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Are You Ready to be Monitored at Work? – A Study of Real-time Employee Monitoring Technologies Adoption for New Zealand Construction Industry from Legal, Ethical and Behavioural Perspectives

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List of Publications

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Executive Summary

Building companies are exploring more extensive use of technologies to improve health & safety and productivity. Real-time Employee Monitoring Technologies (REMTs) are becoming prevalent and have quickly been introduced into the global construction sector. In New Zealand, REMT applications are not well-received in tracking individuals at construction sites, which indicates there are concerns about applying these technologies. These possible concerns can be categorised as legal, ethical and behavioural barriers to REMTs implementation. This project includes an in-depth investigation and classification of these concerns, and from the results, best practice guidelines for REMTs implementation are developed for the New Zealand construction sector.

The study found that '*Privacy Intrusion', 'Employment Relationship', 'Scope of Monitoring', 'Quality of Monitoring', 'Standards and Policies for Monitoring', 'Functions of Monitoring', 'Trust', 'Counterproductive Work Behaviours', 'Mental Health and Well-being,* are the key concerns for REMTs implementation in the construction sector.

A national survey was conducted to investigate the potential concerns of REMT implementation for the New Zealand construction sector. This survey revealed that *two-thirds* of industry practitioners have no experience of being monitored at construction sites. They generally hold a positive attitude toward REMT implementation and believe that REMTs can offer the following benefits:

1. reduce unsafe work behaviours, avoid construction site accidents
2. improve site resource allocation and security,
3. create a healthy and safe work environment, and
4. enable quick emergency responses.

The respondents generally do not support using REMTs as a tool for a performance review associated with pay-related decisions. The survey respondents also raised concerns about their *legal rights*, *monitoring data usage*, *accuracy, consistency and completeness*. However, issues of emotional, mental health and well-being were not raised as key concerns associated with REMT implementation.

With inputs from two focus groups involving construction professionals, '*the Best Practice Guidelines for REMT Implementation*' were developed. This initiative takes the first step in advising the New Zealand construction sector on implementing REMTs appropriately and responsibly. In stage 2 of this project, the guidelines were applied and evaluated in an experimental trial to assess their fitness, benefits and impact on a real construction project where GPS trackers are used as REMT. Generally, the guidelines can help enable construction practitioners to (1) understand their roles and responsibilities, (2) address concerns about the scope and quality of monitoring, and (3) feel comfortable with monitoring when they are carrying the GPS trackers. During this trial, it was observed that the site manager faced challenges in managing REMT implementation. For instance, some workers did not carry the trackers as instructed when they started work, and some devices were reported lost at the end of the trial. In general, the discipline and active participation of the workers play a critical role in the success of REMT implementation. A cost-benefit evaluation was conducted using an evaluation matrix based on the cost data obtained from the trial compared to the benefits. The experimental trial found that the financial costs of using GPS trackers outweigh the

financial benefits. However, the non-financial benefits take precedence over costs in the long term.

To conclude, based on the experience obtained from this project, the following actions will help the New Zealand construction sector address the concerns on REMT implementation:

1. Comply with the principles of the Privacy Act 2020,
2. Apply the best practice guidelines and create a clear communication channel for both sides (i.e., promotors and participants) – aversive actions might become an issue if the participants do not receive sufficient information about using REMTs,
3. Avoid 'scope creep', define and maintain the scope of REMT implementation from the outset,
4. Perform rigorous data management:
    a. Impose a boundary of using monitoring data from third-party companies for commercial or legal reasons
    b. prevent collecting data after normal office hours
    c. avoid installing apps on workers' smartphones and personal devices
5. Ensure tracking is limited to appropriate work activities, with no tracking outside the worksite,
6. Charge REMT devices at the construction site (not at home),
7. Avoid drilling down to individual workers' data during REMT implementation,
8. Educate workers on the benefits of REMT implementation, and
9. Enhance comfort level with the wearable device for implementing REMTs.

1. Introduction

Nowadays, the global construction sector receives considerable support for new technologies. New technological developments such as information communication technology (ICT) and artificial intelligence are transforming the workplace in several ways. Among these, real-time employee monitoring technologies (REMTs) are becoming popular for improving productivity, output level and health & safety (Lin et al., 2013, Michael et al., 2006). These technologies have attracted considerable global interest recently and include real-time location tracking, progress tracking, site visualisation, unsafe behaviour monitoring, and even physiological monitoring. Due to the COVID-19 pandemic, national disaster recoveries and other health and safety issues, technologies, including contact tracing and safety monitoring applications, have been quickly introduced into the construction sector (Keall, 2020). REMTs that enhance capturing and analysing safety and behaviour-related data and workplace monitoring for better industrial development are necessary infrastructures for smart construction sites and are already being implemented worldwide (Gramano, 2019).

Companies are attempting to use REMTs to increase understanding of how the construction business operates and what real-time factors contribute to those operations. For example, improving task management, health & safety and optimising workflow are expected to lead to increased productivity. Software and hardware are readily available and easy to install, and site managers can monitor various activities via apps on phones or tablets. Benefits may be significant: they provide instantaneous support to construction practitioners at risk, correct poor safety practices on sites and reduce on-site inspection personnel. However, these technologies also create complex issues that the New Zealand construction sector needs to resolve before they can be fully adopted. For example, addressing the potential legal, ethical and behavioural concerns associated with REMTs will position the sector for higher technology uptake. However, it could raise many concerns for construction workers who desire more freedom and less monitoring. The utilisation of these technologies may increase stress levels while decreasing job satisfaction amongst personnel, which would be counterproductive. Therefore, the potential risks of REMT implementation for construction practitioners must be identified, managed and regulated.

There is a lack of knowledge of REMT applications and implementation experiences within the New Zealand construction sector. The technologies are not well-received for tracking individuals, indicating questions about REMT implementation amongst construction professionals and workers. For instance, can employers legitimately monitor their employees' work behaviours using location tracking and other personal real-time information? If they can, what data are employers allowed to use and under what conditions? What are the employees' legal rights and ethical expectations regarding privacy in the workplace? What could be the consequences of misuse of employees' private information surveillance in the workplace, and what are remedies for such misuse? All these questions must be addressed in order to reduce concerns about REMT implementation. As such, this project aims to

- identify specific concerns and opportunities in REMTs implementation, and
- develop guidelines to regulate REMT implementation.

This report includes background studies on REMTs, potential concerns and net benefits in the construction sector, followed by the research design, methodologies, results and discussions. The final section presents a conclusion to this research project.

2. Literature Review

The literature review was conducted to understand the existing research on REMTs. This section explores the following topics: (1) What are Real-time Employee Monitoring Technologies (REMTs) (2) REMT implementation in construction sectors, (3) Potential concerns on REMT implementation, and (4) Net benefits of REMT implementation in the construction sector.

2.1 Background Studies on REMTs

The United States Privacy and Consumers Workers Act (1993) defined the term "employee monitoring" as collecting, storing, analysing, and reporting information concerning an employee's activities (Kierkegaard, 2005). REMTs are often defined as user activity monitoring (UAM) and are computerised network systems that capture and store data on employees' work activities and behaviour (Alge 2001). The system transfers the information to a centralised server where it is evaluated and then reported to the employer on a real-time basis to assess performance and observe actions on the job. An increasing number of construction companies monitor employees on construction sites through advanced technologies (Connolly, 2019), and they generally use one or more of four types of monitoring technologies.

1. Internet-based applications and integrated systems, such as 5G cellular-connected Internet of Things (IoT). These usually use mobile, web APPs or computer software systems to collect data and analyse the user's location, activities, behaviours and work performances (Das, 2018).
2. Artificial Intelligence-based cameras or recording systems, including Unmanned Aerial systems (UAS). These can be equipped with cameras, sensors, or other intelligent devices. The technology uses various types of carriers to capture information from the supervised environment (Zhou et al., 2018).
3. Worker management systems on construction sites commonly use traditional technologies and their integration (Lin, Li, Fan, & Gao, 2013). The technologies include Global Positioning System (GPS), QR Code, Radio Frequency Identification (RFID), Wireless Local Area Network (WLAN), and Bluetooth, which have different attributes in terms of range, cost, accuracy, accessibility and security.
4. Sensory technology, for example, Wearable Sensing Devices (WSDs). These devices are worn on the body and used to monitor and analyse data for achieving different functions. These may include environmental sensing, such as fire, explosions and noise; psychological monitoring, such as dehydration, falls from heights, slips and trips, stress, real-time temperature, movement, heart rate, and blood pressure; and proximity detection and location tracking (Khakurel et al., 2018, Nnaji et al., 2020).

2.2 REMT Implementation in the Construction Sector

REMTs have been well-adopted in many sectors, such as the advanced manufacturing and automobile industries. Although creating a safer workplace is the critical objective of deploying monitoring technologies in the construction sector, cost reduction and productivity efficiency stand as the other benefits of employee monitoring. Studies reported that the construction industry globally had not paid enough attention to the development and

implementation of REMT, and it has lagged behind other sectors in productivity improvements and the uptake of technologies. However, the building industry is labour-intensive, and in recent years this has begun to change. (Zhou et al., 2018, Jones et al., 2020). For instance, a real-time worker behaviour monitoring system based on Zigbee tracking technology was successfully used during the construction of a hydroelectric power station in South China. The monitoring system consisted of wireless sensor tracking technology, real-time camera surveillance for capturing data, servers for running software, and remote interaction communication. The low-level Zigbee tracking network utilises fingerprinting software that achieves many functions, such as the worker emergency call facility, real-time monitoring of the entire construction site, and early safety alerting and management. The evaluation system analyses workers' behaviour throughout the construction project. Moreover, on-site tests showed a location tracking accurate range is 3 to 5 metres. The application demonstrated that the localisation algorithm implemented on Zigbee devices based on the received signal strength indicator (RSSI) generated reliable and sufficient data for managerial decisions (Lin et al., 2013).
The first connected construction site in New Zealand uses IoT devices and internet services, such as Azure cloud, Power BI, UAS-equipped 3D cameras and geolocation. The system interface shown in Figure 1 demonstrates the connection, combination and analysis of data from multiple sources. The system monitors the construction site's temperature, humidity, and vibration, thus allowing the contractors to make more informed decisions regarding on-site health and safety procedures. The benefits are that all stakeholders are connected to ONE hub for real-time insights, so there is improved communication, work efficiency, use of the plant, and the built environment (Corner, 2020).

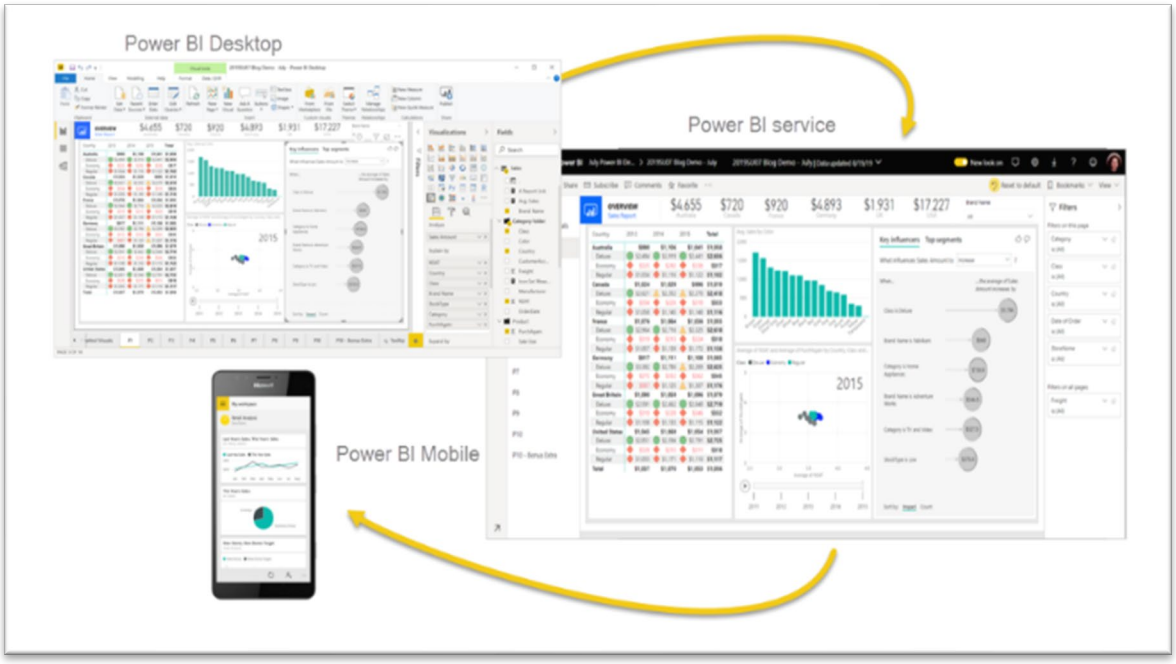


Figure 2.1 Power BI. Interface adopted from (Corner, 2020)

2.3 Potential Concerns on REMTs adoption

There is always a fundamental tension between monitoring technology and privacy at construction sites. Companies intend to monitor employees; reward effort, intelligence, and

productivity; and eliminate unacceptable work behaviours, failure, and health safety breaches. However, employees' attitudes often diverge, and they may argue that employee monitoring could significantly impact the employment relationship and result in trust issues and barriers between the parties. Monitoring may negatively impact their productivity and motivation. Moreover, it can send a message to employees that they are underperforming, lack commitment, or are untrustworthy, which may cause them to engage in deviant or counterproductive behaviours. Employers argue that they need to know their workforce and to understand who does and does not bring an adequate amount of effort and output when on site. Failure to monitor may harm businesses, lead to rogue employee behaviour, compromise trade secrets or leak classified information (Ciocchetti, 2011). Also, employers claim they are responsible for compliance with health and safety regulations, and monitoring their employees is legitimate means of protecting themselves (Gramano, 2019).

As with any new technology implementation process, employee monitoring has its challenges. For example, the main legal issue is that employers must not force employees to install the software on their personal phones. A New Zealand construction company faced the legal, ethical and behavioural challenges of using a mobile application to track employees and site visitors and record check-in and out data (Keall, 2020). A literature review identified potential concerns on REMT implementation, and Table 2.1 summarises the potential concerns.

Table 2.1 Concerns of REMT Implementation – A Summary

Legal Concerns	Ethical Concerns	Behavioural Concerns
Privacy Intrusion	Scope of Monitoring	Trust
Employment Relationship	Quality of Monitoring	Counterproductive work behaviours
Civil Aviation Compliance	Monitoring Standard	Mental Health and Wellbeing
	Function of Monitoring	

2.3.1 Legal Concerns

REMTs collect personal information from employees, and thus potentially encroach upon their privacy, and violate employment and privacy laws. Countries and regions have various legislations and legal approaches to regulate real-time employee monitoring. The primary international standards for collecting personal data are that the collection should be limited, and that selection should be fair (OECD, 2013). Roth (2016) commented that some jurisdictions, such as Hong Kong, are stricter than New Zealand on employee monitoring. New Zealand is legally bound to give substance to the right of privacy under the International Covenant on Civil and Political Rights 1966 (ICCPR) and has its legislation under the Privacy Act 2020. The Act aims to encourage private and public sector agencies to identify risks and prevent incidents that could cause harm (Hornsby-Geluk, 2020). However, the law's implementation is flexibly applied and tends to drive privacy breaches towards conciliation rather than compensation. In other words, it tends to benefit employers more than employees (Roth, 2016). Although in Hammond v NZ Credit Union Baywide (2015), the Tribunal ruled that the employer had interfered with the employee's privacy by disclosing personal information in breach of the Privacy Act and awarded $168,000 compensation to the employee, the critical feature of the Privacy Act is that a breach of privacy principles does not necessarily lead to liability under the Privacy Act (Inglis, 2016).

Under the Privacy Principles, employers should not intrude into employees' private lives and should conduct themselves in a manner that protects employees' personal information; otherwise, employees may claim a personal grievance against employers because of the use of REMTs where the employees have been disadvantaged in their employment. In New Zealand, the Employment Relations Authority and Employment Court have exclusive jurisdiction to determine such claims (Section 161(1) and 187 (1) Employment Relation Act 2000). However, the employment court cannot interpret the privacy principles directly under the Privacy Act, which are not enforceable in the Employment Court (Inglis, 2016). The Employment Court has recognised that "the Privacy Act's provisions may be used to represent current community standards and expectations", considering whether or not employee monitoring activities are reasonable (Roth, 2016). Figure 2 illustrates that New Zealand has specific legal procedures for employment complaints concerning privacy issues.

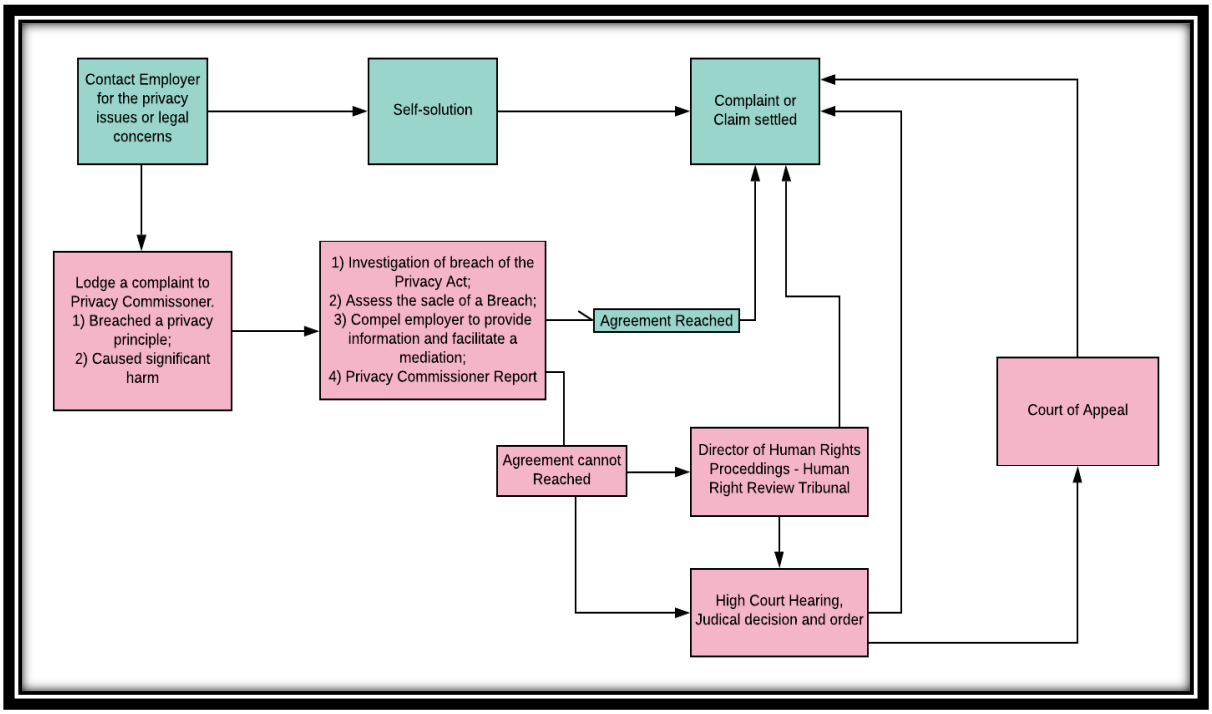


Figure 2.2 New Zealand legal procedures of workplace privacy issues

There are also legal concerns regarding the nature of the technology in use. For instance, many Unmanned Aerial System (UAS) applications and devices are used as REMTs in various stages of construction projects, which can be risky and hazardous to construction practitioners. For example, a faulty drone flying into a construction site may cause accidents and injury. The Civil Aviation Authority (CAA) oversees and applies the rules and regulations in New Zealand, so flying devices should always comply with civil aviation legislation. The general rules relevant to UAS used as REMTs at construction sites are listed below (2015):

- The UAS device must not be over the gross mass of 25 kg.
- The device operating must give way and remain in airspace clear to all human-crewed aircraft on the ground and in flight.
- Operate during the daytime only.
- Operate in a limited location, height, and airspace.
- An approved person or organisation is required for a heavier device and supervised operations.

2.3.2 Ethical Concerns

In the most ethical standard, employers cannot monitor an employee's private life. Using REMTs within the specific scope to an acceptable ethical level may be costly to employers' monitoring activities. However, there is a demand to balance privacy rights and business interests on a case-by-case basis. Previous studies evaluated the balance between employees' right to privacy and employers' need for information to ensure the workplace is properly supervised. (Moore, 2000, Minch, 2005, Hartman, 2001). A study identified that employers might be unable to avoid using REMTs in a way that creates tension or stress in the work environment (Ciocchetti, 2011). For example, building companies may use REMTs to improve and assess their workers' productivity levels during working hours. However, the technology could alarm employees if it monitors or limits toilet time or meal breaks. What personal information collected by REMTs does or does not cross over the 'privacy line' is one of the ethical concerns (Hagen et al., 2018).

A study identified that supervisors perceive increased job efficiency as performance improvement using employee monitoring systems (Valentine, 2002). One of the benefits of REMTs for construction employers is that when an incident occurs, the system produces a real-time record, which can be used as evidence during the safety investigation. However, a system user may be able to challenge the accuracy and completeness of the information provided by the system (Hartman, 2001). The accuracy level of information and data analysis are the key concerns from employees' point of view. Researchers have claimed that recorded evidence might be faulty due to system malfunction or human manipulation (Minch, 2005). It is well-recognised that monitoring devices cannot capture complete information in different environments and surroundings. A study (Lin et al., 2013) reported that tracking devices never provided perfect information and showed different technologies varied in accuracy, maintainability and stability level. A summary of the findings is given in Table 2.2. Inconsistent monitoring or missed technical information can cause concern and lead to mutual distrust between employers and employees. This could cause discrimination that may lead to ethical issues and result in disappointment, dissatisfaction and resentment (Minch, 2005).

Table 2.2 Reliability of tracking technologies

	RFID passive	RFID active	ZigBee	WiFi	GPS
Accuracy	Low	Medium	High	Low	Low
Stability	Medium	Medium	High	Low	Medium
Maintainability	High	High	Medium	Low	High

Research has indicated that when monitoring work-related activities inviting employees to participate in establishing the monitoring standards and policies reduced invasion of privacy and dissatisfaction (Alge, 2001). Where an employer has clarified the need for surveillance, there is a belief that employees would accept REMTs more easily. However, employees' reaction varies. For instance, higher-level employees are less sensitive to surveillance when the employer has explained the procedures or instructions in advance (Alder et al., 2007b, Alder et al., 2007a). A well-designed guideline or standard has become the initial step for employee acceptance of workplace monitoring (Freeman, 2003). A study described the "Hot-Stove-Rule", which explains how to impose disciplinary action without generating resentment. Discipline should be immediate, consistent, impartial, and with a warning (Byars

and Rue, 2004). Introducing monitoring standards into the construction sector requires consistency and discipline (Minch, 2005). A study further suggested that employers should consider and address ethical concerns in monitoring instructions drafted in plain language and show how workers will be monitored (Sproule, 2002). Many workers claim they do not understand the monitoring functions and how the monitoring data will be used and are concerned about the consequences of monitoring. A survey study further revealed that concerns over legal action were the most crucial factor, which over two-thirds of respondents concerning accepting employee monitoring (Wells, 2007).

2.3.3 Behavioural Concerns

Research showed that procedures intended to obtain personal information might lead to behaviour protective of privacy from those subject to these procedures (Alge, 2001). Studies reported that trust is one element that could be destroyed between employees and employers when monitoring is applied (Chang et al., 2015). The workers become reluctant to perform their duties while being monitored, and their job satisfaction and loyalty will be negatively driven. A study developed a Communication Privacy Management (CPM) theory that resolves the controversial tension between managing private and publicly shared information (Petronio, 2004). This theory was then applied to investigate its influence on employee monitoring acceptance. For example, employers socialise with employees in an informal setting to discuss the information boundary of the monitoring. Employees develop their understanding of monitoring purposes and actively participate in health and safety management, and trust will be established in the employment relationship (Chang et al., 2015).

Numerous studies have reported the adverse effects of employee monitoring on morale and productivity and have shown that employees are likely to engage in counterproductive behaviour when they feel less valued and have a low commitment to the company (Ariss, 2002). Using REMTs potentially provides a new way for building companies to evaluate their workers' performance. However, employee monitoring may cause workers to feel constant threat and scrutiny, exhibit counterproductive behaviours, and bring overacting and excessive personal emotions to the workplace. Workers often engage in unsafe behaviours to protect their privacy if they believe it is under threat from surveillance. (Cropp, 2020, Chang et al., 2015, Ciocchetti, 2011).

Employee monitoring negatively affects employee stress levels, work attitudes, and employees' mental health (Holland et al., 2015). A study revealed that more than half of employment terminations are related to workplace surveillance. Employees commonly feel they may lose their jobs or be placed in vulnerable situations when being monitored in the workplace (McParland and Connolly, 2020). Work stress caused by monitoring will negatively affect workers' mental health and well-being and result in anxiety, depression, fear, and grievances (Mishra and Crampton, 1998, Ariss, 2002).

2.4 Net Benefits for REMTs in the Construction Sector

Due to the ramifications of the Covid-19 global pandemic, many building companies are considering using REMTs at the worksites as part of their responses to the post-COVID work environment and human resource management system. (Keall, 2020). However, apart from

movement tracing, REMTs have a range of other functions. The following are the benefits of REMT implementation for employers and employees.

1. Many employers claim that employee monitoring is for business purposes, improved site security, checking workers' performance, and enforcing company policies (Ariss, 2002).
2. Workplace monitoring can maximise the productivity of their employees. Some project managers reported that non-work related personal activities occur at construction sites during working hours, so REMTs can limit distractions and increase work efficiency (Yerby, 2013, Alder et al., 2007a)
3. Ariss (2002) indicated that REMTs prevent company resource misuse and can be used to reallocate resources to the correct place. For example, REMTs give the site manager a holistic real-time view of the worksite, which helps managers plan and assign their workforce accordingly (2019).
4. Studies have shown that emerging monitoring technologies can improve construction worker safety and control legal and financial risks. REMTs help safety managers search out and respond quickly to problem areas so as to prevent poor safety practices and reduce occupational accidents (Khakurel et al., 2018, Nnaji et al., 2020).
5. Many building companies have stated that REMTs are invaluable management tools that benefit the business, provide prompt work support to construction practitioners and allow immediate communication channels (Ariss, 2002).
6. REMTs give both employers and employees digital evidence, which helps them investigate site safety issues, disputes, and prepare a defence in potential lawsuits (Lasprogata et al., 2004).

3. Research Design and Methodologies

This project applied a mixed-method approach that collected and used qualitative and quantitative data. The stages of the project, tasks, methodologies, and deliverables of the current study are presented in Table 3.1.

Table 3.1 Research design and methodologies

Stages of Project		Tasks	Methodologies	Deliverables
Stage 1: Knowing and Exploring	1A: Background Studies	✓ Review REMT catalogues ✓ Identify REMT applications ✓ Literature review	✓ Desktop analyses	✓ Lists of popular REMTs and their respective products ✓ List of their net benefits in the construction sector ✓ The potential list of concerns on using REMT in the construction sector
	1B: Validate the potential concerns and benefits	✓ Validate the potential concerns ✓ Questionnaire Designs	✓ Focus group A ✓ National Survey	✓ Validate and complete legal, ethical and behavioural concerns ✓ Data collection
	1C: Develop the best practice guidelines	✓ Design a set of guidelines to address the critical concerns ✓ Decide one REMT application for the experimental trial	✓ Focus group B	✓ Complete and finalise the draft guidelines and apply them in Stage 2 ✓ Identify a REMT product for testing in Stage 2
Stage 2: Doing and Advising	2A: Trial application	✓ Assess the fitness, benefits, and impact at the construction site ✓ Apply the developed guideline to the experimental trial	✓ Observations ✓ Trial survey ✓ User interviews	✓ Guideline evaluation report ✓ Identify monetary and non-monetary benefits
	2B: Cost-benefit Evaluation	✓ Weigh the costs expended to implement this REMT product versus the benefit gains	✓ Qualitative Cost-Benefit Evaluation	✓ Advise and comment on the trial application

3.1 Stage 1 Knowing and Exploring

Stage 1 aimed at identifying available real-time employee monitoring technologies, which included investigating other countries' construction sectors, assessing the net benefit of these technologies, identifying and validating the potential concerns for REMTs implementation, and developing new best practice guidelines for construction practitioners and executive teams. The background studies provided a basis for the survey design and focus group discussion. The focus groups consisted of members from various professional sectors. Members were expected to join two focus groups (A and B) to provide expert inputs so as to achieve objectives 1B (validate a list of benefits and concerns) and 1C (guideline development), respectively. In focus group A, available REMTs were introduced. A moderator posed a series of questions to gain insight into how the group views these REMTs regarding their legal, ethical, and behavioural concerns, which helped validate the list of concerns identified in the background study. Next, a national survey was conducted to prioritise these validated concerns. The survey was distributed nationwide in New Zealand to solicit construction practitioners' perspectives on REMT implementation. Respondents were randomly identified from construction networks, builders' associations, professional bodies, and construction companies. Focus group B was organised to develop practice guidelines

addressing these concerns and decide on one REMT application for the experimental trial in Stage 2.

3.2 Stage 2 Doing and Advising

Empirical research has proven that an experimental trial is a helpful tool in expanding the scientific body of knowledge (Konda et al., 1999). In this stage, the trial aimed to assess the fitness, benefits and impact of REMT adaptation and to apply the draft guideline at a real construction site. Focus Group B discussed the draft best practice guidelines, available REMT products, and possible risks of adopting REMTs in the New Zealand construction sector. This group advised that the trial use the most accessible and mature technology. On-site observation, short surveys, and conversational interviews were conducted to evaluate the developed guidelines, test the construction practitioners' needs, validate concerns, and evaluate the cost and benefits of New Zealand scenarios.

However, due to the character of the New Zealand construction sector, many of the trades are sub-contracted, so random assignment became impossible. The trial adopted a quasi-experimental approach, also known as 'field-experiment' or 'in-situ experiment', a type of experimental design in which the researcher has limited control over the selection of study participants (Levy and Ellis, 2011). Quasi-experiment does not rely on the absence of randomisation, and participants are assigned to groups based on non-random criteria (Maciejewski, 2020). The experimental trial aimed to evaluate the developed guidelines, and the trial's design considered purposes, objectives, selection criteria, data collection, confidentiality, explanatory variables, and proposed cost-benefit evaluation.

The duration of the experimental trial was set as ten working days, and the researcher randomly visited the worksite during working hours to observe the workers' behaviours when monitoring devices were used at the worksite. All on-site workers were given trial information sheets and consent forms, and workers who agreed and signed to join the research became participants. Several participants were assigned to Group 1 (Guideline Execution group), where monitoring instruction, guideline introduction, and Q&A sessions were organised. The remaining participants were treated as Group 2 (Control group). Apart from general information, no further monitoring details were given. All participants did not know the function of the group they were assigned. Table 3.2 outlines the ten-step procedures for conducting this trial.

Table 3.2 The trial procedures (Steps 1 to 10)

Steps	Tasks	Objectives and Deliverables
1	Trial product selection	✓ Discuss with the Focus Group B members based on the cost, availability, and feasibility of the trial applications to test the guideline ✓ The research team will make decisions
2	Trial site selection	✓ Select and facilitate an accessible construction site with ongoing works
3	Initial meeting with site managers	✓ Introducing research background, purposes of the trial, guideline briefing, previous research results on benefits and concerns Recruitment of participants
4	Troubleshoot the devices	✓ Geofencing, zone setting, device location testing ✓ Device identifier linked with the individual participant
5	Participant's grouping and consent	✓ Information sheets were sent to all on-site workers ✓ Participants' consent was obtained. ✓ An adequate number of construction practitioners in the participation ✓ All participants were randomly assigned to two groups

6	Monitoring devices distribution	✓ The users' instructions or menu were delivered to all participants ✓ Monitoring devices were distributed to participants ✓ The devices were returned to the site office for charging
7	Monitoring Report	✓ Weekly monitoring information report
8	Observation and communication	✓ Random visits to the site to obtain feedback from participants ✓ Observe workers' behaviour under monitoring ✓ Communicate with participants about effective guideline elements
9	Survey and Interviews	✓ A short survey was provided and collected for a group of participants ✓ Interviews with another group of participants
10	Data collection and analysis	✓ Benefits and concerns are validated ✓ The evaluation report on the developed guideline is complete ✓ Recommendations for further study ✓ Advise the sector on trial REMT implementation

After the trial, participants from Group 1 were given a short survey (Table 3.3) to test their understanding and possible recommendations for the developed guidelines. Ten evaluation statements were designed for the developed guideline. Accordingly, at the end of the survey, the following two open-ended questions were asked:

1. What are other concerns, if any, did you have after you were provided with the implementation guidelines during the trial?
2. What are your recommendations for the developed guideline?

Table 3.3 Questions for guideline evaluation

No.	Evaluation statements	Disagree ←						→ Agree
GE1	I understand the purpose of the guideline.	1	2	3	4	5	6	7
GE2	I know my role and responsibility when my worksite or myself is monitored.	1	2	3	4	5	6	7
GE3	The concerns listed in the guideline have covered mine.	1	2	3	4	5	6	7
GE4	I found that the checklist questions help me understand my rights better.	1	2	3	4	5	6	7
GE5	I am satisfied with addressing concerns about the scope of monitoring.	1	2	3	4	5	6	7
GE6	I am satisfied with addressing concerns about the quality of monitoring.	1	2	3	4	5	6	7
GE7	I am satisfied with addressing concerns about data management.	1	2	3	4	5	6	7
GE8	I believe a REMT implementation plan is necessary before applying REMTs.	1	2	3	4	5	6	7
GE9	I am comfortable with monitoring if implementation follows the guidelines.	1	2	3	4	5	6	7
GE10	I believe the worksite monitoring will benefit the project and my safety.	1	2	3	4	5	6	7

The study adopted an alternative approach, a conversational interview, to gain insights from the control group (Group 2) and compare their feedback with that from Group 1. All group members were invited, and key interview questions (Table 3.4) were asked to allow participants to provide their input on the trial monitoring experiment. In the conversational interviews, interviewers were allowed to ask respondents if they did not understand a question and could provide clarification; this specifically investigated the participants' understanding of the worker monitoring, awareness of monitoring data, perception of monitoring activities, and recommendations for monitoring implementation. A brief introduction of the guideline contents and the purposes of the trial study was given to ensure that respondents understood the questions as intended.

Table 3.4 Key interview questions

No.	Key Interview Questions
C1	Do you know how to use this GPS device when working on the site?
C2	Are you comfortable wearing the device when you are working? If not, why?
C3	What are your concerns about the device and monitoring activities on the worksite?
C4	How do you feel if the main contractor/employer requires all workers wear monitoring devices?

C5	How do you think the construction worker monitoring will benefit the project and the construction practitioners?
C6	After this trial, what do you recommend to the employer if they want to implement REMTs in future projects?

Cost-Benefits Evaluation is a tool for assessing the overall benefits and costs of REMT implementation in similar construction projects. This evaluation was conducted based on the knowledge and data from the literature review, national survey, focus group discussions, and experimental trial. In order to help justify the investment decision on REMT implementation, this study adopted an "integrative cost-benefit matrix approach". This approach includes quantifiable and unquantifiable information (Ziller and Phibbs, 2003). The benefits of REMT implementation, such as enhancing safety and boosting productivity, are not measurable in monetary units. Key steps were followed to assess whether the costs outweighed the benefits. These are: (1) to define or describe the scenarios, including construction project size, estimated cost and predicted potential benefits; (2) to evaluate the weight of financial and non-financial costs with perceived benefits; and (3) to compare the relationships between financial and non-financial costs and benefits (Rogers et al., 2009). The evaluation advised building companies to make an investment decision based on costs and benefits for future projects.

4. Results and Discussions

4.1 Focus Group A

Although REMTs have the potential to address health and safety and low productivity issues in the construction sector, monitoring applications that track individuals are not universally welcomed. The background study showed that the key arguments and concerns formed into three main clusters: legal, ethical, and behavioural. To ensure the validity of these initial findings within a New Zealand context, a first focus group (Focus Group A) was conducted on 21 October 2020 to test these broad categories with selected participants. Members of this focus group were carefully chosen to represent a cross-section of sector expertise and perspectives, including technical, academic, legal, and practical views on using REMTs in the New Zealand construction sector. The group members led the discussion with minimal guidance in order to facilitate free, unbiased debate. While individual names remain confidential as per ethics approval and consent agreements, the organisational roles and specialisation of each participant are noted below:

- Lawyer: Construction Law
- Union Representative: Health and Safety
- Recruitment Agency: Construction Sector
- REMT Provider: Product Manager
- Lawyer: Employment and Privacy Law
- University Professor: Construction Contract
- Quantity Surveyor: Main Contractor
- Digital Innovation Manager: Main Contractor

The discussions became centred on legal, ethical and behavioural aspects and explored the potential legal ramifications of using REMTs in the workplace, ethical standards change over the post-Covid work environment, and variation of work behaviours under monitoring. To help the research team authenticate these perspectives, it was envisaged that the information and views shared within the focus group would provide a cross-reference for the key concerns highlighted in the literature review. This process of substantiation could give crucial input for developing new sector-wide guidelines for employees and employers using REMTs and would ensure these technologies are implemented appropriately and consistently across the New Zealand construction sector.

4.1.1 Legal

The first segment of the focus group discussions sought to understand participants' views on the legal aspects of REMTs from New Zealand construction site workers' perspectives. The discussion largely echoed the privacy principles, and Table 4.1 below summarises the discussion and suggestions from keynote speakers.

Table 4.1 Legal concerns – discussions and suggestions

No.	Lead Professionals	Discussion points

1	Quantity Surveyors and Lawyers	✓ Addressing workers' concerns requires a multi-faceted approach, answering queries from the legal requirements ✓ Creating a clear communication channel ✓ The type of safeguards in place to ensure the information is handled appropriately
2	Union Representative	✓ Some construction workers' 'inertia toward REMT systems' is understandable ✓ Participants agreed that aversive actions might become an issue if workers do not receive sufficient information about using such systems
3	REMT Product Manager	✓ The participants held concerns about third-party companies or international organisations using data inappropriately or exceeding the boundaries of data collection and its purpose, even if such use of data is legal within the parent company's jurisdiction ✓ Privacy Act principles (2020) include firm guidance that data is only retained if needed ✓ Storing information for longitudinal predictive capability is permitted if the information is genuinely anonymised. However, this increases the potential for third-party requests for commercial or legal reasons
4	Lawyer	✓ Worker privacy is the backbone indicator for constructing REMT systems and planning how the following data will be shared ✓ Ensuring tracking is limited to appropriate work activities and expressing that being tracked outside the worksite is a great concern for workers
5	Digital Innovation manager	✓ Presenting REMT as part of workers' Personal Protective Equipment (PPE) seemed to increase the likelihood that it would be readily accepted
6	Lawyer and REMT Product Manager	✓ Monitoring devices that need to be charged at home by the workers can raise legal and privacy concerns about off-site monitoring ✓ On/off-site privacy divide is possible using geo-fencing, and devices can also be charged on-site if workers are particularly concerned
7	Lawyer	✓ Employers' liability is slightly more complicated when work vehicles are involved
8	Union Representative	✓ Workers being forced to install and use applications on their smartphones is problematic as the devices constantly transmit and receive data ✓ Safeguards can be established to ensure that after-hours data cannot be gathered or monitored by the software
9	Lawyer	✓ Workers' legal concerns should – and do – extend to the possibility of data being used in various types of legal proceedings
10	Lawyer	✓ From a workers' perspective, REMT development means the quality of the real-time information is much more granular when individuals can be singled out and potentially held legally liable for their behaviour
11	University Professor	✓ The workers hold genuine concerns about the risk of "scope creep". When the REMT information is available, the opportunities for utilising it could expand beyond the scope of what was initially planned

4.1.2 Ethical

There was a significant overlap between the legal concerns raised and the ethical concerns about using REMTs at construction sites. The discussion about ethical concerns was introduced by observing how the Covid-19 pandemic has dramatically changed workplace conditions, including construction sites. The influence of Covid-19 seemed to ease workers' inertia around monitoring; for instance, most workers were already aware that their smartphones could be used as location-tracking devices. Many people seemingly believe that the trade-off between privacy loss and the public good is justified. The risks of unsafe work behaviour and hazardous conditions could outweigh workers' privacy concerns at the construction worksites. The following ethical considerations and points are the result of focus group A:

- Participants acknowledged workers' ethical concerns about the underlying purposes of REMTs. There is a risk that monitoring data could be used to diminish workers' rights, such as providing a baseline that then places excessive pressure upon workers to achieve constant performance improvements.

- The purpose of the data gathering is key to the communication and subsequent degree of acceptance of monitoring by workers. The driver needs to be meaningful, well-intentioned, and genuine in an ideal situation. If these ethical standards are in place, workers' concerns may be eased, and the implementation may be more natural and acceptable.
- The largely contract-based nature of the construction sector could affect workers' ethical concerns about using REMTs. The relationship between workers and contractors is typically weaker than their relationship with their immediate employers, with the former tending to have a shorter, finite timeframe which can set the tone for a more transient and less-trusting working environment.
- While the grounds for using REMTs for health and safety purposes were acknowledged, the focus group discussed how workers' ethical concerns persist around the accuracy of the data and how this might affect its use. Extant REMT data means workers could benefit from a streamlined ACC claim process in the event of an injury. However, this also relies upon the underlying integrity of the REMT system.
- REMT data could be used to track relative productivity levels and make scheduling changes on a real-time basis to avoid project overruns accumulating towards the end of the contract. However, workers could have concerns about the function of such monitoring, particularly if such analysis could be mined down to individual workers' data rather than aggregate project productivity.
- The subtleties of what type of data is monitored and its appropriate collection may be lost in the broader discovery of information. Similarly, data could show which workers spend time in a specific working area, potentially tracking their interactions with other workers.
- The group noted that workers' ethical concerns likely correlate with their relationships with their employers'. Where the relationship between an employer and employee is strained or tenuous, workers could have more significant ethical concerns about their data being gathered and may use obstructive behaviours to avoid being monitored. For instance, participants pointed out that the communication and implementation of REMTs need to be tailored to the workers' cultural backgrounds and consider how this could affect relative levels of comfort and compliance with such systems. A positive working environment driven from top to down with transparent and sensitive communications will help to normalise the activity.

4.1.3 Behavioural

Participants were asked to place themselves in the construction worker position and consider the potential positive and negative concerns they could have about the effects of REMTs on their behaviour. It was noted that research gathered during the literature review for this project found that procedures intended to obtain personal information may lead to protective behaviour regarding privacy. The group noted the following elements for consideration:

- Workers who were used to some form of surveillance should, after a period of adjustment, quickly get used to more sophisticated REMT.
- Just as the effects of REMTs upon behaviour ease after a settling-in period, the group noted that while Covid-19 may have placated many workers' concerns towards

REMTs, it is unclear whether this will be a sustained change in perspective or whether attitudes and concerns will revert to a pre-Covid-19 state.

- Communication about how REMT can benefit workers; for example, using REMT to ensure staff are not working excessive hours is just as important as monitoring non-performance. The group discussed how in some cases, REMTs could institute genuine changes in a work environment by creating a new company culture that instils positive behaviours beyond the data gathering period, which will greatly aid acceptance and promote these permanent behavioural shifts.

The focus group discussions detailed above were compared with the literature review findings regarding workers' perceptions and potential concerns about using REMTs, per the research plan. The literature review identifies concerns which are shown in Table 4.2 below. The **(+)** symbol shows where this concern was independently verified and expanded upon during the focus group discussions, along with selected examples. The focus group discussions comprehensively substantiated the literature review findings and greatly enriched progress towards adopting REMTs in the New Zealand construction context.

The significant overlap between the initial findings and the views expressed during the focus group suggests these concerns are valid and applicable to the New Zealand construction sector and provide a sound basis for further investigation in the subsequent phase of this research project.

Table 4.2 The key discussion points during the focus group

Concerns identified by literature reviews	Discussion and enrichment in the focus group
Privacy Intrusion	The potential loss of privacy using REMTs relates to all aspects of the process, including the scope of purpose, extent and nature of monitoring, storage protocols and safeguards, and the ultimate use of the data by organisations in various locations. For instance, using gathered REMT data may be subject to different laws depending on the company's jurisdiction, which could be more lenient than New Zealand legislation. +
Employment relationship	The discussion reflects the layered nature of employment relationships. Employees are entitled to their communication rights under the Privacy Act (2020) alongside employment law. However, there are concerns about how REMT might affect their rights, such as personal grievances. Additional problems could include where workers' expectations would sit regarding using REMTs within employers' broader responsibilities, such as fair pay agreements and duty of care under health and safety provisions. +
Civil Aviation Restrictions	Not discussed
	Sectoral Court Proceedings + The group noted that 'records cut both ways: for instance, the legal concept of discovery means that REMT analysis would likely be called upon as relevant information if a dispute escalated to court.
Scope of Monitoring	"Scope" has multiple meanings in this context, such as the extent of purposes and utilisation of gathered data. For example, devices charged at home raise concerns about non-working-related monitoring. Also, increasingly high-quality data and advanced technologies raise the risks of unintentional monitored data leakage, in which data is used for purposes outside the initial consultation. +
Quality of Monitoring	Data collection methods may be asymmetric in many circumstances, for example, where technical accuracy guidelines are not communicated to employees - raising concerns around accuracy and the protocol for challenging data if an error arises. +
Standards and Policies for Monitoring	No written standards or policies are a significant workplace monitoring issue. Approved Standards, guidelines or policies form the backbone of the respectful use of REMTs. Employees are concerned about the transparent explanation of monitoring standards, including the purpose, method, benefits and safeguards in place. Such measures for using REMTs could become a necessary addition to existing agreements. +

Functions of Monitoring	The function and purpose of data gathering are key to the ethical concerns around using REMTs. In an ideal situation, the drive needs to be meaningful, well-intentioned, genuine and communicated.
	Employment Relations: ethical + It is closely linked to trust and legal employment concerns. The use of REMTs indicates how this could affect the ethical aspects of employment relations.
Trust	Trust concerns around using REMTs may be intensified by the largely contract-based nature of the New Zealand construction sector. Short-term contractual relationships potentially raise the risk of inappropriate data collection, affecting workers' involvement and decisions to use REMT devices as intended. +
Counterproductive work behaviours	While a participant with previous REMT experience as a worker stated that after an initial adjustment period, normal behavioural patterns rapidly resumed, the group noted that workers with an aversion to REMT might choose counterproductive actions to avoid monitoring (swapping devices with colleagues, for example). +
Mental health and well-being	Employers are responsible for taking all practicable steps to uphold their rights and protect their employees' safety, including their mental health and well-being. Using REMT to check that staff are not working excessive hours; for example, implementing such REMT could also detrimentally affect workers' mental health if misused. +

4.2 National Survey

Due to the Covid-19 pandemic, risks continue to influence the global working environment, and the development and implementation of REMTs are rapidly evolving in the New Zealand construction sector. The voices and perspectives of construction practitioners and other construction professionals are essential before developing new sector guidelines for REMT adoption. An increasing number of New Zealand building companies consider REMTs installed on their worksite to be part of health and safety protocols and management strategies. The benefits and concerns of using REMTs at the construction site can be validated through a national survey, for which carefully designed questionnaires have been sent to construction companies, professional industrial bodies, local builders associations, and independent building practitioners. This substantiation provides crucial input for REMTs' implementation appropriately and consistently across the New Zealand construction sector. The national survey, 236 valid responses were collected from practitioners in the New Zealand construction sector. The profile of respondents by their professional roles is shown in Figure 4.1. About 45 per cent of the respondents are frontline trade workers in the construction sector.

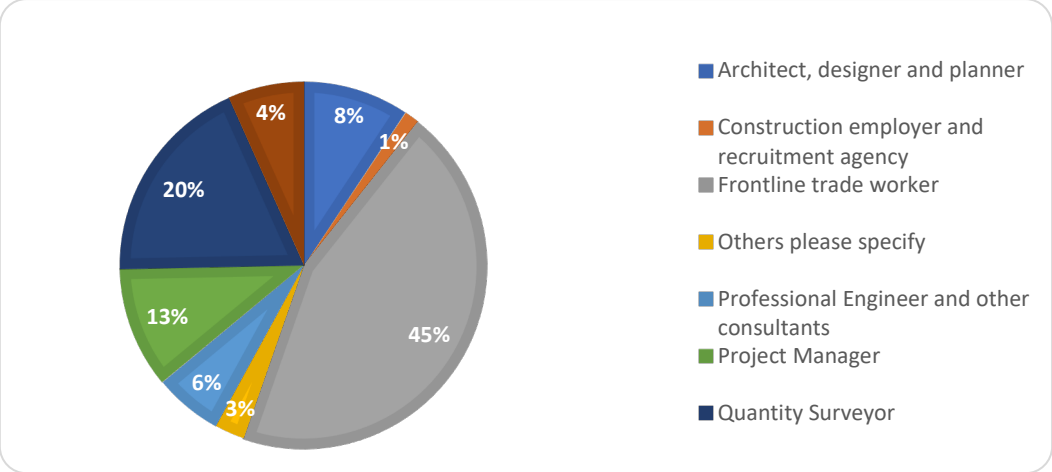


Figure 4.1 Profile of respondents by professional roles (n=236)

The survey covers respondents across the country, from Auckland to Otago. The survey results show that most respondents are from Auckland and Canterbury, where the construction sector is relatively busy (Figure 4.2 refers).

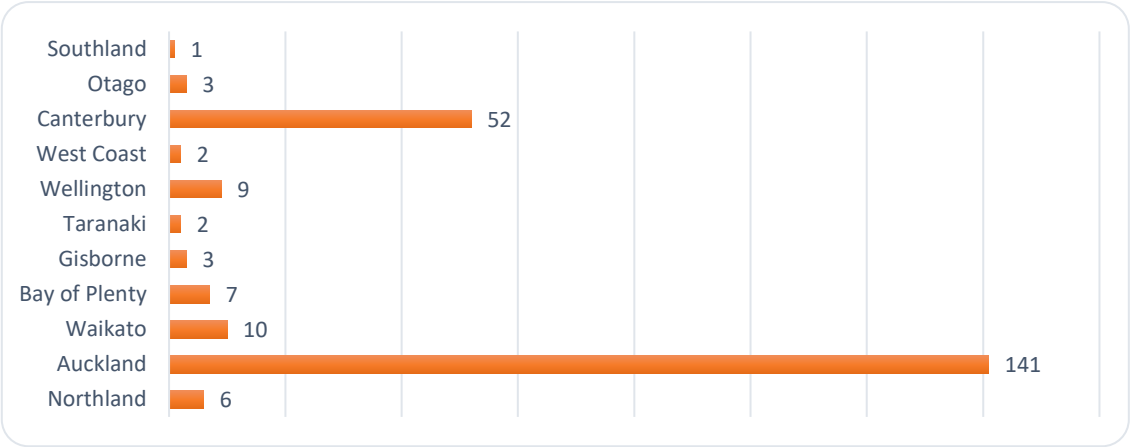


Figure 4.2 Profile of respondents by region (n=236)

The age of respondents and work experience in the construction sector are the factors that need to be considered. Previous research shows that individuals with different age groups might have different privacy attitudes (Chris Jay Hoofnagle, 2010). For example, the impact of attitudes on protective behaviours among mature workers was more substantial than in younger employees. Figure 4.3 illustrates the age group of the respondents. The survey result shows that most are middle-aged (25 – 45), and most respondents have worked in the construction sector for more than one year (Figure 4.4).

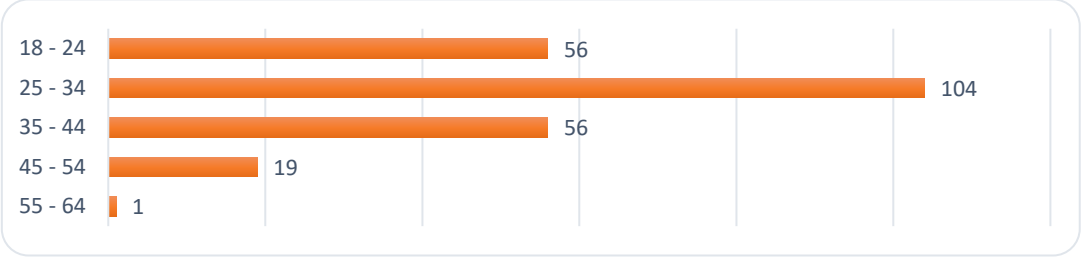


Figure 4.3 Profile of respondents by age (n=236)

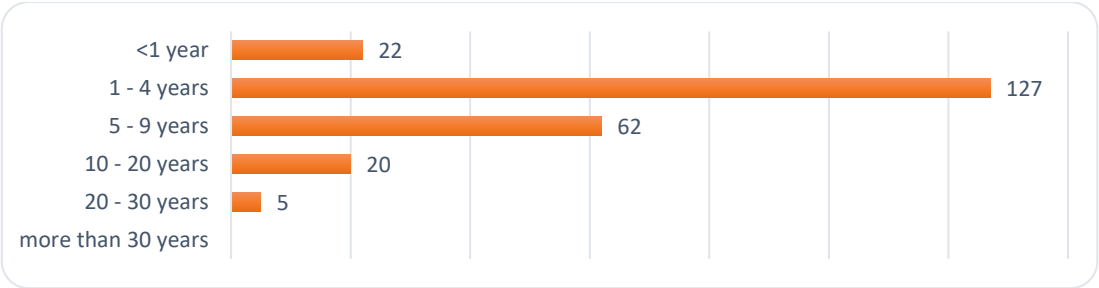


Figure 4.4 Profile of respondents by work experience (n=236)

Experience of being monitored also will influence respondents' views about REMT adoption. A previous study described that the experience of being monitored would cause a higher level of accepting monitoring activities (Rafiq and Fang, 2008). However, respondents with no similar experience or who do not know much about employee monitoring may not be able to accept REMTs fully. Figure 4.5 shows that about two-thirds of the respondents have no experience monitoring at construction sites.

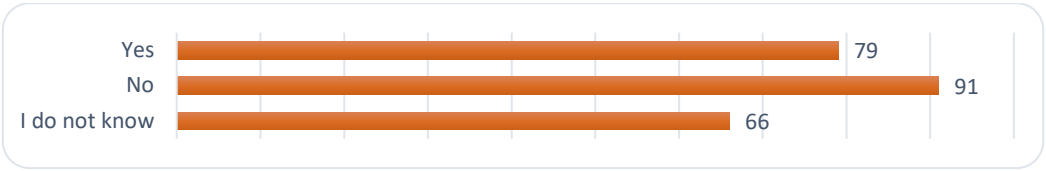


Figure 4.5 Participants by experiences of being monitored (n=236)

4.2.1 Readiness of Being Monitored

Section 2 of the survey used a 7-point Likert scale to assess the readiness for REMT implementation at construction sites. On this scale, (1) means strongly disagrees (not ready), while (7) means strongly agrees (ready). Figure 4.6 shows the mean scores (out of 7) obtained from the collected data.

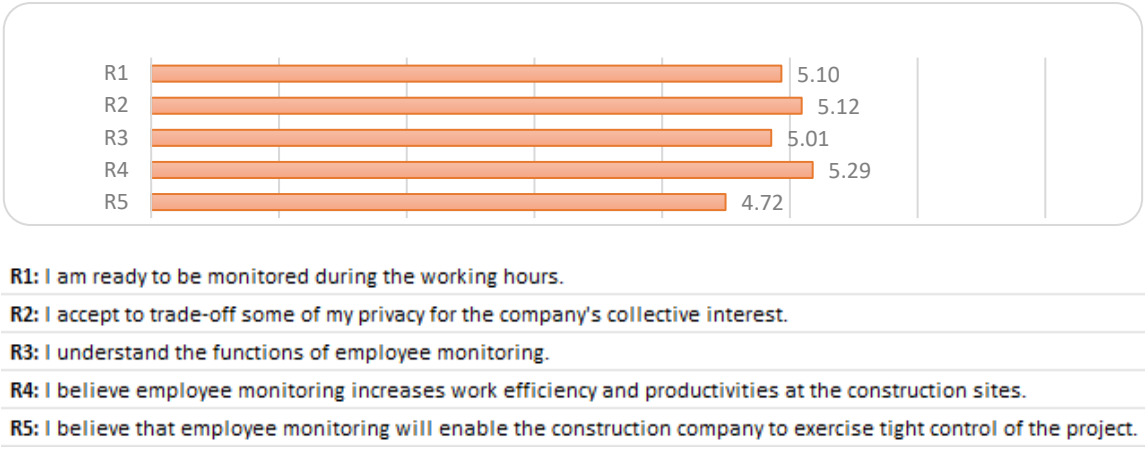


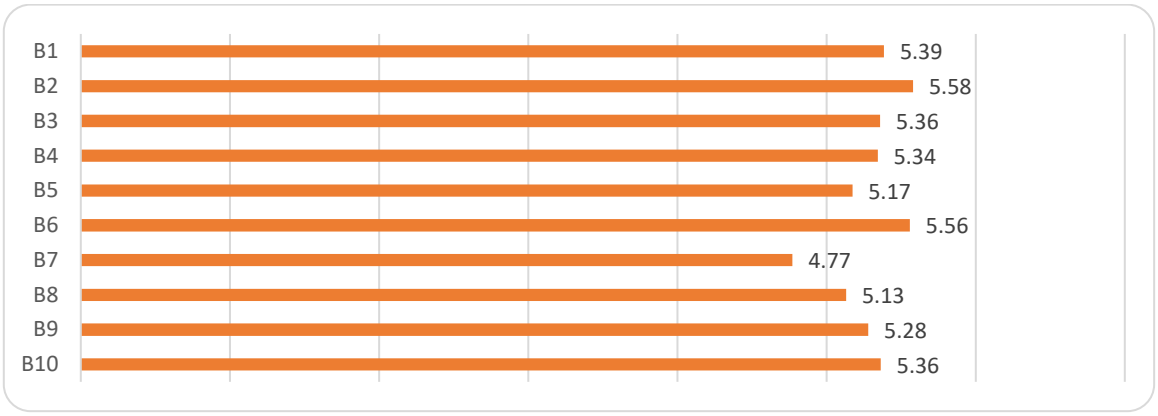
Figure 4.6 Readiness of being monitored (n=236)

The results above show that over 80% of the respondents have rated more than five on the Likert scale, i.e., they hold a relatively positive attitude toward REMT implementation at construction sites and are generally ready to be monitored if employers or authorities require it (R1, mean scores 5.10 out of 7.00). R4 achieves the highest mean score among the five readiness questions. The participants consider REMTs can assist them in working efficiency

and productivity at the construction site. Also, R2 shows a positive willingness to be monitored for business purposes. Interestingly, the respondents consider that the employers might overcontrol the project through REMTs (R5 – 35% of participants rated less than 4).

4.2.2 Benefits and Concerns.

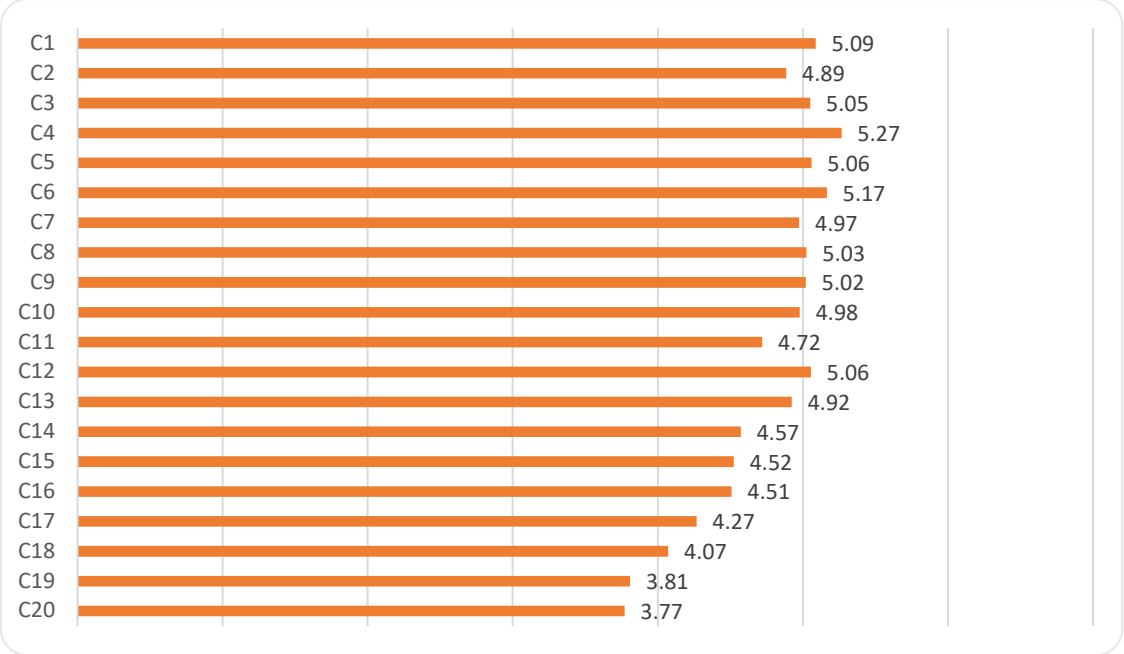
In Figure 4.7, the respondents generally acknowledge the potential benefits of REMTs at construction sites. The survey results show that REMT implementation would improve site resource allocation (B6) and site security (B10), reduce unsafe work behaviours and avoid construction site accidents (B2) from the practitioners' perspective. However, they are less likely to support using REMTs as a tool for a performance review that influences a fair pay agreement (B7).



B1	Protect construction practitioners from dangerous or extreme working conditions (e.g. working at height).
B2	Reduce unsafe work behaviours and avoid construction site accidents (e.g. fire).
B3	Create a healthy and safe work environment.
B4	Ensure construction employers' compliance with legal requirements, regulations and acts (e.g. Health and safety at work Act 2015)
B5	Improve workers' on-site performance.
B6	Improve site resource allocation.
B7	Support fair pay agreements between employers and employees.
B8	Facilitate communication between co-workers, supervisors, contractors and third-party professionals.
B9	Enable quick emergency responses.
B10	Improve construction site security.

Figure 4.7 Benefits of REMT implementation (n=236)

Figure 4.8 revealed the potential concerns of the respondents regarding REMT implementation. The survey results show that the respondents brought up concerns about the purposes of monitoring (C4), their legal rights (C1) and the use of monitoring data on any future legal proceeding (C6). Surprisingly, emotional issues (C18), mental health issues (C19) and well-being (C20) are not their key concerns, according to the data obtained from this survey.



C1: Employees' legal right in the employment relation.
C2: Become to a standard clause written into the employment agreement.
C3: Who has the privilege to access the data.
C4: Whether well-defined purposes of monitoring are properly outlined.
C5: Whether employees be involved on decision making about employee monitoring.
C6: Data collected by employee monitoring as a form of evidence in a legal proceeding.
C7: Using employee monitoring as work performance index or evaluation.
C8: Inappropriate or abused use of private data collected by employee monitoring.
C9: Disclose the collected data to unauthorised parties.
C10: Whether well-defined scopes of employee monitoring are properly outlined.
C11: How long the system will store the data obtained from employee monitoring.
C12: Accuracy, consistency, and completeness of the data collected from employee monitoring.
C13: A thorough standard or guideline for employee monitoring.
C14: Alter the way of employees' work.
C15: Impose more responsibility on employees' current duty.
C16: Create a distrust environment between employees and employers, main and sub-contractors.
C17: Drive the relationships to a negative direction in terms of job satisfaction, cooperation, and loyalty.
C18: Bring overacting and personal emotions to the workplace, which some workers may engage in a counterproductive work behaviour.
C19: Cause mental health issues to some employees such as anxious, depressed, and nervous.
C20: Impact on wellbeing of employees by creating tension in the work environment.

Figure 4.8 Concerns of REMT implementation (n=236)

The national survey results directly respond to the readiness for REMT adoption in the New Zealand construction sector. The following are the key findings:

1. Two-thirds of the respondents do not have any experience of being monitored at the construction site, or they do not know whether they have been monitored;
2. The respondents generally hold a positive attitude toward REMTs that can help increase work efficiency and productivity on the construction sites;
3. The respondents acknowledge the benefits of REMT adoption because it can improve site resource allocation and security, reduce unsafe work behaviours, and avoid accidents;

4. The respondents generally do not support using REMTs as a performance review tool used to justify pay-related decisions from the top level;
5. The respondents are concerned mostly about their legal rights and monitored data usage;
6. Emotional, mental health and well-being issues raised by REMT adoption are unlikely to be the key concerns of REMT users.

4.3 Focus Group B

Having conducted the Focus Group A and the National Survey, a draft guideline was designed to address the concerns of the New Zealand construction sector. To validate this guideline, and to decide on one REMT application for the trial in Stage 2, another focus group, Focus Group B, was conducted on 25 February 2022. The organisational roles and specialisation of each participant are noted below:

- Lawyer: Construction Law
- Home Builder: Residential Construction Sector
- REMT Provider: Product Manager
- University Professor: Construction Contract
- Health and Safety Manager: Main Contractor
- Union Representative: Construction Division
- Recruitment Agency: Construction Sector
- University Lecturer: Construction Safety
- University Lecturer: Construction Management

A draft guideline was distributed to each focus group member for comment and discussion. Five guideline elements were identified during the focus group discussion, and the feedback was used to develop the guideline further.

Table 4.3 Elements in the developed guidelines for the discussion

Guideline Elements	Lead Professionals	Key Discussion Points
Purpose and Understanding of Guideline	Health & Safety Manager, Lawyer	✓ The purpose of guidelines must be concise, and plain language is highly recommended for a better understanding of guidelines by the users ✓ The guidelines include references to show how REMT interacts with users' rights, health and safety on the construction sites, and sector productivity ✓ These guidelines must be read in conjunction with the New Zealand Privacy Act (2020), Health and Safety at Work Act (2015), and Privacy Breach Guidelines
Roles and responsibilities for Promoters and Participants	Home builder, REMT product manager	✓ Before installing REMT on the worksite, the employer or promotor must reasonably consult with and explain the monitoring activities, functions, purposes, and responsibilities to employees and other subcontractors. ✓ The consultation process must be genuine and conducted in good faith ✓ Written authorisation must be obtained as part of the contracting chain, and an information sheet must be made available to all users
Concerns and addressing concerns	Lawyers, Health & Safety Manager	✓ The promotors should make users aware of data security and management ✓ The checklist is a good way to understand potential concerns in a monitored work environment ✓ The written document must clearly define the scope and quality of monitoring
REMT Implementation Plan	Recruitment Agency & Union Representative	✓ Communication is vital to the REMT implementation processes

		✓ The REMT Implementation Plan ensures that Participants and Promoters know the part they should be playing and when and what to expect from other individuals, subcontractors, and organisations
Recommendations	University Lecturers	✓ All parties must agree upon a plan for collecting data, timing, the nature of data to be captured, and the process for sharing, among the other considerations ✓ The promotor also should have a contingency plan in case of data leakage or security breaches

Following the discussion of the developed guidelines, the focus group members were introduced to different categories of REMTs on the market, including 'internet & intranet-based, 'GPS & RFID-powered', 'Artificial Intelligence (AI)-powered Camera', and 'Wearable Sensor'. Finally, the group members voted for REMT applications in the next phase of the study. The result in Figure 4.9 showed that GPS wearable devices are the most practical application for the experimental trial. However, a group member emphasised that the AI-powered camera and its integrated system had been applied in the New Zealand construction sites, and the main contractors will use it for future projects.

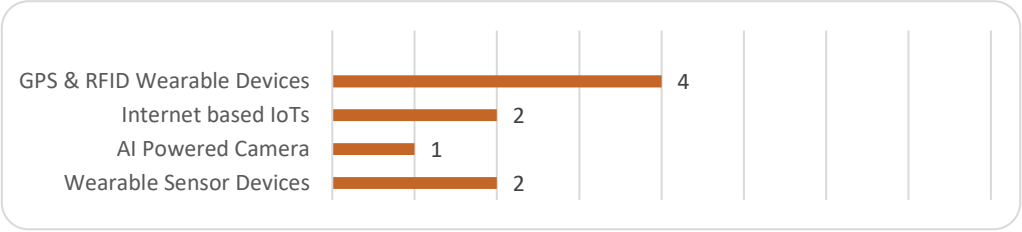


Figure 4.9 Preferred Trial applications

4.4 Experimental Trial of REMT

The Focus Group B members decided to use GPS-powered wearable devices to conduct the experimental trial in Stage 2 of this project, which considered the costs, delivery time, accessibility, service, and maintenance. A New Zealand local GPS tracker provider was identified and allowed the research team to lease the devices to conduct the trial. The trial construction site requires easy access for the researchers to conduct observations, surveys, and meetings with the construction practitioners. Shortly after, a main contractor with a residential development site for twelve townhouses in South Auckland (Figure 4.10) agreed to participate in this trial and distributed the project information sheet to their subcontractors. Over thirty construction practitioners work on project schedules at this construction site, including main contractors' employees and subcontractors. During the trial, structural work was completed, scaffolding was still erected, and the remaining trades were exterior cladding, painting, electricity, plumbing, roofing, site works, and flooring.

Figure 4.10 The construction site for the trial – reproduced with permission of the photograph owner

All workers in the project were invited to participate in the trial. The "Code of Ethical Conduct", Project Information Sheet (PIS) and Consent Form (CF) were included in the invitation, and the workers were given two weeks to consider their response. Eventually, twenty workers agreed, signed the consent forms, and voluntarily participated in the trial. All participants were randomly allocated to two groups: (G1) the Guideline Execution Group and (G2) the Control group. Following the trial procedures discussed in Section 3.2, onboard training was organised for G1, and monitoring instruction was emphasised before the trial. During their work shift hours, the participants must carry a GPS tracker (Figure 4.11), and the devices must be returned at the end of each shift and placed on charge in the site office. Each tracker is pre-assigned to an individual participant by a 4-digit reference number and reports the location and movement every 10 minutes.

Figure 4.11 The GPS trackers used in the trial

The troubleshooting processes successfully tested the map settings (as shown in the grey area of Figure 4.12). It shows that all devices (black dots) appeared within the trial site. The yellow blocks are the worksites mapped inside the geo-fence and indicate location-specific accuracy to the workers' movement.

Figure 4.12 Mapping and troubleshooting

4.4.1 Observations

The duration of the experimental trial was set as ten working days (02/08/22 – 18/08/22). The researcher randomly visited during working hours to observe the workers' behaviour when GPS trackers were required at the construction site (Figure 4.13). Some participants were willing to be monitored by voluntarily collecting and carrying the device when they started work. However, some acted differently, and the site manager reminded them to follow the monitoring instruction. The researcher also observed that a participant left the device in his work vehicle. The devices had to be returned to the site office by the end of each working day. However, some participants did not follow this requirement. Figure 4.14 illustrates that G1 has ten collections and seven returns, but G2 has four collections and two returns. When the trial was completed, it was found that two and seven GPS trackers had been lost from G1 and G2, respectively.

Figure 4.13 On-site observations

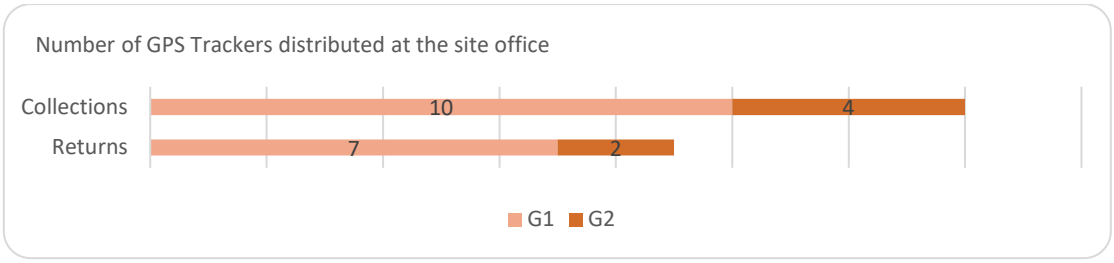


Figure 4.14 Management of the GPS trackers

4.4.2 Guideline Execution Group (G1)

The G1 members were invited to conduct a short survey (Table 3.3) to evaluate the developed guideline. As shown in Figure 4.15, 40% were aged 25-34, and most were carpenters and electricians. Eighty per cent had no experience of being monitored on construction sites. The main contractor employs 20%, and 80% are from subcontractors.

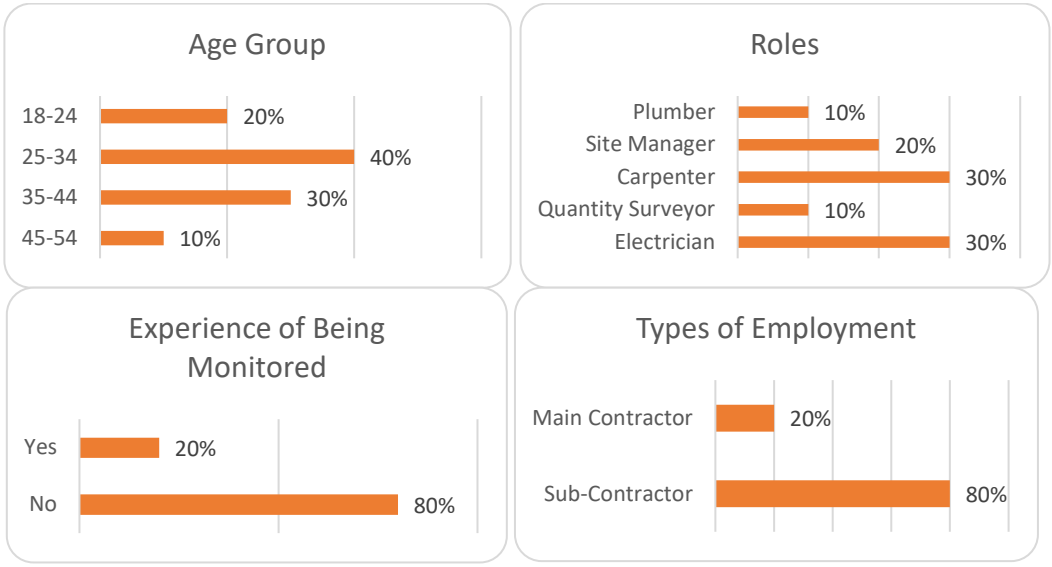


Figure 4.15 Demographic information of the survey (N=10)

Ten questions (GE1 to GE10, as shown in Table 4.4) were designed to evaluate the five guideline elements in the trial. Their mean scores are presented in Table 11. GE2, '*I know my role and responsibility when my worksite or myself is monitored*', was the highest mean score (5.7 out of 7.0), which means the developed guideline help participants understand their roles and responsibilities in a monitored worksite. However, GE8, '*I believe a REMT implementation plan is necessary before applying REMTs*', rated the lowest (3.7 out of 7.0). This result may suggest that the REMT Implementation Plan section needs to be revisited and further developed.

Table 4.4 Evaluation summary of the developed guidelines by the mean score

No.	The Statement of Agreeableness	Mean Scores (out of 7*)
GE1	I understand the purpose of the guideline.	**5.2**
GE2	I know my role and responsibility when my worksite or myself is monitored.	**5.7**
GE3	The concerns listed in the guideline have covered mine.	**5.4**
GE4	I found that the checklist questions help me understand my rights better.	**4.8**
GE5	I am satisfied with addressing concerns about the scope of monitoring.	**5.5**
GE6	I am satisfied with addressing concerns about the quality of monitoring.	**5.4**

GE7	I am satisfied with addressing concerns about data management.	**5.1**
GE8	I believe an implementation plan is necessary before applying REMTs.	**3.7**
GE9	I am comfortable with monitoring if implementation follows the guideline.	**5.5**
GE10	I believe the worksite monitoring will benefit the project and my safety.	**5.6**

*Likert Scale from (1) strongly disagrees to (7) strongly agrees

The raw data obtained from each question in the short survey was further categorised as "Disagree" (1-3), "Neutral" (4) and "Agree" (5-7), and the results are presented in Figure 4.15. Both ratings for GE1, '*I understand the purpose of the guideline*', and GE2, '*I know my role and responsibility when my worksite or myself is monitored*', are relatively high. These imply that the briefing sections of the trial were successful. The participants understood the purpose, roles, and responsibilities during REMT implementation. Moreover, 7 out of 10 participants consider that the developed guideline covers their concerns (GE3: '*The concerns listed in the guideline have covered mine*') on REMT implementation. Another three members show 'neutral' on GE3, which implies that these participants may have other concerns about being monitored. The open-ended questions' results may provide additional comments on this. Another 'neutral' response was given by half of the participants for the GE4 statement; '*I found the checklist questions help me understand my right better*'. This result suggests that the checklist questions may need to be further investigated.

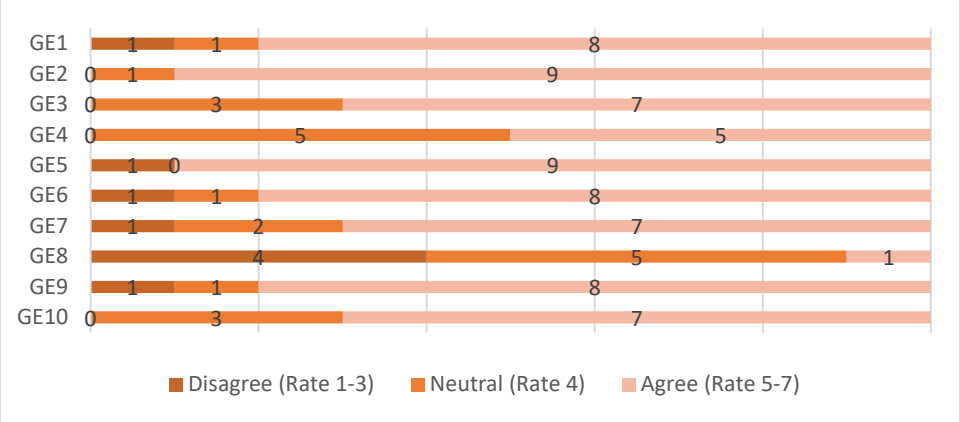


Figure 4.16 Evaluation of concerns and addressing concerns (n=10)

These results demonstrate that the developed guidelines can address the concerns of monitoring participants. A significant portion of participants agree with the statements in GE5 (I am satisfied with addressing concerns about the scope of monitoring), GE6 (*I am satisfied with addressing concerns about the quality of monitoring*), and GE7 (*I am satisfied with addressing concerns about data management*). Furthermore, similar positive results were found for the statements GE9 (*I am comfortable with monitoring if implementation follows the guideline*) and GE10 (*I believe the worksite monitoring will benefit the project or my safety*). The participants generally recognise the benefits of being monitored during the trial, and the developed guideline could reassure the participants on REMT implementation.

Finally, an interesting result was obtained for the GE8 statement; '*I believe a REMT implementation plan is necessary before applying REMTs*'. Only 1 out of 10 participants agreed with this statement. At the same time, another 5 and 4 showed 'neutral' and 'disagree', which indicated that the "implementation plan" may not be necessary before applying REMTs from the construction practitioners' perspective. However, according to the

opinions of the focus group members, an implementation plan is one of the critical aspects of REMT adoptions at construction sites. This result may initiate another study area to revisit the appropriateness of the implementation plan (e.g., using a flowchart suggested by participants, Figure 4.16) and to reveal the expectation gaps between supervisors and construction practitioners.

What are other concerns when you have been provided with the developed guidelines for the trial?	What are your recommendations for the developed guideline?
• Affected work relationships • Increased workload • Not comfortable or easy to wear • Slowed the progress of work	• Use flowchart in the Guideline • The framework of Implementation Plan is recommened

Figure 4.17 Answers to the open questions

4.4.3 Control Group (G2)

After the trial, the control group members (G2) were invited to a 5–7-minute conversational interview, which allowed the researcher to introduce the trial study's background retrospectively, guideline development processes, and clarification of questions from the participants. Half the group members attended the interview. The key interview questions (as shown in Table 3.4) and the feedback from G2 are listed in Table 4.5.

Table 4.5 Feedback from the Control Group

Interviewees	Feedback
C1	**"Do you know the purposes and how to use this GPS device when working on the site?"**
Builder	*"Carry the devices while working but do not know what it is and why they use them."*
Painter	"I understand the GPS tracker will give my real-time location to the contractor."
Plumber	*"I am a subcontractor, and if I asked my worker to wear the monitoring devices, the only reason is to check and supervise if they are actively working on-site."*
C2	**"Are you comfortable wearing the device when you are working? If not, why?"**
Painter	*"The design of the device is not comfortable to wear, as my work environment is indoor painting. I have to carry the device in my pocket, which occupies some space to carry tools."*
Plumber	*"If the device can be smaller and hard-wearing, that would be more suits for my work."*
Builder	*"It was easy to forget to carry it, as this is not a traditional part of my work."*
C3	**"What are your concerns about the device and monitoring activities on the worksite?"**
Builder	*"If the monitoring is only limited to the working hours, that would be ok."*
Plumber	*"I can feel the privacy concern around my work environment, but I am not concerned about my location, movement and even health data released to my employer. However, communication is key regarding what and how monitoring data will be used."*
Electrician	*"I am not sure what information will disclose to the contractors or my employer, and some peer pressures about the monitoring."*
C4	**"How do you feel if the employer requires all workers wear monitoring devices?"**
Builder	*"No one can force me to wear the device if I do not want to. Employers need to provide adequate information to allow us to understand why monitoring and what the result is if I do not wear."*
Plumber	*"The level of monitoring is top of my consideration, and if it crosses my boundary, I will refuse it."*
Electrician	*"If the monitoring proves that it increases productivity or benefits workers, I would accept the monitoring."*
C5	**"How do you think the construction worker monitoring will benefit the project and the construction practitioners?"**
Builder	*"It may benefit the project to some degree, but I do not see any direct benefits to the construction practitioners, and it is not convenient to wear."*
Plumber	*"I do not think the GPS tracker has a direct benefit to us, and it may have some advantage for larger construction work, such as infrastructure or roading."*

Site Manager	*"Location information helps me to track some subcontractors' work progress compared with our agreed work schedule, especially for 'delivery and install' trade.*
C6	**"After this trial, what do you recommend to the employer if they want to implement REMTs in future projects?"**
Plumber	*"A form documents, such as guidelines, instruction or contract, must be presented by the employer before the worker monitoring."*
Site Manager	*"A connected system is recommended for future monitoring activities, which can provide the management team with more valuable data to arrange the work."*

4.4.4 Cost-Benefit Evaluation

The research team identified and verified the benefits of REMT adoption at construction sites through a literature review, national survey, and focus groups. The trial gained direct and indirect cost information on one form of REMT, and the benefits and costs of REMT implementation at construction sites were discussed with the building company employers, site managers and construction practitioners. The cost-benefit evaluation was conducted based on the data obtained from this trial. The items with their cost allocation were added to the total cost sum, which weighed against the benefits of applying GPS-tracking devices.

The construction site in the experimental trial is a medium size residential development project with 12 townhouses, and the estimated project value is $4,000,000. The project construction duration is about ten months, with an average of thirty construction practitioners on-site in the different stages of the construction activities. The projected costs and validated benefits information is summarised in Table 4.6.

Table 4.6 Costs and benefits evaluation for using GPS Trackers in the trial project

Projected Costs	Value in NZ$
Hardware Lease - GPS trackers **Hardware Purchase (option)**	$25/m x 30 units x 10 months = $7,500 $165/unit x 30 units = $4,950
Licensing and subscriptions – Software **Service fee (if purchased)**	Included in the lease $120/hr x 4hr/month x 10 = $4,800
Implementation cost – Site manager **Others, e.g., travel, overheads, etc.**	$50/hr x 8hr/month x 10 = $4,000 Say $100/month x 10 = $1,000
Learning cost – user training	$25/hr x 0.5 hours x 30 = $375
Lost or damaged devices – insurance **Business Equipment Insurance**	Included in the lease 3% of device value per annual, say $150
Projected Total Costs	12,875 (lease) or $15,275 (purchase)
Predicted Benefits	**Validated Benefits (In the Trial)**
Reduce unsafe work behaviours	GPS tracker increased the number use of PPE
Improve site resource allocation	Allow the site manager to observe the location and movement of workers, saving time for site supervision and inspection.
Protect construction practitioners from dangerous or extreme working conditions	The system record and notify to users when the worker is 2 metres higher than the ground
Improve workers' on-site performance	Not valid in the trial but can work with a management system
Support fair payment agreement	Monitoring data compared with individual worker's worksheets, link to Payroll
Facilitate communication between co-workers and supervisors	Not valid in the trial but is possibly connected to an additional system
Enable quick emergency responses	Not valid in the trial but can be achieved by other applications
Improve construction site security	Not valid in the trial but can be activated under the requirement
Create a healthy and safe work environment	Contact tracing, if necessary
Ensure the legal compliance	Monitoring devices attached to PPE help employers comply with their duties

After accounting for all the factors described above, the cost-benefits evaluation is based on the trial participants' views of the weight of benefits against its costs. The costs of the REMTs

are easier to estimate, obtain or manage than their benefits, and the benefits to construction practitioners, subcontractors and main contractors may weigh differently. For example, “improve construction site security” and “improve workers’ on-site performance” will financially benefit the main contractors but not the workers directly. Although some predicted benefits were not validated in the trial due to the experiment's limitations, they were considered in the evaluation.

The benefits and costs were divided into non-financial (without monetary value associated with the Item) and financial (with the determined monetary value associated with the Item) (Ziller and Phibbs, 2003). The evaluation in Table 4.7 demonstrated that overall benefits exceeded the cost in the experimental trial, and non-financial benefits achieved the highest score in the four categories. However, the financial cost exceeds the financial benefits, which may be a critical factor for a short-term investment decision. A higher score indicated more weight on the cost or benefits, and the detailed evaluation scores are illustrated with the colour band in the matrix.

Table 4.7 Evaluation Matrix

	Non-Financial benefits	Financial benefits	Non-financial cost	Financial Costs
Cost-benefits to construction workers	Occupational safety (3) Fair wage payment (4)	No direct financial benefits (1)	Time to train and adjust the devices (3)	No direct financial costs (1)
Cost-benefits to sub-contractors	Better on-site communication (2)	Unlikely financial benefits (2)	Time to train and manage the monitoring devices (3)	Unlikely financial costs (2)
Cost-benefits to main contractors	Improve site resource allocation (4)	legal compliance and avoid fines (4)	Auxiliary risks (2)	Direct costs: Hardware and software (5)
	Improve workers’ on-site performance (5)	Avoid wrong working hours and payments in worksheets (3)	Switching Costs (1)	Administration, supervision and training (4)
	Facilitate communication between co-workers and supervisors (4)		Learning Cost (2)	
	Enable quick emergency responses (5)		Opportunity Cost (2)	
	Improve construction site security (4)			
	Create a healthy and safe work environment (3)			
Total Score	**34**	**10**	**13**	**12**
High Weight 5	4	3	2	Low Weight 1

Building companies typically want REMTs to offer very high benefits and very low adoption costs, which is usually not feasible. As per the evaluation matrix, most of the benefits are intangible and long-term based, and there is a relationship between the cost and benefits. For example, the trial did not validate the benefits of work performance, communication function, and emergency responses. However, additional devices using other types of technologies with support systems can achieve the requirements, but the technology's financial cost needs to be increased. The experimental trial, the developed guidelines and the Cost-Benefit Evaluation give the potential construction REMT users an indicative picture of what they should do and consider before implementing the technologies. Some of the considerations and suggestions are outlined below:

- Main contractors or REMT promoters who choose REMTs to gain the highest benefits with the lowest costs should have an implementation plan and consider project size, duration, future project types, and monitoring purposes through reasonable steps and communication.
- Building companies should consider several auxiliary risks that REMTs may create when implemented on the worksites. Some of them will convert to financial costs in the process.
- High direct costs normally cannot be reduced, and immediate financial benefits are limited for REMT adoption. However, non-financial benefits open a new door for construction businesses in risk control, process innovation, and effective collaboration in the longer term.
- Uncertainties about the level of benefits or quantifiable benefits that REMTs could deliver can be addressed mathematically by discounting values, using net present value analysis, based on their degree of certainty.

5. Conclusions

REMTs have attracted great interest in the New Zealand construction sector, especially in the post-Covid work environment. This project firstly revealed that New Zealand construction practitioners generally accept using REMTs at construction sites and acknowledge the potential benefits. They commonly agree that REMTs help increases work efficiency, reduce unsafe work behaviours, avoid accidents, and improve site resource allocation and security. Although most of the construction workers have no monitoring experience, a considerable number of construction employees accept tradeoffs with respect to their privacy for the company's collective interest. The challenges of REMT implementation also have been identified and investigated within the New Zealand construction industry. Privacy remains the fundamental source of concern. This study also found that monitoring purposes, the consequences of monitoring, and employment relationships are the other top three concerns in the New Zealand construction sector.

A best practice guideline was also developed to address these concerns and to regulate REMT implementation at the project level. By using GPS Trackers as an example of REMT, this guideline was trialled in a residential project. The guideline does help construction practitioners understand their role and responsibilities, addresses their concerns about the scope and quality of monitoring and allows workers to feel comfortable with monitoring. However, the research teams also observed that discipline and active participation of the workers play a critical role in the success of any REMT implementation. Finally, a cost-benefit evaluation was conducted for this trial. Non-financial benefits outweigh the overall costs, but the financial costs exceed the financial benefits.

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Appendix: Best Practice Guidelines for REMT Implementation

BRANZ
Funded from the Building Research Levy
MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND
SCHOOL OF BUILT ENVIRONMENT

Implementing Real-time Employee Monitoring Technologies (REMTs) on New Zealand Construction Sites

Best Practice Guidelines

June 2022

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1. INTRODUCTION

1.1 What is the purpose of this document?

These Best Practice Guidelines (hereafter 'guidelines') have been developed through sectoral research and direct industry engagement to provide potential users of Real-time Employee Monitoring Technologies (REMTs) with a set of principles to consider and address before introducing REMT on New Zealand construction sites.

The guidelines include references to how REMT interacts with users' rights, health and safety on the construction worksite, and industry productivity. These guidelines must be read in conjunction with the New Zealand Privacy Act (2020), Health and Safety at Work Act (2015), and Privacy Breach Guidelines.

1.2 What is Real-time Employee Monitoring Technologies (REMTs)?

REMT is defined as instant user activity monitoring, and uses multiple layers of technologies – including computerised network systems, artificial intelligence devices, and sensory technology – to capture and store data relating to employee behaviours and activities in the workplace.

1.3 Who are the potential users of REMT in the construction sector?

- **REMT Promoters ('Promoters') refer to those who install and control the REMT devices on the construction site(s) and typically have access to the subsequent data for monitoring purposes. This group includes, but is not limited to:**
  - Main contractors;
  - Recruitment agencies;
  - Health and safety consultants.
- **REMT Participants ('Participants') refer to those who are monitored by REMT devices that generate the data referred to above. This group includes, but is not limited to:**
  - Employees of main and sub-contractors (e.g. frontline workers, site managers, etc.);
  - Principal clients' representatives (e.g. engineers, consultant quantity surveyors, etc.);
  - Other parties are permitted to enter or work at the construction sites.

REMT captures and centralises data and transfers this information to the Promoter for evaluation and reporting. This allows the Promoter to observe Participants' safety behaviours, health conditions, and work performance on a real-time basis, thus aiding in assessing and managing worksite risks.

1.4 What are the concerns around the use of REMTs?

As acknowledged, this work was part of a BRANZ research project entitled '*Are You Ready to be monitored at work? – A Study of Real–time Employee Monitoring Technology Adoption in New Zealand from Legal, Ethical and Behavioural perspectives*'. This project's national questionnaire

yielded responses from 236 New Zealand-based construction practitioners, who were asked to rate 20 potential concerns around REMT by perceived significance level. The concerns have been integrated and ranked using the relative importance indices (RIIs) method. These categories of concern are discussed in further sections :

1. The purposes and implementation of monitoring ***(most significant)***
    a. Is the purpose of the monitoring well-defined?
    b. Is the monitoring implemented in a considered fashion, in line with relevant guidelines?
2. Data security and usage ***(second-most significant)***
    a. Who has the right to access the data?
    b. What is the process for addressing inappropriate access to or use of data?
3. Legal Rights ***(third-most significant)***
    a. Rights under the Privacy Act 2020 (e.g. What is the process in the event of a privacy or data security breach?)
    b. The nature of the use of data in legal proceedings
    c. The implications of REMT in relation to employment law and subsequent Employment Agreements
4. Behavioural Effects ***(fourth-most significant)***
    a. An awareness of monitoring can potentially result in changed behaviour or unintended outcomes
    b. The potential impacts on interpersonal working relationships (Promoter-Participant, Participant-Participant, or other)
    c. Participants' Perspectives – potentially positive or negative impacts upon views of trust, increased responsibilities, loyalty and job satisfaction
5. Scope of Monitoring ***(above neutral)***
    a. How will the scope of the monitoring be defined and communicated, for example:
        i. How long will the REMT data be stored?
        ii. How will the data be protected?
        iii. How will the data be used (e.g. for performance review and measurement)?
6. Engagement and potential harm for Participants ***(neutral)***
    a. Processes for Participant feedback on REMT (prior- during- and post-monitoring)
    b. Potential impacts on well-being, including increased performance pressure and associated physical and mental health implications (eg. What steps are necessary to avoid possible physical and psychological harm to participants?

2. The Implementation of REMTs on Construction Sites

2.1 Guidelines and Considerations for Promotors

As noted above, the Promotor refers to those who install and control the REMT devices on the construction sites, and typically have access to the subsequent data for monitoring purposes. Promotors must adhere to the process detailed below when installing and implementing REMT:

- **Before** installing REMT on the worksite, the Promoter must reasonably consult with and explain the monitoring activities, functions and purposes to potential Participants and any 'Person Conducting a Business or Undertaking' (PCBUs) in a shared workplace**.** This consultation process must be genuine and conducted in good faith. If all parties agree to proceed with the proposed REMT programme, written **authorisation** must be obtained as part of the contracting chain.
- **A written REMT Information Sheet ('IS')** must be made available to all Participants, written clearly in straightforward language that is easy to understand and appropriate for the target audience (the potential Participants). The IS will include, but is not limited to, the following information:
  - Why the personal data is being collected (the purpose(s) of the monitoring);
  - Specific details of how the Promoter plans to undertake monitoring activities on the worksite(s) along with a defined scope of monitoring (e.g. the type and frequency of monitoring);
  - Clear identification of who will carry out the monitoring (the Promotor must consider the capability and skills required to ensure monitoring is undertaken by the appropriate internal person or group, or external provider);
  - Clear communication regarding whether providing data is compulsory or voluntary. If voluntary, the Promotor will further explain the processes, including participants choose not to provide information or change his/her decision after monitoring has begun.
- The Promoter may not access, use, share, or transfer the REMT data for **purposes** other than those agreed to in writing.
- The Promoter must ensure reasonable **safeguards** are in place to prevent the loss, misuse or disclosure of personal information. The Promoters must not keep personal data **for longer** than is required for the agreed purpose.
- The Promoter must ensure Participants have **access** to their data captured and stored by the REMT systems. The Promoter must fulfil any access requests by the Participants within a reasonable timeframe (which must be clearly defined and agreed to within the IS above).
- The Promoter must consider the reasonable balance between the benefits of varying degrees of monitoring and the potential for adverse effects.
- The Promoter must maintain the most **accurate** information during the monitoring activities. Despite the Promoters' best intentions, Participants retain the right to request that Promoters correct their captured information if they believe it is inaccurate. The

Promoters will then take reasonable steps to manage **the correction** or undertake further consultation with the Participant.

- Every Participant must consider themselves fully informed and understand the benefits and risks before signing any **authorisation** relating to REMTs.
  - The Participant must declare their understanding of how and where their physical movement and personal data are monitored.
  - Written acceptance of the monitoring functions, purposes, risks, and benefits is recommended.

The following checklist provides a starting point for the specific questions and issues for Participants to consider before authorising any monitoring activities:

Table 1 Checklist for potential participants

1)	**What is the specific purpose of the monitoring?**
2)	**What personal information are Promotors legally entitled to collect?**
3)	**Is there a risk that REMT could monitor Participants outside of work hours? If REMTs were to breach privacy boundaries without permission, what is the Promotors' process to address this?**
4)	**What are the consequences if Participants refuse to give authorisation?**
5)	**How does REMT typically affect employment relationships? (Is a case study/example available to review?)**
6)	**Is the statement of the purpose and definition of the monitoring activities available at all times to ensure participants are aware of their privacy rights?**
7)	**Does the collection of data involve any risk of physical or psychological harm? If so, how will this be mitigated?**
8)	**What is the procedure for addressing complaints about monitoring?**
9)	**How will any detrimental effects on the employment relationship be treated within this process?**
10)	**What are the benefits to participants? How can individual Participants benefit from monitoring?**
11)	**How does the REMT improve compliance with health and safety and other legal obligations?**
12)	**Does REMT shift legal liability from Promotors to Participants in any way?**
13)	**Which will be measured during monitoring, and how will qualitative metrics be measured (e.g., quality of work, professional performance)?**
14)	**What are the limits or constraints of REMT when capturing Participants' work-related or personal data?**
15)	**If Participants do not fully understand the monitoring activities, instruction and functions, what resources are available to help them understand the process?**
16)	**What specific devices will be used, and why were these selected?**
17)	**Will the mode of monitoring be visible or hidden?**
18)	**How accurate is the monitoring? (e.g. refresh rate, margin around geofencing, error rate)**
19)	**How reliable is the process for data collection and analysis?**
20)	**What are the potential consequences of the monitoring analysis, both for Participants overall and individually?**
21)	**Are formal monitoring instructions in place before Participants' acceptance?**
22)	**How will Participants' data be stored and safeguarded?**
23)	**How can Participants or third parties access the monitoring information?**
24)	**How long will the captured data be stored?**

2.2 Addressing Concerns

2.2.1 Scope of Monitoring

The function and value of REMT depend heavily on the selected scope of monitoring. The range and options for the scope of monitoring must be discussed by Promoters and Participants to ensure the selected scope aligns with the stated purpose(s). Possibilities include:

- Real-time or post-analysis location monitoring;
- Real-time or post-analysis work behaviour monitoring;
- Real-time or post-analysis monitoring of individuals' health status;
- Real-time or post-analysis evaluation of work performance.

2.2.2 Quality of Monitoring

The results of REMT analysis may be challenged by the Participant based on the quality and completeness of the system's data. With this potential eventuality in mind, the Promoter must explain, discuss and agree upon the following aspects of data quality with the Participant:

- The accuracy level of the REMTs must be stated in the monitoring instructions;
- The factors which affect the data quality must be specified and considered prior to any use of the data, in line with a pre-agreed process;
- The Promoter or their agents must not use unreliable and incomplete data for evaluation purposes.

2.2.3 Data Management Systems

Assuming each Participant fully understands and authorises the process, data captured and stored by REMT may be integrated, transferred or shared with other systems for evaluation and other agreed purposes, which could include comparative analysis and integration into more extensive data sets.

3. The REMT Implementation Plan (RIP)

Communication is vital to the REMT implementation process. The REMT Implementation Plan ('RIP') can ensure that every Participant and Promoter knows the part they should be playing and when and what to expect from other individuals, subcontractors, and organisations.

3.1 The benefits of having an REMT Implementation Plan

A RIP can provide several key benefits. As a guiding document, it helps Promoters and Participants identify any REMT at various stages of the construction project. A RIP also ensures all parties are fully conversant with the goals and targets at every implementation step. More specifically:

- Having an RIP in place encourages early communication. It also establishes who is responsible for communicating information at different stages of the implementation and prescribes responsibilities in specific areas;

- A clear RIP creates an alignment regarding monitoring standards and collaboration;
- Taking the time to create a detailed RIP that sets out key deliverables, procedures, and other information will streamline the REMT implementation process and minimise misunderstandings further in the project.

3.2 Creating an effective RIP: Key Points

To effectively introduce REMTs on the construction site, all parties must agree upon a plan for collecting data, timing, the nature of data to be captured, and the process for sharing, among the other considerations noted above.

The Promoter should present an RIP that communicates the agreed deliverables. The RIP must be developed prior to the implementation of the REMT, and the REMT programme must only proceed if both the Promotors and Participants accept the finalised RIP and state that they both clearly understand the implications noted above, especially:

- The purpose(s) for the implementation and function of the REMT;
- Promotors' and Participants' roles and responsibilities regarding the monitoring activities;
- The nature and process of Participants' involvement in the implementation;
- The possible benefits and risks of the monitoring activities for both parties;
- The potential social effects of implementing REMT;
- The processes in place for the resolution of disputes arising from REMT.

The Promoter must also include provisions for data use and security within the RIP, which should include (but are not limited to) the following:

- The channels for Participant to access their data;
- The nature and specifications of the monitoring system (for example, details of the security firewall to avoid cybersecurity issues and the security selection process);
- An assurance that the monitoring data aligns with the agreed purposes;
- The situations in which the Promotor is able/unable to share the monitoring data with third parties, including government agencies;
- The contingency solutions for data leakage or a data security risk.

3.3 Participants' Rights

- The checklist above (Table 1) provides examples of considerations for potential Participants. However, all Participants are strongly encouraged to seek their own independent legal advice.
- All Participants have the right to fully enjoy their privacy and other legal rights, as specified under the Privacy Act 2020[1].

[1] Full specifications of the Privacy Act 2020 are provided here: https://www.legislation.govt.nz/act/public/2020/0031/latest/LMS23223.html (Accessed 18 April 2022).