Anbar Journal of Engineering Science (AJES) **Vol. 16 , No. 1 (2025) , pp. 48 ~ 60**
P-ISSN: 1997-9428 ; E-ISSN: 2705-7440 DOI: http://doi.org/10.37649/aengs.2025.156176.1119

University of Anbar

Anbar Journal of Engineering Science

journal homepage: https://ajes.uoanbar.edu.iq/

Construction Methods and Their Impact on the Productivity of the Construction Projects Site (Iraq Case Study)

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PAPER INFO

Paper history
Received: 26/12/2024
Revised: 14/02/2025
Accepted: 11/03/2025

Keywords:
Relative Importance Index (RII)
Traditional Construction
Prefabricated Construction
Steel Structure Construction
Precast Concrete Construction

ABSTRACT

This study aims to investigate the impact of various construction methods on labor productivity in Iraq, focusing on traditional, prefabricated steel structures, precast concrete, and mechanical or self-build construction techniques. The research employs a descriptive-analytical methodology, utilizing a structured survey distributed to 200 participants from different construction industry sectors, including engineers, contractors, and field workers. The survey examines key indicators of labor productivity, such as task completion speed, work quality, labor costs, safety, and project cost.

The findings reveal significant differences in labor productivity across the construction methods. Traditional construction methods moderately impacted task completion speed and work quality but were less efficient in terms of cost reduction and safety. On the other hand, prefabricated and precast concrete methods demonstrated improvements in work quality, safety, and cost efficiency, although with some limitations regarding flexibility. Steel structures offered enhanced durability and faster construction times, while mechanical and self-build methods utilizing automation significantly reduced labor costs and accelerated the construction process.

Based on these results, the study recommends incorporating modern construction methods, such as prefabricated and mechanical techniques, to improve overall productivity in the Iraqi construction sector. Additionally, it emphasizes the importance of training and adapting to these advanced methods to ensure long-term efficiency, safety, and cost-effectiveness in construction projects.

1. Introduction

The creation industry is one of the most complicated and impactful sectors in the country wide economic system, requiring excessive technical capabilities, green control, and the utility of present-day technologies to attain gold standard productivity [1]. In recent years, numerous studies have shown that distinctive construction techniques immediately affect hard work productiveness on construction web sites, starting from conventional methods to trendy tactics designed to boost initiatives and reduce fees. The have a look at by Soekiman et al. (2011) [2] offers a comprehensive analysis of the effect of conventional strategies on labor productivity at production web sites, indicating that manual hard work in traditional methods can lead to delays in mission completion, which in turn increases venture costs and extends crowning glory time [3].

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On the other hand, several innovations within the creation industry have emerged that contribute to enhancing productivity, including prefabricated production and metallic structures. The use of prefabricated homes drastically aids in decreasing the on-website labor time and fees, consequently dashing up the development system. This approach now not only reduces construction time but also effects in a better finished product [4]. Similarly, the usage of steel systems performs a crucial function in improving the structural overall performance of homes, enhancing their resistance to environmental situations, and consequently boosting productiveness whilst decreasing destiny renovation costs [5].

In addition to those techniques, precast concrete is any other innovation that has transformed how structural frameworks are constructed. spotlight the high-quality effects of the usage of precast concrete at the accuracy of dimensions and finishes, decreasing the want for transform, and enhancing labor performance [6]This era speeds up the construction technique while enhancing safety at production sites, making it a preferred choice for big-scale creation tasks.

Furthermore, mechanical or self-build production techniques, including automation technology, have been shown to increase productiveness by dashing up techniques and decreasing the need for guide hard work. reveal that automation now not only enhances the rate of production obligations but also contributes to reducing human errors and enhancing task accuracy [7]. Although the initial funding for these technologies may be high, the long-term advantages include better usual assignment efficiency and first-class final products.

In Iraq, the development industry faces unique challenges associated with economic and technological situations. While organizations try to improve productivity using these superior techniques, local elements influence the adoption of such innovations, including the lack of proper education and present-day technology. The literature addresses both the possibilities and demanding situations of the enterprise in Iraq, wherein the response to modern technology ranges from careful recognition to confined application. This study makes a speciality of studying the impact of those specific construction strategies on labor productivity in Iraq through a hard and fast survey questions designed to recognize how every production approach influences venture crowning glory velocity, paintings nice, and undertaking expenses.

2. Methodology

This study applied a descriptive-analytical technique to examine the effect of various production strategies on exertions productiveness in Iraq. A survey was designed with a fixed of questions aimed at assessing the effect of every production method on key indicators, which include task completion speed, work high-quality, exertions expenses, safety, and the overall undertaking price. The survey was changed and dispensed to two hundred participants from specific sectors of the development enterprise: engineers, contractors, and field employees.

The survey questions were classified based on the construction approach used, addressing how each approach affects the challenge of entire velocity, exceptional, protection, exertions charges, and the power of the mission for modifications after completion. The statistics were accumulated and analyzed using the Relative Importance Index (RII) scale and other statistical analysis strategies to discover patterns and tendencies in how the distinct creation methods affect hard work productiveness at production web sites.

3. LITERATURE REVIEW

Understanding hard work productiveness in the construction enterprise requires a broad view that sees it not as a standalone measure of worker performance but as a part of a standard system that integrates exertions, system, and capital to transform effort into valuable output. hard work productiveness ought to be seen as a detail inside this system, emphasizing that it's far greater than just a measure of hard work's ability to carry out duties.[8] The performance of an entire production operation and managerial and technical aspects play a critical function in determining productivity.

This observer empirically evaluated existing literature to comprehensively discover the elements that affect labor productivity in the Iraqi production industry. [4] The assessment aimed to perceive and categorize the key elements into relevant corporations. Table 1 summarizes the literature reviewed, listing the primary classes of things recognized and the whole range of things discussed by special authors.

Table 1. Summary of Literature Review

No	Authors	No. of Main Categories	Total No. of Factors
1	Jang, Kim, Kim, and Kim (2011)	4	25
2	Durdyev and Mbachu (2011)	8	56
3	Enshassi, Mohamed, Mustafa, and Mayer (2007)	10	……
1	Soekiman, Pribadi, Soemardi, and Wirahadikusumah (2011)	5	113
2	Gidado and Ailabouni (2012)	5	32
3	Hafez et al. (2014)	5	27
4	Shashank et al. (2014)	5	34
5	Makulsawatudom, Emsley, and Sinthawanarong (2004)	……	23
6	Hicksona and Ellis (2013)	5	42

From the literature overview, 5 essential factors have been diagnosed that can affect exertions' productiveness on construction websites.

The literature on construction techniques and their effect on work productivity famously covers a range of things that may affect performance, cost, safety, and the general achievement of production initiatives. Through an extensive literature assessment, five key creation techniques were recognized as having the potential to seriously affect work productivity on production websites. [4] These strategies include conventional construction (guide strategies), prefabricated production (ready-made buildings), steel shape construction, precast concrete construction, and mechanical or self-construct production (automation techniques). This phase outlines these methods, drawing from applicable research that provides insights into their advantages and demanding situations. [6]

Traditional Construction (Manual Method): [2]Pribadi, Soemardi, and Wirahadikusumah (2011) examined the impact of traditional manual techniques on production performance, highlighting the vast reliance on professional exertions for duties, masonry, and finishing work. They determined that even as guide methods allowed for more customization, they also caused longer project timelines due to slower project completion prices. Similarly, Gidado and Ailabouni (2012) [9] conventional techniques often led to better mistakes costs and lower first-class control than modern strategies, impacting usual productivity and growing remodel. This aligns with the findings from the survey inside the modern-day look at, in which traditional creation techniques had been ranked lower in terms of speed and protection, even though they scored better in terms of fee-effectiveness.

Prefabricated Construction (Ready-Made Buildings): Research by way of Hafez et al. (2014) [10]and Shashank et al (2014) [11]. supports the view that prefabricated construction techniques can considerably enhance hard work productivity. Using pre-manufactured components lets in for quicker on-site assembly, lowering labor time and minimizing delays associated with guide production methods. Prefabrication contributes to stepped forward best manipulate, as additives are produced in managed manufacturing unit environments. This approach has been proven to lessen waste, decrease cloth fees, and reduce the risk of accidents. These findings are consistent with the survey statistics in this study, where prefabricated construction strategies scored fantastically for lowering task timelines, exerting prices, and improving work quality.

Steel Structure Construction: In the look at by Makulsawatudom, Emsley, and Sinthawanarong (2004) [12], the usage of metallic systems became highlighted for its contribution to structural stability and resistance to outside forces like earthquakes and wind. Steel creation is likewise recognized to lessen the weight of homes, which could bring about much less foundation work and quicker installation times. However, the additionally cited metallic construction strategies no longer continually cause faster ordinary task finishing touch, because meeting steel additives on-website can be labor-intensive and time-consuming. This aligns with the survey results in this take a look at, where metal shape construction showed excessive scores for sturdiness but moderate scores for velocity and exertions productiveness. Steel production may be most beneficial for projects requiring resilience for a lengthy period in preference to speedy crowning glory.

Precast Concrete Construction: The blessings of precast concrete in improving labor productiveness were tested through Hicksona and Ellis (2013) [13], who stated that precast elements allow for particular manufacturing and faster installation on-website. The method reduces the need for good-sized on-web page hard work, as massive additives are already fabricated in a managed environment. Precast concrete complements safety because of the uniformity of components and fewer on-website dangers.

This supports the findings in the modern survey, in which precast concrete construction changed into rated incredibly for its effect on accuracy, price discount, and safety, but decrease in terms of design flexibility and mission timeline flexibility. [9]

Mechanical or Self-Build Construction (Automation Techniques): The use of mechanical and automation techniques, including cranes and robotic devices, is increasingly being followed to improve productiveness in production. Studies, including those using Soekiman et al. (2011) [2] and Gidado and Ailabouni (2012) [9] Automation techniques can notably boost production strategies, reduce manual labor, and enhance the accuracy of responsibilities. The use of cranes and other automated equipment allows for faster material management, while automation of repetitive tasks improves precision and reduces human blunders. These findings are contemplated in the modern survey outcomes, where mechanical creation strategies acquired the highest ratings for speed, accuracy, and exertions value discount.

Comparative Analysis and Implications for Labor Productivity: The literature review highlights a clear trend within the production enterprise toward adopting more efficient techniques, including prefabricated, metallic structure, precast concrete, and automation strategies. These techniques are proven to enhance exertions productivity by reducing guide labor, improving velocity, and enhancing good management. However, the selection of method depends on venture requirements, available assets, and particular constraints. [13] Regarding exertions productiveness, automation and prefabrication techniques are consistently rated better, as they reduce the time spent on-web site and permit extra specific and constant work. Steel shape and precast concrete methods, whilst beneficial for particular production varieties, won't constantly result in faster crowning glory times.

Challenges and Opportunities in the Iraqi Context: In the context of Iraq, the development industry faces precise challenges, which include a scarcity of skilled labor, frequent disruptions in supply chains, and financial constraints. While present-day production techniques, which include automation and prefabrication, offer clear blessings, they also come with excessive preliminary investment fees, which won't be feasible for all projects. The Iraqi construction sector, consequently, faces an important preference in balancing the need for speedy project finishing touch with available sources.

The opportunities for improving hard work productivity lie in investing in contemporary production technologies, enhancing worker schooling, and developing more efficient deliver chain management systems. However, addressing these challenges requires overcoming large economic and infrastructural barriers [14].

In end, the literature reviewed emphasizes the essential function that construction methods play in shaping labor productiveness. Prefabrication, automation, and metal systems can noticeably enhance performance and reduce prices. However, traditional construction methods remain relevant in certain contexts because of their cost-effectiveness, particularly for smaller or less complicated projects. The Iraqi production enterprise can benefit from adopting extra modern strategies, but challenges along with fee, schooling, and generation adoption need to be addressed to recognise these productivity profits completely [15] [16].

4. DATA ANALYSIS APPROACH

To analyze the collected data, the Relative Importance Index (RII) was calculated using the following formula number (1):

$$\text{RII (\%)} = \frac{5\times n5+4\times n4+3\times n3+2\times n2+1\times n1+5}{5(n5+n4+n3+n2+n1)} \quad (1)$$

Where:

- n1, n2, n3, n4, n5n_1, n_2, n_3, n_4, n_5n1, n2 , n3, n4, n5 represent the number of participants who rated a particular factor as having (1) No influence, (2) Weak influence, (3) Medium influence, (4) Strong influence, or (5) Very strong influence.

The RII was used to rank the various factors influencing labor productivity. The scores obtained allowed for the evaluation of the relative importance of these factors as perceived by the respondents. Additionally, SPSS 23 was utilized for all data analysis techniques [12] [17].

5. DATA ANALYSIS AND RESULTS

The study aimed to assess the impact of five elements on construction labor productivity in Iraq. These elements were grouped into 5 primary categories, as proven in Table 2. The comparative significance of each element inside its corresponding institution, as well as its universal ranking, become decided, evaluated, and as compared with findings from preceding comparable research [18].

Table 2: Proposed factors affecting labour productivity in Iraq

No.	Category	Proposed Factors Affecting Labor Productivity
1	Traditional Construction (Manual Method)	1. Use of manual tools and techniques
		2. Dependency on manual labor for walls and foundations
		3. Risk of accidents due to manual operations
		4. Speed of task completion using manual labor
		5. Cost implications of traditional methods
2	Prefabricated Construction (Ready-Made Buildings)	1. Use of prefabricated building components
		2. Reduced labor and time costs
		3. Safety and work environment provided by prefabricated structures
		4. Impact on the quality of finishing works
		5. Flexibility for expansion and modification of the structure
3	Steel Structure Construction (Metal Construction)	1. Durability and integrity of steel structures
		2. Reduction in the overall weight of the building
		3. Speed of construction using metal structures
		4. Resistance to natural disasters (earthquakes, wind)
		5. Long-term maintenance costs for steel structures
4	Precast Concrete Construction	1. Accuracy of dimensions and finishes with precast concrete
		2. Reduction in labor and waste costs
		3. Safety and reliability of precast components
		4. Impact on project timeline and schedule
		5. Ability to expand and modify the structure with precast concrete
5	Mechanical or Self-Build Construction (Automation Techniques)	1. Use of automation techniques (e.g., cranes, machines)
		2. Reduction in manual labor requirements
		3. Improved accuracy in construction tasks
		4. Impact of automation on overall project costs
		5. Flexibility for modifications and changes with automation

Before supplying and discussing the consequences, the descriptive analysis, which incorporates the individuals' history facts (illustrated in Figures 1 to 3), could be presented first. From those figures, it could be concluded that the individuals represent numerous roles within the production industry, including web page managers, task engineers, architects, supervisors, and laborers, ensuring a comprehensive angle. Additionally, the enjoy stages of the members are numerous, with a vast share having 5 to fifteen years of experience, highlighting their familiarity with enterprise practices even as additionally taking pictures insights from early-profession and veteran experts. [14] Furthermore, the information shows various degrees of exposure to construction methods, with some contributors reveling in more than one technique and others restrained to standard tactics. This diversity in backgrounds enhances the generalizability and relevance of the findings for evaluating productiveness elements in creation projects. Following the descriptive evaluation, each category can be mentioned individually to evaluate its impact on labor productiveness. An average dialogue of the findings will also be provided on the cease of the evaluation segment [19].

A. What is your current role or job title in the construction industry? (see Figure 1)

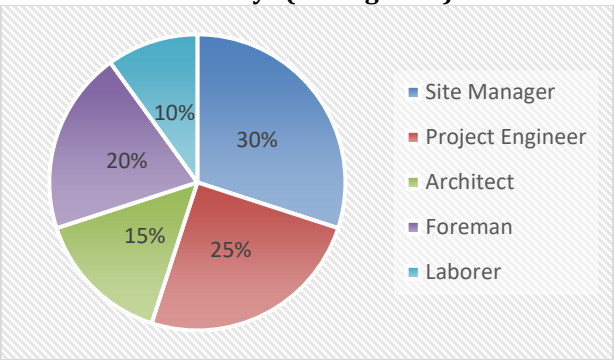

Figure 1. role or job title in the construction industry

B. How many years of experience do you have working in the construction sector? (see Figure 2)

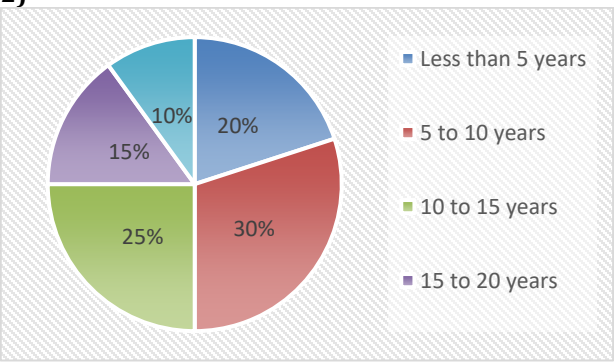

Figure 2. years of experience

C. Have you previously worked on construction projects using different methods (e.g., traditional, modular, prefabricated)? (see Figure 3)

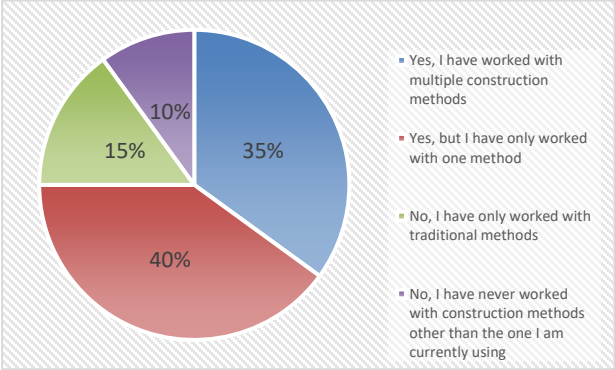

Figure 3. Construction projects using different construction methods

The distribution of participants' task titles exhibits a tremendous representation of website managers (30%) and undertaking engineers (25%), indicating a sturdy cognizance on managerial and technical roles within the construction industry. Architects make up 15% of the pattern, reflecting their involvement in design techniques. Supervisors and workers account for 30%, showcasing the diversity of hands-on people inside the sector. This distribution guarantees that the records reflect insights from diverse hierarchical tiers, from making plans to execution. The pattern covers a balanced representation of roles, permitting a complete knowledge of production productivity from each managerial and operational view [2], [20].

Most participants (30%) have among 5 and 10 years of enjoy, suggesting a focal point on mid-profession experts who own substantial but developing information. Meanwhile, 25% have 10 to fifteen years of enjoy, indicating a dependable pool of pro people. However, the look consists of 20% with much less than five years of experience, which might limit their capacity to offer insights into long-time productivity traits. The 10% with over two decades of experience provides credibility by incorporating views from industry veterans. The various enjoy ranges enrich the research using combining views from early-career, mid-career, and veteran specialists, though the especially high proportion of much less experienced members might also barely impact the intensity of the findings [21].

A considerable percentage of members (35%) have experience with a couple of production strategies, providing treasured insights into the comparative blessings and challenges of different strategies. The biggest group (40%) has labored with handiest one approach, reflecting specialization in positive tactics. A smaller percentage (15%) has used traditional strategies handily, indicating constrained exposure to modern strategies. Finally, 10% record no experience outside their contemporary methods, suggesting a want for further training or diversification. The responses spotlight a mix of specialised and assorted reviews, suggesting that whilst many members are acquainted with current construction methods, there stays room to make bigger their exposure to opportunity and innovative tactics [3], [22].

6. Results

Table 3: particularly traditional construction (manual method)

No.	Survey Question	No of Respondents	Mean	RII%
1	How much does the use of manual methods in construction influence the speed of task completion?	200	3.80	76.00
2	How does relying on manual labor for constructing walls and foundations affect the quality of work?	200	3.90	78.00
3	To what extent do manual techniques reduce the risk of accidents at the construction site?	200	3.50	70.00
4	What is the expected impact of using manual tools on the efficiency of finishing tasks?	200	3.70	74.00
5	How does reliance on traditional methods affect the overall cost of the project?	200	4.00	80.00

The desk (3) responds to two hundred individuals regarding the impact of traditional creation methods (guide techniques) on various aspects of creation productivity. The survey evaluated how these strategies impact project finishing touch velocity, pleasant labor, protection, performance, and basic project expenses. The effects from the survey regarding conventional creation (guide methods) display several key insights into its impact on construction hard work productiveness. Manual techniques moderately influence task crowning glory speed, with an average rating of three.Eighty (RII% of 76.00%) suggests that these methods tend to slow down the finishing touch of responsibilities compared to more mechanized techniques. However, the fine of work, mainly in constructing partitions and foundations, is

undoubtedly impacted, as pondered in a higher mean score of three.90 (RII% of 78.00%). This shows that manual exertions are often related to better craftsmanship and interest in the element, which complements the general quality of creation. Regarding protection, the influence of guide techniques in lowering the hazard of injuries at the construction site is moderate, with a median of three.50 (RII% of 70.00%). This suggests that while manual methods may lessen certain dangers, they do not offer equal safety as greater computerized or mechanized processes. In phrases of efficiency, using manual tools for finishing tasks indicates a mean score of three.70 (RII% of 74.00%), indicating that while these tools can be effective, they're no longer as efficient as modern-day technology, mainly due to longer timeframes for finishing positive obligations [7], [8].

Finally, reliance on conventional techniques tends to increase the general cost of the assignment, with a mean rating of four.00 (RII% of 80.00%). This result highlights the trade-off between exceptional and fee, wherein the longer construction time and want for skilled exertions contribute to better undertaking fees, in the end lowering the general productivity. In end, at the same time as conventional methods provide blessings in best and attention to detail, they lead to slower progress, better prices, and decreased performance, suggesting that adopting more contemporary techniques could improve productivity at construction sites [4], [23].

Table 4: Prefabricated Construction (Ready-Made Buildings)

No.	Survey Question	No of Respondents	Mean	RII%
1.	How much does the use of prefabricated buildings influence the speed of project completion?	200	4.10	82.00
2.	How does using prefabricated buildings help reduce labor and site time costs?	200	4.00	80.00
3.	To what extent do prefabricated buildings provide a safer and more suitable work environment?	200	3.80	76.00
4.	What is the expected impact of using prefabricated buildings on the quality of finishing works?	200	3.90	78.00
5.	How does the design of prefabricated buildings affect the ability to expand and modify the structure after construction?	200	3.60	72.00

In desk (4) The outcomes from the survey on prefabricated production (ready-made homes) offer valuable insights into the effect of this production technique on exertions productivity. Prefabricated production extensively enhances the speed of mission completion, with a mean rating of 4.10 (RII% of 82.00%), indicating that using prefabricated buildings hurries up the overall construction timeline compared to traditional techniques. This is essentially due to the reality that a lot of the work is performed off-site, reducing on-website online creation time. Regarding fee efficiency, the usage of prefabricated homes allows less exertion and site time charges, as reflected within the suggest rating of four.00 (RII% of 80.00%). By minimizing on-web site labor and the time spent on the web site, initiatives are finished more quickly, leading to lower average prices, enhancing this method's cost-effectiveness. Regarding safety and painting environments, prefabricated homes contribute to a more secure and greater suitable work environment, with an average rating of 3.80 (RII% of 76.00%). This result indicates that at the same time as prefabricated techniques enhance protection compared to traditional production, there may also nevertheless be room for similarly upgrades in creating even safer work situations. In terms of pleasant, prefabricated homes positively affect the quality of work completion, with an average score of three.90 (RII% of 78.00%). This indicates that prefabrication contributes to higher pleasant standards, as additives are produced in managed factory environments, ensuring consistency and precision. [4] However, the layout of prefabricated homes may additionally restrict flexibility for future expansions or modifications, as shown using the decrease imply rating of three.60 (RII% of 72.00%). This suggests that at the same time as prefabricated buildings offer advantages in velocity and cost, their designs may be much less adaptable to destiny changes or expansions, which might be a capability drawback for positive tasks [6], [24].

In conclusion, prefabricated construction offers extensive advantages in terms of pace, value reduction, and protection, making it an enormously green method for production projects. However, limitations in layout flexibility for future modifications can be an issue depending on the nature of the undertaking.

Table 5: Steel Structure Construction (Metal Construction)

No.	Survey Question	No of esponde nts	Mean	RII%
1	ɔw much does using steel ɾuctures influence the ɪrability and integrity of the ɪilding's framework?	200	4.30	86.00
2	ɔw does the use of metal ɾuctures contribute to ducing the overall weight of e building?	200	4.00	80.00
3	› what extent does the use of ɛel structures accelerate the ɪnstruction process?	200	3.90	78.00
4	hat is the expected impact of ing steel structures on the ɪilding's resistance to rthquakes and wind?	200	3.85	77.00
5	ɔw does choosing steel ɾuctures affect the long-term aintenance costs of the ɪilding?	200	3.70	74.00

The table (5(The survey effects for metallic shape construction (metallic creation) screen several key insights into the impact of this approach on labor productivity and the overall performance of creation projects. Steel systems are pretty valued for their sturdiness and integrity, as indicated by the very best suggest rating of 4.30 (RII% of 86.00%). [13], [25] This suggests that the usage of metallic structures substantially complements the long-term stability and strength of the building's framework, making it a favored choice for tasks requiring robust structural aid. Steel systems also decrease the overall weight of the construction, with a median score of four.00 (RII% of 80.00%). The reduced weight results in fewer foundation necessities and permits for faster and extra efficient construction, which undoubtedly affects exertions productivity using minimizing the attempt required for handling and assembling materials. In terms of rushing up the construction process, metallic systems have a wonderful impact, as reflected inside the imply rating of 3.Ninety (RII% of 78.00%). This suggests that metallic components may be pre-fabricated off-website online and assembled quickly online, mainly for quicker assignment crowning glory compared to traditional methods.

The use of metallic systems additionally presents good-sized benefits for the building's resistance to external forces, including earthquakes and wind, with a median rating of 3.Eighty five (RII% of 77.00%). This shows that metallic production is recognized for its capacity to withstand seismic and wind forces, supplying better protection to the building and ensuring its resilience. [14] Lastly, the long-time period preservation costs of buildings constructed with metal structures are also an attention, with a median rating of 3.70 (RII% of 74.00%). While metal structures tend to have decreased renovation requirements compared to other materials, this end result indicates that there are still a few ongoing expenses related to their renovation, but these are surprisingly attainable [9], [26].

In conclusion, steel structure construction offers great blessings in phrases of durability, weight loss, speed of construction, and resistance to herbal forces like earthquakes and wind. These factors contribute to stepped forward labor productivity and typical undertaking performance. However, interest need to take delivery of two lengthy-term preservation costs, though they're commonly lower than the ones associated with other production techniques.

Table 6: Precast Concrete Construction

No.	Survey Question	No of Respondents	Mean	RII%
1	How much does using precast concrete affect the accuracy of dimensions and finishes?	200	4.20	84.00
2	How does using precast concrete help reduce labor and waste costs?	200	4.10	82.00
3	To what extnt does using precast concrete improve safety and reliability?	200	4.00	80.00
4	What is the expected impact of using precast concrete on the project's timeline?	200	3.80	76.00
5	How does using precast concrete affect the ability to expand and develop the structural framework?	200	3.60	72.00

The table (6) The survey effects for precast concrete creation reveal several key insights into the effect of this method on venture overall performance and hard work productiveness. Precast concrete is especially valued for its ability to enhance the accuracy of dimensions and finishes, with the very

best mean score of four.20 (RII% of 84.00%). This shows that precast additives are manufactured with high precision in controlled manufacturing unit situations, ensuring the final shape meets actual specs and decreasing the chance of mistakes for the duration of creation. [15] The use of precast concrete additionally contributes to decreasing hard work and waste charges, as indicated by using the second-highest imply score of 4.10 (RII% of 82.00%). The prefabrication system allows for a discount in the amount of on-website labor required, at the same time minimizing cloth waste. These factors assist in streamlining the construction process, leading to value financial savings and advanced productiveness. In terms of protection and reliability, precast concrete indicates sturdy performance, with a mean rating of 4.00 (RII% of 80.00%). The use of precast factors improves safety on construction web sites by way of decreasing the want for complex on-website online operations and providing a greater predictable production schedule. Additionally, the controlled manufacturing surroundings complements the reliability of the components, ensuring that they meet strict great standards [12], [27].

The impact of precast concrete at the task timeline is likewise noteworthy, with a mean score of 3.80 (RII% of 76.00%). Precast concrete can boost construction timelines by considering simultaneous web site instruction and the fabrication of components off-web site. However, a few demanding situations may also arise related to logistics and scheduling, which may barely affect ordinary assignment duration. Finally, the capacity to enlarge and expand the structural framework using precast concrete scored the lowest with a mean of three.60 (RII% of 72.00%). This shows that at the same time as precast concrete affords several benefits in terms of structural integrity and assignment performance, it is able to present limitations on the subject of future modifications or expansions due to the pre-defined nature of the additives [18], [28].

In conclusion, precast concrete construction offers widespread benefits in terms of accuracy, price discount, protection, and reliability. These factors positively affect work productivity and venture performance. However, there are some challenges in terms of pliability for future expansions, which must be considered throughout the layout and planning stages.

Table 7: Mechanical or Self-Build Construction (Automation Techniques)

No.	Survey Question	No of Respondents	Mean	RII%
1	How much does using automation techniques like cranes influence the speed of work completion on-site?	200	4.50	90.00
2	How does relying on mechanical equipment reduce the need for manual labor?	200	4.30	86.00
3	To what extent do automation techniques improve the accuracy of construction tasks?	200	4.10	82.00
4	What is the expected impact of mechanical equipment on the overall project cost?	200	3.90	78.00
5	How does using automation techniques affect the flexibility for modifications and changes in the project?	200	3.80	76.00

The table (7) The survey effects for mechanical or self-construct creation, which specializes in using automation strategies, including cranes and other mechanical gadgets, imply a strong high-quality effect on labor productiveness and undertaking performance. The maximum-ranking factor on this class is the affect on of automation techniques like cranes on the velocity of labor final touch on-site, with an average score of 4.50 (RII% of 90.00%). This result indicates that automation is important in extensively speeding up production strategies, particularly in tasks that might otherwise require tremendous manual exertions. As an instance, cranes enable quicker handling and motion of heavy substances, reducing delays and enhancing usual productiveness on-site. The 2d most influential aspect is the discount of manual exertions through the usage of mechanical devices, with an average score of 4.30 (RII% of 86.00%). This indicates that automation reduces the dependence on human labor for bodily disturbing tasks, mainly for extended performance, decreased labor fees, and probably fewer worker-associated injuries. The ability to automate tasks additionally improves consistency and precision in creation activities. Automation techniques also improve the accuracy of creation tasks, with a median score of 4.10 (RII% of 82.00%).

The precision of machines and automation equipment guarantees that production duties are completed with excessive accuracy, lowering mistakes and the need for remodel, which in the end contributes to exertions productiveness and first-rate control [29].

In terms of assignment fee, the effect of using mechanical gadgets scored a median of 3.Ninety (RII% of 78.00%), indicating that whilst automation can reduce labor prices, it would require a higher initial funding in equipment and equipment. The cost savings, however, are realized over time through multiplied velocity and reduced guide labor expenses.

The flexibility for changes and adjustments throughout the task become ranked lowest, with a median score of three.80 (RII% of 76.00%). This indicates that, while automation brings numerous advantages, it might provide much less flexibility compared to greater traditional production methods. Automated systems and equipment are typically designed for precise tasks, and adapting them for assignment scope modifications can be tougher. In conclusion, mechanical or self-build construction using automation techniques significantly improves the speed, accuracy, and performance of production projects. While the initial investment in equipment might be higher, the long-term advantages, such as reduced labor expenses and progressed productivity, make this technique distinctly effective. However, concerns regarding the ability of changes and the preliminary fees must be made at some stage in the planning phase [19], [30].

7. DISCUSSION:

In this take a look at, five creation strategies had been analyzed to evaluate their impact on hard work productiveness in Iraq. The methods included have been traditional production (guide approach), prefabricated construction (equipped-made buildings), metallic structure creation, precast concrete creation, and mechanical or self-build production (automation techniques). Based on the survey responses, it is clear that every method has various stages of effect on productivity, with some promoting better performance even as others gift demanding situations. The following discussion evaluates those five methods, referencing the survey results from 2 hundred respondents.

Traditional Construction (Manual Method): The traditional production approach, relying heavily on guide exertions, ranked high in the survey for its effect on exertions productivity, particularly in terms of the cost of the challenge (RII% 80.00). However, it acquired decreased ratings for speed (RII% 76.00) and protection (RII% 70.00). Respondents indicated that even as manual hard work allows for distinctive craftsmanship, it additionally slows down the general pace of creation. The reliance on manual strategies for tasks such as wall and foundation construction regularly leads to delays, as employees are required to perform repetitive responsibilities without the aid of contemporary machinery. This suggests that even as conventional techniques are familiar and price-effective, they may be less efficient in terms of time and safety as compared to more contemporary methods. [2], [31].

Prefabricated Construction (Ready-Made Buildings): Prefabricated construction emerged as one of the most efficient methods for enhancing labor productivity, as indicated by the survey effects. The technique's effect on speed (RII% 82.00) and value discount (RII% 80.00) obtained the best ratings for all elements analyzed. Prefabricated creation lets in for additives to be manufactured off-site, decreasing the time spent on-site and minimizing hard work and fabric waste. Moreover, prefabricated buildings provide extra protection (RII% 76.00) and better first-rate finishes (RII% 78.00), constructed in controlled environments. Respondents highlighted that prefabricated creation notably hastens task timelines, boosting ordinary productiveness. Despite those advantages, the layout flexibility of prefabricated buildings obtained a decreased rating (RII% 72.00), indicating that modifications and customizations can be more challenging [21].

Steel Structure Construction: Steel systems are extraordinarily regarded for their sturdiness (RII% 86.00) and ability to resist external forces, including earthquakes and wind (RII% 77.00). Respondents cited that metallic structures additionally contribute to reducing the overall weight of the construction (RII% 80.00), which can assist in optimizing cloth usage and enhancing the project's structural integrity. However, metallic construction does not substantially boost up the development manner (RII% 78.00), and preservation prices have been seen as a capacity downside (RII% 74.00). While metallic production is robust and able to withstand tough situations, the manner of assembling steel systems on-site may be extra time-consuming as compared to prefabricated construction or automation techniques. As a result, even though steel systems are beneficial for the long-term performance of buildings, their effect on labor productiveness is quite neutral compared to quicker construction methods [32].

Precast Concrete Construction: Precast concrete, like metal production, is thought for its precision and ability to enhance the accuracy of creation duties (RII% 84.00). Respondents indicated that precast concrete factors contribute substantially to lowering

hard work and waste prices (RII% 82.00), as the manufacturing process occurs in managed manufacturing facility environments. This results in less material wastage and fewer mistakes, which without delay improves hard work productivity on-site. Precast concrete enhances safety (RII% 80.00) due to its standardization and first-rate manipulation at some point in production. However, just like prefabricated creation, the flexibility to regulate the design after the shape is ready in the area is constrained (RII% 72.00). The impact on the task timeline (RII% 76.00) is also mild. However the use of precast concrete remains tremendously fantastic in terms of value-performance and hard work productiveness whilst thinking about the overall construction manner [32].

Mechanical or Self-Build Construction (Automation Techniques): Automation techniques, which include cranes and robotic machinery, acquired the best scores for influencing velocity (RII% 90.00) and hard work reduction (RII% 86.00). The use of mechanical gadgets appreciably boosts exertion productiveness by lowering the dependency on guide exertions and rushing up duties, including fabric handling and location training. Survey participants also noted that automation improves assignment accuracy (RII% 82.00) and reduces human error. The impact of automation on price (RII% 78.00) is generally fantastic because it reduces labor costs through the years. However, automation has limitations regarding flexibility for changes within the layout (RII% 76.00), and the preliminary investment in machinery and gadgets is better. Despite those worries, the general impact of automation on labor productivity is giant, as it not only speeds up the development process but also enhances the satisfaction of work with the aid of reducing human errors.

Comparative Analysis and Implications for Labor Productivity: When evaluating all 5 creation techniques, it is glaring that strategies that make use of off-web site manufacturing, inclusive of prefabricated and precast concrete production, have a giant effect on exertions productiveness. These techniques lessen on-website online labor wishes and shorten mission timelines, making them somewhat effective in environments wherein time and value efficiency are crucial. Traditional strategies, at the same time as nonetheless precious for certain types of paintings, are slower and more significant labor-intensive, making them less suitable for initiatives that demand short turnaround times [33].

Steel structure production offers blessings in phrases of sturdiness and resistance to external forces; however, it no longer appreciably improves exertions productivity compared to prefabricated or computerized methods. The use of automation strategies stands proud as a transformative factor, as it affects velocity, accuracy, and labor performance. However, the excessive preliminary prices may deter some projects from adopting this method in the short term.

Challenges and Opportunities inside the Iraqi Context: The creation industry in Iraq faces specific challenges, along with hard work shortages, protection worries, and mission delays. Methods that lessen the reliance on guide labor, such as automation and prefabricated creation, offer sizeable possibilities to cope with these challenges. Given the USA's desire for speedy infrastructure improvement and reconstruction, adopting advanced construction techniques could enhance productivity and first-class projects. However, monetary constraints and restraints to entry to superior equipment might also restrict the sizeable adoption of those techniques, especially in smaller-scale tasks.

8. Conclusions

In summary, the construction techniques examined in this research have varied degrees of influence on the work that workers can accomplish. Implementing prefabricated building and mechanical automation systems can significantly improve efficiency, lower costs, and increase safety throughout construction. Although steel structure and precast concrete methods offer advantages in terms of durability and precision, they are not as successful as other approaches in accelerating the construction process. Traditional building, even though it is still commonly employed, provides additional obstacles regarding productivity and efficiency. For Iraq to increase labor productivity, decrease costs, and satisfy the growing demand for construction projects, it may be necessary to adopt modern construction technologies.

Funding

No funding was received for this work

Acknowledgments

We are grateful to everyone who provided support to make this work a success. Thank you.

References

[1] M. A. J. Q. Franco, P. Pawar, and X. Wu, "Green building policies in cities: A comparative assessment and analysis," Energy Build, vol. 231, p. 110561, 2021, doi: https://doi.org/10.1016/j.enbuild.2020.110561.

[2] A. Soekiman, K. Pribadi, B. Soemardi, and R. Wirahadikusumah, "Factors Relating to Labor Productivity Affecting the Project Schedule Performance in Indonesia," Procedia Eng, vol. 14, pp. 865–873, Dec. 2011, doi: 10.1016/j.proeng.2011.07.110.

[3] M. R. Kadir, W. P. Lee, M. S. Jaafar, S. Sapuan, and A. Ali, "Factors affecting construction labour productivity for Malaysian residential projects," Structural Survey, vol. 23, pp. 42–54, Feb. 2005, doi: 10.1108/02630800510586907.

[4] K. El-Gohary and R. Eskander, "Factors Influencing Construction Labor Productivity in Egypt," Journal of Management in Engineering, vol. 30, pp. 1–9, Jan. 2014, doi: 10.1061/(ASCE)ME.1943-5479.0000168.

[5] A. Visca, L. Di Gregorio, E. Clagnan, and A. Bevivino, "Sustainable strategies: Nature-based solutions to tackle antibiotic resistance gene proliferation and improve agricultural productivity and soil quality," Environ Res, vol. 248, p. 118395, 2024, doi: https://doi.org/10.1016/j.envres.2024.118395.

[6] A. Enshassi, S. Mohamed, and P. Mayer, "Factors affecting labour productivity in building projects in the Gaza strip," JOURNAL OF CIVIL ENGINEERING AND MANAGEMENT, vol. 13, pp. 245–254, Dec. 2007, doi: 10.3846/13923730.2007.9636444.

[7] F. M. Al-Zwainy, A. Mohammed, and H. Aljumaily, "Using Multivariable Linear Regression Technique for Modeling Productivity Construction in Iraq," Open Journal of Civil Engineering, vol. 03, pp. 127–135, Jan. 2013, doi: 10.4236/ojce.2013.33015.

[8] S. Durdyev and J. Mbachu, "On-site Labour Productivity of New Zealand Construction Industry: Key Constraints and Improvement Measures," Australasian Journal of Construction Economics and Building, vol. 11, pp. 18–33, Sep. 2011, doi: 10.5130/ajceb.v11i3.2120.

[9] N. Ailabouni, N. Painting, and P. Ashton, "Factors affecting employee productivity in the UAE construction industry," Association of Researchers in Construction Management, ARCOM 2009 - Proceedings of the 25th Annual Conference, pp. 555–564, Jan. 2009.

[10] R. Eskander, S. Hafez, E. Morgan, M. Mohammed, and E. Ahmed, "Critical factors affecting construction labor productivity in Egypt," Feb. 2014.

[11] A. J.Dakhil, Z. M.Naji, and S. K.Faleh, "Factors Affecting Construction Labour Productivity in Iraq Using Basra City As a Case Study," Kufa Journal of Engineering, vol. 8, no. 3, pp. 55–75, 2017, doi: 10.30572/2018/kje/8031157.

[12] A. Makulsawatudom, M. Emsley, and K. Sinthawanarong, "Critical Factors Influencing Construction Productivity in Thailand," Construction, vol. 14, no. 3, pp. 1–6, 2004.

[13] B. Hickson and L. Ellis, "Factors affecting Construction Labour Productivity in Trinidad and Tobago," The Journal of the Association of Professional Engineers of Trinidad and Tobago, vol. 42, Apr. 2014.

[14] H. Jang, K. Kim, J. H. Kim, and J. Kim, "Labour productivity model for reinforced concrete construction projects," Construction Innovation: Information, Process, Management, vol. 11, pp. 92–113, Jan. 2011, doi: 10.1108/14714171111104655.

[15] I. Mahamid, "Common risks affecting time overrun in road construction projects in Palestine: Contractors' perspective," Australasian Journal of Construction Economics and Building, vol. 13, p. 45, Jun. 2013, doi: 10.5130/ajceb.v13i2.3194.

[16] A. M. R. Mahjoob, A. M. Burhan, R. A. R. Ibraheem, O. A. Al-Juboori, and H. A. Rashid, "The adoption of green management in Iraqi construction industry: The challenges and benefits," Periodicals of Engineering and Natural Sciences, vol. 10, no. 5, pp. 101–114, 2022, doi: 10.21533/pen.v10i5.3324.

[17] N. Shrestha, "Factor Analysis as a Tool for Survey Analysis," Am J Appl Math Stat, vol. 9, no. 1, pp. 4–11, 2021, doi: 10.12691/ajams-9-1-2.

[18] P. O. Olomolaiye, A. K. W. Jayawardane, and F. Harris, Construction Productivity Management. in Chartered Institute of Building Series. Longman, 1998. [Online]. Available: https://books.google.iq/books?id=fzFPAAAAMAAJ

[19] K. J. Shashank, S. Hazra, and K. N. Pal, "Analysis of Key Factors Affecting the Variation of Labour Productivity in Construction Projects," 2014. [Online]. Available:

https://api.semanticscholar.org/CorpusID:155 53119

[20] P. Bijalwan, A. Gupta, A. Johri, and M. Asif, "The mediating role of workplace incivility on the relationship between organizational culture and employee productivity: a systematic review," Cogent Soc Sci, vol. 10, no. 1, p. 2382894, Dec. 2024, doi: 10.1080/23311886.2024.2382894.

[21] T. H. Randolph and N. C. L., "Quantitative Effects of Construction Changes on Labor Productivity," J Constr Eng Manag, vol. 121, no. 3, pp. 290–296, Sep. 1995, doi: 10.1061/(ASCE)0733-9364(1995)121:3(290).

[22] J. L. Davis, "Science , Fiction , and the Hollywood Machine : Creators and Consultants , Consensus and Conflict," 2022.

[23] B. Nikmehr, M. R. Hosseini, I. Martek, and E. K. Zavadskas, "B Nikmehr; M Hosseini; I Martek ; E Zavadskas; J Antucheviciene -2021- Digitalization as a Strategic Means of Achieving Sustainable Efficiencies in Construction Management. A Critical Review.pdf," Sustainability (Switzerland), vol. 13, pp. 1–12, 2021.

[24] M. N. Yabanigül and D. Gulec Ozer, "Exploring Architectural Units Through Robotic 3D Concrete Printing of Space-Filling Geometries," Buildings, vol. 15, no. 1, 2025, doi: 10.3390/buildings15010060.

[25] A. Laureys, R. Depraetere, M. Cauwels, T. Depover, S. Hertelé, and K. Verbeken, "Use of existing steel pipeline infrastructure for gaseous hydrogen storage and transport: A review of factors affecting hydrogen induced degradation," J Nat Gas Sci Eng, vol. 101, p. 104534, 2022, doi: https://doi.org/10.1016/j.jngse.2022.104534.

[26] A. Keshmiry, S. Hassani, U. Dackermann, and J. Li, "Assessment, repair, and retrofitting of masonry structures: A comprehensive review," Constr Build Mater, vol. 442, p. 137380, 2024, doi: https://doi.org/10.1016/j.conbuildmat.2024.137380.

[27] K. W. See et al., "Critical review and functional safety of a battery management system for large-scale lithium-ion battery pack technologies," Int J Coal Sci Technol, vol. 9, no. 1, 2022, doi: 10.1007/s40789-022-00494-0.

[28] E. Cakici, I. Kucukkoc, and M. Akdemir, "Advanced constraint programming formulations for additive manufacturing machine scheduling problems," Journal of the Operational Research Society, pp. 1–16, doi: 10.1080/01605682.2024.2382867.

[29] G. Robles, A. Stifi, J. Ponz-Tienda, and S. Gentes, "Labor Productivity in the Construction Industry -Factors Influencing the Spanish Construction Labor Productivity-," International Journal of Civil, Architectural, Structural and Construction Engineering, vol. 8, pp. 999–1008, Jan. 2014.

[30] Z. Jiaying, C. J. C. P., C. Weiwei, and C. Keyu, "Digital Twins for Construction Sites: Concepts, LoD Definition, and Applications," Journal of Management in Engineering, vol. 38, no. 2, p. 4021094, Mar. 2022, doi: 10.1061/(ASCE)ME.1943-5479.0000948.

[31] A. U. Khan, L. Huang, E. Onstein, and Y. Liu, "Overview of Emerging Technologies for Improving the Performance of Heavy-Duty Construction Machines," IEEE Access, vol. 10, pp. 103315–103336, 2022, doi: 10.1109/ACCESS.2022.3209818.

[32] W. Yi and A. Chan, "Critical Review of Labor Productivity Research in Construction Journals," Journal of Management in Engineering, vol. 30, pp. 214–225, Feb. 2014, doi: 10.1061/(ASCE)ME.1943-5479.0000194.

[33] S. P. Stier et al., "Materials Acceleration Platforms (MAPs) Accelerating Materials Research and Development to Meet Urgent Societal Challenges," Advanced Materials, vol. 2407791, pp. 1–26, 2024, doi: 10.1002/adma.202407791.