FOCUS

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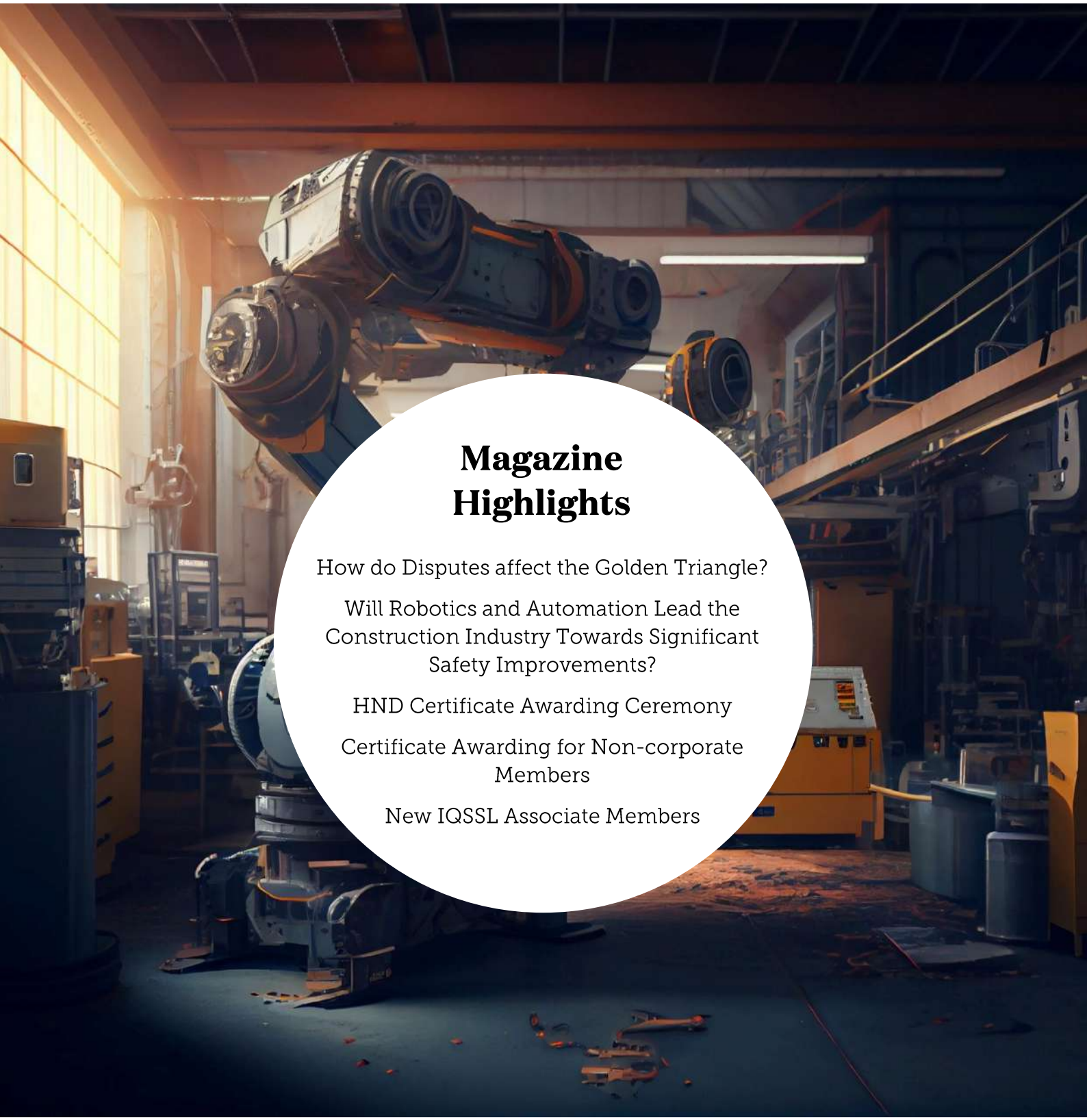

Magazine Highlights

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Notice to All Members: Call for Research Papers

If any member, including students, of IQSSL and the College of Quantity Surveying would like to get their research, technical, and other papers or articles published in the next issue of Focus and / or the website, kindly email the relevant article documents to "duleesha.wijesiri@gmail.com". These articles will then be subjected to review by the Committee Members of the BQSP and published accordingly.

Ch. QS Duleesha Wijesiri
Chairman - BQSP

Research Article

How do Disputes affect the Golden Triangle?

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Introduction

The construction industry acts as a key component in converting the desires and requirements of people into reality through the physical implementation of various construction development projects (Ibrahim, Roy, Ahamed, & Imtiaz, 2010). Hence, the contribution of the industry to the growth of the economy and the long-term development of the country is widely acknowledged (Ofori, 2015). As one of the major industries in the world, its foremost objective is to complete construction projects according to the estimated cost, time, and accepted quality (Cakmak, 2016). Consequently, several parties are involved to achieve this common objective, though they have their own objectives and perceptions as well.

As a result of these individual beneficial interests, disputes in the construction industry are unavoidable (Cakmak, 2016). There is a high possibility of arising disputes and complications of contracts at any stage in the project lifecycle due to the complexity of the construction projects (Alaloul, Hasaniyah, & Tayeh, 2019). When a dispute has occurred, its resolving process will be long, expensive, and acrimonious (Cakmak, 2016). As stated by El-Sayegh et al. (2020), if disputes are not properly managed, it will result in many adverse effects on both the project and its stakeholders. Therefore, it is worth investigating the effects of disputes on the golden triangle of project management.

The Golden Triangle of Project Management

In the construction industry, time, cost, and quality are referred to as the three project objectives that measure the success of any project (Santoso & Soeng, 2016). Completing a project on time within the allocated budget is considered the main indicator of evaluating the efficiency of a project (Manoharana et al., 2020; El- Karim et al., 2019). However, as stated by Santoso and Soeng (2016), achieving these objectives in a project is arduous as disputes directly affect all the aspects of the golden triangle in construction projects. Figure 1 depicts the effects of disputes on the golden triangle of project management. It is important to note that these effects can also serve as potential causes of disputes. These elements may contribute to conflicts, leading to disputes that subsequently impact the project's time, cost, and scope. The relationship between these elements is dynamic, and they can manifest as both causes and effects depending on the context of the project.

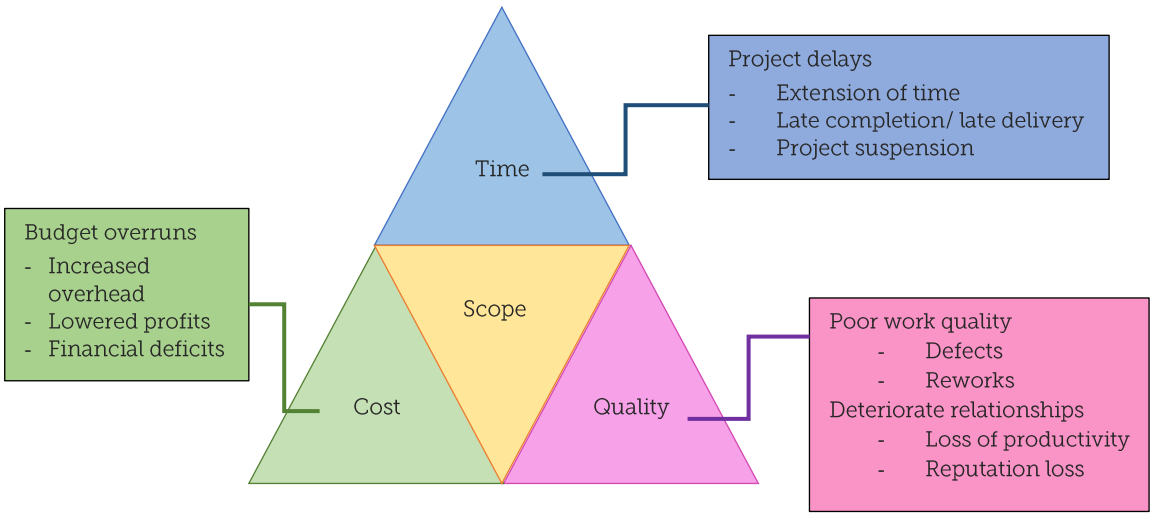

Figure 1: Effects of Disputes to Golden Triangle

Time

One of the primary effects of construction disputes is the extension of the stipulated time frame for project delivery (Durdyev & Hosseini, 2018). Employers may lose their investment revenues, and contractors may have to incur additional costs for materials and labour due to the delays associated with construction disputes (Jayasena & Kavinda, 2012). As the project implementation status report (IPMD, 2018) by the Government of India stated, 22 percent of their projects were experiencing time overruns, whereas in Dubai, a staggering 70 percent of projects are prone to time overruns due to disputes in the industry (Prasad et al., 2019; Vaux et al., 2018).

Nevertheless, if a delay claim is filed, it results in severe financial impacts on resolving it (Stevens, Frame, & Henjewele, 2016). When the disputes are larger and more complex, they may possibly face lengthy litigation processes. Research conducted in Nepal as of May 2022 indicates that the total time lost during the dispute settlement process is approximately 37.5 years. On average, this amounts to nearly 4 years, 6 months, and 7 days for each project (Mishra & Aithal, 2023). Further, if it is unable to resolve disputes in their initial stages, the delays due to disputes may intensify to work suspensions, abandonment, or termination of the contract as well (Othman & Ismail, 2014).

Cost

The surplus of actual costs over the estimated budget is referred to as the cost overrun in construction (Vu et al., 2020). Similar to project delays, cost overruns are also widely considered the key determinant that eliminates project success (Durdyev, Omarov, & Ismail, 2017). It can be identified as a common issue in construction projects all over the world, but it affects developing countries significantly since construction is a major contributor to economic and social development (Niazi & Painting, 2017). In spite of the size and complexity of a project, the primary goal of each party to the contract is to complete the project within the allocated budget (Abdul-Rahman, Memon, & Karim, 2013). However, the Chartered Institute of Building (CIOB) reported that in some projects, 85% of cost overruns resulted from disputes (Wilks, 2015). Disputes are not only affecting the visible costs but also the intangible costs since inefficient dispute resolution loses the potential value of the businesses. As Aryal and Dahal (2018) revealed, the direct costs associated with disputes typically range from 0.5 to 5% of the project's contract value. However, the indirect costs are even more substantial, encompassing lost productivity, stress, fatigue, loss of future work opportunities, the expense of strained business relationships among parties involved, and damage to the reputation of the project stakeholders.

Quality

In construction, quality is defined as 'conformance with requirements', which fulfills the owners' needs per the defined scope of work within a budget and specified schedule to satisfy the owners/user requirements (Mashwamaa et al., 2017). Disputes have an effect at the project and organisational levels. In the case of the project level, a dispute impacts poor work quality, whereas at the organisational level, disputes deteriorate the relationship quality among project stakeholders (Trangkanont, 2017).

If the construction works do not meet the required quality, then they are rejected, or non-conformance, and they must be reconstructed to achieve the quality of the works (Mishra & Aithal, 2023). Then they directly hinder project schedules, introducing delays and increasing overall project costs in construction projects. Eventually, the projects will culminate in poor performances, quality defects, and poor stakeholder satisfaction (Meng, 2012). The project team may be demotivated, and project success will be taken into great danger in the end (Ilter & Bakioglu, 2017).

Conclusions and Recommendations

Disputes become inevitable in the industry due to the complexity and dynamic nature of construction, which become a foremost consideration in hindering project success. Construction disputes negatively affect all three components of the golden triangle and stakeholder relationships.

It will result in several adverse consequences, not only for the project stakeholders but also for society, the economy, and the environment. If a construction project faces many disputes where it seems impossible to continue further, the project will be abandoned. Hence, it is recommended that construction professionals be proactive in dispute management by having efficient dispute management approaches to minimise the occurrence of disputes and prevent disputes from escalating.

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Research Article

Will Robotics and Automation Lead the Construction Industry Towards Significant

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1. Introduction

Construction has endured as a symbol of human achievement for decades, developing to meet the changing demands of communities. In the dynamic evolution of the construction industry, the integration of robotics and automation stands as a transformative force, poised to revolutionise not only efficiency and productivity but, significantly, the safety of construction sites (Manu et al., 2023). Automation and robots have significantly changed the construction industry, which has previously been recognised for its reliance on manual labour and traditional methods. In construction, robotics has expanded beyond controlled environments, becoming essential for tasks like welding and material handling, thereby improving safety by minimising human exposure to hazardous conditions (Xiao et al., 2022). Beyond robotics, the precision and accuracy afforded by automated construction reduce the likelihood of errors that could compromise structural integrity (Oesterreich & Teuteberg, 2016).

2. Robotics on Construction Sites

In the construction sector, robotics constitutes a varied range of technologies that integrate computerised control systems into diverse automated processes within the industry (Balzan et al., 2020). Incorporating robots into construction offers numerous opportunities to transform the way we design and build structures. These innovations enhance efficiency and accuracy, paving the way for creative designs and safety practices. It is a fundamental shift in how we approach building construction, promising a future of more efficient and innovative construction methods (Gharbia et al., 2020). The first construction robots were developed in Japan with the aim of improving the quality of building materials for modular homes (Juan et al., 2019).

The literature on robots in construction can be divided into three categories, as tabulated in Table 1.

Table 1: The categorisation of robotics in construction (Source: Xiao et al., 2022)

Category	Tasks	Advantages
On-site operations	Digging Laying bricks Pouring concrete Inspecting the site	Improve efficiency Speed of construction Accurate measurements Enhancing safety Quality control
Off-site manufacturing	Work in controlled, factory-based environments to create building parts such as walls and beams	High-quality construction Reducing waste Resource efficiency Enhance productivity
Additive manufacturing	On-site and off-site 3D printing, build structures and building elements layer by layer	Enhance innovative design Minimise the waste

The most recent advancements in the construction industry have focused on the integration of robots for various tasks such as inspection, monitoring, and maintenance (Juan et al., 2019). Altogether, these categorisations encompass the diverse ways in which robotics is transforming construction, from enhancing on-site operations to enabling advanced manufacturing techniques, ultimately reshaping the industry for greater safety.

3. Automation for Construction

Automation is a transformative force that not only enhances operational efficiency but also drives the creation of new business models and fosters competitiveness at both national and corporate levels (Aparicio et al., 2020).

models and fosters competitiveness at both national and corporate levels (Aparicio et al., 2020). Automation comprises a variety of procedures, including prefabrication, modular construction, 3D printing, autonomous machines, project management software, computer-aided design (CAD), and building information modelling (BIM) (Balaguer & Abderrahim, 2008). Automation in construction project management brings about significant improvements in efficiency and error reduction (Balaguer & Abderrahim, 2008). By automating communication, scheduling, resource allocation, and quality control, construction projects are better equipped to meet their timelines and budgets.

The use of automated tools and systems facilitates real-time collaboration among project stakeholders, minimising miscommunication and ensuring everyone is working with up-to-date information. It also enables the optimisation of resource allocation, reducing waste and cost overruns. Automated risk assessment and quality control mechanisms catch potential issues early, mitigating risks and reducing errors. With automation, project managers can access data-driven insights and reports, allowing for informed decision-making and timely adjustments. Han et al. (2012) highlight that the quality control and precision offered by automation ensure that modular components fit together, reducing the potential for accidents or structural issues during assembly.

4. Safety Benefits of Robotics and Automation in Construction

In the construction industry, ensuring the safety of workers is paramount. Automation and robotics have the potential to reduce risks by handling high-hazard tasks and collaborating safely with human workers. Automation enhances safety by significantly reducing the need for manual labour in high-risk environments. Robots and automated systems can undertake tasks that are inherently dangerous, such as site inspections in risky conditions or handling heavy materials, thus minimising the potential for accidents and injuries (Oesterreich & Teuteberg, 2016). Automation systems can be programmed to respond to emergencies quickly.

For example, in the event of a fire or structural failure, automated systems can activate alarms, shut down equipment, and even initiate evacuation procedures. Furthermore, automation brings in advanced safety monitoring systems that use sensors and artificial intelligence to quickly identify and deal with safety hazards, ensuring that proactive measures are taken to mitigate risks (Balaguer & Abderrahim, 2008).

5. Challenges and Future Prospects

Navigating the challenges and future prospects of construction automation and robotics offer both opportunities and obstacles for the industry. The main challenges in the adoption of robotics and automation in construction are tabulated in Table 2:

Table 2: Challenges in the adoption of robotics and automation

Category	Challenges	Source
Financial challenges	High initial cost Operational costs for monitoring and training	(Yahya et al., 2019)
Technical challenges	Lack of functional integration Adaptability in different environment Technological limitation	(Juan et al., 2019)
Industry related challenges	Limited use of digital modelling Conflicting interests in the supply chain Poor information exchange Significant duplication of efforts Product complexity	(Hatoum & Nassereddine, 2020; Juan et al., 2019)
Security challenges	Data privacy Regulatory complexities Liability for errors made by automated systems	(Chen et al., 2018)
Social challenges	Job replacement / unemployment Lack of government incentives Require skills and training	(Yahya et al., 2019), (Chen et al., 2018)

The future prospects of automation and robotics in the construction industry are exceptionally transformative. These technologies are poised to revolutionise the way we build and reshape the industry in several key ways. Automation will significantly enhance efficiency, reducing project timelines and labour costs while improving precision (Cai et al., 2020).

As robotic technology becomes increasingly prevalent, it begins to permeate various aspects of our lives, especially within the built environment. This widespread adoption of robot technology is closely tied to advancements in construction automation, and it is from this connection that we can expect new opportunities and fields of activity to emerge in the future (Bock, 2015). Overall, the future of the construction industry holds the potential for faster and safer projects, with automation and robotics at the forefront of this transformation.

6. Conclusions

The integration of robotics and automation in the construction industry holds the promise of leading us towards unprecedented levels of safety. By taking on high-risk tasks, ensuring precision and accuracy, and providing real-time monitoring and control, automation enhances safety across the construction lifecycle. While challenges exist, including the need for skilled operators and cost considerations, the potential benefits in terms of reducing accidents, improving worker well-being, and enhancing the overall quality of construction are undeniably significant. Automation and robotics are not merely tools but catalysts for innovation, anticipating a future where our built environment reflects the unlimited possibilities of human-machine collaboration. As the industry continues to evolve and refine these technologies, it is clear that the future of construction will be marked by safer and more efficient practices, ultimately benefitting both the workforce and society as a whole.

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