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Key Elements of Workshop Management System For Vocational College in Malaysia

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Abstract

Workshops or engineering laboratories are a crucial part of implementing technical and vocational education and training (TVET) programs because this is where practical activities are carried out to ensure that students are competent in performing specific tasks. However, several issues in workshop management within TVET institutions, such as record management, maintenance, and safety concerns, require improvement to optimize their use in TVET programs. This study systematically examines relevant documents and materials to determine and prioritize key elements and sub-elements essential for developing a workshop management system in TVET educational institutions, particularly in Malaysian Vocational Colleges. Findings from the document analysis through READ approach are categorized into five themes, serving as key elements management areas for tailoring the workshop management system: 1) asset and stock management, 2) safety management, 3) workshop environmental management, 4) workshop maintenance management, and 5) workshop documentation management. Additionally, 22 sub-elements are organized into suitable themes to guide the design of the workshop management system. By focusing on these specific elements, the study aims to provide administrators and educators with a guide for effective workshop management, outlining critical activities for implementation.

Keywords: Workshop and Laboratory Management, TVET, Vocational College, Document Analysis, READ Approach

Introduction

In the dynamic landscape of technical and vocational education, workshop management stands at the heart of innovation, skill development, and quality assurance. As the demand for a competent and adaptable workforce continues to grow, Technical and Vocational Education and Training (TVET) programs have become central to preparing the next generation of skill workers (Ismail et al., 2018; Fadel et al., 2022). These programs, particularly when supported by well-structured and effectively managed workshops, play a pivotal role in bridging the gap between academic knowledge and practical proficiency (Bakri & Zakaria, 2018).

The significance of workshops and laboratories in TVET programs cannot be overstated. According to Bakri et al (2022); Yasin et al (2012), these workshops function as living workshops where students acquire practical skills, explore real-world engineering problems, and hone their problem-solving abilities. They cultivate future engineers and technicians who are not only well-versed in textbook material but also skilled in applying this information in practical situations. They are the fertile ground where theory meets practice. While the role of engineering laboratories in TVET is pivotal, it comes with its share of challenges. Managing these facilities effectively can be complex due to budget constraints (Manap et al., 2017), equipment maintenance (Bakri et al., 2022; Bakri & Zakaria, 2018), and alignment with rapidly evolving industry standards (Ali et al., 2020; Syahrial & Wibawa, 2020).

Workshop or laboratory management in vocational colleges involves various parties, particularly lecturers who directly utilize the workshop, especially during practical sessions with students. The workshop is usually managed by a workshop coordinator, who is typically a lecturer (Kolej Vokasional Arau, 2018). The workshop coordinator plays a crucial role in maintaining the workshop's optimal condition to ensure the efficient execution of students' practical sessions (Yasin et al., 2012). Consequently, this paper aims to determine key elements to serve as guidance for workshop or laboratory management, specifically tailored for TVET programs in vocational colleges. Additionally, identifying sub-elements for each key element is imperative to ensure compatibility with activities related to workshop management for the system's design and development.

Literature Review

One of the responsibilities of the workshop coordinator or lecturer is to make sure that equipment and materials used in practical session are in good condition and adequate (Arau, 2018). Record management is one of the good practices to ensure the equipment and material in the workshop is sufficient (Junaid & Jangda, 2020). Thus, one critical aspect in the effective functioning of workshop or laboratory management systems is the transition from manual record management to digital solutions (Rabiah et al., 2022; Setiawan et al., 2019). Traditional manual record-keeping systems are often prone to errors, inefficiencies, and delays (Fauzan et al., 2019; Pangestu & Sukardi, 2019). Furthermore, manual records tend to become dirty during practical sessions in the workshop while keeping them up to date (Pangestu & Sukardi, 2019). Researchers Zuhdi & Sukamta (2017); Junaid & Jangda (2020); Oktavia & Wongso (2015); Ramadina & Hadi (2015) highlighted the need for vocational colleges to adopt automated record management systems to enhance accuracy, accessibility, and overall efficiency. The shift to digital platforms not only streamlines administrative tasks but also facilitates real-time data retrieval, improving decision-making processes.

Another critical aspect of workshop management is the maintenance of equipment and facilities, which is paramount for the smooth operation of vocational college workshops or laboratories. Studies (Bakri & Zakaria, 2018; Junaid & Jangda, 2020; Setiawan et al., 2019) emphasize the importance of implementing a comprehensive maintenance record management system. This system should include preventive maintenance schedules, historical data tracking, and timely alerts for necessary repairs. Addressing maintenance proactively ensures the longevity of equipment, reduces downtime, and contributes to a conducive learning environment (Abdelrahman et al., 2020).

Ensuring the safety of students and staff are also a top priority in workshop or laboratory management. Workshop or laboratories involves the use of real equipment and machine that might be dangerous to students without proper attention and guidance.

Windasari et al (2019) stress the need for an integrated safety issue management system. This involves the development of protocols for reporting and addressing safety concerns promptly. By incorporating technology, such as IoT sensors and automated incident reporting, vocational colleges can enhance their ability to identify and mitigate safety risks effectively.

In conclusion, the literature supports the integration of automated systems to address manual record management, maintenance record management, and safety issue management in vocational college workshops or laboratories. This shows that the workshop management system is crucial and it can be done by determining elements and sub-elements to develop the system as the first step to achieve it. These advancements not only align with global trends in education but also contribute significantly to the efficiency, safety, and overall quality of technical and vocational education and training (TVET) programs in Malaysia.

Methodology

Document analysis, a qualitative research method similar to other methodologies, was used in this article. The word 'document analysis,' also known as 'document review,' is used as a means of obtaining data and information in several disciplines and has various meanings depending on how it is conducted, understood, and used (Kayesa & Shung-King, 2021). This article investigates important papers and resources methodically to identify and prioritize key elements and sub-elements required for creating and implementing a workshop management system in TVET educational institutions, specifically Malaysian Vocational Colleges.

Document Analysis

Document analysis is often used in combination with other qualitative research methods as a means of triangulation; multiple sources of data (Fusch et al., 2018). The qualitative researcher is expected to draw least two sources of evidence; that is, to seek convergence and corroboration through the use of different data sources and methods (Bowen, 2009). Apart from documents, such sources include interviews, participant or non-participant observation, and physical artifacts (Yin, 1994). Although document analysis has primarily been employed as a supplement with other research techniques, it has occasionally been utilized independently (Bowen, 2009). Dalglish et al (2020) also added that document analysis can be used as a stand-alone method, for example, to analyze the contents of specific types of policies as they evolve and vary across geographies, but it can also be powerfully combined with other types of methods to cross-validate (triangulate) and deepen the value of concurrent methods.

In order to provide meaning, improve understanding, and create empirical knowledge, this approach entails a thorough inspection and analysis of data taken from various texts (Karppinen & Hallvard, 2012). According to Bowen (2009), a study's use of documents for systematic review might take many different forms without the researcher's intervention. Examples of their contents include advertisements, meeting agendas, minutes, and attendance records, background papers, books, brochures, diaries, journals, event programs, correspondence, memoranda, maps, charts, newspaper clippings, articles, press releases, application forms, summaries, program proposals, radio and television show scripts, institutional or organizational reports, survey data, and other public records. Additionally, photo albums and scrapbooks can serve as documented content for academic research. Such records can be found in institutional or organizational files, historical society offices, newspaper archives, and libraries.

In examining document analysis, scholars utilize a research method known as content analysis. As defined by Krippendorff (2004) content analysis is a research approach aimed at deriving reliable and meaningful insights from texts (or other relevant materials) regarding their usage contexts. This article will employ the READ approach, the document analysis techniques recommended by (Dalglish et al., 2020). The READ method involves four steps: *R*eadying materials, *E*xtracting data, *A*nalyzing the data, and *D*istilling the findings (Table 1).

Table 1
READ approach suggested by Dalglish et al (2020)

Steps	**Explanation**
(R) Readying materials	Researchers should decide the type and approximate number of documents they plan to analyze based on the research question. They need to establish criteria related to the topic, dates of inclusion, and a list of places to search for documents.
(E) Extract data	Gathering information can take different forms, depending on the research query and document characteristics. A straightforward approach involves using an Excel spreadsheet, where each row signifies a document, and columns encompass various information categories for extraction. Additionally, documents can be imported into thematic coding software like Atlas.ti or NVivo for data extraction.
(A) Analyze data	During the data extraction phase, the researcher is already analysing data and forming initial theories—as well as potentially modifying document selection criteria. However, only when data extraction is complete can one see the full picture.
(D) Distil the findings	Refining the findings involves revisiting memos, improving them, incorporating graphics and quotes, and addressing any incomplete areas. Documents undergo a thorough review when one of these conditions is met: 1. Researchers collect pertinent documents that satisfy the criteria. 2. If time is limited, refine the review criteria. 3. Grasp the phenomenon, even if not all documents meeting the criteria are analyzed, progressing until saturation.

To sum up, content analysis is a valuable method often used with other research techniques for a more robust understanding. While it can stand alone, its power is in combining with other methods for a richer perspective. This systematic process aims to uncover meaningful insights and contribute to the objective of this paper.

Data Analysis and Findings

Ready (R)

The documents chosen for analysis follow the criteria proposed by Dalglish et al (2020) to ensure their suitability and relevance to the study's objectives (see Table 2). To meet the inclusion criteria, the researcher selected material related to two main topics: "workshop or laboratory" and "workshop or laboratory management system". Due to a scarcity of literature on workshop management systems, the researcher also decided to review articles published between 2012 and 2023 to gather relevant information through Scopus and Google Scholar

databases. To ensure the inclusion criteria were satisfied and the papers fit within the current study, the current research aims, the titles, and the main content of each article were carefully reviewed. As a result, 18 articles available to be extracted.

Table 2
Material parameters suggested by Dalglish et al (2020)

Parameters	Inclusion
Topic	1) Workshop/ Laboratory 2) Workshop/ Laboratory Management System
Timeline /Years	2012 – 2023
Document sources	Scopus and Google Scholar

Extract (E)

In Step E, relevant information from the 18 articles selected was extracted into data matrix (refer to Table 3). This process also called as coding process in content analysis. There are total of 57 codes or data extracted from the articles.

Table 3
Extraction Results

Author	Findings	Data extracted
Ruhizan M. Yasin et al. (2012)	Based on three-round Delphi study conducted among 15 experts, the findings were group into four themes: documentation management, safety management, environmental management, and equipment management.	• Asset and stock management • Safety management • Workshop environmental management • Workshop documentation management
Bakri & Zakaria (2018)	For better maintenance of facilities and infrastructure, the conventional has to be improved while providing a good environment.	• Facilities maintenance • Infrastructure maintenance
Vengidason et al. (2021)	To prevent accidents, we can use methods like putting up signs, keeping the workshop clean, and enforcing strict rules. If a danger arises, students suggest solutions such as having a first aid kit, providing training for students and teachers, maintaining a clean floor, installing fire extinguishers and alarms, and having emergency exit routes.	• Signage • Keeping the workshop clean • Strict rule • First aid kit • Training for students and teachers • Clean floor • Fire extinguisher • Alarms • Emergency exit route
Pangestu & Sukardi (2019)	The laboratory on Vocational High School in Banggai district still needs further improvement if it is	• Workshop atmosphere • Lighting • Workstation

	seen from four indicators from student-respondents which are atmosphere, lighting, maintenance, and workstation. While there are three indicators from teacher-respondent which are the practice area, lighting, and maintenance.	• Practice area • Facilities Maintenance

Author	Findings	Data extracted
Azizi Yahaya et al. (2020)	Based on the study that has been conducted to examine the factors that influence the effectiveness of teaching and learning in vocational workshop, it is found that the most dominant factor for a vocational workshop in a technical secondary school is the environment factor, followed by management, safety, and lastly, equipment.	• Asset and stock management • Safety management • Workshop environmental
Nasir, Azri, & Ujang (2022)	Presently, it is found that asset management practices in Malaysia primarily focus on assets operations such as management, monitoring, maintenance, and disposal	• Asset management • Monitoring asset • Machine and equipment maintenance • Asset disposal
Abdelrahman, Abdalaal, & Shukri (2020)	The time and effort needed to select and implement computerize maintenance management system are well spent because of the benefits and savings they offer in managing the maintenance function.	• Asset maintenance management system
Mohamed, Nawi, & Ghafar (2022)	Most Vocational College lacked essential safety information, and more than half of engineering workshops had high noise levels. Emergency preparedness was lacking in some computer workshops, and improvements were needed in ergonomic design.	• Safety information • High noise levels • Fire equipment • Ergonomic design for furniture and workspace
Bakri et al. (2022)	To make sure these facilities are always available for hands-on participation in labs and workshop, we need good maintenance management.	• Workshop maintenance management

Fauzan et al. (2019)	Computerize information system was developed to manage assets, which include the process of registration, request, acceptance, and maintenance	• Register asset • Request asset • Acceptance asset • Maintenance asset
Ramadina & Hadi, (2015)	The administration management of the Workshop at Vocational High Schools (SMK) includes five essential aspects: human resources, machinery or equipment, materials or raw materials, finances, and the practical work environment in the workshop.	• Human resources • Machinery or equipment • Materials or raw materials • Finances • Work environment in the workshop
Author	**Findings**	**Data extracted**
Sulistyo, Achmad, & Purnama (2022)	The results show that the asset management and tracking system helps TVET to keep track of their equipment and vital inventories in real time.	• Instruments and equipment management
Mtshali (2021)	A significant weakness in terms of the training was that lecturers had no specific lesson plans or outlines and no documented task descriptions. Lessons were often conducted in an ad hoc fashion.	• Documentation of equipment and material needed in practical session
Riswanto, Suseno, Partono, Harjati, & Dedy (2019)	The results of the research are online school laboratory management system products (online inventory systems, online laboratory documents, online administration system)	• Inventory system • Laboratory documents • Administration system (reservation on equipment and tools)
Halimatun Sa'adiah Harith et al. (2020)	The TMQRCODE system facilitates the recording process of hand tool management and workshop usage during the teaching and learning process.	• Hand tool management • Workshop usage (booking)
Setiawan et al. (2019)	Proper asset management can support operational activities especially in the maintenance, repair, and procurement of assets for the organization.	• Asset maintenance • Asset Repair • Asset management
Windasari et al. (2019)	The application made has been able to handle the records of K3 inspection tools, namely fire extinguishers and first aid kits, and	• Fire extinguishers • First aid kits • Incidents report

	to report incidents were developed	
Rabiah et al. (2022)	A web-based inventory application with QR Code and RFID technology can assist in monitoring inventory and the process of borrowing equipment	• Monitoring inventory • Borrowing equipment

Analyze (A)

The document review conducted for this study extracted a substantial amount of data from 18 previous research studies focused on workshop/laboratory and workshop/laboratory management systems. The 57 data extracted form a pattern that leads to categorizing the data into six groups: 1) related to equipment, machine, and materials; 2) related to workshop safety; 3) related to maintenance; 4) related to workshop environment; 5) related to workshop documentation; and 6) not related or not suitable to be implemented within the system. The categorization (refer to Table 4) serves for easy visualization, synthesis, and comparison.

Table 4
Categorizing the data extracted from the articles

Related to equipment, machine, and materials	**Related to workshop safety**	**Related to maintenance**
1. Asset and stock management	19. Safety management	31. Facilities maintenance
2. Asset and stock management	20. Keeping the workshop clean	32. Infrastructure maintenance
3. Asset management	21. First aid kit	33. Facilities Maintenance
4. Monitoring asset	22. Clean floor	34. Machine and equipment maintenance
5. Asset disposal	23. Fire extinguisher	
6. Register asset	24. Alarms	35. Asset maintenance management system
7. Request asset	25. Safety management	
8. Acceptance asset	26. Safety information	36. Workshop maintenance management
9. Machinery or equipment	27. Fire Equipment	
10. Materials or raw materials	28. Fire extinguishers	37. Maintenance asset
11. Finances	29. First aid kits	38. Asset maintenance
12. Instruments and equipment management	30. Incidents report	39. Asset Repair
13. Inventory system		
14. reservation on equipment and tools		
15. Hand tool management		
16. Asset management		
17. Monitoring inventory		
18. Borrowing equipment		

Related to the workshop environment	Related to workshop documentation	Not related or not suitable to be implemented within the system
40. Workshop environmental management	47. Workshop documentation management	52. Human resources
41. Workshop atmosphere	48. Documentation of equipment and material needed in a practical session	53. Safety Signage
42. Lighting	49. Laboratory documents	54. Training for students and teachers
43. Workstation	50. Workshop usage (booking)	55. Strict rule
44. Practice area	51. Emergency exit route	56. High noise levels
45. Workshop environmental		57. Ergonomic design for furniture and workspace
46. Work environment in the workshop		

The codes or data in the "not related or not suitable group to be implemented within the system" will be eliminated and duplicate data or similar meaning data in each group will be combined to contribute significantly to the efficiency of the analysis. This not only simplified the dataset but also reduced redundancy, ultimately enhancing the accuracy of the results. The results after the filtering process are shown in Table 5.

Out of the initially extracted 57 data points, 21 were deemed applicable for in-depth analysis to identify key elements and sub-elements. The categorization of these data also led to the identification of five essential themes (key elements) for a workshop management system: 1) Asset and stock management, 2) Safety management, 3) Workshop environmental management, 4) Workshop documentation management, and 5) Workshop maintenance management.

Table 5
Creating key elements and sub-elements for the workshop management system

Asset and stock management	Safety management	Workshop Maintenance management	Workshop environmental management	Workshop documentation management
1. Monitoring asset 2. Asset Disposal 3. Register asset 4. Request asset 5. Acceptance asset 6. Borrowing asset	7. First aid kit 8. Fire extinguisher 9. Alarms 10. Safety information 11. Incidents report	12. Facilities and infrastructure maintenance 13. Asset maintenance management 14. Asset Repair	15. Ventilation 16. Lighting 17. Workstation condition 18. Housekeeping record	19. Documentation of equipment and material needed in a practical session 20. Finance record 21. Workshop usage based on booking record

These key elements find support and validation in the body of existing research, as evidenced by studies conducted by (Yasin et al., 2012; Bakri & Zakaria, 2018; Yahaya et al., 2020; Bakri et al., 2022). This consolidation of findings strengthens the proposed components and provides a robust foundation for the development of an effective workshop management system. The conclusive insights into these key elements and their corresponding sub-elements will be presented in the concluding stage (Step D).

Distil (D)

The final products of the distillation process will vary by research study, but they will invariably enable articulation of findings in connection with research questions (Dalglish et al., 2020). The key elements and sub-elements to design and develop a workshop management system are presented in the mind map (Figure 1). The system is divided into several key management areas (key elements) and each represented by a different colour and connected by lines to related subtopics (sub-elements). It also presents a holistic view of how a workshop can be managed effectively across different facets of operation. It emphasizes the importance of documentation, safety protocols, asset management, and environmental conditions, all of which contribute to a functional and efficient workshop.

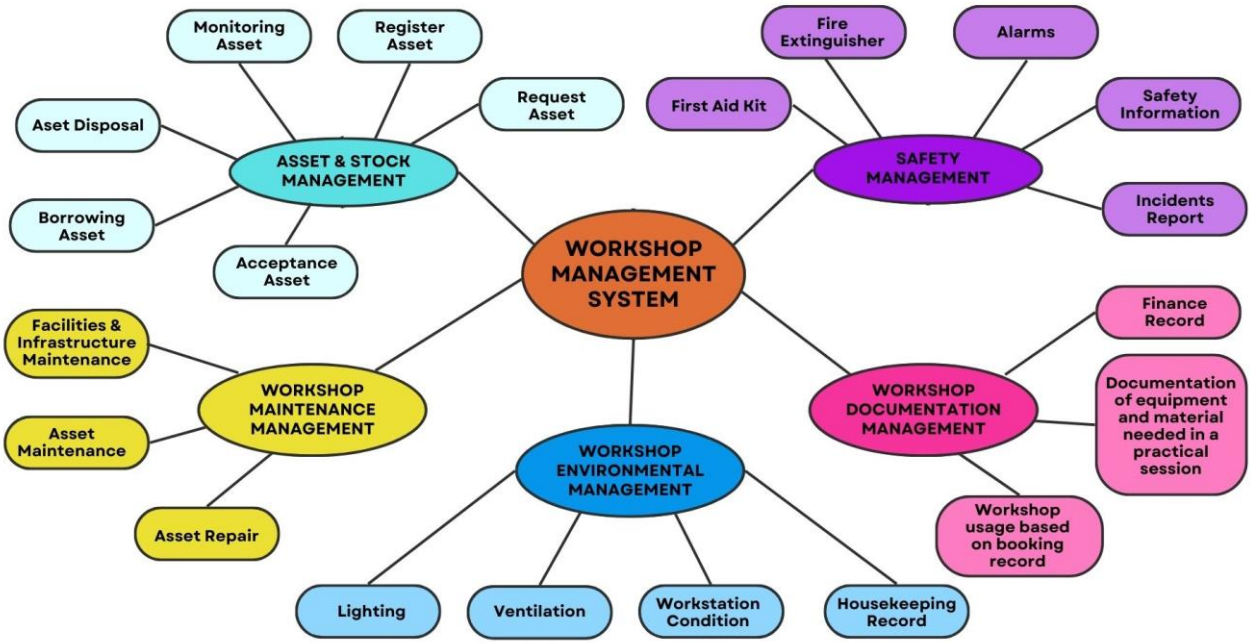

Figure 1: Key elements and sub-element for workshop management system

Discussion and Conclusion

The integration of technology into management systems, while prevalent in industries, is not yet widely adopted in vocational colleges. This observation underscores the potential for further advancements and integration of technology to enhance workshop management in TVET settings. The results of this research are anticipated to serve as a roadmap for enhancing the standard of education in vocational colleges, offering valuable insights for administrators and instructors in efficient workshop management. The identified key elements, including asset and stock management, safety management, workshop environmental management, workshop documentation management, and workshop maintenance management, draw strength and relevance from a synthesis of diverse perspectives found in reputable research studies.

The application of the READ approach in document analysis indirectly introduces diversity in TVET research methods, aligning with the broader goal of improving the quality and achievement of students. It's important to highlight that document analysis, being a cost-effective method, plays a crucial role in acquiring empirical data discreetly and without causing reactions. Although it has significant strengths, it's crucial to recognize its limitations. Researchers should not view document analysis as a replacement for other forms of evidence that might better suit the research problem and conceptual framework. Combining results from document analysis with data from multiple sources (triangulation) can enhance the robustness of research findings. In the context of this research, the triangulation with the findings from document analysis is crucial to ensure that the key elements and sub-elements are suitable for setting in Malaysian vocational college.

In conclusion, the comprehensive document review and data analysis undertaken in this study have successfully identified essential elements and sub-elements crucial for the development of an efficient workshop management system. This synthesis of knowledge contributes significantly to the existing body of research in the field, offering a consolidated understanding of workshop management components. The insights from these findings also

lay the groundwork for contributing a comprehensive model or framework for effective workshop management.

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