

Utilisation of Robotic Systems in Automating Manufacturing Applications While Reducing the Amount of Labour and Production Costs and Time Associated With the Process

Jaya Rubi ^{1*}, Mohammad Musthak Ahammad ²

¹ Vels Institute of Science Technology and Advanced Studies, India.

² Associate Professor in Mechanical Engineering Department, Deccan College of Engineering and Technology, India.

*Corresponding Author Email: ¹ jayarubiap@gmail.com

Abstract

This article is based on the robotic system in automating manufacturing applications and industry. Robotics is the assembles of various kinds of technology, devices, and others kinds of mechanisms. Cameras, sensors, artificial voice, microphones, and motors are the fundamental requirement that needs scientists to build a robot. Automating manufacturing applications helps to boost productivity and also creates a modern industrial aspect. Robotics provides opportunities to build an updated working place. It can able to reduce production costs and also provides technical knowledge to the laborers. Additionally automating the manufacturing process can detect system-related issues and suggest ways for reducing the issues. Robotics is one of the innovations that help to reduce the pressure of labour. This study has shed light on the purpose of robotic systems in automation manufacturing and known their impact on the manufacturing process. Accordingly, this article also talked about the types of robotic systems that are necessary for the manufacturing industry. In addition, this paper tries to analyze the collected data and also shines a light on the future application of robotics and its outcomes in the manufacturing industry. This paper has preferred the secondary qualitative process for the doing entire research work and it can be said that this is one of the smooth ways to get outstanding outcomes from this particular subject matter. Apart from this, robotics in automating applications is one of the curious subjects that help to gain more intellectual information to increase experiences for the future.

Keywords

Articulated robots, automation process, cost, cyber security, Delta robot, labour, manufacturing industry, robotic process automation (RPA), robotic system, time.

INTRODUCTION

Robotics is one of the popular branches of engineering that includes design, conception, robot operations, and manufacturing. The aim and objectives of robotics are to create intellectual machines that help humans in various ways. Robotic technologies cover all kinds of complementary technologies such as force sensing, machine vision, advanced mechanics, and speech recognition. The purpose of robotics is to perform the essential task better than humans and provide zero error outcomes. In this context, automation makes a huge impact on the manufacturing industry. It is able to increase the capacity of production, and decrease the cost of the product also. The automated manufacturing process generally uses by-product management software, robotic tools, and advanced devices that assist businesses with various kinds of tasks such as inspection, processing, assembly, production management, and inventory management. There are several kinds of automation systems such as programmable automation, flexible automation, fixed automation, and integrated automation. This study will highlight the purpose of robotics technologies in the automating industry and also will discuss their effectiveness in the manufacturing industry. On the other hand, this paper will explain the various kinds of

robotic system that helps the fabricating industry. Those help to determine the cost and also are able to mitigate the labor pressure also. This study will elaborate on the significant factors of using robotics such as data security and speed developments, growing customer support, labor reduction, and others. Accordingly, this paper tries to analyze the future perspective of the robotic system and also tries to predict the future aspect of implementing robotic systems in the automated manufacturing industry. It can be said that the implementation of robotic functions in the industry can able to improve the working environment and develop the work culture. It provides knowledge of technologies and educates the labours for their betterment. These technologies can also make an impact on the nation's economic sector that can create a position in the world economic platform.

LITERATURE REVIEW

Purpose of robotic technologies in automating the manufacturing applications and industry

Different automation in the supply chain process, providing data entry operations and providing the proper after-sales services for the organizations. The development of speed in the manufacturing process is the main purpose of industrial robots that are helping to provide growth for companies. Robotic technologies are helping to ensure better

growth for manufacturing industries and ensure competitive advantages for companies.

Speed and data security development: The overall speed of the manufacturing process is increased with the help of robotic technologies that are able to produce working 24/7 and do not allow any breaks in the work. These facilities are helping to provide continuous growth in the industry to bring maximum output by reducing the cycle timing. The improvement of data security for businesses is increased with robotic process automation (RPA) in the manufacturing sectors. Enhancement of opportunities with the help of the efficiency of robotic technologies is developing the manufacturing sectors at their highest levels[1].



Figure 1: Increasing speed in the manufacturing industries (Source:)

Enhanced consumer service: A better experience in consumer services is gained with robotics helping to ensure the visible differences in the companies by achieving goodwill that is beneficial for aiming towards development in the companies. Consumer services are helping to ensure value in the industries that are aiming towards betterment in the production industries. Consumer satisfaction by providing consumer services is beneficial for the expansion of the market and creating opportunities to generate revenue for the companies.

Working in difficult situations: Prevention of accidents, and saving money and time are the important purposes of robotics that are aiming towards developing the capabilities of working. The errors in the manufacturing process are reduced by using robotic technologies and providing high-quality results. Increasing satisfaction of consumers is developed with robotic technologies in the manufacturing industries [2]. The elimination of dangerous situations for humans is provided with different robotic technologies that are helping to maintain production in different hazardous situations for humans. Handling different hazardous chemicals and radioactive materials that are used with automatic robotic systems is helping to improve the safety conditions of humans. The companies that are able to control losses developed with robotic systems are promoting growth in the industries. These safety elements are added with the help of automating processes in the manufacturing industries

reducing the chance of accidents in the companies. This is helping to provide a better atmosphere for the workers to work more effectively and productively.

Reduction of fatigue: Fatigue is reducing the work growth of humans and it is also decreasing the quality of work. Fatigue is also an important issue that is decreasing the growth of manufacturing industries with the help of robotic technologies. These issues are eliminated with early detection and ensure the repetition of production in the manufacturing industries. Efficient production can be developed with the help of robotics in the manufacturing industries [3]. The quality of the products or services can remain the same with the help of automation processes in manufacturing industries. Manufacturing efficiencies developed with automation processes are helping to bring a visible difference in industries.

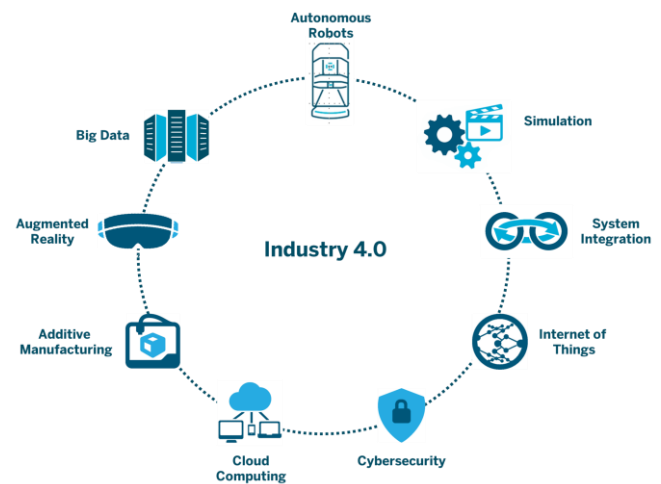


Figure 2: Automatic robotic system (Source: 3)

Reduction of labour in the manufacturing industries:

The difficulties of work for humans that cannot be handled without any injuries and also different tasks that are beyond the limits of humans are developed with the help of automation robotics technologies in the manufacturing industries. The importance of accuracy is developed with automation technologies that are able to ensure growth in manufacturing industries. The reduction of labour costs can be ensured with the automation processes in the manufacturing sector as the reduction of employee hours can be developed with modern-day manufacturing development. The reduction of labour costs is helping to increase the profitability of manufacturing units [4]. Modern-day manufacturing is promoting automation for the revenue generation process. It is also helping to develop flexibility and responsiveness in industries with robotic automation processes. The increase in employee satisfaction and engagement can be developed with robotic automation processes in manufacturing sectors. Conflicts in the workplace can be reduced with the help of automation processes in the manufacturing industries. It is also beneficial for the reduction of staff turnover in industries.

Reduction of production cost in the manufacturing industries: Reduction of operation cost can be seen with the help of automation in the manufacturing industries. Robotic technologies are used to develop an automation process that is effective to ensure empowerment in the business which is important for gaining visible growth in the manufacturing process. Increasing the reliability of production is aimed towards a money-saving way by promoting robotic technologies in the automation process in manufacturing industries. These industries are helping to reduce the workload of tasks that are easily prone to error [5]. The production cost of the companies can be reduced with the help of lean production methods that are providing efficiency in the workers and increasing production due to these costs per unit of the products being reduced.



Figure 3: Automation process in the manufacturing industries
(Source: 5)

Different new capabilities are developed by automation robotics helping to increase the manufacturing process of manufacturing industries. Developing craftsmanship in the manufacturing industries is helping to ensure better quality for the products that are aiming towards better growth in the industries. The high-volume production activities can be achieved with automatic robotics that is aimed towards better growth in the production industries. Cyber security is gained by manufacturing industries with the help of robotics systems that are bringing ease in the industries by protecting the secrets of the industries and delivering a better pathway towards competitive advantage [6]. Working alongside humans robotic systems are helping to fulfill the demand of the market and provide the rebalancing of production lines when demands are fluctuating. Companies decided the right automation process for them as per the need for automation processes. The fully automatic and semi-automatic processes developed by manufacturing industries are helping to increase production in the industries. The decision of successful automotive strategies for companies shows a return on investment by understanding the process of organizations and manufacturing systems. The link of improvement with the company's overall strategies is aiming

towards better growth for the automation process of the manufacturing industries. Business challenges are solved with the help of different automation processes which are aiming to increase the productivity and efficiency of the industry. Automation processes in industries are going to replace jobs that are required little skills and are highly repetitive, this is creating a negative effect in the automation industries. Robotics are developed continuously in our lives and changing the growth in industries. The automation process is making our life easier and providing better knowledge to grow in the competitive marketing world. Robotics are increasing in every sector and changing our lifestyle by providing a visible change by doing different innovations. Innovations on the daily basis are improving growth in life and changing every sector.

Types of robotic systems in the manufacturing industry

As mentioned previously, it has been seen that robotic system plays a significant role in the manufacturing industry. Evaluation of robotics changes the whole face of the manufacturing industry. This is the combination of engineering and knowledge of computer science to bring the advancement of the efforts of the human. In this context, some robots and robot technologies are essential to all kinds of the manufacturing industry which are explained below.

Articulated robots



Figure 4: Articulated robots
(Source: 7)

This type of robot is generally able to make up the soft elements and it has some muscular parts and some skeletal systems of mammals. These robots generally represent the joints, actuators, and transmissions that help to support the motions of the robots. Those kinds of systems are able to mimic natural and adaptive behaviors [7]. Articulated robots can able to handle the material, sealing, assembling, picking, spraying, and also performing other activities.

Cartesian Robots

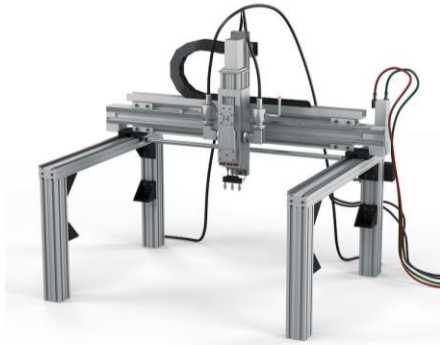


Figure 5: Cartesian Robots
(Source : 7)

This type of robot is one kind of linear robot and it plays a major role in 3D printing. Accordingly, these machines are more useful for numerical controlling [7]. It can able to create leveraging, drawing, and also able to show the X-Y axis.

SCARA



Figure 6: SCARA
(Source:8)

SCARCA has liner movement and it allows its arms to retract and extend due to one kind of orthogonal joint. It provides accuracy and also gives consistency quality [8]. On the other hand, this kinds of process enable a flexible and modularised line of production with high consistent quality.

Parallel Manipulators



Figure 7: Parallel Manipulators
(Source:9)

In the manufacturing industry parallel robots helps to produce biomaterial and it is also considered electrospinning tool or extrusion tool [9]. It is one kind of kinematic chain mechanism. It has an effective link with the different kinds of kinematic chains.

Delta robot



Figure 8: Delta robot
(Source: 10)

These robots are also known as spider robots and these robots are generally used to pick and place products [10]. This is very light in weight and performs the task easily with very fast movement. It has crucial connections with the parallel manipulator.

In current times robotics plays a highly major role in the manufacturing industry and it is also able to grab the attention of people. These kinds of robots are able to improve the manufacturing process and also able to do all the things of fabricating. It assists humans and reduces the workload which increases the retention rate of the employees and also attracts customers.

The Future of robotic systems in automating the manufacturing industry

The possibilities in manufacturing industries are developing in an endless process which is beneficial for improving the growth of the companies in the competitive business market. The different adaptations of decision-making are developed by robotic systems in responding to real-time operating conditions and situations. Robotics are using different other industries than manufacturing that are helping to provide better growth for humans. The pharmaceutical industry and industries related to treatment are completely changed with the help of different robotics development. Robotics is changing different elements in manufacturing industries as new innovations are developing on daily basis[11]. These enhancements in the robotic industries are changing the lives of humans and making them easier choices for them which is promoting better growth for the industry. The efficiency is increased which is helping to produce an accuracy that is beneficial for saving time and resources. Robotics in the future are

becoming easier to install, simple to use, and helping to provide a huge difference in the labour cost in the industries that are improving the production cost in industrial development [12]. Different countries are increasing the production of robot manufacturing which is beneficial for providing better growth in the market as per the data in the year 2020. The data also says that South Korea is a country that is using robotic systems in the manufacturing process for increasing production. The multitasking ability developed with the automatic manufacturing industries is improving production and ensuring growth in the industries which are essential for companies to ensure a cost-effective way to grow [13]. Modern industrial Internet of Things (IIoT) technologies, machine learning (ML), AI, different edge and cloud software, and low-code platforms are enabling this type of advanced automation process for the companies to grow in the industries and putting companies on the path to benefitting from artificial intelligence of things (AIoT) implementations are the future of the automation industries.

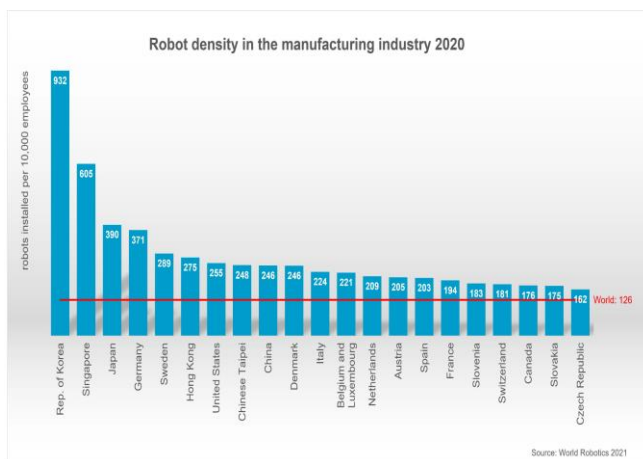


Figure 4: Robotic manufacturing development in the industries in the world (Source: 14)

Due to the increase of robotic systems in the manufacturing industry, the rate of unemployment increases. In the world, which is an alarming situation for humanity. People are losing jobs due to different advancements in the robotic industries and artificial intelligence [14]. This is a dangerous situation for the economic development of the countries. Different researchers said that children are losing their natural ability of thinking by using robotic systems and artificial intelligence (AI).

METHODOLOGY

The methodology is one of the essential sections of the study and it has been divided into several stimuli that are also important for the research work. The research approach, research philosophy, research design, data assembling, and data examination are the most vital parts of the research study. This article has applied the positivism philosophy that helps to achieve the research aim and objective of the work. On the other hand, this research has used the benefit of

inductive approaches that helps to make an impact on the research process. It helps to provide the study with a specific and authentic conclusion [15]. Generally, researchers used the deductive approach to examine the hypothesis and this study does not require any kind of hypothesis, for this reason, this paper has selected the inductive approach. To assemble and examine the data, a secondary qualitative method is more appropriate for the study. There are several kinds of research design methods presented under the secondary qualitative process. Particularly this paper used data from different kinds of sources and it is only possible in the case study design model [16]. This method allows gathering information from electronic articles, journals, periodicals, books, editions, and other sources that is always accessible in google scholar and search engine. Additionally, these data are based on the genuine case and this information helps to provide an extraordinary experience for the study. Those above factors help to reduce the cost and also reduce the time of data collection that make a positive impact on the entire research work. This research process does not mandate high skills of technical knowledge and high effort to the study. In other words, this formula of research is not complicated and always keeps going ethically.

Robotic systems in the automated manufacturing industry are one of the effective ideas that play a major role in the modern world [17]. All over the world, there are various kinds of manufacturing industries and it is not possible to visit all over the world to collect information. The secondary qualitative process gives golden opportunities to gain knowledge from world-based data [18]. It may also help in future work and also raise the value of the work. There are various kinds of robotic systems that are used in the manufacturing industry. Each robotic system has a particular role in the manufacturing process. From several studies, it has been seen that all the robots use various kinds of technologies and mechanisms that make a smooth way of fabricating. This paper uses other essential information for the study that can help organizations with their further robotic implementation and modernization of fabricating processes.

DISCUSSION

From this study, it can be observed that robotic systems in automation have changed the entire system of manufacturing. Each system has a different and essential role in the manufacturing process. It makes an impact on the supply chain management system, and data operation and also provides a sale service related facilities. On the other hand, the automation and robotics process is fast and provides the accurate and desired outcome for the business [19]. Robotics technologies are able to bring the maximum output by decreasing the timing. It can be said that the automation process can give high production capacity to the industry. According, it can able to control the entire manufacturing process and procedures that are not required a high labour base. Robotic technology also provides high security on data that is not possible for a human to take care of it. Robotic

process automation gives benefits to the manufacturing industry. From this study, it has been found that robotic systems in the automated manufacturing application and industry enhanced customer service that increase the customer retention rate. These process also helps the organizations to provide the security of the data of customers and always be available to provide the services to the customers.

The cost-saving way of development can be achieved by the companies by introducing robotics in manufacturing processes [20]. With the help of automation, the shortage of skilled labour issues can be solved easily which is helping to develop an improvement in production. The use of robotics is helping to secure the reduction of labour costs and different increasing labour rates which are manipulating the product pricing in the market. Real-time interactions with humans are able to ensure decision-making and product development in the industries which are effective for providing better growth in industrial development. Real-time interactions with workers, machinery, and objects are helping to ensure productivity in the industries which is providing a visible change in the industries. Different human errors are easily mitigated with the help of different automatic processes in production which are essential for bringing change in productivity. Reliability and productivity process are increased with the help of different automation process which is progressing in the manufacturing industries [21]. Different dangerous jobs for humans are reduced with the help of automation processes which are creating a better way of development for ensuring a better way of productivity in the manufacturing industries. The return on investment of the companies is increased with the help of automation processes in the industries that are increasing productivity and growth. Purchase order creation can be done by robots with the help of accurate and speedy results that are improving the growth of industries and provide accurate, speedy results by dividing products into multiple order categories. The real-time monitoring of inventories can be developed with robotic systems and providing minimal human intervention is important for aiming toward better growth in the supply chain and improving the condition of production. Different communications with vendors are also developed with the automation process increasing the efficiency and growth in the industries. The requirements of human efforts are almost zero by adding the automation process in the manufacturing sectors. Price forecasting is also done with the help of AI which is helping to increase the productivity and assurance of revenue generation of companies. Robotics is developing the safety of the employees working in the industries is essential for progress in the competitive market [22]. Error in productivity is reduced with the help of The most common type of robots in the manufacturing industries are Cartesian Robots These are often used for different industrial functions, CNC machines, and 3D printing. By the year 2030, it is predicted that up to 20 million manufacturing jobs globally will be replaced by different artificial intelligence (AI),

machine learning, and robots in industries, service providers, and other sectors.

CONCLUSION

From the above-mentioned study, it can be concluded that robotics is one of the groups of technologies that can give positive and negative effects on the manufacturing industry. Particularly this study has discussed the utilization of robotics in the automating industry. It has been seen that all robotic systems change the entire concept of the manufacturing process. It is able to reduce time, mitigate production costs, and naturally reduce the cost of the product. Accordingly, it can able to provides the high-security whole manufacturing process and provides a solution in an emergency. Additionally, robotics has the capability to work with zero error and also can communicate with humans. In the manufacturing process, robotics helps the employees to get attached to the technologies and improves their job skills as well. This study has highlighted the actual purpose of the robotic system. From the above analysis, it can be stated that the advancement of technologies provides a wide range of opportunities to industries as well as it can be responsible to increase the unemployment rate. Automating manufacturing applications does not require much labour. Because those applications are responsible for joblessness. On the other hand, the automation process is able to produce a high amount of production, and the industry needs to set the sale process and planning before manufacturing the product. accordingly, these kinds of robotics technologies are more costly that are not possible to implement for small manufacturing companies. Apart from that, this study has also shed light on The Future of robotic systems in automating the manufacturing industry. All the information has been collected by the secondary qualitative process and this process assists to deliver authentic data for the study. This process provides some intellectual information that allows proceeding with the whole work with interest and enjoyment. finally, it can be stated that robotics systems make a renaissance in the manufacturing industry and industry authorities need to enhance their process of working that can increase employment and put a positive impact on the nation.

REFERENCES

- [1] Gharbia, M., Chang-Richards, A., Lu, Y., Zhong, R.Y. and Li, H., 2020. Robotic technologies for on-site building construction: A systematic review. *Journal of Building Engineering*, 32, p.101584.
- [2] Yang, L., Henthorne, T.L. and George, B., 2020. Artificial intelligence and robotics technology in the hospitality industry: Current applications and future trends. *Digital transformation in business and society*, pp.211-228.
- [3] Ashima, R., Haleem, A., Bahl, S., Javaid, M., Mahla, S.K. and Singh, S., 2021. Automation and manufacturing of smart materials in Additive Manufacturing technologies using Internet of Things towards the adoption of Industry 4.0. *Materials Today: Proceedings*, 45, pp.5081-5088.

- [4] Kurt, R., 2019. Industry 4.0 in terms of industrial relations and its impacts on labour life. *Procedia computer science*, 158, pp.590-601.
- [5] Javaid, M., Haleem, A., Singh, R.P. and Suman, R., 2021. Substantial capabilities of robotics in enhancing industry 4.0 implementation. *Cognitive Robotics*, 1, pp.58-75.
- [6] Nguyen, V.L., Lin, C.Y. and Kuo, C.H., 2020. Gravity compensation design of planar articulated robotic arms using the gear-spring modules. *Journal of Mechanisms and Robotics*, 12(3).
- [7] Lettori, J., Raffaelli, R., Bilancia, P., Peruzzini, M. and Pellicciari, M., 2022. A review of geometry representation and processing methods for cartesian and multiaxial robot-based additive manufacturing. *The International Journal of Advanced Manufacturing Technology*, pp.1-28.
- [8] Prakash, A., Rajendran, A., Pranav, V.K. and Sreedharan, P., 2021, April. Design, Analysis, Manufacturing and Testing of a SCARA Robot with Pneumatic Gripper for the Poultry Industry. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1132, No. 1, p. 012010). IOP Publishing.
- [9] Zhao, Q., Guo, J. and Hong, J., 2019. Closed-form error space calculation for parallel/hybrid manipulators considering joint clearance, input uncertainty, and manufacturing imperfection. *Mechanism and Machine Theory*, 142, p.103608.
- [10] Rodriguez, E., Riaño, C., Alvares, A. and Bonnard, R., 2019. Design and dimensional synthesis of a Linear Delta robot with single legs for additive manufacturing. *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, 41(11), pp.1-23.
- [11] Bader, F. and Rahimifard, S., 2018, September. Challenges for industrial robot applications in food manufacturing. In *Proceedings of the 2nd International Symposium on Computer Science and Intelligent Control* (pp. 1-8).
- [12] Bi, Z.M., Luo, C., Miao, Z., Zhang, B., Zhang, W.J. and Wang, L., 2021. Safety assurance mechanisms of collaborative robotic systems in manufacturing. *Robotics and Computer-Integrated Manufacturing*, 67, p.102022.
- [13] Delgado, J.M.D., Oyedele, L., Ajayi, A., Akanbi, L., Akinade, O., Bilal, M. and Owolabi, H., 2019. Robotics and automated systems in construction: Understanding industry-specific challenges for adoption. *Journal of Building Engineering*, 26, p.100868.
- [14] Perzylo, A., Rickert, M., Kahl, B., Somani, N., Lehmann, C., Kuss, A., Profanter, S., Beck, A.B., Haage, M., Hansen, M.R. and Nibe, M.T., 2019. SMERobotics: Smart robots for flexible manufacturing. *IEEE Robotics & Automation Magazine*, 26(1), pp.78-90.
- [15] Chatfield, S.L., 2020. Recommendations for secondary analysis of qualitative data. *The Qualitative Report*, 25(3), pp.833-842.
- [16] Dufour, I.F. and Richard, M.C., 2019. Theorizing from secondary qualitative data: A comparison of two data analysis methods. *Cogent Education*, 6(1), p.1690265
- [17] Davidson, E., Edwards, R., Jamieson, L. and Weller, S., 2019. Big data, qualitative style: a breadth-and-depth method for working with large amounts of secondary qualitative data. *Quality & quantity*, 53(1), pp.363-376.
- [18] Lochmiller, C.R., 2021. Conducting Thematic Analysis with Qualitative Data. *Qualitative Report*, 26(6).
- [19] Melenbrink, N., Werfel, J. and Menges, A., 2020. On-site autonomous construction robots: Towards unsupervised building. *Automation in construction*, 119, p.103312.
- [20] Madakam, S., Holmukhe, R.M. and Jaiswal, D.K., 2019. The future digital work force: robotic process automation (RPA). *JISTEM-Journal of Information Systems and Technology Management*, 16.
- [21] Goel, R. and Gupta, P., 2020. Robotics and industry 4.0. In *A Roadmap to Industry 4.0: Smart Production, Sharp Business and Sustainable Development* (pp. 157-169). Springer, Cham.
- [22] Evjemo, L.D., Gjerstad, T., Grøtli, E.I. and Sziebig, G., 2020. Trends in smart manufacturing: Role of humans and industrial robots in smart factories. *Current Robotics Reports*, 1(2), pp.35-41.