

INNOVATIONS IN MANUFACTURING SYSTEMS AND TECHNOLOGIES FOR GLOBAL COMPETITIVENESS: A CONTEXT OF LEAN MANUFACTURING

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ABSTRACT

Manufacturing industries are to be competent enough in order to cope with the changing market trends and requirements of the consumers and sustain successfully in the long run in the industry. Innovation is a management concept by which organizations do something new and unique from that of its competitors. Innovation as a management strategy is being adapted all across the globe. Recently manufacturing companies have started focusing more on innovative concepts of manufacturing products. This paper discusses in detail the impact of innovation in manufacturing organizations and the impact that it has created in the organizations.

KEYWORDS: Lean, Small & Medium Sized Enterprises, Innovation, Manufacturing Systems

INTRODUCTION

Literally innovation means implementing something new. An innovation exists is assumed only when it is commercialized and implemented successfully in the business context. In manufacturing innovation encloses vast areas like implementation of new materials, new practices/processes, new equipment/technology, etc. Businesses could recourse to manufacturing innovation for many reasons. The innovation approach could be either reactive or proactive. In addition to quality profits and productivity innovation also outcome in developed responsiveness to demands of customers, reduced downtime and waste levels, reduced turnaround times, better configured products, streamlined relationships with customers and suppliers, greater product quality and capacity for vast range of products. Retail customers and businesses have an ever-developing number of products to select from, so the businesses of manufacturing face stable rivalry to higher or retain their share market. Therefore manufacturers required to be flexible and to assume new technologies as well as new ways of performing which will permit them to answer cost effectively and rapidly to demands of customers. Businesses can implement innovation in manufacturing to vast number of area including new materials, new usage of components and new processes. It can develop the quality of manufacturing results and the health of the business (Jarmin, 112).

Manufacturing denotes approximately 21 percent of gross domestic products and 20 percent of its employment, offering more than 30 million jobs in 2, 40 000 organizations mostly small medium enterprises. Moreover, every job in industry is assumed to be connected to more than two in common services. In international trade the manufacturing is a dominant component leading the world in different areas such as agricultural, machinery and automotive engineering. The situation of manufacturing companies was made more critical by the downturn which was threatened already by both high technology competitors and lesser income economies. Achieving sustainability and restoring growth needs a strategic replacement from cost-based rivalry to an approach concerned on high added value creation. There is a developing claim

for more customized, greener and greater quality products. Manufacturing requires representing the challenge of generating several while creating small waste and securing less material, using small amount of energy (Mansfield, Edwin, 230).

NEED FOR INNOVATION IN MANUFACTURING

Klette (1998) described that innovation is difficult to manufacturing business competitive positions. In manufacturing the key to innovation is to make sure that it is driven by their business requirements not by attraction of alteration for its own purpose. Therefore the manufacturers should:

- Assume what business areas would several benefits from new approach.
- Assume all the varied business areas where innovation in manufacturing could be introduced.
- Innovate in those places which operate their business performance.

There are several areas with opportunities for manufacturers to innovate consisting of:

- **Technology of Materials:** New materials could higher manufacturers' presentation and packaging or their products.
- **Sourcing of Component:** New suppliers, new tools or a developed deal with their already occurring suppliers could higher their gains and products.
- **Control of Factory Process:** Manufacturers could enhance control of process including quality control, to give good products and efficiency.
- **Maintenance of Supplies:** Automatic planning of maintenance will assure that supplies are kept performing smoothly and that they construct downtime into the smallest busy section of production cycle. This will also develop them to conform to safety and health regulations (Becheikh, Landry and Amara, 652).
- **Information Technology Systems:** Keep up to date with information technology systems developments which the manufacturers use.
- **Marketing:** The strategies of innovative marketing are an essential way to manage the products which the manufacturers manufacture apart from those generated by rivalries.
- **Warehousing and Logistics:** Rethink how manufacturers promote their products to their customers so that they take benefit of new conveyance opportunities and keep costs of warehousing reduced.
- **Design:** Designers can support their manufacturers to enhance new services and products or redesign their occurring products to develop their client appeal and functionality.
- **Order Processing and Stock Controlling:** View constantly for good ways to design their stock control and order processing to assure that they have appropriate stock amount.
- **Accounting Processes:** Their invoicing, payment and accounting processes should be constructed with their order processing and stock control and updated regularly.
- **Supplier and Customer Relationship Management:** Manufactures can achieve worth able insights into how to develop their products and their promotion from their suppliers and customers (Amara and Landry, 250).

A CASE STUDY

ABC is one of the biggest Electronics & Electrical Manufacturing Industry in India. ABC employs nearly 1400 people and has 2 manufacturing units in India. The organization answers to complicate business challenges of clients with a global service delivery approach and with vast number of services across national boundaries and industry sectors.

ABC's services focus on assisting their organization's clients to represent major problems facing the Electronics industry consisting of market expansion and entry, consumer trends, regulation and reporting, emerging market companies, private equity investment, developing efficiencies of operations, developing distribution channels, sustainability and the surroundings, business operating model framework, and closures, relocation and plant location (Website, Wikipedia.org). The global Electronics market is varied. ABC's global Electronics sector provides a forward and pro active thinking service to their organization clients to support assure that the importance for development that the industry is presently witnessing is not missed and that the challenges and problems faced by the industry can be solved.

Primary Research was conducted.

RESEARCH PARADIGM

This study adapts positivism since it refers to positivist and scientific methodologies that are desirable and possible to learn social behavior in ways common to those used by natural scientists to learn behavior in natural world.

RESEARCH APPROACH

Research approach is defined as the systematic method of collecting new information. The research approach refers the method by which a research is conducted.

RESEARCH DESIGN

This study makes uses of descriptive research design. Descriptive research enumerates descriptive data about the population being studies and does not try to establish a casual relationship between events.

SAMPLING DESIGN

The sampling design adapted in this study is simple random sampling. Simple random sampling is assumed to be the purest probability sample form. A probability sample is in which each population element a common and known probability of being chosen into sample has.

SAMPLING UNIT

The sampling unit is ABC Electronics & Electrical Manufacturing Company.

TARGET POPULATION

Table: 1 The Target Population for Quantitative Study is 100 Working in the Company Limited

Designation in the Company	Number	Percentage (%)
Manufacturing Manager	17	17
Chief Operating Officer	25	25
Supply Chain Manager	10	10
Deputy Chief Executive Officer	48	48
Experience		
1 year	10	10
1-3 years	75	75
>3 years	15	15

SAMPLE SIZE

The sample size for this study is 100.

SAMPLING PLAN

It has been planned to collect data from 100 manufacturing managers, chief operating officer, supply chain manager and deputy chief executive officer working in ABC Electronics Company in India. The data is to be collected by handing out the questionnaires to the respondents to their corresponding workplaces.

ANALYSIS

What are the Opportunities for Innovation in Manufacturing?

Based on manufacturers assessment of successful innovations across many manufacturing sectors the major kinds of innovations can be categorized under the following classifications such as (Bettencourt et al., 120):

- Innovation in processes of manufacturing
- Innovation in sourcing
- Innovation through technology
- Management Innovation

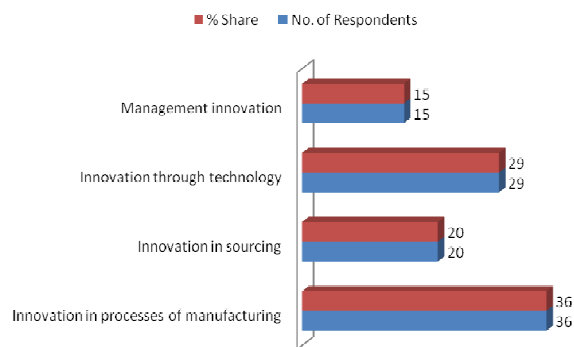


Figure 1: Opportunities for Innovation in Manufacturing

The respondents were asked about the opportunities for innovation in manufacturing. Nearly 36% of the respondents responded innovation in processes of manufacturing because companies can innovate in a manner products are

manufactured or developed either across the supply chain or within the organization. Such innovations are referred as process innovation. Typically it is targeted at collecting competitive benefit through reduced costs, reduced time to market or developed quality. The innovation in manufacturing did not alter the product but it permanently and essentially altered the manufacturing process and promoted the product. Many Electronics Manufacturing Companies nowadays use integrated development of product to reduce their new cycles of product development in integration with tier I suppliers (Breschi, Malerba and Orsenigo, 400). Similarly 29% of the respondents said that innovation through technology is the opportunities for innovation in manufacturing. Technology has been an enormous motivating force for businesses innovation specifically in present times. Several businesses development and breakthrough concepts have been driven mainly by new generation technology development. New materials could develop products or their presentation and packaging. There has been a developing concern globally about the quick reduction of global stocks and the requirement to secure them for future over the previous few decades. These consist of both human and natural resources. Another major concern is the requirement to manage pollution and to secure the surroundings. These have been the major innovation drivers in enhancing manufacturing practices and greener technologies (McDougall G and Swimmer, 1997). Such innovations takes time to achieve agreement and become successful commercially as the big term benefits provided by technology are not evident immediately to customers. Hence companies which innovate in these places required to have a big term look. Some other opportunities mentioned by respondents are innovation in sourcing (20%) and management innovation (15%). New suppliers, new tools or a developed deal with the occurring suppliers could develop gains and products essentially in innovation in sourcing. Several companies have combined suppliers into the processes of manufacturing to assure visibility of online on inventory at different stages and quality control. Reverse auctions and electronic auctions to handle costs of material are examples of developing procurement efficiency. Finally management innovation defines to management processes and principles innovation which will alter the practice of what managers do, how they do it eventually. Typically such innovations have big lasting influence on the organization. Business models innovation falls under this classification (Camacho and Rordriguez, 463). For such a practice Toyota's lean manufacturing model is a better example. It not only represented major processes but exceeded the process innovation definition by consisting of a major change in philosophy of management. The model of Toyota has altered the way the manufacturing industry performs. The global competitive benefit of Toyota is based on the corporate philosophy referred as Toyota Production System (Shingo, 1985). The company has a market driven and customer friendly approach to both product distribution and development. It thinks that the workers empowerment is the HRMS centerpiece which develops innovation, creativity and continuous development. Thus the organization motivates their employees to involve in all decision making aspects and it enhances high employee loyalty levels. Thus the major Toyota's success hallmark in the world market is driven directly to synergy in its supply chain networks and HRM policies (Black, 1991).

What are the Key Manufacturing Technologies of Manufacturing Innovation?

The developing number of manufacturers is using technologies and software packages to develop their performance of business. For manufacturing businesses the major information technology solutions consists of (Gallouj, 145):

- Enterprise Resource Planning
- Supply Chain Management
- Manufacturing process simulation

- Computerized maintenance management systems
- Product Data Management
- Manufacturing execution systems

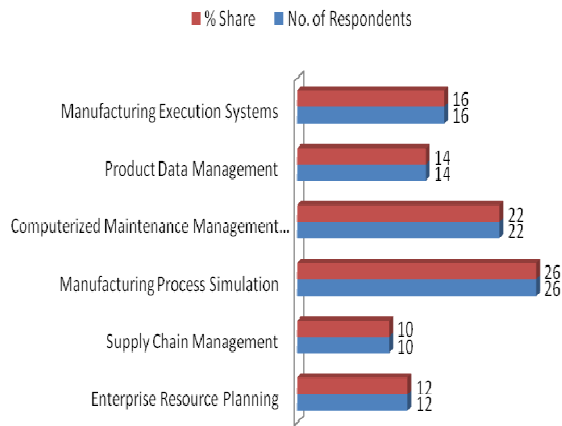


Figure 2: Key Manufacturing Technologies of Manufacturing Innovation

The respondents responded the key manufacturing technologies of manufacturing innovation. Nearly 26% of the respondents responded manufacturing process simulation as the key manufacturing technologies of manufacturing innovation because this the software usage of software models to learn and develop the processes of manufacturing. 22% of the respondents pointed out computerized maintenance management systems because these use electronic systems to control plants, equipment and assets in manufacturing mainly to recognize maintenance needs but also for needs of accounting. 16% of the respondents mentioned manufacturing execution systems as the key manufacturing technologies (Cooke, Heidenreich and Braczyk, 2004). Manufacturing execution systems uses software configured to perform factories more effectively and efficiently comparing several factors such as wastage and downtime. Contrary to that 14% of the respondents pointed out product data management because it uses electronic systems configured to support reduction of costs and time by bringing products to market. 12% of the respondents denoted Enterprise resource planning as the key manufacturing technology. Enterprise resource planning offers a manufacturing business view using an individual software piece to link operations across the business and to take account of every area's position when assigning scheduling production plans and resources. Final 10% of the respondents mentioned supply chain management as the key manufacturing technologies because SCM uses software components to handle the flow of products and materials from manufacturers business to their customers and from manufacturer's supplier to them within their business (Womack, Jones and Roos, 1990).

What are the Benefits of Manufacturing Innovation?

Innovation in the manufacturing sector defines to the implementation of innovative equipment and processes always information technology driven, product innovation and green technologies which uses consumables and lowers down waste more effectively (Nevins and Whitney, 1989).

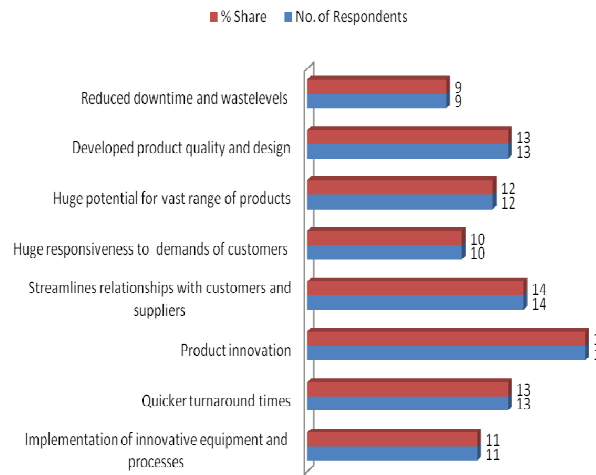


Figure 3: Benefits of Manufacturing Innovation

The respondents give varied views on the benefits of innovation in manufacturing. 18% of the respondents pointed out product innovation as the benefit of manufacturing innovation. 14% of the respondents mentioned streamlined relationships with customers and suppliers as the benefit of manufacturing innovation. Some other benefits pointed out by respondents for manufacturing innovation are developed product quality and design and quicker turnaround times (13%), huge potential for vast range of products (12%), implementation of innovative equipment and processes (11%), huge responsiveness to demands of customers (10%) and reduced downtime and waste levels (9%). Implementing innovation to manufacturers business needs money and time. They can implement innovation either on go or gradually which is the timeframe will rely upon range of factors consists of: 1) whether they might require to sway interruptions to their capacity of production while the transition is being made; 2) particular alterations which they need to implement; and 3) the resources availability to finish them quickly. Configuring demand is a practical mentoring programme enhanced to support SMEs technology and businesses initiates use design to develop performance. It supports businesses imbed efficient procedures for the management of innovation and design and gives manages the qualifications to avoid configuration by representing opportunities, detailing designers and performing projects that deliver (Macpherson, 64).

What are the Organizational Imperatives for Successful Innovation in Manufacturing?

Enhancing a successful innovative organization consists of efforts not only from organization but also achieves support from government and external stakeholders.

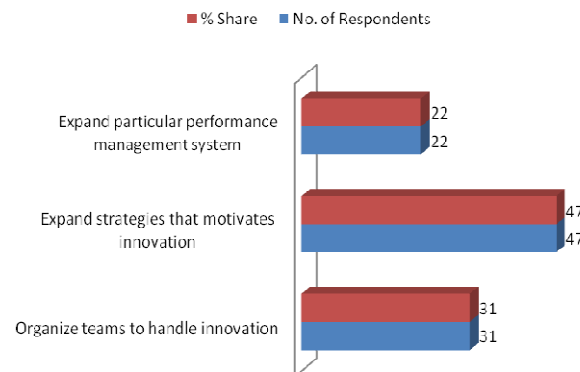


Figure 4: Organizational Imperatives for Successful Innovation in Manufacturing

When the respondents were asked about the organizational imperatives for successful innovation in manufacturing around 47% of the respondents mentioned expanding strategies that motives innovation as the organizational imperatives. Innovations consists of big investment and gestation periods thus to simplify the procedure businesses could acquire 3prolonged strategy for innovation i.e. fast wins, initiatives which would influence the big term organization and continuous incremental developments for occuring products. This would widen the scope and alleviate the risk of placing several resources into a single initiative (Leiponen, 243). An innovative strategy which consists of continuous improvement and incremental innovations will support in setting free minds throughout the organization. It will also make people more susceptible alteration when huge breakthroughs exists. Contrary to that 31% of the respondents pointed out organize teams to handle innovation as organizational imperatives because companies which have an experience of creating innovation successfully reveals that an efficient manner of promoting innovation is to organize flexible frameowrk of innovation group. The group is managed by a leader suportred by a innovators team in an integrated surroundings. Specialist teams of innovation must have huge communication with major business. Productive communication would enhance regular development and free ideas flow into mainstream. Final 22% of the respondents said that expanding particular performance management systems are the organization imperatives. Traditional associated metrics and their performance opinions is another severe innovations zone. Organizations required to configure the metrics based on particular requirements. A better practice acquired by succesful innovators is to maintain measurement of performance of continuous business tasks detached from efforts of innovation (Chryssolouris, 1992).

What are the Government Imperatives for Innovation in Manufacturing?

The government imperatives for innovation in manufacturing are:

- Assure Intellectual Property Rights security; and
- Through fiscal measures supports innovation.

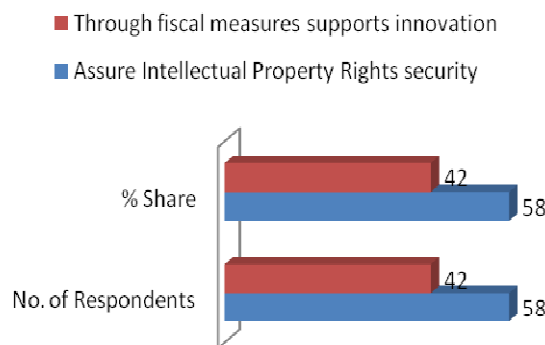


Figure 5: Government Imperatives for Innovation in Manufacturing

When the respondents were asked to mention the government imperatives for innovation in manufacturing half of the respondents assures intellectual property rights security as the government imperatives because manufacturers intellectual property will be secured will go in a huge way in motivating companies to spend in innovation. This is another place where the government can play a major role. The requirement is not just for stronger laws but also for establishing them efficiently to assure that companies have resort to quicker legal settlement of intellectual property rights disputes (Malerba, 680). Another half of the respondents i.e. nearly 42% of the respondents pointed out through fiscal measures supports innovations. Several companies specifically SMEs are daunted to from spending in innovation in a huge way.

This is because of the risks involved and the big period of gestation for payback. The government could play a major role either by offering fiscal incentives and tax deductions for the investment made by organization or by motivating capitalists venture to spend in business through common measures (Kalpakjian, 1997).

CONCLUSIONS

Enhancing rivalry in domestic and global markets represent that companies cannot maintain cost benefit for a big term. The experience of entire successful companies globally underneath the fact that the success relies on stable innovation so as to reside ahead of rivalry. Business can innovate on many manufacturing fronts on technologies, management principles and processes. Innovation is not a single time practice it consist of regular gains in re-establishing organization's services, processes and products in the light of technology and market developments. This would need organizations to enhance particular teams, performance measures and strategies to motivate innovation. At the same time government can help innovation by offering an evidence that intellectual properties of companies is secured sufficiently through legal supplies which are also manage effectively. Thus in the final observations success relies on willingness of each company to implement alterations and take risks.

REFERENCES

1. Jarmin R S, "Evaluating the Impact of Manufacturing Extension on Productivity Growth," *Journal of Policy Analysis and Management* 18 (1), 1999, p 99-119.
2. Mansfield, Edwin, et al, "Social and Private Rates of Return from Industrial Innovations," *The Quarterly Journal of Economics*, MIT Press, vol. 91(2), 1977 p 221-40.
3. Klette T J, "Market Power, Scale Economies and Productivity: Estimates from a Panel of Establishment Data," *Memorandum 15/1998*, Oslo University, Department of Economics, 1998.
4. Becheikh N, Landry R et Amara N, Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993-2003. *Technovation*. 26(5/6): 2005, p 644-664.
5. Amara N et Landry R, Sources of Information as Determinants of Novelty of Innovation in Manufacturing Firms: Evidence from the 1999 Statistics Canada Innovation Survey. *Technovation*. 25: 2005, p 245-259.
6. Bettencourt L A, Ostrom A L, Brown S W et, Rountree R E, Client co-production in knowledge-intensive business services, *California Management Review*, 2002, 44 (4):p 100-128.
7. Breschi S, Malerba F et, Orsenigo L, Technological Regimes and Schumpeterian Patterns of Innovation, *The Economic Journal*, 2000, 110: p 388-410.
8. McDougall G and Swimmer D, *Business Strategies of SMEs and Large Firms in Canada*, Micro-Economic Policy Analysis, Industry Canada, 1997.
9. Camacho J A. et Rordriguez M, Patterns of innovation in the service sector: Some insights from the Spanish Innovation Survey. *Economics of Innovation and New Technology*. 2008, 17(5): p 459-471.
10. Shingo S, *A Study of the Toyota Production System*, Productivity Press, 1985.
11. Black J T, *The Design of the Factory with a Future*, McGraw-Hill, 1991.

12. Gallouj F, Innovation in services and the attendant old and new myths. *The Journal of Socio-Economics*, 2002, 31(2): p 137-154.
13. Cooke P, Heidenreich M et, Braczyk C Z, *Regional innovation systems: the role of governances in a globalized world*, 2004, Routledge, London.
14. Womack J P, Jones D T and Roos D, *The Machine That Changed the World, Based on the Massachusetts Institute of Technology 5-Million-Dollar 5-Year Study on the Future of the Automobile*, Rawson Associates, 1990.
15. Nevins J L and Whitney D E, *Concurrent Design of Products and Processes - A Strategy for the Next Generation in Manufacturing*, McGraw-Hill Publishing Co. 1989.
16. Macpherson A, *The Role of Producer Services Outsourcing in the Innovation Performance New York State Manufacturing Firms*. *Annals of the Association of American Geographers*, 1997, 81(1): p 52–71.
17. Leiponen A, *Managing knowledge for innovation: The case of business-to-business services*, *The Journal of Product Innovation Management*, 2006, 23: p 238-258.
18. Chryssolouris G, *Manufacturing Systems Theory and Practice*, Springer Texts in Mechanical Engineering, Springer-Verlag New York Inc., 1992.
19. Malerba F, *Innovation and the dynamics and evolution of industries: Progress and challenges*, *International Journal of Industrial Organization*, 2007, 25(4): p 675-699.
20. Kalpakjian S, *Manufacturing Processes for Engineering Materials*, Addison Wesley Longman Inc., New York, 1997.