RECENT STUDIES ON INDUSTRY 4.0 WITH INTERNET-BASED APPLICATIONS IN SMALL AND MEDIUM INDUSTRIES

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Abstract

Industrial revolution for progress of manufacturing systems in the carrying of cyber - physical manufacturing systems and use of digitization in business has become vital for aspiring smart manufactory or manufactory of the future. Most industrial vertical experiences machines take up the mortal role; however mortal integration is unavoidable with a digital, electronic, virtual world. As most manufacturing industry units are in transition in tune to fourth revolution requirements and are implementing, the next development of manufacturing systems are looking for accuracy, capability and security. The trending requirements for the manufacturing systems development is characterized by adapting to rapid digital technological changes to bring sustainable industrialization of existing industries and revitalization of major functions. This paper analyses and proposes to have more and more innovations to bring the industry together and closer by integration within industry and horizontal integration of stakeholders.

Keywords: 3D printing, INDUSTRY 4.0,AI,robots, IoT, Industrial revolutions, IT, OT self-ruling creation, CNN.

I. INTRODUCTION

Industrial revolutions of yester years have developed the world to new heights in productivity by using lesser resources, but the revolution 4.0 has been now in place to be enacted if not done so far. Internet of Things (IOT) has made this revolution more impacts and prevalent worldwide as the network of interconnected technologies and resources have made it uniform to be implemented and needs to be addressed by all the industries from huge corporates to small micro and tiny units. The communication is now mandatory and standard with most reliable protocols of life on internet. The large numbers of devices (heterogeneous) are now used for data exchange as most smart applications are now connected through cloud platforms which are the most significant development and leads to many advantages for the companies and also throws challenges in the field of data security and protection of intellectual property rights. Previous revolutions had developed and modernised manufacturing processes and systems between revolutions 4.0 seems to be drastically changing the environment than never before. The inception of the Internet and application (app) technologies of modern times undoubtedly made a huge leap in manufacturing movement. Hence it is a must to integrate manufacturing systems, which will increment the benefits in productivity and entanglement of the old manufacturing systems.

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II. LITERATURE REVIEW

This paper is interested in reviewing important recent publications, especially reviews to gather wide knowledge and coverage with lesser manuscripts in the same field. Sandra Grabowska[1]had discussed about fourth revolution of industries, which is now being promoted by many governments of industrialized European and Asian major developing countries however USA leads in select industries especially in computer software and hardware fields and have already implemented pilot cyber centric production systems in manufacturing shop floor for production of home appliances, cars, plants and machinery. The initial signs of change are seen around the early years of the 21st century and are also expected to take some more time in complete

implementation to reach on to the lowest layer of the industry. However, it predicts the early creation of cybernetic production solutions for manufacturing and looking forward to the interesting confluences and challenges yet to be resolved as it involves huge investments.

Chaitanya Vijay Bidnur[2]imagines the blend of innovations in Industry 4.0 the accompanying gatherings of advances like quick application improvement, digital protection advances added substance assembling and 3D printing visual checking, wearable observing for labourer well being in unsafe spots, man-made consciousness (AI), cloud, edge, mist and furthermore, computerized twins, virtual and expanded reality, re-enactment, progressed mechanical technology and robots, IoT, huge information, IT, OT self-ruling creation, simultaneous designing across the whole worth chain, intensive information assortment and provisioning, frameworks joining systems administration and correspondence advances, incorporation and network standard conventions, block chain advances to unite it the watchword is coordination.

Dan Li, AsaFast-Berglund, Dan Paulin [3]has done research on contextual analysis dependent on primary zones like assets, data frameworks, authoritative design, and culture on Industry 4.0 empowering advances to abilities, which are been executed in different degree among the underlying territories and construed that setting needs to begin with digitalization for administrators. To arrive at perceivability (stage3) and incorporating IT frameworks the administrators need to make up for lost time office laborers regarding accessibility of systems additionally alluded to conceivable standpoint for a close. Resulting research should be bi-overlap concerning sharing data and information in an Industry 4.0 setting. It is essential to seek after to evolvability with regards to assets and data frameworks however may be significantly more critical to make a steady hierarchical design and culture, as these two underlying zones construct the dream and fabricate the interest of working environments like Assembly System 4.0 for Operator 4.0.

Yuval Cohen, Maurizio Faccio, Francesco Pilati, Xian Yao.,[4]has talked about the Digital assembling possibilities with CNC innovations structure the centre of PC supported assembling, code and PC helped designing. What's more, surrenders the vital job of PCs in assembling digitalisation and furthermore the resultant is PC supported advancements (CAX) with PC helped measure arranging (CAPP) to be combined and is arisen to zest up the information trade and the executives inside the blending of CAD and CAM, and especially in item information the board (PDM) improved such reconciliation to the information the board of an item life cycle. At that point the adaptable assembling framework (FMS) and PC coordinated assembling framework (CIMS) were proposed to incorporate CAD, CAM, CAPP and MRP/MRPII as a full. Afterward, such ideas as lean creation (LP), simultaneous designing (CE), and lithe assembling (AM) were additionally proposed. These brilliant assembling models upheld arising ICT and registering (AI), particularly WM and SCPPS that incorporate Internet of individuals (IoP), IoT, Internet of Services (IoS) and Internet of Content and Knowledge (IoCK), produce a large measure of information huge data.Thus, large information handling just as subsystem combination in computerized fabricating frameworks is a major test.

William Pagnon[5]has guided the new generation implementation firms, as to how effectively the fourth revolution adaptability can be managed by existing industrial outfits and clusters. The author summarised a way to automate smart factories from order to product delivery with readily available technologies in the open source but with limited liabilities. He had also included machine tool manufacturer's case studies for smart technology with ready to put into practice. These technological advancements, when adapted successfully, resolve into fewer hours of work

this paper would be capable of coordinating the existing industrial facilities and still has to accept new plants with new settings for virtual factory. Therefore, rapid change within the prevailing situation is required, and it must include general assistance in defining a development plan of action and policies of its cognizance. A typical industry 4.0 framework for the implementation and its requirements is depicted here for the better understanding of the readers of this journal.

Fig. 1 Industry 4.0 Core Components for Implantation

The following are the most commonly used terms for implementation of the new revolution called Industry 4.0. The above figure clearly indicates different integral parts of industry 4.0 and also accepted worldwide as the reference framework for sustainable development of the new revolution industrial model (figure 1). It is to be noted that the above different protocols are needed to be understood by the companies for its sustainable growth in this global shrinking localisation scenario. Most companies in the small and medium scale sector are the true manufactures of most of the products of the world as they are really relying on the orders from major corporate companies with clear design and developed virtually tested products which need to be produced flawlessly using the resources. The competitive best is to have advanced manufacturing machines and methods to gain productivity as their advantage for profit-making business models.

Nowadays by the introduction of robotics and automation models of the newer developments the industries are to adopt the latest automation method for manufacturing, material handling conveyors, inspection gadgets, image processor based quality control methods and tools, with robotic arms for perfection is being used in industries with a concern to have sustainability.

Though augmented reality (AR) and virtual reality (VR) are the new technologies and most industrial units are yet to get adopted and also cost of installation of such advanced software requirements are high in small and medium scale industrial units. Computer-aided design (CAD), Manufacturing (CAM), analysis(CAE), Simulation and process planning (CAPP), QC/QA tools require different input and output modes and gadgets for its implementation. The cost associated may also be a concern for the small players in the business. However, it is inevitable to get on with the technologies of the future to stay in the race if not fully a partial phased automation on these lines are expected to happen in near future for the sustainability of the business firm. System integration is one of the software which needs more and more sophistication and specialization according to the specifications of the individual player/ company and the systems of management a company follows for its normal functions of the firm. Intranet for the different client locations of the company is another important intranet requirements based on the level of authentication and security of the industry the system needs to be reconfigured and the protocols are needed to be reconfirmed for the internal requirements, which is fully of site-specific to the requirements and needs customised solution in such cases. Data storage and retrieval in recent years is one of the causes of concern as most of the companies started to rely more on

money and more buying power as the custom products can be made available at a cheaper cost than market price. The author also emulated the benefits like faster return on investment (ROI), customized products at a cheaper cost, competitiveness by cost reduction, Widening the market, lesser maintenance breakdowns, low human errors to improve first time best quality, safety, better traceability, accountability and many more advantages.

Li Da Xu, Eric L. Xu & Ling Li [6] advocates early intervention of digital technologies for sustainability and development of the future factories. As cyber-physical systems are now reality than a dream at the very threshold of industrial revolution4.0. Digitization and wireless networks are inevitable to be operatives in the new era of intelligent factories, which includes imaginative ideas, creative design, aesthetic development, rapid quality manufacturing, productive maintenance, satisfactory services and maximised recycling possibilities. Revolution 4.0 is about rapid horizontal integration of data flow between stakeholders like partners, suppliers and customers, however vertical integration also becomes mandatory as the flow of key components like men, machine and material are near just in time (JIT) within the organization as development to final product to happen in a gist to reach the customer early. Hence merging of virtual and the real world is the resultant for a fully integrated system in which processes are fully digitized for flow of information in real-time frame.

Ateeq Khan and Klaus Turowski[7]gives some insights by informal interviews to experts and factory men on current challenges in production on different industry segments and different complexities of their business has some common challenges. Numerous types of data collected are in huge heterogeneous in number and form like sensor, process, product, quality, plant, logistics, data from partners, infrastructure requires more and data, the other challenges are data exchange, skill development, process flexibility, security, integration of various data sources, real-time data collection and distribution, predictive maintenance are few challenges, which need to be addressed exquisitely for the factories of future.

Sureshkumar, Thangarasu and John Alexis [8]have reviewed the possibilities of implementation of CNC machines in adaptive mode to address such challenges in an environment much closer to Industry 4.0 for small and medium type industries. The addictiveness comes only after the integration of internal systems with optimization techniques and physical integration of CAD and CAM soft tools into one by a customized adaptive software.

Challenges faced by manufacturing systems are in many ways like assembly systems as discussed, however many such challenges must be addressed from a broader viewpoint of manufacturing systems engineering as the world grows sharply in integrated approaches based on computerisation and the internet of things. whereas these challenges require an interdisciplinary approach than self centric approach in the name of copyrights and royalty issues. The cluster of industries needs more an adaptive approach to the requirements of the developed order of the world[9]. This paper vouches for faster adapting to the proposed knowledge-based systems to address those challenges in manufacturing systems for future-readiness and to face the subsequent challenges, which may arise after fully-fledged industry 4.0 adaptation by all the industries surrounded.

III. DISCUSSION ON THE POSSIBLE IMPLEMENTATION STRATEGIES

The technological development is to be taken into account on the requisites of sustainability of companies[10]. The foremost significant factor and a major prerequisite of general development in Industry 4.0, the manufacturing units needs application of recent technologies and in turn, the requirements for restructuring of existing methods are needed to be addressed, this virtual environment proposed in

data clouds and relational database management systems in place.

Industrial Revolution 4.0	Software Requirements
Design	Computer-aided Design (CAD)
Simulation	CAE, CAD,CAM
Manufacturing	Computer-aided Manufacturing and Planning CAM, CAPP,
Testing	Virtual and computerised testing CAE
Quality control	CMM, Image processing based tests
Process and control	Enterprise, material and customer-based ERP, MRP, CRP, SAP tools
After-sales Maintenance and Customer support	CRP, SAP tools

Table1: Software Requirements

The physical systems for the complete cyber cover is also a cause of concern in installation of 4.0[11] requirements and the cost on cyber-physical systems is also to be noted and it is again one of the constraints to be addressed and need for a cheaper long-lasting, feasible hardware systems based on industrial requirements is the need of the hour.

Data storage and security is another important issue to be sorted out for successful installation and implementation of the 4.0 regime in small and medium scale industries by the continuous pursuance only a small player can become tech-savvy and sustainable growth puller in current industrial scenario. The following table 1 shows different requirements for the minimum guarantee implementation of a completely computerized environment for a small and medium type enterprise with its limited liabilities.

One's solidarity might be recorded for flexibility by different organizations aside from the proprietary innovations. The data on extra season of machine or necessities of a provider might be skimmed in the portable or PC based android application, to the best utilization of the bought-in people and firms. Mechanical coordinated improvement of the most recent intellectual substance and their immediate exchange into the economy of the area. Synchronous changes are conceivable just on the reason of an interesting advancement system inside which a major spot should take the foundation of provincial, particularly development organizations of keen plant, which ought to be the generator of most recent items, administrations and occupation creation. Large information in assembling digitalisation along with the occasion of PCs, ICT and AI, lands up in modern huge information, which brings 4Vs (Volume, Velocity, Variety and Value) challenges for assembling, and such enormous preparing is totally not the same as that that attention on organized information before incorporation. There exist together solidification, reconciliation and start to finish mix in CPPS/SCPPS, which challenge existing conventional vertical and/or combination, for example, in CIMS. and Security as information gathered for SCPPS includes actual gadgets, digital administrations/computerized twins, and social people, measures should be taken to validate hardware wellbeing, advanced robbery and staff protection.

IV. CHALLENGES AND SOLUTIONS

To summarize the review of the most recent literature we propose the expectations for a complicated production system for age 4.0, the requirement of the hour to develop the digital manufacturing systems of this and future are in need of the subsequent sustainable parameters. By developing Adaptable Digital Manufacturing for the current system, and on implementation in new-age factories the expectation is very strong improvements in production management and its maintenance systems, which improves quality and robustness production process for completely integrated adaptable Digital manufacturing systems. Adaptable Digital Manufacturing systems will be the new era of manufacturing paradigm, wherein the automation and integrated hardware and software solutions from the internet of things and trending methods thereon would contribute to solutions for the challenges predicted in this paper, however the latest

systems provide support to modern enterprise within the price of aspiration. How much an industry adapts to collaborated systems is slowly and readily becoming a key factor in industrial production of the new industrial revolution. IOT based production systems are being constructed or accepted to be structured to integrate the market requirements and challenges in real-time for derivation and design of solution methods. This is the only way to be in-line with the world order to make the industries in industry 4.0 to react in accordance with the precise requirements of individual customer's requirements. Collaboration of processes within the company will get optimized through a network operating worldwide for the progressive / adaptive systems for better productivity and the revolution 4.0 is looking for better organizing the existing production systems with considerable changes due to advancements of new technologies.

V. FUTURE SCOPE FOR RESEARCH

A new step forward would always depend on the potential for savings and possibility of profitability with new innovations being adopted in new-age production facilities is expected to be bigger. The subsequent areas and associated cyber-physical production systems for smart factories of the future gets more importance for the development of manufacturing technology within Industry 4.0 framework. Further research and developments for small customised innovations for new production strategies customised to suit small and medium type production industrial houses. It is proposed to research further to get real-time breakthroughs for new-age manufacturing processes and production methods. The manufacturing industries are looking for robust, fast, efficient production processes, which may be performed safely without much of human intervention and verification. Adaptive digital manufacturing systems are the need of the hour for the Small and medium enterprises within the affordability of the tiny but captive entrepreneurs to develop the third world countries at large. Hence it is expected to have more and more hybrid digital manufacturing systems and architecture which could support the abilities of the MSME's in real-time to achieve faster processes and models for production engineering capabilities of the manufactures. These above points are suggestive and a place to begin newer research within smart future factories in manufacturing.

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