International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-2, Issue-3, March 2016
ISSN: 2395-3470
www.ijseas.com

ADVANCED MANUFACTURING PROCESS

M.Narasimha , PhD Scholar, Shri Venkateshwara University Meerut (India)

Abstract:

Manufacturing is considered as the back bone of the developing and developed countries. As we have already indicated manufacturing activities indicate a countries wealth at many times. It is defined as the utilization of enabling technologies, incorporating design and business process innovation, to deliver high value added processes and products in ways that are novel and competitive. Everywhere one finds manufactured or processed articles in use. Even in our daily routine the clothes we wear, the hooks, buttons, belts, shoes are processed or manufactured articles. These manufacturing processes when further developed bring valuable revenue to the country, may be through exports. Then provide employment to its people and offer better product alternatives to improve the overall life standards. The need for advanced manufacturing can be attributed to the following.

- Limitations in conventional methods,
- Rapid improvements in material properties,
- High tolerance requirements, product requirements

During the period 1960 to 1990, in general the following developments took place. Numerical control, computer numerical control machines, group technology, robotics and control, computer aided design and computer aided manufacturing, adaptive controls etcetera squeeze casting single crystal turbine blades. Vacuum castings, compacted graphite, automation in molding and pouring, large aluminum casting for aircraft structures, rapid solidification technology. Advanced manufacturing processes, which includes advanced casting, joining, machining and finishing methods. And in the recent years, particularly since the year 1990 till date, the following developments are noteworthy. Hybrid manufacturing processes, micro manufacturing processes, nano manufacturing, hard machining, lean manufacturing, agile manufacturing etcetera. High production with low costs, automated data transmission, miniaturization, precise and ultra-precession finishing etcetera. Then another important aspect, which is becoming very, very important and worldwide the researchers are giving emphasis in hybrid manufacturing. Hybrid manufacturing processes promise, most of these things that whatever we have spoken about. Researches are in-progress to make them more suitable at the production stage. Most of these processes are in research stage itself and they need to be fine-tuned to make them better or more suitable to bring it to the actual production stage. Once developed they will help in giving valuable substitutes for the future.

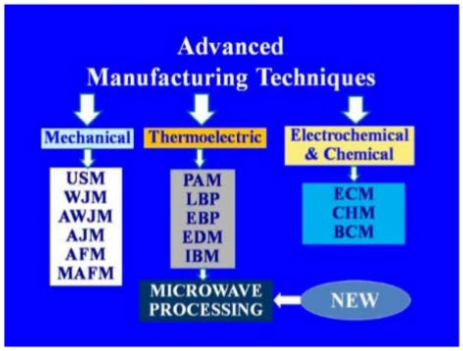
Key Words: Technology, Innovation and Utilization

International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-2, Issue-3, March 2016
ISSN: 2395-3470
www.ijseas.com

I.INTRODUCTION

The major drivers of advanced manufacturing are material driver, process driver and operational driver, while material driver is significant due to the developments in difficult to machine materials. The process driver is basically due to the stringent product requirements like tight tolerance miniaturization high quality etcetera. On the other hand the operational driver is attributed to the shrinking time to market requirements to offer products at competitive cost etcetera.

Manufacturing philosophy wise the trends can be identified as follows, in the 1960's it was basically cost driven. Then towards 1980, it became quality driven. However, if we see today, cost quality and time to market are the basic drivers in manufacturing. Let us now identify some major advantages of advanced manufacturing processes. Number one, no conventional tool hence better control over shape, size, tool wear etcetera. Number two, hardness of the work material becomes immaterial. Number three, more convenient for miniaturization. Number four, secondary operations are largely eliminated. Let us see a generic classification of advanced manufacturing techniques. Advanced manufacturing techniques can be broadly classified into three categories, Mechanical, thermoelectric, electrochemical and chemical.



Mechanical processes include some of the techniques like ultrasonic machining, water jet machining, abrasive water jet machining, abrasive jet machining, abrasive flow machining, magnetic abrasive flow machining etcetera. On the other hand, thermo electric methods include plasma earth machining, laser beam processing, electron beam processing, electric discharge

machining, ion beam machining etcetera. In this category one new process are emerging, this is microwave processing in the recent years. Microwave processing of materials have been extensively used particularly in ceramic and polymeric material processing. Of late, it has been used in processing of metallic materials also. It has been found that the process is efficient and sustainable. Hybridization of manufacturing processes has been the new trend in advanced manufacturing. In hybrid processes simultaneous working of two or more different material removal actions have been exploited to advantage. For example, combined actions of ultrasonic machining and electric discharge machining provides the hybridization in the form of UAEDM, that is ultrasonic assisted electric discharge machining, in which USM and ETM, both the processes will be working at a time, to keep the advantage in the form of ultrasonic assisted electric discharge machining. Some examples of hybridization of manufacturing processes are abrasive electrochemical grinding known as AECG, abrasive electrochemical honing known as AECH, electrochemical arc machining ECAM.

Magnetic abrasive machining - MAF. Magnetic abrasive flow machining - MAAFM. Magneto rheological abrasive flow machining- MRAFF. Electrochemical discharge machining – ECDM. Abrasive electrical discharge grinding - AEDG.

Centrifugal force assisted abrasive flow finishing CFAFM, spiral flow assisted abrasive flow machining SFAFM, ultrasonic assisted abrasive flow machining USAAFM, ultrasonic machining with electrochemical assistance USMEC.

Let us see an example of hybridization namely AEDG in little detail. Here in this process, synergetic interactive effect of electro discharge machining and grinding process is employed to increase the machining productivity the schematic of the AEDG process is shown in this fig.1

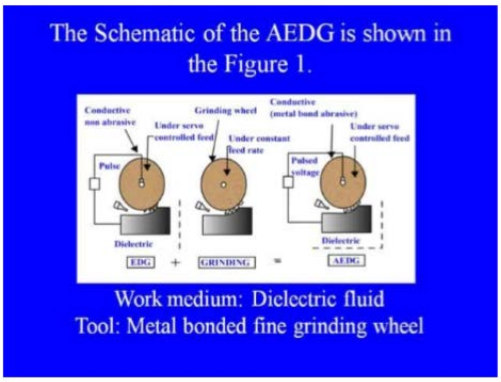


Fig.1 Schematic of the AEDG

In this, this is the conventional grinding wheel with abrasives, which is will be responsible for abrasive actions and connecting this will under work base, through an electrical field, which will work as electric discharge machining. Here work medium is dielectric fluid and the tool is metal

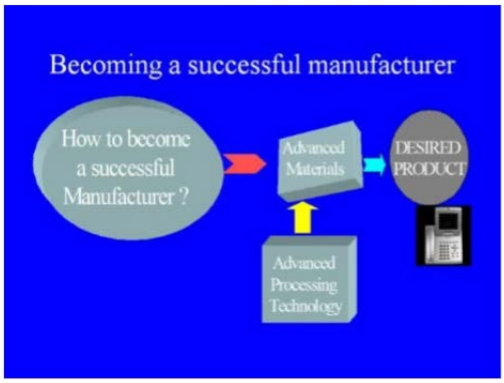
bonded fine grinding wheel. In this hybrid process, the passive and heat effected layer produced due to electric discharge action is removed simultaneously by the mechanical grinding, which is combined in the system. Thus the synergy of the both the systems could be exploited for effective machining of the material similarly. Hybridization in the form of electrochemical grinding ECG process can be obtained. In which conventional grinding will be combined with electrochemical machining, to obtain the electrochemical grinding process. The process is used for machining metallic components, combining these two processes improved productivity and tool life to a great extent. The schematic of ECG setup is shown in this figure 2. Let us have a quick look at the manufacturing challenges. Now, with the emerging economies and with the social and political transitions taking place, new ways of doing business are changing the world dramatically. (1)

Figure 2 Schematic of ECG setup

II. LITERATURE REVIEW

It is visualized through these trends that manufacturing environment of the future would be extremely competitive and significantly different from what it is today. Then how to become successful in order to remain successful? In such an environment the manufacturers need to be updated with latest trends and process distinct dynamic capabilities. For this one needs to build the following capabilities. Ability to innovate ideas and develop a creative environment for such innovations. Developing effective and efficient training or education programs for the workforce as more skilled workforce is required. Use and implementation of information technology in various areas of manufacturing industries, and their sub functions. Sustainability of small and medium scale enterprises to provide support to large manufacturing units. Focusing on clean and green manufacturing technologies for fulfilling the environmental and societal concerns. Responsibility for production process that is, goes hand in hand with responsibility for the final disposal of products that is recycling aligned with environmental policies. In this process advanced manufacturing can contribute significantly.

To become a successful manufacturer, what next? Then with the development of newer materials, newer processes and improvised technology special skills are required. For handling them, the customer requirements have increased in manifolds and the demand is for customization along with the basic.



Requirements of high quality, low cost timely delivery and service and there are many scopes for further improvements. There is a vital necessity and tremendous scope for improvement in terms of development of a sustainable research base. Concurrent flow of technology and manufacturing for fulfilling new demands, up gradation of existing technology, and managing the change. How to fill up the gap then? Advanced manufacturing technology is one area, which promises to fulfill the gap between present and the future requirements development of new and hybrid processes, cleaner and competitive processes can help develop the economy of the country.

Concurrent flow of technology and manufacturing for fulfilling new demands, up gradation of existing technology, and managing the change. How to fill up the gap then? Advanced manufacturing technology is one area, which promises to fulfill the gap between present and the future requirements development of new and hybrid processes, cleaner and competitive processes can help develop the economy of the country. (2)

As we have already indicated due to the enormous population growth, there is an increasing necessity of providing and developing or processing the resources. As in earlier manufacturing caters to almost every segment in day to day life activities, and applications. Some of these examples where manufactured products are used include kitchen items, furnitures, building products, doors, locks, automobiles, instrumentation, medical equipment, office equipment, machineries, pipelines, spacecraft, satellites, electronic appliances, robots and so on.

Everywhere one finds manufactured or processed articles in use. Even in our daily routine the clothes we wear, the hooks, buttons, belts, shoes are processed or manufactured articles. The rise in education levels have led to increase in income levels, which demand higher quality and luxury the development of technology, has led to new alternatives and thereby availability of

new products with increased sophistication and comforts. For maintaining this increased growth sustainability in production and services manufacturing plays a very important role. As most of the traditional manufacturing processes are based on energy our aim for the future is to develop products such that, they consume less energy, that means their energy efficient. They use renewable sources of energy, and then the time for processing is minimum. That is one way we can say that is again energy efficient. Time for processing is minimum means; we are spending less energy in producing in some way. Also time is a very, very valuable resource. Therefore, less use of time means, we are using fewer resources and therefore, it is cheaper.

Then use of green energy sources, then provides alternate processes for the future generation requirements. So, these are some of the primary considerations for better manufacturing in future. In most of the cases the conventional manufacturing, produces lot of greenhouse gases or some detrimental products to the environment, which is not a good sign for the future of the mankind. Therefore, the emphasis or the trust is on to have manufacturing processes; that is green in nature that is one step towards sustainability.

Then another important aspect, which is becoming very, very important and worldwide the researchers are giving emphasis is hybrid manufacturing. Hybrid manufacturing processes promise, most of these things that whatever we have spoken about. Researches are in-progress to make them more suitable at the production stage. Most of these processes are in research stage itself and they need to be fine-tuned to make them better or more suitable to bring it to the actual production stage. Once developed they will help in giving valuable substitutes for the future. Globally, manufacturing output (as measured by gross value added) continues to grow-by about 2.7 percent annually in advanced economies and 2.7 percent in large developing economies (2000 and 2007). Economies such as China, India, and Indonesia have risen into the top ranks of global manufacturing Fig. 3 and in the world's 15 largest manufacturing economies, the sector continues from 19 percent to 33 percent of value added. (3)

Fig.3 Global manufacturing

Manufacturing makes outsized contributions to trade, research and development (R&D), and productivity Fig. 4. The sector generates 70 percent of exports in major manufacturing economies- both advanced and emerging – and up to 90 percent of business R&D spending .As economies mature; manufacturing becomes more important for other attributes, such as its ability to drive productivity growth, innovation, and trade. Manufacturing also plays a critical role in tackling societal challenges, such as reducing energy and resources consumption and limiting greenhouse gas emissions. (4)

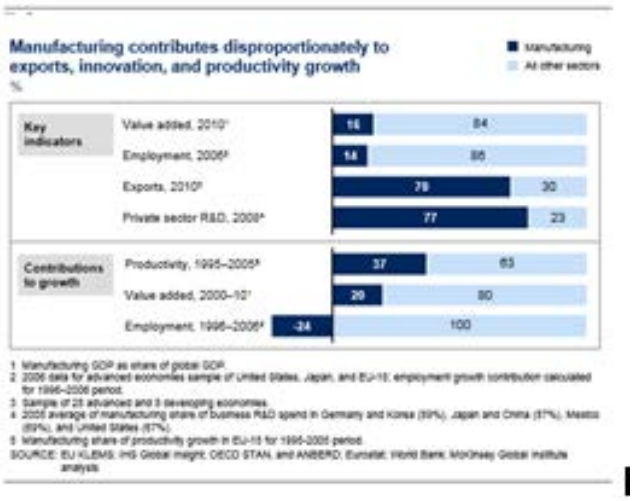


Fig. 4 Productivity Growth

III. THE DISTINCTION BETWEEN MANUFACTURING & SERVICES HAS BLURRED

Manufacturing has always included a range of activities in addition to production. Over time, service-link activities – such as R&D, marketing and sales, and customer support- have become a larger share of what manufacturing companies do. Depending on the segment, 30 to 55 percent of manufacturing jobs in advanced economies are service – type functions Fig.5 and service inputs make up 20 to 25 percent of manufacturing output, (5)

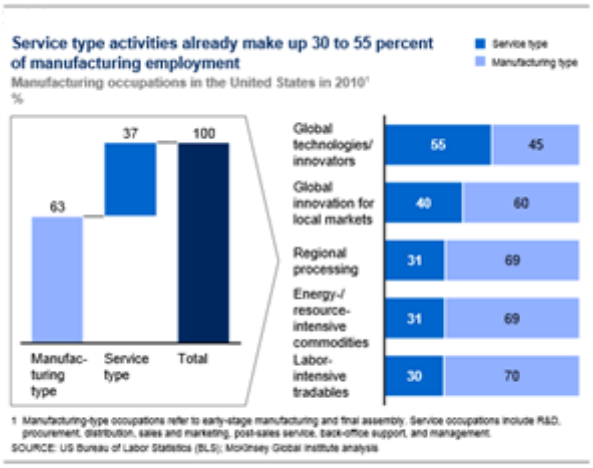


Fig.5 Service – Type functions

The diagram depicted in Figure 6 shows the layout of a typical manufacturing plant. We show This to illustrate the traditional view of what manufacturing is and what its various inputs and outputs are. (6)

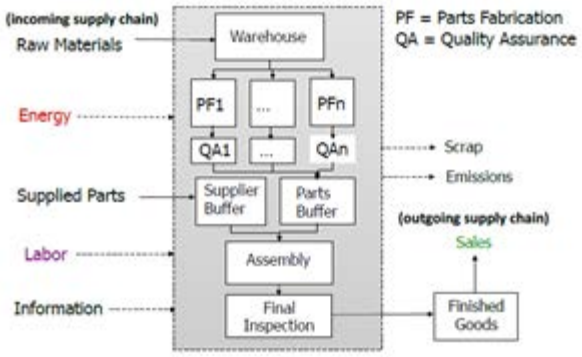


Fig.6 Layout of Traditional Manufacturing Plant

Advanced manufacturing technologies lead us to a much broader definition of what advanced manufacturing is in 21st century. Traditional manufacturing is shown below (top of figure 7) and consists mainly of fabrication and assembly and the making of finished goods in a more or less linear step wise fashion. This is an abstracted and simplified view of what is shown in Fig.7

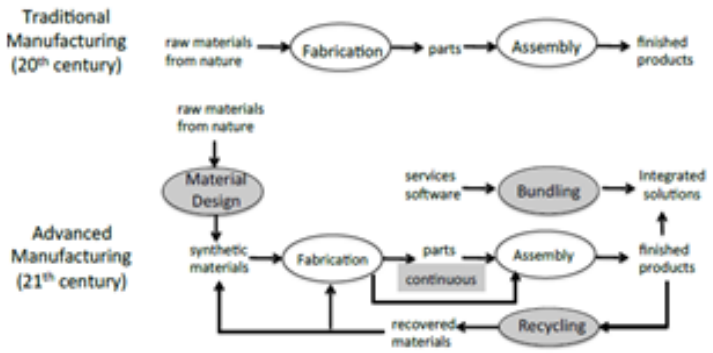


Fig.7 Traditional and Advanced Manufacturing

Advanced Manufacturing is the creation of integrated solutions that require the production of physical artifacts coupled with valued---added services and software, while exploiting custom---designed and recycled materials and using ultra---efficient processes.

The diagram in Figure 8 maps the seven manufacturing technology categories to this expanded view of manufacturing.

Fig.8 Manufacturing Technology

IV. SUMMARY

These manufacturing processes when further developed bring valuable revenue to the country, may be through exports. Then provide employment to its people and offer better product alternatives to improve the overall life standards. As most of the traditional manufacturing

processes are based on energy our aim for the future is to develop products such that, they consume less energy, that means their energy efficient. They use renewable sources of energy, then the time for processing is minimum. That is one way we can say that is again energy efficient. Time for processing is minimum means; we are spending less energy in producing in some way. Also time is a very, very valuable resource. Therefore, less use of time means, we are using less resource and therefore, it is cheaper. Then use of green energy sources, then provides alternate processes for the future generation requirements. So, these are some of the primary considerations for better manufacturing in future. In most of the cases the conventional manufacturing, produces lot of greenhouse gases or some detrimental products to the environment, which is not a good sign for the future of the mankind. Therefore, the emphasis or the trust is on to have manufacturing processes; that is green in nature that is one step towards sustainability. (7)

Some facts about manufacturing and era wise evolution of manufacturing. Then we have seen, how to become a successful manufacturer, what are the conditions required, then how to survive in this era of competition. These things we have seen and also we have seen the new trends towards sustainability or green manufacturing and hybrid manufacturing. What are the next steps to be taken or are coming up in near future. Hope this session was enjoyable and informative.

V. CONCLUSIONS

It is observed significant amounts of innovation in advanced manufacturing technologies. MIT and other U.S. Universities continue to innovate in some key technology areas related to manufacturing. Many of these innovations are potentially transformative, and not simply evolutionary. Evolutionary work is happening mainly at applied Universities. Research tends to cluster into seven manufacturing categories that are somewhat orthogonal / complementary to each other: (8)

1. Nano-engineering of Materials and Surfaces

Synthesis of multifunctional materials at the nano-scale from the ground up

2. Additive Precision Manufacturing

Building up components by adding layers of material in complex 30 shapes

3. Robotics Automation and Adaptability

Using robotics to substitute for or complement human labor in new ways

4. Next Generation Electronics

Next generation circuits non- Si materials, using mask-less processes and flexible substrate

5. Bio-manufacturing /Pharmaceuticals

Continues manufacturing of small molecules, turning cells/ organisms into programmable factories

6. Distributed Supply Chains / Design

Enabling flexible and resilient decentralized supply chains, new approaches to web-enabled mfg.

7. Green Sustainable Manufacturing

New manufacturing processes that use minimal energy recycle materials and minimize waste and emission

References

[1] Abdi, Tahir A. Machinery & equipment and growth: Evidence from the Canadian manufacturing sector. (Canadian) Department of Finance working paper, number 2004-04,2004

[2] Agrawal, Mani, T.V. Kumaresh, and Glenn A. Mercer. The false promise of mass customization. The McKinsey Quarterly, August 2001

[3] Alix Partner, US manufacturing – outsourcing cost index: Overview & highlights

[4] Sheffi,Y., "Logistics Clusters:Delivering Value and Driving Growth" ,MIT Press,ISBN: 9780262018456, September 2012

[5] Barr, M.C.,Rowehl, J.A.,Lunt, R.R.Xu, J.,Wang, A.,Boyce, C.M.Im, S. G.,Bulović, V and Gleason, K. K.(2011),Direct Monolithic Integration of Organic Photovoltaic Circuits on Unmodified Paper. *Adv.Mater.*,23: 3500–3505. doi: 10.1002/adma.201101263

[6] Gordon, M. "Cramming More Components onto Integrated Circuits," *Electronics Magazine* Vol. 38, No. 8 (April 19, 1965)

[7] Gregory,J.; Atlee, J.; Kirchain, R.; ,"A Process---Based Model of End---of---Life Electronics Recycling Driving Eco---Efficiency---Informed Decisions," *Electronics And the Environment, 2006. Proceedings of the 2006 IEEE International Symposium On* , vol., no., pp.138---143,8---11 May 2006

[8] Amicus. The Future of Manufacturing. September 2006

Authors Biography

M.Narasimha .Received his B.Tech. Degree in Mechanical Engineering from JNTU, HYDERABAD .He received M.E. Degree from VMU, TAMILNADU. Currently PhD Scholar of Sri Venkateshwara University Meerut.