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Competitiveness of Manufacturing Industry in India: Need for Flexible Manufacturing Systems

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Abstract: ***The ongoing process of globalization has brought about radical changes in industry and business across the globe. Because of global competition, there is ever growing need for higher productivity as well as quality in production. So also, there is a imminent need for improving cost effectiveness in industrial operations to withstand the competitive pressures. So, every business constantly seeks innovative ways of production processes for improving their competitiveness. In this context, this study looks into the need for Flexible Manufacturing Systems (FMSs) in Indian, the effectiveness of FMS in raising the productivity of manufacturing operations, FMS adoption being still in its infancy in India. FMS concept, its suitability, its applications and main trends are discussed. Suitable suggestions for effective FMS implementation in Indian industry are made.***

Keywords: Productivity, Advanced Manufacturing Technologies, Competitiveness, Flexible Manufacturing Systems, Innovation.

I. INTRODUCTION

Worldwide the relevance of quality and productivity in manufacturing operations is of vital significance today, as the competition is mounting up in every industry and business in the wake of globalization. Hence, an imminent need for improvising the cost effectiveness of production processes has arisen for the purpose of withstanding the intense competition. So, all businesses constantly seek innovative and novel means of production processes and techniques of manufacturing, and look for innovative technologies that can improve competitiveness in manufacturing. A very effective way of productivity enhancement and quality improvement that has great significance in the contemporary centrality, is that of automation of production systems; more specifically, embracing modern manufacturing technologies like FMSs (Flexible Manufacturing Systems), CIMs (Computer Integrated Manufacturing systems), Robotics and so on. In fact, in many of the advanced nations like Japan, Germany and the US, Advanced Manufacturing Technologies (AMTs) like the ones mentioned above, particularly FMSs, have been in use right from the early eighties.

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Further, many a progressive government has officially declared AMTs like FMSs as the ones that can bring about tremendous economic advantages capable of industrial recovery. Though the immense capabilities of AMTs in general and FMS in particular are n well accepted, and so also the urgency for embracing the same many manufacturers are reluctant for AMT adoption.

II. NEED FOR ADVANCED MANUFACTURING TECHNOLOGIES IN INDIA

Indian manufacturing has been late in adopting AMTs like FMSs. In spite of the appreciable growth rate in AMT adoption over the last few years, it has to be noted that India is still in its infancy in this regard; the huge investments required and the availability of cheap labour being the main inhibiting factors. Moreover, in India the need for improving manufacturing competitiveness is of vital significance today. Globalization and deregulation policies have led to intense competition in the Indian industry, on the one hand. On the other hand, the relative share of the industrial sector in general and the manufacturing sub-sector (within industries) in specific in the gross GDP of India is remaining stagnant over the last few decades. This has prompted the policy makers to consider the issue of manufacturing competitiveness very seriously. A specialized body viz. National Manufacturing Competitiveness Council (NMCC) was set up in 2004 to initiate the requisite measures to improve competitiveness of Indian manufacturing industry. Later, NMCC was wound up in 2013, and a comprehensive 'Make in India' initiative is in place, since 2014. Ongoing process of globalization is a reality worldwide, and this is rather an irreversible process. So, adoption of modern AMTs, particularly FMSs, has become an imperative rather than a choice, particularly for an emerging economy like India. Thrust on MSMEs (Micro, Small and Medium Enterprises) is also required in the Indian context, in view of their huge employment potential and capability to bring in balanced and equitable growth, devoid of regional and other divides.

III. OBJECTIVES OF THE PAPER

1) To understand the concept of the term Flexible Manufacturing System (FMS) and to assess the need for a change from traditional system to FMS;

2) To study the suitability of adoption of FMS in the Indian context, and also to study in detail the status, weaknesses and prospects of machine tool industry in India; and
3) To suggest steps for effective adoption of FMSs in India.

IV. MATERIALS AND METHODS

The paper is descriptive-analytical and exploratory. It is based on data collected primarily from authentic secondary sources, like, RBI, CRISIL, DIPP (Govt. of India), industry associations etc. Common statistical tools are used for analysis and interpretation.

V. FLEXIBLE MANUFACTURING SYSTEMS

Despite the growing significance of FMSs, there is no universally accepted definition of the term FMS. The most important distinguishing feature of an FMS is the flexibility that it offers to the production process wherein it is employed. One of the most referred to definition of FMSs is the one given by Ranky [17] who defines FMS as follows: *A system* dealing with high level distributed data processing and automated material flow using computer-controlled machines, assembly cells, industrial robots, inspection machines and so on, together with computer integrated *material handling and storage system*s. Regarding the scope and variety of FMSs, there are differences of opinions. Still, the components and characteristics of an FMS, as described by different authors and researchers are generally as follows:

i. Potentially independent NC machine tools.
ii. An automated material handling system
iii. An overall method of control that coordinates the functions of all the machine tools and materials handling systems so as to achieve flexibility.

The specific manufacturing systems wherein FMSs can be employed conveniently were identified as early as 1973. Typical situations identified by Darrow [6] are as follows:

i. A variety of high precision parts are machined.
ii. A relatively large number of direct numerical control (DNC) machines are needed
iii. Some form of automated material-handling system (MHS) is used to move the work pieces into, within, and out of the FMS
iv. On-line computer control is used to manage the entire FMS under conditions of varying parts, production mixes and priorities.

It can be concluded from the above that an FMS involves a number of machine centers and material-handling systems integrated by a hierarchy of computer control. Klahorst [11] offers a comprehensive definition of FMS which is as follows: A group of machines and related equipment brought together to process a group or family of parts completely and includes the following primary and secondary components for a complete FMS. Primary components: (i) Machine tools, (ii) A material handling system, (ii)A supervisory computer network. Secondary components: (i) Numerical Control (NC) process technology, (ii) Spindle tooling,(iii) Work-holding fixtures, and (iv) Operations Management

VI. CHANGING TO FLEXIBLE SYSTEMS: NEED

The key reason for the fresh rise focused attention on FMS and other kinds of factory automation is the growth in competition, which has become fierce in this globalized era. Motivators include reduced production costs, compatibility with ever changing work situations, etc. FMSs and other aautomated systems can improve the status of companies on both these aspects. Other motivators for FMS adoption by companies are reduction in product life cycle and enhanced complexity of products. Klahorst[3] has reported that those companies that have installed FMSs have reported the following results: (i) Benefits related to cost reduction (55 percent), (ii) Benefits relating to market response improvement (30 percent), (iii) Benefits related to flexibility in production (15 percent).Salomon and Biegel[4] compare FMS with conventional manufacturing technology under states of risk and show that FMSs provide substantial productivity improvement. Table I gives the relevant details.

Table I: Comparison of how machine and work-parts spend their time in the shop of a Conventional System and in an FMS using Optimistic-Pessimistic Format.

Parameter	FMS Performance			
	Conventional System Performance	Pessi-mistic	Most Likely	Opti-mistic
Percentage (%) of machine time the machine spends without parts	50	35	20	5
Percentage (%) of machine time that there is a part on the machine.	50	65	80	95
Percentage (%) of time that the part is not being worked on while on the machine	70	35	21	7
Percentage (%) of time that the part is being worked on while on the machine	30	65	79	93
Percentage (%) of manufacturing lead time that the part spends either moving or waiting	95	92.5	90	85
Percentage (%) of manufacturing lead time that the part spends on the machine	5	7.5	10	15

Source: Salomon and Beigel

Based on extensive research and analysis, Yilmaz and Davis[5] presented some propositions regarding issues of flexibility, productivity, and quality. Major findings of their investigation support the premise that FMS investment leads to reduced labour costs, increased output, decreased manufacturing costs, increased flexibility, and reduced production lead time.

Installation, Implementation and Integration of FMSs

Suitability of an FMS to a given production setting is of utmost importance. Such a suitability has to be ensured before investment commitments are made. To help determine their fitness, the type of FMS has to be considered. Classification of manufacturing systems (with respect to their type, degree of flexibility, and volume-handling capacity) helps to determine when and where an FMS is most beneficial. FMSs can be broadly classified into dedicated FMS, sequential FMS, and manufacturing cells. (Table II).

Table II: Manufacturing Systems and FMSs–Various Types.

Manufacturing system s-Different Types	Level of flexibility	Parts produced in product family	Average lot size
Transfer lines	Low	1-2	7,000 and up
Dedicated FMS	Medium	3-10	1,000-10,000
Sequential or, random FMS	Medium	4-50	50-2,000
Manufacturing cell	Medium	30-500	20-500
Stand-alone NC machine	High	200 and up	1-50

Source: Kaighobadi, Mehdi and Venkatesh, Kurapati. [9].

The circumstances under which FMSs should be installed are extremely important. Klahorst[6] has identified such circumstances as follows:

i. when part size and mass exceed "jib crane" standards;
ii. when production volume is in excess of two parts per hour.
iii. when processing requires more than two machine types to complete a work piece;
iv. when more than five machines are required;
v. when phased adoption is planned so that material-handling provisions can be incorporated in the initial phases of it and bad habits can be avoided from the start.

VII. GLOBAL MACHINE TOOL PRODUCTION AND THE CURRENT STATUS OF INDIA

The relative share of India in the global machine tool production is rather low, India is placed in the twelfth position as of 2016 and its production is roughly one-third of China – the leader (first position) in this regard. But, based on growth rate India comes first (12.5 per cent) and the growth rates of other countries nowhere compared to India, because most of them have registered only negative growth rates, the overall growth rate is also negative (-3.5 per cent). The leader viz. China could grow only at the rate of 3.6 per cent, the other four nations with positive growth rates being France (7.4 per cent), Italy (5.5 per cent), Finland (4.2 per cent) and Germany (0.1 per cent). So, India's growth performance is really remarkable. (Table III).

Table III: Global Machine Tool Production

Country	2011-'12	2012-'13	2013-'14	2014-'15	2015-'16
China	27540.0	24700.0	24649.1	22100.0	22900.0
Germany	13622.9	14800.6	14456.7	12422.0	12,450.4
Japan	18252.9	11333.6	14857.2	13489.5	12174.5
USA	4983.2	4956.1	5480.4	5910.6	5912.6
Italy	5912.6	5308.0	5797.7	5205.3	5489.2
South Korea	5754.0	5150.0	5675.4	5400.0	4317.0
Taiwan	5160.0	4537.0	4864.2	4097.5	3730.0
Switzerland	3199.3	3143.4	3681.3	3244.8	2988.1
Spain	1060.3	1245.7	1177.9	1043.5	1039.2
Austria	1032.0	1179.7	1049.5	945.8	905.3
France	805.8	772.9	763.6	742.7	797.9
India	720.7	576.0	683.4	692.7	779.4
Brazil	643.2	417.5	293.8	845.8	680.6
Canada	693.0	685.0	556.4	730.3	673.5
Czech Republic	728.4	697.2	754.2	696.0	638.6
Turkey	649.0	719.0	762.7	661.6	629.4
UK	649.8	1007.1	956.8	725.6	627.7
Netherlands	402.3	415.7	468.3	387.4	386.2
Belgium	296.9	308.1	373.1	263.1	244.6
Sweden	201.8	163.4	193.3	186.5	185.9
Finland	185.1	185.9	183.9	148.8	154.9
Mexico	122.4	140.6	145.8	137.1	113.6
Portugal	46.3	115.5	130.2	107.7	107.3
Denmark	70.0	47.8	87.3	81.7	80.8
Argentina	36.4	36.2	94.3	96.7	0.0
Russia	263.0	210.9	450.6	485.0	0.0
Other countries	173.6	160.0	2904.7	--	--
Global Production	93204.9	83012.9	91491.8	80,833.0	78,006.8

Source: IMTMA [22]

Regarding the share of BRIC nations (Brazil, Russia, India, China) it is noted that China is leading very distantly from the other three viz. India, Brazil and Russia ('IBR'). Share of 'IBR'is nowhere comparable to China. (Table IV).

Table IV: Machine Tool Production: Share (%) of BRIC

BRIC Nations	2011-'12	2012-'13	2013-'14	2014-'15	2015-'16
Brazil (B)	0.69	0.50	0.32	1.05	0.87
Russia (R)	0.28	0.25	0.49	0.60	0.00
India (I)	0.77	0.69	0.75	0.86	1.00
China (C)	29.55	29.75	26.94	27.34	29.36
BRIC Nations-Total	31.29	31.21	28.50	29.84	31.23

Source: IMTMA [22]

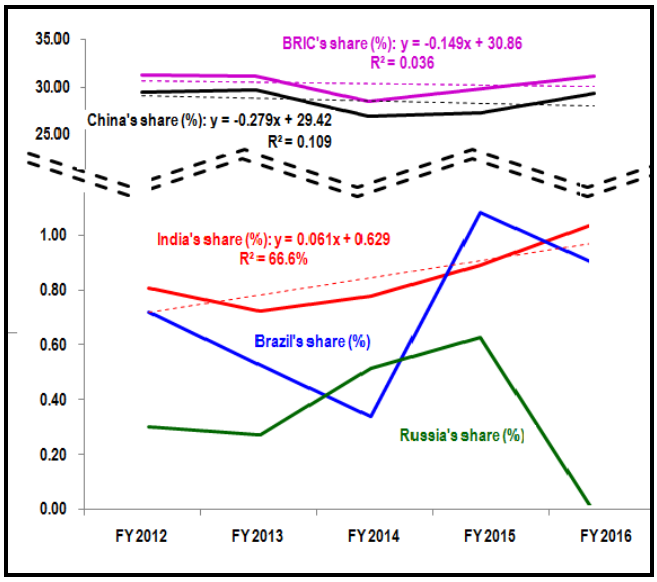

Figure I: Machine Tool Production - Share of BRICS

In spite of the poor share of India among the nations of the world in respect of machine tool production and also within the group of BRIC nations, it is noted that India has been almost steadily improving its share year after year, unlike most of the other nations including BRIC nations like China. India's pace of growth alone needs improvement (Figure I).

Table V: Top 5 Machine Tool Consuming Countries

Country	Value (USD Mn)	Share in Global Consumption	Rank
China	27500.0	34.8 Percent	1
United States	7361.0	9.3 Percent	2
Germany	6360.8	8.1 Percent	3
Japan	5804.5	7.4 Percent	4
South Korea	3823.0	4.8 Percent	5
India	1541.1	2.0 Percent	10

Source: IMTMA [22]

In respect of consumption of machine tools India occupies 10th position in the world (Table V) with 2 percent of the total global consumption. But, India is producing only 1 percent of the global production (Table IV). This fact points to the need for enhancing the production by increasing the present increasing trend in production (Figure I).

Table VI: Working Machine Tools: Production (India) (Rs. Cr.)

Machine Tools	FY 2014-'15		FY 2015-'16		Value Growth	FY 2016-'17		Value Growth
	Qtty.	Value	Qtty.	Value		Qtty.	Value	
Metal Forming								
CNC	371	126	438	126	00 %	516	137	09 %
Conventional	639	336	711	395	18 %	744	456	15 %
Total	1010	462	1149	521	13 %	1260	593	14 %
Metal-Cutting								
CNC	12280	3296	13335	3755	14 %	19266	4854	29 %
Conventional	1957	473	1778	451	-05 %	1454	356	-21 %
Total	14237	3769	15113	4206	12 %	20097	5210	24 %
Metalworking								
CNC	12651	3422	13773	3881	13 %	19782	4991	29 %
Conventional	2596	809	2489	846	05 %	2198	812	-04 %
Total	15247	4231	16262	4727	12 %	21980	5803	23 %

Source: IMTMA [22]

Table VII: Working Machine Tools: Exports (India) (Rs. Cr.)

Machine Tools	FY 2014-'15		FY 2015-'16		Value Growth	FY 2016-'17		Value Growth
	Qtty.	Value	Qtty.	Value		Qtty.	Value	
Metal Forming								
CNC	--	--	04	01	--	07	05	400 %
Conventional	21	41	30	45	10 %	12	87	93 %
Total	21	41	34	46	12 %	19	92	100 %
Metal-Cutting								
CNC	662	219	649	244	11 %	704	214	-12 %
Conventional	70	20	35	06	-70 %	119	54	-800 %
Total	732	239	684	250	05 %	775	268	07 %
Metal Working								
CNC	662	219	653	245	12 %	711	219	-11 %
Conventional	91	61	65	51	-16 %	131	141	-176 %
Total	753	280	718	296	06 %	842	360	22 %

Source: IMTMA [22]

From the data on exports of machine tools from India, for metal forming machine tools there has been encouraging performance. But, in respect of metal cutting machine tools and metal working machine tools, India's performance needs to improve many fold, the country's performance being very discouraging at present (Table VII).

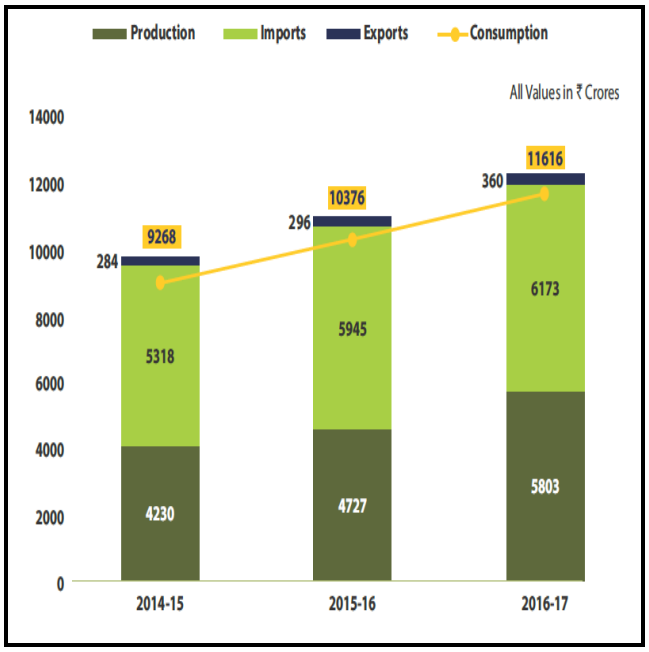

Figure II: Machine Tool Industry in India (FY 2015-2017)

VIII. WEAKNESSES AND PROBLEMS OF THE MACHINE TOOL INDUSTRY IN INDIA

Though India is manufacturing CNC machines of several types, the CNC machines produced in India are observed to be of less advanced features. Rao and Deshmukh (1994) [18] have observed that the CNC machines manufactured in India are lacking certain advanced features and that these in turn are required in many FMC and FMS applications. The features that are lacking for machine tools produced in India:

- Automated work-piece changing
- Recognition of work-pieces
- Selection of part programmes
- Tool condition and tool life-monitoring system
- In-process gauging for on-line and active quality control
- Electronic probes for tool and work-piece qualification
- Facilities for thermal error compensation
- Management data acquisition system.

It may be stated that even today India is in its infancy in FMS adoption. As such, to improve India's status in FMS adoption, manufacturing industries will have to face great challenges in the days to come. These challenges include, inter alia, huge investments, enhanced technical skills, sophisticated equipment, etc. Many inputs required for the automation of factories like, sensors, flexible couplings, cables and connectors, processors, drive packages, NC code loaders, special bearings etc. are still being imported at a high cost. Further, as already noted, the share of imported machine tools in the total consumption of machine tools is increasing year after year and the same now stands at about two-third of the total consumption.

The observation by Mohanty and Parundekar (1990) [14] is relevant here. Accordingly, few Indian manufacturing concerns have seriously considered installation of flexible automation.

Huang and Sakurai (1999) [8] have underlined the utmost importance of workers' participation in implementation of automation projects. Citing the Japanese scenario, they have noted that for successful FMS implementation, company's own technical people are designing and selecting automation projects. These insiders know the specific needs of their company better than outside consultants, and further by adopting the above approach the company could save the consultants' fees. Rao and Deshmukh (1994) [18] have observed that the significance of workers' participation in implementation of automation projects has been well-demonstrated in the case of M/s. MarutiUdyog Ltd. (MUL) – a public sector company (now in private sector). MUL in collaboration with a Japanese company could systematically implement this sophisticated technology with the active support and co-operation of the employees. The other reasons for this astounding success have been the implementation of healthy work practices and ensuring strict discipline among employees– these ultimately led to higher productivity levels as well as higher levels of value added per employee. However, it may be noted that the above kind of sophisticated FMS/CIMS installations commercially adopted in India so far are virtually nil.

IX. FLEXIBLE MANUFACTURING SYSTEMS IN INDIA: THE NEED, RELEVANCE AND USES

In spite of the favourable signs of the surge in the Indian machine tool industry in general and the component of CNC machines in particular, India has remained almost isolated from the world economy.

The vast and unparalleled changes taking place in the social and economic conditions the world over have not fully been appreciated by India so far. Though there has been considerable increase in the machine tool production over the years, the share of exports in the total production as well as the share of indigenous goods in the total consumption of machine tools have been constantly on the decline. The reasons for the not-so-encouraging status of as noted by Rao and Deshmukh (1994) [18] are as follows:

- Industries in India could not meet its needs in some areas like NC code loaders, processors, special bearings, etc.
- Poor quality, low reliability and poor customer satisfaction.

  Indian goods have poor support in the global market.
- Indian technological advancements have not been on a par with those of the developed countries.
- Low level of productivity.
- Large investments have been made but they have not been utilized to the level of multinational companies.
- Under utilization of cheaply available skilled manpower.

Rao and Deshmukh (1994)[18] points out that to achieve the above goals and attain the global standards, India must concentrate on technological advancements. It would not only raise India's productivity but also improve the quality of India's products and services in international markets.

Scope of Flexible Manufacturing Systems in India.

In spite of the various handicaps and weaknesses that India suffers in the adoption of FMSs, there are quite good scope of improvising the position of India in the days to come. The more recent developments, say, those of the post-reforms period, particularly those of the last few years (2000s), indicates a bright future for the FMSs, though there is a pretty long distance to traverse in this regard. The Government's policy of economic deregulation through Liberalization, Privatization and Globalization (LPG), offers immense opportunities for the industry. Though the threat of global competition is there, with the huge resources of the country, it can produce comparatively cheaper goods and effectively compete in the global markets. Rao and Deshmukh (1994)][18] point out the following in this regard:

- In the current scenario, companies can raise huge investments through the capital market, because of easier access to these markets.
- Foreign equity has been allowed to the extent of 51 percent. Many foreign companies are eager to utilize the resources of India and to compete in the world market.
- Indian market is promising for high quality products.
- Fierce competition exists in the market.
- There is good customer support for high quality goods.
- Skilled manpower is a great advantage.
- Favourable export / import policies have been established by the Governments

Applications of FMSs

Though there exist a number of reports and case histories about the installation of FMSs, accurate statistics regarding the application of these systems are difficult to obtain. Determining the extent of installation of FMSs throughout the machine tool industry is also rather difficult; such efforts being susceptible for many confounding issues both statistically and methodologically. In spite of the above impediments, of late, more and more case studies regarding FMS installations are being published from various sources, like, trade and professional journals. Dallas [7] has reported that FMSs can succeed in the following situations:

i. it is functioning in the right economic context;
ii. the company's organizational structure has been redesigned to accommodate the special circumstances of FMS;
iii. there is close co-operation between vendors and users of technology; and the
iv. the management understands that the rules of the game have changed.

The last requirement as give above is particularly important since it entails the mind-set reorientation of managers with respect to performance evaluation, capital rationing criteria and human resources management.

Basic Inputs for FMSs and Favorable Factors in India.

Rao and Deshmukh (1994)][18] suggest that basic inputs to FMS have many relative advantages to India. The basic inputs for FMSs and the respective favouarble factors are given in Table VIII.

Table VIII: Basic FMS Inputs and Favourable Issues (India)

Basic Inputs of FMSs	Favoring Issues in India
I. Market Situation: (i) Fierce Competition. (ii) Increase in product variety and product differentiation. (iii) Customary support of high quality product.	➢ Competition exists ➢ High quality products widely accepted ➢ Large market for variety of products ➢ Tax concessions for specific items.

II. Government Policies: (i) Liberalized industrial policies (ii) Technical support (iii) Assurance of continuous supply of raw-materials. (iv) Liberal import/export policies (v) Equity participation for foreign companies.	➢ Technical know-how and training ➢ Certain items have been exempted from import / export duty. ➢ Assured financial assistance from Govt. institutions. ➢ Foreign equity participation allowed upto 51 percent.
III Investment Opportunities: (i) Availability of large amount of capital. (ii) Long term loans with interest rates (iii) Subsidies on industrial inputs.	➢ Capital can be raised through capital markets ➢ Financial support from mutual funds and financial institutions. ➢ Special incentives from government
III Availability of Resources: (i) Reliable and continuous supply of raw-materials (ii) Cheap and skilled manpower (iii) Assured power supply (iv) Technology position	➢ Skilled and cheap manpower. ➢ Certain specific raw materials are exempted from import duty. ➢ Certain raw materials are consistently available.
III Management Goals: (i) Reduction in inventory (ii) Reduced manufacturing costs (iii) Reduction in Lead Times (iv) Reduction in Labour Costs (v) High quality products (vi) Variety of products.	(These goals are set by each individual firm and the goals will be prioritized based on the firm's strategies.)

X. RESULTS AND DISCUSSION

A large number of FMSs have been implemented the world over effectively and these have been proving themselves to be quite helpful in enhancing the productivity of operations, quality of output, time and cost effectiveness and so on. Though, adoption o FMSs generally involve high capital investments initially, the same has been observed to be recouped by way of cost savings in the following years. Though there have not been very many studies in this regard in the Indian context, whatever studies have been made so far have clearly pointed to the meaningfulness and rationality in FMS investments. The immense availability of skilled manpower in India – a basic requirement for effective functioning of FMSs, as well as the supportive role of the Government particularly in the wake of economic deregulation initiatives sweeping across the nation are definitely favourable features in the Indian context. Looking into the ever growing competition in every walks of industry and business in the LPG regime and highly demanding customers, competitiveness in terms of quality of the product or service, cost and time effectiveness are of paramount significance. In this context, adoption of modern AMTs like FMSs appears to be more like an imperative for survival and growth rather than simply an option. The easier availability of financial resources from various governmental and other agencies, and the very supportive import export policies followed by the governments over the last one or two decades make the proposition of FMS adoption still more attractive. Of late, the government's policy is to give maximum thrust for promoting manufacturing competitiveness in this globalized era characterized by cut-throat competition. This can be fruitfully achieved only with adoption of effective industrial automation efforts sincerely and systematically.

In view of the foregoing, it appears that in spite of the various weaknesses that Indian machine tool industry is currently facing and also the fact that the industry is in its infancy, there do exist good scope for FMSs in India in the days to come. In fact, the performance indicators of the relevant industry over the last few years clearly indicates the growing awareness of all the stakeholders in favour of FMS adoption as are revealed by the consistent growth in production and consumption of automated machine tools.

The following are the suggestions for effective adoption of FMSs and other AMTs in the Indian context, based on the findings of this study.

(1) Increasing the growth rate in production of automated machine tools (like CNC machines) still further, the present rate being less when we look into the fact that the share of indigenously produced tools are fast eaten away by the imported ones.

(2) The exports have also to be promoted in tandem with the increased production; the rate of growth in imports being too much on the higher side, compared with those of production as well as exports.

(3) The favourable policies adopted by the government, like those relating to imports / exports, liberalization of procedural formalities, capital market reforms resulting in easier access to financial resources, tax concessions etc. have to continued and made further market friendly.

(4) Concerted efforst are required to enhance the quality image of the Indian made machine tools as they used to lack quality image badly vis-à-vis their international counterparts.

(5) Any FMS initiative to be successful needs maximum co-operation from the employees and such every effort from the part of manufacturers and the Governments in gaining the co-operation and support of the employees on an ongoing basis have be initiated and promoted.

(6) In the globalized industrial and business scenario, success of any endavour depends on PQR (Productivity, Quality and Reliability). Industrial automation efforts through FMS adoption should be promoted in such a way that the above goals are achieved very meaningfully and effectively.

XI. CONCLUSION

India is still in its infancy in adoption of various AMTs, including FMSs. But, given the special advantages of Indian industry and the favourable governmental policies AMTs can effectively in adopted in India in the days to come.

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