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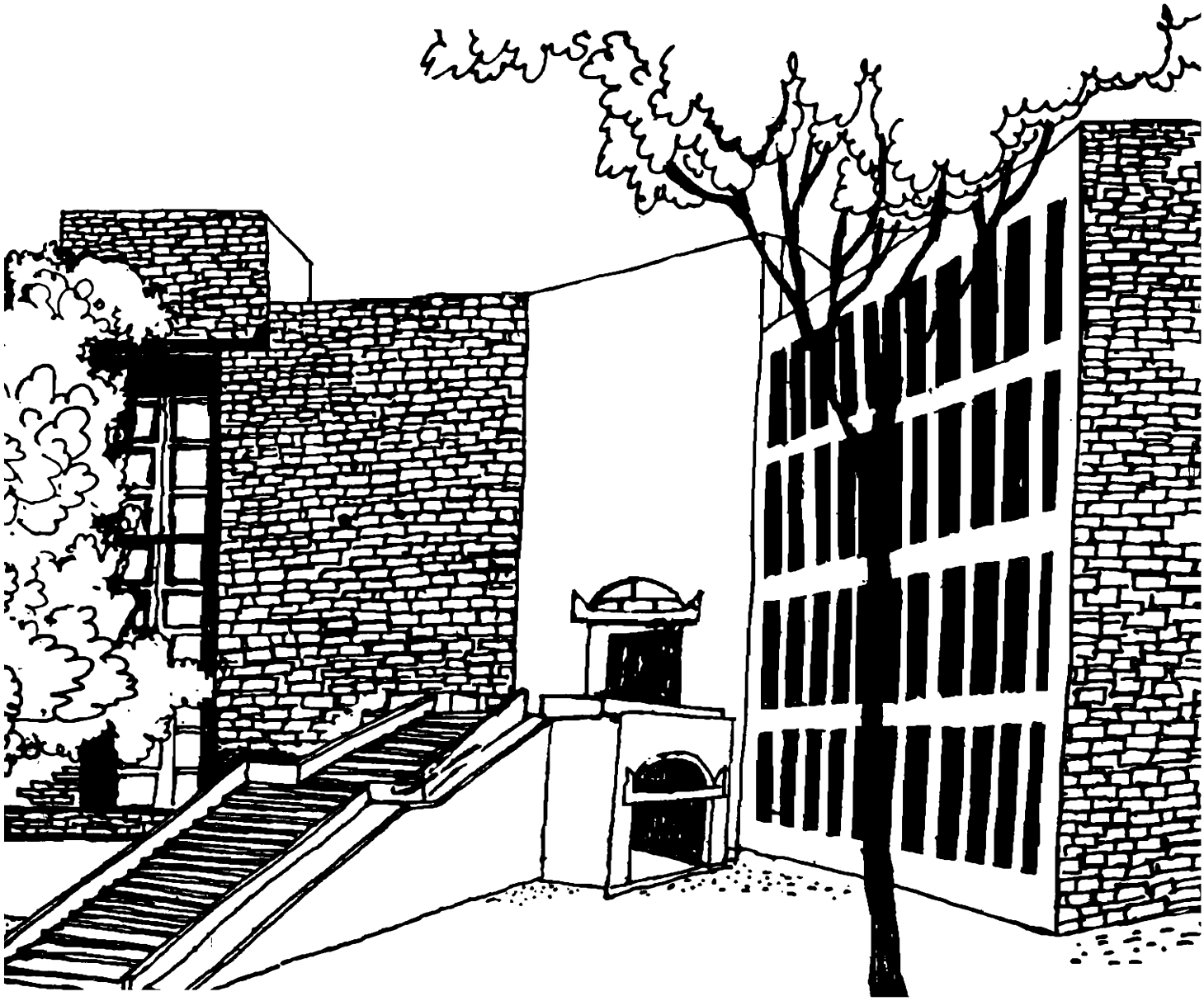
# Working Paper



# COMPETITIVENESS OF INDIAN MANUFACTURING: FINDINGS OF THE 1997 MANUFACTURING FUTURES SURVEY

By

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# COMPETITIVENESS OF INDIAN MANUFACTURING

## Findings of the 1997 Manufacturing Futures Survey

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## Abstract

This paper reports the findings of a survey to study the competitiveness of Indian manufacturing sector. The paper conceptualizes these findings in terms of priorities of Indian manufacturing firms, the programmes that they undertake to reach their objectives, and the outcome or the performance of these firms. We also present some international comparisons based on a similar study done in the USA. The paper highlights the role of innovation and supply chain management, as a part of any robust manufacturing strategy, in developing world class operations.

## I Introduction

How competitive are Indian manufacturing firms? What are some of the key manufacturing issues that leaders of Indian manufacturing are concerned about? What kinds of initiatives are being taken by these firms to improve their competitiveness? How do these leaders perceive their own strengths and weaknesses? What will make Indian manufacturing world-class? These were some of the many questions we have been seeking to answer through the 1997 Manufacturing Futures Survey. While changes have been numerous at the firm level we wanted to examine to what extent they have achieved their objectives and met the emerging competitive needs. Another key question we address is whether our industry is gearing up to realise its full potential or whether firms are satisfied with limited success. The survey measures broad trends in the Indian manufacturing sector and assesses its competitiveness through a variety of self-answered questions in a sample survey. Appendix 1 describes the methodology. The larger purpose of this study is to disseminate good practices across the industry and to help firms to benchmark their performance. An closely related issue is our standing vis-à-vis the best in the world. In this report, we also present some of the key practices and characteristics of world class plants.

The cost structure of Indian plants shows that materials constitute 66 percent of total costs, direct labour 10 percent and overheads 24 percent. This implies that initiatives to control manufacturing costs may need to focus on reduction in material costs and overheads. However, traditionally the focus has been on managing labour costs. Efforts to control material related costs may need to address several issues including rejects and rework on the shop floor, identifying alternative materials, and better materials management and sourcing. An underlying implication is that all sources of uncertainty to materials need to be eliminated or reduced. Otherwise costs of high

inventories would go up. Interestingly, the break-up of the manufacturing cost for USA was 55 percent, 31 percent and 14 percent for the three factors respectively. The emphasis on labour cost is therefore hard to explain.

In the following sections, we describe the findings of a nation-wide survey of top executives in manufacturing organizations. In the next section we describe the new competitive challenges that Indian firms face followed by the manufacturing strategies that these leaders have devised for their firms in order to face the competition. We then examine how effective these strategies have been in the past, compare these strategies with those of US firms, look at the future in term of efforts needed to improve manufacturing and effectively manage the entire supply chain, and finally, present conclusions of the study.

## II New Competitive Challenges

Today, Indian firms are facing a very different competitive scenario as compared to the past. They are facing competition from imports and from MNCs in the domestic markets. Several firms also have to compete as new entrants in global markets. Earlier, firms would segregate these two markets and serve them with different quality products and services, while perhaps compromising on quality in the home market. This is no longer possible. Therefore, many strategies that may have worked in the past are not likely to succeed in the future.

The new competition is in terms of reduced cost, improved quality, products with higher performance, a wider range of products, and better service - all delivered simultaneously. A lot

has already been written the in business press about many of these issues. However, Indian firms have quite often followed an opportunistic approach to growth as opposed to a capability driven approach that seeks to strengthen key aspects of manufacturing. Consequently, firms have paid very little attention to their shop floors in the last few decades. There have no doubt been notable exceptions to this and some firms have systematically built up their capability in the recent past. Firms have also started paying attention to quality, but it is not clear whether enough is being done about faster throughput and delivery, introduction of a wider range of products, and better service. It would not be incorrect to say that we are still struggling to get the "quality" right and that firms will perhaps focus on other issues at a later date.

The Indian market place has been witnessing a quiet revolution where old products are being substituted by better ones. In fact, for the first time, products and services are being introduced to meet certain customer needs that were only partially met in the past. One implication of this rapid introduction of new products is the pressure on manufacturing facilities to profitably produce a larger variety in smaller volumes. Firms have to search for new processes, new materials, new vendors, new shop floor layouts, new ways of reducing cycle times, new designs, new channels etc. to deliver these products and services . In addition, manufacturing firms are being increasingly required to integrate services with products to meet customer needs. The real challenge is therefore to improve substantially on several dimensions, including quality, technology, shop floor practices, supply chain coordination, and new product introduction over a short period of time.

## III Manufacturing Strategies

The 1997 survey shows that to improve their competitive position, Indian firms will give the highest priority to quality improvement in the next five years. Figure 1 shows the relative importance given to four sets of issues by Indian firms on a 7 point scale, with higher scores indicating higher priority. These are Quality, Operations, Structural Changes, and Innovation & R&D. Quality for purposes of this research, comprises *conformance* quality or adherence to specifications, *performance* quality of products, product reliability and product durability. Operations related practices were those that improved the distribution network and performance, on-time delivery, ability to handle production volume changes, product support, and after-sales service. These practices can usually be changed or improved without fundamental changes in the manufacturing system. For instance, production volumes can often be increased by the use of overtime, or by operating an additional shift. On the other hand Structural Changes, which include fast delivery capabilities, low prices, and ability to change product mix, often require major changes in manufacturing. For instance, to substantially improve delivery performance of a wide variety of products, firms would need to cut down on production throughput times, reduce set up times, improve scheduling, and in some cases, change the manufacturing system or bring in new equipment. These changes require much greater effort and often take time to implement. Innovation and R&D included new product introduction, broadening the product line, making design changes and customizing the product. Quality is the number one competitive priority, followed by Operations, Structural Changes and finally, Innovation & R&D.

However, there is a close link between Quality and Structural change, and between Quality,

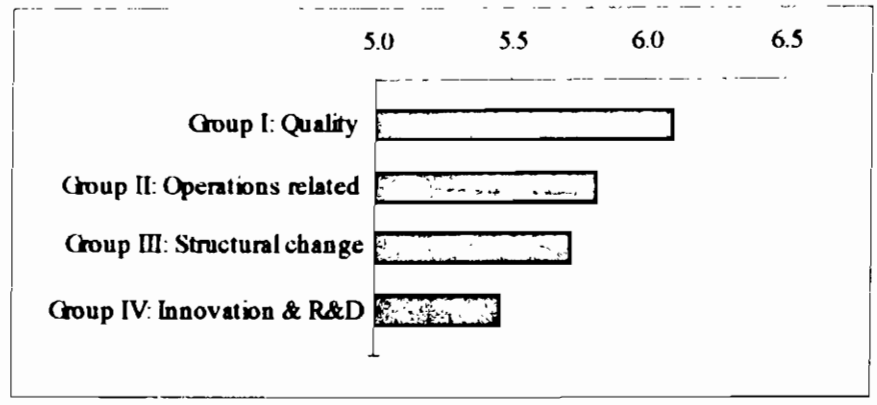


**Figure 1: Competitive priorities of firms: group averages**

Innovation and R&D. For instance, quality often cannot be improved without major changes in production processes. In discrete part manufacturing, the use of some key ideas from the Toyota Production System, which in turn require changes in layouts, process improvements and so on, have helped several firms across the world to improve quality. An exclusive focus on quality tools like SQC and SPC, or on programs like TQM and TPM without some basic changes may not achieve the desired purpose. However, this is currently not a priority, and it is not clear whether this link between quality and other required changes is well understood. Similarly, quality is largely a function of design. Without attention to product design, it is unlikely that improvement can be sustained. The recent interest in Business Process Re-engineering within the manufacturing function is more encouraging since it focuses on making some required fundamental changes.

Figure 2 gives a relative ranking of various manufacturing priorities of Indian firms. At the top of the list is the ability to provide consistent quality with low defects. It is being widely recognized that by reducing defects, firms can improve not only on price but also on delivery and flexibility parameters significantly as lead times reduce drastically. World class firms are now targeting six-

sigma quality levels and are measuring defect in parts per million (or ppm). Figure 2 shows that firms are planning to pay attention to several aspects of manufacturing, and this is encouraging.

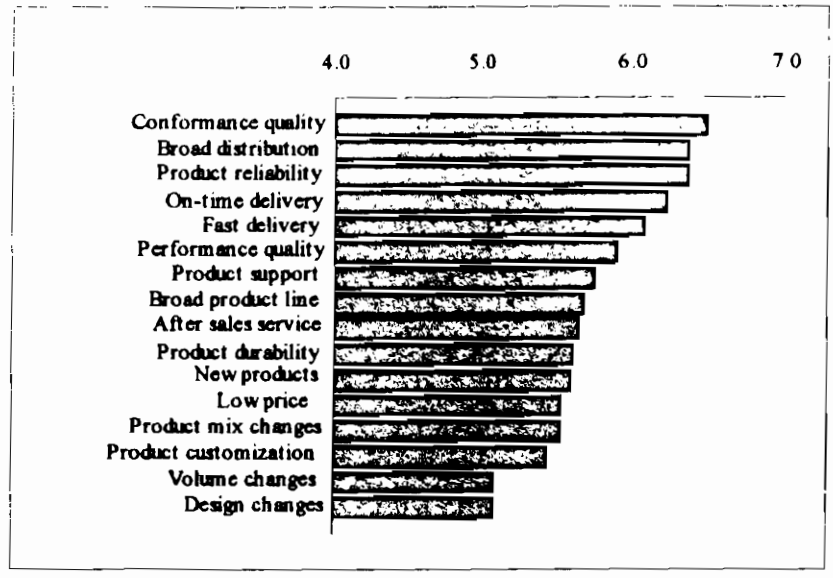


**Figure 2: Competitive priorities of firms (degree of importance over next five years)**

Interestingly, firms also perceive quality (as shown in Figure 3) as their key strength with respect to their primary Indian competitor. The Figure shows how firms have rated themselves with respect to domestic competition on a 7 point scale where a score of 4 indicates that they are as good as the competition, and higher scores indicate that they are better. These firms rate their ability to introduce new products and offer flexibility (in terms of managing volume changes or design changes or product mix changes) as being relatively low.

The competitive gap, or the difference between stated importance & strength, gives an idea of areas that require maximum attention in order to make manufacturing more "market driven". The largest gap is for broad distribution, followed by fast and on time delivery, developing new products, offering consistent quality with no defects, and reducing costs (Figure 4).

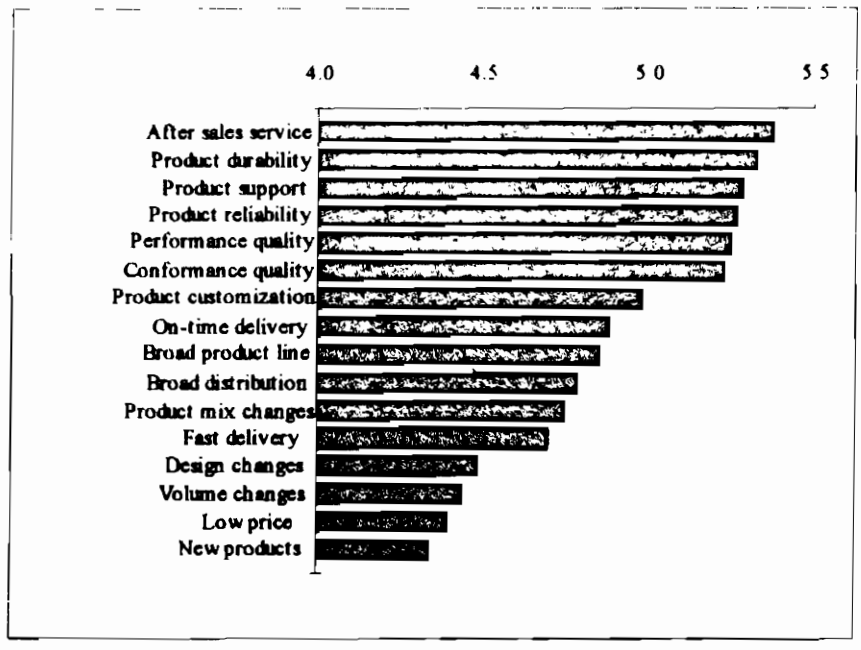


**Figure 3: Perceived competitive strengths of firms (degree of strength relative to Indian competitors)**

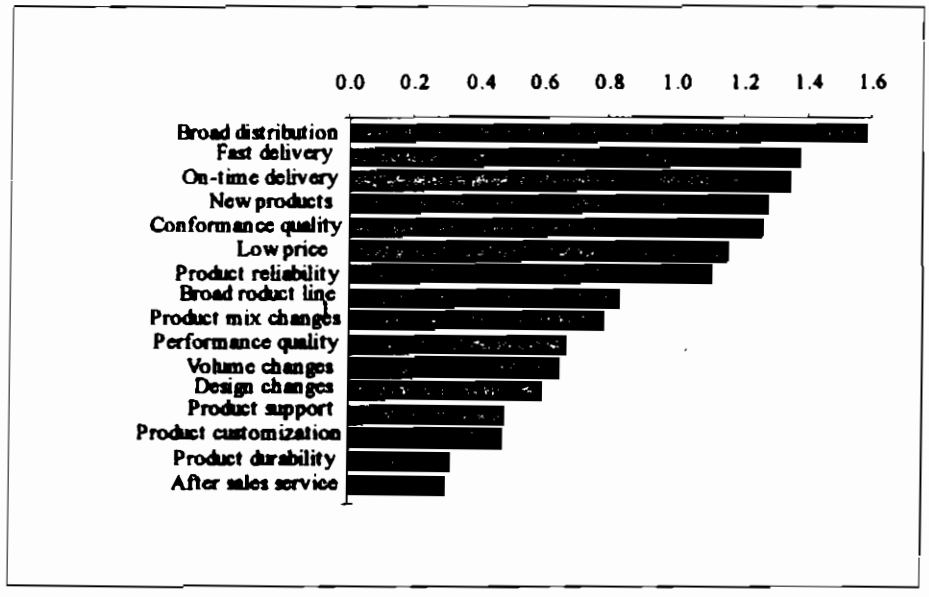


**Figure 4: Competitive gap (difference of future priorities and current strengths)**

It seems that the manufacturing strategy of most firms is focused on improving product and process quality, after sales service and on delivering products on-time. However, as mentioned

earlier, improvements often require more fundamental changes in the way manufacturing is organised. Firms on the other hand are currently giving low priority to these fundamental changes which require changing processes, developing the ability to change product mix rapidly or investing in R&D to develop new processes and products.

On the other hand, in the United States, Innovation and R&D has the highest priority followed by structural changes. We discuss this issue in greater detail in the Section on International Comparisons. Interestingly, most Indian firms believe that they are at least as good as, or better than their foreign competitors on price, flexibility, quality, service and product design capabilities. This is seen in Figure 5 which has a 5 point scale, and where any score above 3 shows that the firm considers itself to be superior to foreign competitors. It is obvious that the average Indian firm's perception of its abilities differs considerably from its status in the global market place. This perception could be because many firms are not directly competing with MNCs in the same product market segments, or due to an inherent bias when firms are asked to rate themselves.

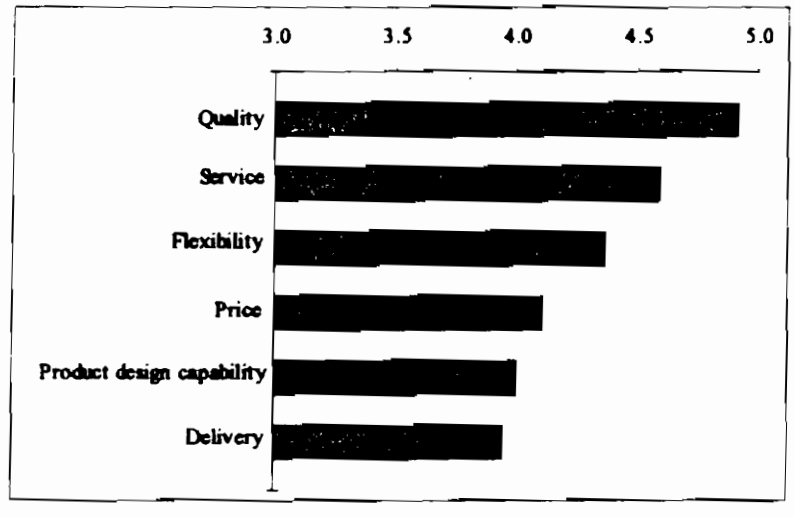


**Figure 5**: Comparison with foreign firms on various factors

Manufacturing companies have recently invested in a variety of improvement programmes or activities in order to enhance their competitiveness. Table 1 gives the changes in emphasis on various manufacturing related programmes. It lists the top ten programmes that Indian managers implemented in the last two years and compares them with the top ten initiatives that they will focus on in the next two years. It is evident that firms are investing in training their employees (note: worker training was accorded the eleventh position in terms of future emphasis) and on making their workers cross functional. In addition, firms believe that their investment in information technology (IT) in manufacturing will increase in the future. What is not clear is how they plan to use this information for better decision making. While managers have rated functional teamwork quite high in their list of priorities, they have given low priority to "reconfiguration of plant layouts" - a step necessary for implementing functional teamwork. Perhaps may firms have already made some of these changes. Automation in the form of robots, CIM, CAM, FMS,

| **Initiatives in the Past** | **Initiatives in the Future** |
|---|---|
| 1. Work Enlargement | 1. Continuous Improvement |
| 2. Management Training | 2. Management Training |
| 3. Continuous Improvement | 3. Manufacturing Strategy |
| 4. Worker Training | 4. Information System within Business Unit |
| 5. Supervisor Training | 5. Total Quality Management |
| 6. ISO 9000 | 6. Supervisor Training |
| 7. Manufacturing Strategy | 7. Information System within Manufacturing |
| 8. Quality of Work Life | 8. ISO 9000 |
| 9. Functional Teamwork | 9. Cross Functional Teams |
| 10. Cross Functional Teams | 10. Functional Teamwork |

**Table 1: Changes in emphasis: Top ten manufacturing initiatives of the past and the future**

automated inspection etc., have been rated in the bottom ten in terms of future importance.

The absence of some practices that have become synonymous with world class manufacturing from the top ten list in Table is noticeable. Just-in-time manufacturing has still not found acceptance in Indian firms. This could be because of several hurdles encountered while trying to implement such programs, or in some cases, due to poor understanding of JIT or pull production systems in the industry which has led to "unfavourable" myths developing around it. Other practices that have not been given adequate importance include forging customer and supplier partnerships, strategic outsourcing, use of statistical process control (SPC) effectively and continuously, value engineering and product re-design, use of CAD/CAE systems etc. Moreover, inadequate attention from top managers has sometimes not allowed firms to develop manufacturing into a competitive strength. Manufacturing related interventions are sometimes done piece meal, in line with the fads of the time. A well defined strategy with a clear understanding of the sequence of manufacturing programmes that must be implemented is missing.

It must be mentioned that Indian industry have "islands of excellence," i.e., firms that have recognized the need to change and have a well thought out plan of action to become competitive. Such firms have started implementing practices that are employed by world class plants. However, many firms do not seem to have a coherent plan about what needs to be done. For instance, in discrete part manufacturing, one possible route could be to first implement house-keeping and preventive maintenance programs, followed by conversion of manufacturing to flow shops,

introduction of quality systems, setup reduction, and ISO certification, with the eventual goal of getting close to just-in-time manufacturing systems.

House Keeping involves maintaining a proper discipline in demarcating parts, tools & equipment locations, cleanliness etc. (including 5S Tools); preventive maintenance of equipments (including TPM) follows a regular schedule for machine & tool checkups instead of doing maintenance during breakdowns; flow manufacturing involves process flow analysis and cellular production layouts to smoothen flows of material on the shop floor and reduce WIP; quality systems include SPC and process capability analyses; setup reduction further enhances process effectiveness by trying to reduce changeover times and thereby increasing the flexibility of firms; and ISO certification helps the firm strengthen its internal systems. Finally, JIT manufacturing facilitates a pull based production control, reduces investments in inventory, drastically cuts throughput and delivery times, improves quality on a sustained basis, and makes new product introduction much easier. Similarly, a well thought out plan is required for continuous production or process industries. Establishing a program that implements these practices in a defined sequence allows the development of process discipline that is necessary to become a competitive manufacturer. Moreover, improvements of the nature mentioned above require little capital investment except those in training, instrumentation and calibration, and some changes in tooling and layouts.

## IV Manufacturing Performance

The first question that needs to be asked is, given the above mentioned manufacturing strategy of Indian firms, how well have they performed ? It would also be useful to identify areas where

intervention has been most beneficial and where it has not been successful. The 1997 survey shows that, over the last two years, there has been a marked improvement in the performance of firms on a variety of factors. Improvements in quality, especially, within the plant have been significant. In fact, 77 percent of firms that were surveyed reported an increase in profitability while 87 percent of firms claimed to have increased their market share. While these improvements should be viewed in terms of the low base value in many cases, the fact remains that the Indian industry has been changing rapidly for the better.

Figure 6 shows the extent of improvement in Indian manufacturing firms over the last two years. The maximum improvement has occurred in the productivity of direct production workers (about

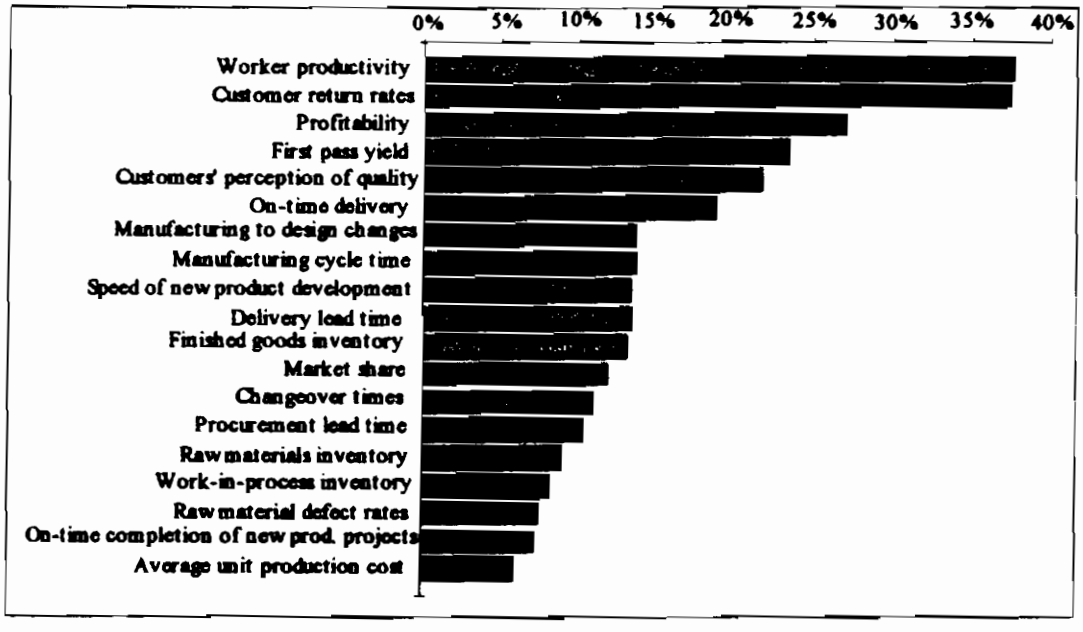


**Figure 6: Percent improvement on various manufacturing performance indicators over the last two years**

38 percent). There could be a variety of reasons for the same: improved as well as increased

emphasis on training of workers, incorporation of faster machines that also require fewer workers, etc. This has been followed by reduction in customer returns, improvements in first-pass yields and in the overall perception of quality by customers. Other dimensions that are worth mentioning in terms of improvements are on-time delivery, speed of response on the shop floor to design changes and reduction in manufacturing cycle times. It is apparent that shop floor improvement programmes, in many firms, are proving to be beneficial. However, there are three disturbing trends. First, though the mean improvement scores for factors like productivity of direct labour, customer return rates and profitability were the highest, the variance was also very high. Thus many firms have done well on these factors, but several others have not. In fact, 9 percent of firms have reported a decline in productivity of production workers, 13 percent have seen an increase in return rates and 23 percent of firms have witnessed a loss in profitability in the last two years. Second, there has not been adequate improvement on inventory levels, i.e., raw material, work-in-process (WIP) and finished goods. In this case, 27 percent, 26 percent and 27 percent of sample firms have reported an increase in raw material, WIP and finished goods inventory respectively, over the last two years. This increase is not entirely explained by a corresponding increase in turnover. Third, the pre-occupation with labour productivity is evident although on the average, labour is only 10% of total cost. This is reflected in the fact that improvements in costs are relatively low compared to other improvements. More attention to materials and overheads which comprise 90% of costs is perhaps needed.

Therefore, we may have gained in some areas, but may be losing on others. Many of our firms have not yet been able to tightly control inventories across the supply chain. They still appear to

be using inventories to meet demand rather than developing quick response manufacturing to meet changes in market needs. The relationship between batch sizes, WIP and lead times is very close. Increase in batch sizes leads to higher WIP and longer leadtimes. The key is to perform process analysis, de-bottleneck, reduce setup times and synchronize order release with throughput rates. In short, manufacturing has to become process oriented.

A summary of manufacturing performance of the sample firms is given in Table 2. It provides a comparison on various indicators across industry types (e.g., automotive, consumer goods, electronics, engineering & machinery, textiles and process industry). We also present averages on these indicators for the entire sample as a whole. Some of this data can be benchmarked against overall industry averages from a similar survey done in the USA in 1994[1]. Performance appears to be varying across industry types. Interestingly, for the period under study, Indian firms on the whole had a higher growth rate in sales (in unit as well as rupee terms) as compared to firms in the US though the pre-tax profit ratio was lower for the Indian firms. This lower realization of profits might indicate hidden costs due to low first pass yields, low inventory turns, high outstanding accounts, long lead times, etc. in Indian firms.

As can be expected, capacity utilization in the process industry is higher than that in discrete part manufacturing. The consumer goods, electronics, and engineering & machinery industries stand out in terms of low capacity utilization. The inventory turns in the process industry is quite low implying that working capital is tied up in this sector for longer periods of time. Often process

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Source: Kim, J.S. and M.T. Frohlich (1994) "Summary Results From the 1994 U.S. Manufacturing Futures Survey," Boston University's Manufacturing Roundtable, Boston University, mimeo.

| Indicators | Automotive | Consumer Goods | Electronics | Engineering & Machinery | Textile | Process | Overall (India) Mean | Overal (USA) Mean* |
|---|---|---|---|---|---|---|---|---|
| Annual sales revenues (RS. crores) | 292.7 (286.5) | 248.0 (171.3) | 160.9 (237.8) | 162.8 (341.0) | 601.1 (1197.3) | 1096.6 (384.4) | 393.4 (941.6) | 4327.5 |
| Net pretax profit ratio (profit/sales) * 100 | 9.6 (5.0) | 7.5 (4.6) | 9.8 (6.7) | 11.6 (7.8) | 5.1 (6.8) | 12.0 (9.5) | 9.9 (7.2) | 11.8 |
| Growth rate in unit sales (%) | 13.7 (14.7) | 13.5 (6.6) | 17.9 (10.5) | 8.0 (13.1) | 12.2 (5.5) | 9.4 (17.7) | 11.9 (12.5) | 7.7 |
| Growth rate in rupee sales (%) | 26.5 (14.3) | 20.4 (10.0) | 15.9 (12.1) | 25.7 (21.2) | 24.4 (10.4) | 15.9 (16.9) | 21.5 (16.0) | 6.4** |
| Market share of primary product (%) | 33.6 (30.8) | 35.0 (19.0) | 18.3 (14.1) | 28.6 (17.9) | 36.3 (41.2) | 13.8 (10.5) | 26.5 (20.6) | 34.1 |
| Capacity utilization | 80.0 (11.0) | 70.3 (11.6) | 69.6 (38.4) | 64.2 (37.6) | 90.6 (1.59) | 91.7 (21.7) | 76.1 (27.5) | 73.7 |
| On-time deliveries (%) | 80.8 (14.6) | 84.8 (8.2) | 75.0 (24.0) | 80.2 (11.1) | 93.0 (4.5) | 92.9 (7.3) | 83.7 (13.7) | 88.9 |
| Average manufacturing lead time (days) | 19.2 (9.0) | 21.3 (40.3) | 13.3 (10.5) | 74.7 (51.3) | 19.2 (23.4) | 30.0 (38.8) | 39.5 (45.4) | - |
| Annual inventory turns per year | 8.0 (3.4) | 6.6 (3.7) | 5.3 (2.5) | 6.4 (6.6) | 8.12 (6.7) | 6.4 (3.0) | 6.6 (4.7) | 11.2 |
| First pass yield (%) | 74.4 (41.3) | 75.4 (29.4) | 82.3 (16.9) | 91.0 (7.5) | 96.0 (5.4) | 92.8 (12.7) | 85.6 (21.2) | - |
| Sales from new products (% of annual sales) | 22.7 (29.0) | 24.3 (20.4) | 44.5 (34.7) | 12.8 (13.6) | 52.8 (29.4) | 16.1 (13.4) | 25.4 (25.3) | - |
| Cash-to-cash cycle (days) | 50.3 (64.1) | 41.3 (31.2) | 61.0 (53.6) | 116.5 (78.4) | 76.6 (59.4) | 72.0 (58.8) | 75.0 (64.4) | - |
| Value of existing backorders (% of annual sales) | 10.4 (13.6) | 17.5 (17.5) | 10.1 (9.9) | 62.9 (45.1) | 26.0 (42.5) | 9.6 (11.8) | 30.1 (37.7) | - |
| Value of outstanding accounts receivable (% of annual sales) | 9.8 (6.1) | 13.1 (10.5) | 21.8 (9.9) | 21.6 (10.4) | 14.2 (13.7) | 15.7 (8.1) | 17.2 (10.4) | - |

* Overall mean values for US industry is given for the year 1994; ** reflects growth rate in dollar sales

**Table 2: Mean (standard deviation) values of manufacturing business unit performance by various industry**

industries feel compelled to operate their plants continuously even when the demand is low thereby building up inventory. Inventory turns across are low - an issue which has been discussed earlier as well. Firms sometimes tend to keep expensive resources like machines busy all the time in order to recover their fixed cost. This approach, stemming from an accounting view of manufacturing, often adds inventory, schedules production in large batches, and prevents firms from being market driven. Similarly, the first pass yield is relatively low in the automotive, consumer goods and electronics industries.

Many firms in the textile sector seem to be doing well financially but modern manufacturing practices and their benefits are yet to take roots here. Average cash to cash cycle (i.e., total elapsed time from the date that a firms paid its suppliers for materials to the date it was paid by its customers for the products that were made from the same materials) ranges from over one month in the consumer goods industry to over two and half months in textile and slightly less than four months in the engineering & machinery sector. A similar picture emerges if we look at the value of outstanding accounts. There is scope for improvement on these dimensions.

## V International Comparisons

We now examine how we stand in comparison to the US industry for which a similar survey was done in 1994. As seen in Figure 7, the importance given to different aspects of manufacturing is different in the two countries. The data shown there is the difference in the level of importance of Indian firms and the US firms on various attributes. Each attribute value (on a scale of 1 to 7) was first normalized for each country before computing the difference. The US is paying more

attention to several Innovation and R&D type of issues like product customisation, new products, design changes, and to issues which require manufacturing to be more flexible like product mix changes, production volume changes, and finally, low price. Indian industry on the other hand is paying attention to more basic issues like broad distribution, after sales service, product reliability and durability. Indian industry is also interested in broadening their product line; however, to do that, they would need to invest in R&D, which is currently not a priority. To some extent these differences reflect the current realities and requirements. In the future, the Indian industry might need to change some of its priorities, especially if it wants to compete globally.

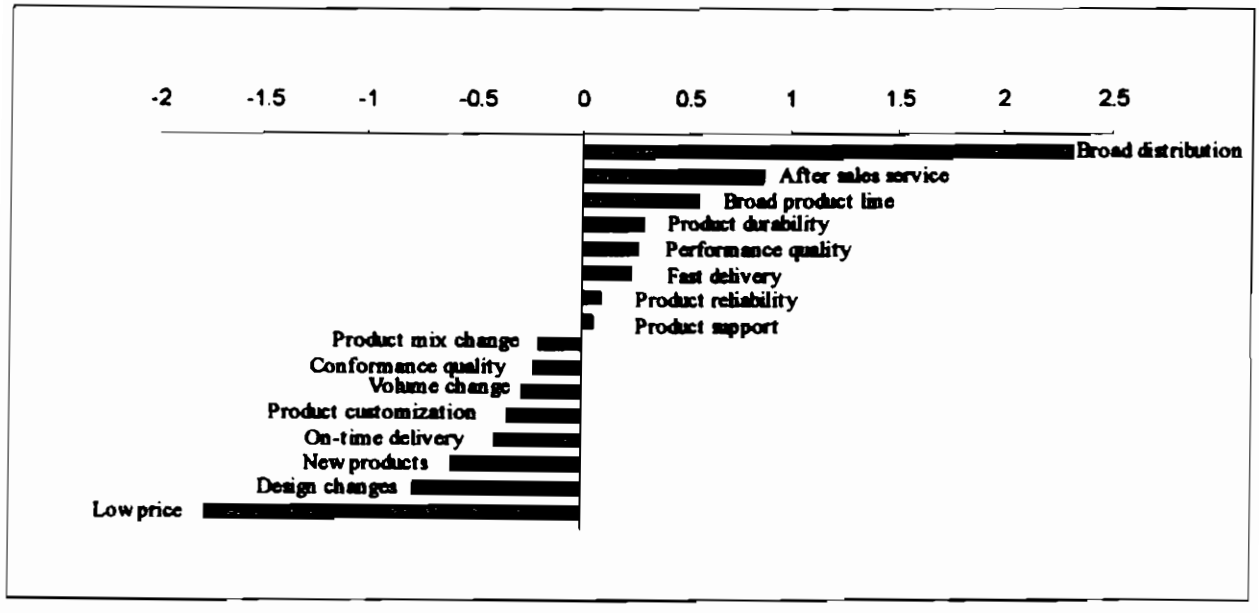


**Figure 7. Comparison of manufacturing priorities between India and the US**

Figure 8 shows the ten programs which are most important for US firms and least important for Indian firms. Here there are really significant differences in issues like design for manufacturability (DFM), supplier partnerships which now include global partnerships, worker training, business

process re-engineering (BPR), cross functional teams and JIT. The numbers in the figure are the difference between the normalized values of different attributes of US firms and Indian firms.

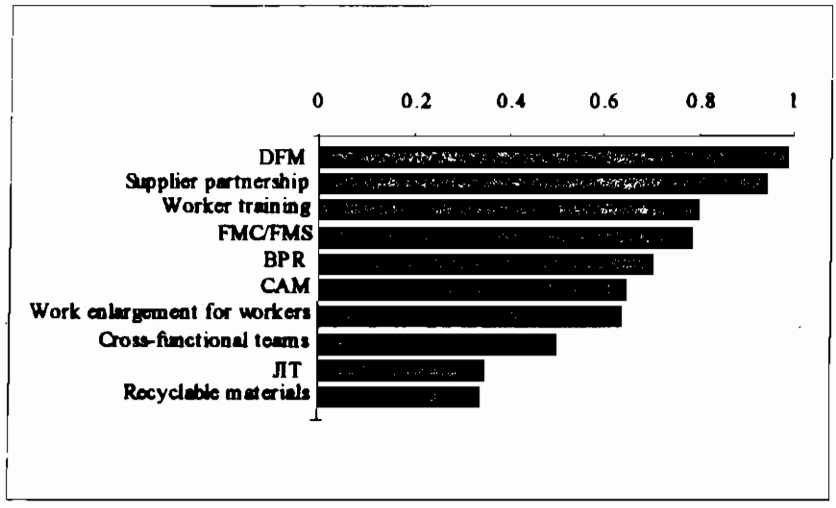


**Figure 8. Programs which are the most important in the US and least important in India.**

There are significant differences in terms of payoffs from manufacturing programs carried out in the two countries. The top ten programs where Indian industry reported greater payoffs than the US industry are shown in Figure 9. These include improving quality of work life, outsourcing, teamwork, benchmarking, new processes and training. These programs seem to be aimed at bringing manufacturing up to a basic minimum standard. In contrast, Figure 10 shows the programs where the US industry reported greater payoffs. These include programs like JIT, SQC and SPC, CAD/CAE, DFM (design for manufacturability) and relocation or closing of plants. Although some of these options may not be practical in India at least at this point of time, programs like JIT, SPC and DFM have shown quite clearly that they substantially improve manufacturing costs, quality and flexibility.

The differences in priorities and in the type of programs in the two countries reflect perhaps

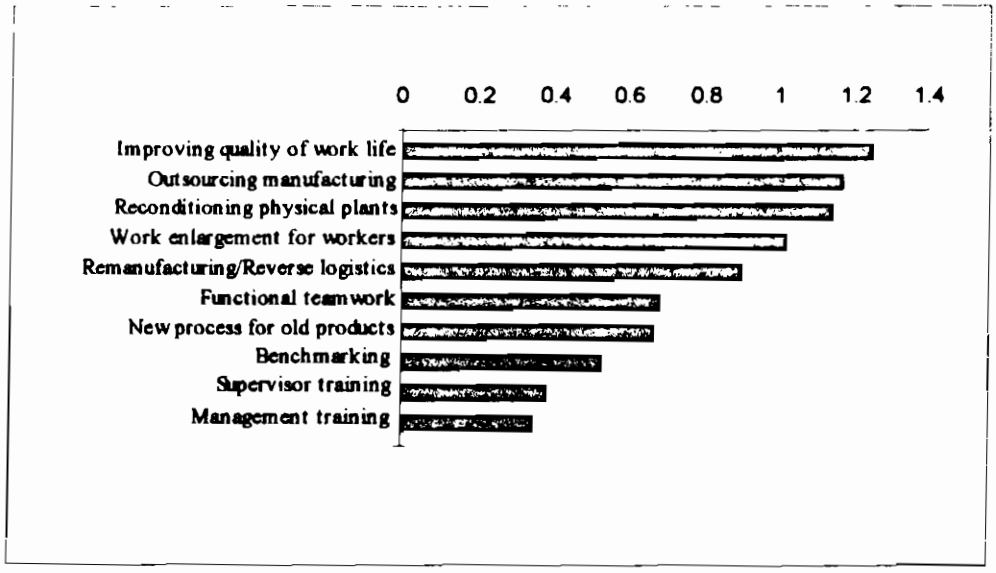


**Figure 9. Programs where Indian companies got better payoffs than US companies**

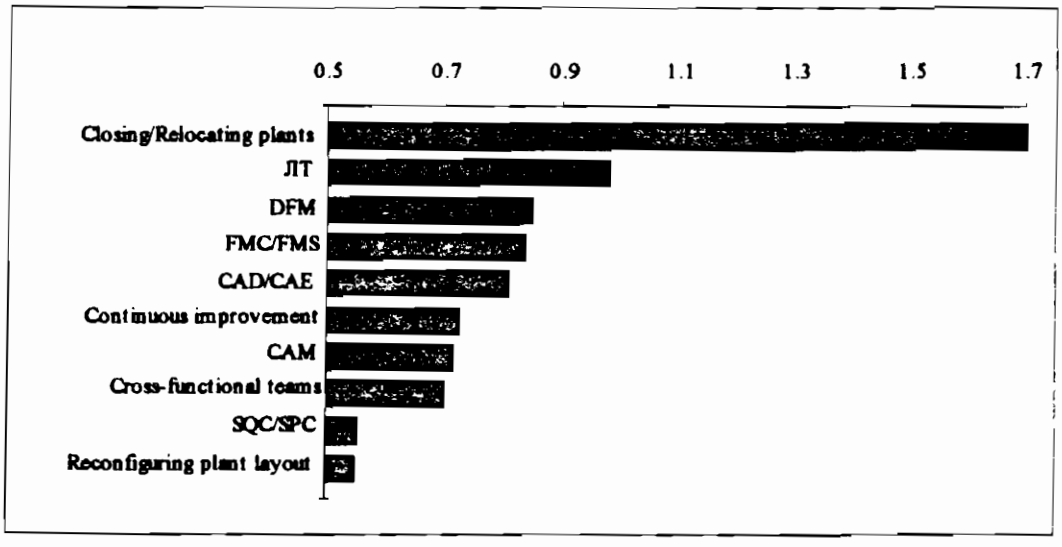


**Figure 10. Programs where US companies got better payoffs than Indian companies**

different stages in the evolution of a manufacturing firm. Indian firms seem to be clearing up some basic issues like improving existing products and delivering them to the customer more

effectively. US firms on the other hand have moved to the next level and have a different set of concerns.

## VI Towards the Future: Innovation

Innovation is widely seen as delivering long term benefits to an organization. In this context, innovation includes any new or substantially improved products that have been commercialized or any new or substantially improved manufacturing processes that have been used for the commercialization of products. Figure 11 shows the nature and extent of benefits that sample firms have enjoyed from innovation in the past with 7 denoting very high benefits and 1 denoting

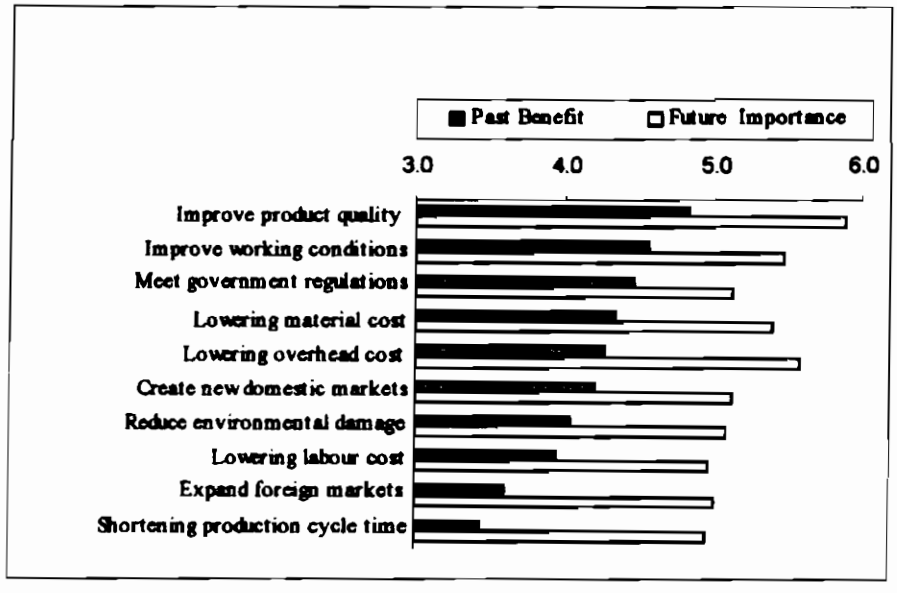


**Figure 11: Potential advantages from innovation (past benefits and future importance)**

little or no benefits. The firms have also reported the future importance of these benefits via innovation. The top three benefits of innovation in the past have been improvement in product quality, improvement in working conditions & safety and ability to meet government regulations. Interestingly, product quality remains the top focus for innovation even in the future. However, the potential for maximum benefits of innovations are expected to come through product design

changes, design for manufacturability, shortening of production cycle times, developing or expanding into foreign markets, and reduction in overhead costs

While almost all the firms recognize the benefits of innovation, very few are investing adequate resources to make such programmes successful. On the average, the sample firms invested barely 0.84 percent of their sales revenue on internal research & development, 0.15 percent on acquiring externally developed technology, 1.15 percent on training for the implementation of new technology, 2.57 percent on toolings and other engineering changes to start-up new technology and 0.93 percent on coordination for commercializing new technology. These amounts are woefully inadequate given the relatively low turnovers in the Indian industry. As Figure 12 shows, Indian firms do not plan to change these patterns of investment significantly to develop

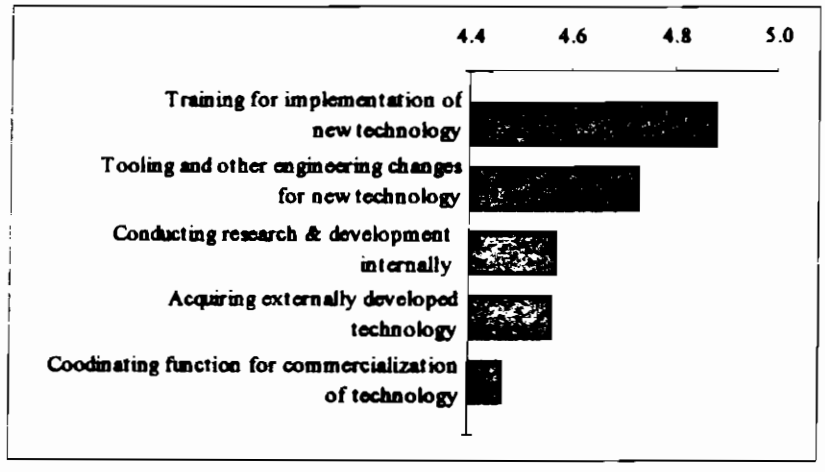


**Figure 12: Projected investments (over next two years) in activities involved in innovation**

long term capabilities. In this Figure, a score of 4 indicates that firms plan to invest about the same amount in each of the innovation activities as they did in the past two years. The maximum score of 7 represents a plan to invest "much more" in the future.

## VII Supply Chain Management

Supply chain management deals with the process of coordinating the flow of information and goods to customers across a network of suppliers, manufacturers and distributors. Two factors often affect the bottom lines of firms significantly - uncertainty in demand or in availability of men, materials and machines; and long lead times. This is often not well understood in the industry. It has been seen that by improving the flow of information across the supply chain and by reducing cycle times, firms are able to reduce the impact of uncertainty. As we have seen in an earlier section, Indian firms have started paying attention to reducing lead times. However, availability of information on current inventory levels, flow of materials, as well as demand forecasts to different functions within a firm remains poor. As a result, coordination across functions is based either on inaccurate data or personal contacts. This leads to high inventories and delays in most supply chains. There is an absence of a systems approach to planning across the chain.

Most firms in the sample rate the capabilities of their suppliers lower than those of their distributors. Figure 13 shows the difference between the current capabilities of the suppliers of firms and those of their distributors. The key concern that firms have relates to inventories. On a scale of one to seven, the firms on the average rate the ability of their suppliers to optimize inventory levels as 4.18 and those of its distributors as 4.98. Both these figures are not very good, and there is scope for improvement.

The supply chain of an Indian firm has an interesting structure. The mean (median) values for

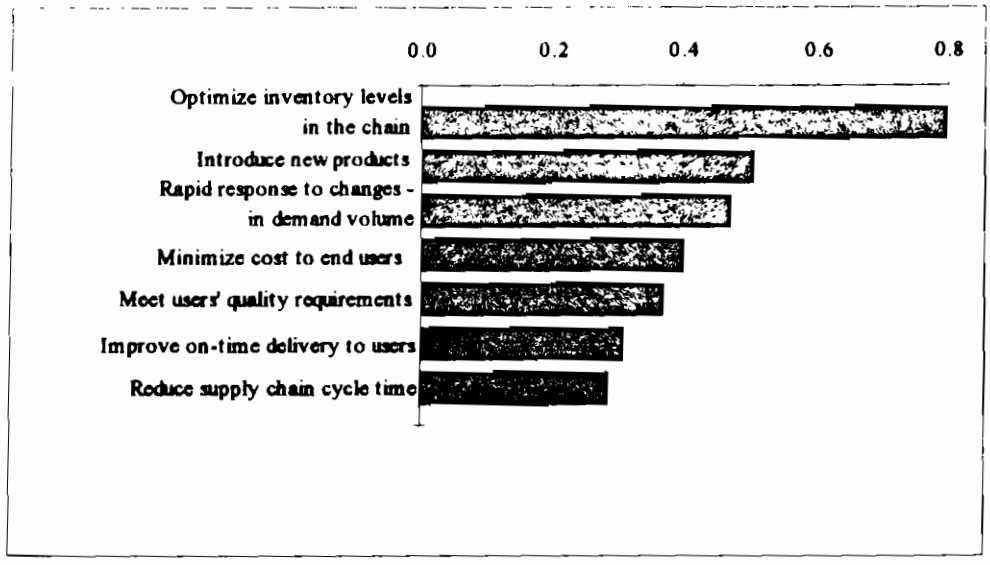


**Figure 13**: Difference between current capabilities of suppliers and distributors

number of suppliers per firms, number of regional distributors and number of approved retailers were around 436 (112), 210 (15), and 35,077 (200) respectively. By international standards, firms still have far too many suppliers. This adds to problems of coordination, delivery, quality and cost. A smaller supplier base sometimes allows firms to work closely with suppliers and raise the level of the entire operations in terms of product quality, cost and even product design. The data shows that about 43 percent of firms had less than 100 suppliers. Similarly 46 percent firms had less than 100 distributors and 23 percent of firms had less than 100 approved retailers. As the chain progresses from the suppliers to customers, the number of entities increases. While development of capabilities in suppliers becomes crucial, effective coordination of flows & information is the key to successful channel management.

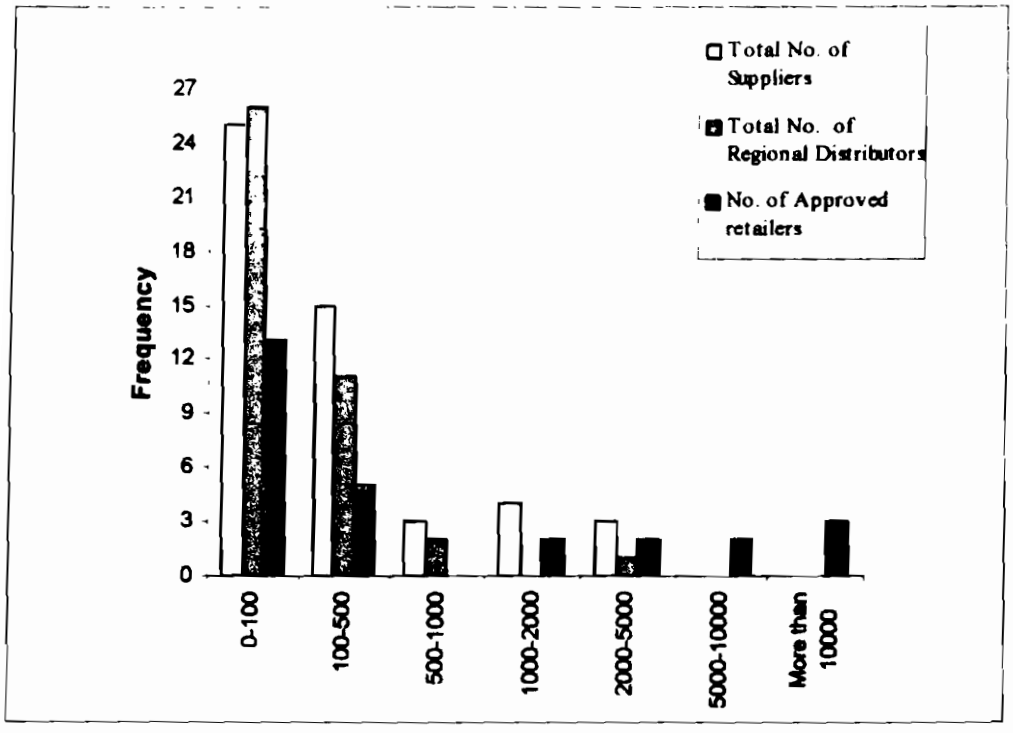


**Figure 14**: Distribution of various entities in Indian manufacturing supply chain

## VIII Becoming World Class Manufacturers

The focus of this survey has been to understand how top managers are trying to develop a coherent strategy for improving the manufacturing competitiveness of their firms. We also try to identify factors that these top managers find important in order to enhance the performance of their operations in the future. It can be clearly stated that our firms are going through a "quiet" quality revolution - quality systems are being developed and put in place, measurements are being refined and people are getting trained. The benefits are also obvious. However, the distribution of firms with significant quality programs is highly skewed. A few firms have progressed by leaps and bounds where workers plot control charts and practice SPC, their managers are trained in TPM (often in Japan) and are implementing the same, process capability of their machines is strictly monitored (with world class $cp_k$ levels above 1.33), in-process defect rates are in the

range of 200-700 ppm, and customer return rates are less than one per cent. On the other hand, a large number of firms is struggling with housekeeping, monitoring quality problems, training of managers but not of workers. There are two related observations: first, in a large number of firms the understanding of quality tools is superficial - as a result, progress beyond a certain level is slow; second, many firms are not consistent in their emphasis on quality which results in employees not taking it very seriously.

Some firms have improved their performance on lead time, and have started simplifying the flow of information and material. However, in discrete part manufacturing, most firms have not adequately addressed some difficult issues like drastically cutting lead times by changing the mode of operation from push to pull, reducing setup times, converting job shops to flow shops or using cellular layouts. Very few implementations of JIT are found in our plants - partly due to the fact that we are unable to contain the impact of uncertainty, partly due to high setup times and partly due to the fact that many managers still do not understand the basics of JIT. There is a widespread feeling that JIT simply transfers inventory to suppliers, or that it does not deliver any benefits, especially in India. However, JIT goes far beyond inventory reduction and improves quality, lead times, cuts cost and makes manufacturing more flexible and responsive. Cellular manufacturing is also not a priority for similar reasons. On the positive side, the recent interest in business process re-engineering is encouraging because it is process oriented and helps bring about fundamental changes.

One area of concern is the management of inventories across the supply chain. Most firms have not appreciated the advantage of coordinating various decisions and plans across different entities in the chain - the suppliers are optimizing locally, the plants are optimizing locally and the distribution channels are doing the same. As a result, inventories remain high with working capital being tied up for longer periods of time, there are delays in delivery and the overall cost across the chain remains high. Decisions that seem to be good for one entity turnout to be bad for the entire supply chain. More information has to flow between entities in the supply chain and more decisions have to be made collectively. Many firms are still reluctant to help their suppliers improve their capabilities.

Investments in innovation and R&D activities continue to be very low. Indian manufacturing managers must be aware of the potential dangers of becoming over-dependent on borrowed technology (i.e., products, processes as well as practices). It must be recognized that in the future, firms can stay competitive only through their own innovations. A one time import of technology might be useful, but continuous dependence on borrowed technologies may not be feasible in the future with several multinational corporations themselves entering the Indian market. For firms in the export market, a certain level of strength in manufacturing and R&D is even more important. Put simply, there is no world class company in the manufacturing sector which does not have world class manufacturing and innovation.

One factor that may be partly responsible for the inadequate attention to innovation and continuous improvement is a lack of the right type of training to workers. Whenever firms have

paid attention to workforce training, benefits have followed. The authors have documented a number of such cases. Training of workers has been a significant contributor to improvements in several other countries. The automotive sector in India seems to have appreciated the need for worker training. One of the worst training records can be found in the textile sector. As a result the former is quite modern while the latter is very outdated.

Finally, we must get into the habit of benchmarking our performance. The perception of our top managers that their plants are at least as good as their global competitors' plants is a little disturbing. Benchmarking reveals a lot of information on our strengths and weaknesses and several world class manufacturing plants have used this as a starting point in their improvement efforts.

Manufacturing in India is at a critical juncture. Many of our firms are already on the way to becoming world-class, and several others are standing at the threshold. But the average firm is still very far from this threshold. A fundamental issue here is our view of manufacturing. The traditional view that manufacturing is a support activity for marketing or finance, and therefore needs little top management attention is perhaps no longer there in Indian firms. However, a more subtle view still persists. Thus, top managers often want to invest in one large effort to improve manufacturing. After that, they want to go back to their traditional concerns. Meanwhile, international competitors are continuously working on improving manufacturing, bringing in new products, and making manufacturing more flexible and responsive. These firms view manufacturing and R&D in a different way: they recognise it as one of the key sources of their

competitive advantage. Therefore, they are continuously honing and perfecting their skills and capabilities in manufacturing. A senior executive of a well known international company, widely acknowledged as the industry leader in manufacturing, said at a conference " it seems we enjoy a good reputation. But internally, we know our weaknesses and are constantly striving to overcome them."

To effectively institutionalise a culture of continuous improvements, top management must have a well thought out manufacturing strategy. Instead, companies often rely on a massive one time effort or a series of piece meal efforts. Top management must understand the strategic dimensions of manufacturing as well as it understands marketing or finance. Very often, top management's involvement in manufacturing is confined to approving capacity expansion plans, approving budgets for equipment purchase, training, or for hiring consultants. But evolving a strategy and carrying it through requires much more than that. Companies that have successfully done this have either become industry leaders worldwide, or have established a secure and profitable niche. They have realised that competitors can quickly imitate marketing or financial strategies, but it takes several years to duplicate a manufacturing advantage.

## Appendix 1: Details of the Survey Methodology

This survey was based on the Manufacturing Futures Survey questionnaire that was developed initially by Boston University and is now administered in many countries around the world. The questionnaire for the survey comprised six sections, namely, Business Unit Profile, Manufacturing Strategy, Competitive Health Check for Manufacturing, Managing Innovation for Competitive Advantage, Integrated Supply Chain Management and Thinking Differently about Manufacturing Strategy. There were three types of questions in the survey instrument - those which required firms to rate various aspects of their operations vis-à-vis their competitors; those that required firms to rate the nature of past & future interventions in manufacturing in order to improve the competitiveness of their units; and some that required firms to give information on various performance parameters.

The survey instrument was mailed to managing directors of 700 select medium and large firms in the India. These firms were chosen from various sources - they represented a cross-section of size, industry type, and performance. The response, however, was extremely poor. Follow-up letters were sent to all these firms and phone calls made to many in order to remind them of the questionnaire. Duplicate copies of the questionnaire were mailed to many firms. Finally, the number of valid questionnaires that we used for analysis was 56. This number itself provides a lot of information on Indian firms ! Interestingly, our sample consisted of firms that have been generally performing well according to many published sources. Whenever, comparisons were made with US firms, the data was first normalized by the mean and standard deviation of each attribute score for each country to reduce any systemic biases.