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Improvement of an Existing Racking System Safety Inspection Checklist for Warehouse Operations in the Food Industry

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Abstract

The goal of this project is to overcome the drawbacks of manual paper-based inspection techniques by developing and testing a streamlined digital racking safety inspection checklist for warehouse operations. Conventional checklists frequently lead to incomplete documentation, subjective damage classification, and inconsistent assessments. The suggested digital checklist incorporates QR code access, structured inspection items, photo documentation, and automated reporting workflows. It was created using Microsoft 365 tools, including Microsoft Forms, SharePoint, and Power Automate. The results indicate an improvement in usability, with the System Usability Scale (SUS) showing an average score of 90, signifying excellent usability. In support of more efficient and proactive warehouse safety management, the results show that the digital checklist improves inspection clarity and data consistency, guaranteeing higher user satisfaction than the manual checklist.

1. Introduction

Racking systems are frequently used in warehouses, which are crucial parts of logistics and industrial operations, to store goods in huge quantities. However, racking systems are often subject to risks like overloading, forklift impacts, incorrect installation, and poor maintenance, which can lead to product damage, structural failure, and accidents at work. Therefore, to guarantee operational safety and adherence to occupational safety regulations, routine racking safety inspections are required [1,2].

Safety checklists on paper are typically used for manual racking inspections. According to earlier research, manual inspection systems are vulnerable to human error, inconsistent damage classification, and incomplete documentation, even though these checklists offer fundamental inspection guidance [3]. The reliability of inspection results is decreased when inspectors make subjective decisions due to a lack of structured reporting and standardized inspection criteria [4]. Furthermore, photographic documentation is usually not supported by paper-based checklists, which makes it challenging to accurately communicate damage conditions and confirm inspection results [5].

As an alternative to manual checklists, digital inspection systems have drawn attention in recent years. Real-time data recording, centralized storage, and automated reporting are some benefits of digital checklists [3]. Through structured interfaces and predefined inputs, digital inspection tools can enhance inspection efficiency,

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data accuracy, and reporting quality, according to earlier research [6]. It has also been demonstrated that adding photographic evidence improves traceability and facilitates safer decision-making [7].

Despite these advancements, warehouse racking inspection systems have received little attention in previous research, which has mostly concentrated on general safety inspections, healthcare, or manufacturing environments. Additionally, very few studies have used standardized measurement tools to empirically evaluate the usability of digital racking inspection tools. This draws attention to a gap in the creation and evaluation of workable, affordable digital solutions made especially for racking safety inspections.

In order to fill this gap, the current paper proposes the design and evaluation of a digital inspection checklist for racking safety issues designed using Microsoft Forms, SharePoint, and Power Automate. As the proposed solution is designed to reduce the effectivity gap during inspection processes related to racking safety issues, the key contributions of the current paper will be the transformation of the existing paper-based inspection checklist into the proposed digital inspection checklist solution and the evaluation of the proposed solution through the SUS method.

The aim of this study is to improve the current inspection procedures by reviewing and modifying racking safety inspection checklists and recommendations, such as those provided by OSHA, RMI, and ANSI MH16.1. The study also seeks to use Microsoft Forms to redesign and implement a digital racking inspection checklist prototype that includes photo documentation and QR code access. A centralised SharePoint list is connected to this prototype in order to store and report data. Lastly, using the System Usability Scale (SUS), the study will assess the digital checklist prototype's usability and efficiency with an emphasis on task completion, user satisfaction, and ease of use.

2. Methodology

In this paper, the approach employed in the study included the use of the user-centered and applied system development approach to transform/convert the paper-based racking safety inspection checklist to carry out the inspection electronically through the design of the computer-based inspection system. The study had four stages: system design and development, implementation of the checklist, process of inspection, and process of usability assessment, which fits well within the principles of design science and the process of the user-centered design for the development of safety and inspection systems [1,2]. Fig. 1 shows the overall conceptual framework of the study process.

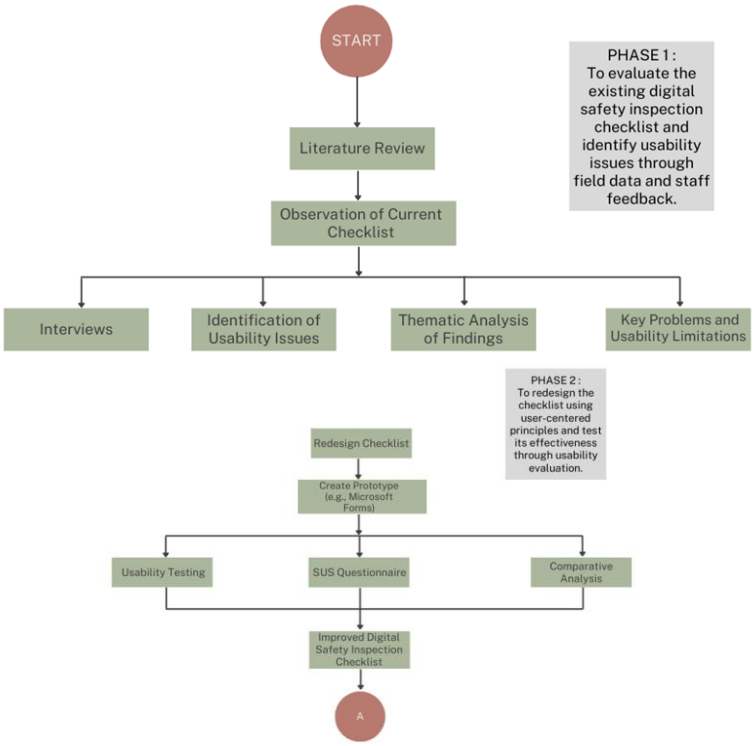

Fig. 1 *Overall methodology flow of the study*

2.1 System Overview

The digital racking safety inspection system was designed using Microsoft Forms, SharePoint, and Power Automate. The system was developed with a view of supporting real-time data gathering, data centralization, and automated report generation. Microsoft Forms was employed as the main user interface for carrying out the

inspections, while SharePoint was employed as the central data repository for the inspection data and images. The system utilized Power Automate for automated processes such as data analysis and sending notifications via emails for any critical observations made.

The use of the digital checklist was made possible by the incorporation of QR code technology, which enabled inspectors to quickly start the inspection process via mobile devices. Similar inspection systems have been demonstrated to decrease the handling of data by humans in industrial safety inspection systems [3,4].

2.2 Digital Checklist Design

The digital checklist was redesigned based on limitations that had been found earlier in respect of the traditional checklist, which lacked proper damage classification, was not consistently marked, and lacked photo documentation. The checklist was developed based on primary components related to racking, which include uprights, base plates, beams, and bracing systems, following guidelines for inspection of warehouses for safety [5].

In order to make it more objective and consistent, a predefined response format using drop-down menus and conditional logic was introduced. The inspectors were asked to rate the level of damage and make comments when required. An image upload function was also added to enable adding photography evidence to the inspections, which has been found to enhance traceability and decision-making skills during inspections of potential health and safety hazards [6].

2.3 Participants and Inspection Procedure

A purposive sampling method was used in order to select participants who were deemed to have experience in warehouse operations and racking inspection activities [7]. This study had five participants in total, which is consistent with usability testing recommendations that indicate a modest sample size of five users is adequate to identify most system usability concerns [8]. Even though the small sample size can restrict generalizability, it offers valuable information about the digital checklist's usability and is consistent with studies that indicate up to 85% of usability problems can be identified by five users [13].

Prior to this, each participant performed an independent racking inspection using the existing manual checklist under observation. This was followed by an inspection using the redesigned digital checklist in a simulated warehouse environment. During both inspections, participants' interactions with the checklist were observed to identify any issues related to comprehension, navigation, and task execution. Semi-structured interviews were conducted after the inspections to gather more qualitative feedback about usability and effectiveness.

Besides, there is a chance of sampling bias because of the small sample size and the purposive sampling technique used. Although the participants were safety personnel, engineers and warehouse operators with knowledge of racking inspections, they might not accurately reflect the larger group of warehouse employees with different degrees of expertise. Given that more experienced participants might complete tasks more quickly and have different ideas about usability than those with less expertise, this could induce bias. In order to fully capture the variety of user experiences, future studies should increase the sample size and guarantee a more varied selection of participants.

2.4 Usability Evaluation

In particular, the usability and effectiveness of the digital checklist were employed through Observation, Interview Feedback, and the System Usability Scale (SUS). SUS is a commonly employed and validated technique for the assessment of perceived usability in studies related to human computer interaction research [9,10].

Responses to the SUS questionnaire were recorded using a five-point Likert scale. The results were scored using the standard procedure for the SUS questionnaire, resulting in a usability score between 0 and 100. Scores above 68 are above average, but scores above 80 are excellent, indicating very good usability [10]. The results of the SUS test can quantitatively determine the satisfaction level of the users from the digital checklist tool relative to the manual inspection process.

2.5 Ethical Considerations

Universiti Tun Hussein Onn Malaysia (UTHM) gave this study ethical approval. All participants received thorough information about the purpose, nature, and voluntary nature of the study prior to their involvement. Every participant was made aware that they might leave the research at any time without facing any repercussions. All participants provided written informed permission after being made aware of their rights and the study's objectives. Participant confidentiality was completely preserved throughout the study in compliance with ethical norms. No personally identifiable information was used in the results, and all data collected was

anonymised. The rights of the participants were protected throughout the entire research procedure by following ethical guidelines.

3. Results and Discussion

This section describes and discusses the results from the evaluation of the manual and digital safety inspection checklists for racking system. These results were gathered from direct observation, usability testing, interview techniques, and the SUS scale. To ensure that the observations are interpreted accurately and compared well, the observations are put into tables.

3.1 Usability Evaluation

The digital racking safety checklist was much better at ensuring usability and performing inspections. The participants were able to move around the digital checklist without pause or help. The predefined sections of the inspection and the format of the responses helped generate less interpretation and promoted a more systematic inspection.

The addition of photographic documentation enabled the inspectors to document visual evidence directly in the checklist. This improved the accuracy and recording of the inspections. The use of QR code access also improved efficiency as the inspectors were able to start the inspection process readily via mobile devices. The results are in line with other studies that indicated decreased cognitive load, accuracy, and efficiency in safety management reporting with the use of digital inspection software [13, 14]. Table 1 summarizes the key usability problems observed during manual racking inspections.

Table 1 An Observation Findings of Manual Checklist

Participant	Observation Findings
R1	Rapidly finished the checklist without doing a thorough inspection; had a hazy understanding of the damage codes; and added no remarks.
R2	Uncertain about item categories; impulsively checked boxes without carefully inspecting them; unable to describe the exact type of damage.
R3	Misunderstanding a number of checklist items; had trouble distinguishing between base plate, beam, and upright components; and was very dependent on help.
R4	Needed constant supervision during the inspection; no remarks were made; and there was no proof of damage.
R5	Lack of confidence when marking H/M/L classifications; repeated requests for clarification; lack supporting documentation; absence of the remarks section; incorrect identification of damage.

3.2 Performance of the Digital Checklist

In contrast, the digital racking safety checklist demonstrated significantly improved usability and inspection performance. Participants were able to navigate the digital checklist easily and complete inspection tasks without hesitation or external assistance. The predefined inspection sections and structured response options reduced ambiguity and encouraged a more systematic inspection process.

The inclusion of photographic documentation allowed inspectors to capture visual evidence directly within the checklist, improving the accuracy and transparency of inspection records. QR code access further enhanced efficiency by enabling inspectors to initiate inspections quickly using mobile devices. These findings are consistent with previous research showing that digital inspection systems reduce cognitive load, improve data quality, and enhance reporting efficiency in safety management applications [13,14]. A summary of observed user interactions with the digital checklist is presented in Table 2.

Table 2 Summary of Digital Checklist Observation

Participant	Observation Findings
R1	The participant filled out the information accurately and had a clear understanding of the inspection items. There were no layout or navigation problems, and it took a fair amount of time to finish the checklist. It was easy to use the photo upload feature. There were no mistakes or misunderstandings found.
R2	The participant completed the information accurately and had no trouble comprehending the inspection items. There are no layout or navigation problems. It took a fair amount of time, and the photo upload feature was functional. There were no mistakes or misunderstandings found.
R3	The participant comprehended the inspection items and accurately filled out the information. The time it took them to finish the checklist was reasonable, and they had no trouble navigating. The internet connection hindered the inclusion of photo documentation. There was no confusion or mistakes found.
R4	The participant had no trouble comprehending the inspection items or completing the information. The checklist took the right amount of time to complete, and the navigation was easy. There were no mistakes or misunderstandings, and the photo upload feature operated as intended.
R5	The digital checklist was clear and simple to use, according to the participant. The time was efficient, and there were no layout or navigation problems. There were no mistakes or misunderstandings when using the photo upload feature.

3.3 System Usability Scale (SUS) Results

The usability of the proposed digital racking safety inspection checklist was quantitatively evaluated using the System Usability Scale (SUS). SUS is a widely adopted and validated usability assessment tool used to measure users' perceived ease of use, efficiency, and overall satisfaction with a system. The individual SUS scores obtained from all participants are presented in Table 3.

Table 3 System Usability Scale (SUS) Results

Participant	Raw Score	SUS Score (%)
R1	37	92.5
R2	37	92.5
R3	36	90
R4	33	82.5
R5	37	92.5

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The mean SUS score was calculated by averaging the SUS scores of all participants, as expressed in (1). For additional specifics regarding the individual SUS raw scores and computations, kindly refer to **Appendix A**.

$$Mean\ SUS\ Score = \frac{92.5+92.5+90++82.5+92.5}{5} = 90 \quad (1)$$

As derived from the results in Table 3, the mean SUS score for the digital checklist was calculated to be 90, which falls into the category of excellent usability. The established guideline for the interpretation of SUS dictates that systems scoring above 80 have high usability and are highly accepted by users. The high score indicates that the participants felt the digital checklist was intuitive, easy to use, and supported racking safety inspections. Additionally, no usability issues were evident during task execution, and the participants performed the inspection tasks without confusion or interference. These findings confirm that the proposed digital checklist indeed offers a user-friendly and reliable solution for warehouse racking safety inspections.

3.4 Comparison of Manual and Digital Checklist

A comparative analysis was conducted to evaluate the performance of the manual and digital checklists across key inspection criteria, including ease of use, clarity, documentation, and reporting efficiency. The comparison between both checklist types is summarized in Table 4.

Table 4 Comparison of Manual and Digital Checklist

Criteria	Manual Checklist	Digital Checklist	Advantage
Ease of Use	Needs manual input and analysis of data	Simple to use with set fields and choices	Digital: Quicker data input, fewer mistakes
Clarity	Frequently imprecise, resulting in misunderstanding	Well-organized format featuring visual elements and set responses	Digital: Improved visibility and direction
Reporting	Entering data manually results in slow and inconsistent reporting	Automated reporting and instant data storage	Digital: Quicker, precise, and reliable reports
Documentation	Confined to handwritten notes, at times hard to read	Enables photo uploads and provides clear, comprehensive records	Digital: Enhanced documentation with visual proof

The findings illustrate how the digital checklist performs better than the manual checklist in every aspect. Quick data entry into pre-defined fields decreased human error and saved time, which accelerated reporting. Additionally, the use of photo uploads allowed inspectors to more precisely record circumstances, enhancing traceability and the general quality of inspections. This is consistent with other research highlighting how digital and user-friendly analysis tools are important to enhance user efficacy regarding personal safety inspections [12,16].

Despite the positive findings found in this study, several limitations need to be noted. Initially, the results may not be as broadly applicable as they may be due to the limited sample size (n = 5) used for usability testing. In order to include a more varied collection of people, future study ought to consider about increasing the sample size. Furthermore, since the study was limited to a single warehouse, the findings might differ in other operational contexts. Additionally, during testing, some features like photo uploads, performed poorly due to internet access problems. This emphasises the necessity of additional optimisation in settings with erratic connectivity.

4. Conclusion

This paper presented the design and evaluation of a digital racking safety inspection checklist to enhance the effectiveness and usability of warehouse inspections. This system has developed a traditional paper-based checklist into a structured digital solution with predefined inputs from an inspection, photographic recording, QR access, and automated reporting, while leveraging Microsoft Forms, SharePoint, and Power Automate.

The results of the evaluation showed that, for clarity, consistency, and quality of documentation, the digital checklist outperformed the manual checklist by a wide margin. The average score from the SUS evaluation was 90, indicating excellent usability and good user acceptance. These findings confirm that the proposed system provides a practical and reliable tool in supporting racking safety inspections within a warehouse environment.

Future efforts may expand in terms of accessibility to the system and system functionality, including developing a mobile app for the system, allowing offline inspections, or testing it on an extended and heterogeneous user group to further validate the system's performance.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper. All research and findings are reported impartially, and no financial or personal relationships have influenced the research outcomes.

Author Contribution

Nur Syamimie Airul Azhar led the study's design, development of the digital checklist, data collection, analysis, and manuscript preparation. Mohd Akhir Ahmad provided supervision and reviewed the manuscript, while Muhammad Najmi Ibrahim assisted with data collection, analysis, and manuscript review. All authors approved the final version of the manuscript.

Appendix A: Raw SUS Scores and Computations

SUS SCORE

Question	1	2	3	4	5	6	7	8	9	10	Raw Score	SUS score (%)
	I think i would like to use this tool frequently	I found this tool unnecessarily complex	I thought the tool was easy to use	I think that I would need the support of a technical person to be able to use this tool	I found the various functions in this tool were well integrated	I thought there was too much inconsistency in this tool	I would imagine that most people would learn to use this tool very quickly	I found this tool very cumbersome to use	I felt very confident using the tool	I needed to learn a lot of things before I could get going with this tool		
Participant	Score : Strongly Disagree (1) - Strongly Agree (5)											
R1	5	1	5	4	5	1	5	1	5	1	37	92.5
R2	5	1	5	4	5	1	5	1	5	1	37	92.5
R3	5	1	5	4	4	1	5	1	5	1	36	90
R4	4	2	5	4	4	1	5	1	4	1	33	82.5
R5	5	2	5	2	5	1	5	1	4	1	37	92.5

Odd-numbered questions (1, 3, 5, 7, 9) :
Item score = (Response Answer - 1)
Even-numbered questions (2,4,6,8,10) :
Item score = (5 - Response Answer)
Raw Score = Total item score
SUS Score = Raw Score x 2.5

References

[1] K. H. Koh, N. A. M. Zulkifly, and R. Ranjan, “Warehouse safety management and risk mitigation strategies,” Journal of Occupational Safety and Ergonomics, vol. 28, no. 3, pp. 145–153, 2022.

[2] N. A. M. Zulkifly and R. Ranjan, “Assessment of industrial racking system failures and safety compliance,” Safety Science, vol. 155, p. 105870, 2024.

[3] S. Kumar, M. Yusof, and T. Lee, “Digital inspection systems and workplace safety: A review of current practices,” Safety Science, vol. 120, pp. 45–52, 2019.

[4] Y. Chang and C. Lin, "Reducing subjectivity in safety inspections through structured checklist design," International Journal of Industrial Ergonomics, vol. 78, p. 102975, 2020.

[5] F. Fridrich, P. Gausden, and R. Smith, "Improving traceability in safety inspections through digital documentation," Journal of Safety Research, vol. 74, pp. 101–109, 2020.

[6] A. Rahman, N. A. Ahmad, and S. Hassan, "Usability evaluation of digital safety inspection tools in industrial environments," Applied Ergonomics, vol. 92, p. 103333, 2021.

[7] D. Gillespie and A. Marshall, "The role of photographic evidence in occupational safety management," Safety Science, vol. 74, pp. 33–40, 2015.

[8] A. Hevner, S. March, J. Park, and S. Ram, "Design science in information systems research," MIS Quarterly, vol. 28, no. 1, pp. 75–105, 2004.

[9] D. Norman and S. Draper, User Centered System Design: New Perspectives on Human–Computer Interaction. Hillsdale, NJ, USA: Lawrence Erlbaum Associates, 1986.

[10] H. Chou and C. Lee, "Workflow automation for inspection and reporting systems," IEEE Access, vol. 10, pp. 55231–55240, 2022.

[11] ANSI MH16.1, Specification for the Design, Testing and Utilization of Industrial Steel Storage Racks. American National Standards Institute, 2020.

[12] I. Etikan, S. Musa, and R. Alkassim, "Comparison of convenience sampling and purposive sampling," American Journal of Theoretical and Applied Statistics, vol. 5, no. 1, pp. 1–4, 2016.

[13] J. Nielsen, "Why you only need to test with 5 users," Nielsen Norman Group, Fremont, CA, USA, 2000.

[14] J. Brooke, "SUS: A quick and dirty usability scale," in Usability Evaluation in Industry, P. Jordan, B. Thomas, B. Weerdmeester, and I. McClelland, Eds. London, U.K.: Taylor & Francis, 1996, pp. 189–194.

[15] A. Bangor, P. Kortum, and J. Miller, "An empirical evaluation of the System Usability Scale," International Journal of Human–Computer Interaction, vol. 24, no. 6, pp. 574–594, 2008.

[16] Y. Zhou, L. Wang, and H. Chen, "User-centred digital inspection systems for improving industrial safety," IEEE Transactions on Human–Machine Systems, vol. 49, no. 4, pp. 356–365, 2019.