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TOWARD THE RESILIENT SMARTMANUFACTURING

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ABSTRACT

The focus of this paper is to highlight general overview reliability and resilience of smart manufacturing inthe nearest future, the current system of smart manufacturing is at infancy stage even with the emergence and integration of smart sensors, internet of things, artificial intelligence, Cloud computing and powerful software into it. its benefits are to all parties involved in the supply chain, which was hindered by different factors such as lack of policymakers' intervention, funding, skilled workforce and widen the gap between industries and academia. Therefore, there is an urgent need to allocate a very huge amount to thesector, equipped with enough skilled manpower, as well as special package to support both small and medium scaled industries. Through the implementation of proposed recommendations made, the future of smart manufacturing especially in developed countries can safely be guaranteed.

Keyword: Resilience, Smart Supply Chain, Intervention, System

I. INTRODUCTION

Over the past few years, smart manufacturing is one of the most top topics of discussion between professionals and experts in the industrial sector especially the technology industries. which can be the most competitive scenario in the future industrial revolution. The world competition in smart manufacturing transformation is taking new shape among technological industries in Europe, U.S.A and Asia. This competitive moves between these industries in recent time hasbrought about a rapid change toward their activities and help manufacturers to smartly transform and change their entire system of production into digitized one. an industrial revolution for implementing smart production and artificial intelligence would bring about progress in economic development, meeting costumers demand, time reduction, improved quality as well as the flexibility to suit the demanding market through an integrated human-machine interaction. The recent innovation would drastically minimize the manpower requirement, increased product quality. Cyclic, undisrupted and connected supply chain of production in manufacturing process. This has brought about transparency in the industrial hierarchy thereby increasing the effectivenessof productivity. However, up to now very few manufacturingindustries have been able to rapidly adopt these technologies. Many attempts have been made by professionals to give anexcellent definition of smart manufacturing but the mostrobust definition is given by the [1] of the United State o America as it's

"fully-integrated, collaborative manufacturing systems thatrespond in real-time to meet changing demands and conditions in the factory, in the supply network, and in customer needs."

But the above definition is not considering the possible effect caused to the environment by the activities of smart manufacturing, therefore the smart manufacturing can be redefined as the process of applying advanced automation, control, simulation, and modelling in production which will result in safer, quicker, efficient, effective, cheaper productsor service that meet the demand of the consumer withoutcausing due effects to the habitat and environment. in the simplest way it's the future system of which machinery, components will automatically be communicating between themselves through wireless interconnectivity for the output of relatively high quality in lesser time, less emission of pollutant and without causing the degradation to the environment. It also involves the integration of automation, computation, networking, cloud computing and adoption of advanced information technology for the production ofreliable and updated goods and services.

The main objective of resilience in smart manufacturing is to have a sustainable innovation by using state-of-the-art Advanced automation and control, simulations and modelling system that will be incorporated with the utilization of energy, manpower, cost, other resources an intended aim of satisfying customer needs without compromising the manufacturing processes and causing disturbance to the environment also thisinnovation will remain capable of considering political, economic and social demand of the society and also capable of resisting future possible disruption from unforeseen circumstances such as natural pandemic, which can be achieved by ongoing competitive and initiation of innovative

ideas of world-leading technologies companies in developed and developing countries such as china USA, India etc.

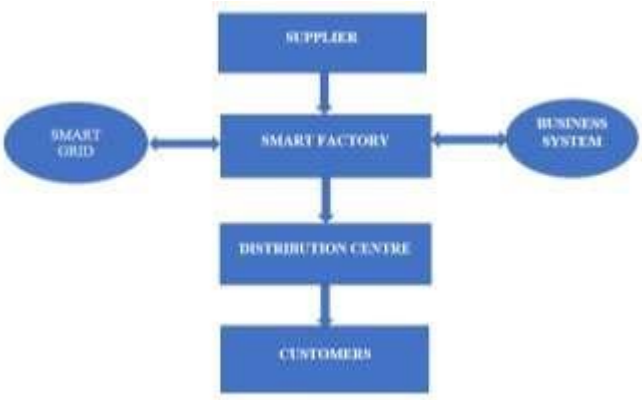

Fig 1: System of Resilient Smart Manufacturing [2]

II. IDEA BEHIND THE RESILIENT SMART MANUFACTURING

Production exists long ago in the human history starting from the stone age down to the current digital world, for example, the British industrial revolution of 18th century was empowered, secured and successful due to its capacity in manufacturing in utilizing steam engine and iron, while USA and China as the two main competitors in the world economy and leaders of fourth industrial transformation are still in the race of dominating the emerging fifth era of smart manufacturing which include the integration of wireless communication especially the 5G, cloud computing, internetof things, artificial intelligence and even forecasting the digitized way of the real-time interface between visible and virtual world. all these superpower countries rely heavily on

manufacturing industries, therefore there is a need for continuous improvement to sustain the system. Also, another factor that necessitates the smart manufacturing is thelimitation of the small and medium manufacturers to access the costlier business model. Also, besides most traditionalindustrial processes are now been replaced with the current technology of industry 4.0 and may in the nearest future going to be replace with the system which was equipped with smart sensors to have flexible, simpler, transformed, the real-time products that would satisfy the consumer's need. [3]

III. KEY DRIVERS TO THE RESILIENT SMART MANUFACTURING

The Keys technologies enabling the smart manufacturing are sensors, wireless connection, data analysis, generative design, computer-aided design, and advanced robotics. But Technological industries are faced with two challenges: these are, visible one which includes detectable machine fault, decrease in output, which can be detected and be appropriately solved depending on the problem encountered using normal manufacturing approach and non-visible one which includes wear and tear of a component part, the main problem of these industries they just focused on implementing program and methodology to foster the costumers demand in preference to the solving problems. i.e. they only consider their profit output.Therefore, implementing artificial intelligence as part of smart manufacturing processing will yield a very fruitful result as it can be used to detects both the visible and non-visible defect, as mentioned by [4] using artificial intelligence in smart manufacturing can lead to a reduction of work, waste, championing other competitors, providing costumers demand and improve the quality of the manufactured goods.

Also, the emergence of Artificial Intelligence (AI) gives the breakthrough to the development of the smart manufacturing due to its multipurpose characteristics of capable storing, computing, sharing huge data which gives the technological manufacturers ability to improve the level of production and increase their competitiveness. Internet of Things (IoT) which sometimes correlated with the cloud computing which serves as the main storage of Internet of Things (IoT) data and provide medium to which the users can interact and retrieve data, the innovation of Internet of Things (IoT) and cloud computing provides an opportunity to manufacturers to save a lot by avoiding them to unnecessarily to create individual sites and communication platforms for their product which can be they can be accessed by other independent service providers companies. [5]

IV. REQUIREMENTS FOR RESILIENT SMARTMANUFACTURING

For successful smart manufacturing, the following driving points need to be considered which was described by [6] Providing Universal interactive platform to share the idea for industries in the new research obtained in the field of smart manufacturing,

i. Cheaper, Reliable, Accessible and Robust System for collection processing retrieving and management of data in smart manufacturing.
ii. Sustained, optimized and valued supply chain system.
iii. Establishment of an organized and well-integrated educational system to which the smart manufacturing industrials will rely on [7].

BENEFITS OF RESILIENT SMART MANUFACTURING TO THE SUPPLY CHAIN PROCESSES

All the parties involved in the supply chain benefit from the smart manufacturing

i. **To the Supplier:** as the supply chain include the continuous and cyclic processes from manufacturer, supplier to the final consumer. The supplier might use the opportunity of using smart manufacturing to optimize the end-user requirement especially in an environment where there is limited medium to which he can interact with the end-user directly.

ii To the Manufacturer: the most important factorthat enhances supply chain is better and effectiveinteracting medium. Therefore, implementing the resilient smart manufacturing in production will lead to a sustained and valuable product that can be traced, tracked and apply simulation processes to detect possible variation in the supply chain.

iii To the End User: The basic consumer needs are to have an assurance of quality and timely delivery of the product. he can also be able to access different alternatives of his demand. And also send feedback and suggestion to the other parties in the supply chain using smart manufacturing technology.

V. CHALLENGE TO THE RESILIENT SMARTMANUFACTURING IMPLEMENTATION

Besides this rapid development in resilient smart manufacturing still, most of the companies have little knowledge about these innovations. Therefore, there is a need to explore those benefits of resilient smart manufacturing and let those companies strictly adhere to them promptly [8]. Other challenges faced by the smart manufacturing industries as identified by [6]. include, 1. No evidence or any reliable ordependable fact that for them to embrace the innovations in manufacturing, 2. Complex and wider range variability in datato be processed by the machines. 3. No system that can beused to detect the machine failure which may lead to output with high possible errors. 4. Some Complex industrial processes may be impossible for machine to handle without human intervention. Other challenges as describe by [9] include Data Management and Lifecycle Challenges, data Processing Architectures Challenges, Data Analytics Challenges, Data Protection and Security Challenges, and lastly Data Visualization Challenges.

VI. CONCLUSION

The existence of the digital world in the production and manufacturing industries has been the key factor in the revolutionary movement of resilient smart manufacturing which may lead to the fifth edition of the industrial revolution. Also, considering the current challenges and disruption in supply chain and value chain activities, implementing the smart manufacturing in the production industries will help in alleviating them. Also, the successful trends in smart manufacturing is likely to be the conditional advancement to the change in the current perspective in global manufacturing competition. However, most of the industries embarked on this trend are still at the infancy stage crippled with the funding scarcity, poor and unavailability of well-trained and skilled manpower and lack proper support from their government. And lastly, to have a robust, resilient, reliable, less costly, environmentally friendly smart manufacturing it is necessary for both private and public sectors especially in the production sector to work hand in hand with the provisional guidelines prescribes by the policy makers.

VII. RECOMMENDATIONS

To have long-lasting, sustained and resilient smart manufacturing especially in the production sector there is a need to implement the following recommendations.

1. A very huge amount needs to be allocated by the manufacturers in the countries interesting and competing to lead the advancement in smart manufacturing, the allocation should uniformly be distributed to the whole digital system which includes modern tools, installing state of the art plants and equipment, sophisticated sensors and strong cloud for proper communication in the sector.
2. Enough manpower in cooperated with updated required essential skills is needed by industries to speed up the smart manufacturing revolution in the world. This can be achieved by improving the consistency and quality of manufacturing education.
3. To bust the economy and speed up the process of smart manufacturing its prerequisite to all the nations interested to invest and gain in resilient smart manufacturing for the inclusion of research activities in the universities. which should be encouraged by supportive effort through special grant allocation to these kinds of research and also strengthens the bond between industries and academia.
4. Several conferences and seminars have to be organized on a timely basis by professionals and experts in such fields for sharing ideas and otherupdated and innovative information.
5. another factor which needs to be considered to have successful, resilient smart manufacturing is the integrational intervention to support both small and medium scale industries in those countries which may lead to economic improvement for them.

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