International Conference on Recent Innovations in Engineering and Management
Dhananjay Mahadik Group of Institutions (BIMAT) Kolhapur, Maharashtra (ICRIEM-16)
23rd March 2016, www.conferenceworld.in ISBN: 978-81-932074-5-1

ADVANCE MANUFACTURING TECHNOLOGY

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ABSTRACT

Advance manufacturing of US manufacturing is future lies in educating technologies and implementation of process based on computer based. The entire supply chain ecosystem encompassing manufacturers, distributors and retailers in undergoing a business transformation global competition is being dictated by the rising Internet and mobile economics. The constrains on increasing manufacturing speed have some common themes and several of these are examined in to identify absolute limits to perform. The physical processes of production are constrained by factors such as machine stiffness, actuator acceleration, heat transfer and the delivery of fluids and for each of these, a simplified model is used to analyze the gap between current and limiting performance. The wider systems of production require the co-ordination of resources and push at the limits of human biophysical and cognitive limits. Evidence about these is explored and related to current practice. Additive technology used to quick fabricate and create complex shaped part in short time. Besides traditional occupational risks, advanced manufacturing processes (AMP) can generate other risks described by the European Agency for Safety and Health at Work (EU-OSHA) as "new and emerging risks" (NER) to occupational safety and health. Several studies have been carried out by the EU-OSHA in order to identify all these risks.

Keywords: Advance manufacturing workforce, Distributed Manufacturing Systems, Manufacturing Speed Productivity Constraint, new and emerging risk, Rapid protyping, Modified Rapid Prototyping process.

I. INTRODUCTION

Historically, manufacturing has been "the driver of economic growth, structural change, and catch-up" "manufacturing has long been a cornerstone" Advanced manufacturing processes (AMP) are characterized by innovative variables of a technological and organizational nature which tend to change with workplaces, processes and conventional work practices, and can generate, as well as traditional occupational risks, other so-called new and emerging risks (NER). This raises new challenges for workers and companies, and in turn creates political demands, administrative and technical approaches that ensure high levels of safety and health at work

 ISBN: 978-81-932074-5-1

When Americans think of manufacturing the usual conjured images are “stuff” large and small—and “dirty” factory floor where menial and dead end job are performed. The specific stuff being made is ever changing and includes

Food textile, chemicals, drug devices, equipment, machinery. However today, the materials, components and system by which “stuff” get produced have change dramatically and in way in which the “dirty factory floors” of the past decidedly play no part.

The term “Advanced Manufacturing” is used to describe this transformation and refers to “stuff' whose creation requires higher degree of technical competence, leveraging of new technologies and implementation of processes often entirely computer based. A better known commercialized example includes precision machining with computerized numerical control mechatronics and process technologies. In the Ensuring Leadership in Advanced Manufacturing (2011) report to President Barak Obama ,future new technologies involve advanced sensing, measurement and process control; advance material design e.g.; metals,coating,ceramics. IT including visualization, energy efficient processing as well nanotechnology. These efforts will permit “stuff” to be made on a large scale by robots, artificial intelligence machines, and 3-D printing. The workforce leading the research and development activities.

In Advance Manufacturing has the multiplier effects, being closely related to the other sectors of the economy. According to these links can be both “backwards” (such as with mining or construction), or “forwards” (such as with transportation, wholesale and retail trade and business services). Inter-linkages between manufacturing and services have been underlined in many recent studies Spillover effects are presumed to be stronger within manufacturing than within other sectors .The increasing demand for manufacturing stimulates the creation of jobs, investments and innovations .The European Commission has highlighted recently that , the manufacturing industry “has a strong spill-over effect to other sectors - additional final demand in manufacturing generates around half as much additional final demand elsewhere in the economy” Empirical studies based on Kaldor’s Law argue that the manufacturing sector in developing countries represents the engine of economic growth and development. Other empirical studies and statistical data argue that manufacturing represents a high export sector and pays relatively high wages, a main driver for employment in other sectors, including services, a key source of investment in research and development. Moreover, manufacturing is important for SMEs and it is critical for education and innovation .McKinsey Global Institute points out that the role of manufacturing in the economy changes over time and it differs according to the economic development stage of the country. Thus, in developed economies manufacturing has the ability to drive productivity growth, innovation and trade. Furthermore, this sector plays an essential role in reducing energy and resource consumption and limiting greenhouse gas emissions .Despite all these well acknowledged advantages, Europe, and not only Europe, has entered a process of deindustrialization for several decades In the developed economies, deindustrialization, which is illustrated, especially, by the constant reduction in the manufacturing share in gross domestic product (GDP) and employment and the rise in the share of service sector, has not been perceived, in general, as a negative phenomenon, but it has rather been seen as a natural consequence of the economic development process. On the contrary, according to Tregenna , in the developing countries, deindustrialization began too early, considering that these countries had lower levels of income per capita than the levels recorded in advanced economies. This deindustrialization process can rather be attributed to the policy shifts, the radical economic reforms respectively, than to the economic structure maturity (transfer to the tertiary sector). Szirmai and Verspagen state that manufacturing has become a more difficult route to growth than before in developing economies since 1990.The acceleration of the deindustrialization process, as a result of the financial and economic crisis of 2008-2009, highlighted the vulnerability of the European industry, especially of the manufacturing industry. Thus, there is an urgent need to look for new sources of economic growth. Warwick argues that productivity growth generated by innovation, such as investment in intangible assets and exploiting new demands, needs to be the driving factor for future growth. Therefore, the manufacturing industry is seen as an important source for growth, both in Europe and USA economy. At the moment, deindustrialization is no longer perceived as a natural process of economic development .At the level of the European Union, it is believed that a relaunch of manufacturing is needed in order to stop the EU's economic decline. This represents a strong point of the production system. In line with this, the European Commission under the European Strategy 2020 has established a goal to raise the industry contribution to GDP from15.6% (2011) to 20% by 2020.

II. TRENDS IN MANUFACTURING TECHNOLOGIES.

Technological and engineering system tends towards ideality over time according to the law of technical system evaluation. Considering the constantly changing business environment in which manufacturing industries operate, production systems have to be evaluated and modified on the fly to align with the market conditions. The major trends that underlie research in production technology can be categorized into:

- Capability for dynamic production characterized by system adaptability,
- Flexible production that can handle a large number of product variants,
- Near net shape manufacture for resource saving production, and
- Production of new materials, new product functionalities, high quality and accuracy.

As rapidly changing technology requirements warrant flexible and versatile production systems, it is increasingly Imperative that existing technology knowledge is used effectively for the fast adaption of manufacturing systems to suit new demands. Some of the solutions to this end refer to the design of application of new materials and energy fields, hybridization of production systems and multi-level technology integration.

III. 5 Manufacturing Trends that will shape the market in 2015.

Greater automation and investment driven by accelerated production cycle. Advance technology and changing labor demographics will continue to revolution of industry to remain economically viable, retailers must sell products faster and at competitive prices. Which send a ripple effect down the supply chain for example Advance manufacturing must accelerate production cycle and distributor takes shorter delivery time.

Stakeholders throughout the supply chain have no choice but to adjust their business models to meet consumer demand and increase profits however technology helping business stay relevant in there changing time. Five manufacturing trends that will impact the industry in 2015.

3.1'SMAC Stack' adoptions to gain speed.

A manufacturing comeback is being driven by SMAC-Social, Mobile, Analytics and cloud. The SMAC Stack is becoming an essential technology tool kit for enterprises and represents the next wave for driving higher customer engagement and growth opportunities. The need to innovate is forcing cultural change without historically conservative "if it's not broke don't fix it" industry and SMAC is helping early adopters in the manufacturing market increase efficiencies and change.

3.2 Social media to further impact business model innovation.

According to IDC white paper "The Future of Manufacturing" sponsored by Infore, social media is forcing manufacturer to become customer –centric. The traditional business-to-business model is becoming outdated because today's connected consumers are better informed and expect products demand. Consumers compare, select or buy multiple products with a tap of their smartphone and social media has become their preferred communication platform.

3.3 Internet of Things (IOT) will increase automation and job opportunities.

A renewed focus on science and engineering education is cultivating a manufacturing workforce that can manage highly technical systems and allow for greater automation. This frees up employees to put their talents to work on R & D which is helping to redefine what it means to have a career in manufacturing. In addition, Iot allows for condition based maintenance which is driving efficiencies as business save on labor and service costs.

3.4 Greater capital investment.

Though the slow economic recovery continues to hinder expansion and growth opportunities, recent government and industry reports show an uptick in capital investment funding. As manufacturers become focused on capturing value through innovation, original design and speed to market, they are increasing spend for upgrading plant, equipment and technologies.

3.5 The emergence of "Next-Shoring."

The rise of a more technical labor force to manage supply chain operations- combined with rising wages in Asia, higher shipping costs and consumer demands – has led to more companies shifting their manufacturing strategies from outsourcing overseas to developing products closer to where they will be sold "Next-shoring" as this tactic has been dubbed, allows manufacturers to increase the speed at which product is replenished on store shelves. The faster inventory can be moved to the consumer, the sooner the costs to warehouse ship and dock goods can be freed up.

IV. Double Speed Manufacturing

The speed of manufacturing processes today depends on a trade-off between the physical processes of production and the co-ordination a supply chain in the pursuit of meeting customer needs. The examining manufacturing at the double the speed is to develop an improved understanding of limits to current processes. Material selection affected on the speed of manufacturing, this speed might be increased by substitution of different components

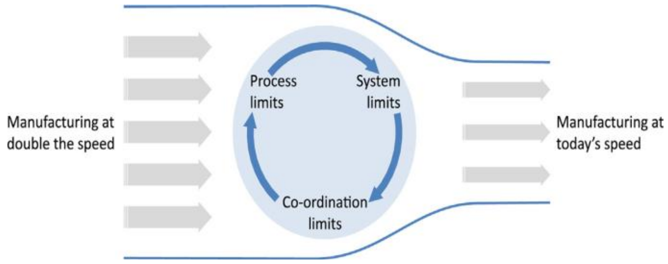

Fig. 1. Rotating bottlenecks that inhibit manufacturing at double the speed.

The speed of manufacturing could be increased by increasing the capacity of the processes for example running machine in parallel, increasing machine power or switching between existing processes as well as speed by reducing requirements for tolerance or quality. Tool path design ,tool selection and vibration control are also affected on speed of manufacturing. The advance manufacturing processes of improvement is in normal industrial practice with trial and error approach.

4.1 Limitation to double speed

The limits to manufacturing speed may arises from material handling, CNC programming and equipment testing, switchover between parts in job shop. Increasing cutting speed increases the size of stability lobes and increasing the stiffness of the system increases the magnitude of them. Tool speed in turning and drilling operation is a function of motor speed and In milling tool follows a complex path, tool speed is limited by acceleration rapid, rate of change of acceleration may also lead to an impulsive force on the machine that triggers vibration at machine resonant frequencies. Surface quality in machined and turned components is principally determined by machine stiffness, feed rate and precision tool geometry. Surface quality also constrained by the material speed. A speed improvement in manufacturing varies with different manufacturing processes.

V. ADVANCE MANUFACTURING TECHNOLOGIES USED IN INDUSTRY.

5.1 Additive Manufacturing:

Additives manufacturing (AM) is an appropriate name to describe the technologies that build 3D objects by adding layer-upon-layer of material whether the material is plastic,metal,concrete or human tissue common to AM technologies is the use of a computer,3D modeling software, machine equipment and layering material. Once a CAD sketch is produced, the AM equipment reads in data from the CAD file and days down or adds successive layer of liquid, powder, sheet material or other in a layer-upon –layer fashion to fabricate 3D object AM application is limitless.AM is being used to fabricate end use products in aircraft, dental, medical, implants automobile and even fasten products. RP is an additive manufacturing process in which a three dimensional product or component is produced from a three dimensional design using computer aided design (CAD) software in a very short period of time. The components are produced by metal deposition or plastic process.

5.1.1 Rapid prototyping is mainly classified in 4 types.

(a) Stereo lithography (SL)

(b) Selective laser sintering (SLR)

(c) Fused deposition modeling (FDM)

(d) Laminated object sintering (LMS)

1. Stereo Lithography (Sl)

In the advanced stereo lithographic systems a blade spreads resin on the part of the material as the blade travels through the vat.This process helps in obtaining a reduced recoating time, smoother surface and reduced Trapped volumes. After the part is deposited the block is removed from the vat and excess resin is drained. It will take a long time because of the high viscosity of liquid resin. The part obtained will be in green color and is then Post-cured in an ultra violet oven after removing support materials.

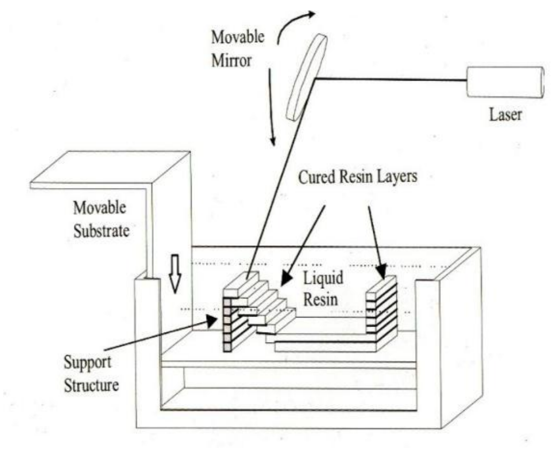

Fig.2 Stereo Lithography Set-up

2 Selective Laser Sintering (SLR)

It is a metal addition process that uses 3 Dimensional printing technology in which the power source is a laser which directs the laser beam on the points defined by the designed Computer Aided Design model to sinter the Powdered material and binds the material to form the final product. In the Selective Laser Sintering process a fine polymeric powder is spread on the substrate with a help of a roller. Before the process starts the entire bed's temperature is raised just below the melting point by infrared heating. This reduces the thermal distortion and facilitates the fusion to the previous layers. The laser is modulated in a way that the grains that are in contact with the beam are only affected. Then the process starts and the laser scanning cures a slice and the bed is lowered, so that the powder fed chamber is raised and covers with the powder. By the

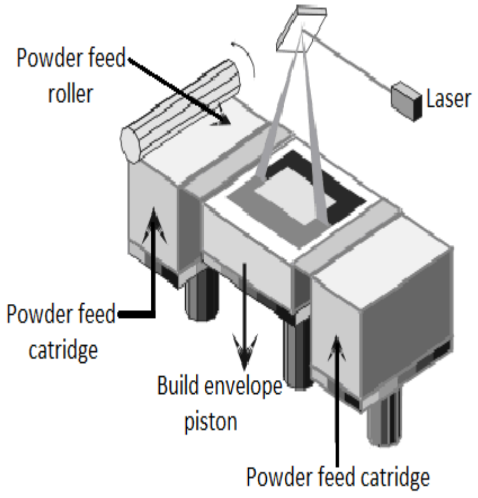

Fig 3. Selective Laser Sintering Set-up

Counter rotating roller the powder is spread evenly over the build area. The main advantage of this process is the support structures are not required because of the unsintered powder acts as a support structure. And this powder can be cleaned away and it also can be recycled after the model is completed. Fig 2.Shows a detailed schematic diagram of Selective Laser Sintering Process (SLS).

3 Fused Deposition Modeling (FDM)

In this method, material is laid down in layers and the material is supplied by plastic filament or a metallic wire. In Fused Deposition Modeling a movable nozzle which has only X-Y movement deposits a molten polymeric material on to a substrate. The material is heated slightly above its melting temperature. It is chosen in order to get it solidified within a very short period of time after extension and cold-welds to the last formed layer. The modern Fused Deposition Modeling process involves two nozzles, one for the part material and the other for additional material. The support material is of poor quality and it can be broken easily. In more advanced process water-soluble support structure material is used. The additional structure can be deposited with fewer densities by providing gaps between the consecutive roads. Fig3. Shows a detailed schematic diagram of fused deposition modeling process (FDM).

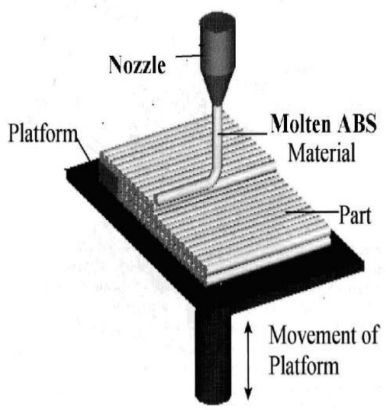

Fig.4 Fused Deposition Modeling

4 Laminated Object Manufacturing (LOM)

In this method layer of adhesive coated material is in turn glued out to obtain the component's shape using laser or a knife. In Laminated Object Manufacturing process the slices are being cut in required shapes from roll of material by using a laser beam. The new slice is bonded to the previous slice with the help of a hot roller which applies a heat sensitive adhesive. The wanted material is also hatched in rectangles for later removal. If one slice is completed, the platform can be lowered and the roll of the material can be advanced by winding this onto a roller until a new area of sheet lies over the part. After the process is completed they are sealed to prevent laser distortion of the prototype

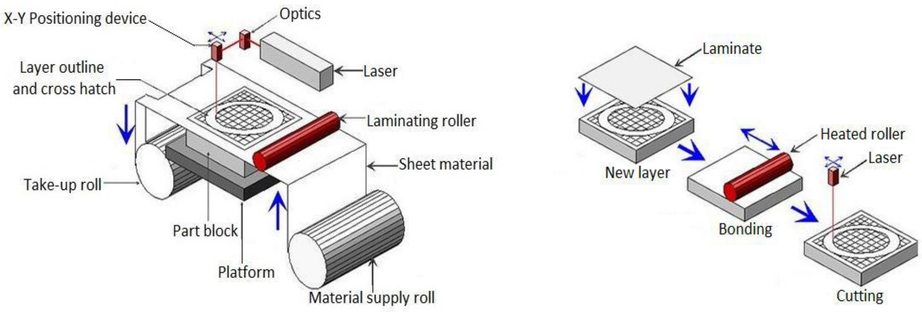

Fig.5 Laminated Object Manufacturing

through the absorption of water. This process is 5-10 times faster than other rapid prototyping process. The limitation of this process is undercuts and re-entrant features cannot be made. Fig. shows a detailed illustration of Laminated Object Manufacturing process

VI. NEW AND EMERGING RISKS IN RELATION OF ADVANCE MANUFACTURING.

Advance manufacturing process (AMP) are characterized by innovative variables of technological and organizational nature which tends to change with workplaces, process, and conventional work practices, and can generate traditional occupational risks that called new and emerging risks(NER). General nature NER susceptible in AMP but it not possible in more cases, to establish direct link with specific AMP. However it has been possible to identify among those NER a set of technical aspects with which can be established starting point to facilitate the identification of AMP that are potential

The advanced manufacturing process (AMP), due to its innovative characteristics, are susceptible to generating, as well as traditional occupational risks, others defined by the European Agency for Safety and Health at Work (EUOSHA) as new and emerging risks (NER), being its basic definition "any occupational risk that is both new and increasing" with that Agency taking the first steps in identifying specific NER with the publication of four reports, that make up the framework of this study, covering physical risks , biological , psychosocial and chemical. The International Labor Organization indicates the need for research in the field of NER, looking at alternatives when they are the result of new technologies, work processes or substances. In this reference , in the prospective study on NER associated with new technologies in 2020, published by the EU-OSHA , were selected from the eight new technologies that could help create NER in green jobs by 2020.

6.1 Occupational risk model

Known risk components must be defined according to the objective of this work, being necessary for it complement the definitions given by the reference standards, given its generic nature in the context of risk management, by analyzing more specific sources in the field of OSH.

Definition 1. Source of risk (SR): hazard leads to a source of potential damage may be the source: materials, equipment, methods or work practices. And it is understood as damage: human damage or deterioration of health, or a combination thereof, besides being able to fall on someone, it could also do it something.

Definition 2. Cause (C): act or condition responsible for an action or outcome. Or the facts that report on why they occur or may occur, both accidents and incidents.

Definition 3. Event (E): occurrence or change of a particular set of occupational circumstances which cause or may cause personal injuries through accidents, incidents and exposures to adverse situations.

Definition 4. Consequences (CO): personal injuries: injury for occupational accidents; occupational diseases; fatigue; dissatisfaction, stress; nonspecific pathologies. And the consequences of an incident: a result of any unexpected and unwanted event which may cause damage to property, equipment, products or the environment, production losses or increased legal responsibilities .

Definition 5. Likelihood (L): indicates the possibility that some event occurs that this possibility is defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general or mathematically terms. , as the process of risk identification is associated with four characteristic components, and to the subsequent risk analysis is carried out joint assessment of the likelihood and consequences of the identified risks, can be considered that the risk is further configured by a fifth component, namely the likelihood. Thus, it can be described as the risk model according to Definition 6.

Definition 6. Risk model (R): a risk (R) is a structure consisting of five components, being: the source of risk (SR), causes (C), events (E), consequences (CO) and the likelihood (L); this set may be expressed as

$$R= (SR, C, E, CO, L)$$

VII. CONCLUSION

The aim of this review paper was to understand the manufacturing process and their advanced technologies.AM contribute a job creation both in manufacturing and service sector .one point is that in the future because of citizen with well suited and advanced knowledge and skills could emerge so that peaks and carrier achievements and advance manufacturing industry sector prove successful. The future product development will be based on market development reasons for decentralized production strategy. Manufacturing speed increases with line arrays of point actuators, advanced tool, proper selection of material, also by adopting advanced manufacturing processes (AMP) speed of manufacturing process will develop. The additive manufacturing technologies can be adopted for mass production of complex parts, product to be produced at a time by helping additive technology this help in mass production. The advance manufacturing (AM) and new emerging risks NER are closely related to each other, NER do not explain their quality of new and emerging. The NER model developed, consistent with the general procedures for the identification and evaluation of occupational risks.

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