JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

To Enhance The Productivity And Speed of Construction Using Application of Automation Industry

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Abstract : Tools have given way to machines and automation in building. Automation improves construction productivity, precision, and safety. Structured prefabrication is gaining popularity as a technique to boost production and reduce environmental impact. Automation and prefabrication may improve the building business. Current accomplishments, difficulties, and future prospects in structural prefabrication and construction; design, construction management, robotic production, autonomous transportation, and automatic structural assembly; the article suggests that construction automation is preferable to structural prefabrication, and that connection advancements can simplify difficult activities and improve robotic assembly.
Many machines can reduce human effort, lower labor costs, and boost building output. India should expand construction automation for infrastructure development.

Keywords-Automation, construction industry, Infrastructure projects, Cobot Technology, Building Construction

I. INTRODUCTION

Any building's construction involves earthworks, structure construction (concreting, frame assembly, walling, etc.), and finishing works. These phases' construction technologies are traditionally labor-intensive and dangerous. Construction industry concerns include volatile labor supply and escalating wages. Specialized automation reduces labor needs and boosts construction site productivity. Many researchers are striving to introduce automation and robotics into construction sites.
Construction uses automation and robotics. Automation and robots offer benefits in construction job execution that may boost their use. Among the most important advantages are:
Less reliance on direct labor - Quality and repetitiveness of work, as well as expenses, may be decreased by lowering labor, whereas the automated system requires fewer operators;
Automated systems can execute a wide range of jobs, which increases workplace safety.
v. better control over the production process - faults can be recognized more easily because each stage is controlled to ensure the correct end.

Figure1.1: Human interaction between co-bots

Space construction is a fast-growing sector of construction technology. In hazardous construction work, there are various well-defined systems. You can also employ them in specific building applications by choosing the right materials based on safety, affordability, and procurement possibilities. ISRU can be used in civilian and military robotics, for example. Visualize ISRU with lunar concrete. NASA and other space exploration roadmaps plan a manned lunar exploration voyage and Moon infrastructure. This requires steps

Areas of automation in Construction

- Roads & Runways construction
- Structures
- Buildings construction
- Ports

- Tunnels
- Factories and industries

On-site construction, building maintenance or control after completion, and eventual dismantling or demolition of the building are all possible applications for automation and robotics technologies in construction. Automation and robotics are used in all stages of construction, from design to completion, from cost estimation to project management. The use of automation and robotics in construction varies greatly from project to project.

A reprogrammable multi-functional manipulator designed to move material, parts, tools or specialized devices," says the Robot Industries Association (RIA). A robot is a programmable machine that can process human characteristics like judgment, reasoning, learning, and vision.

Intelligent robots respond to changes in their environment via sensors linked to their controller. Human safety is a major consideration when using a robot in the workplace.

A robot with sensors that detect an obstacle or a human worker in its workspace could automatically shut down to protect itself and/or the human worker.

How can cobots be used?

Cobot is small, light, and easy to assemble. The Cobot can work in small spaces and is mobile.

You could, for example, mount this co elaborative robot on a mobile workbench and move it around, but a robot can also stay in one place for longer.

Who are COBOT?

Traditional industrial robots are built and programmed to do a single task away from human workers. They are often used to process large batches of single items: welding, drilling, spray application (paint, adhesive), transporting items across an area, loading and unloading heavy items. They are large, heavy, fast, and strong, making them dangerous to humans and requiring fencing or other barriers. Traditional industrial robots work in parallel, not in collaboration, with humans.

The task performed is less important than the features of the robot that make it safe and useful for working alongside humans. In a work cell, station, or bench, a machine and a person can work on the same task, assembly, object, or activity.

There are several “off-the-shelf” collaborative robot options to suit a variety of needs. Accessories and tools like vision cameras, suction cup grippers, and welding tips can be added to most cobots (check out this example from Universal Robots on the right). No longer is it necessary to build a large, dedicated machine from scratch to use a robotic arm.

Cobots also have built-in controls for safe operation. Included are programmable speed zones, collision avoidance, and sensors that stop the machine when a hand or other object enters an unexpected area.

A Cobot assistant can help with safety and ergonomics. Worker ageing, dexterity loss, and effects of standing, lifting, or twisting earlier in a shift are relevant. It also allows users to perform tasks while seated, programme the robotic arm to do a task, and adjust settings based on computer data. Then you can expand your manufacturing workforce.

Rather than completely replacing human workers, cobots usually integrate into repetitive or dull processes where errors or injuries can occur.

- Pick and place
- Machine tending
- Packaging and palletizing
- Process tasks, when equipped with end effector tools (e.g. gluing, drilling, welding)
- Finishing (sand, polish, deburr, trim)
- Quality inspection, when equipped with a vision camera
- Assembly
- Dispensing (e.g. adhesive, lubricant, sealant)
- Painting, coating, dipping

Constructing, operating, and maintaining buildings and engineering structures is all part of the construction automation life cycle. Computer science and robotics advancements have aided in the development of new construction technologies. Japanese robotics and automation innovations have helped the construction industry reduce human labour, lower construction costs, and shorten project timelines while increasing productivity.

II. OBJECTIVES

1. To determine how much automation is used in the existing construction sector and its future trends, as well as to determine which impediments are severely affecting the application of automation in construction and how they might be eliminated.
2. To maximize resource value, intelligent and integrated control over all building activities is required.
3. To enhance and reach optimal optimum value in terms of construction quality, safety, profitability, and productivity.
4. To find current use of automation in construction and on-site construction work. And main barriers to the implementation of automation technologies in construction.

III. RESEARCH METHODOLOGY

In the dissertation following methodology has been decided to measure and manage the

- ✓ By operating advance technology (Application Of COBOT) at construction project reduce delay in transporting of material and increase efficiency of work that ultimately reflect of time and cost in construction Sector.
- ✓ From literature found that because of frequent change of project managers, Appointment of staffs in the site who are not experienced and also Non sequential progress of works and that Work was not followed as per procedure instead it was followed as per availability of resources caused delays in construction project on pandemic situation

- ✓ Unavailability of adequately trained health workers and lack of experience in managing an unprecedented emergency; the pandemic and the confinement measures created a psychosocial burden for the population and, especially, the wellbeing of the health workforce.

- ✓ The construction industry is the vehicle through which physical development is achieved, and this is truly the locomotive of the national economy. The more resources, engineering know-how, labor, materials, equipment, capital, and market exchange provided from within the national economy, the higher the extent of self- reliance. The increasing complexity of infrastructure projects and the environment, within which they are constructed, place greater demands on construction managers to deliver projects on time, within the planned budget and with high quality.

- ✓ Therefore, improving construction efficiency by means of cost-effectiveness and timeliness would certainly contribute to cost savings for the country as a whole. Efforts directed to cost and time effectiveness were associated with managing time and cost.

- ✓ It also aims to identify the main factors that lead to project delays and to suggest recommendations on how to overcome or mitigate effects of the problem. Data is gathered from responses from questionnaire survey and interviews with those involved in automation construction project.

- ✓ The surveys and research findings indicate that delay incidents & Accidents occur mainly during the construction phase of a project and one or more parties usually contribute to delay. This paper highlights the importance of having more experienced and capable construction managers as well as skilled labourers to enable the industry to develop at a faster rate either nationally or internationally.

- ✓ A questionnaire and personal interviews have formed the basis of this research. Factor analysis and regression modelling were used to examine the significance of the delay factors. From the factor analysis, most critical factors of construction delay were identified.

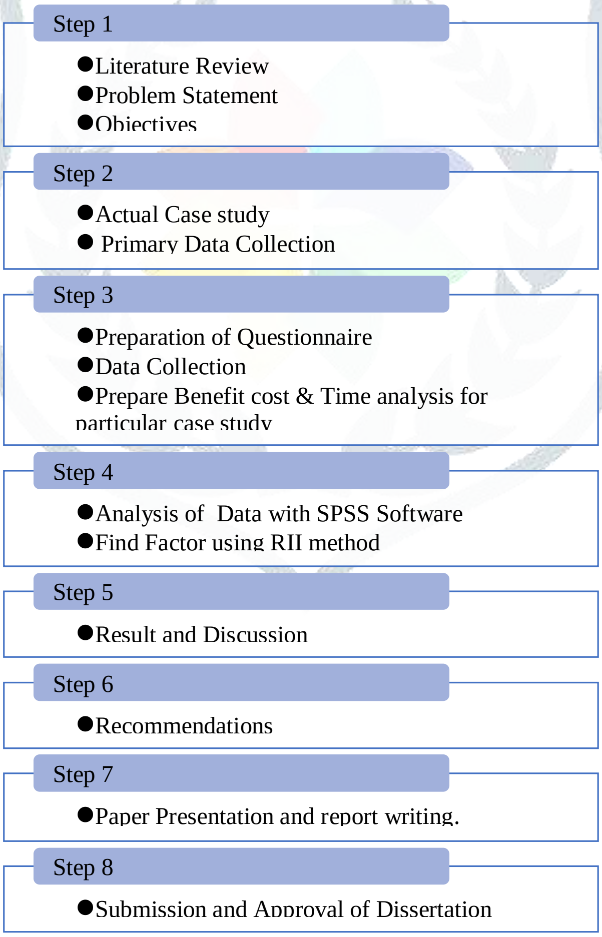

Step 1
●Literature Review
●Problem Statement
●Objectives
Step 2
●Actual Case study
● Primary Data Collection
Step 3
●Preparation of Questionnaire
●Data Collection
●Prepare Benefit cost & Time analysis for particular case study
Step 4
●Analysis of Data with SPSS Software
●Find Factor using RII method
Step 5
●Result and Discussion
Step 6
●Recommendations
Step 7
●Paper Presentation and report writing.
Step 8
●Submission and Approval of Dissertation

Figure1.2: Flowchart of Methodology

IV. RESULTS & DISCUSSION

4.1 Questionnaire Survey

The questionnaire design practice advanced on a communicating basis. It was categorized into profile of the respondent and various factors affecting construction cost and time required completing particular work with automation.

Questions in the respondent profile were created to collect information such as job position, experience of the work, locations of the current and/or previous works and contact information. It was studied; these questions in the survey were of great important to the research by analyzing personal qualification concerns from a variety of different profiles from different regions

The set of questions was prepared and targeting the factors/sources affecting cost saved on Automation Industry. The responses were to be based on the understanding, knowledge and experience of the respondents and related to particular project.

This simple and straight method was selected to establish a means of developing a list of factors affecting cost. A Five-point scale of 1 to 5 was considered for evaluating the impact of each factor. Questions are attached in annexure page. These numerical impact values are assigned to the respondents' rating:

1: Strongly agree
2: Agree
3: Neutral
4. Disagree
5. Strongly Disagree

Pilot Survey and Questionnaire Revision:

To improve the questionnaire section, a pilot study was accompanied. This section contained identification of different causes, collection, and conclusions of data. The application of this section benefited in better formation of the survey development.

Total 65 questionnaires, were sent to labourers, contractors, architectures, owners, project managers, valuators and project engineers of various building construction organizations.

- Questionnaire should always start with the general information of the organization
- Some factors are not related to construction. They should be removed or modified.
- To get more suitable and consistence meaning some factors should be rearranged.
- Some factors should be revised with additional information.
- Factors repeated with similar meaning should be removed.
- Some factors should be changed to give clearer importance and understanding.

4.2 SPSS SOFTWARE-

Analysis of the questionnaires survey was done using IBM SPSS Software. SPSS Statistics is a software package used for statistical analysis. The software name originally stood for Statistical Package for the Social Sciences (SPSS), reflecting the original market. It is a Windows based program that can be used to perform data entry and analysis and to create tables and graphs. It is capable of handling large amounts of data and can perform all of the analyses covered in the text and much more.

It is a widely used program for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners, and others. All the responses obtained from the questionnaires are entered in to the software. First, the variables or the questions are entered in the data view, then, the responses are entered into the software from the various data entered into the software, frequency can be found which is used to determine the relative importance factor.

4.2.1.SPSS data View: The Questioner Survey responses were reported in excel file. After opening data, SPSS displays them in a spread sheet-like fashion as shown in below figure 6. The excel file was export in data View and check the values and other information in spread sheet.

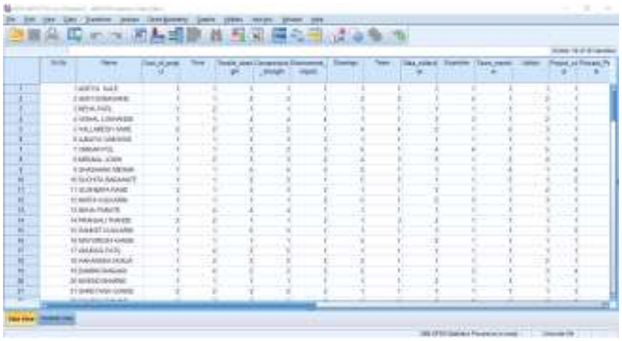


Figure1.3: SPSS Data View

4.2.2. SPSS Variable View:

An SPSS data file always has a second sheet called variable view. It shows the meta-data associated with the data. Meta-data is information about the meaning of variables and data values. In Variable View, different columns are displayed. Each line corresponds to a variable. A variable is simply a quantity of something, which varies and can be measured, such as height, weight, number of children, educational level, gender and so forth.

4.2.3.SPSS Data analysis:

SPSS can open all sorts of data and display them and their metadata in two sheets in its Data Editor window. In our data contain a variable holding respondents' on ferrocement related question, we can compute the frequency by navigating to Descriptive Statistics. For better understanding and detailed study pie charts option is also selected.

4.2.4.SPSS Output Window:

After clicking Ok, a new window opens up, SPSS output viewer window. It holds a nice table with all statistics on all variables we chose. Output Viewer window has a different layout and structure than the Data Editor window we saw earlier. Creating output in SPSS does not change our data in any way; unlike Excel, SPSS uses different windows for data and research outcomes based on those data.

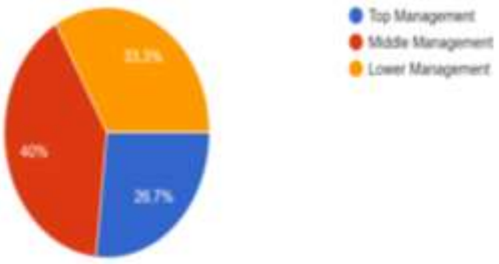


Figure1.4: SPSS output window

Among the many available methods in collecting data two methods were adopted; these are literature review and questionnaires. The first step involves general information collection, including both first-hand and second-hand data, in order to identify major themes from the literature. In the second step, with the literature review and unstructured interviews, important factors of safety were identified. With these factors, a questionnaire was formed and Survey was conducted. The questionnaires were distributed through various electronic media platform to a variety of respondent working around the construction projects. About 100 people have responded to the questionnaire survey.

SPSS data View:

The Questionary Survey responses were reported in excel file. After opening data, SPSS displays them in a spread sheet-like fashion as shown in below figure. The excel file was export in data View and check the values and other information in spread sheet.

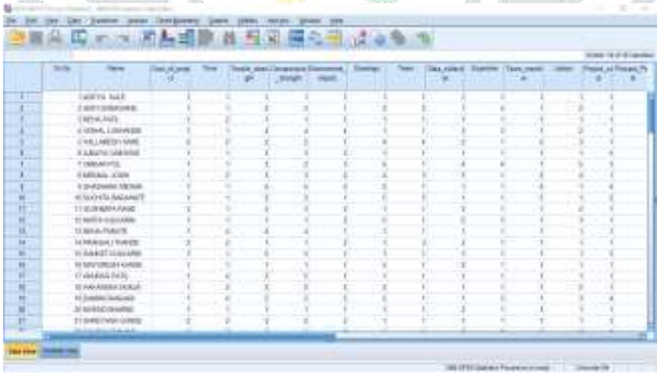


Figure1.5: SPSS Data view

4.2.5.SPSS Variable View:

An SPSS data file always has a second sheet called variable view. It shows the metadata associated with the data. Metadata is information about the meaning of variables and data values. In Variable View, different columns are displayed. Each line corresponds to a variable

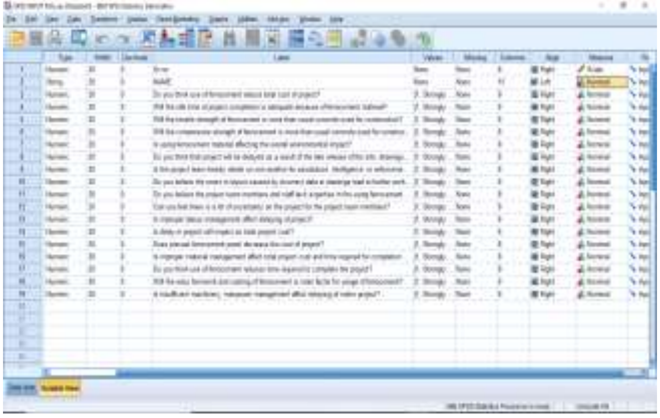


Figure1.6: SPSS Variable View

A variable is simply a quantity of something, which varies and can be measured, such as height, weight, number of children, educational level, gender and so forth. Name of the variable it is your own choice, but make it understandable and do not use numbers or symbols as the first letter since SPSS will not accept it. Moreover, you cannot use spaces in the name. The name of variable was used such as EMI, Construction material etc. The variable view spread sheet is shown in the below figure.

4.3 SPSS Data analysis:

SPSS can open all sorts of data and display them -and their metadata- in two sheets in its Data Editor window. In our data contain a variable holding respondents' on related question, we can compute the frequency by navigating to Descriptive Statistics as shown in below figure. For better understanding and detailed study pie charts and Bar chart option is also selected.

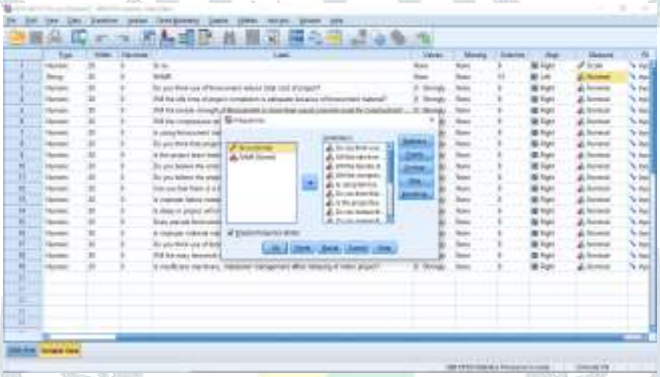


Figure1.7: SPSS data analysis

4.3.1SPSS Output Window:

After clicking Ok, a new window opens up, SPSS output viewer window. It holds a nice table with all statistics on all variables we chose. The screenshot below shows what it looks like. As we see, the Output Viewer window has a different layout and structure than the Data Editor window we saw earlier. Creating output in SPSS does not change our data in any way; unlike Excel, SPSS uses different windows for data and research outcomes based on those data.

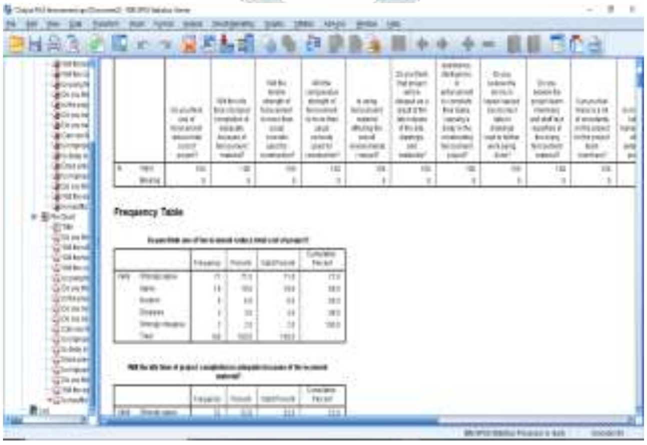


Figure1.8: Output File

4.3Frequency Table

With India in mind, it introduces the idea of building. However, companies implementing construction tools and strategies from a corporate point of view are unlikely to maintain their use or achieve maximum advantages from the implementation of construction because their operation is not accompanied by sufficient strategic planning.

RII Technics

The sample for this study is relatively small. As a result, the analysis had combined all groups of respondents (clients, consultants, contractors and regulatory boards) in order to obtain significant results. Data was analyzed by calculating frequencies and Relative Importance Index (RII). In this project, Relative Importance Index technique approach is used for data analysis. This technique is used to determine the relative importance of the various factors affecting the waste generation working on construction sites. The data analysis was carried out using SPSS software. SPSS was used to generate the frequency (fi) of the response category index for the cause and effect factors. The relative importance index (RII) for each factor was calculated using the frequency data for each response categories generated from SPSS.
Assessment of questionnaire was carried out using three point likert scale from 1 to 5 representing can be not at all, no, most of the times, yes respectively. Data analysis was done calculating Relative Important Index (RII) by following formula. Ranking of the various factors according to their significance, and calculating their Relative Importance Index (RII)

$$\mathbf{RII = \Sigma W / A * N}$$

Where, W = weight given to each factor by respondents

$$\sum \mathbf{W = 5 \times W5 + 4 \times W4 + 3 \times W_3 + 2 \times W_2 + 1 \times W_1}$$

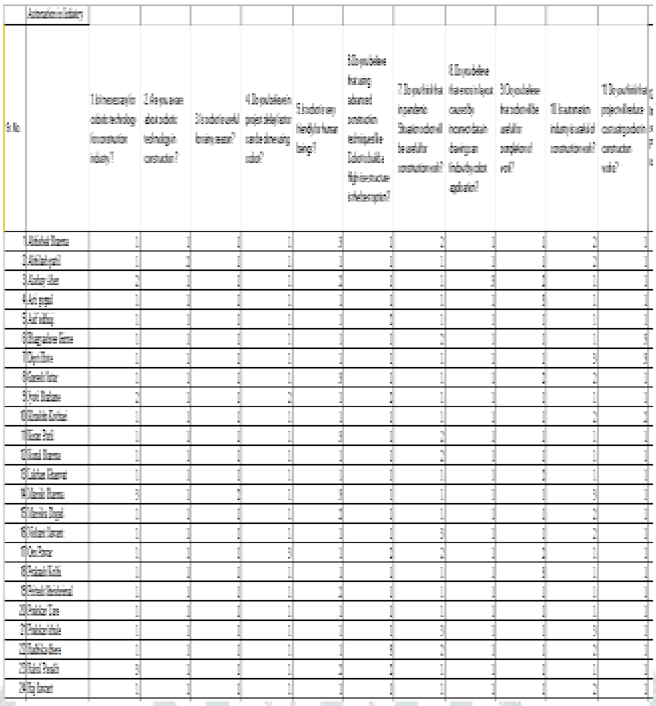
A = highest weight (i.e. 5)
N = total number of respondents (N=150)
These rankings made it possible to cross-compare the relative importance of the factors. Each individual causes RII perceived by all respondents should be used to assess the general and overall rankings in order to give an overall picture of the factors of material management in Indian construction industry.

Name of Company: UBT Technology Private Ltd.
Questionnaire Survey Related to Automation Industry
(Cobot Technology)

Sr.No.	Questions
1	Is cobotic technology required in the construction industry?
2	Are you aware about cobotic technology in construction?
3	Is cobot is useful for rainy season?
4	Do you believe in project delay factor can be done using cobot?
5	Is cobot is very friendly for human beings?
6	Do you believe that using advanced construction techniques like Cobot to build a High rise structure is the best option?
7	Do you think that in pandemic Situation cobot will be useful for construction work?
8	Do you believe that errors in layout caused by incorrect data in drawing can find out by cobot application?
9	Do you believe that cobot will be useful for completion of work?
10	Is automation industry is useful of construction work?
11	Do you think that project will reduce cost using cobot in construction works?
12	Do you believe that India‘s Construction is sufficient to solve the Pandemic problem using Cobot?
13	Do you think that quality of the work would suffer as a result of the fast-track construction using Cobotic Technology?
14	Do you think the best choice for constructing a High rise building is to use advanced building techniques?

15	Do you believe that the task of construction management is required to complete the project on time?
16	In summer season, do you think that cobot can bear high temperature?
17	Does cobot is advance equipment required for big construction sites?
18	Is climatic conditions in pune favorable enough for advanced technology?
19	Do you believe a cobot can be a one-time purchase with multiple uses?
20	Is your site's labour dedicated to various software upgrades aimed at increasing productivity?
21	Do you use any of the building industry's technologically advanced methods on your construction site?
22	Do you believe that including a cobot into a project will reduce the overall cost?
23	Will the ideal time for project completion be sufficient due to the use of cobots?
24	Does the use of cobot technology have an influence on the environment as a whole?
25	Do you believe the project will be delayed as a result of the site, drawings, and materials being released late?
26	Is improper material management affect total project cost and time required for completion of project?
27	Do you think the best choice for constructing a High rise building is to use advanced building techniques?
28	Do you believe that a High rise Building should be built at the start of the Pandemic Situation on site?
29	Is it true that heavy rain causes building activity to slow down?
30	Do you believe that cobot can reduced errors?
31	Do you think the fastest speed of cobot technology maintain the quality of construction?
32	Does the material shifting from floor to floor is fastest that labour?
33	Is knowledge required is for labour to handling the cobot?
34	Do you think the cobot increase the profit of company?
35	Do you offer any technology training to your employees?
36	Do you think wastage is reduced by using cobot technology?
37	Does the speed of painting is improve and fast using the technology?

4.4 Survey Report

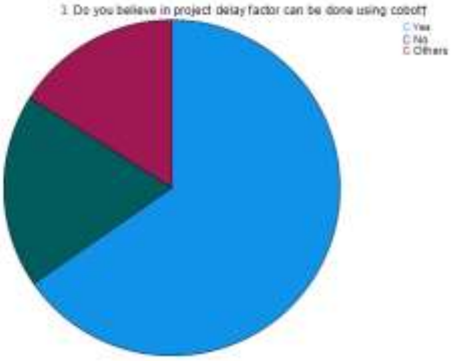


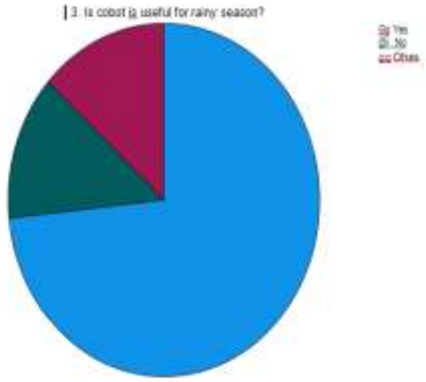
Are you aware about cobotic technology in construction?

		Frequency	Percent	Valid Percent	Cumulative Percent
	Yash Tiware	1	.7	.7	97.4
	Yash Tiwari	1	.7	.7	98.0
	Yashodit bhambre	1	.7	.7	98.7
	Yogesh Mne	1	.7	.7	99.3
	Yutesh Kumar	1	.7	.7	100.0
	Total	151	100.0	100.0	

Is cobot is useful for rainy season?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	110	72.8	73.3	73.3
	No	20	13.2	13.3	86.7
	Others	20	13.2	13.3	100.0
	Total	150	99.3	100.0	
Missing System		1	.7		
Total		151	100.0		





V. CONCLUSION

This study aims to determine how construction and on-site labor employ automation. And the biggest obstacles to building automation are:

Literature reviews and case studies uncover difficulties.

After that, survey questionnaires are produced and data is analyzed using frequency analysis.

According to the Frequency analysis technique, high cost, firm size, and difficult-to-update technology are top barriers to construction automation. Lack of technological understanding and difficult-to-use technologies are low-scoring barriers.

Cost of automation technology (purchase, maintenance, and upgrade prices), firm size, project size, and workforce limit all affect site automation.

From this study, it can be stated that building easier-to-use and comprehend technologies, as well as training programs for workers and employees, will remove barriers. Making technology more economical to maintain and upgrade was scored lowest.

Automation in construction improved project performance, job quality, time savings, working conditions, safety, and productivity.

Due to the intricacy of the development process and technological advances, a long-term plan is needed to access cutting-edge development methods. Modelers, specialists, and all other development process members must be coordinated in this method. Short- and long-term improvements will be made to application-specific automation.

Implementing automation technologies helps infrastructure and development companies enhance productivity, worker safety, and job quality. SMBs need automation in many areas.

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