Emerging Challenges and Sustainability of Industry 4.0 Era in the Malaysian Construction Industry

Taofeeq D Moshood, A.Q. Adeleke, Gusman Nawanir, W.A. Ajibike, Rukayat A Shittu

Abstract*: Today's businesses are challenging what to call a new technological change. Technological advancements are going towards more enhanced internet-based method resolutions. This step is usually pointed to being Industry 4.0 and is supposed to hold the potential for new adaptable, independent products able to manage themselves. By modern technologies, nevertheless, there is additional demand for new skills and qualification demands on the workforce in the construction industry. Moreover, manufacturers or construction companies of today usually have obstacles with hiring newly qualified workers, particularly the younger one. Construction companies are looking to achieve Industry 4.0 would consequently have to maintain the development and education of existing workers while including attracting new workers. The paper objects are to explain what modifications that help achieve a sustainable of industry 4.0 in the construction industry, efficient and recognizing potential developments, understanding hazards connected with economics and supporting the simulation improvement.

Keywords: Industry 4.0, Sustainability, Qualification Challenges, Challenges in Industry 4.0.

I. INTRODUCTION

By rising human population growth, more prosperous lifestyles, and growing GDP levels, the humankind is progressively overwhelming, driving to an ever-increasing requirement for non- renewable resources and renewable resources. The difficulty of resource deficiency is, accordingly, rising because of it uncertain whether the industrial increase in the globe with limited genetic resources can be sustainable. Even if the economics still secured in a way that supports the long-established production pattern, a deficiency of resources, more stringent environmental measures, and increasing consumer expectations will require existences to discover alternatives [1]. Modern technologies can be applied to track stocks within the value chain and to follow the situation of the product throughout its life cycle. In Malaysia, the construction companies are working to obtain on the potential of developing technologies to more sustainable, more assistance, restructure the product, business models or changing the whole systems. What is sure is that several presume that the fourth industrial replacement will hold a substantial impact on employment global as first robotics; synthetic capacity and industrialization are growing more prominent.

The construction companies in Malaysia are challenging a technological advancement, which described as Industry 4.0. The indoctrination of industry 4.0 launched the idea of the creative industry by all the provided features of remarkably individualized methods attaching the real world with pragmatic existence. Collaboration between machines and humans has been profitable for an extended period, but the associated uncertainties have remained a constraint. The communication between virtual reality and collaborative methods allows the opportunity where fresh ideas and opinions can generate and sustainable climate. The ability to build, estimate and explore new ideas and concepts without changing the real world is acceptable related to the recently launched information in sustainability.

Ever since the introduction of Industry 4.0, it has remained a well-known concept in the whole world and researchers are thinking how the new technology can be employed and how Industry 4.0 can be sustainable, valid, reliable and secured. Modern technologies deliver new requirements toward the workforces. Therefore, the construction industry requires improving the abilities of the current workforce [1]. Nowadays, most companies are in endless efforts by hiring qualified workers, particularly young people that are fresh graduate and women. Hence, it is essential to allow a harmonious workplace that is exciting and extends skill advancement within the industries [2]. Nevertheless, the requirement or qualification is a fundamental difficulty for industry 4.0, and it needs specific action. The challenge of professions in the production sector is increasing as the industries become digital. The views of the construction industry to accelerate productivity increases and benefit on the industry 4.0 revolution can consume because the education system is trying to implement the best measurement and kind of skills to fit the requirements of the sector (Industry 4.0 Revolution). Construction companies will require continuing advancing in teaching current workers to follow up with new methods in order with company requirements. One main difficulty is to improve the digital abilities and experiences of the existing workers and, in particular, more experienced workers (older workers), by generating a suggestion of digital education.

Revised Manuscript Received on May 22, 2020.

***** Correspondence Author

Taofeeq D Moshood*, Faculty of Industrial Management, Universiti Malaysia Pahang. Email: taofeeqmoshood@gmail.com

A.Q. Adeleke, Faculty of Industrial Management, Universiti Malaysia Pahang. Email: adekunle@ump.edu.my

Gusman Nawanir, Faculty of Industrial Management, Universiti Malaysia Pahang. Email: gusman@ump.edu.my

W.A Ajibike, Faculty of Industrial Management, Universiti Malaysia Pahang. Email: niyifavourite@gmail.com

Rukayat .A. Shittu, Faculty of Applied Social Science Universiti Sultan Zainal Abidin, Terengganu. Email: shitturk2017@gmail.com

II. LITERATURE REVIEW

A. Industry 4.0

As discussed earlier, Industry 4.0 incorporates several improvements and modifications to various organizational perspectives by introducing technologies and a broad range of methods [3]. Industry 4.0 can be described as the digital conversion of production and manufacturing, creating third stage technologies, such as Analytics, Big Data and Internet of Things.

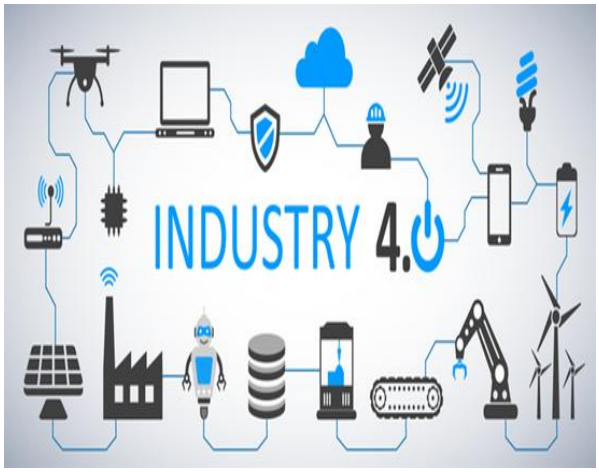

Fig. 1. Industrial 4.0 Era (forbes.com)

The 1st industrial revolution meant the migration of farmers to city areas due to the initiation of steam-powered locomotives, which appropriated by machines like the harvesting machine and engines. The 2nd industrial revolution appeared in the second half of the 19th century that was due to electrical-generation systems achieved. The electrical-generation or electrical-mechanical systems observed the installation of equipment lines by Henry ford. Therefore there is existed a collaboration between electrical systems and mechanical, which was the commencement of mass generation. The equipment lines offered use conveyor systems that were extended by the notion of Henry Ford, which the car can develop, to be operative [1].

Over the 20th century, the world encountered the installation of processors, microelectronics and computer technology in production industries. The initiation of computers and the internet started in the 3rd industrial revolution. The industrialization of production methods appeared to light, and this was encouraged by electronic systems and robotics systems that transformed the whole production methods. Those technological discoveries were disruptive, and they created a transformation in business models of current industries and implemented new possibilities for start-up businesses.

The primary fundamental of the 4th industrial revolution is the connectivity of everything; i.e. big data, services, internet of things, artificial intelligence and superior robotics, this entire are at the core of the revolution. Industrialization and Optimization of methods created in a completely new system. Machine learning and data analytics is playing a significant part. Machines can communicate with other devices to perform quick choices based on big data analytics algorithms. Industry 4.0 can ultimately obtain with a digital supply chain and self-optimizing systems [1], [4]. The digitization demands the concentration operational technologies, big data, information technology, manufacturing processes and robotics to understand consistent facilities. The transmutation from the 1st to the 4th industrial revolution can be seen in Figure 2.

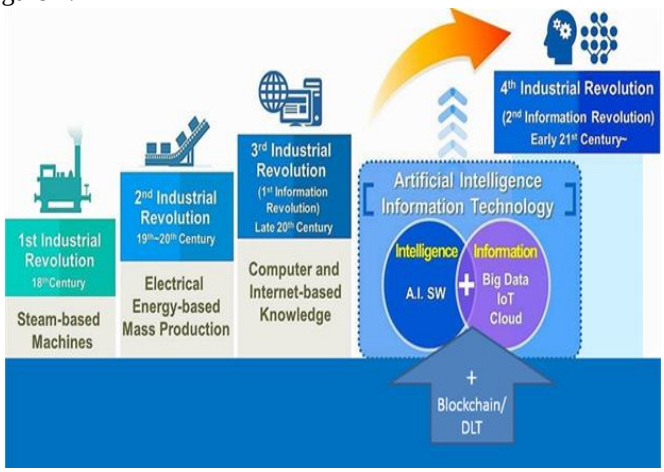

Fig. 2. Fourth Industrial Revolution (Huawei.com)

Currently, industry 4.0 is still a concept for the construction industry that wish to achieve their aims in the next 5 to 10 years ultimately. Technology discoveries have transformed various phases of our day-to-day lives. Manufacturers and construction industry in Malaysia are modified significantly with employment market that is being disturbed. Advancements in robotics, big data analytics, and artificial intelligence have replaced various work profiles, separated the responsibilities and created entirely new job profiles, which required skills within other occupations. The results of those technological improvements are currently being witnessed now. Quick reply to those technologies will influence on modern business patterns. That will define the relevant security or lightness of future employment markets [1], [4].

B. Internet of Things

Gubbi, Buyya, Marusic, & Palaniswami (2013) has defined the internet of things as the act of affording to actuate and sensing devices with a way to share information effectively. That is to accomplish by more data analytics, universal sensor readings and information description through cloud-based computing [3]. In other words, systems will and machines through (IoT): gather more information and data; have that data be analyzed and calculated by internet-connected computing, and present that data in an easy-to-read and comprehensive way. According to Atzori, Iera, & Morabito, (2010), the internet of things (IoT) can also locate Radio Frequency Identification tags or RFID-tags. These tags were used nowadays to recognize machines and products and to see their locating data. The data of the RFID-tags can be distributed among the products and machines so that the production methods can adequately maintain the record of individual members during the process. Figure 3 shows the concept of the internet of things.

Fig. 3. Internet of Things (ww2.frost.com)

C. Decentralization

According to Núbia Carvalho, Omar Chaima, Edson Cazarinia, (2018) affirmed that decentralization in Industry 4.0 as supporting machines and local operators to obtain more choices themselves instead to relying upon orders passed down hierarchically and basic computers. By the improved demand for individualized outcomes, decentralization would require improved versatility required to meet those requirements [3]. The production line would be capable of adjusting itself to the clients' needs with the intelligent mechanisms and efficient transfer of data or information from CPS, without requiring operatives or operators to reprogram or modify the machines. Instead, activists or operators would just need to perform maintenance or monitoring the device and intervene in a situation of faults or obstacles. Another instance of decentralization provided by Brettel, Friederichsen, & Keller (2014) is whereby production operations could appear to work together and to support by other product operations and supply chains autonomously. That would require production methods distribution information about the clients or customers' requests with material suppliers and their methods to obtain the right quantity of stocks and provide transfers without the responsibility of people. According to the authors, this would provide for the extra manageable allocation of production capability in those value chains. Figure 4 shows an example of decentralization production control on tablet CPS.

Fig. 4. Examples of Decentralization (mpdv.com)

Lundmark (2019) explains whereby the internet-based machines, digitalized, and productions can provide several kinds of work to be conducted remotely, away from the product itself. An instance, the drivers of mining machines can control the device from outside the mine itself. The operators can utilize VR technology to simulate sitting in the computer and communicating with its controls [3], [10].

D. Operators of the future

In addition to the technologies trying to increase the effectiveness and versatility of production methods, there are modern technologies connected by Industry 4.0, which intends to support the workforce. Romero, Bernus, Noran, & Stahre, (2016) employs the term "Operator 4.0" which outline how operators can work with Industry 4.0 technologies [3]. According to the authors, operators must advance into various contemporaries, from actually operating manual and quick work throughout the earlier years of industrialization into doing work supported by machines. This improvement extended into operators now interacting with robots, computers and devices to perform their task. This process will increase toward the 4th generation of operators, who will use machines to improve their physical, cognitive skills and sensorial. Figure 5 shows the concept of operators of the future.

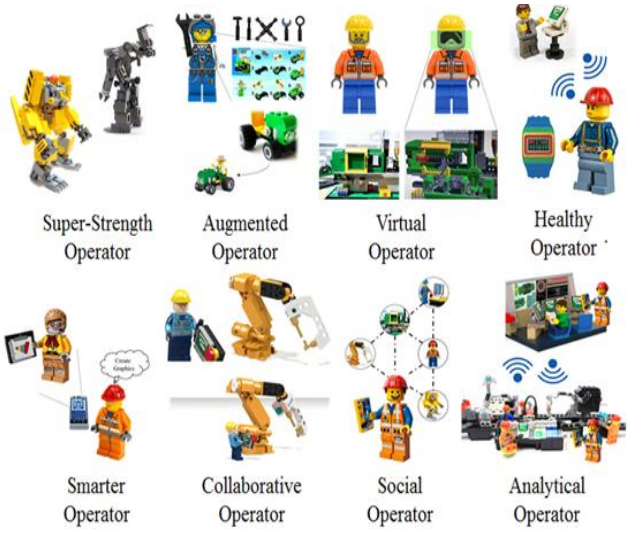

Fig. 5. Operators of the future (theconversation.com)

E. Big Data

Industry 4.0 comprises of various ambitious models of systems and technologies that can enhance and increase productions and industries considerably. Nevertheless, a common denominator among these technologies is that they rely on a huge number of data to operate. According to Oussous, Benjelloun, Ait, & Belfkih, (2018) and Chen, Mao, & Liu, (2014), the word “Big Data” is employed to explain the huge numbers of data that is usually handled in today's’ organization that cannot be managed by conventional IT devices in a sensible amount of time. Instances of big data collections provided by the authors cover pictures and images uploaded to social media sites, individual location data, data from RFID tags and industrial machine sensor data. The connection between Industry 4.0 and big data sprawls in IoT.

If IoT is succeeded in a company, the terminals and the sensors that combine the systems, machines and operators would create a huge number of data when estimating and explaining the production. The big data from IoT terminals and sensors can operate by employed CPS to provide whole intelligent factories to regulate their production lines according to a system-wide goal [14]. This involves using data from consumer orders to improve production and machines autonomously [3].

Fig. 6. Big Data

III. QUALIFICATIONS DEVELOPMENT

The introduction of Industry 4.0 brings a change about what information required of the people operating with its systems and technologies. It may need adjustments in the professions, general skills and specializations that workers and companies possess. At the same time, the worker's knowledge, workers' abilities and their experience may help as valuable resources in the future while growing and improving the workplace [3], [10]. Hence, these issues introduced to implement the context of the knowledge and training methods that people can meet in future, also to explain the value of both worker and management responsibility in training. In an establishment or organization, the workers' experience and creativity is an essential support to use and promote industry 4.0. To achieve this, workers' needs to equip with a chance to grow their abilities and capability by learning.

Sundström (2019) describes learning as a process of substituting old knowledge and generating new knowledge. When used in organizations, one of the purposes is to improve employee skill. An employee with an ability or skin in a particular job is not only capable of completing the project successfully, but it can additionally learn and struggle to develop the design. To accomplish that, the worker needs to have the opportunity to reflect on the job, know its meaning, and capable of combining their practical and technical experience of the work. Additionally, the company need to give chances for the workers to implement and deliver their awareness to allow them to study from one another, and perhaps providing the company itself to learn. Giving adequate assistance for training, the opportunity for the idea and learning improvement in the operators' job can produce many advantages. Those can introduce extra productive and more reliable work, more dependable conversation between people in the industry and workers that are more interested in the advancement of their job. That is reason people are usually more absolutely inclined towards transformations and methods that they should support in planning.

IV. CHALLENGES OF INDUSTRY 4.0 IN THE CONSTRUCTION INDUSTRY

It is so essential to estimate and identify the economic impacts and challenges of Industry 4.0 in construction companies through the digitalization of the manufacturing methods. Those improvements include substantial difficulties at the company and the governmental level [15]. Problems which must be recognized involve; Security and confidence required for demanding machine-to-machine interaction (M2M), IT safety issues, short and permanent latency, Require to sustain the reliability of product methods, to evade all IT snags, Absence of fit jobs-sets of facilitating the movement to the 4th industrial revolution, Menace of the excess of the corporate IT division, Loss of many jobs to electronic means and IT-controlled methods, particularly for below-educated members of the community. Conceivably the most challenging phase of achieving Industry 4.0 in construction companies is IT safety hazard. Industry 4.0 requests online or internet combination between different items, and that online combination can provide an opportunity to protect data losses and crimes.

The construction industry challenges several restrictions more than the industrialized subdivision to improve their yield. For instance, enormous numbers of unified methods, competing participants at various steps, sub-processes and across multiple building areas make the construction companies complex [16]. That complexity drives to high stages of risk in the construction companies. Construction developments commonly are exclusive, exceptional demand levels of customization time-limited and the part is offered on the site, a situation which is deeply affected through climate circumstances. Furthermore, in line for the transient nature of construction plans, materials, uniform terms for the programs, complete, workers and crews are missing. Additional difficulty particular to the construction companies is its disjointed supply chain that comprises of various small-sized and medium-sized enterprises (SMEs) that demand comprehensive effort to regulate. Furthermore, SME typically has restricted abilities to advance in advanced equipment [17]. To conquer these obstacles, there are four answers to the digital transformation, which regarded as crucial: automation, digital data, digital access, connectivity. Some researches reveal that decision-making efforts in the construction companies concerning the digital revolution are undeveloped. Nowadays, Building Information Modeling (BIM) regarded to be the original equipment for the digitization of the construction building environs. Further related technologies and ideas are well-known industrial ideas that are static undeveloped construction industry. These cover Product-Lifecycle-Management (PLM); Robotics and Modularization; Communication Technologies and Information Technologies, such as Mobile Computing and Radio-Frequency Identification (RFID), which is one of the fundamental technologies for Cyber-Physical Systems; and so-called based technologies like

the Internet of Services, Internet of Things, Big Data, Cloud Computing, 3D-Printing, Smart Factory, Embedded Systems or Cyber-Physical Systems. Virtual Reality, Augmented Reality and the Human-Computer-Interaction also are recognized as central elements of Industry 4.0 which allow digitized construction surroundings [17].

Cyber-crime can be another dangerous threat or fulmination. In that situation, the obstacle is not personal, and that can cost companies extensively and can still damage their reputation. Hence, safety is a vital concern, which needs to be dealt with thoughtfully. The conversion to Industry 4.0 will demand huge expenses in modern technology, and choice for such changes need to consider at the top level of management in the industry. Nevertheless, before the consideration, the hazards need to be determined and manage seriously [15].

Oesterreich & Teuteberg (2016) point to the advantages the construction industry can deliver by adopting Industry 4.0. Lowered employment costs can be accomplished by the application of automated workflows and robotics, computerized tracking of supplies and devices (by utilizing fixed sensors like RFID) can minimize material losses, time economies can be accomplished by ideas like Additive Manufacturing and Prefabrication rather than modern system technology. Thorough usage of BIM can promote building quality by facilitating the convenient identification of likely obstacles through exceptional detail and information in the design period. BIM-based programs and Cloud or social media applications can efficiently promote collaboration within organizations and support to keep projects under budget and to overcome project delivery time [17]. Therefore, it is still early to think about works problems by the approach of Industry 4.0; surely, workers will need to obtain an all-new collection of skills or different services. That can boost employment rates growth, but it can also separate a large division of workers. Novel and quite diverse educational methods need to be introduced, still does not clarify the obstacle for older employees (Sung, 2018; Ellingsen & Einar, 2019). This problem might demand a long period to resolve. Privacy is not the only client's interest but also the manufacturers. In such an interconnected Industry 4.0 network, companies require to receive and examine a large size of data. To the clients, this might seem like a threat to their privacy.

V. SUSTAINABILITY OF INDUSTRY 4.0

Industry 4.0 is a fabulous chance for achieving sustainable industrialization content production on the three sustainability stages: environmental, economic and social [19]. The opportunities for developing methods and material using while the Malaysian construction industry employing Industry 4.0 ideas are smart. Material prices can decrease by more limited faulty goods and techniques can be optimized (into yield or speed) by adopting cyber-physical methods, which can enable process measurement in live-time. Through utilizing those technologies, it can be likely to respond immediately and automatically to issues in the real world. According to Nongendzi, (2019) which stated that, to updating production methods, including optimizing substance consumption, can stimulate profit up and allow productivity to improve.

It is potential to decrease machine changeover periods or downtime through the early discovery of likely failures and constant maintenance with constant remote monitoring of device statuses. Hence, avoiding and repairing errors quick can preserve costs and make product throughput, so driving value and securing a competing edge [1]. The adoption of Industry 4.0 technologies in the construction industry, consequently, allows the employment period to be increased and promotes the benefit of construction and manufacturing tools in a modern method by the ecosystem policies. That can, hence, provide substantially to the environmental and economic perspectives of sustainability that signifies the intellectual assets previously existing clarifications to several resource difficulties. In the 4th industrial metamorphosis, people still arrange the production of benefit.

Nevertheless, the techniques demands are growing, and many competencies are essential. Regular tasks can disappear, the new roles can develop more complicated, and new industrial sectors will rise within the dispatch of digitalization. To meet the communicative problem of Industry 4.0; it is attainable to increase the practice performance of employees by connecting new knowledge and information technologies in a sustainable form.

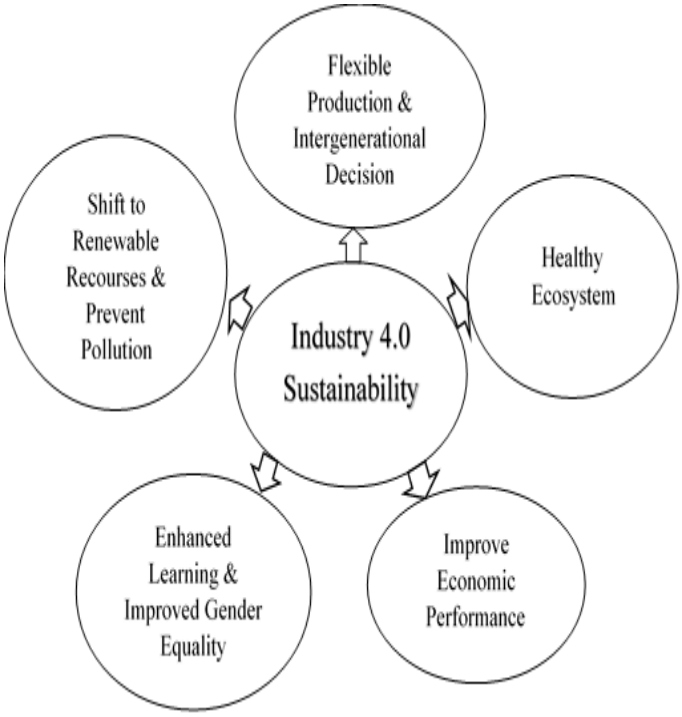

Fig. 7. Sustainability of Industry 4.0

Through adopting industry 4.0 technologies in the Malaysian construction industry, excess inventory operators can approach obstacles such as unpredictable market plan and excess stock. That is achievable, e.g., Optimization of the supply chain in real-time. Technologies such as systems that automatically reconfigure themselves if needed can decrease inventory charges. Innovative business models can appear in Industry 4.0. These models lead companies or service providers closer collectively with clients [1].

There are models in which goods or services are solely hired or rented preferably than obtained. As a result, after-sales and service are growing more powerful in these models. On the other hand, it can be more comfortable for the supplier to exchange goods after their use because the supplier can track products and pieces during the whole PLC. Goods can, hence, be reproduced or reused maintained in circular economics.

VI. Research Methodology

Research can be broadly classified in terms of their purpose; case study analysis, exploratory, hypothesizes testing, and descriptive analysis. However, the nature of research is mainly depended upon the level of advancement in understanding. This study proposed and verified the conceptual principle that was being developed with expert and literature support. Descriptive research is assumed in a situation to explain the features of the parameters of interest. This study reveals what modifications that help achieve a sustainable of industry 4.0, efficient and recognizing potential developments, understanding hazards connected with economics and supporting the simulation improvement. To accomplish the aims of this study, a systematic review was conducted to present proof for the synthesis. The overall systematic review method recommended by Lu & Liu (2014), is previously operationalised. At the commencement of the systematic review, the study issues need to be discussed unambiguously and stipulated system in step 1, the framing of the problem or problems for a review [21]. Research keywords are needed to be established to fit the demands of the research. To ensure the research area of the review, many patterns of research keywords are desirable. In step 2, the adoption of data sources, extensive and comprehensive search from the appropriate journals and database is needed.

Hence, to obtain various related references, journals, the proper field of research requires to be recognised and chosen. Furthermore, in step 3, the review of previous research involves the usage of research keywords in a particular area of titles, abstract and keywords. These research keywords are embedded and inserted in the known and then picked from the publication or journals databases. The research requires to be accurate, without any language limitations, and subject to move from the study questions as preference. Ke, Wang, Chan, & Cheung, (2009); Lu & Liu, (2014) recommended that in that stage, limited parameter research should be applied to guarantee compatibility.

Further, step 4 includes evaluating the nature of research to assure scholarly precision. That means that the paper gained for review and synthesise should be constrained to a collection of qualities for fitting evaluation. The conditions of these articles from the preceding search demand to be cleaned. Naturally, the preceding search conducted in step 3 would produce a wide spectrum of issues and mainstreams of articles. Therefore, visible review of the article content is necessary. Besides, step 5 includes compiling the proof. Here a comprehensive report will be accompanied to interpret and integrate the outstanding refined articles, concentrating on the papers that are only associated with the topics of attention. That requests for removal of materials which followed with research field and background or framework [20]. Usually, the data are reviewed and synthesised in the kind of a present by research features, nature and conclusions of the research.

VII. Result

This paper aimed to identify and detail how Industry 4.0 can be utilized to create sustainable and to be effective in the Malaysian construction industry. The vision was able to deliver a description of Industry 4.0's potential positive and negative impact on the construction industry through the scenarios. The new demands on the employees, the workplace and the organization for new knowledge and technology also needed describing. From the Malaysian construction industry point of view, qualification is a key challenge for industry 4.0 and requires decisive action. The challenge of skills in the construction sector is growing as the industry becomes more digital. The plans of the construction industry to drive productivity improvements and capitalize on the 4th industrial revolution could be eroded because the education system is struggling to provide the right quantity and quality of skills to meet the needs of the sector.

These help with more clearly illustrating the potential benefits that Industry 4.0 may bring, depending on its implementation. The Malaysian construction industry finds its competitive global niche. And even with breakthroughs in robotics and artificial intelligence, there is a major disruption in employment throughout the world. The Malaysian construction industry has succeeded in creating a small but intelligent base for youth who can recognize and exploit opportunities in the global market. Industry 4.0 has a high potential to ensure more sustainable production methods. New technologies can be used to trace materials through the value chain and to track the status of the product during its life cycle. Companies are beginning to capitalize on the potential of emerging technologies to more sustainably reorganize production, services, business models or entire organizations. What is certain is that many expect that the fourth industrial revolution will have a substantial effect on jobs worldwide as advanced robotics, artificial intelligence, construction industry and automation are becoming more influential. Digitalization has a full impact on the automotive industry, construction industry and society.

A. Research Implication

The powerful transformations that sustain the industry on a global scale and local scale, advance essential thought and idea sharply required to generate maximum socio-economic influence and to secure sustained improvement. The productions have various aspects of being examined; it needs a well-organized and all-inclusive penetration into the dynamics that influence increase and profitability. A well-informed structured approach to the future is necessary. The visible environment grows quickly in a changeable way; this is a resultant of the technology revolution. The possibilities given by producing digitalization are therefore crucial. Several construction companies in Malaysia already adopt digitalization by adopting more affordable technologies, such as sensors, to combine their companies and draw on the data they provide so that methods and products

developed.

Digitalization can help companies to reduce costs, to save time, and respond efficiently to customer request as part of the discovery practice and constant development in the manufacturing industries. Digitalization becomes a continuing and unique impact on the performance of manufacturers. It influences all the phases of improvement of manufacturing, logistics, and challenges business models, changes the way we work, and changes the place of work.

For this reason, a well- developed infrastructure and skilled workforce are key factors in transforming the construction industry successfully. Qualification is a crucial challenge for industry 4.0 in the construction industry in Malaysia and requires decisive action. The problem of skills in the construction sector is growing as the industry becomes digital. The plans of the construction industry to drive productivity improvements and capitalize on the fourth industrial revolution could erode because the education system is struggling to provide the right quantity and quality of skills to meet the needs of the sector. The construction industry will need to keep investing in training current employees to keep up with new processes in line with company needs. One major challenge is to increase the digital skills of current and, in particular, older workers, by creating an offer of digital training.

VIII. CONCLUSION

To persist competing globally. The chances given through construction industry digitalization are essential. Embracing technology will increase the competitiveness of the country as a hole. Technology reduces barriers for entry into new markets. New business models as a result of technology emerge. The country needs to take advantage of the 4th industrial revolution. The fourth industrial revolution is the next level of autonomous systems whereby digitization of the entire value chain in the production environment is realized. In areas where the is no existing broadband infrastructure the government must put equipment that support the fourth industrial revolution, in areas with existing infrastructures, upgrades must be done. The fourth industrial revolution will eliminate cross border barriers, this will allow information to be more available and encourage international trade which in turn open new market for firms. Digitalization can assist the construction industry in Malaysia in reducing costs, saving time and responding more efficiently to consumer request as part of the innovation practice and continuous development in the society. Digital infrastructure requires to be developed, the professions gap needs to be approached, and simple cybersecurity procedures require to established, and financing in digitalization necessitates to be promoted. Those are some of the difficulties that this industry and government need to overcome if the 4th industrial revolution is to be achieved. To be victorious, the government, the construction industry and stakeholders need to cooperate. That means realizing digitalization to the forefront of the 4th industry revolution policy of the government and operating in partnership to assure that we understand the possibilities and opportunities offered by this technological revolution.

REFERENCES

1. S. Nongendzi, Future scenarios in the automotive industry as a result of the social impact of industry 4.0 in the period up to 2033, no. January. 2019.
2. J. Edlund, The future of maintenance work at a Swedish steel producer. 2019.
3. E. Sundström, Control 4.0. 2019.
4. O. Ellingsen and K. Einar, "Journal of Engineering and Digitalizing the maritime industry : A case study of technology acquisition and enabling advanced manufacturing technology," J. Eng. Technol. Manag., vol. 54, no. August 2017, pp. 12–27, 2019.
5. J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A vision, architectural elements, and future directions," Futur. Gener. Comput. Syst., vol. 29, no. 7, pp. 1645–1660, 2013.
6. L. Atzori, A. Iera, and G. Morabito, "The Internet of Things : A survey," Comput. Networks, vol. 54, no. 15, pp. 2787–2805, 2010.
7. M. G. Núbia Carvalho, Omar Chaima, Edson Cazarinia, "Manufacturing in the fourth industrial revolution : A positive Costing models for capacity optimization in Industry 4. 0 : Trade-off between used capacity and operational efficiency," Procedia Manuf., vol. 21, pp. 671–678, 2018.
8. M. Brettel, N. Friederichsen, and M. Keller, "How Virtualization, Decentralization and Network Building Change the Manufacturing Landscape : An Industry 4.0 Perspective," 2014.
9. F. Lundmark, Arbete och organisation i framtidens digitaliserade industri. 2019.
10. S. Bahrami, B. Atkin, and A. Landin, "Journal of Engineering and Innovation diffusion through standardization : A study of building ventilation products," J. Eng. Technol. Manag., vol. 54, no. October, pp. 56–66, 2019.
11. D. Romero, P. Bernus, O. Noran, and J. Stahre, "The Operator 4.0 : Human Cyber-Physical Systems & Adaptive Automation Towards Human-Automation Symbiosis Work Systems," Springer Int. Publ., vol. 2, pp. 677–686, 2016.
12. A. Oussous, F. Benjelloun, A. Ait, and S. Belfkih, "Big Data technologies : A survey," J. King Saud Univ. - Comput. Inf. Sci., vol. 30, no. 4, pp. 431–448, 2018.
13. M. Chen, S. Mao, and Y. Liu, "Big Data : A Survey," Springer Sci. Media New York, no. January, pp. 171–209, 2014.
14. S. Wang, J. Wan, D. Li, and C. Zhang, "Implementing Smart Factory of Industrie 4.0 : An Outlook," vol. 2016, 2016.
15. T. K. Sung, "Technological Forecasting & Social Change Industry 4.0 : A Korea perspective," Technol. Forecast. Soc. Chang., vol. 132, no. November 2017, pp. 40–45, 2018.
16. A. Dubois, L. Gadde, A. Dubois, and L. Gadde, "The construction industry as a loosely coupled system : implications for productivity and innovation The construction industry as a loosely coupled system : implications for productivity and innovation," vol. 6193, 2010.
17. P. Dallasega, E. Rauch, and C. Linder, "Industry 4. 0 as an enabler of proximity for construction supply chains : A systematic literature review," Comput. Ind., vol. 99, no. April, pp. 205–225, 2018.
18. T. D. Oesterreich and F. Teuteberg, "Computers in Industry Understanding the implications of digitisation and automation in the context of Industry 4.0 : A triangulation approach and elements of a research agenda for the construction industry," Comput. Ind., vol. 83, pp. 121–139, 2016.
19. T. Stock and G. Seliger, "Opportunities of Sustainable Manufacturing in Industry 4.0," Procedia CIRP, vol. 40, no. Icc, pp. 536–541, 2016.
20. W. Lu and J. Liu, "Research into the moderating effects of progress and quality performance in project dispute negotiation," Int. J. Proj. Manag., vol. 32, no. 4, pp. 654–662, 2014.
21. K. S. Khan, R. Kunz, J. Kleijnen, and G. Antes, "Five steps to conducting a systematic review," J. T H E R OYAL Soc. O F M EDICINE, vol. 96, pp. 118–121, 2003.
22. Y. Ke, S. Wang, A. P. C. Chan, and E. Cheung, "Research Trend of Public-Private Partnership in Construction Journals," J. Constr. Eng. Manag., vol. 135, pp. 1076–1086, 2009.

AUTHORS PROFILE

Taofeeq D Moshood is currently a PhD fellow at the Faculty of Industrial Management, Universiti Malaysia Pahang, Malaysia. He badged his Master degree in Construction and project management from Universiti Malaysia Pahang in 2019. During his master degree, he served as a research assistant in one national project at Universiti Malaysia Pahang under the supervision of Dr A Q Adeleke in 2018. He also served as a technical committee member at the first international conference on business intelligence, industrial engineering and management (ICBIIEM 2018) at Universiti Malaysia Pahang in 2018. During his degree, he was elected as a president of the national association of Elect/Elect engineering student at Ospoly Nigeria. His current research focused on the influence of organizational factors on contractor's risk attitudes in Malaysian oil and gas construction projects: the moderating role of government policy. His research interests include Risk Management in Construction Project, Issues in Construction Industry, Organizational Control, Industry 4.0 related issues and Sustainability in Construction Project. He has published in many international journals such as Safety Science, Journal of Engineering, Design and Technology, Construction Economics and Building, International Journal of Construction Management, Journal of Construction Business and Management and so on. Currently working on one national grant at Universiti Malaysia Pahang.

Dr. A.Q. Adeleke is a senior lecturer of Project Management at the Faculty of Industrial Management, Universiti Malaysia Pahang since 2017. He was conferred a Ph.D. degree from Universiti Utara Malaysia, Malaysia in 2016. He badged his BSc. in Business Information System with First Class Honors from the University of East London in 2014. Presently, Adeleke is a professional member of the Malaysian Institute of Management (M.I.M) and Association of Construction Project Managers (ACPM), Malaysia. His primary research activities involve the area of Project Management (e.g., Risk Management in Construction Project, Issues in Construction Industry, Organizational Control, Sustainability in Construction Project, Waste Management in Construction Project, Quantitative and Qualitative research experts). He has authored books and published more than 50 publications in top-rated journals. Presently, he is a leader of local and international grants monitored by Universiti Malaysia Pahang. Adeleke is currently the coordinator for Research, Postgraduate and Publication, and leader of Risk Management expert representing the Faculty of Industrial Management from the university level. He also serves as a research and development officer (RDO) for Transinex Singapore and rendered several consultation services for companies.

Dr. Gusman Nawanir is a senior lecturer and head of operations and supply chain management research cluster at the Faculty of Industrial Management, Universiti Malaysia Pahang, Malaysia. He earned his bachelor in industrial engineering from Universitas Andalas, Indonesia; MSc and PhD in Operations Management from Universiti Utara Malaysia. He taught courses in quality management, stakeholder management, operations management, lean management, research methodology, and procurement management. His main research interests include lean operations, business sustainability, manufacturing flexibility, production management, performance management, and Industry 4.0-related issues. As a scholar, Dr. Gusman is actively having papers published in reputable journals and conferences. His publications appear in Journal of Manufacturing Technology Management, International Journal of Lean Six Sigma, Global Business Review, Benchmarking: International Journal, International Journal of Service and Operations Management, International Journal of Supply Chain Management, Journal of Recent Technology and Engineering, International Journal of Knowledge and Learning, International Journal of Engineering and Technology, Journal of Technology and Operations Management and many more. Some of his papers secured best paper awards in international conferences.

W.A. Ajibike is a Ph.D. candidate in project management at the Faculty of Industrial Management, Universiti Malaysia Pahang, Malaysia. He holds MSc in Sustainable Development Practice from the University of Ibadan, Nigeria with much focus on economic sustainability. His main research interest centers on environmental sustainability and how it can be integrated into the construction projects. His current research focuses on factors that can improve the environmental sustainability performance of construction projects being executed by the G7 contractors in Malaysia. Before his postgraduate programmes, he had over 8 years of experience in IT firms with a keen interest in renewable energy (Inverters and Solar PV technology). He also had a short stint with International Fund for Agricultural Development (IFAD) where he was attached with Marketing Infrastructure, Value Addition and Rural Finance Support Programme (MIVARF) under the Office of Prime Minister of Tanzania, as a researcher saddled with the responsibility of researching rural finance and how it affects productivity and welfare of smallholder farmers in Iringa Region of Tanzania. When not obsessing over sustainable development research, Waliu loves watching football especially matches been played by Manchester United.

Rukayat A Shittu is currently pursuing her Master degree in Faculty of Applied Social Science, Universiti Sultan Zainal Abidin. She obtained her B.sc in Business Education from Kwara State University Malete, Nigeria in 2015. Her current research is focused on the cross-cultural impacts, communication in corporate social responsibility, government-linked companies and information communication technology (ICT).