Journal of Advances in Science and Technology
Vol. 19, Issue No. 1, March-2022, ISSN 2230-9659

A Study of Automation in Construction and Barriers to Implementation on Construction Site

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Abstract – Automation and robotics is now widely used in India in different sectors / fields however the construction industry which is an indicator of development of the nation still lacks behind in using the advance technologies. The extent of automation in construction is quite low compared to the current technologies. There is increasing demand on implementing automation in the construction activities. The quality of work is improved by using automation, the productivity of the construction project is increased and also safety, it reduces the time required for the project. The significance of automation in construction has increased rapidly in developed countries. In India, the construction field need different technologies like electronic devices, new machineries the use of automation in large sized projects like construction of bridge, tunnel, road, highway etc. As the construction industry is labour intensive it requires more number of labor that are skilled, good quality of work, and increase in productivity etc. There are several problems related to construction work such as low quality of work, shortage of labour and labor safety etc. which can be overcome by automation technologies.

Keywords – Automation, Conventional, Innovative Technologies.

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INTRODUCTION

Automation in construction captures the processes, methods, equipments and tools which uses automated workflows to construct different infrastructures and large buildings. Implementing automation techniques can help in increasing the quality, reliability and speed of the work that was earlier performed by humans. Any industry that consist of repetitive type of work can use automation. Automation is now used in a number of areas such as transport, utilities, defense, facilities, manufacturing, operations, IT, construction industry etc. There is a paradox of automation that it replaces humans but it cannot completely take the place of humans because humans are still needed for handling, supervising and monitoring of work done by the machines.

Robotics can help in optimizing equipment operation and improving safety of workers by working in hazardous and dangerous conditions where there is risk for workers. There should be maximum use of machines and equipments for rapid construction with reduced risk and good quality. India has second largest population in the world which means it has good man-power, automation cannot replace human-power but is an important supplement that caters to the need of mega-construction and fast-track construction. Some examples of automation in construction include Robotic brick layer, Automatic brick making machine, drones that help foe preparing topographic mapping and land surveys, equipment tracking, report monitoring and progress report, autonomous machines etc.

AIM OF THE PROJECT

This study first explains the term automation and how it is used in the construction industry. Further it elaborates the need of automation in the construction industry and its advantages.

The study is conducted based on several objectives, which are :

1) To study about how much Automation is utilized in current construction industry.

2) To study the need of construction automation and its benefits.

3) To learn about the application and impact of automation in construction industry.

4) To investigate and find the barriers to the implementation of automation on construction site.

LITERATURE REVIEW

Following are some research papers reviewed for the study -

1) Smit Rangani and Jayraj Solankhi (June 2020) - "Automation in construction industry it's application and barriers to implementation on construction site."

Findings - This study identifies the significance of construction automation, and future scope of automation in construction. It aims to study about the use of automation in current construction industry and to find about the barriers that affect implementation on construction site. For this study literature review has been done from previously published papers and data is collected by questionnaire survey and rating scale is prepared to rate different factors in the questionnaire. Data analysis is carried out with the help of quantitative, qualitative and frequency analysis method.

2) Patrik Folkesson and Robbert Lonnroos (2018) - "Construction Automation - Assessment of state of the art and future possibilities."

Findings - This report investigates into technologies that can automate on-site construction operations by using digital technologies. Different existing and emerging automation solutions for automating on-site construction operations with the use of digital technologies is reported in this thesis. To reach this goal, data is collected through literature, interviews, global analysis and conference attendances which all gave similar results showing possibilities for increased automation, bringing forth important benefits.

3) Ammar Bakir and Issa Balchi (2018) - "Development and implementation of robotics in construction."

Findings - This paper studies robotics or automation in construction from managerial perspective. This study investigates about the application of robots in the construction sites, looking through the information and change management as main facilitators that could widen the range of application of robotics on site. It answers to questions like how could robotisation improve the construction industry on-site through information and change management, the impacts of applying robotics on the construction site, what are the main hinders for the adoption of robotics technology in the construction industry etc.

4) Ayodeji Oke, Clinton Aigbavboa, Siphiwe Mabena (2017) - "Effects of automation in construction industry performance."

Findings - Firstly it explains the concept of automation in construction and need of automation due to increase in urbanization. In research methodology the data was collected by distributing questionnaires to 40 respondents out of which 43% comprises of contractors, 18% project management firms, 13% quantity surveying firms, 18% worked for government and 10% were architectures. From the responses collected the analysis of data was done and conclusion was provided based on the top disadvantages and effects were ranked in order of the ratings given by the above mentioned construction professionals.

5) Mamta B.Rajgor and Jayeshkumar Pitroda (2013) - " Automation: A new millennium technology for construction industries."

Findings - This paper studies about the application of automation in the construction industry and sets opportunities and challenges through a new framework for better planning and control of construction equipment operation. This paper gives examples of automation being used in construction in different sectors like road construction, earthwork, interior finishing, brick masonry etc. that use automation technologies like OSYRIS project sensor based compactor, CSIRO's dragline project, Kajima's interior wall assembly robot, Takenaka's concrete compactor robot, ROCCO project brick assembly robot etc.

6) Pentti Vaha, Tapio Heikkila, Pekka Kilpelainen, Markku Jarviluoma, Rauno Heikkila (2013) - "Survey on automation of the building construction and building products industry."

Findings - It discusses about the history of automation in construction, motivation for building construction automation, data acquisition technologies for construction operations, applications for building construction automation, experimental work for automation, robotics, digital design and manufacturing in architecture etc. Several research groups are currently studying this kind of technologies like 3D Concrete printing, Flexible moulds in manufacturing freeform concrete elements, Robotic tile placement, Graphic concrete etc.

7) Zuzana Strukova, Matej Liska - "Application of automation and robotics in construction work execution."

Findings - This research paper discusses about implementation of automation and robotics technologies in on-site construction process and the factors restraining the automation and robotics

systems implementation in the construction sites. For the study total 300 questionnaire were distributed to collect the data out of which 66 responses were recorded giving a response rate of 22%. The results obtained are shown in the form of graphical representation like bar charts and graphs. It concludes that the usage of automation and robotics in on site construction work is low compared to that of designing and scheduling or other planning work. .

8) Visa Hokkanen (Dec 2012) - "Methods for automated civil construction production control."

Findings – The objective of this paper is to gather the data or information for a system that enhances the production phase of civil construction projects. It shows the autonomy level of construction machinery with the help of pictures of machineries like compaction machine, asphalt paver, motor grader, bulldozer, excavator, surface- top drill etc. It also discusses about Building Information Modelling (BIM), Civil construction stakeholders, Construction jobsites, Management in the civil construction jobsites etc.

9) Hyojoo Son, Changwan Kim, Hyoungkwan Kim, Seung Heon Han and Moon Kyum Kim (2009) - "Trend Analysis of Research and Development on Automation and Robotics Technology in the Construction Industry."

Findings - This paper discusses about automation, development of automation and robotics technology in the construction industry, research and development trends on automation and robotics technology, key research areas on automation and robotics technology, construction robotics etc.

10) Rohana Mahbub (2008) - "An investigation into the barriers to the implementation of automation and robotics technologies in the construction industry."

Findings - This research aims to identify the problems and barriers in implementation of construction automation. It examines research questions based on the key factors that determine the level of implementation of automation and robotics in construction, barriers to the infiltration of automation and robotics technologies into the construction work processes, the reason behind greater use of constructon automation in one country compared to another and the future trends and opportunities for the implementation of automation and robotics technology in the construction industry.

METHODOLOGY

The data collected in the survey will be analyzed to know the current level of automation in the construction industry. The questionnaire will be distributed to the construction professionals for the study purpose. The main purpose of a questionnaire is to extract data from the respondents first hand. The questionnaire will be distributed to construction professionals like contractors, engineers, project managers, quantity surveyors, architects and construction managers. Purposive sampling will be done so that the accuracy of results obtained will be good as the data is collected from the people who have knowledge related to that particular field. The questionnaire is designed in such a way that the first part covers background information and about the awareness and present scenario of automation in construction industry. And the second part consists of questions regarding the barriers into the implementation of automation on construction sites. Detail analysis will be done based on the reports. The following is the step wise procedure or methodology adopted for this project.

Step 1: Literature Review

Step 2: Preparation of Questionnaire Survey

Step 3: Distribution of Questionnaire

Step 4: Collecting data from respondents

Step 5: Frequency analysis method

Step 6: Conclusion and Recommendation

Following are the list of questions mentioned in the questionnaire prepared.

1) Name of the respondent

2) Designation

3) Are you aware about the concept of automation in construction?

4) Have you seen/implemented Automation on your site or other construction sites?

5) According to you in which area of construction, automation and robotics technology is mostly used?

6) Rate the areas of usage of Automation for on-site work.

7) Problems or barriers in implementation of Automation in construction work.

8) Overcome statement to minimize barriers in implementation of automation in construction work.

9) Rate different benefits of Automation technology to implementation on project performance.

CONCLUSION

The researcher has studied about the concept of automation, need of automation in the construction industry and its advantages and disadvantages. The researcher has searched and studied the above mentioned research papers for the study purpose. This study also describes about some examples of automation/robotics in construction like the robotic bricklayer SAM100 and Hadrian X, drones, automatic brick making machine, autonomous machines on construction site and robotics in concrete work. The questionnaire survey is prepared to investigate into the barriers for implementation of automation on construction site. The questionnaire now will be distributed to construction professionals like contractors, engineers, project managers, quantity surveyors, architects and construction managers. Purposive sampling will be done and after collecting the data from the respondents, detail analysis will be carried out to find out the awareness about the construction automation, area of usage and on-site application of automation in construction, barriers and overcome statement for it.

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