



# An Investigation into the Barriers to Implementation of Automation 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 in comparison with the current technologies. There is increasing demand on implementing automation in the construction activities. Automation increases the quality of work as compared to unskilled workers, it increases the productivity of the construction project and also safety, it reduces the time required for the project. The significance of automation in construction has grown rapidly in developed countries. In India, the construction industries need different technologies such as new machineries, electronic devices, the automation of road, tunnel, and bridge construction earthwork, etc. As the construction industry is labour intensive it requires more number of skilled labor, good quality of work, and increase in productivity etc. There are several problems associated with construction work such as low quality of work, shortage of labour and safety of labor etc. which can be overcome by automation technologies. This paper shows the current scenario of automation in the construction industry, barriers in its implementation, overcome statement and its benefits.

**Keywords:** Automation, Conventional, Innovative Technologies

## INTRODUCTION

Automation in construction captures the processes, methods, equipments and tools that use automated workflows to build buildings and infrastructure. It is the creation and use of technologies to produce and deliver goods and services with reduced human assistance. Implementing automation techniques can help in increasing the quality, reliability and speed of the work that was previously performed by humans. Automation is being used in a number of areas such as manufacturing, transport, utilities, defense, facilities, 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 more and more use of machines as well as equipment in the construction industry for rapid construction with less risk and good quality. As India has second largest man – power in the world, automation is not replacements of the human-power but is an important supplement that caters to the need of mega-construction and fast-track construction. Automation increases the productivity of the construction project, reduces the duration and laborious work, and increases the construction safety, increases the quality of work as compared to unskilled workers. Some examples of automation in construction include Robotic brick layer, Automatic brick making machine, drones that help for preparing topographic mapping and land surveys, equipment

tracking, report monitoring and progress report, Autonomous machines e.t.c.

### **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 into the barriers to the implementation of automation on construction site.

### **Data Collection**

Literature review has been done from the previously published research papers based on automation in construction. The data collection chapter deals with how the data or information required for the study is accessed from the respondents i.e. the means of data collection and the type of data. The data is collected by distributing questionnaires to construction professionals like engineers, contractors, quantity surveyors, architects and others. The questionnaire was distributed in the form of Google-form so as to reach to maximum number of feedbacks.

### **Design of the Questionnaire**

The questionnaire is prepared by taking reference from similar kinds of research paper related to automation. The questions involved in the survey covered about the details of the respondents like their name, designation etc., the further part covered about the awareness of automation in the construction industry and the rest part involved questions based on different aspects of automation in construction industry like area of usage, barriers in implementation of automation in construction work, overcome statement to minimize the mentioned barriers and benefits of automation technology to implementation on project performance.

Following is 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) 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.

### **Alternatives in the questionnaire**

Area of construction where automation and robotics technology is mostly used:

- a) Design
- b) Costing and Scheduling
- c) Planning
- d) Project Management
- e) Tendering

Area of usage of automation for on-site work

- a) Earthwork
- b) Concrete work
- c) Steel work
- d) Painting work
- e) Building assembly and lifting
- f) Flooring work

Barriers in implementation of Automation in Construction work

- a) High cost
- b) Technology is expensive to update and maintain
- c) Low technology literacy
- d) Locally unavailability of automation technologies
- e) Technology difficult to use
- f) Project Magnitude i.e- size, location, project period etc.

Overcome statement to minimize barriers in implementation of automation in construction work

- a) Reducing the cost of technology and robots
- b) Developing technologies that are easier to use and understand
- c) Automation system will be more easily locally available
- d) Training program for workers and employees

- e) Developing technologies that are user friendly

Benefits of automation technology to implementation on project performance

- a) Finance Saving
- b) Less human labour
- c) Less human error
- d) High productivity
- e) Safety improvement
- f) Less material wastage
- g) Work quality increased
- h) Time saving

#### **Rating Scale**

The rating scale helps in positioning the given alternatives in order of their rankings. It is used to compare among different alternatives that are present. The rating scale adopted in this paper ranges from 1 to 5. The following table gives idea about the rating scale –

SCALE	DESCRIPTION
1	Very low
2	Low
3	Moderate
4	High
5	Very high

#### **The Size of Sample**

In total 60 questionnaires were distributed to the constructional professionals. Out of which 50 number of people responded which means that 83.33% is the response rate given to the distributed questionnaires by the respondents.

Total number of questionnaire distributed - 60

Number of responses received - 50

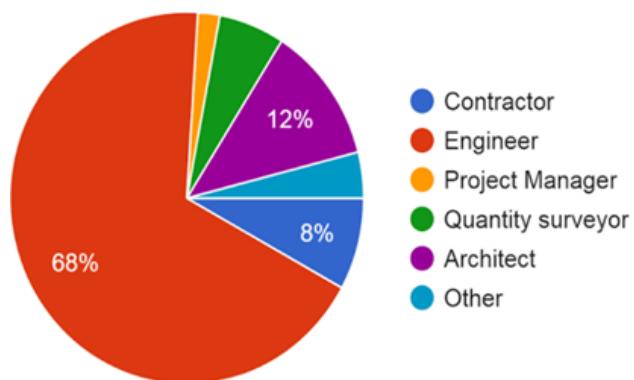
Percentage rate of response - 83.33%

#### **DATA ANALYSIS**

From the responses collected in the survey the following results can be seen :

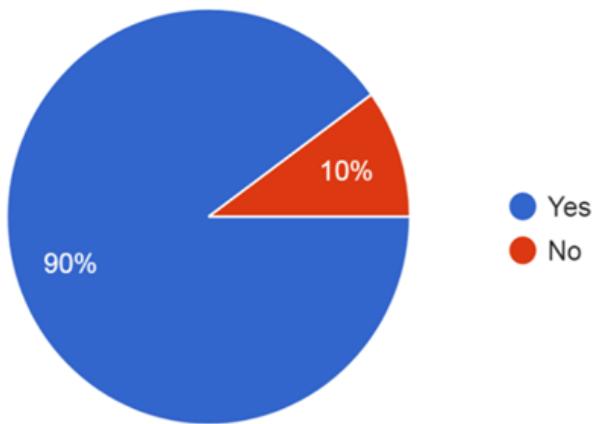
The questionnaires were distributed to construction professionals like contractors, engineers, project managers, quantity surveyors, architects and construction managers. Purposive sampling was adopted by

ensuring that the respondents have adequate knowledge of the construction industry. Out of 50 number of people who responded it was found that 68% were engineers, 8% were contractors, 2% were project managers, 6% were quantity surveyors, architects included 12% and 4% were from other background.



**Figure 1 Graphical representation of the designation of the respondents**

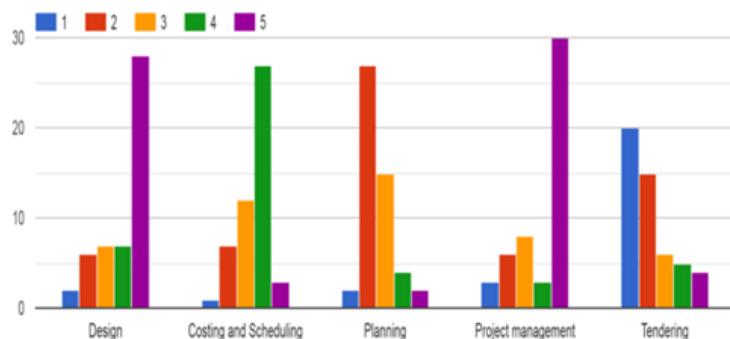
The awareness percentage was such that 90% of the respondents were aware about the concept of automation in construction while the rest 10% were unfamiliar with this concept.



**Figure 2: Circle graph of the awareness of automation concept**

In the survey they were asked about whether they have seen or implemented automation practices on their site or other construction sites. The result was 30% have seen/implemented it on the site and 70% didn't.

- **Response on area of construction where automation and robotics technology is mostly used.**



**Figure 3 - Bar graphs for the ratings of area where automation is mostly used.**

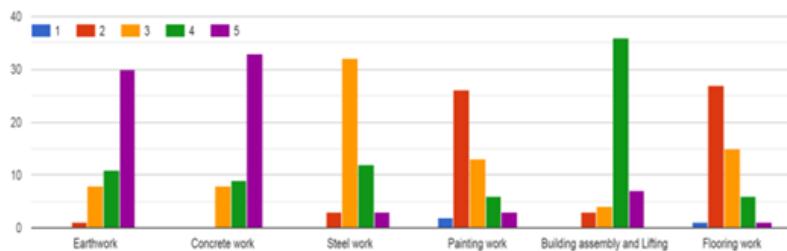
The area of construction where automation is mostly used is for project management with a mean of 4 and minimum rating is given for tendering.

Area of usage	Number of responses	Mean	Mean Rank
Design	50	3.9	2
Costing & Scheduling	50	3.47	3
Planning	50	2.34	4
Project Management	50	4	1
Tendering	50	1.97	5

- Responses on area of usage for on-site work**

The high percentage of automation in on-site construction is used for concrete work with a mean of 4.45 and also for earthwork with a mean rank of 2 and lowest for painting work.

On site work	Number of responses	Mean	Mean Rank
Earthwork	50	4.34	2
Concrete work	50	4.45	1
Steel work	50	3.19	4
Painting work	50	2.46	6
Building assembly and Lifting	50	3.9	3
Flooring work	50	2.48	5



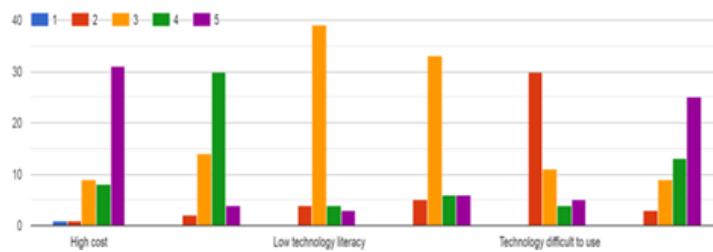
**Figure 4 - Bar graph for the area of usage of automation**

- Barriers in implementation of Automation in Construction work**

The biggest barrier in the implementation of automation in construction work is high cost with a mean of 4.31. The second most barrier is that its implementation depends on the project magnitude i.e.- size, location, project period etc. with a mean of 4.18 and technology is expensive to update and maintain being the third barrier. Locally unavailability of automation technologies ranks fourth in the list.

Barriers	Number of responses	Mean	Mean Rank
High cost	50	4.31	1

High Cost	50	4.31	1
Technology is expensive to update and maintain	50	3.72	3
Low technology literacy	50	3.09	5
Locally unavailability of automation technologies	50	3.17	4
Technology difficult to use	50	2.24	6
Project Magnitude i.e- size, location, project period e.t.c	50	4.18	2



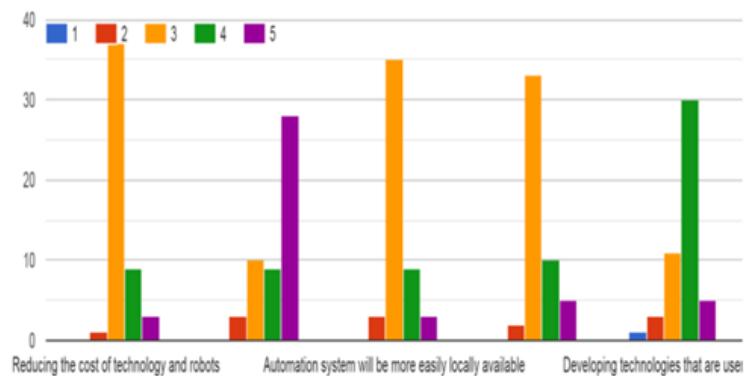
**Figure 5- Graphical representation of the barriers in the implementation of automation technology**

- Overcome statement to minimize barriers in implementation of automation in construction work

The above barriers can be overcome by the following overstatement in which developing technologies that are easier to use and understand ranks first with a mean of 4.08 and developing technologies that are user friendly ranks second with a mean of 3.66.

Overcome statement	Number of responses	Mean	Mean Rank
Reducing the cost of technology and robots	50	3.23	4
Developing technologies that are easier to use and understand	50	4.08	1
Automation system will be more easily locally available	50	3.13	5

Training program for workers and employees	50	3.34	3
Developing technologies that are user friendly	50	3.66	2



**Figure 6 - Bar charts for the overcome statement in implementing automation**

- Benefits of automation technology to implementation on project performance**

The top 5 benefits of automation are time saving, work quality increased, less human labour, high productivity and safety improvement.

Benefits	Number of responses	Mean	Mean Rank
Finance Saving	50	3.08	7
Less human labour	50	2.98	3
Less human error	50	3.35	6
High productivity	50	3.94	4
Safety improvement	50	3.88	5
Less material wastage	50	3.03	8
Work quality increased	50	4.38	2
Time saving	50	4.59	1

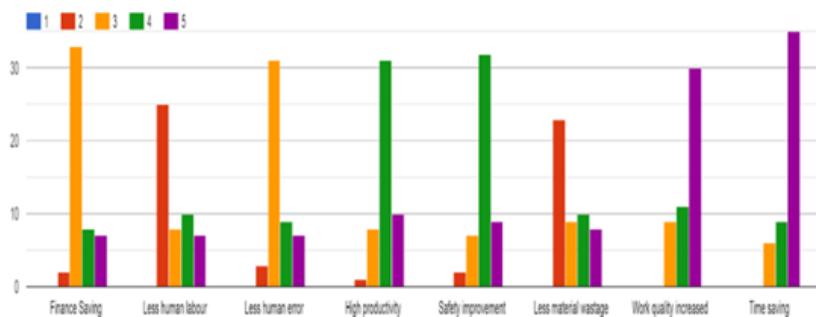


Figure 7 - Bar charts for the benefits of automation

## CONCLUSION

The researcher has studied about the concept of automation, need of automation in the construction industry and its advantages and disadvantages. The questionnaire survey was prepared to investigate into the barriers for implementation of automation on construction site. The questionnaire was distributed to construction professionals like contractors, engineers, project managers, quantity surveyors, architects and construction managers. Purposive sampling was adopted by ensuring that the respondents have adequate knowledge of the construction industry. In the data analysis it was found that 90% of the respondents were aware about the concept of automation. The area of construction where maximum automation technology is used is project management with a mean of 4 and tendering being the lowest in the list. Similarly area of usage for on-site work in terms of use of automation, concrete work ranks first, earthwork ranks second and painting work with a lowest of 2.46 mean. There are several barriers in implementation of automation in construction with most rating for high cost, project magnitude ranks second and technology is expensive to use with a mean rank of 3. These barriers can also be overcome by solutions like developing technologies that are easier to use and understand, developing technologies that are user friendly and training program for workers and employees e.t.c.

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