FUTURE OF TRENDING CONSTRUCTION TECHNOLOGY IN CONSTRUCTION INDUSTRY

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Abstract: Technology has been becoming an important part of the construction industry as it makes work easy and increases productivity, but not every technology can be successful so, figuring out the potential of technology in the future has become an important part to study. Hence, this study aims to know about the current use of technology in the construction industry and its willingness to adopt new technology in the future. Also, to know awareness in people about technology and the barrier in the adoption of technology.

Index Terms **– Trending technology, Construction, Building Information Modeling, Virtual Reality and Augmented Reality, Robotics and Automation, Prefabrication.**

I. INTRODUCTION

The construction industry is known to have a passive reaction to new emerging technology since the beginning. In recent years, technologies available to increase productivity, quality, safety, and profit have seen a fast adoption rate and advancement in the construction industry. The recent development within the computational tools and hardware has correspondingly enhanced the construction methodology also to keep pace with the developments in design developments. For example, the development of technology regarding concrete has led to the utilization of temperature-controlled transit mixers, automated batching plants, and placer booms. In a uniform manner, project management, estimation, and BIM technologies are now commonly found in the construction industry. The need for efficiency in managing the construction process is increasing day by day and emerging technologies are the result of the best opportunities to enhance the construction process through better integration and efficiency.

The Growth of Technology will have an impact on construction on the basis of how construction will perform. With the change of technology way of working is expected to change.

The construction industry is tending to adopt the new technologies to counter its challenges like labor force shortage, low productivity, and delay in completion of projects causing serious effects, huge involvement of funds, and safety issues.

The timely execution of construction projects with safety and quality has become one of the main concerns of the industry. The Indian construction industry has a low rate of adoption to change with new materials, technologies, software, digitalization, and artificial intelligence. These technologies are not only cost-effective, but also have the advantages of low effort, high earthquake resistance, high durability, and low maintenance. Such technologies are capable of improving the quality and durability of construction.

Recognizing which emerging technologies would bring value to an organization and have the most potential can be the key differentiator for an organization's future position in the industry.

Objectives

- To study the potential of trending construction technologies in the construction industry with the pros and cons.
- To improve the knowledge and awareness about the new technologies which are invented for batter project management.

II. LITERATURE REVIEW

(Benham, Holt, & Bigelow, 2015) [2] In this study the main objective is to spread awareness of technology and provide recommendations for technologies that should be introduced to students beyond computer applications for estimating, scheduling and BIM. In this study, a survey has been taken on the basis of which technology people in industry use, or don't use or they don't know about technology. Technologies focused are BIM, VR, wearable technology, and barriers to adoption of technology are also included.

In this study out of 1014 responses, only 24 were using AR & VR, and out of 708 responses, only 13 were using wearable technology.

In a total of 104 responses 48% using mobile tech, 27% BIM, 10% 3D Scanning, 7% 3D printing, and 9% ware using drones. In this study, it is clearly seen that awareness about technology and its use is too low, and it is necessary to study the potential of technology for future advantages.

- In this study public opinion only taken on either they use stated technology or not.
- Public opinion in case they use this technology in the future or not is not taken and taken technology is also in limited numbers.

(Gupta, Mohota, Datta, & Pradeep, 2019) [4] In this paper, data was collected through a questionnaire based survey on the basis of the demographic data of the respondents and questions about individual perception and opinion of awareness, usage, benefits, and constraints of robots and automation in the construction sector in India. And, favorable and non-favorable factor has also studied.
People in the industry don't know much about the latest technology and still using the old way of working and in this study, it is also visible that the source of information about the technology isn't from the workplace or institutes, but according to study the main source is an online platform like YouTube, Facebook, etc.
This technology has many benefits and potential in the construction industry, but this study reveals the current perception of the Indian construction industry that there are doubts about the compatibility of robots to various construction applications.

- This study is only focused on the adeptness of robotics in India. And only favorable and non-favorable factor has studied.
- People's opinion about using it or will use it or not, is not taken.
- So, doing research on much trending technology and finding out what people think about it will be helpful in the near future for a new generation.

(K & K, 2020) [5] In this paper methodology adopted is a questionnaire survey on the basis of benefits, difficulties, and measures of adopting prefabrication. Study regarding prefabrication has been carried out and factor which affects benefits, difficulties, and measures of adopting prefabrication has been studied in an area of Tamil Nadu, India.
In survey the main benefit showed are shorten construction time, reduce cost, while the main difficulty is inadequate suppliers of prefabrication.
Prefabrication is now started being used in India now but still, there are lots of barriers to adopting this technology.

- This study is focused on only the productivity of prefabrication in construction, so, knowing that what is potential of prefabrication compare to other technology is also important.
- There are no numbers showing how many people use this technology or not, and they will use or will not use it.

(Badawy & Omayer, 2020) [1] In this paper data was collected through a questionnaire based survey on the basis of people using it or not, the effect of BIM on tender preparation, the effect on the cost of the lifecycle, risk, analyzing, and help in clash detection.
This study is based in Egypt and from a survey, 77% of people don't use BIM in their company. Study show that those who are using BIM are getting benefits in cost, tender preparations, analyzing, and clash detection.
It shows clear benefits but still, a majority of people are not using BIM in their project and still use 2D drawing (Traditional Way) because of the lack of knowledge and benefits.

- In this paper, only one technology BIM is focused on.
- It doesn't show barriers to using BIM which are affecting those who are not using BIM.
- This paper is based on Egypt, so, it doesn't show conditions in India.

(Mishra, 2019) [7] In this paper methodology adopted is qualitative research of technology and its proficiency and only in-depth study of five emerging technology is taken which are 1. Virtual Design and Construction (VDC), 2. Drones, 3. 3D Printing, 4.Big Data, and 5. Mobile/ Paperless Tech.
Overview of those five technologies is taken in the study with pros of technology and based on that study conclusion is written.
This study shows that finding out technology that has potential can be a key point for an organization.

- This study only has a few of technology taken and only, use of technology has been given.
- Public opinion or any kind of survey has not been taken.

(Tkáč & Mésároš, 2019) [11] This paper is focused on drone use in the construction industry and detailed information on drones is given.
It also includes benefits it has in various perspectives and usefulness in the construction industry. And shows that how useful drones are in a construction process if being used and how much potential it has in the industry.

- This study is totally focused on drones and their usefulness.
- This study doesn't include a barrier to adoption in technology.
- It doesn't carry any survey or public opinion.

(Noghabaei, Heydarian, Balali, & Han, 2020) [8] This paper is focused on using AR & VR in the construction industry and has carried a survey on basis of using AR/VR and will use it in the future or not and the effectiveness of AR/VR.
This paper has carried two surveys on two different years for analyzing data and it shows that 40% of people were using AR/VR while 25% were not aware of it.
While more than 70% of all respondents say that AR/VR will be used on the majority of projects in the next 5 to 10 years.
A total of 55% of the participants said that more than 1% of savings can be achieved by using VR/AR tools during the design and construction phases.
This clearly shows that a majority of people are not using it right now but expecting to use it in the future.

- This paper is only focused on AR/VR and not on other technology.
- Barriers to the adoption of technology are not discussed which might change the future.

(Schia, Trollsås, Fyhn, & Ola, 2019) [10] This research paper is focused on the usefulness of AI in the construction industry and its impact on human behavior.
AI can work better than humans without doing mistakes and can give more efficient results but AI can't decide everything so, it needs collaboration with humans to give maximum results.
The world is going through digitalization where AI is going to develop more and more efficiently in the near future with more possible benefits.

- This paper is focused on theoretical data and any kind of survey is not conducted.
- This paper is only focused on one technology and its use.
- People's opinion regarding technology isn't taken.

(Vukomanovic, Radujkovic, & Alduk, 2012) [12] This paper is focused on PM Software used in the construction industry in three different countries, and in which processes they using it for, are they satisfied or not.
Survey results show that 56.2% of people use Excel for PM, followed by MS Project, GALA, and Primavera, with 26.5 %, 7.0 %, and 4.6 %, respectively.
Even after having batter software SEE country people still use basic software for PM, unlike the USA ware 64% company use Primavera for PM.
PM software has lots of benefits and potential in the construction industry if used in planning but compare to developed country undeveloped countries have fewer people using it.

- This paper not have conducted a survey on will people use it in the future or not.
- In this research, people know about PM software or not is not included in the survey.
- Only one technology of PM software is taken in the paper.

(Choi, Hwang, & Sungjoo, 2017) [3] This paper is focused on wearable technology (e.g., smart vest, wristband, etc.) and its usefulness also a survey on the basis of how many people have used it or not, will they adapt or not is carried out.
In the survey, only 15% of people was having experience with wearable technology, and the rest ware not having experience, but there are willing to adopt wearable technology.
Wearable technology has lots of potential in improving the safety of workers if applied in the construction industry, and it will also improve productivity.

- In this paper, only one technology is focused and the barrier to adopting technology hasn't discussed.
- This study is from the US so, it doesn't show conditions in India.

(Osunsanmi, Aigbavboa, & Oke, 2018) [9] In this paper, the focus is given to the willingness of adopting new technology in the construction industry in Africa. And the most preferred technology in Africa according to the result is prefabrication, BIM, and mobile computing.
Spreading awareness about new technology is necessary since it has more benefits but finding out which technology people are willing to use in the future is important too for preparing in advance.

- This study doesn't contain a survey regarding do people use stated technology or not.
- Also, this study doesn't contain a survey regarding barriers to using technology.
- This study is from Africa so, it doesn't show conditions in India.

Crux of Literature

All literature review shows that how useful new technologies are and how many benefits it has. In all literature details about technology is given, but every research has some of the gaps like in some paper only has detail information and use of technology is given while, in few papers survey is taken, but an only small area is covered and only one technology is discussed, meanwhile in few research papers more than one technology is taken, but the survey is limited like, people are using it or not type of question is asked.
There are few studies where the survey about willingness to adopt technology is taken, but barriers are not discussed and focused on a specific target.
Most of the studies aren't from India, so, it doesn't show conditions in India.
From all literature, it has been clear that awareness about new technology in the industry is low compare to other developed countries.
New technology has lots of benefits, but among them which one is people are willing to adopt fast and what are the barriers regarding adopting those technologies is also important. With the change of technology, the way of working in the construction industry is expected to change, but knowing the potential of technology in the field can be helpful in spreading awareness and can be a key point for the organization.

III. DATA COLLECTION

Data has been collected by studying research papers, articles, doing a web search, and by conducting questionnaire surveys through google form on the basis of objectives of study from construction industry related people.
Survey form has been shared via WhatsApp to the industry experts and students of the construction field and asked them to share with their contacts in the construction industry.
Data will be analyzed by reliability analysis for reliability check and the relative importance index for ranking.

Phase 1:

Selection of Trending Technology

By researching trending technology on the internet and studying research papers following technologies have been selected for this study.

- ✓ BIM (Building Information Modeling)
- ✓ AR & VR (Virtual Reality and Augmented Reality)
- ✓ Robotics and Automation
- ✓ Prefabrications
- ✓ Project Management Software's
- ✓ Wearables
- ✓ Drones
- ✓ AI (Artificial Intelligence)

Selection of barriers in adoption of technology

Selection of barriers is done by doing research on the internet and studying research papers related to barriers of technology adoption, and by asking industrial professionals "why they are not using new technology?"

Barriers which are selected for study are,

- ✓ Lack of budget
- ✓ Lack of Knowledge
- ✓ Lack of Skilled Staff
- ✓ Benefits are not enough
- ✓ Traditional methods
- ✓ Resistance to change
- ✓ Contraction market is not suitable yet
- ✓ Management hesitant
- ✓ Non-availability of technology
- ✓ Lack of trust in technology

Phase 2:

Questionnaire survey

After the selection of technology, a survey was formed on those technologies on the basis of objectives of the study.
The data sampling method selected for the survey is the "snowball sampling method".

Snowball Sampling Method

Snowball sampling is a non-probability sampling technique that is used by researchers to identify potential subjects in studies where subjects are hard to locate or unknown in numbers. [1]
Snowball sampling can be used to recruit participants via other participants. In which researchers share a survey with the people they know and ask them to share with another person with the same trait as your subjects.
The minimum sample size for a non-probability method is 20-35 for grounded theory.[2] Which is considered in this study.

For batter result and quality survey remark about a survey from an industry expert was taken for validation of the survey.

Link of Survey: https://forms.gle/RFSPmUQmxDEvsfD97

This survey is divided into total 4 sections which cover all objectives of this study as below,

Section 1

In this section on top, a short summary about the aim of the study is given and detail about respondents are collected such as names and professions.

Section 2

Use of Technology

In this section question is "whether people are using new technology or not, or they didn't know about those technologies here, each technology is listed with an option of

[1] Explorable.com (Apr 24, 2009).
[2] Source: Saunders, M., Lewis, P. & Thornhill, A. (2012) "Research Methods for Business Students" 6th edition, Pearson Education Limited

- Yes
- No
- I don't know

Where, select "Yes", if you have seen or used the following technology on your site., "No", if you haven't, and Select "I didn't know" if you don't know about the following technology Criteria have been given.

Section 3

Willingness of adopting technology in future

Question of this section is "what is the willingness of adopting technology in the future ?", each technology listed with an option of 5 Point Scale (1-Very Low, 2- Low, 3- Average, 4- high, 5- Very high) for measuring the willingness of people on adopting new trending technology.

Section 4

Barrier to the adoption of technology

In this section of the survey question asked is "What are the barriers in adopting new technology?" for determining barriers to adopting technology.
Barriers which are added in the survey are,

1. Lack of budget
2. Lack of knowledge
3. Lack of skilled staff
4. Benefits are not enough
5. Traditional methods
6. Resistance to change
7. Construction market is not suitable yet
8. Management hesitant
9. Non-availability of technology
10. Lack of trust in technology

IV. DATA ANALYSIS

Data analysis is the most important part of the study since it decides the conclusion of the study, hence for better results data analysis is done by using SPSS 28. For the reliability check and RII method for ranking.
In the survey total of 42 response has been collected, a response rate of the survey could not be calculated because snowball sampling was used in which a total number of individuals invited to participate could not reliably be determined.
From the total of 42 responses, there are Contractors, engineers, students (who are pursuing master in a civil branch having on-site experience), and from other professions related to construction.

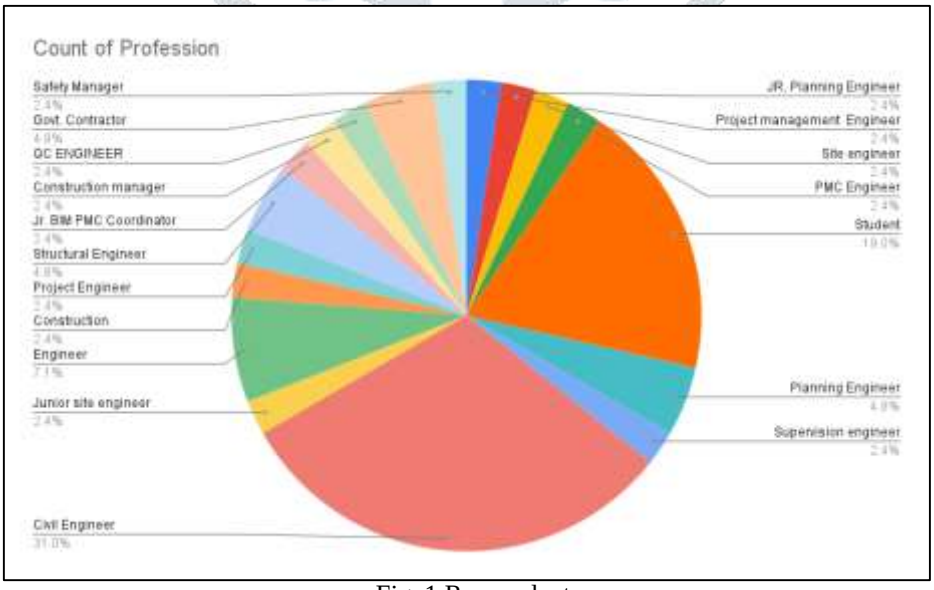

Fig. 1 Respondents

Out of the total 42 respondents, 31 % are civil engineers, 19% are students, 5 % contractors and 45% are from various professions from the construction industry.

Reliability Analysis:

Reliability analysis was performed in IBM SPSS 28. Where check was performed by Cronbach's alpha reliability test.

Table 1 Case Processing Summary

Case Processing Summary			
		N	%
Cases	Valid	42	100.0
	Excluded[a]	0	.0
	Total	42	100.0
a. List wise deletion based on all variables in the procedure.			

Table 2 Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.882	8

In the test result, Cronbach's alpha value for reliability was 0.882 which is good since 0.70 is a cut-off value for acceptance of data.

Ranking of Factors:

The Relative Importance Index is used for classifying the ranking for the willingness of using technology in the future.

$$Relative\ Importance\ Index = \sum W / (A\ X\ N) \qquad (4.1)$$

Where,

∑W = Sum of Weightage given to each factor by the respondents
A = Highest Weight (i.e. 5 in this case)
N = The Total Number of Respondents (i.e. 42 in this case)

Table 3 Ranking of factors for the willingness of adopting technology in future

Rank	Sr. No.	Technology	RII
1	5	Project Management Software's	0.8429
2	4	Prefabrication	0.8143
3	1	BIM (Building Information Modeling)	0.7810
4	6	Wearable	0.7429
5	3	Robotics and Automation	0.6571
6	7	Drones	0.6333
7	8	AI (Artificial Intelligence)	0.6143
8	2	AR & VR (Virtual and Augmented Reality)	0.5905

From the survey of willingness to adopt trending technology in the future, Project Management Software's was ranked first, similarly, prefabrication was second, BIM was third, Wearable was fourth, robotics and automation fifth, drones sixth, AI seventh, and AR&VR was on eight number.

This result shows that people are willing to adopt technology like, management software, prefabrication, and BIM which is people have more knowledge about and have seen being used.

Validation of Data Analysis

Validation of survey results has been checked by industry experts (which are mentioned in the validation of questionnaire survey) for figuring out fault or any suggestion in the result. In which question was asked that "are they satisfied with the result?", "Is there any need for change?" Result in all experts has no problem with the result and are satisfied.

V. FINDINGS/DISCUSSION

BIM (Building Information Modeling)

Building Information Modeling (BIM) is an emerging technology in the construction industry, though the concepts of BIM have been around since the 1970s it is still one of the trending technology. The concept of building information modeling is to build the project virtually so that all phases of the project can be planned and corrected before site construction begins. This level of preplanning includes spatial coordination of all the materials, labor, and sequencing for the construction of the project, and then allows for the virtual planning of how the building will be constructed.
Building information modeling has three primary spatial dimensions (width, height, and depth), in addition, time can also be added which called 4D BIM, and by providing a cost in the model it is defined as 5D BIM, also you can add (6D) sustainability, (7D) asset management, etc. BIM therefore covers more than just geometry.

Image source: wsp.com

Fig. 2 Building Information Modeling

- **Pros**
- Availability of accurate information for construction.
- Give an understanding of project costs, schedule, and project progress
- Reduced error, rework, and waste so, better sustainability for design and construction.
- Reduce cost by solving issues before even the project start.
- Increase the overall productivity of the project.

- **Cons**
- Need skilled staff.
- Software costs can be high on low-cost projects.
- Change in drawing can increase work in BIM.

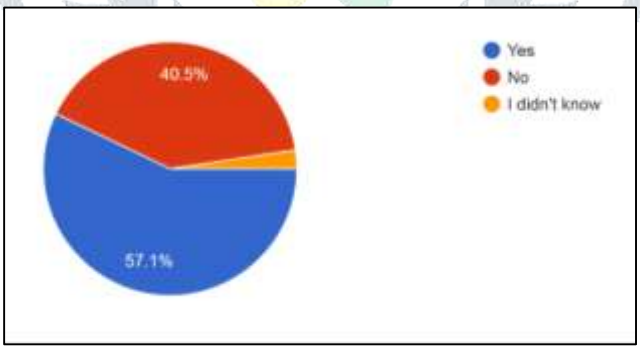

Fig. 3 Use of BIM

In a survey of either people use this technology or not 57.1% of respondents selected yes, which is more than half, and 40.5% of people haven't seen it in use while 2.4% weren't aware of this technology.
This result clearly shows that more than half of respondents are using, but there are still large numbers of people that are not using it while having so many benefits.
This technology is ranked 3rd in ranking of willingness to adopt in the future so, many people are willing to use this technology in the future and have potential in a future.

AR & VR (Virtual Reality and Augmented Reality)

AR & VR are two different technology where virtual reality (VR) enables you to fully immerse yourself in a computer-simulated reality and augmented reality (AR) on the other hand adds a virtual layer to the real world.
VR helps in visualizing the construction process and design for avoiding future problems while AR help before construction to see construction in the real world or during construction to understand the work.
Both of technology can be used to improve productivity in the construction industry and is very helpful.

Image source: pepperconstruction.com

Fig. 3 Augmented Reality

Image source: jasoren.com

Fig. 4 Virtual Reality

- **Pros**
- Help in stakeholder engagement to give realistic representation.
- Support designers to make design decisions and understanding them.
- Use in construction support (like, planning, monitoring, safety.)
- Helpful in operations and management.
- Useful in training.

- **Cons**
- High investment regarding device and skilled staff.
- Can be uncomfortable for users.
- Difficulty in achieving AR & VR outputs.

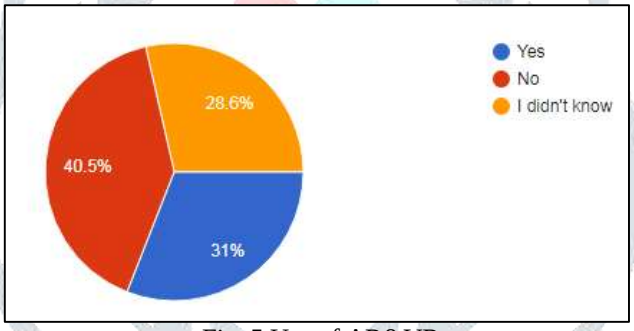

Fig. 5 Use of AR&VR

In a survey of people who have seen or used this technology or not 31% of respondents selected yes, which is not much and 40.5% of people haven't seen it in use while 28.6 % weren't aware of this technology which is quite a low awareness.
This result clearly shows that the use of technology is low and there are still large numbers of people that are not using it and not aware of it.
This technology is ranked 8th in the ranking of willingness to adapt in the future so, this technology has the lowest adoption rate in the future and will take a long time to be used in the industry.

Robotics and Automation

Robotics and automation are two different technology where, Automation is the process of using physical machines, computer software, and other technologies to perform tasks that are usually done by humans. While Robotics is the process of designing, creating, and using robots to perform a certain task.[3]
There are lots of robotics with or without automation that can help increase construction productivity. Like, automated excavator, sensor-based compactor, inspection robots, wall assembly robot, bricklaying machine, kerb casting machine concrete finishing robot, brick assembly robots, column welding robot, etc.,

[3] colors-newyork.com/author/Manon

Fig. 6 Sensor-based compactor

Fig. 7 Automated excavator

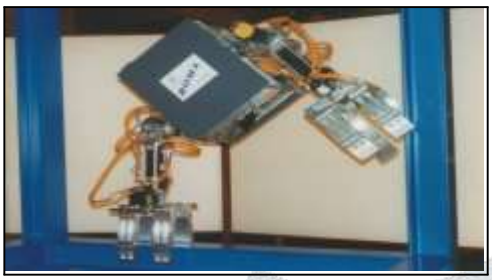

Fig. 7 climbing inspection robot

Fig. 8 Brick assembly robot

- **Pros**
- Reduce time duration of work complete.
- Increase productivity.
- Increase safety and reduce the risk for workers.
- Give batter work quality.

- **Cons**
- The cost is high.
- Need skilled and experienced staff.
- The wrong programming can result in faulty work.
- Malfunctioning in robots can be risky.

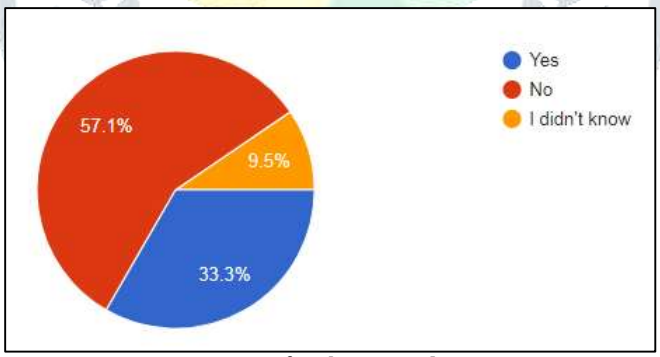

Fig. 9 Use of Robotics and Automation

In a survey of people use this technology or not 33.3% of respondents selected yes, which is not much and 57.1% of people haven't seen it in use while 9.5 % weren't aware of this technology.
This result clearly shows that the use of technology is low and there are still large numbers of people that are not using it and not aware of it.
This technology is ranked 5th in the ranking of willingness to adapt in the future, so, this technology has a medium adoption rate in the future.
Since robotics are costly many people avoid using them and are stuck on traditional ways. This problem may be solved in the future and more people started using it.

Prefabrication

Prefabrication is the technique where a component of the structure is manufactured in a factory or on a manufacturing site and then transporting the entire part to the construction site where work is going on.

This practice save lots of time in construction and give batter quality this technique is already started used by lots of Construction Company, but not significantly.

Image source: technologycards.net
Fig. 10 Prefabrication

- **Pros**
- Increase productivity.
- Reduce the timeline of the project.
- Maintain quality.

- **Cons**
- A component can damage while transporting.
- Transporting large components is difficult.
- Lack of manufacturers in the local area.

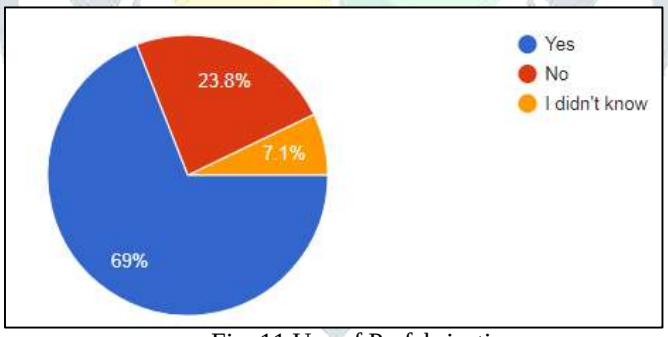

Fig. 11 Use of Prefabrication

In a survey of people use this technology or not 69% of respondents selected yes, which is high and 23.8% of people haven't seen it in use while 7.1 % weren't aware of this technology which is quite a good use of technology.
This result clearly shows that the use of technology is high and there are only small numbers of people that are not using it and not aware of it.
This technology is ranked 2nd in the ranking of willingness to adopt in the future so, this technology has the highest adoption rate in future and can be seen everywhere in the future. If someone wants to do business in an industry they should consider this technology.

Project Management Software's

Project management software is in the market for a long time and one of the trending technology.
Project management software has the capacity to plan, organize, and manage resources including estimation of cost. There are lots of management software like Primavera, MS Project, etc.

- **Pros**
- Help in planning projects.
- Give estimate cost.
- Help in monitoring progress.
- Help in completing the project on time.

- **Cons**
- Need skilled staff.
- The cost of software is high.
- Need to update data from time to time.

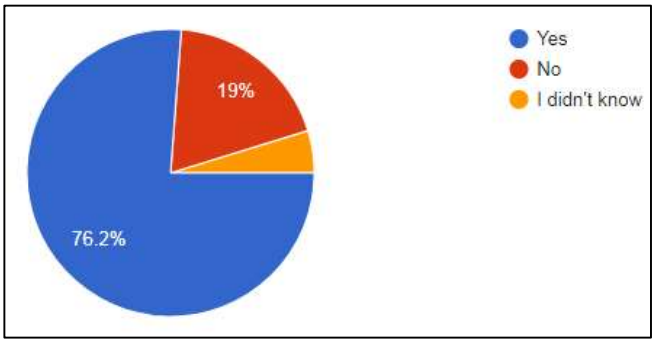

Fig. 12 Use of Project Management Software's

In a survey of people who have seen or used this technology or not 76.2% of respondents selected yes, which is the highest out of all technology and 19% of people haven't seen it in use while 4.8 % weren't aware of this technology.
This result clearly shows that the use of technology is the highest out of all technology listed, and there are still a few people that are not using it and not aware of it.
This technology is ranked 1st in the ranking of willingness to adopt in the future so, this technology has the highest adoption rate in future and can be seen everywhere in near future. Studying how to use that software may benefit in the future.

Wearables

Wearables are smart electronic devices that are worn on the human body, where they detect, analyze, and transmit information concerning work and workers.[4]
There are lots of devices like Smart helmets, Smart glasses, Smart safety vests, Smart work boots, Wearable sensors, etc.,

Image source: bigrentz.com
Fig. 13 Wearables

- **Pros**
- Increase the safety of workers.
- Easy communication.
- Monitoring on workers.

- **Cons**
- Need skilled staff.
- Cost can be high.
- Uncomfortable to some users.

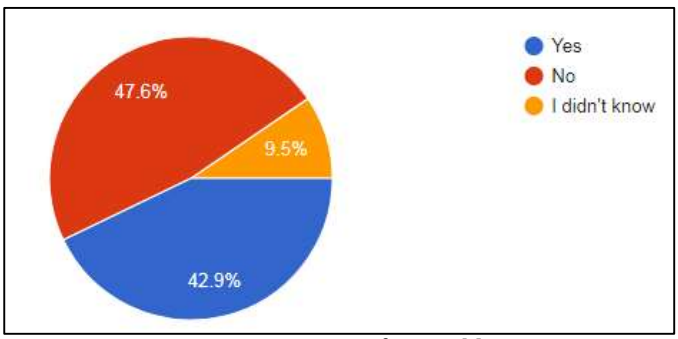

Fig. 14 Use of Wearables

[4] https://suomenapostolienblogi.blogspot.com/2021/05/wearable-electronic-devices

In a survey of people who use this technology or not 42.9% of respondents selected yes, which is not much and 47.6% of people haven't seen it in use while 9.5 % weren't aware of this technology which is a high number of people not using it.
This result clearly shows that the use of technology is low and there are still large numbers of people that are not using it and not aware of it.
This technology is ranked 4th in the ranking of willingness to adopt in the future so, this technology has quite a good adoption rate in the future and will take a long time to be used in industry since workers may like or not to wear those wearable devices.

Drones

Drones are considered as a trending technology and are started being used in many fields commonly drone is aircraft without a human pilot. Drones are known as unmanned aerial vehicles (UAV).
A drone can fly anywhere and give required data where humans can't reach. It can be used in construction for increasing productivity and quality control.

- **Pros**
- It can access every place on site.
- Help in doing surveys.
- Help in the inspection.
- Improve quality control.

- **Cons**
- Can be expensive.
- Need skilled operator.

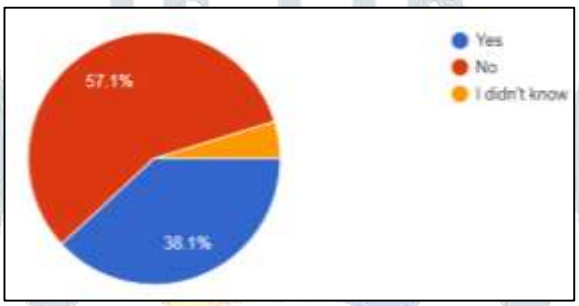

Fig. 15 Use of Drones

In a survey of people who have seen or use this technology or not 38.1% of respondents selected yes, which is not much and 57.1% of people haven't seen it in use while 4.8 % of people weren't aware of this technology which is quite a low use of technology.
This result clearly shows that the use of technology is low and there are still large numbers of people that are not using it and not aware of it.
This technology is ranked 6th in the ranking of willingness to adapt in the future, so, this technology has one of the lowest adoption rates in the future and will take a long time to be used in the industry.

AI (Artificial Intelligence)
AI is a simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. [5]AI technology allows the machine to mimic functions of humans such as learning and problem-solving, to conduct tasks that are normally performed by humans.

It can perform a task without in need of humans on the basis of the command programmed in it. There are many things where AI is being used like, 3D maps, Autonomous vehicles, drones, robots, safety sensors, etc.

- **Pros**
- Help in analyzing large data.
- Improve safety on site.
- Increase productivity and save time and cost.

- **Cons**
- Can be costly

[5] https://cybertecz.in/what-is-artificial-intelligence-future-of-artificial-intelligence/

- Malfunctioning in AI can Cause problems.

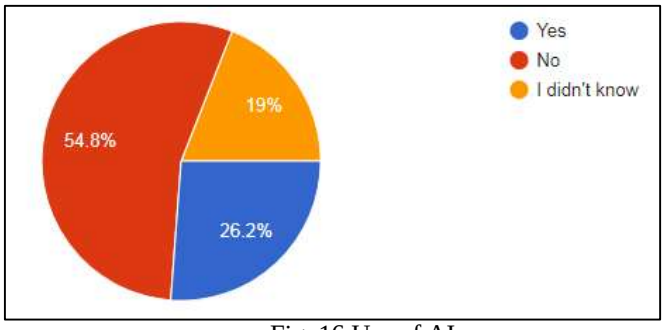

Fig. 16 Use of AI

In a survey of people who have seen or used this technology or not 26.2% of respondents selected yes, which is not much and 54.8% of people haven't seen it in use while 19 % weren't aware of this technology which is quite a high unawareness.
This result clearly shows that the use of technology is low and there are still large numbers of people that are not using it and not aware of it.
This technology is ranked 7th in the ranking of willingness to adapt in the future, so, this technology has one of the lowest adoption rates in the future. Since people don't trust machines so much adoption rate is quite low and India has a high unemployment rate that resists AI in the major sector, but in everyday life, AI is being started to used and there is a possibility that it will be started being used in the construction sector in the long run.

Barrier to Adoption of Technology

In this survey barrier in adopting technology has also studied, while people may want to adopt new technology, but there are lots of barriers that will stop them doing it. Hence, a barriers in the adoption of technology are important to study with an adoption rate of technology.

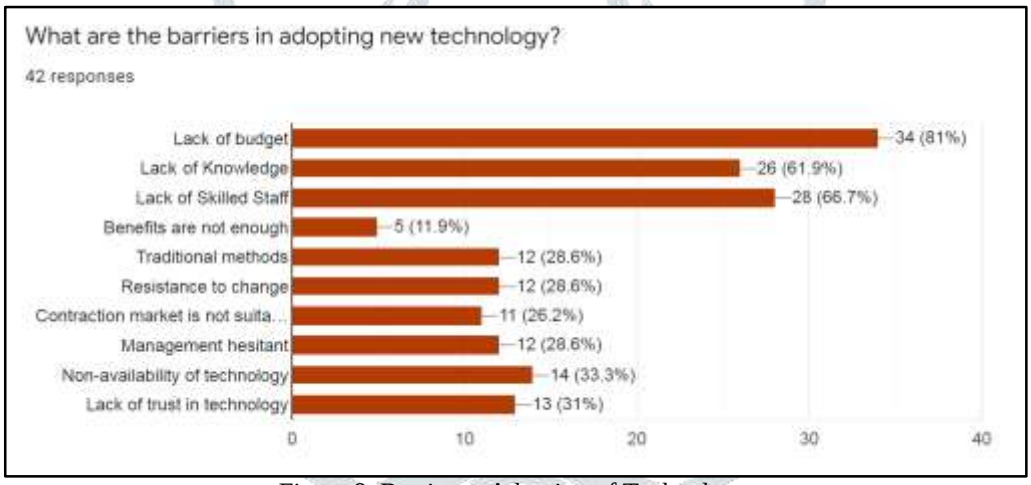

Figure 9. Barrier to Adoption of Technology

The question was asked to respondents that "What are the barriers to adopting new technology? "In which selected barriers were given with the option to add a new one.
Out of the total 42 responders, 34(81%) have selected lack of the budget as a primary barrier, It is a problem for the majority of people that they don't have enough budget for adopting new technology.
While 2nd number with 66.7% people selecting a lake of skilled staff, And 3rd 61.9% selecting lack of knowledge as a major barriers which affect the adoption of technology. With India having a low adoption rate of new technology people not giving priority to a knowledge of technology and having a shortage of skilled persons even if people want to adopt technology they need a skilled staff to adopt it.
Those factors are a major factor in adopting technology, while there are still many of them like, with 33.3% of people has selected non-availability of technology where people want to use technology, but not available in local, 31% selected lack of trust in technology, 26.6% of people selected traditional methods, resistance to change, and management hesitant, there are lots of people which are comfortable with the traditional way of working and don't want to adopt new things. While few people also selected a construction market is not suitable yet and benefits of technology aren't enough.

VI. CONCLUSION

The construction industry is one of the largest sector of the country where a large number of resource is being used every day so, making efficient use of those resource by using new technology has been an important thing to focus on. Hence, this study was aimed at figuring out the current use of technology, the future adeptness of those technologies, and a barriers affecting the adoption of technology.

In this study, it has been seen that project management software, prefabrications, and building information modeling are the technologies that are being used by most people and have most current use than other technology. While one that is lower in use and has low awareness are wearables, AR & VR, robotics and automation, drones, and Artificial intelligence.

While in a survey of adopting technology in the future, ranked 1st technology is a project management software's which also in highest in current use of technology. This technology is the highest selected one in a survey, while on 2nd rank is prefabrication and 3rd is BIM.

Those three technology has the highest number of people using with the highest number of people willing to adopt in the future since those technologies are likely to be seen in near future students should be having knowledge about those technology's and everyone should adopt those technologies for batter productivity.

Other than first three ranked technology, 4th is a wearable which is for safety and productivity improvement and should be batter practice to use this technology in the future.

While technology having a low adoption rate are ranking 5th is robotics and automation, on rank 6th drones, ranked 7th AI (Artificial Intelligence), and ranked 8th AR & VR (Virtual and Augmented Reality), Which are having a low adoption rate in near future as per survey due to lots of barriers.

According to the survey, major barriers to the adoption of technology are lack of budget selected by 81% of people, lack of skilled staff selected by 66.7% of people, a lack of knowledge selected by 61.9 % of people, those are major barriers selected by a majority of people.

Technologies have lots of benefits in the construction sector and are capable of improving productivity, quality and reducing resource uses. Hence, people should start using those technologies as much as possible for benefits and stop avoiding them. If one is looking forward to surviving in this competitive world having technology as the positive point may turn into a key differentiator for the future of the organization.

VII. Future Scope

Technologies are involving with the time hence, one can consider new trending technology with the potential in their future studies and can find out promising technologies in their result. In this study majority of technologies which are in trending have been taken, but there are lots of technology with the potential that can be considered in a study for further research work.

In this study methods for data collection are limited because of a pandemic but in the future, one can choose a better methodology that may give more quality results for their study.

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