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Smart Manufacturing with Smart Technologies – A Review

Chockalingam Palanisamy*

***Abstract* - The application of smart technologies like the Internet of Things (IoT), Cloud Computing (CC), Cyber Physical Systems (CPS), Big Data (BD), and Artificial Intelligence (AI) in production is known as "smart manufacturing" (SM). This article examines how SM changed as a result of the advancement of these technologies. This review summarises the development of each technology before explaining how SM made these technologies possible. The final topic is the future improvements for Industry 4.0. With the purpose of elucidating next-generation smart manufacturing, this review will make an effort to respond to these questions, i.e., present date of resources in manufacturing and the difficulties associated with using smart technology in manufacturing.**

Keywords— Smart Manufacturing, IoT, CPS, BD, AI.

I. Introduction

Currently, the world of manufacturing is being transformed to put more emphasis on IoT, virtualization technologies, and cloud computing [1]. Smart manufacturing enterprises should pay more attention to key areas such as cyber physical systems, big data, cloud computing, IoT, and AI in all types of framework [2]. IoT links the physical and digital worlds to expand services [3]. For betterment, the manufacturing sector is adopting technology like wireless sensors, cloud computing, etc. By running equipment and facilities and making rational decisions, these technologies enhanced production technologies [4]. As a result, it helps manufacturers be more productive and efficient [5]. To prevent breakage and costly repairs, many manufacturers utilise IoT-based predictive maintenance to monitor the condition of spindles [6]. By using an IoT-based predictive maintenance solution, for instance, damage can be anticipated. This solution will collect data from various machines' attached sensors, analyse the acquired data, and help detect vulnerable parts before they fail [7]. The adoption of IoT by manufacturers has made it possible for them to embrace digital transformations in a variety of contexts, including customer attention, effective productivity, automation, competitive advantages, and quick returns [8]. IoT technology implementation will improve manufacturing industries efficiency by less errors and low cost [9]. It has been demonstrated that cloud computing can support current technologies. Industry adoption of cloud computing in product development, design, and manufacturing is gaining traction. CPS can be broadly defined as digital and physical systems, such as autonomous vehicles, intelligent structures, and smart manufacturing. Their applications are monitored, coordinated, and integrated by a computer [10]. These cyber-physical platforms aid in monitoring manufacturing processes, culminating in intelligent factories or smart manufacturing. Cyber-physical systems facilitate modelling, simulation, optimization and helps in manufacturing and automation [11]. The process of obtaining, storing, and analysing referred to as BD. Over the years, big data has emerged as a new area of artificial intelligence. Industry 4.0, or the fourth industrial

*Corresponding author, email: palanisamy.chockalingam @mmu.edu.my, ORCID: 0000-0003-1795-8285
Chockalingam Palanisamy is with the Multimedia University, Melaka 75450 Malaysia (e-mail: Palanisamy.chockalingam@mmu.edu.my).

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revolution, has been made possible by big data [12]. BD is frequently related to the idea of analytics, which is the capacity to derive knowledge from data by using techniques such as simulations, optimizations, econometrics, statistics, and mathematics to assist in decision-making [13]. Big Data Analysis, for manufacturing operations, is significantly greater [14]. The engineering of creating intelligent devices is known as artificial intelligence (AI). Early AI researchers created programmes that encoded rules for doing tasks and making judgments because the original goal of AI was to emulate the way that people thought. Industry 4.0 introduces digitisation and automation of production processes by integrating computers and robotics into manufacturing [15]. AI decision-making in cyber physical systems is autonomous due to connected IoT and only AI can analyse the big data generated [16]. Smart manufacturing, support digitalisation, in operations, integrate design and planning and management [11]. Smart Manufacturing uses intelligent technologies to design production system and process [17]. Smart Manufacturing incorporates all latest technologies such as, computer vision, and the big data analytics [4].

II. Literature review

Radio Frequency Identification (RFID), Middleware, Wireless Sensor Networks (WSN), Application Software and Cloud Computing are the main IoT technology subfields. RFID uses radio waves to automatically detect items or persons [18]. A Wireless sensor network (WSN) is a grid of devices that monitors and logs the condition of different devices. WSN can communicate without a reader present and have greater radio coverage than RFID. By creating links between all the various components, such as RFID tags, actuators, and sensors, middleware facilitates communication. Using a cloud services platform through the internet and cloud computing is the access to a collective group of configurable resources including stored, applications and other technical means. Real-time WIP inventory management, tracking, and information management via wireless manufacturing were covered [19]. Through a suggested work shop arrangement, they have created an RFID shop floor configuration. Similar research was undertaken [20], who also presented a case study of a small automobile component and accessory manufacturer (APAM) using a Real Time Manufacturing Execution System (RT-MES) to manage and control manufacture procedures in concurrent. Zhang et al. [21] showed the instantaneous collecting of manufacturing info from several means that are connected through sensors. A multi-agent system, the workflow management (AWFM) mechanism, and a model of a usual assembly terminal where the idea of a smart gateway is realised in real time have all been shown along with the smart entrance. Real-time information collecting is made possible [22]. By fitting conventional manufacturing goods with RFID sensors, they were able to show how information could be tracked and traced in real time.

An IoT based production logistics synchronisation (PLS) system for a cloud manufacturing environment has been presented [23]. With the use of this system, a clever PLS mechanism may manage real-time variations occurring in manufacturing. Radziwon et al. [24] attempted to create a common description of "smart factory" and explored the difficulties in implementing the concept in SMEs. A proposed architecture for the manufacturing internet of things (MIoT) was made [25]. Tsang et al. [26] examined numerous IoT characteristics to analyse the impact of the IoT on manufacturing. According to Wang et al. [27], the Cloud Manufacturing (CMfg) technology can be used to satisfy consumer demands. According to Garetti and Taisch [28], it is essential that people are aware of trusted manufacturing services are there. Tao et al. [29] presented a novel service system with an architecture based on cutting-edge technologies like the IoT and CC to address issues in current smart manufacturing. Research on demand-supply, and the best utilisation of industrial property knowledge was done [30]. in 2014. Their suggested four-layered IoT architecture accesses manufacturing resources and capabilities and utilises intricate network models to realise efficient manufacturing.

Access to resources and services are made possible through cloud technology. It stimulates consumer collaboration [31], fosters inter-organizational ties [32]. The adaptability and resources of computing persuade firms to use cloud applications to enhance and reinvent their production method. Cloud application service gives manufacturers access to management dashboards, collaboration tools, and software, which moves the manufacturing process to the cloud manufacturing. The cloud services are Infrastructure as a Service (IaaS), Software as a Service (SaaS), and Platform as a Service (PaaS) [33]. SaaS offers resources for software setup and configuration for Enterprise Resource Planning (ERP) and Computer-Aided-Design (CAD) tools. Users are given access to software and hardware resources through PaaS, enabling them to create applications like operating systems, databases, and web servers. IaaS offers physical resources, enabling users to deploy their own preferred platform and software configuration. Because of the flexibility and resources of cloud technology processing industrial information, manufacturers are urged to shift their manufacturing technology to cloud [34]. The cloud manufacturing is an exchange information that uses cloud and attempts to meet the rising demands for more individualised products, international collaboration, innovation, and swiftness [35]. However, there isn't just one standard for CM implementation. According to research investigations, there are numerous distinct CM structures [36]. By creating routine reports, ad hoc reports, and alerts utilising business intelligence technologies, descriptive analytics provides insight into the current condition of a company scenario. Analytics that are enquiring about why this is happening. A detailed analysis of the output and data will be generated by using this analytics toorder to reveal the causes of an issue [37]. The goal of predictive analytics is to offer a glimpse and sense of the future. Predictive analytics uses prediction and statistical modelling based on historical and present data to provide insight into what will happen for the other data's. This will be the model for the future smart manufacturing applications [38]. The widespread use of sensors, the emergence of big data, the expansion of e-commerce and cyberspace have all significantly helped for AI development [39]. Intelligent manufacturing refers to a new standard in manufacturing as well as the product development strategy that is integrated with product lifecycle. The making of new models, methods, and forms is made at ease by AI. Comprehensive study of the literature on the use of the IoT, cloud computing, cyber physical systems, big data, artificial intelligent reveals knowledge gaps that may be useful as a direction for future research Among them are: a shortage of learning that will quantify the benefits of these smart technologies, as well as insufficient decision-making tools that can exploit the copious amounts of data created by smart devices. The concept for applying smart technology in small and medium-sized industries is also non-existent. Finally, there are no standard solutions for data interchangeability, security, or privacy.

III. Conclusions and Future Directions

The IoT, CC, and AI were all examined in this review along with their many definitions. It also compared and contrasted them together with other conventional collaborative design and manufacturing systems from various angles, found common core traits, and established needs. In response to the initial query, cloud-based manufacturing is a new emerging area. It is going to rule the industry in design and manufacturing. The following inquiries need more research in the interim. What will be the effect of technologies which are coming is future on manufacturing industries and in future what is the roadmap for AI in manufacturing? IoT, BD, AI, and Industry 4.0, are widely used in manufacturing. The majority of newly developed manufacturing methods are having one or two technologies such as IoT enabled smart factories, cloud manufacturing, Enterprise 2.0, crowdsourcing and Big Data-based predictive manufacturing. These new manufacturing models all share big data. The BD by way of information intensive method gives us a new area that goes past theory and experiments. as well as computer modelling of natural processes, to reconsider what AI or smart manufacturing needs. However, transforming BD into useful knowledge for these new production methods is the need and it is difficult as well. With the smart manufacturing, which integrates artificial intelligence, smart technology, human intelligence as a whole Industry 4.0, is focused on mass produced and personalization which were centred on mass manufacturing to transform the earlier technical movement into a social technical, combines smart manufacturing technology with social intelligence. It helps to source human knowledge, by social computing, crowdsourcing, and creativity. In manufacturing systems, the development of intelligent system affects decisions, adding feature, varieties, grouping, applications, flexibility, worthiness, and manufacturability.

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Chockalingam Palanisamy: Conceptualization, Data Curation, Methodology, Validation, Writing.

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