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Cognitive Manufacturing in Perspective of Future Manufacturing Industries

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Abstract: Automation of manufacturing process and production systems can reach lead time and quality levels mass production. It enables industries to cope with challenges of production with the versatility in production in short lead time with higher quality, In which Intelligent Manufacturing play an important role ,that provides not only automation and productivity but also improve collaboration between supply chain, engineering, sales and operations. Intelligent manufacturing in other words we can say cognitive manufacturing helps industries to improve their fundamental objectives like production output, reliability, versatility, quality, safety and yield, while reducing downtime and lower the costs. This section reviews the role of advancement and intelligent manufacturing techniques in Industries and its impact.
Keywords: Cognitive manufacturing, IOT, Smart manufacturing, Automation, Industry 4.0

I. INTRODUCTION

Recent Advancement in manufacturing technology has a big revolution in manufacturing architecture with the integration of automation network, devices and Services. The scientific community has worked actively on developing intelligent systems to optimize manufacturing processes [1]. Technical point of view cognitive systems will lead to developing a set of technologies to enable more efficient, flexible and faster manufacturing through cooperative, self-organized, and self-optimized behavior [2].Manufacturing industries can only compete successfully if there product and services that meet the customers requirement without compromise in quality and reliability with cost, therefore every production system should pursue the following three main objectives:

1) Providing capability for rapid response in process;
2) Enhancement the product quality;
3) Low cost Production.

It can be achieved by creating short response times to variations in the production and manufacturing system, or the configuration of the product in consistent to get overall performance targets [3].Traditional manufacturing system is not able to deal with the ever-rising complex task of modern production systems. Especially, a high reactivity, agility and adaptively that is required by modern production systems that are only complete with immense cognitive capabilities and techniques. Thus, new techniques are required, that applies these cognitive principles to the planning, process and control systems of production systems [4].

II. OVERVIEW OF KEY CONCEPT

Cognitive manufacturing analyzed and materialized the raw data exist into equipment, systems and processes to derive actionable insight across the entire value chain through different processes from design through manufacturing to process support activities. Cognitive manufacturing creates an interactions bridge between humans and machines. It enables a machine operator to assess the maximum utilization and performance of a process or machine and receive immediate answers, preventing unplanned downtime. It also allows machine to access years of stored performance insight, quality evaluation, manuals and repair detail, presented with concern of user needs.

III. CURRENT MANUFACTURING ARCHITECTURE

A. Industry 4.0 & Internet of things (IOT)

In today competitive market, the manufacturing enterprises now strive to create an extraordinary featured product with quality and reliability. As a result manufacturing system becomes more complex with the adoption of smart manufacturing techniques. Industry 4.0 is a digital-Physical vertical integration within the organizations themselves from product development to finished product. It merges the real (Physical) world to virtual world [5]. It can also define as a component of smart manufacturing in which products are developing into intelligent factory environment with automation; Industry 4.0 can be further specified through three pillars of production: Smart Product, Smart Machine and elongate the Operator.

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On the other hand Internet of things (IOT) is the formation of global information network with large number of things interconnected with each other. These things include machine elements, sensors, actuators, robots, controllers, human operators, materials, equipments, products sample, and material handling tools etc. The IOT infrastructure provides a remarkable opportunity to link manufacturing "Things," and service to achieve effective digital integration of the Manufacturing units [7].

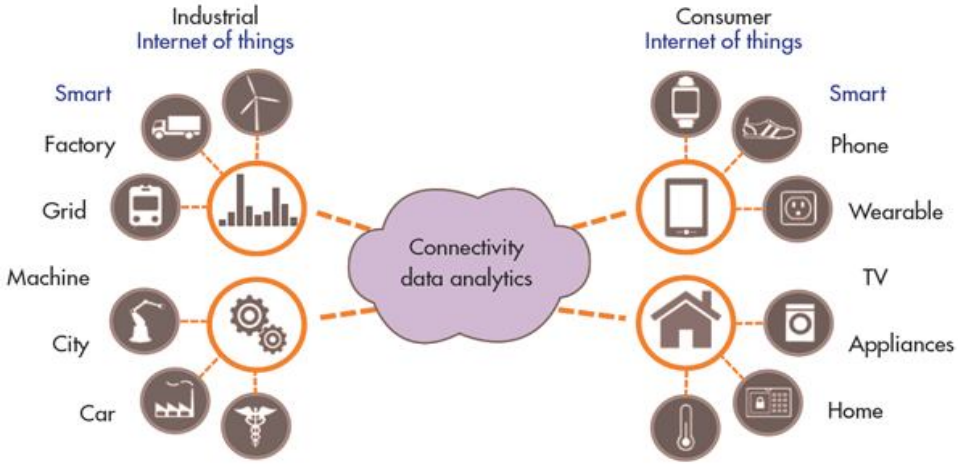


Fig. 1: Internet of Things (IOT) for Industry-Consumer relation

Industrial IOT is an integration in which sensors attached to industrial machines and component that can transmit the database over the virtual world for analysis field performance.

B. Smart manufacturing

In this generation of industry 4.0 the key elements of manufacturing are innovation, productivity and growth with technological advancement that is the new generation manufacturing infrastructure with the integration of automation, robotics, additive manufacturing, cloud computing etc we can say all these in single word "Smart manufacturing"[9]. The objective of smart manufacturing is to transform traditional manufacturing from cost operations to values added operations and increase competitiveness in terms of productivity. It is a value-creation method from design to production, logistics, and service. It is the techniques of integration of Physical world (manufacturing, Machines) to information communication technology (ICT) cyber world. In competitive age scenario and variations in technological demands Smart Manufacturing provides collection of technologies that support effective and accurate decision-making simulation in real time. It minimize the efforts, create workforce, improve safety and sustainability in the manufacturing industry, reduce energy use and waste streams from manufacturing plants, and seamless inter-operation of manufacturing automation tools and equipment [10].

There are Four Constituent Elements of a Smart Manufacturing Implementation Design
(I)Smart Process (II) Smart Solutions (III) Smart Technologies (IV) Empowered manpower

TABLE 1
Elements of a Smart Manufacturing Implementation Design [11]

S. No.	Technology	S. No.	Technology
1	Advanced Manufacturing	9	Predictive analytics
2	Intelligent Automation & control	10	Smart Sensors & Actuators
3	Cyber security	11	Robotics
4	Virtual-Physical infrastructure	12	Smart materials
5	Data Science and Big Data	13	Machine Learning
6	IOT/IIOT	14	Forecasting & Simulation
7	3d printing/Additive manufacturing	15	Decision making techniques
8	Information communication tech. (ICT)		

IV. COGNITIVE MANUFACTURING-NEED

Cognitive manufacturing is an integration of digital generation with manufacturing technology it covers automation, decision making and product control information, products are connected through networking and share design process and data flows into entire manufacturing system. Cognitive manufacturing covers Artificial intelligence (AI), deep learning, and human machine hybrid, these all are still in under developing stage and it can help to understand the complex systems as well as addition of new technology to upgrading manufacturing industries into powerful engine [13].Manufacturing organizations is adopting high degree of cognition to improve production capability, higher degree of flexibility with the high level of mass customization. For organization design technology and social structure are the main concern elements, so that the proper coordination is the prime requirement and it plays fundamental task, for all these purpose cognitive manufacturing and cognitive machines are necessary for the gradual migration from the batch production system to customer centric system. Conventional manufacturing system is not able to deal with the complexity of modern production system specially high adaptively, flexible and quick reaction to unpredictable situations, thus new concept are required in production .planning and control system in the form of cognitive manufacturing [4].In brief Cognitive manufacturing applications are- (a) Reliability and performance management (b) Process and quality improvement (c) optimization of resources (d) Supply chain optimization.

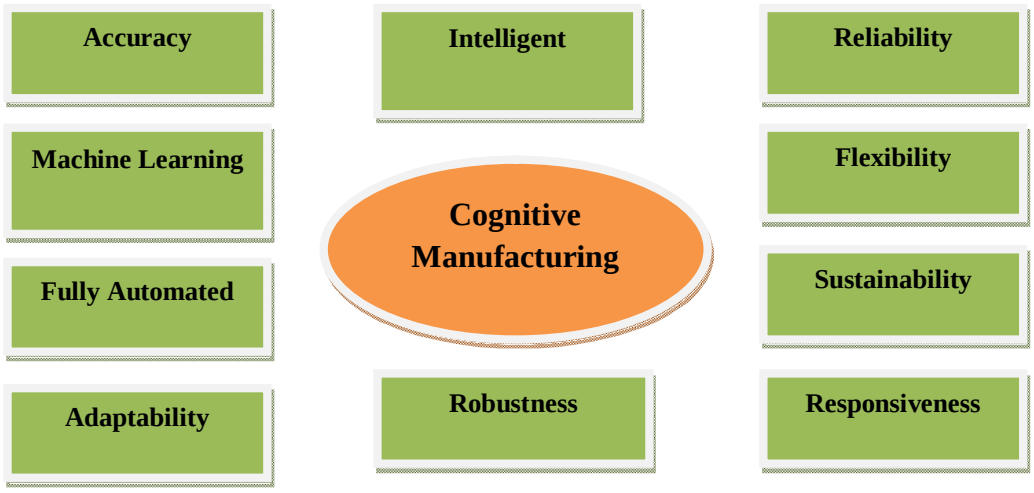


Fig.2 Visual representation of cognitive Manufacturing technology

A. Cognitive Manufacturing -A new Industry Revolution

Traditional manufacturing include two main elements machine and human, in which machine operation control are manually in this system it requires human engagement to complete manufacturing process task including information, inspection, operation, decision making and control it requires high labor intensity but still efficiency and complex system works are limited on the other way cognitive intelligent manufacturing system still highlight the human position in centre with the integrated system coordination of human, digital cyber system and physical machine system with three functional subsystem : Intelligent product, Intelligent process and Intelligent Service.

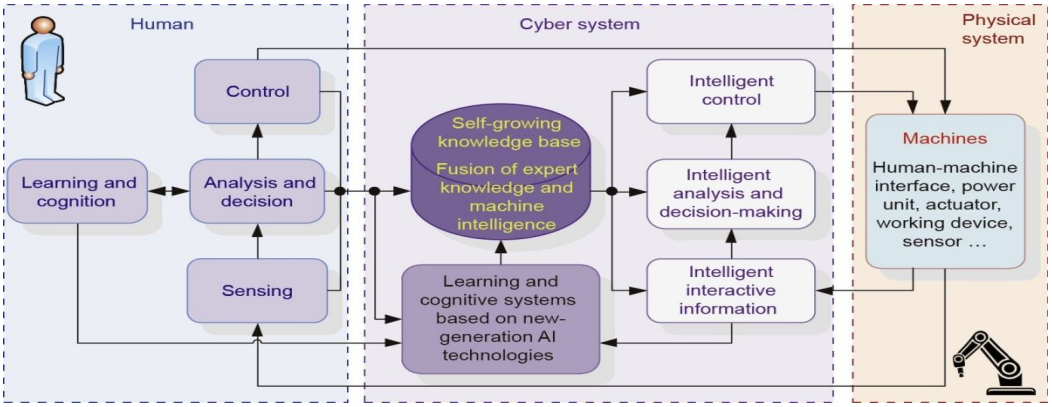


Fig.3 Basic mechanism of Cognitive manufacturing [13]

This new generation Cognitive system achieves precision and optimization in real time and complex system decision making, it creates self learning, self sensing, self adaption, self controlling operation, intelligent production line, intelligent plant environment which can achieves high quality reliable, flexible ,efficient eco-friendly manufacturing**.**

Developed countries has followed sequential development in cognitive intelligent techniques as a result in recent years rapid changes seen in manufacturing industry in the form of technological progress still there are lot of challenges to Small and medium enterprises (SMEs) have not transformation in the age of digital manufacturing [13].

B. Cognitive Manufacturing Architecture

The emerging trends of product development need new approaches with diversification introduce Computer integrated manufacturing (CIM) with flexible manufacturing system (FMS) [12].Traditional approach is not able to deal upcoming challenges because the production planning and control system become less effective. For abrupt changes, diversification and for central planning based manufacturing system creates complexity, therefore it encourage the development of concept of Reconfigurable Manufacturing Systems (RMS) that provide scalable systems in response to market fluctuations as well as system and machine adaptability to new products, it can be achieved by modular software and hardware structures in the system[4].

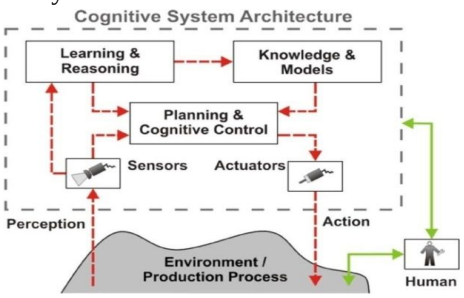


Fig. 4 Close action loop-cognitive System Architecture [4]

C. Cognitive Manufacturing System for Production, planning & Control

In order to improve flexibility in production management is to realize the active and prime consideration of product in production control that includes availability of specific product, product location, quality of product information in the production process. The availability of the information of current production process helps to introduce additional element of control. In which we can say the smart product who can share the information with the planning level through respective communication source in manufacturing system, it can itself communicate with the resources in production process, for this specific feature of smart product needs product customization, traceability and information management. By using the above mentioned smart product, each masterpiece is equipped with RFID Transponder in order to ensure reliable and standardized process gives the product specific manufacturing information

V. FUTURE PROSPECTS

Now a day's number of industries with the latest technological transformation successfully catching up digital –physical integration in manufacturing and taking advantages of fast developing advanced information technology, it can help to reduce problematic system by installing new hybrid high quality technologies.

There are some essentials steps to be taken for fully utilization of Cognitive manufacturing

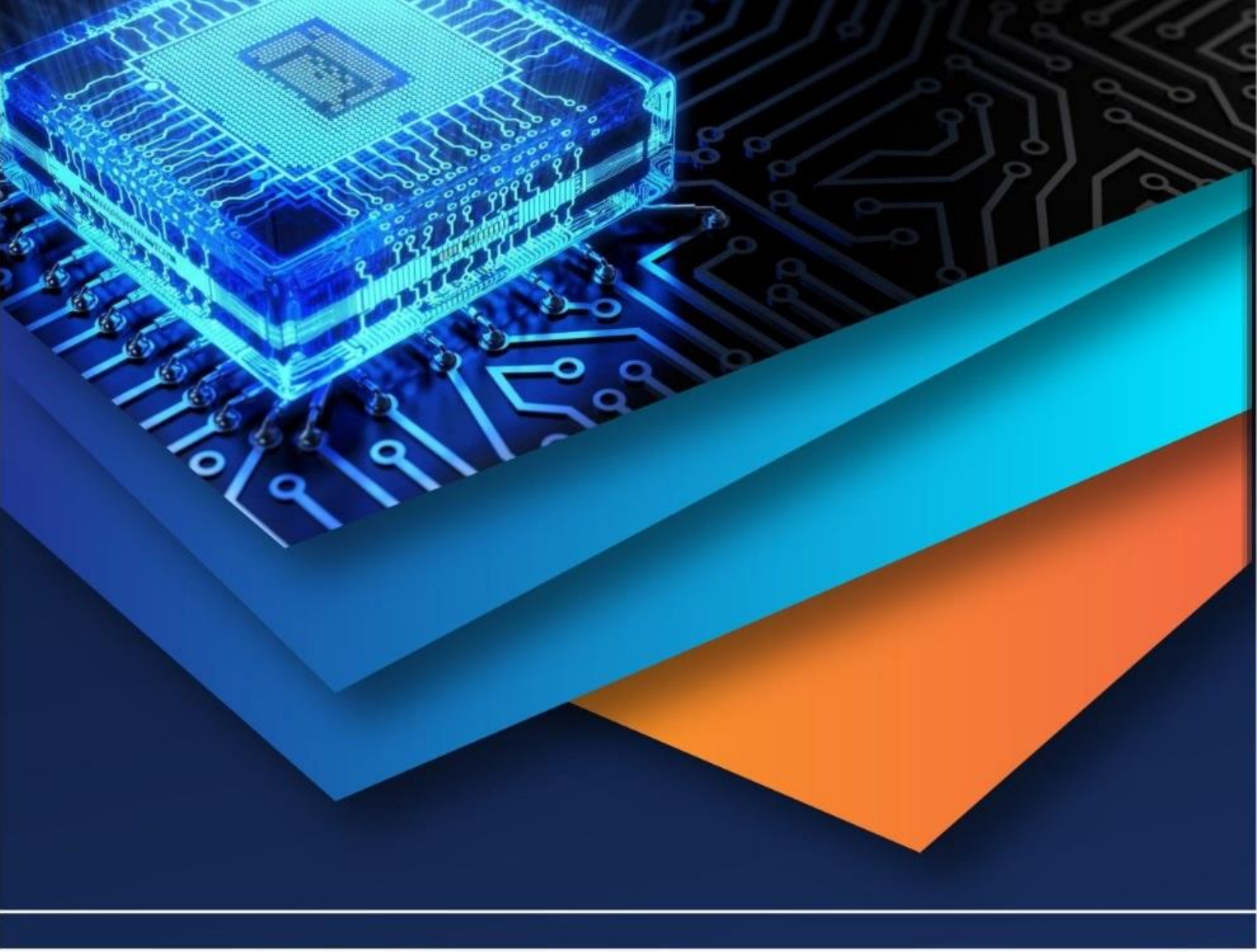
1) *Enterprise Policies:* To push industrial Production up to maximum utilization with variant customers demand motivate industries to fully adopt intelligent manufacturing, maintain a balance between technological advancement with economy and production output.
2) *Industrial Upgrading:* To apply the model of cognitive manufacturing must attention to be paid on upgrade the industry environment this will advance surrounding, quality, efficiency and moral energy in the development of industry that will achieve intelligent transformation.
3) *Create a Better Ecology:* A joint venture of government, Research, academia, economic sector is need to establish to create a better ecology to help industries for the transformation and adoption of cognitive tools and techniques , it is also prime necessity to aware application of enabling technologies to emerging industries.
4) *Collaboration of Innovation:* Manufacturing sector should be scale up internationally with open innovation system, they must be work together across the world to push forward the new generation cognitive techniques and intelligent system to create a new industrial revolution to serve for betterment of humankind.

VI. CONCLUSION

Cognitive manufacturing integrate the virtual –Physical system era of technology with the tools and techniques like IOT, computing, smart manufacturing and optimize manufacturing processes in such a ways that were not previously possible, cognitive manufacturing is a powerful technological tool for industry because it combines sensor based machine learning and artificial intelligence which create relevant information together in real time and applies analytics to extreme levels of understanding and enhance the intelligent manufacturing process. Now manufacturing industries are entering into a new phase that features with variety of application of new generation intelligent manufacturing.

REFERENCES

[1] Sergii Iarovyi, Jose Luis, Rodolfo Haber, Raul del "From artificial cognitive systems and open architectures to cognitive manufacturing systems" in 13th International Conference on Industrial Informatics (INDIN), July 2015
[2] Farle S Nobre, Andrew M Tobias, David S Walker "The pursuit of cognition in manufacturing organizations " Elsevier-Journal of Manufacturing Systems ,Vol. 27 ,Page 145-157.
[3] Y. Koren, A. I. Dashchenko, Ed. Berlin, "General RMS characteristics Comparison with dedicated and flexible systems," in "Reconfigurable Manufacturing Systems and Transformable Factories" Germany: Springer-Verlag, 2006, pp. 27–45.
[4] Alexander Bannat, Thibault Bautze, Michael Beetz "Artificial Cognition in Production Systems" IEEE transactions on automation science and engineering, vol. 8, no. 1, january 2011
[5] Mehrabi, M.G., Ulsoy, A.G., Koren, Y. et al. Trends and perspectives in flexible and reconfigurable manufacturing systems. "Journal of Intelligent Manufacturing" 13, 135–146 (2002).
[6] P. Valckenaers and H. Van Brussel, "Holonic manufacturing execution systems," Ann. CIRP, vol. 54, no. 1, pp. 427–430, 2005.
[7] Hui Yang, Soundar Kumara, Satish T, Fugee Tsung,"The Internet of Things for Smart Manufacturing: A Review" IISE Transactions DOI:10.1080/24725854.2018.1555383.
[8] Sameer Mittal , Muztoba Ahmad Khan , David Romero and Thorsten Wuest "Smart manufacturing: Characteristics, technologies and enabling factors" Article in Proceedings of the Institution of Mechanical Engineers Journal of Engineering Manufacture, January 2019.
[9] Matthew N. O. Sadiku, Olaniyi D. Olaleye and Sarhan M. Musa, "Smart Manufacturing: A Primer" International Journal of Trend in Research and Development, Volume 6(6),Nov.-Dec.2019.
[10] G. S. Ogumerem and E. N. Pistikopoulo, ―Smart manufacturing,‖ Kirk-Othmer Encyclopedia; John Wiley & Sons, 2019.
[11] Ananth Sethan "A Smart Manufacturing Value Frame of Reference https://alltechevent.com/smart-manufacturing-value-frame-of-reference
[12] F. Jovane, Y. Koren, and C. R. Boer, "Present and future of flexible automation: Towards new paradigms," January 2003 CIRP Annals - Manufacturing Technology 52(2):543-560
[13] Zhou Ji , Li Peigen , Zhou Yanhong , Wang Baicun c , Zang Jiyuan , Meng Liu "Toward New-Generation Intelligent Manufacturing" Research Intelligent Manufacturing—Perspective Elsevier 4(2018) 11-20.



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