IOP Conference Series:
Earth and
Environmental Science

PAPER • **OPEN ACCESS**

The perception of commercial construction companies on using technology to review contracts in New Zealand

To cite this article: C Sweet and D Paes 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **1101** 052005

The perception of commercial construction companies on using technology to review contracts in New Zealand

C Sweet, D Paes
School of Built Environment, Massey University, Auckland, New Zealand

Abstract. A lack of understanding of project risks and the use of unnecessarily complex contracts have been identified as weaknesses in construction procurement. Contract reviews are often rushed, and risks are not assessed and allowed for appropriately. This process can be improved using digital technology solutions. This research investigated the NZ commercial construction practitioners' views about adopting computational tools to review construction contracts. A mixed-methods study using a survey questionnaire was undertaken and accompanied by descriptive statistical analysis. The sample consisted of 66 participants from different groups within NZ's commercial construction industry. The study found a strong positive response towards digital technology adoption, and the overall perception is that there are benefits to using computational tools for contract review. Findings confirmed that these have not been widely adopted for contract review, mainly due to the lack of familiarity with existing solutions. Further research is recommended to investigate how a small portion of the population is currently using computational solutions. The benefits of manual contract reviews may also be explored to enhance software systems for easier adoption.

Keywords. Contract Review, Construction Contract, Digital Technology, New Zealand Construction

1 Introduction

The construction industry is in poor health, as evidenced by failed and delayed projects, insolvent contractors and unpaid subcontractors [1]. In January 2020, the NZ Construction Accord – a joint commitment from government and industry – was formed to address these problems and create a high performing construction sector. One of the areas that the transformation plan will focus on is Procurement and Risk. The Accord states that the weaknesses in procurement are the lack of understanding of the risks and the use of unnecessarily complex contracts [2].

In commercial contracting, it is the responsibility of each party to ensure they properly scope and understand every risk allocated to them [1]. A few commonly used standard forms of contract in NZ, such as NZIA, NZS3910:2013 and NZS3915:2005, aim to share the risks fairly. However, they are often amended in favour of the client [3]. A prudent contractor should assess the project risks and allocate or allow for these appropriately prior to submitting a tender [4]. However, as tender teams are already constrained for time, crucial terms may get missed. The impact of missing a critical term in the contract will not be known until later in the construction phase, resulting in financial losses. Poor contract management is also a big contributor to disputes in construction [5].

In summary, there is a need for a faster way to review contracts thoroughly and accurately during the pricing phase of the project. The contractor must be able to quickly identify all risks and have clarity around what the expectations, roles and responsibilities are under the contract. Technology solutions could be implemented to improve this process. However, there is a lack of understanding of the risks associated with construction contracts in NZ's commercial construction sector, and companies have not adopted computational tools to identify the risks quickly and clearly within the contracts. To introduce digital technology to assist with reviewing contracts, it is important to understand the perceptions of the potential users. Once the perceived benefits and barriers are identified, technology developers can focus on removing the barriers and enhancing the benefits.

Therefore, this research aims to investigate the NZ commercial construction industry practitioners' views about adopting computational tools to review construction contracts. The following questions will be investigated: 1) What would be perceived as the benefits for commercial construction companies in NZ to invest in computational solutions to review construction contracts?, and 2) What are the perceived challenges associated with the adoption of computational solutions to review construction contracts by commercial construction companies in NZ?

2 Literature Review

2.1 Technology-supported Construction Contract Review

Various digital technologies could simplify the contract management process, including computational techniques and off-the-shelf software applications. Blockchain technology has been a research topic in recent years and has been developed to enable parties to enter a smart contract without third-party involvement [6]. One study focused on designing a blockchain smart contract adoption model and understanding the need for this type of contract in the construction industry of Thailand [7]. The study found that there will need to be a paradigm shift in perception and formulation of contract administration if blockchain smart contracts were to be adopted.

Another study was done to explore the trending technology of iContracts. It revealed a desire to digitalise construction contracts but an unclear readiness for such a disruptive change and concluded that proposing the use of an iContract would face challenges. However, if used consistently to minimise disputes and add clarity to the construction process, an iContract could encourage a more collaborative approach instead of being used as a weapon when disputes arise [5].

Various automated contract review platforms are already in operation. Examples include a) ThoughtRiver, an intelligent contract pre-screening platform [8], b) LawGeex, a contract review automation solution based on AI (Artificial Intelligence) that claims to cut *"contract review time in half, enabling legal teams to work with greater speed, consistency and accuracy"* [9], c) Diligen, another AI-based contract review platform used to identify key provisions and generate contract summaries [10], and d) Contractworks, also an AI-based contract management software that provides a secure contract repository, smart document tagging, Optical Character Recognition (OCR) text search, built-in electronic signature, custom alerts and notifications, and reports [11].

AI promises to be more efficient in the necessary but mundane and repetitive tasks that lawyers do each day. The technology relies on Machine Learning (ML) and Natural Language Processing (NLP) techniques to understand contracts, make suggestions, or flag potential problems and is based on "narrow" or "weak" AI. There is also a "strong" AI under development, which would apply intelligence to any problem. Once developed, its potential for legal will be great [11]. AI-based technologies for contract review and management empower legal professionals to engage in higher-value work, helping them to accomplish routine tasks more quickly. They allow lawyers to focus on the problem areas that need attention and spend less time reviewing acceptable clauses. However, for a legal department to adopt any AI-based software, management needs confidence in the benefits gained. Also, the legal team requires a mind shift in terms of their roles and function [11].

Another technology solution is the Dynamic Text Analytical Model for contract and correspondence utilising BIM (Building Information Modelling), developed by Marzouk and Enaba [12]. Their model assists parties to explore texts through text mining. Their study found that text mining applied to contracts helps in reducing contract reading time and effort. It also validated that performing text mining to a construction contract identified parties' obligations and effectively explored the contract [12].

Research has also been conducted to establish whether contract interpretation can be automated. Catterwell [13] states that although computers can be programmed to recognise a small number of interpretive arguments, contract interpretation is a unique cognitive process and could never be fully automated. Although smart contracts may propose exciting new ways in which transactions occur, they will not be able to replace what is in fact a human activity [14]. Nonetheless, AI can still help lawyers to be effective and productive when reviewing and managing contracts. Based on the different studies

on this topic, it is evident that technology does not have to *replace* humans – instead, it can be used to *assist* them.

2.2 Current Barriers to Technology Adoption

There are numerous barriers to technology adoption in the construction sector, including inherent problems in the innovation, lack of recognition for the need to change, insufficient technical capabilities, reluctance to change, lack of training, inadequate resources, weak commitment by managers, lack of integration and collaboration, lack of a learning environment, lack of incentives and difficulty in complying with existing standards and regulations [15].

Technology advancement can significantly improve construction cost, quality and productivity [15]. Experts believe that technology may cut a construction project's costs by 50% over the next ten years. Nonetheless, the construction industry has fallen behind other industries in adopting new technology. Over the past ten years, construction companies typically spent less than 1% of their revenue on new technology [16]. As per McNamara and Sepasgozar [5], the construction sector is one of the largest in the world economy, yet it is slow to adopt technological advancements. However, they also found that investment in construction technology is on the rise [5].

As the construction industry starts to invest more in technology, companies need to prioritise. According to a study on solution selection in digital construction design, information technology solutions are selected based on the perceived level of effort associated with their usage [17]. Therefore, the easier the technology is to use and apply, the more likely companies will invest in it. Moreover, companies may need to change their existing processes to adopt digital technologies. For instance, to implement and benefit from AI-based contract management, businesses need to abandon paper-based record-keeping methods and adopt digitisation [18].

3 Research Methodology

This research can be formally defined as an empirical mixed-methods study comprising descriptive statistical analysis. Participants' views about adopting computational techniques to review construction contracts are collected using an online Likert scale-based survey questionnaire. While it surveys participants' opinions (subjective responses), these are further processed and analysed as percentages (numerical analysis) to reach conclusions. The questionnaire included demographic questions (to characterise the sample) followed by topic-related questions based on a five-point Likert scale with options ranging from "strongly agree" to "strongly disagree".

The literature review highlighted perceived barriers and benefits to implementing computational technology in construction. The topic-related questions were based on these barriers and benefits and divided into three categories:

- 4 questions that explored the participants' opinions on the perceived benefits;
- 5 questions that explored the participants' opinions on the perceived barriers;
- 1 open-ended question to explore the opinions of the participants on the use of computational technology for contract reviews.

The study population were NZ commercial construction professionals involved in contract reviews. A human ethics application was submitted to Massey University Human Ethics Committee. Once approved, participants were recruited via email and LinkedIn with an invitation and link to the survey. The survey invitation was also posted in the NZ Institute of Quantity Surveyors' E-bulletin. The sample comprised 66 respondents from different groups within the commercial construction industry, including main contractors, subcontractors, suppliers, consultants, and clients.

Descriptive statistics were used to describe and analyse the data. The nominal data collected were inserted into a table and percentages calculated. These results were then described and discussed in detail. One open-ended question was analysed by creating a coding system to capture themes and patterns from the responses. The different themes were categorised into positive, negative, and neutral opinions on adopting digital technology solutions for contract reviews.

4 Findings and Discussion

4.1 Participants Characteristics

There was an even spread of age groups between 26-33, 34-41, 42-49 and 50-over in the sample. Most participants have either a diploma or a bachelor's degree. All the respondents use a computer in their roles. 89% stated that they always use a computer, 9% said they often use a computer, and only 2% said they sometimes use a computer. Most participants are quantity surveyors at 61%. 20% are managers, 12% project managers, 1% lawyer, 1% engineer and 5% other. Half of the sample identified their category as main contractor. 26% were classified as subcontractors, 12% consultants, 5% suppliers, 4% as other and 3% as client. The sample is experienced, with 65% having over 10 years' experience. This suggests that the data can be trusted to come from people experienced with contract reviews. Most of the participants (58%) have over 10 years' experience in NZ. All the participants review contracts, with 20% that always review contracts, 44% often review contracts and 36% review contracts occasionally or sometimes. In sum, the demographic data shows that the sample is a good representative of the study population (NZ commercial construction professionals involved in contract reviews).

As expected, most people do not use computational technology solutions when reviewing contracts. Only 20% stated that they make use of such to review contracts. This is in line with the literature in that people are slow to adopt digital technology in construction. When asked what software applications were used by this portion of participants, the range included Procore (7%), PDF tools (14%), Word search (7%), Nimbus (7%), Measure (7%), Google (7%), Docusign (7%), Bluebeam (7%), Excel (21%), Cost X (7%) and Affintext (7%). However, none of the participants uses platforms specifically designed to assist with reviewing contracts. Of the 20% that use computational technology to assist with contract reviews, only 3% of the respondents always make use of computational tools. Again, this is in line with the literature.

4.2 Results relating to the perceived benefits for commercial construction companies in NZ to invest in technology solutions to review construction contracts

Four potential benefits were presented in the survey as follows:

1. With the right computational tools, risks will be identified which will avoid costly situations;
2. Productivity can be greatly improved if computational tools are adopted for reviewing contracts;
3. By using computer applications to assist with reviewing contracts, the review will get done much faster;
4. If risks are quickly identified using computer applications, more time is available to discuss the risks and strategies.

Figure 1 shows that the perception of NZ commercial construction professionals is that, with the right technology solution, risks can be identified and costly situations avoided.

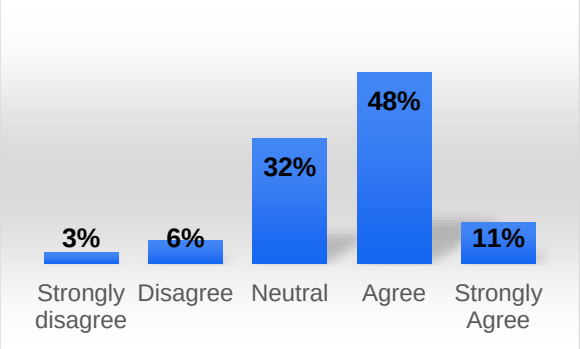


Figure 1. With the right technology solution, risks will be identified which will avoid costly situations.

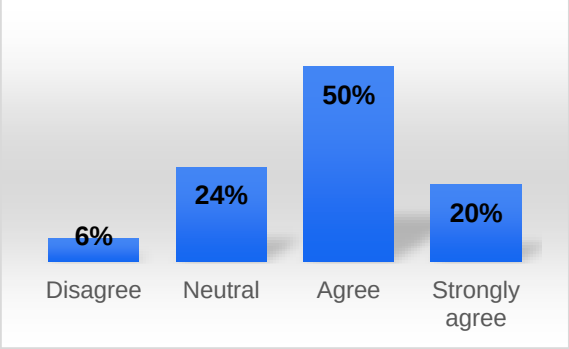


Figure 2. Productivity can be greatly improved if technology is adopted for reviewing contracts.

The data confirms that most NZ commercial construction professionals perceive that productivity can be greatly improved if technology is adopted for contract review, as shown in Figure 2.

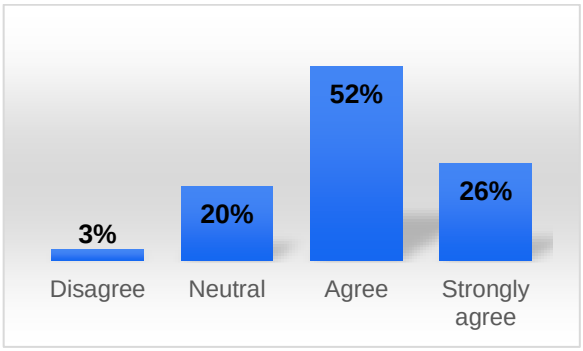


Figure 3. By using technology to assist with reviewing contracts, the review will get done much faster.

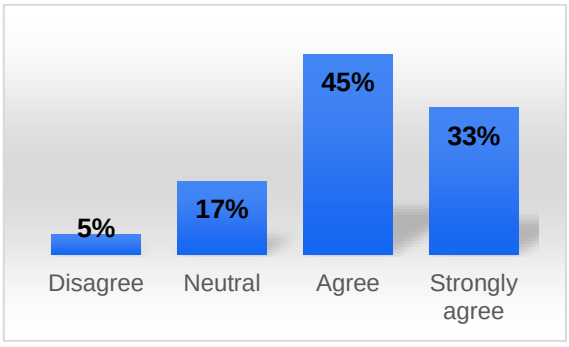


Figure 4. If risks are quickly identified using technology, more time is available to discuss risks and strategies.

As per Figure 3 and 4, this research confirms that the perception of most NZ commercial construction professionals is that the review will get done faster with computational tools and more time will be available to discuss risks and strategies.

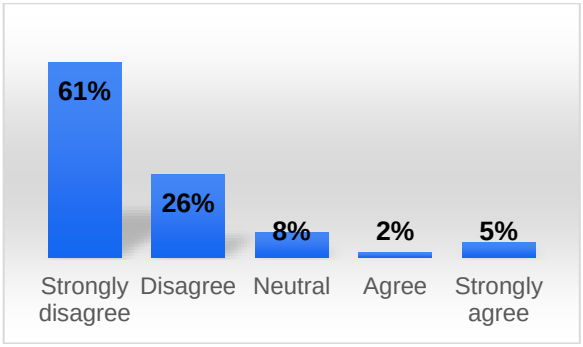
Overall, the data suggest that NZ construction companies agree with the benefits identified in the literature. However, many participants provided a neutral response for every benefit, indicating unfamiliarity – the first barrier investigated next.

4.3 Results relating to the perceived challenges associated with the adoption of technology solutions to review construction contracts by commercial construction companies in NZ

Five potential barriers were presented in the survey to gain insights on the participants' perception of these barriers:

1. Familiarity with existing technology solutions available to automate the contract review process;
2. Too expensive to invest in software applications to review contracts;
3. Management will not invest in software applications if it can be done manually;
4. Too time-consuming to learn to use the computational tools efficiently;
5. Lack of trust that technology can identify all the risks within the construction contract; therefore, the review should be done by humans.

The data confirms that unfamiliarity with technology solutions is a barrier to using technology for contract review (Figure 5). This is also supported by the large portion of neutral responses to the potential benefits listed in Section 4.2 above.



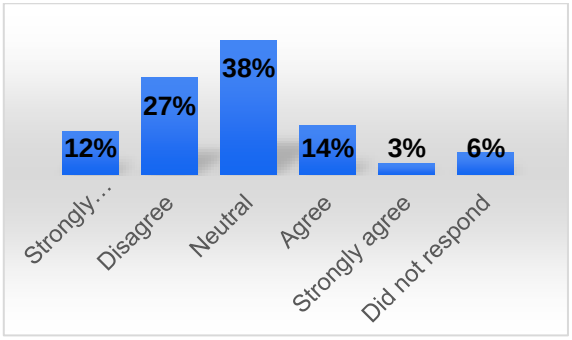


Figure 5. I am familiar with types of technology solutions available to automate the contract review process.

Figure 6. It will be too expensive to invest in a technology solution to review contracts.

In Figure 6, the data shows that affordability is not a strong barrier to adopting software applications. The large neutral response suggests that unfamiliarity is the barrier.

The findings suggest that investment by managers is not a strong barrier to software applications, but with the large portion of neutral responses, it could be concluded that unfamiliarity is the barrier (Figure 7).

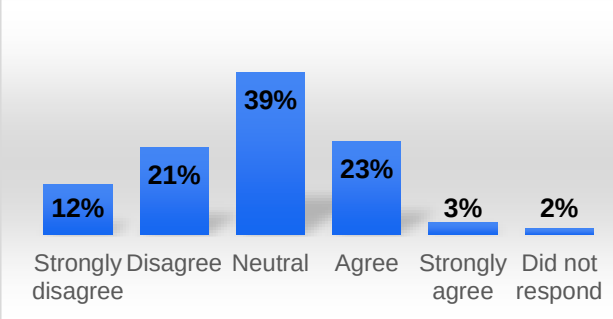


Figure 7. Management will not invest in technology solutions to review contracts if it can be done manually.

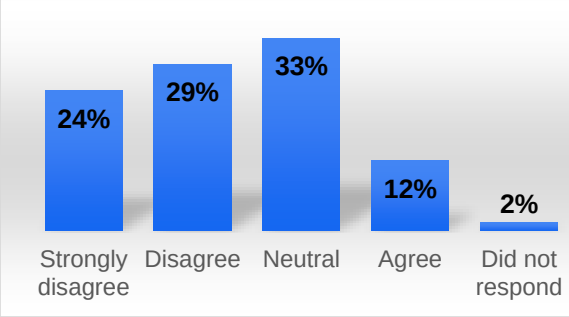


Figure 8. It will be too time consuming to learn to use the technology efficiently.

As with the second and third barriers discussed above, the idea that it will be too time-consuming to learn to use the computational tools efficiently is not a strong barrier to technology adoption. It is the large portion of neutral responses that indicates unfamiliarity is the stronger barrier (Figure 8).

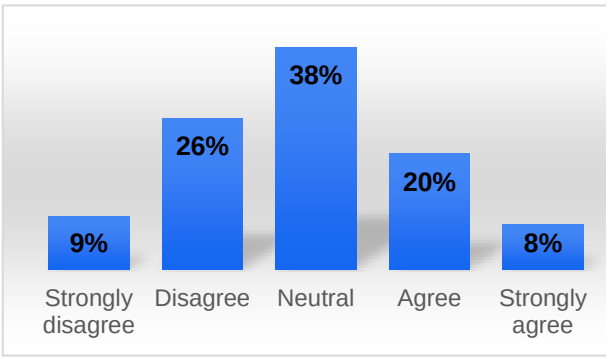


Figure 9. I don't trust that technology solutions can identify all the risks within a construction contract, therefore reviews should only be done by humans.

The data did not confirm that trust in computer applications to identify all risks is a strong barrier to technology adoption. Although some respondents agreed with this barrier, most participants gave a neutral response, which again indicates that unfamiliarity is a barrier (Figure 9).

4.4 The opinion of participants on using technology solutions to review contracts

One open-ended question in the survey aimed to gain insights into the respondents' overall opinion on adopting computational techniques for contract review. 70% of participants responded positively towards adopting technology solutions for contract review. 21% of participants responded negatively, and 9% of respondents gave a neutral response.

Some participants provided both positive and negative comments. There were common themes identified within the responses. 40% of responses indicated that quicker contract review is a strong benefit to adopting technology. Improved accuracy (11%), more time for teams to discuss strategies (6%) and assistance with contract interpretation (6%) are also considered benefits. 37% of responses expressed their lack of familiarity with computational tools or understanding of how it would work. The themes identified in the negative responses included concern of misinterpretation of contract clauses (31%), limitation of automation or technology (31%), a preference for manual review (15%), and the perception that technology adoption would create complacency (8%). 15% thought that technology is not sufficiently developed yet. Finally, the barrier of unfamiliarity appears in the themes of the neutral responses. Participants have either never thought of using technology solutions for contract review (20%) or are unsure how it would work (80%).

5 Conclusions and Further Research

This research aimed to investigate the NZ commercial construction industry practitioners' views about adopting computational techniques to review construction contracts and gain insights into the perceived benefits and barriers. Technology developers may focus on removing these barriers and enhancing benefits to develop innovative and user-centred software systems that enable NZ construction professionals to review contracts quickly and efficiently.

As expected, the data showed that most people do not currently use digital technologies when reviewing contracts. However, by exploring two questions about the benefits and challenges of technology adoption for contract review, the research found that most NZ commercial construction professionals have a positive view on the use of computational technology for contract reviews. The overall perception is that quicker contract review would be a strong benefit of using computational tools. Productivity, improved accuracy, more time for a team to discuss strategies and assistance with contract interpretation are also considered benefits.

The findings also supported the researchers' belief of expectation-related challenges linked to implementing technology solutions for contract reviews. Unfamiliarity with computer applications was found as the strongest barrier to technology adoption. The results indicate that if industry professionals become more familiar with available computational tools, other barriers will diminish. Such barriers include preference for manual review, concern of misinterpretation of contract clauses and creating complacency. As technology becomes more widely used, these barriers can be further removed if standard forms of contracts are used. The user will be familiar with the standard clauses and the computational tools will quickly identify the unusual ones for the user to focus on. As highlighted in previous studies, technology should not replace humans but rather assist them. There will still be a strong need for human interpretation. This also relates to the barrier of limited automation. The literature found that "strong" AI is still being developed; therefore, technology can only be used to assist with human activities.

In summary, findings indicate a positive perception towards the use of digital technology for contract reviews, even though existing tools are not widely used for this process yet. NZ commercial construction professionals will adopt technology that can deliver the benefits if they know it exists and how it works. The findings also show a lack of familiarity with software for contract review. It appears that none of the tools already available for contract reviews have been adopted by NZ construction companies, but some people have adopted commonly used software to assist their contract reviews (tools not originally designed for such purpose). Therefore, the appetite for using technology exists. Since the perceived barriers have been identified, they can be addressed by educating users on the available software options

and emphasising that technology should only be used to enhance human activities and not replace humans.

While this study does not focus on specific technology solutions, the ones covered are all existing or emerging computational tools. The literature review section briefly explains their working principles and limitations. Further research is required to explore how the software identified by participants in this study are currently being used for contract reviews. Software developers can use this information to improve their systems by incorporating what is already familiar to users, so that the new software can be easily adopted.

An investigation is recommended into the use of standard forms of contracts in New Zealand. If more companies use standard forms of contracts, people will become more confident that software applications will be able to identify unusual clauses, as opposed to a bespoke contract where most clauses are unusual. The adoption of technology could drive wider use of plain English wording of contracts so that the technology can become increasingly accurate and effective. This may also address the unnecessarily complex contracts highlighted by the Construction Sector Accord [2] as one of the weaknesses in procurement.

6 References

[1] Becke I, Heath G, Jewell D, Wheatley C and Payne K 2019 *Challenges ahead for the Construction Sector Transformation Plan* [Online]. Available: https://www.bellgully.com/Shared%20Documents/A%20critical%20review%20of%20risk%20in%20the%20New%20Zealand%20construction%20market.pdf [Accessed].
[2] Construction Sector Accord 2020 Procurement and Risk. https://www.constructionaccord.nz/transformation-plan/procurement-and-risk/
[3] Molloy D 2008 Building contracts. *Build.* Oct/Nov 2008 ed.
[4] Macfarlane M A H and Holderness S 2017 Managing Risks and Disputes in Construction. *Build.*
[5] McNamara A J and Sepasgozar S M E 2020 Developing a theoretical framework for intelligent contract acceptance. *Construction Innovation* **20** 421-445. Available: 10.1108/CI-07-2019-0061
[6] Wang S, Ouyang L, Yuan Y, Ni X, Han X and Wang F-Y 2019 Blockchain-Enabled Smart Contracts: Architecture, Applications, and Future Trends. *IEEE Transactions on Systems, Man & Cybernetics. Systems* **49** 2266-77. Available: 10.1109/TSMC.2019.2895123
[7] Chaveesuk S, Khalid B and Chaiyasoonthorn W 2020 *Understanding Stakeholders Needs for Using Blockchain Based Smart Contracts in Construction Industry of Thailand: Extended TAM Framework*. 13th Int. Conf. on Human System Interaction (HSI). Tokyo, Japan: IEEE.
[8] ThoughtRiver 2020 How keeping lawyers in the flow drives deal velocity and pulls revenue forward.
[9] Lawgeex 2020 Platform: The contract review platform that means business. https://www.lawgeex.com/platform/
[10] Diligen 2020 www.diligen.com
[11] Contractworks 2021 How AI contract management improves the value of the legal department.
[12] Marzouk M and Enaba M 2019 Text analytics to analyze and monitor construction project contract and correspondence. *Automation in Construction* **98** 265-274. Available: 10.1016/j.autcon.2018.11.018
[13] Catterwell R 2020 Automation in contract interpretation. *Law, Innovation and Technology* **12** 81-112. Available: 10.1080/17579961.2020.1727068
[14] Sklaroff J M 2017 Smart Contracts and the cost of inflexibility. *University of Pennsylvania Law Review* **166** 263-303.
[15] Chowdhury T, Wilkinson S and Adafin J 2019 Review of digital technologies to improve productivity of New Zealand construction industry. *Journal of Information Technology in Construction* **24** 569-587. Available: 10.36680/J.ITCON.2019.032
[16] Kirkwood K 2018 *"The Robo Age" A Review of 30 the new Technological Advances and how*

they will impact upon our industry. 8th International Society of Construction Law Conference. Chicago, IL, USA.

[17] Merschbrock C, Tollnes T and Nordahl-Rolfsen C 2015 Solution Selection in Digital Construction Design – A Lazy User Theory Perspective. *Procedia Engineering* **123** 316-324. Available: 10.1016/j.proeng.2015.10.097

[18] Cutright E 2018 What is AI and how will it impact contract management? [Online]. Available: https://www.contractworks.com/blog/what-is-ai-and-how-will-it-impact-contract-management [Accessed].