Research in Management of Technology and Business Vol. 4 No. 1 (2023) 1052-1066

RMTB

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/rmtb
e-ISSN : 2773-5044

RFID Implementation for Material Safety at Storage Area in Construction Site

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DOI: https://doi.org/10.30880/rmtb.2023.04.01.073
Received 31 March 2023; Accepted 30 April 2023; Available online 1 June 2023

Abstract: Malaysia's construction industry is impacted by material safety issues as a result of poor safety management, lack of standardization, and insufficient technology. Radio Frequency Identification (RFID) is currently being used in a variety of industries, including manufacturing, health care, transportation, and tracking applications, particularly in supply chain management. However, RFID has not been widely used in the construction industry specifically for materials safety in storage areas. Therefore, the objectives of the research are to identify the potential, factors, and steps to promote RFID implementation for material safety in the storage area at the construction site. To achieve the objectives, the research was conducted using quantitative methods for primary data collection and questionnaires as the instrument used to collect the data. There were 254 respondents among G7 contractors selected at Johor state to obtain information for this research. The data were analyzed through SPSS software to determine the mean and standard deviation. Furthermore, Microsoft Excel generates pie charts, bars, frequency, and percentage values for the respondents' backgrounds. The results showed that RFID had the potential to track activities and eliminate human error. The influencing factors to implement RFID is efficient delivery of materials and an anti-theft system. In addition, the steps to promote RFID implementation in material safety were to require RFID technology promotion by top management support. In conclusion, the research provided a great deal of knowledge for effective safety management with RFID implementation for material safety at the construction site.

Keywords: Construction Site, Material, RFID, Storage Area

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1. Introduction

The construction industry is one of the most important industries that help a country's economy. People in Malaysia, a country that is still growing, know that the construction industry has a big impact on their lives and the economy. A report from Trading Economics in 2020 says that the GDP of the Malaysian construction industry went down from RM 14861 million in the third quarter to RM 14278 million in the fourth quarter of 2020. However, the safety situation of material safety or management in construction site is not optimistic. According to Bell and Stukhart (1986), it is critical for material planning and control to guarantee that the required quality and quantity of materials and installed equipment are defined in a timely way, procured at a reasonable cost, and readily available when needed. As a result, effective materials management is required in building projects. As a result, in order to avoid issues such as delays in a building project, an effective materials management system is essential. According to some research, experimenting with new technology could help solve some of these issues (Karimi *et al.*, 2016).

Radio Frequency Identification is now employed in a variety of industries, including manufacturing, healthcare, transportation, and tracking applications, particularly in supply chain management (Naskar *et al.,* 2017). RFID is a generic term for technologies that use radio waves to automatically identify people or objects from several inches to hundreds of feet. This is an Automatic identification (Auto-ID) technology by which any object can be identified automatically (Polniak, 2007). RFID technology use automatic data capture system which helps in increasing system efficiency. RFID has been extensively developed and utilised in other industries, demonstrating its effectiveness in tracking various firm assets and, as a result, assisting with operational issues (Lee and Shim, 2017). Moreover, the usage of RFID in the construction sector includes tracking and controlling unique tagged goods along the supply chain and on the construction site (Wood and Alvarez, 2005). Besides, RFID can help avoid products going missing, being misplaced, or not being received, provide accurate information regarding shipping, receiving, and inventory.

In construction projects, materials management is a critical role that contributes greatly to the project's success. Unfortunately, materials shortages, supply delays, price changes, damage and loss, and a lack of storage space all complicate material management in building projects. Besides that, one of the most common issues in a construction project is the loss of construction resources (such as materials and machines) due to theft and negligence. When there is a lack of monitoring at a building site, these resources can be lost, especially in situations where strangers can readily access and exit due to poor site security. Theft and material loss can also be caused by the designated person's failure to adequately examine the quantity of materials kept and monitor vehicle movement at the construction site. Contractors will be struck with the loss, but it will eventually be factored into their operating costs. As a result, the price of their construction projects will rise. When this issues happen, it has the ability to substantially delay project performance (Ogunlana, 1996). While there are numerous guidelines or checklists focusing on site security to prevent the loss of materials and machinery, it is considered that a study of Malaysia's construction resources (i.e. materials and machinery) is still inadequate.

Currently, RFID is used in a lot of different industries. This includes production and healthcare as well as transportation, tracking, and supply chain management (Naskar *et al.,* 2017). Furthermore, smart devices, like RFID, have not been used very often in the construction business. One of the main reasons is that it hasn't been used to its full potential by people who train people. There may also be technical, financial, or ethical barriers that keep it from being widely used in this very diverse industry. Ergen *et al.* (2007) comes to the conclusion that the difficulty in locating pre-cast components in the storage area is a problem that pre-cast manufacturers face. Because there are thousands of different pieces housed in the storage room and barcode technology requires line of sight, finding the essential components can be difficult. Also, the construction industry is having a hard time adopting new technologies for smart devices because there isn't enough standardisation, high implementation costs, slow technology development, and low-skilled labour (Schneider, 2003). Therefore, this research seeks to identify the potential, factors, and steps of RFID implementation for material safety at the storage area.

2. Literature Review

2.1 Overview of Construction Project

Safety management is a process for identifying health and safety (H&S) risks and taking steps to lower the likelihood of risk realization as well as the potential repercussions of the risks identified in a project. All hazards and mishaps that could put project workers in danger should be considered by safety management. Any workplace's health and safety (H&S) is critical legally and ethically to limit such risks, but big dangers, such as health and safety (H&S) in the construction industry, are critical since the industry's daily operations are extremely dangerous (Twort & Rees, 2011). RFID is an automatic identification technology that captures and transmits field data using radio frequency. RFID tags and RFID readers are common components of an RFID system. Data from the test project can be stored and retrieved using small tags with reading and writing functions enabled. RFID tags are typically constructed with a microchip that stores data and an integrated antenna that serves as a transmitter (Lu *et al.,* 2011).

2.2 RFID implementation at storage area in construction site

(a) Concept of RFID

RFID is an automatic identification technology that captures and transmits field data using radio frequency. RFID tags and RFID readers are common components of an RFID system. Data from the test project can be stored and retrieved using small tags with reading and writing functions enabled. RFID tags are typically constructed with a microchip that stores data and an integrated antenna that serves as a transmitter (Lu *et al.,* 2011). RFID systems can be deployed in a variety of ways, depending on the frequency and purpose of their use. The advantage of using RFID systems is that they are hidden. The tag differs from barcodes and other automatic identification technologies in that it does not need to be in the reader's line of sight to be read or identified. Despite this, the tags have limitations in that they can only be identified within a certain range based on the radio frequency used. RFID today is more than just reading the tag and sending its serial number or serial ID to a computer network. RFID tags in some forms of packaging contain tiny semiconductor chips and small antennas.

(b) How RFID Works

The RFID system is made up of three components: a scanning antenna, a transceiver, and a transponder. The transponder is built into the RFID tag. It is capable of transmitting data signals via radio waves and attaching them to physical objects or materials to be identified. The radio frequency is read by the transceiver and transmitted to the RFID tag. The identification information is then transmitted from the microcomputer chip embedded in the tag to the RFID reader. To communicate data with the tag, the RFID reader or interrogator provides read and write functions via a fixed or mobile reader (Kereri, 2018). Figure 2.1 depicts how RFID technology works. However, at the storage facility, materials delivered to the storage area were labeled with RFID tags. It is the responsibility of the manufacturers or suppliers to equip the delivered materials with RFID tags. Materials information such as the date of arrival at the store, the scheduled date of installation, the person in charge, and others were entered into the tags (Ren *et al*, 2011). The inward and outward movement of materials within the storage was tracked using an RFID reader installed at the storage's entry and exit points. When the material is removed from storage, an alert is generated, and the system database is updated. Furthermore, using the handheld RFID reader, regular material updates at the storage facility are possible.

2.3 Summary of the Literature Review

In summary, from the literature review that has been carried out the first objective which is to identify the potential of RFID implementation for material safety at storage area in construction site. The second objective is to determine the influencing factors of the RFID implementation for material safety at storage area in construction site. Lastly, the third objective is to examine the steps to promote

the RFID implementation for material safety at storage area in construction site. These objectives of this research show in Table 1.

Table 1: Summary of literature review

Potential of RFID implementation	Influencing factors of RFID Implementation	Steps to Promote RFID Implementation
• Tracking activities • Easy to obtain information • Improve efficiency and safety • Eiminating human error • Lowering labour cost	• Efficiency delivery materials • Tools saving and safety • Anti-theft system • Reduce cost • Decrease time consumption	• Government policies • Research on RFID technology • Demonstration of projects • Top management

The RFID implementation for improving material safety plays a key role at the construction project to reduce manufacturing time, improve accuracy and assist employees in performing their material management and jobs more effectively. The literature review shows that RFID technology has the potential implementation for improving RFID in construction site. The RFID technology also track activities and improves effiency and safety. RFID technology also can reduce human error and lowering labour cost. Although RFID has been used for many years in the construction industry, the influencing factors of the RFID implementation were to increase industry capability. RFID technology also had a high-quality, productivity and safety at the construction industry. Therefore, RFID implementation also can help save money by decreasing incompetent labour, and lowering cost materials. The proper knowledge and awareness also important in RFID implementation, this is because at a construction industry need a labour who had an experience about the RFID technology and need to be trained to get the knowledge. The integrated cost technique of the RFID implementation had been able to provide a rational method to reduce cost and decrease time consumption. Lastly, due to the decreasing material loss in construction site anti-theft system and tool saving and safety must have during implementation RFID. Although RFID has been used for many years in the construction industry, the influencing factors of the RFID implementation were to increase industry capability. RFID technology also had a high-quality, productivity and increase safety at the construction industry. Therefore, RFID implementation also can help save money by decreasing and lowering labour cost. The proper knowledge and awareness also important in RFID implementation, this is because at a construction industry need a labour who had an experience about the RFID technology and need to be trained to get the knowledge. The integrated cost technique of the RFID implementation had been able to provide a rational method to determining the projects has the correct cost and did not over the cost. Lastly, top management support are needed to help in implmentation RFID for material safety at storage area in construction site.

3. Research Methodology

3.1 Research Design

Qualitative research is multi-method in nature and takes an interpretative, naturalistic approach to its topic. This implies qualitative researchers look at objects in their natural habitats, aiming to understand or interpret events in terms of the meanings individuals assign to them (Denzin & Lincoln, 1994). While, quantitative approaches seek to explain what is observed by classifying features, counting features, and building statistical models (Creswell & Creswell, 2017). A mixed-method study combines quantitative and qualitative research. Because it incorporates the strengths of both methodologies, mixed methods can provide a more complete picture than a standalone quantitative or qualitative study. In the behavioral, health, and social sciences, mixed methods research is frequently employed, particularly in multidisciplinary settings and complicated situational or societal studies.

The quantitative method will be used in this investigation. A survey will be used to collect data using the quantitative method. This is because questionnaire research is a dependable and rapid means of collecting information from respondents in an effective and timely manner, where time is a critical constraint. It also ensures that the data is reliable and accurate. According to Akomah, Ahinaquah, and Mustapaha (2020), collecting data through a survey approach is an economically sound method since, when compared to other methods, it aids in obtaining high volumes of data.

Quantitative data will be information regarding quantities and, as a result, numbers. Quantitative approaches are concerned with discovering the truth about social processes and anticipating a definite and measurable truth. Data is acquired by measuring objects and investigating through numerical comparison. Finally, data will be reported through objective examination (McLeod, 2019). A survey questionnaire will be created and given to the respondents for this study. The collected data and results from the respondents, as well as the literature study, are analyzed and studied to meet the research objectives.

3.2 Data Collection

Primary and secondary data will be used in this investigation. Data gathering will be thoroughly investigated as a result of this. According to Kabir (2016), primary data is information that has been gleaned directly from the source. The more reliable, accurate, and unbiased raw data has yet to be made public. Primary data has a higher level of validity than secondary data because the raw data has not been manipulated by humans. Due to population scarcity or a lack of cooperation, primary data sources are scarce and difficult to get. Experiments, surveys, interviews, and questionnaires are all examples of primary data sources (Kabir, 2016). Quantitative approaches will be used to collect the study's fundamental data, with questionnaires being distributed to the intended respondents. The questionnaires' questions will be geared toward achieving the study's goals. The term "secondary data" refers to information gathered from publicly available sources. Secondary data is the foundation of any study's literature evaluation. Data that was collected by someone else for a different reason but is then used by researchers is called secondary data. For a variety of reasons, it is impossible to conduct a fresh survey that accurately reflects how things have changed over time. Government papers, books, online pieces, and journal articles are secondary data sources (Ajayi, 2017).

The process of selecting a statistically representative sample of individuals from a population of interest is referred to as sampling (Kamangar & Islami, 2013). Because the population of interest usually consists of too many individuals, any study project to be included, sampling is an important instrument for research and research. A good sample is a statistical representation of the target population that is large enough to address research issues (Majid, 2018). Contractors are the respondents to the survey, and there are 729 G7 contractors in Johor. As a result, the sample size is determined to be 254 (Krejcie & Morgan's,1970). Table 2 shows the sections in the questionnaires used in this study.

Tools for collecting, measuring, and analyzing data are known as research instruments. Strategies and instruments for collecting data are known as research tools (Annum, 2019). Patients, consumers, students, teachers, and other employees are evaluated with these instruments most frequently in the health, social, and educational sciences. Interviews, examinations, checklists, and surveys are all examples of research instruments. It is usually determined by the researcher and tied to the study process. Based on the methodologies defined in process research, a research design can be formulated. Defining data from gathered information is the goal of a research design. Gathering and analysing data are the first two steps in any research project (Maccioni, 2020). It is important to use an effective research design to minimise data bias and to increase confidence in the data obtained. The goal of most research methods is to produce the least amount of error possible. An investigation's purpose statement, methods of data collection and analysis, methods of data analysis, possible objections to research, the research study's settings, timeline, and analysis measurement are all critical components of a research design.

Table 2: Questionnaires contents

Section	Questionnaire	Measure Technique
A	The question will ask the respondents about the demographic which consists of race, age, working experience, education level and occupational.	Frequency
B	The question will ask the respondents about the demographic which consists of race, age, working experience, education level and occupational.	Likert Scale
C	This section it toward obtaining the data to achieve second objective, which is influencing factors of Radio Frequency Identification Technology (RFID) implementation for material safety at storage area in construction site.	Likert Scale
D	This section refers to the desire to achieve the third objective of teps to promote Radio Frequency Identification Technology (RFID) implementation for material safety at storage area in construction site.	Likert Scale

3.3 Data Analysis

The process of gathering, modeling, and analyzing data in order to derive insights that aid decision-making is called data analysis (DA). Statistic Package for the Social Science (SPSS) can be used to examine the data gathered from the questionnaire distribution procedure. After all the data has been evaluated, the averages can be used to calculate the ranking. SPSS generates a frequency table that may be used to calculate the percentage. SPSS may be used to create pie charts, bar charts, and other data visualizations. For better visualization of the data, a graph, chart, or table including the frequency and mean score values will be created.

4. Results and Discussion

4.1 Response Rate and Reliability Test

Descriptive analysis methods was used to evaluate the data from the questionnaire more systematically to assess the frequency, percentage, and average of the data. The target respondent of this questionnaire survey was 729 G7 contractors in Johor. Hence, number of 254 was taken as the sample size according to Krejcie and Morgan Sampling Method, 1970. Table 3 specifically indicated the proportion of the questionnaire distributed, received, and not received.

Table 3: Response rate of questionnaire

Questionnaire	N	Response Rate (%)
Questionnaire Distributed	254	100%
Questionnaire Received	80	32%
Questionnaire Not Received	174	68%

In this study, the reliability of variables was assessed using Cronbach's Alpha coefficient, and the reliability analysis was assessed using 80 sets of questionnaires. An alpha value greater than 0.9 is considered to be excellent in Table 4. It is regarded as very good if the coefficient alpha is between 0.8 and 0.9. However, it is regarded as good if the coefficient alpha is between 0.7 and 0.8. However, it is regarded as moderate if the coefficient alpha is between 0.6 and 0.7. Finally, a poor alpha value is one that is less than 0.6. The background of the respondents and the primary test objectives for the reliability assessment were included in the 254 questionnaires that were represented in the following Table 4.

Table 4: Cronbach's alpha coefficient (Shamsuddin, 2015)

Coefficient Alpha, α	Level of Reliability
α > 0.9	Excellent
0.8 to 0.9	Very Good
0.7 to 0.8	Good
0.6 to 0.7	Moderate
α < 0.6	Poor

This research used Cronbach's Alpha to evaluate the reliability of variables and 146 sets of questionnaires were used to evaluate the reliability analysis. According to Table 5, an alpha value greater than 0.9 is excellent. If the coefficient alpha is between 0.8 and 0.9, it is considered very good. But if the coefficient alpha is between 0.7 and 0.8, it is considered good. However, if the coefficient alpha is between 0.6 and 0.7, it is considered moderate. Last, an alpha value less than 0.6 is considered poor. The reliability test were included part A, part B, part C and part D. The following Table 5 illustrated 254 questionnaires, which included the background of the respondents and the main test objectives under the reliability assessment.

Table 5: Reliability statistics

Cronbach's Alpha	Number of Item (N)
0.861	51

4.2 Respondent Background

Table 6 shows a data analysis summary in Section A. Based on Table 6, the percentage of Male respondents is higher than female respondents with a total percentage of 55% with a total respondent 55 respondents. The percentage for Age for 31-40 years old is the highest with 53.8 % and 43 respondents. Furthermore, the highest academic qualification is Bachelor'segree with 48.7 % and 39respondentst. Furthermore, the position that receives the highest percentage is Engineer with 34 and 48.7%. Next, the highest working experience is 37.5 with 30 respondents. The majority of the respondent experiencing RFID is 72.5 (58)

Table 6: Summary of respondent's background

No.	Respondent Background	Frequency	Percentage (%)
1.	Gender		
	Male	44	55
	Female	36	45
2.	Age		
	31-40 years old	43	53.8
	41-50 years old	17	21.3
	22-30 years old	16	20
	51 years and above	4	5
3	Highest Academic Qualification		
	Bachelor Degree	39	48.7
	Master	23	29
	Ph.D	11	14
	Diploma	7	8.8
4	Position		
	Engineer	34	42.5
	Architect	16	20
	Project Manager	16	20

	Site Supervisor	12	15
	Student	2	2.5
5	Working Experience		
	4-6 years	30	37.5
	7-9 years	24	30
	Less than 3 years	17	21
	10 years above	9	11
6	Experience with RFID		
	Yes	58	72.5
	No	22	27.5

4.3 Potentials of the Fourth Industrial Revolution (IR 4.0) Implementation for Improving Industrial Building

The data analysis has been collected at Johor from objective one with only a Grade 7 contractor qualified to anticipate the questionnaire. A result from the questionnaire shows that objective one, which is to identify the potentials of RFID implementation for material safety at storage area in construction site, has been achieved. Contractor Grade 7 at Johor is ideal to be a respondent for this questionnaire because, based on SCORE-CIDB 2021, Grade 7 is at the top three on the list. There are 5 types of potentials that may occur for RFID implementation for material safety at storage area namely, tracking activities, easy to obtain information, improve safety, eliminating human error and lowering labour cost. Based on summary Table 7, there are 5 types of factors namely, efficiency delivery materials, tool saving and safety, anti-theft system, reduce cost and decrease time consumption it can conclude that all the respondents are having the idea on choosing the same potentials for the RFID implementation for material safety at storage area. As a result, it can be concluded that indeed there is a potentials of Radio Frequency Identification Technology (RFID) implementation for material safety at storage area in construction site as mentioned by previous researchers.

The top three rankings for objective 1 are 'Tracking activities' with the highest mean of 3.9033, and a 'agree' consent level. In ranking moderate is 'Eliminating human error' with a mean of 3.88 and a 'agree' consent level. Next, for the lowest is 'Easy to obtain information' with a mean of 3.86 and a consent level 'agree'. In conclusion, the rankings for these potentials show that the objective is to identify the main potentials Radio Frequency Identification Technology (RFID) implementation for material safety at storage area in construction site.

Table 7: Summary potentials of RFID

No.	Potential of RFID implementation for material safety in the storage area.	Mean	Agreement Level	Standard Deviation	Ranking
Tracking Activities		3.90	Agree	-	1
1.	Increase traceability of materials	3.90	Agree	0.930	2
2.	Easy detection for material loss	3.91	Agree	0.925	1
3.	Reduce time spent in locating and tracking materials	3.90	Agree	0.875	3
Easy to Obtain Information		3.86	Agree	-	3
4.	Easy to transfer data for materials identification	3.73	Agree	0.791	3

5. Easy to obtain material data in the storage area	3.96	Agree	0.858	1
6. Providing up-to-date materials data location	3.90	Agree	0.816	2
Improve Safety	3.85	Agree	-	4
7. Reduce loss of material in the storage area	3.86	Agree	0.771	1
8. Increase the safety for material in the storage area	3.83	Agree	0.891	3
9. Reduce the probability of misplacing items	3.86	Agree	0.945	2
Eiminating Human Error	3.88	Agree	-	2
10. Reduce human errors in material management	3.81	Agree	0.910	3
11. Improve tracking of lost material in the storage area	3.90	Agree	0.846	2
12. Improve tracking of materials used in the storage area	3.94	Strongly Agree	0.857	1
Lowering Labour Cost	3.73	Agree	-	5
13. Minimizing the usage of workers	3.74	Agree	0.787	2
14. Reduce the involvement of skilled workers	3.68	Agree	0.878	3
15. The number of direct labour decreases	3.78	Agree	0.880	1

The others potentials of RFID implementation were shorter stock taking time and full control over stock. Using RFID technology on construction industry can reduce cost, this is because used a prefabricated technology can reduce the labors at the construction site. Meanwhile, RFID implementation also can reduce time to track material. This is because the construction project used RFID technology can using tagging to detect material loss. Additional feedback from the respondents based on potentials of the IR 4.0 implementation as follow.

• Considerably shorter stock-taking time

• Full control over stock/production levels in real time

• RFID offers the lowest error rate among all automatic identification technologies

• Material and asset tracking in the supply chain leading to lower stock levels

4.4 Influencing Factors of the Fourth Industrial Revolution (IR 4.0) Implementation for Improving Industrial Building System (IBS) Construction Project

Objective 2 is to find the Influencing Factors of Radio Frequency Identification Technology (RFID) implementation for material safety at the storage area in construction site in Johor by using a

questionnaire. The qualification for the respondents is a contractor Grade 7. Objective 2 is to find out whether the influencing factors given is related to the potentials that occur on the RFID implementation for materia safety at storage area. Based on summary Table 8, there are 5 types of factors namely, efficiency delivery materials, tool saving and safety, anti-theft system, reduce cost and decrease time consumption.

The top three rankings for objective 2 are 'Efficiency delivery materials' with the highest mean of 4.05, and a 'agree' consent level. For the moderate is 'Anti-theft system' with a mean of 3.90 and a 'agree' consent level. Next, for the lowest is 'Reduce cost' with a mean of 3.90 and a consent level 'agree'. In conclusion, the rankings for these potentials show that the objective is influencing factors of Radio Frequency Identification Technology (RFID) implementation for material safety at storage area in construction site.

Table 8: Summary influencing of RFID

No.	Potential of RFID implementation for material safety in the storage area.	Mean	Agreement Level	Standard Deviation	Ranking
Tracking Activities		3.90	Agree	-	1
1.	Increase traceability of materials	3.90	Agree	0.930	2
2.	Easy detection for material loss	3.91	Agree	0.925	1
3.	Reduce time spent in locating and tracking materials	3.90	Agree	0.875	3
Easy to Obtain Information		3.86	Agree	-	3
4.	Easy to transfer data for materials identification	3.73	Agree	0.791	3
5.	Easy to obtain material data in the storage area	3.96	Agree	0.858	1
6.	Providing up-to-date materials data location	3.90	Agree	0.816	2
Improve Safety		3.85	Agree	-	4
7.	Reduce loss of material in the storage area	3.86	Agree	0.771	1
8.	Increase the safety for material in the storage area	3.83	Agree	0.891	3
9.	Reduce the probability of misplacing items	3.86	Agree	0.945	2
Eiminating Human Error		3.88	Agree	-	2
10.	Reduce human errors in material management	3.81	Agree	0.910	3
11.	Improve tracking of lost material in the storage area	3.90	Agree	0.846	2

12. Improve tracking of materials used in the storage area	3.94	Strongly Agree	0.857	1
Lowering Labour Cost	3.73	Agree	-	5
13. Minimizing the usage of workers	3.74	Agree	0.787	2
14. Reduce the involvement of skilled workers	3.68	Agree	0.878	3
15. The number of direct labour decreases	3.78	Agree	0.880	1

The others of the influencing factors of the RFID implementation were high technology and improve labor skill. RFID implementation for improving material safety in construction site is the high technology. This is because RFID is the modern technology in construction industry and it can produce the high-quality material management. However, RFID implementation also need a labor who had the experience and knowledge about the technology, so the labors can manage and handle the machines safely. Additional feedback from the respondents based on the influencing factors of the RFID implementation as follow.

• Speedy and accurate information retrieval

• Accurate asset tracking

• Better-quality information

• Better decisions

4.5 Steps to Promote the Fourth Industrial Revolution (IR 4.0) Implementation for Improving Industrial Building System (IBS) Construction Project

Objective 3 is to find steps to promote Radio Frequency Identification Technology (RFID) Implementation for Material Safety in the Storage Area in Johor by using a questionnaire. The qualification for the respondents is a contractor Grade 7. Objective 3 is to find out whether the steps to promote given is related to the RFID implementation for material safety at storage area. Based on summary Table 9, there are 5 types of factors namely, government policies, top management support, research on RFID, demonstration project and education industry.

The top three rankings for objective 3 are 'Top management support' with the highest mean of 3.99, and a 'agree' consent level. Next for the moderate is 'Research on RFID' with a mean of 3.91 and a 'agree' consent level. Next, for the lowest is 'Government policies' with a mean of 3.82 and a consent level 'agree'. In conclusion, the rankings for these steps to promote Radio Frequency Identification Technology (RFID) Implementation for Material Safety in the Storage Area.

Table 9: Summary steps promote of IR RFID

No.	Steps to Promote Radio Frequency Identification Technology (RFID) Implementation for Material Safety in the Storage Area	Mean	Agreement Level	Standard Deviation	Ranking
Government Policies		3.8200	Strongly Agree	-	3

1. Introduce RFID technology at the school and college levels	3.8600	Agree	0.997	2
2. Provide incentives by the government	3.7300	Agree	1.013	3
3. Provide RFID technology training for employees	3.8900	Strongly Agree	0.935	1
Top Management Support	3.9900	Agree	-	1
4. Technology promotion at the management level	3.9500	Agree	0.893	3
5. Introduce RFID starting at the top management level	4.0000	Strongly Agree	0.806	2
6. Strong support from top management to use RFID technology	4.0400	Agree	0.828	1
Research on RFID	3.9133	Agree	-	2
7. Improve research and development (R & D) on RFID implementation	3.9000	Agree	0.831	2
8. Improve RFID technology implementation through R&D for the safety of materials	3.9500	Agree	0.893	1
9. Increase awareness of RFID usage through R&D among construction industry players	3.8900	Agree	0.949	3
Demonstration Project	3.7033	Agree	-	5
10. Increase demonstration of RFID usage	3.7200	Agree	0.855	2
11. Increase knowledge of RFID technology	3.6000	Agree	0.890	3
12. Increase investment in RFID education In the construction industry	3.7900	Agree	0.945	1
Education Industry	3.8100	Agree	-	4
13. Encourage employees to learn RFID technology	3.7000	Agree	0.914	3
14. Provide comprehensive training program for RFID usage	3.8800	Agree	1.005	1
15. Increase investment in RFID education in the construction industry	3.8500	Agree	0.910	2

The other steps to promote the RFID implementation were applying modern applications and promotion through CIDB Malaysia. However, RFID implementation also need to do the promotion through CIDB Malaysia because it had been more widely introduced in other country. Additional feedback from the respondents based on the steps to promote of the RFID implementation as follow.

- Evaluate needs and infrastructure

- Develop new process
- Set goals
- Train workers

5. **Conclusion**

The findings of this research have demonstrated that all of the objectives of this research have been successfully accomplished through the utilisation of the outcomes of the data analysis obtained from the questionnaires that have been returned. The accomplishment of the aims is critical to guaranteeing the success of the research. Based on the research that has been done, the researcher found that the main problems and main solutions to empower RFID implementations for material safety were agreed upon by the Grade 7 contractors. The problems can be solved by the strategies that had suggested. This demonstrates why putting RFID into practise in the construction industry at this time is of the utmost importance. As a result of the fact that it is still fairly new in the world of construction, there is a demand for advice, rewards, and strategies to help control it and make the appropriate judgments. As a result of this research, one can draw the conclusion that it is hoped that the parties involved and responsible for addressing the problems will do so by utilising strategies that are successful. The building and construction industry has the potential to enjoy increased levels of prosperity and success if it is conducted in this manner. As a conclusion of this research, one can draw the conclusion that it is hoped that the parties involved and responsible for addressing the problems will do so by utilising strategies that are successful. The construction industry has the potential to enjoy increased levels of prosperity and success if it is conducted in this manner.

While conducting this study, the researchers ran into some obstacles and constraints. Research limitations are flaws or restrictions that emerge in the study but are out of the researcher's control. When conducting research, the researcher must ascertain the constraints on the study. Due to the significant capital investment needed to implement RFID, there are few options for target respondents. As a result, the G7 contractors are the study's target respondent. Additionally, not all G7 contractors are qualified to respond to this questionnaire; only G7 contractors with RFID experience are qualified to do so. The next limitation is the need for data collection from respondents over an extended period of time. This is due to the fact that some respondents lacked the motivation to complete the questionnaire, and others took a long time to resolve the issue. Thus, only 80 out of 254 respondents' collective data were gathered by the researchers.

The contribution of this research study for the construction industry is that contractors will be better able to comprehend and use Radio Frequency Identification (RFID), which can record data and information about materials being used on-site in real time, thereby reducing issues with material loss. The contractor can more easily detect lost material and expedite finding processes by implementing RFID technology. This is due to the fact that RFID enables on-site, real-time visibility and traceability of information to guarantee accurate material tracking for safety management. Additionally, the contractor will have a better understanding of the biggest obstacle to the use of RFID in the material safety of the material tracking system and will be able to use the best ways to make improvements to overcome the issue. The key issue of the construction industry's ignorance of RFID technology can be resolved by the contractor's top management promoting it. The potential, the influencing factors, and the steps to promote the implementation of Radio Frequency Identification (RFID) technology for material safety in storage areas at the construction site have all been discussed in this research study's academic contribution. This study added knowledge to the academic literature on the potential for implementing RFID. The use of RFID could replace conventional human tracking system techniques. Additionally, this research study added knowledge to the academic references of the motivating elements and actions to support the implementation of RFID for material safety in construction sites. The implementation of RFID for material safety on site is something that readers can better understand how to improve.

The incorporation of "internet of things" (IoT) and RFID-based labor tracking systems as a real-time safety early warning system to prevent losses and improve material safety at construction sites is

advised and recommended for the construction industry. BIM, IoT, and RFID technology combined can better direct worker activities on the construction site. This safety warning system aids business in altering risky habits and preventing material losses on construction sites. The system, which is crucial for enhancing safety material management, will be used for on-site equipment and monitored during construction. Consequently, the construction site's workplace is safer. Future research recommendations are provided to support this study. The advice that follows can serve as a guide for future RFID studies in the construction sector. This study uses a quantitative approach, and it asks participants to answer each question in the questionnaire in a way that best represents their opinions. Despite being practical, this method prevents respondents from offering more in-depth information and opinions. It is advised to combine two research methods, namely quantitative and qualitative methods, for any researcher planning to conduct research in this field in the future. The researcher will be able to have a complete and in-depth understanding of the potential of RFID through the integration of these two techniques.

Acknowledgment

The author would like to thank the Faculty of Technology Management and Business and Universiti Tun Hussein Onn Malaysia for its support.

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