programmes is given in the Appendix V].

The top ten and bottom ten in terms of the mean scores for the various action programmes are as follows:

Top Ten

ISO 9000 certification	2.66
Worker training	2.66
T Q M	2.58
Periodic review / action programme for follow up	2.56
Integrating information system in manufacturing	2.47
Interfunctional workteam	2.41
Standardising components	2.39
Awareness in the staff about cost aspects	2.39
C A D	2.38
Value analysis / product redesign	2.37

Bottom Ten

Poka-yoke (foolproofing)	1.61
Quality circles	1.74
Introduction of activity based costing	1.75
Cellular manufacturing/group technology	1.81
concurrent engineering	1.86
Just-in-time	1.86
F M E A	1.86
Reduction of suppliers	1.95
Reduction in setup time	2.00
Automation	2.00

It may be observed from the top ten action programmes that:

1. The preference is for ISO 9000 certification, TQM and Training Programmes for the workers which is in line with what is popular at present and as being emphasised by various Industry Associations.

2. The emphasis is more on activities in the shop floor, through programmes like worker training, periodic review, awareness in the staff, value analysis, etc., indicating that the emphasis is still on the activities in the operational level.

3. Computer utilisation is more in the area of CAD and also for integrating the information system at the functional level rather than the total organisational level.

4. The emphasis on CAD, standardisation of components and VA / Product redesign indicates the importance being given for design issues.

It may be observed from the bottom ten action programme that:

1. The less emphasis on aspects like automation, cellular manufacturing / GT and reduction in setup time indicates reluctance for investment. Is it due to taking low risks in the changing environment or investment inertia ?

2. The less emphasis on aspects like introduction of ABC, concurrent engineering, JIT and reduction of suppliers indicates that organisations are not ready to make major structural changes in the organisation and the present method of working.

3. The emphasis on Quality Circle is low. Is it due to past experience of not being much effective?

4. The less emphasis on FMEA and Poka-yoke and also ABC indicates that the organisations have to still gear up in terms of understanding towards adapting these advance types of techniques.

It would be of interest to compare the action programmes pursued by companies operating in other parts of world with those followed by Indian companies. Table 2 lists and compares top five action programmes in the order of emphasis laid by companies in India, Europe, Japan, USA, Korea and Mexico.

Table 2. Comparison of Manufacturing Action Pogrammes

Table 2 clearly shows how different countries pursuing different manufacturing priorities have translated them into action programmes. One does find by and large a strong linkage between action programmes emphasised and manufacturing priorities set for a respective country. This should help in putting a word of caution to some of the Indian companies who have started action programmes which are popular in developed countries, without clearly spelling out their manufacturing priorities. A case in point is that the priority given to action programmes in India like ISO 9000 certification and TQM are not in line with the priority given for manufacturing objective viz. reduce unit cost.

MANUFACTURING PROGRAMMES - Future

In the manufacturing programmes the emphasis to be given in the coming years were compared with the present one to check whether there is any significant difference in the priorities. The details of the analysis is shown in the Appendix VI.

Top Ten

Worker training	2.89
ISO 9000	2.86
Periodic review of program / follow-up	2.86
Reduction in overhead costs	2.84
Value analysis / product redesign	2.76
Standardising components	2.76
Interfunctional workteam	2.76
Awareness in staff about cost aspects	2.75
Integrating information system in manufacturing	2.75
T Q M	2.75

Bottom Ten

Introduction of CIM	1.90
Redundancy in capacity	2.00
Cellular manufacturing / GT	2.03
Introduction of ABC	2.09
Investment in CNC machines	2.10
Automation	2.15
Reduction of suppliers	2.19
Just-in-time	2.24
Poka-Yoke	2.29
Quality Circles	2.32

1. Among the top ten and bottom ten programmes for future there is no significant change as compared to the present indicating no shift in their approach. However all these programmes have received higher emphasis in terms of mean scores as compared to the present - indicating that companies seem to feel the necessity of pursuing all these programmes more rigorously in future, along with the new programmes required for improving the overall manufacturing capability.

2. Some of the programmes for future which have a substantial increase in the emphasis in terms of mean score are -

	Absolute difference	% increase over the present
Poka-Yoke	0.68	42.24
Concurrent engineering	0.62	33.33
Quality circles	0.58	33.33
Reduction in OH cost	0.58	25.66
Reduction in setup time	0.57	28.50
Involvement of suppliers	0.55	27.09
F M E A	0.51	27.42

This shows that there is a definite appreciation of the importance of initiating these action programmes which are

getting lot of attention in the recent literature on manufacturing in the changing context, though they seem to have been considered to be difficult options in the past. However among these programmes, there is still a preference for the soft options.

Among the new programmes considered for future, the programmes like (i) Process Reengineering, (ii) Benchmarking and (iii) Supply Chain Coordination have got higher emphasis and introduction of CIM does not receive much priority, which again shows the preference for non-high investment options.

The programmes where there is substantial increase in the emphasis indicates that:

(i) there is a continued emphasis on Quality and Cost;

(ii) Design issues are gaining more importance as companies are trying to reduce Lead Time for introduction of new products.

As reported in earlier section, Indian companies are likely to move from emphasis on cost reduction to quality and delivery over a period of time. This would necessitate shift in kind of action programmes which need to be pursued in line with the change in priorities. Indian companies need to gear up for these likely changes. They should be proactive in developing necessary expertise in the respective programmes before actual shift takes place. If companies start developing understanding of those programmes only when the actual shift takes place, companies may loose valuable time in the whole process.

SUMMARY AND CONCLUSION

There has been a need to understand how Indian manufacturing companies are responding to major changes taking place in the changing economic environment of India since 1991. The discrete manufacturing companies consider Cost, Quality and Delivery as the important objectives to be pursued with lower priority for the Flexibility - the preference being for those aspects which can give immediate returns. The action programmes for achieving these objectives emphasise on the shop-floor activities and also favour adapting softer options like worker training, periodic reviews etc. There is less preference for automation and introducing techniques like ABC, Poka-Yoke, Concurrent Engineering etc., which indicates that there is an inertia for investments and reluctance for restructuring. The action programmes proposed by these companies for future show no significant change as compared to present, indicating no major shift in their approach. However there is a higher degree of emphasis on bulk of these action programmes showing the realisation for pursuing these programmes more rigorously and also to catch up with implementation of new technique which are popular in the recent literature on strategic manufacturing. However the mindset for adapting softer options continues.

The comparison of Indian companies with those from the other parts of the world brings out clearly that countries in various stages of development pursue different priorities. Indian companies used to protective environment pursue cost reduction as

the most important objective which is not a priority in other countries. It is observed that there is generally a strong linkage between action programmes emphasised and manufacturing priorities set for a respective country the exception being India. The above comparison also helps to put a word of caution to some of the Indian companies who have initiated action programmes which are popular in developed countries, without clearly spelling out their manufacturing priorities.

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Table 1 : COMPARISON OF MANUFACTURING PRIORITIES

INDIA	EUROPE	JAPAN	USA	KOREA	MEXICO
Reduce unit cost	Reduce rejection/rework rate	Increase delivery reliability	Reduce rejection/rework rate	Improve performance of the products	Reduce unit rate
Improve performance of the products	Increase delivery reliability	Improvre ability to change product design to customer needs	Increase delivery reliability	Increase delivery reliability	Reduce rejection/ rework rate
Increase delivery speed	Improve performance of the products	Reduce rejection/ rework rate	Improve performance of the products	Increase delivery speed	Increase delivery speed

* The priorities for Europe, Japan,USA, Korea and Mexico are taken from 1990 survey [9]. In the survey respondents were asked to provide competitive priorities keeping next five years horizon in mind. Exact terminology used in the survey has been modified to suit the framework of the present study.

Table 2 : COMPARISON OF MANUFACTURING ACTION PROGRAMMES*

INDIA	EUROPE	JAPAN	USA	KOREA	MEXICO
ISO 9000 certification	Linking manufacturing and business strategies	Integrating information systems in manufacturing	Linking manufacturing and business strategies	Quality function deployment	Linking manufacturing and business strategies
Worker training	Integrating information systems in manufacturing	Developing new processes for new products	Job enlargement and enrichment	Supervisor training	Worker, supervisor training
Total Quality Management	Quality function deployment	Investing in improved production inventory control systems	Statistical Quality Control	Management training	Statistical Quality Control
Periodic review/ action programmes for followup	Supervisor training	Developing new processes for old products	Worker and supervisor training	Recondition-physical plants	Management training
Integrating information systems in manufacturing	Worker training	Integrating information systems across functions	Inter-functional workteams	Worker training	Giving workers broader range of tasks and responsibility

* The top five action programmes for Europe, Japan ,USA, Mexico, and Korea are taken from 1990 survey [9]. In the survey respondents were asked to provide the information keeping next five year horizon in mind.

Appendix I

Analysis 1
Nature of Businesswise

	Total	Consumer products	Industrial products
C			
Mean	4.5526	4.3333	4.5938
Std. Deviation	0.6450	0.5164	0.6652
Q1			
Mean	4.4737	4.0000	4.5625
Std. Deviation	0.7965	1.2649	0.6690
Q2			
Mean	4.1351	4.1667	4.1290
Std. Deviation	0.9178	0.7528	0.9571
D1			
Mean	4.3158	4.0000	4.3750
Std. Deviation	0.8732	1.0954	0.8328
D2			
Mean	4.1579	3.5000	4.2813
Std. Deviation	0.8551	1.0488	0.7719
F1			
Mean	3.5278	3.5000	3.5333
Std. Deviation	0.9996	0.5477	1.0743
F2			
Mean	3.3243	2.8333	3.4194
Std. Deviation	1.0555	0.4082	1.1188
F3			
Mean	3.0541	3.0000	3.0645
Std. Deviation	1.1291	1.5492	1.0626
F4			
Mean	4.0000	3.1667	4.1563
Std. Deviation	1.1150	1.1690	1.0506
F5			
Mean	4.0526	3.8333	4.0938
Std. Deviation	0.8366	0.9832	0.8175

Appendix II

Analysis 2
Type of Industrywise

	Total	Electronic	M/c. tool	Others
C				
Mean	4.5526	4.6667	4.5714	4.5000
Std. Deviation	0.6450	0.5000	0.7868	0.6726
Q1				
Mean	4.4737	4.4444	4.5714	4.4545
Std. Deviation	0.7965	0.8819	0.7868	0.8004
Q2				
Mean	4.1351	3.8889	3.8333	4.3182
Std. Deviation	0.9178	1.2693	0.9832	0.7162
D1				
Mean	4.3158	4.2222	4.5714	4.2727
Std. Deviation	0.8732	0.9718	0.7868	0.8827
D2				
Mean	4.1579	4.1111	4.2857	4.1364
Std. Deviation	0.8551	0.7817	0.7559	0.9409
F1				
Mean	3.5278	3.2222	4.0000	3.5238
Std. Deviation	0.9996	1.3017	0.6325	0.9284
F2				
Mean	3.3243	3.4444	3.3333	3.2727
Std. Deviation	1.0555	1.2360	1.2111	0.9847
F3				
Mean	3.0541	3.0000	2.5714	3.2381
Std. Deviation	1.1291	1.0000	1.2724	1.1360
F4				
Mean	4.0000	3.4444	4.5714	4.0455
Std. Deviation	1.1150	1.5092	0.5345	0.9989
F5				
Mean	4.0526	4.5555	3.8571	3.9091
Std. Deviation	0.8366	0.5270	0.6901	0.9211

Appendix III

Analysis 3
Type of Production Processwise

	Total	Job shop	Batch floor	Floor shop
C				
Mean	4.5526	4.7692	4.4667	4.4000
Std. Deviation	0.6450	0.5991	0.7432	0.5164
Q1				
Mean	4.4737	4.6923	4.3333	4.4000
Std. Deviation	0.7965	0.6304	0.7237	1.0750
Q2				
Mean	4.1351	4.3333	4.0000	4.1000
Std. Deviation	0.9178	0.8876	1.0690	0.7379
D1				
Mean	4.3158	4.3846	4.5333	3.9000
Std. Deviation	0.8732	0.7679	0.6399	1.1972
D2				
Mean	4.1579	4.2308	4.3333	3.0000
Std. Deviation	0.8551	0.8321	0.6172	1.1353
F1				
Mean	3.5278	3.8182	3.4667	3.3000
Std. Deviation	0.9996	0.8739	0.9904	1.1595
F2				
Mean	3.3243	3.5833	3.2667	3.1000
Std. Deviation	1.0555	1.1645	1.0998	0.8756
F3				
Mean	3.0541	3.0000	3.1429	3.0000
Std. Deviation	1.1291	1.3540	1.0271	1.0541
F4				
Mean	4.0000	4.3077	4.0000	3.6000
Std. Deviation	1.1150	1.1094	1.0690	1.1738
F5				
Mean	4.0526	4.2308	4.2000	3.6000
Std. Deviation	0.8366	0.7250	0.7746	0.9661

Appendix IV

Analysis 4
Size of Unitwise

	Total	<Rs.100 M	Rs.100 M to 500 M	>Rs.500 M
C				
Mean	4.5526	4.8750	4.4667	4.4667
Std. Deviation	0.6450	0.3536	0.7432	0.6399
Q1				
Mean	4.4737	4.7500	4.1333	4.6667
Std. Deviation	0.7965	0.4629	0.9904	0.6172
Q2				
Mean	4.1351	4.6250	4.0000	4.0000
Std. Deviation	0.9178	0.5175	0.9608	1.0000
D1				
Mean	4.3158	4.1250	4.3333	4.4000
Std. Deviation	0.8732	1.1260	0.8997	0.7368
D2				
Mean	4.1579	4.2500	4.0667	4.2000
Std. Deviation	0.8551	0.7071	0.9612	0.8619
F1				
Mean	3.5278	3.1250	3.5385	3.7333
Std. Deviation	0.9996	0.8345	1.0500	1.0328
F2				
Mean	3.3243	3.6250	3.3571	3.1333
Std. Deviation	1.0555	0.9161	1.0818	1.1255
F3				
Mean	3.0541	3.1250	2.5333	3.5714
Std. Deviation	1.1291	1.1260	1.0601	1.0163
F4				
Mean	4.0000	3.7500	4.2000	3.9333
Std. Deviation	1.1150	1.0351	0.9411	1.3345
F5				
Mean	4.0526	4.0000	3.8000	4.3333
Std. Deviation	0.8366	0.9258	0.9411	0.6172

Appendix V

Manufacturing Action Programmes

Reduce unit cost

C1 Automation
C2 Developing new processes
C3 Value analysis / Product redesign
C4 Reduction in overhead costs
C5 Introduction of ABC (Activity Based Costing)
C6 Awareness in the staff about cost aspects

Improve performance of the products

Q11 Quality function deployment
Q12 Interfunctional workteam
Q13 F.M.E.A (failure mode and effect analysis)

Reduce rejection / rework rate

Q21 Worker training
Q22 Statistical quality control
Q23 Quality circles
Q24 Poka-yoke (foolproofing)
Q25 Supplier education

Increase speed of delivery

D11 Cellular manufacturing / group technology
D12 Integrating information system in manufacturing
D13 Reduction of batch sizes

Increase delivery reliability

D21 Total productive maintenance
D22 Periodic review / action programme for follow-up
D23 M R P
D24 Quoting realistic lead time

Improve ability to make rapid product mix changes

F11 Investment in C N C machines
F12 Developing multiskilled workers
F13 Reduction in setup time

Improve ability to make rapid changes

F21 Redundancy in capacity
F22 Increase / decrease OT / additional shifts
F23 Building flexibility of supplies

Improve ability to change product design to customer needs

F31 C A D
F32 Investment in C N C machines

Increase variety of products

F41 Modular design
F42 Standardising components

Reduce lead-time for introduction of new products

F51 Interfunctional teams
F52 Quality function deployment
F53 Design for manufacturing
F54 Involvement of suppliers
F55 Concurrent engineering

Improving overall manufacturing capabilities

M1 I S O 9000 certification
M2 T Q M
M3 Manufacturing reorganisation
M4 Just-in-time
M5 Reduction of suppliers
M6 Reduction of components
M7 Computer integrated information systems
M8 Empowering of employees
M9 Process reengineering*
M10 Benchmarking with global competitor*
M11 Introduction of C I M (computer integrated manufacturing)*
M12 Supply chain coordination*

(*) Programmes were included only in the list of action programmes to be pursued in the future.

Appendix VI

Comparison of Mean scores for the
Manufacturing Action Programmes
Present vs Future

Action Programme	Present Mean	Future Mean	Absolute Difference	Relative Difference %
C1	2.00	2.17	0.17	08.50
C2	2.25	2.50	0.25	11.11
C3	2.37	2.76	0.39	16.45
C4	2.26	2.84	0.58	25.66
C5	1.75	2.09	0.34	19.43
C6	2.39	2.75	0.36	15.06
Q11	2.31	2.67	0.36	15.58
Q12	2.46	2.73	0.27	10.98
Q13	1.86	2.37	0.51	27.42
Q21	2.66	2.89	0.23	08.65
Q22	2.16	2.49	0.33	15.28
Q23	1.74	2.32	0.58	33.33
Q24	1.61	2.29	0.68	42.24
Q25	2.16	2.54	0.38	17.59
D11	1.81	2.03	0.22	12.15
D12	2.47	2.75	0.28	11.34
D13	2.31	2.43	0.12	5.19
D21	2.09	2.44	0.35	16.75
D22	2.56	2.86	0.30	11.72
D23	2.18	2.59	0.41	18.81
D24	2.35	2.72	0.37	15.74
F11	2.21	2.18	-0.03	-1.36
F12	2.33	2.75	0.42	18.03
F13	2.00	2.57	0.57	28.50
F21	2.00	2.00	0	0
F22	2.06	2.35	0.29	14.08
F23	2.00	2.46	0.46	23.00
F31	2.38	2.72	0.34	14.29
F32	2.12	2.12	0	0
F41	2.06	2.43	0.37	16.96
F42	2.39	2.76	0.37	15.48
F51	2.37	2.76	0.39	16.46
F52	2.14	2.59	0.45	21.03
F53	2.25	2.74	0.49	21.78
F54	2.03	2.58	0.55	27.09
F55	1.86	2.48	0.62	33.33

Appendix VI (contd...)

Action Programme	Present Mean	Future Mean	Absolute Difference	Relative Difference %
M1	2.66	2.86	0.20	7.52
M2	2.58	2.75	0.17	6.59
M3	2.17	2.60	0.43	19.82
M4	1.86	2.24	0.38	20.43
M5	1.95	2.19	0.24	12.31
M6	2.06	2.36	0.30	14.56
M7	2.24	2.61	0.37	16.52
M8	2.21	2.62	0.41	18.53
M9	-	2.58		
M10	-	2.50		
M11	-	1.90		
M12	-	2.39		