

<https://doi.org/10.31705/ICBR.2024.28>

Paper ID: 35

STREAMLINING DOCUMENTATION AND TRACEABILITY: A STUDY AT SHOP FLOOR LEVEL

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ABSTRACT

This study explores the inefficiencies and bottlenecks in the documentation and traceability processes of a workshop that relies extensively on manual record-keeping methods. The primary objective of this study is to streamline the documentation process and enhance traceability by transitioning from outdated manual methods to a digital solution. The research methods include semi-structured interviews with key stakeholders and an analysis of the current documentation system. Significant issues identified include technicians' reluctance to document information, delays in recording, errors, and the lack of an effective documentation system for tracking repairs. The study conducted data analysis, including process mapping, document review, employee interviews, and value-added and root cause analysis, which ultimately proposed the implementation of a computer-based document management system integrated with QR scanners. This digital solution aims to increase overall efficiency, automate data entry, and improve document traceability. The QR system entails making a linked database for tracking, creating and attaching QR codes to repair items, and updating the system at every stage of the repair process. The study identified the significance of this sort of technology, which includes improved accuracy, decreased errors, and more efficient operations. According to the study's findings, implementing a QR-based system will significantly enhance resource management and operational effectiveness. Future suggestions involve implementing the system through a pilot program, continuing staff training, and doing frequent assessments to ensure the system is functional and flexible.

Keywords: Documentation, Process Improvement, QR Code, Digital Documentation, Traceability

1. Introduction

This paper aims to explore methods for streamlining the documentation process by reducing inefficiencies and bottlenecks and enhancing the traceability of the repair process at a workshop of a well-known company operating in the emission testing industry in Sri Lanka. The workshop mentioned is the central hub for repairing the damaged testing equipment coming from each workstation located around the country. The workshop, staffed with fifteen executives and non-executive workers, including ten specialized technicians, handles routine maintenance, infrastructure repairs, mobile maintenance, and daily equipment servicing. The key challenge faced in this research is tracing repair items and document management within the workshop, which heavily relies on manual record keeping. These outdated and inefficient practices are prone to errors, delays, time-consuming, and increased operational costs, and there is a lack of use of that data in strategic decisions.

The study was conducted with three main objectives:

- I. To explain the current repair process of the selected company's workshop,
- II. To explore inefficiencies in the current process and identify where streamlining and improvements are required
- III. To develop an appropriate solution to streamline documentation and enhance traceability

The research questions of the study were:

- I. How does the current repair process function at the company's workshop?
- II. What are the inefficiencies in the current repair process in the workshop related to documentation and traceability?
- III. How can inefficiencies at the workshop be mitigated?

This study employs applied research methods, focusing on the practical application of process optimization theories through a comprehensive analysis of the current documentation processes within the workshop setting. This consisted of current process mapping, document analysis, interview analysis with staff, value-added analysis, and root cause analysis to pinpoint the primary issue affecting workshop documentation inefficiency. Based on the findings gathered from the above analysis, the study came up with a digitalized solution, a computer-based document management system integrated with QR scanners. That solution enhances the traceability of the documentation and potentially impacts the workshop's operations. That proposed solution is a long-term strategy to improve traceability, reduce errors, enhance the accuracy of the records, and ultimately improve the overall efficiency of the workshop.

The study commences with a literature review of previous studies related to documentation, documentation inefficiencies, and solutions in similar contexts, establishing the theoretical foundation for

the study. Subsequently, the research methodology with the methodological approach outlines the approach used to collect and analyze data. In the results and discussion chapter, data is presented and critically analyzed, highlighting the findings. The recommendation chapter provides the most feasible solution based on the findings for the workshop to streamline its documentation and enhance traceability. Finally, the conclusion and implication chapter summarize the findings, discusses the implications for the workshop mentioned and other similar contexts, and suggests future recommendations.

2. Literature Review

Documentation is a process that involves several activities. These activities include determining the required information and establishing methods to acquire it, recording the obtained information, and storing it in appropriate containers known as documents (Guzman & Verstappen, 2003). Documentation also involves collecting pre-existing documents containing the necessary information, organizing these documents to enhance accessibility, and providing them to users who require the information (Guzman & Verstappen, 2003). The first-person theory of documentation offers a novel approach to understanding the creation and interpretation of documents through the lens of personal experience (Gorichanaz, 2019). By focusing on the subjective and individual aspects of documentation practices, the theory aims to capture the nuances and complexities involved in the process. The study also presents a theoretical framework that underscores the idea that each individual engages with documentation in a unique way, influenced by their personal background, skills, and motivations. By considering the first-person perspective, the theory seeks to uncover the rich tapestry of experiences that shape how people interact with documents in their daily lives. It emphasizes the importance of acknowledging the individual's agency and subjectivity in the documentation process, moving beyond traditional, object-focused approaches to document analysis (Gorichanaz, 2019).

Manual documentation systems, characterized by paper-based forms and spreadsheets, are riddled with inefficiencies that impede repair shop operations. Manual data entry is susceptible to human error, leading to inaccurate or incomplete information in repair records. Chen et al (2017) highlighted that those errors in maintenance logs resulted in delayed repairs and increased maintenance costs. Recording and retrieving data from physical documents is a time-consuming process. Technicians and executives spend valuable time searching for records instead of focusing on repairs. Dewi (2019) highlights that manual paperwork reduces productivity and influences customer satisfaction due to extended waiting times. Physical documents are often confined to specific locations, hindering accessibility for technicians across the

workshop. Gwozdz and Togno (1992) explored that nurses spend a considerable portion of their workday, over 15%, on documentation tasks. This extensive documentation workload often leaves nurses feeling exhausted and disillusioned with their profession. Despite their commitment to patient care, nurses find themselves dedicating substantial time to filling out numerous, often repetitive, forms. The overwhelming paperwork hinders their ability to focus on patient welfare.

Ungan (2006) highlighted that well-documented procedures and workflows facilitate clarity and consistency in task execution, minimizing errors, and delays. Their study also highlighted that consistency is difficult to attain because employees perform the same tasks in different ways. Employees' styles are determined by their education, experience, and skill levels, and disparities in styles lead to variations in process output. Haas et al. (2021) describes the successful implementation of documentation management and visualization system in nursing management. This system enables nursing managers to efficiently generate required documentation while also offering interactive visualization dashboards for analyzing patient and staff data. Notably, the study also mentioned that the system has been effectively utilized in nursing management tasks without requiring any changes to existing IT infrastructure. Compared to previous methods, the new process saves approximately 35 hours per month and reduces errors. The documentation functionality automates data retrieval and calculation, ensuring accuracy. Franceschi et al. (2020) demonstrated the significant impact of standardizing documentation processes, particularly within perioperative settings. By implementing standardized procedures across various areas such as billing, reporting, registration, device integration, scheduling encompassed all, and central supply, the study reported completing 242 perioperative enhancements. These enhancements not only focused on documentation but also aspects of perioperative operations, leading to notable improvements in workflow efficiency and overall performance metrics. For instance, the First Case On-Time Start (FCOTS) metric improved from less than 70% to over 85%, indicating a substantial reduction in delays. Moreover, the total delay in perioperative processes was halved, underscoring the effectiveness of standardized documentation in streamlining operations. Hark et al. (2008) present that radio frequency identification (RFID) technology can be used to improve traceability and streamline documentation processes. Radio-frequency identification (RFID) tags can be attached to items or documents, allowing for easy identification and tracking throughout the repair process.

Mahmood et al. (2017) provide valuable insights into the benefits and execution of an electronic document management system. The study emphasizes that transitioning to an Electronic Document

Management System will lead to streamlined documentation processes and enhanced traceability.

Haas et al. (2021) focus on automating nursing management documentation processes using a Business Intelligence (BI) system to improve efficiency and compliance. However, this research aims to streamline documentation processes and improve traceability for repair items in a workshop setting. Both studies share a common goal of streamlining documentation processes and process optimization. However, the context and industry differ, with one focusing on healthcare and the other on automotive repair services. Gwozdz and Togno (1992) focus on streamlining patient care documentation in nursing, emphasizing the merging of traditional patient care plans with nursing care management Multidisciplinary Action Plan (MAP). While this research focuses on streamlining documentation in the repair process in the repair workshop, both share similarities in the need for efficient documentation systems to improve workflow. However, the context and specific processes differ, as this research involves repairing items in a workshop setting, unlike patient care documents in a healthcare environment.

3. Methodology

The study applied a qualitative approach since it provided a comprehensive understanding and improved the documentation and traceability of that selected company. According to the comparison of three methods of research by Christensen et al. (2014), as a research approach, a qualitative research approach is the most appropriate methodology for examining the streamlined and traceability of documentation. Qualitative research specializes in exploring complex events and experiences, which is well aligned to fully understand the current documentation system of that service provider. This applied research focuses on the issues related to documentation procedures inside that workshop or else focuses on solving real-world problems and creating tangible results that perfectly match that selected company. The research design encompassed a structured approach to gathering and analyzing data. Therefore, a descriptive research design is more suitable for the study as a descriptive design study is a type of non-experimental research (Siedlecki, 2020).

In the data collection of the study, both primary and secondary data collection methods were used to gain a comprehensive understanding of the current documentation and traceability practices of the workshop. As data collection methods, the study mainly conducted semi-structured interviews, discussions, and observations with workshop management, technicians, and other relevant stakeholders to gather their insights, experiences, and suggestions. Interview questions covered how documentation is currently handled including the

techniques and tools used, challenges they faced to Identify specific issues and inefficiencies in the current documentation process, and impact on operations to explore how documentation issues affect daily operations and employee performances. There were 10 interviews conducted with key stakeholders, including the technical manager, two workshop executives, the assistant manager of quality and safety, and two technicians. They included closed-ended and open-ended questions and structured and unstructured questions. These were aimed at getting rich information regarding the current repair procedures, experiences, and suggestions.

Further reviewed existing documentation practices and records, such as repair logs, repair in and out notes, beyond repair reports, maintenance schedules, and equipment manuals, to understand the current data capture methods and identify inconsistencies. The study employed qualitative data analysis methods such as interview analysis, documentation analysis, process mapping, value-added analysis, and fishbone diagrams to identify inefficiencies, bottlenecks, and areas for improvement in the documentation process. Ultimately, this methodology aimed to develop a solution that streamlines documentation procedures and enhances traceability.

Figure 1 shows the breakdown of the steps that were performed to achieve the three main objectives of the study. Structured and semi-structured interviews were conducted with workshop stakeholders, and existing documentation practices and operations were reviewed to get an overview of the current documentation process. Then, those data were analyzed to explore inefficiencies in the current process and the improvement required. After considering several feasible solutions, the most appropriate solution was proposed to streamline the documentation and traceability of the workshop.

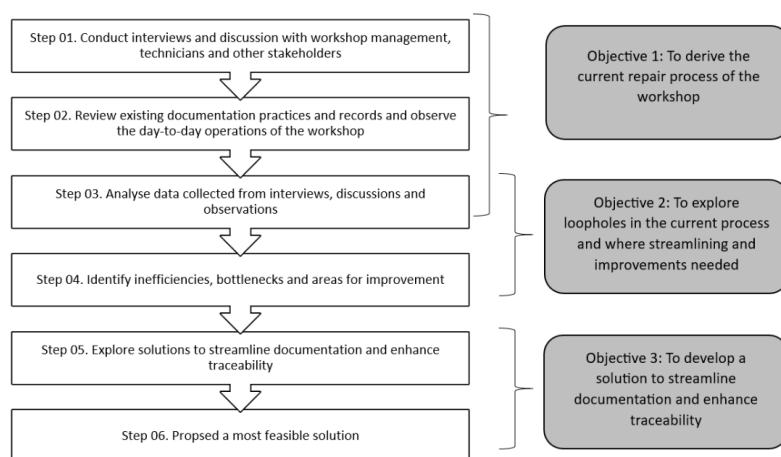


Figure 1: Methodological Approach: Research Process.

4. Results/Analysis and Discussion

4.1. Analysis and Findings

The analysis stage mainly considered the current operational procedure of that selected company, which consists of three main phases: receiving items for repair, repairing the damaged item, and handing over the repaired items to the store. Based on data collected from interviews and observations, current processes have been mapped using the Bizagi software for better understanding. The start point of the map is the arrival of an item, and the endpoint is handing over the item after the repair is done.

As the figure in the appendix, initially, when damaged items are received with a "Repair out note", it is documented by the workshop staff, and a technical evaluation is performed for any physical damage or fault by an executive and non-executive. During the repair phase, technicians document each step to ensure traceability. A "Beyond Repair Report" is generated to write off items that are beyond repair formally. Once repairs are completed, a "Repair in Note" is used to record the transfer of items back to the store officially. The beyond repair summary report is a collection of details of items written off during the month, ensuring accurate records are maintained and accessible to both workshop management and store personnel.

4.1.1. Key Problems and Inefficiencies

By analyzing the interview data, current procedures/practices, and documents, several important concerns were identified. Heavy reliance on manual documentation causes extensive delays and inefficiencies. The other problem was missing details in manual logbooks, and that oversight was noticed when the executive updated the Excel spreadsheet weekly. The inability to get documented information immediately was another problem that led technicians to spend additional time searching. Reluctance to engage in manual documentation causes inconsistency in record keeping. Therefore, overall challenges impact both operational efficiency and the assessment of employees.

4.1.2. Value-Added and Non-Value-Added Activity Analysis

After analyzing the process map, recognizing individual activities, and examining other related information, all activities were categorized into value-added (VA), non-value-added (NVA), and business-value-added (BVA) activities.

Table 1: Value-Added and Non-Value-Added Activity Analysis.

Activities	VA/BVA or NVA	The reason for the categorization
Receive for Repair		

Activities	VA/BVA or NVA	The reason for the categorization
Receive from store	BVA	This step is essential to initiate the repair process but does not directly add to the repair itself.
Record in relevant book	BVA	This activity ensures documentation and traceability, supporting the repair process indirectly.
Repair		
Technical evaluation	VA	Directly assesses the item to identify repair needs, transforming the product closer to completion.
Repair In-house		
Received additional parts required from Warehouse	VA & BVA	Necessary to obtain the required parts for repair, indirectly supporting the repair process.
Repair Outsource		
Send to the third party to repair	NVA	Represents a delay and adds waiting time without directly adding value.
Receive repaired parts	VA	Necessary to continue the repair process but does not add value directly.
Repaired Item Handover to the Store		
Check the quality	VA	Directly adds value by ensuring quality
Check whether the ability of re-repairment	NVA	Represents potential rework and does not add direct value.
Write off	NVA	Represents failure in the repair process and does not contribute to completion.
Live run	BVA	Ensure the item functions correctly, indirectly supporting the repair process.
Record repair details	BVA	Ensures documentation and future traceability, indirectly supporting the repair process.
Return to stores	BVA	Necessary for managing inventory and ensuring availability but does not add direct value.

Value-added analysis revealed that 35% of activities directly impacted the documentation process as value-added activities (VA). However,

only 18% were identified as non-value-added activities that should be eliminated or minimized from the existing process. The remaining 47% were business value-added activities that did not directly increase the documentation process but were essential for optimizing workflow. Those findings helped reduce resource wastage, streamline the documentation, and increase operational efficiency.

4.1.3. Root Cause Analysis

Root cause analysis was conducted to pinpoint the key issues that contribute to inefficiencies in documentation and the lack of traceability of the selected company (Ershadi et al., 2018). Those issues were categorized under man, method, machine, and materials. Therefore, that analysis helped identify issues such as inadequate training, inconsistent practices, and resistance to manual documentation as significant human factors (Man). Outdated documentation methods and a lack of digital tools (Method and Machine) further compound the problem. Additionally, incomplete records (Materials) hinder traceability. All the above issues affect daily operations and decision-making processes. The following figure shows the fishbone diagram of root cause analysis.

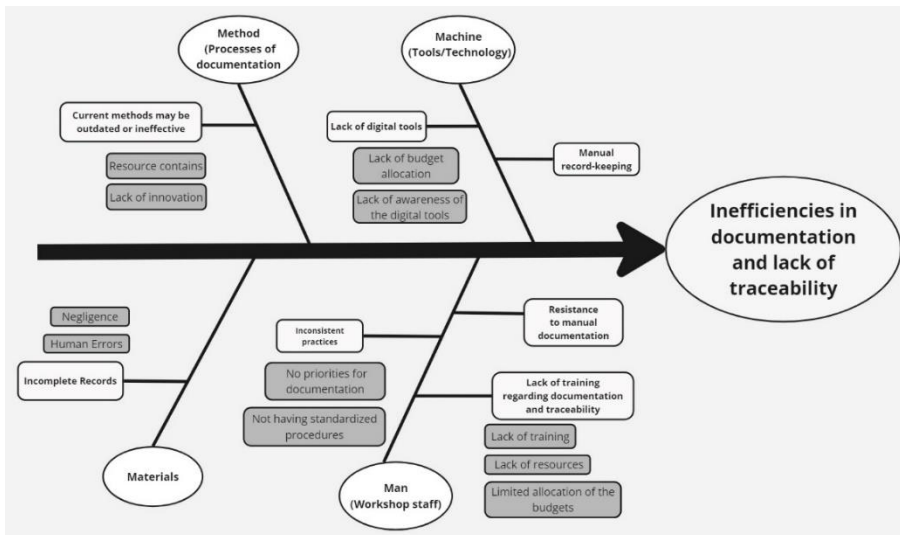


Figure 2: Fishbone Diagram.

This root cause analysis only focuses on four categories which are Man, Method, Machine, and Materials as these directly address the core issues related to documentation and traceability. The categories of Environment (Milieu) and Measurement were not included, as they were less relevant to the specific operational inefficiencies. Furthermore, this repair process is where the primary issues such as human factors, outdated processes, and inadequate digital tools, rather than precision

measurements or environmental controls. Therefore, the categories are limited to making the analysis more relevant and aligned with the unique challenges of the workshop.

4.2. Recommendation

Based on the analysis chapter, it is determined that the manual and unstructured nature of the existing documentation procedure is the main cause of these difficulties. For example, delays in data entry, misplacement of documents, and human errors, all of which bring down overall workflow efficiency. In this regard, a Document Management System integrated with QR scanners can reduce most of the inefficiencies mentioned above by automating data entry, improving the traceability of documents, and ensuring faster retrieval of information. After designing the Document Management System (DMS), in the initial stage, QR codes should be generated and attached to each item that comes into the workshop (Figure 3). That will ensure QR codes are generated and attached to inventory phase by phase. After that, a database should be created and updated with the QR codes generated. Each QR code must be linked to a database entry containing information about the item, including the item code, description, source, and any other relevant information. This database will be the digital repository for tracing an item within the repair process. QR code can be attached to an item by a sticker or a hanging tag with a QR code. In case an item cannot have or attach a QR sticker because of the size, shape, or other factors, an item code can be assigned to the whole batch of items, and the batch code can be entered into the system manually by a person and retrieve the information later (for items such as RPM sensor). The QR code should be scanned, or the item code should be entered manually at every stage of the process to collect data on the item in the system.



Figure 3: Steps from Designing the DMS to Updating the Database.

The following wireframe of the Document Management System provides a visual blueprint of the system's layout and functionality. Upon logging in, users navigate the home page with four main features. The first three features allow them to input information into the system, and the last portal, records, and reports, enables them to access past information.



Figure 4: Wireframe of Document Management System: Login Screen and Homepage.

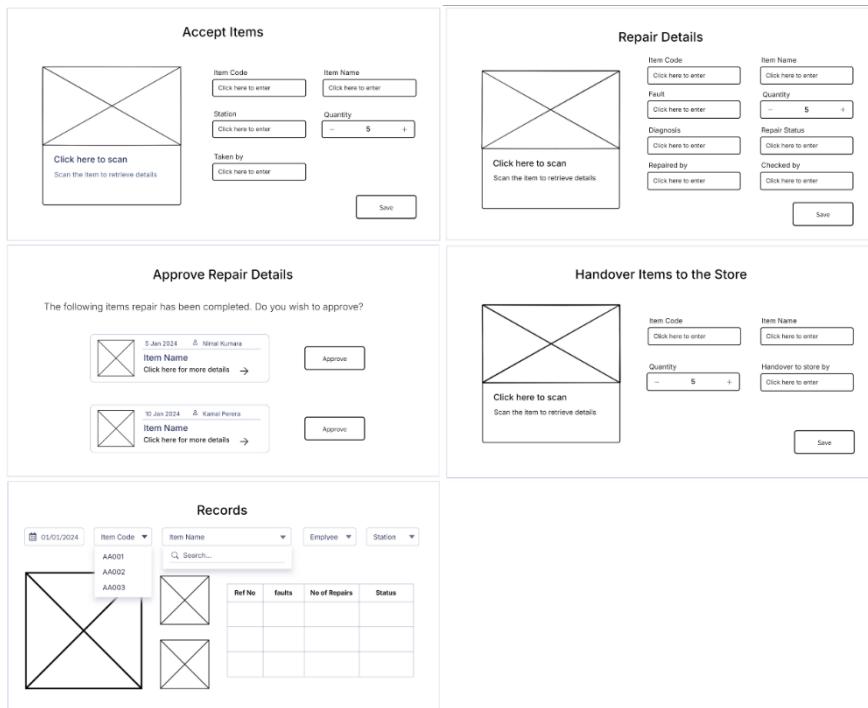


Figure 5: Wireframe of Document Management System: System Features.

4.2.1. Receiving Items for Repair

When receiving any item for repair, staff should update the system by scanning the QR code or entering the item code. With that, they can enter the relevant information into the system that workshop employees previously entered into repair in notes and logbooks. This work can be done through the system’s accepted item window, as shown in the wireframe in Figure 5. Information can be captured either using the scan option or entering manually. After scanning the item code or entering the QR code manually, some information will be filled in automatically and other information can be entered.

4.2.2. Repair

In the repair process, the system can be updated sequentially after every step of fault identification, actions taken, and the employee responsible for the case to ensure a full traceable record of the whole repair process. After that, a quality check ensures the item has met the needed standards. The system is updated to indicate that the item has passed the check and is marked as "Repaired." These tasks can be performed through the system's repair details feature, as in Figure 5.

4.2.3. Handover Repaired Items to the Store

At the last stage, the QR code is updated in the system with the repair-out details, ensuring that the handover is recorded, and the item is tracked back into inventory. Workshop employees can use the "system's handover items to the store" feature to enter those details, as in Figure 5.

5. Conclusion and Implications

The research work underlines integrating digital solutions to streamline the documentation and repair processes at the company's workshop. The main principles concern the accurate entry of data in real time and the centralization of documentation tasks to reduce errors and improve traceability. Introducing the computer-based Document Management System integrated with QR scanners, a solution that places the organization a step ahead in terms of operational efficiency by automating and simplifying traceability. The study conducted by Brusckhe and Wacker (2016) demonstrated that digitalizing the documentation process enhanced efficiency by streamlining tasks such as paperwork, printing, and filing, thereby saving time and effort. It provides the capability of valuable analytics and insights into document usage and informed decision-making. The accessibility of digital documents from anywhere with an internet connection facilitated improved collaboration and flexibility in work arrangements.

Though proposed solutions align with solving the identified problems, implementation has some potential challenges. For instance, initializing a system with a QR code scanning mechanism requires enormous investments in technology and staff training. Additionally, items that are difficult to tag or capture accurately with picture recognition systems may still pose traceability challenges, indicating that the system may need supplementary methods or hybrid approaches for full efficacy.

The study highlights the practical implications of digital transformation in documentation and repair processes, which can significantly enhance operational efficiency across industries. The findings suggest that the workshop could greatly benefit from adopting technology-driven solutions to streamline its operations. The significance of a Document Management system with QR scanners is not

only practical but scaled, offering a template for similar processes in other environments oriented towards repair or maintenance.

In conclusion, the implementation of a computer-based Document Management System integrated with QR scanners is recommended to address the inefficiencies identified in the current repair process. This would improve the accuracy of the records, enhance traceability, and streamline the workflow, hence higher operational efficiency and better resource management. Future recommendations include piloting tests to fine-tune the system before its full implementation, continuous staff training to adapt to the new system, and regular reviews to ensure that the system stays effective.

Acknowledgment

We would like to extend our heartfelt gratitude to all of the participants who kindly contributed their time and insights to make this research possible. Their significant contributions considerably improved the quality and depth of this study.

References

- Bruschke, J., & Wacker, M. (2016). Simplifying Documentation of Digital Reconstruction Processes. In S. Münster, M. Pfarr-Harfst, P. Kuroczyński, & M. Ioannides (Eds.), *3D Research Challenges in Cultural Heritage II* (pp. 256–271). Springer International Publishing.
https://doi.org/https://doi.org/10.1007/978-3-319-47647-6_12
- Chen, X., Zhang, H., Zhang, M., & Chen, J. (2017). Optimal decisions in a retailer Stackelberg supply chain. *International Journal of Production Economics*, 187, 260–270.
<https://doi.org/https://doi.org/10.1016/j.ijpe.2017.03.002>
- Christensen, L. B., Johnson, R. B., & Turner, L. A. (2013). *Research Methods, Design, and Analysis* (12th ed.). Pearson Education.
<https://books.google.lk/books?id=OaAsAAAAQBAJ>
- Dewi, R. S. (2019). Maturity Level Assessment for ERP Systems Investment Using Val IT Framework. *Procedia Computer Science*, 161, 250–257.
<https://doi.org/https://doi.org/10.1016/j.procs.2019.11.121>
- Ershadi, M., Aiassi, R., & Kazemi, S. (2018). Root cause analysis in quality problem-solving research information systems: A case study. *International Journal of Productivity and Quality Management*, 24, 284.
<https://doi.org/10.1504/IJPQM.2018.091797>
- Franceschi, D., Suarez, M. M., Ruiz, J. W., Seo, D., & Merchant, N. B. (2020). A Novel Interdisciplinary Iterative Approach for Optimizing the Electronic Health Record to Improve Perioperative Efficiency. *Annals of Surgery*, 272(4).
https://journals.lww.com/annalsofsurgery/fulltext/2020/10000/a_novel_interdisciplinary_iterative_approach_for.31.aspx
- Gorichanaz, T. (2019). A first-person theory of documentation. *Journal of Documentation*, 75(1), 190–212.
<https://doi.org/10.1108/JD-07-2018-0110>

- Guzman, M., & Verstappen, B. (2003). WHAT IS DOCUMENTATION (Vol. 2). HURIDOCS.
- Gwozdz, D. T., & Togno-Armanasco, V. Del. (1992). Streamlining Patient Care Documentation. *JONA: The Journal of Nursing Administration*, 22(5), 35-39.
https://journals.lww.com/jonajournal/fulltext/1992/05000/streamlining_patient_care_documentation.9.aspx
- Haas, O., Hutzler, M., Egginger, T. H., Maier, A., & Rothgang, E. (2021). Automating Time-Consuming and Error-Prone Manual Nursing Management Documentation Processes. *CIN: Computers, Informatics, Nursing*, 39(10), 584-591.
https://journals.lww.com/cinjournal/fulltext/2021/10000/automating_time_consuming_and_error_prone_manual.10.aspx
- Hark, B. S., Choi, J. H., & Leem, C. S. (2008). A Database Design of RFID Document Management System with e-Ink technology. 2008 Fourth International Conference on Networked Computing and Advanced Information Management, 1, 14-17. <https://doi.org/10.1109/NCM.2008.155>
- Ismael, A., & Okumus, I. (2017). Design and Implementation of an Electronic Document Management System. *Mehmet Akif Ersoy Üniversitesi Uygulamalı Bilimler Dergisi*, 1, 9-17.
<https://doi.org/10.31200/makuubd.321093>
- Siedlecki, S. L. (2020). Understanding Descriptive Research Designs and Methods. *Clinical Nurse Specialist*, 34(1), 8-12.
https://journals.lww.com/cns-journal/fulltext/2020/01000/understanding_descriptive_research_designs_and.4.aspx
- Ungan, M. (2006). Standardization through process documentation. *Business Process Management Journal*, 12, 135-148.
<https://doi.org/10.1108/14637150610657495>

Appendix

As-Is Repair Process of the Workshop

