

## **CHAPTER II Literature Review**

### **II.1 Construction Project Management**

In order to effectively manage construction projects and ensure their timely, cost-effective, and contract-compliant completion, it is essential to establish and implement an integrated procedure. This comprehensive approach encompasses various aspects of project management, including the enhancement of labor productivity, which is a crucial component in achieving successful outcomes. By focusing on optimizing labor productivity, construction projects can not only reduce costs but also increase overall production levels, leading to improved project efficiency and profitability (Almohsen 2013). Construction projects may vary in their development, planning, realization, and operation, there are underlying recurring procedures that serve as a cornerstone for risk identification. The implementation and realization phases hold particular importance in this regard, as they provide opportunities to identify project-specific risks and address recognized concerns. By focusing on these stages and applying effective risk management strategies, construction projects can be successfully completed within the set timelines, budget, and quality standards, ensuring their overall success (Schieg 2010).

### **II.2 Construction Logistics**

The logistics process, which is an integral component of the overall supply chain, encompasses a range of activities including the planning, coordination, and execution of the planned operations associated with material procurement. This process involves careful consideration of factors such as sourcing, transportation, and storage, with the ultimate goal of ensuring that high-quality items are obtained, effectively distributed, and properly stored in accordance with established best practices and industry standards. By effectively managing the logistics process, organizations are better able to streamline their supply chain operations, enhance efficiency and productivity, and ultimately, drive greater profitability and long-term success (Olayeni 2017). A corporation has its own internal logistics system in the

form of supply chains since it is a part of a bigger supply chain of suppliers and customers. Within a corporation, there are many different domains of operation that use logistical procedures (purchase, production, sale etc.). A corporation can create logistics departments to manage all the flows by isolating and combining the logistic duties carried out by each organisational unit (Sobotka 2005). Within the context of the construction industry, logistics represents a critical management function that encompasses a diverse range of activities aimed at acquiring, moving, managing, storing, and effectively utilizing goods on the construction site. These logistics-related tasks are essential to ensuring that all necessary materials and equipment are available and ready to use when needed, and that they are properly stored, transported, and managed throughout the entire construction process. By effectively managing construction logistics, project managers are able to enhance productivity and efficiency, reduce waste and downtime, and ultimately, ensure that projects are completed on time, within budget, and to the highest possible standards of quality and safety (Olayeni 2017). The construction sector will benefit from the development of a logistics management system using current technology. For instance, contractors will be better prepared for receiving deliveries if they are aware of the precise time of arrival and the status of shipments. This will shorten the time required for preparation and speed up the delivery of products on site (Almohsen 2013).

### **II.3 ISO 9001:2015**

ISO 9001:2015 is a quality management standard that was released in September 2015 by the International Organization for Standardization (ISO). This standard is applicable to organizations of all sizes and types, and it provides a framework to establish, implement, and maintain a quality management system that meets the requirements of customers and other stakeholders.

The primary goal of ISO 9001:2015 is to ensure that an organization's products and services consistently meet customer expectations and comply with applicable regulations and standards. To achieve this, organizations must document and define their processes and procedures for achieving quality objectives. They must also

monitor and measure their performance regularly to identify opportunities for improvement.

ISO 9001:2015 is based on a set of quality management principles that emphasize customer focus, leadership, engagement of people, process approach, improvement, evidence-based decision making, and relationship management. These principles are recognized and used by organizations worldwide to demonstrate their commitment to quality and to improve their overall performance.

The standard emphasizes the importance of adopting a process approach for the establishment, implementation, and enhancement of a quality management system to ensure customer satisfaction. The process approach involves managing and improving quality management practices to meet customer expectations, resulting in higher levels of satisfaction.

By adopting ISO 9001:2015, organizations can improve their quality management practices and enhance customer satisfaction, ultimately leading to improved overall performance. This standard is widely recognized and used by organizations worldwide as a way to demonstrate their commitment to quality and to meet the needs of their customers and other stakeholders (ISO 9001 5th Edition 2015).

### **II.3.1 ISO 9001:2015 Clause**

The successful management of construction projects relies on adherence to specific standards and regulations, with the ISO 90001 Clause serving as a pivotal aspect, and these are the following clause:

#### **1. Clause 1: Scope**

Clause 1 of ISO 9001:2015 sets the scope of the standard, defining the boundaries and applicability of the quality management system (QMS). It outlines the general requirements for organizations seeking to establish, implement, and maintain a QMS that aims to enhance customer satisfaction and meet applicable statutory and regulatory requirements. This clause emphasizes the importance of determining the scope of the QMS, including the processes, products, and services that will be covered. It highlights the need for organizations to consider the external and internal

factors, as well as the requirements of relevant interested parties, when defining the scope of their QMS.

By incorporating Clause 1 into their QMS, organizations can clearly establish the extent and boundaries of their quality management efforts. It helps organizations to focus their resources and efforts on specific processes, products, and services, ensuring that the QMS is effectively tailored to their unique business context and customer requirements.

## **2. Clause 2: Normative References**

Clause 2 of ISO 9001:2015 addresses the normative references that are essential for understanding and implementing the requirements of the standard. It specifies the external documents and standards that organizations should consider when establishing and maintaining their quality management system (QMS).

By incorporating Clause 2 into their QMS, organizations can ensure that their quality management practices are aligned with recognized industry standards and regulations. It enables organizations to access valuable guidance and requirements from external sources, enhancing the effectiveness and credibility of their QMS implementation.

## **3. Clause 3: Terms and Definitions**

Clause 3 of ISO 9001:2015 provides a list of terms and definitions that are used throughout the standard. It aims to ensure a common understanding and interpretation of key concepts and terminology used in the quality management system (QMS) context.

By incorporating Clause 3 into their QMS documentation, organizations can promote clear communication, reduce ambiguity, and align the understanding of terms and concepts across different processes and functions. This facilitates the implementation and maintenance of the QMS and ensures that everyone involved has a common understanding of the terminology used in quality management discussions and documentation.

#### 4. Clause 4: Context of the Organization

Clause 4 of ISO 9001:2015 emphasizes the importance of understanding the context in which the organization operates. It focuses on analyzing and considering the internal and external factors that can impact the organization and its quality management system (QMS).

- Sub-clause 4.1: Understanding the Organization and Its Context - This sub-clause requires organizations to identify and understand the internal and external factors that can affect the QMS and its ability to achieve desired outcomes. It emphasizes the need for considering the organization's purpose, culture, values, and stakeholders when establishing and implementing the QMS.
- Sub-clause 4.2: Understanding the Needs and Expectations of Interested Parties - This sub-clause emphasizes the importance of identifying and understanding the needs and expectations of interested parties, such as customers, employees, suppliers, regulators, and other relevant stakeholders. It highlights the need for considering these requirements when determining the scope and objectives of the QMS.
- Sub-clause 4.3: Determining the Scope of the Quality Management System - This sub-clause focuses on defining the boundaries and extent of the QMS within the organization. It requires organizations to determine the processes, products, and services that are included in the QMS and establish clear criteria for its scope.
- Sub-clause 4.4: Quality Management System and Its Processes - This sub-clause highlights the need for establishing, implementing, and maintaining a robust QMS that includes the necessary processes, resources, and controls. It emphasizes the importance of ensuring that the QMS is aligned with the organization's objectives and can consistently deliver products and services that meet customer requirements.

By incorporating Clause 4 into their QMS, organizations can gain a better understanding of their internal and external context, stakeholders' needs, and establish a well-defined scope for their QMS. This enables organizations to tailor

their quality management efforts and processes to address specific risks, opportunities, and customer expectations effectively.

## 5. Clause 5: Leadership

Clause 5 of ISO 9001:2015 emphasizes the critical role of leadership in establishing and sustaining a robust quality management system (QMS). It focuses on the active involvement and commitment of top management in promoting a quality-oriented culture within the organization.

- Sub-clause 5.1: Leadership and Commitment - This sub-clause highlights the importance of top management's active leadership and commitment to the development, implementation, and improvement of the QMS. It emphasizes the need for establishing a quality policy, ensuring customer focus, and providing resources necessary for the QMS to be effective.
- Sub-clause 5.2: Quality Policy - This sub-clause emphasizes the requirement for top management to establish a quality policy that aligns with the organization's objectives and customer requirements. The policy should provide a framework for setting quality objectives and ensuring the QMS's integrity and continual improvement.
- Sub-clause 5.3: Organizational Roles, Responsibilities, and Authorities - This sub-clause focuses on defining and communicating organizational roles, responsibilities, and authorities for implementing the QMS effectively. It emphasizes the need for ensuring that personnel are aware of their roles and responsibilities and have the necessary authority to carry out their assigned tasks.

By incorporating Clause 5 into their QMS, organizations can establish a strong foundation for quality management. Effective leadership provides the direction, commitment, and resources needed to drive the organization towards achieving quality objectives, meeting customer expectations, and continuously improving the QMS.

## 6. Clause 6: Planning

Clause 6 of ISO 9001:2015 focuses on the planning aspects of the quality management system (QMS). It emphasizes the need for organizations to adopt a proactive approach to identify and address risks and opportunities, establish quality objectives, and develop plans to achieve them.

- Sub-clause 6.1: Actions to Address Risks and Opportunities - This sub-clause requires organizations to identify and assess potential risks and opportunities that could affect the QMS and its ability to deliver desired outcomes. It emphasizes the importance of taking appropriate actions to mitigate risks, exploit opportunities, and enhance overall performance.
- Sub-clause 6.2: Quality Objectives and Planning to Achieve Them - This sub-clause highlights the significance of establishing measurable quality objectives that align with the organization's strategic goals. It emphasizes the need for developing plans and implementing activities to achieve these objectives effectively. The sub-clause also stresses the importance of ensuring that the objectives are communicated, understood, and supported throughout the organization.

By incorporating Clause 6 into their QMS, organizations can adopt a systematic and proactive approach to identify and manage risks, seize opportunities, set measurable quality objectives, and develop plans to achieve them. This enables organizations to enhance their ability to consistently meet customer requirements, improve performance, and drive continual improvement.

## 7. Clause 7: Support

Clause 7 of ISO 9001:2015 emphasizes the importance of providing adequate support for the implementation and maintenance of the quality management system (QMS). This clause covers various support functions that are necessary for the effective operation of the organization. It includes sub-clauses such as resources, competence, awareness, communication, and documented information.

- Sub-clause 7.1: Resources - This sub-clause addresses the need for identifying and providing the necessary resources, including infrastructure,

personnel, and work environment, to support the QMS and achieve quality objectives.

- Sub-clause 7.2: Competence - This sub-clause focuses on ensuring that personnel performing work affecting product or service quality have the necessary competence through appropriate training, education, skills, and experience.
- Sub-clause 7.3: Awareness - This sub-clause emphasizes the importance of raising awareness within the organization about the relevance and importance of quality management, quality objectives, and individual contribution to achieving them.
- Sub-clause 7.4: Communication - This sub-clause highlights the need for effective internal and external communication to ensure the QMS functions smoothly, including communication of quality objectives, customer requirements, and information related to the QMS.
- Sub-clause 7.5: Documented Information - This sub-clause addresses the requirements for creating, controlling, and maintaining documented information necessary for the effective operation of the QMS, such as policies, procedures, work instructions, and records.

Clause 7 emphasizes the significance of providing the necessary resources, competence, awareness, effective communication, and appropriate documentation to support the QMS and facilitate the achievement of quality objectives. By ensuring adequate support, organizations can enhance their ability to consistently deliver products and services that meet customer requirements and comply with applicable standards and regulations.

## **8. Clause 8: Operation**

Clause 8 of ISO 9001:2015 focuses on the operational activities involved in the quality management system (QMS). It encompasses the planning, control, and execution of processes to deliver products and services that meet customer requirements and enhance customer satisfaction.

- Sub-clause 8.1: Operational Planning and Control - This sub-clause emphasizes the need for organizations to plan and control their operational



processes to ensure they are carried out effectively and consistently. It requires organizations to determine process requirements, establish criteria for operation and control, and implement measures to monitor and control the process outcomes.

- Sub-clause 8.2: Requirements for Products and Services - This sub-clause highlights the importance of determining and understanding customer requirements and ensuring that products and services meet those requirements. It emphasizes the need for organizations to establish processes for the review, verification, and validation of requirements to ensure customer satisfaction.
- Sub-clause 8.2.1: Customer Communication - This sub-clause focuses on the communication process with customers to understand their needs, expectations, and any changes in requirements. It emphasizes the importance of effective communication to ensure clarity, mutual understanding, and the ability to meet customer expectations.
- Sub-clause 8.2.2: Determining the Requirements for Products and Services - This sub-clause outlines the process of determining the specific requirements for products and services. It highlights the need for organizations to consider customer requirements, legal and regulatory requirements, and any additional requirements identified by the organization.
- Sub-clause 8.2.3: Review of the Requirements for Products and Services - This sub-clause emphasizes the importance of reviewing customer requirements before accepting orders or contracts. It requires organizations to ensure their ability to meet the requirements and identify any potential issues or conflicts.
- Sub-clause 8.3: Design and Development of Products and Services - This sub-clause addresses the design and development processes for products and services. It requires organizations to establish and control these processes to ensure that the resulting products and services meet customer requirements.
- Sub-clause 8.4: Control of Externally Provided Processes, Products, and Services - This sub-clause focuses on the control of processes, products, and

services provided by external parties. It emphasizes the need for organizations to evaluate and select external providers, establish controls, and monitor their performance to ensure compliance with customer requirements.

- Sub-clause 8.5: Production and Service Provision - This sub-clause outlines the requirements for the production and service provision processes. It emphasizes the need for organizations to plan and carry out these processes under controlled conditions, monitor and control production/service activities, and implement measures to prevent nonconformities.
- Sub-clause 8.5.1: Control of Production and Service Provision - This sub-clause highlights the need for organizations to control the production and service provision processes, including equipment, personnel, and environmental conditions, to ensure the conformity of products and services.

By implementing Clause 8 and its sub-clauses, organizations can effectively plan, control, and execute their operational processes to deliver products and services that meet customer requirements. This ensures consistent quality, enhances customer satisfaction, and supports the achievement of organizational goals.

## **9. Clause 9: Performance Evaluation**

Clause 9 of ISO 9001:2015 focuses on the evaluation of the performance and effectiveness of the quality management system (QMS). It emphasizes the importance of monitoring, measuring, analyzing, and evaluating relevant data and information to assess the performance and conformity of the QMS, as well as to drive continual improvement.

- Sub-clause 9.1: Monitoring, Measurement, Analysis, and Evaluation - This sub-clause emphasizes the need for organizations to establish and implement processes for monitoring, measuring, analyzing, and evaluating the QMS. It highlights the importance of using reliable data and information to determine the effectiveness, performance, and conformity of the QMS and its processes.

- Sub-clause 9.2: Internal Audit - This sub-clause focuses on the internal audit process, which is a systematic and independent examination of the QMS to determine its conformity and effectiveness. It highlights the need for organizations to plan, conduct, and report on internal audits to ensure compliance with requirements and identify areas for improvement.
- Sub-clause 9.3: Management Review - This sub-clause emphasizes the importance of top management conducting periodic reviews of the QMS to evaluate its continuing suitability, adequacy, and effectiveness. It requires management to assess the QMS's performance, review its objectives, and make necessary adjustments to ensure its continued relevance and alignment with organizational goals.
- Sub-clause 9.3.1: General - This sub-clause outlines the general requirements for management review, including the frequency of reviews, the involvement of relevant stakeholders, and the documentation of review outcomes.
- Sub-clause 9.3.2: Management Review Inputs - This sub-clause identifies the inputs that should be considered during management reviews, such as audit results, customer feedback, process performance, and the status of preventive and corrective actions.
- Sub-clause 9.3.3: Management Review Outputs - This sub-clause outlines the expected outputs of management reviews, including decisions and actions related to improving the QMS, addressing risks and opportunities, and allocating resources.

By implementing Clause 9 and its sub-clauses, organizations can systematically evaluate the performance of their QMS, identify areas for improvement, and make informed decisions to drive continual improvement. This ensures the QMS's effectiveness, enhances customer satisfaction, and facilitates the achievement of organizational objectives.

## **10. Clause 10: Improvement**

Clause 10 of ISO 9001:2015 focuses on the continual improvement of the quality management system (QMS) and organizational processes. It comprises the following sub-clauses:

- **Sub-clause 10.1: General** - This sub-clause emphasizes the need for organizations to continually improve the effectiveness of their QMS and its processes. It highlights the importance of establishing a culture of continual improvement as a fundamental aspect of the organization's quality management approach.
- **Sub-clause 10.2: Nonconformity and Corrective Action** - This sub-clause requires organizations to identify and address nonconformities in their products, services, or processes. It emphasizes the need for taking appropriate corrective actions to eliminate the causes of nonconformities and prevent their recurrence.
- **Sub-clause 10.3: Continual Improvement** - This sub-clause highlights the significance of seeking opportunities for continual improvement in all aspects of the QMS. It encourages organizations to engage in proactive measures to enhance their performance, efficiency, and customer satisfaction.
- **Sub-clause 10.3.1: Continual Improvement and the PDCA Cycle** - This sub-clause promotes the Plan-Do-Check-Act (PDCA) cycle as a framework for driving continual improvement. It emphasizes the need for organizations to plan their improvement activities, implement them, monitor and measure their effectiveness, and make necessary adjustments to achieve desired outcomes.
- **Sub-clause 10.3.2: Continual Improvement and Corrective Action** - This sub-clause highlights the interconnectedness between continual improvement and corrective action. It emphasizes that corrective actions can serve as opportunities for improvement and should be implemented in a systematic manner.

By implementing Clause 10 and its sub-clauses, organizations can foster a culture of continual improvement, ensuring that nonconformities are addressed, corrective

actions are taken, and opportunities for improvement are pursued. This approach enables organizations to enhance their QMS, increase efficiency, meet customer expectations, and continually improve their overall performance.



Table II.1 Table of Literature Review

| No | Title   | Author and Year of Publication                                 | Objective  | Method   | Findings   | Connection  |
|----|---|--|--|--|--|---|
| 1  | An Empirical Study of Applying ISO 9001 Elements in Large Size Indonesian Contractors | Trigunarsyah, Bambang, Coffey, Vaughan, & Willar, Debby (2011) | The objective of this paper is to describe the effectiveness of the implementation of ISO 9001 Quality Management System in large size Indonesian contractors. The paper aims to present the findings of an empirical study of applying ISO 9001 elements. | The methodology used in this paper is the survey method using a questionnaire. | The paper presents the findings of an empirical study of applying ISO 9001 elements in large size Indonesian contractors. The study found that the implementation of ISO 9001 elements has a positive impact on the performance of large size Indonesian contractors. The study found that the implementation of ISO 9001 elements has a significant impact on the quality of construction products and the satisfaction levels of project owners. | Implementing ISO 9001 for construction logistics can improve Indonesian construction companies' quality management practices. Standard procedures and statistical tools can help meet ISO 9001 standards, particularly in logistics. Ongoing evaluations should include an assessment of logistics practices. |

| No | Title   | Author and Year of Publication                     | Objective   | Method   | Findings   | Connection  |
|----|---|--|---|--|--|---|
| 2  | ISO 9001 Standard and Organization's Performance: A Literature Review | Behnam Neyestani & Joseph Berlin P. Juanzon (2017) | Identifying the effectiveness of ISO 9001 on organization performance | The study conducts a systematic review of empirical studies that examine the relationship between ISO 9001 and various performance measures. | While ISO 9001 improves internal processes, its impact on innovation, learning, customer results, and financial performance is uncertain. Previous research highlights 13 benefits, including improved quality, customer satisfaction, and relationships with suppliers and authorities. | Implementing ISO 9001 for construction logistics can improve an organization's performance by enhancing the quality of products/services, increasing efficiency, and better managing risks. The standard helps ensure that logistics processes are consistently implemented, documented, and continuously improved. |

| No | Title   | Author and Year of Publication                                    | Objective   | Method   | Findings  | Connection  |
|----|---|---|---|--|---|---|
| 3  | Effects of ISO 9001 Standard on Critical Factors of Project Management in Construction Industry   | Behnam Neyestani, & Joseph Berlin P. Juanzon (2017)               | To evaluate the impact of ISO 9001 standard on critical elements of construction projects | This research use quantitative methods, followed by a simple random sampling technique to distribute the questionnaire to the respondents and the data from the questionnaire was analyzed using SPSS (Statistical Package for Social Science) | According to the study's findings, adopting the ISO 9001 standard will help construction initiatives perform better in terms of quality.                  | The implementation of ISO 9001 can help construction initiatives perform better in terms of quality by establishing a structured approach to quality management and demonstrating a commitment to quality and continuous improvement. |
| 4  | Design Of Risk Management system on Material Handling Services to Fulfill ISO 9001:2015 Requirements Clause 6.1 Based on ISO 31000:2018 | Hasya Qinthara Putri, Wiyono Sutarib ,Sheila Amalia Salmac (2021) | Minimizing the risk of a logistic company by implementing ISO 9001:2015 clause 6.1        | The method used for this research involves a comparison of the actual conditions of the company with the requirements of ISO 9001:2015 clause 6.1.   | The outcome of the suggested risk management system design is a risk management system SOP that can help businesses implement risk management procedures. | The need for risk management and process improvement to meet ISO standards.   |



| No | Title  | Author and Year of Publication | Objective   | Method   | Findings   | Connection  |
|----|--|--------------------------------|---|--|--|---|
| 5  | The Impact of Quality Management System on improving Logistic Customer Service in Distribution Service | Dominik Zimon (2017)           | Determine to what extent the implementation of the requirements of standardized quality management system supports the logistics customer service in the process of distribution. | Questionnaire, which consisted of 8 questions, both open and closed                            | The implementation of the requirements of the ISO 9001 standard has a significant positive influence on the improvement of logistic customer service. This was confirmed by 76% of the respondents who were medium-sized enterprises | The overall improvement of implementing ISO 9001 for logistics  |
| 6  | The impact of ISO 9001 effectiveness on the performance of service companies                           | Evangelos L. Psomas (2012)     | confirm the three ISO 9001 objectives identified in the literature that define ISO 9001 effectiveness.  | An empirical study was carried out using a sample of 100 ISO 9001 certified service companies. | ISO 9001 effectiveness, evaluated by the degree of achievement of the standard's objectives, has a significant impact on the performance of service companies.   | Explores the effectiveness of ISO 9001 implementation in construction logistics and its contribution to the performance of service companies. |

| No | Title   | Author and Year of Publication   | Objective   | Method   | Findings   | Connection   |
|----|---|--|---|--|--|--|
| 7  | Examining the implementation of ISO 9001 in Indonesian construction companies | Debby Willar, Vaughan Coffey, and Bambang Trigunarsyah (2015)  | The paper aims to analyze the implementation of quality management systems (QMSs) in Indonesian construction companies.             | A quantitative research approach was employed to collect the relevant information associated with the QMSs practices | The study emphasizes the need for a more critical application of ISO 9001 principles and elements to achieve full implementation and enhance the effectiveness of the current Quality Management System (QMS) among contractors. | The study emphasizes the need for a more critical application of ISO 9001 principles and elements to achieve full implementation and enhance the effectiveness of the current Quality Management System (QMS) among contractors.   |
| 8  | The effects of implementing ISO 9001 in the Spanish construction industry     | Camilo Prado-Roman, Carlos Del Castillo-Peces, Carmelo Mercado-Idoeta & Julian Del Castillo-Peces (2018) | The paper aims to analyze the positive effects of implementing the ISO 9001 quality assurance standards in civil engineering firms. | The paper used a questionnaire as the primary data collection instrument to obtain the necessary data                | The paper finds that implementing the ISO 9001 standard has positive effects on construction industry, with internal improvements in organizational processes and external benefits  | The study highlights internal process improvements, increased market competitiveness, and minimal impact of organization size. These findings support the importance of implementing ISO 9001 in construction logistics practices. |

| No | Title   | Author and Year of Publication | Objective   | Method   | Findings   | Connection  |
|----|---|--------------------------------|---|--|--|---|
| 9  | Effectiveness of Quality Management System (QMS) on Construction Projects | Behnam Neyestani (2016)        | The objective of the paper is to evaluate the impact of Quality Management System (QMS) implementation on the main factors of construction projects, The study aims to understand the characteristics of vital factors of construction projects, identify the effects of QMS on construction projects | Descriptive methods to evaluate the effectiveness of QMS implementation on construction projects. Such as, In-depth literature review from different books, journals, and websites and Designing a questionnaire based on previous studies and literature review to collect data from construction projects. | The implementation of Quality Management System (QMS) can have a significant impact on customer satisfaction, cost, and time of construction projects. | By adopting ISO 9001, which is a well-established QMS, construction logistics processes can be effectively managed to enhance customer satisfaction, optimize costs, and improve project timelines. |

| No | Title  | Author and Year of Publication  | Objective   | Method  | Findings  | Connection   |
|----|--|---|---|---|---|--|
| 10 | A Review and Classification Framework of Traceability Approaches for Identifying Product Supply Chain Counterfeiting | Sotiris P. Gayialis, Evripidis P. Kechagias, Georgios A. Papadopoulos, Dimitrios Masouras | To present a structured literature review on traceability approaches for combatting the product supply chain counterfeiting phenomenon that led to forming a structured classification framework. | Literature review, they used the Elsevier Scopus database, which hosts more than 23,000 scientific titles and 5000 publishers, to extract academic articles and research. | The results of the paper show that traditional traceability methods are not effective in combating product supply chain counterfeiting, as they can be easily falsified using today's technological advancements. | Traditional traceability methods are ineffective against product supply chain counterfeiting due to advancements in technology. This aligns with the implementation of ISO 9001 for construction logistics, which explores how ISO 9001 can address these limitations and enhance traceability practices in the construction industry. |

The research article, "An Empirical Study of Applying ISO 9001 Elements in Large Size Indonesia Contractors" (From table II.1 number 1) has been chosen as a relevant source for the interview questions in this thesis due to its direct connection to the current study. The article examines the twenty Quality Management System (QMS) 9001 elements and their practical implementation in large size contractors . By incorporating these elements into the interview questions, the aim is to gather valuable insights from professionals and practitioners within the construction industry. The article's empirical methodology and focused investigation make it a suitable resource to inform this thesis and contribute to a deeper understanding of the effective integration of ISO 9001 elements in the Indonesian construction sector.

### **II.3.2 Variables of ISO 9001 QMS Implementation**

To implement ISO 9001 in construction projects, one needs to understand the standard, set quality objectives, establish a QMS, implement document control, train personnel, manage suppliers, mitigate risks, monitor performance, address non-conformities, conduct audits, review progress, and prioritize continual improvement. In this process, a comprehensive understanding of the standard is crucial. Quality objectives should be set to guide the project effectively. A QMS needs to be established to ensure compliance with ISO 9001 requirements. Document control must be implemented to manage and maintain essential project documentation. Personnel should undergo training to acquire the necessary knowledge and skills.

In addition to the essential steps mentioned earlier, it is crucial to consider specific variables that significantly contribute to the successful implementation of ISO 9001 standards in the construction industry. These variables have been identified in the research article "An Empirical Study of Applying ISO 9001 Elements in Large Size Indonesia Contractors" by Trigunaryah et al. (2011). They shed light on the crucial factors that enhance the effectiveness of ISO standards in improving construction project outcomes. These variables cover a wide range of aspects, including quality

management practices, process documentation, employee training, and customer satisfaction. Through the analysis of these variables, we can gain valuable insights into the multifaceted nature of ISO implementation in construction projects. Such analysis enables us to develop a deeper understanding of how ISO standards positively impact construction project outcomes and drive continual improvement.

Table II.2 Variables for QMS implementation ISO 9001 by (Trigunarsyah et al 2011)

| No | Area  | Relevant ISO 9001:2015 Clause |
|----|---|-------------------------------|
| 1  | Control of a Nonconforming Product                      | 8.3 & 8.7                     |
| 2  | Process Control   | 7.5 & 8.1                     |
| 3  | Contract Review   | 8.2.3                         |
| 4  | Control of Quality Records                              | 7.5                           |
| 5  | Control of Inspection Measuring and Test Equipment      | 7.1.5                         |
| 6  | Inspection and Testing                                  | 8.2.4, 8.4 & 8.5.3            |
| 7  | Corrective and Preventive Action                        | 10.2 & 10.3                   |
| 8  | Internal Quality Audits                                 | 9.2                           |
| 9  | Inspection and Test Status                              | 8.4 & 8.5.1                   |
| 10 | Handling, Storage, Packaging, Preservation and Delivery | 8.5                           |
| 11 | Purchasing  | 8.4                           |
| 12 | Design Control  | 8.3, 8.3.2 & 8.3.3            |
| 13 | Document and Data Control                               | 7.5                           |
| 14 | Product Identification and Traceability                 | 8.5.1 & 8.5.2                 |
| 15 | Servicing   | 8.2.4 & 8.2.3                 |
| 16 | Quality System  | 4.2.2, 4.2.3 & 4.3            |
| 17 | Training  | 7.2                           |
| 18 | Management Responsibility                               | 5.2 & 9.3                     |
| 19 | Control of Customer Supplied Products                   | 8.5.3                         |
| 20 | Statistical Techniques                                  | 9.1.3, 10.2 & 10.3            |

Based on the table II.2, the following are the meanings of each variable along with the related ISO clauses:

1. The Control of Nonconforming Products in ISO 9001 aligns with the process of rejecting and separating materials or products that do not meet specified requirements. Authorized individuals are solely responsible for deciding whether rejected materials should be used as is, reworked, or returned to the supplier. ISO 9001 sets criteria for quality management, providing guidelines for organizations to consistently meet customer

requirements and enhance satisfaction. Relevant clauses include 8.3 on Control of Nonconforming Products, specifying identification, documentation, evaluation, and segregation of nonconforming items, and 8.7 on Control of Outsourced Processes, Products, and Services, emphasizing the organization's responsibility for ensuring conformity of outsourced materials.

2. Work instructions, quality plans, and workmanship standards are vital in ensuring accurate task execution. Work instructions provide step-by-step guidance, ensuring consistency and minimizing errors. Quality plans establish quality objectives and inspections, while workmanship standards define acceptable quality levels. These align with ISO 9001's Control of Production and Service Provision (Clause 7.5) and Operational Planning and Control (Clause 8.1), enhancing consistency, accuracy, and adherence to quality standards.
3. Thorough contract reviews align terms with customer needs and expectations, ensuring fulfilment of contractual requirements. ISO 9001's Clause 8.2.3 emphasizes the review of customer requirements to assess organizational capability. By adhering to this clause, organizations can verify accurate capturing of customer needs, align processes, and deliver satisfactory products/services. Contracts are vital for reflecting customer expectations and guiding high-quality outcomes.
4. Quality records provide an audit trail for auditors, ensuring transparency and accountability. ISO 9001's Clause 7.5 emphasizes the need for organizations to control and maintain records to demonstrate conformity to requirements. By adhering to this clause, organizations establish an effective audit trail for both internal and external audits

5. Regular calibration and record keeping are crucial for accurate measurements in quality control. ISO 9001's Clause 7.1.5 on Control of Monitoring and Measuring Equipment emphasizes the need to determine, calibrate, and maintain equipment. It requires procedures for calibration and maintenance, along with record keeping to demonstrate conformity. Adhering to this clause ensures reliable measurements and compliance with quality standards.
6. Inspection and testing are vital for quality compliance throughout a product or service's lifecycle, ensuring adherence to specified requirements. ISO 9001's Clauses 8.2.4, 8.4, and 8.5.3 are relevant in this context. Clause 8.2.4 emphasizes monitoring, including inspection and testing, to verify conformity. Clause 8.4 focuses on controlling externally provided processes, products, or services, necessitating inspection and testing. Clause 8.5.3 highlights identification and traceability, including the retention of inspection and test records. Compliance with these clauses enables effective processes, record-keeping, and supports overall quality management.
7. The corrective action system is crucial in quality management, addressing identified concerns by identifying root causes and implementing corrective and preventive actions. It investigates issues, determines underlying causes, and develops effective solutions. ISO 9001's Clauses 10.2 and 10.3 are relevant: 10.2 emphasizes establishing a process for corrective actions and investigating nonconformities, while 10.3 highlights continual improvement. Adhering to these clauses enables systematic problem-solving, improved quality, and a culture of ongoing enhancement.
8. Trained teams conduct internal quality audits to verify compliance with ISO 9001 requirements. These audits assess the effectiveness of the company's Quality System, identify nonconformities, and find areas for improvement. ISO 9001's Clause 9.2 on Internal Audit is relevant, outlining the need for



organizations to establish an audit program, maintain independence, and communicate results. Adhering to this clause ensures ongoing evaluation and improvement of the Quality System.

9. The statement emphasizes the importance of using inspected materials and identifying inspected products in the production or service delivery process. Inspection verifies conformity and helps prevent nonconforming items from entering further processes. ISO 9001's Clause 8.4 on Control of Externally Provided Processes, Products, and Services emphasizes the need to ensure that externally provided products and services meet requirements, which includes inspection. Clause 8.5.1 on Control of Production and Service Provision requires organizations to establish criteria for production and service delivery, including inspection. Additionally, Clause 8.6 on Release of Products and Services addresses the control of inspection and test status. Adhering to these clauses enables organizations to establish procedures that ensure the use of inspected materials and the proper identification of inspected products, contributing to quality control and conformity.
10. Procedures are crucial for protecting products during construction and delivery. They outline guidelines for handling, storage, packaging, preservation, and delivery to ensure product integrity. ISO 9001's Clause 8.5 on Control of Production and Service Provision is relevant, requiring procedures to prevent damage, deterioration, or loss. Adhering to this clause enables organizations to safeguard products and maintain conformity throughout their lifecycle.
11. Clear purchasing procedures and a formal compliance system are essential for effective supplier management. ISO 9001's Clause 8.4 on Control of Externally Provided Processes, Products, and Services is relevant, ensuring

criteria for supplier selection and conformity. Adhering to this clause enables robust procedures and improves overall quality.

12. Carefully documenting design changes ensures coordination and approval internally and by clients, maintaining control and facilitating proper review and authorization. ISO 9001's Clause 8.3 on Design and Development, specifically Clauses 8.3.2 and 8.3.3, is relevant to this practice. Clause 8.3.2 emphasizes the need to ensure design changes are reviewed, verified, and validated before implementation. Clause 8.3.3 requires organizations to retain documented information on design changes. Adhering to these clauses enables effective documentation, coordination, and approval of design changes, ensuring compliance, and satisfying client requirements.
13. Strict control of quality documentation creation and modification is crucial. ISO 9001's Clause 7.5 on Documented Information is relevant. It requires procedures for document approval, distribution, and control. Adhering to this clause ensures accurate and up-to-date documentation, maintaining the organization's quality management system.
14. Tracking dates and lot codes of products and raw materials ensures traceability, enabling identification and accountability throughout their lifecycle. ISO 9001's Clauses 8.5.1 and 8.5.2 on Control of Production and Service Provision and Identification and Traceability are relevant. They require organizations to establish procedures for product identification and traceability, using suitable means to record unique characteristics. Adhering to these clauses enables effective tracking, quality control, and compliance with regulatory requirements.
15. Establishing procedures to verify servicing meets contract requirements is crucial. ISO 9001's Clauses 8.2.4 and 8.2.3 on Monitoring and Measuring Resources and Review of Requirements are relevant. Adhering to these

clauses enables effective monitoring and evaluation of servicing activities, ensuring customer satisfaction and contractual compliance.

16. The organization has established and maintains a Quality Manual, supporting procedures, and documented information to effectively implement its quality management system. ISO 9001's Clauses 4.2.2, 4.2.3, and 4.3 on Quality Manual, Control of Documents, and Control of Records are relevant. Adhering to these clauses ensures the availability of documented guidelines, procedures, and records that enable consistent implementation, control, and improvement of the organization's quality management system.
17. Maintaining training records for employees is crucial for assessing competence, meeting regulatory requirements, and ensuring ongoing skill development. ISO 9001's Clause 7.2 on competence is relevant to this statement. Adhering to this clause enables organizations to establish procedures for documenting training records, supporting effective training management, and demonstrating compliance with quality standards.
18. Management sets the quality policy, provides resources, and offers training. This ensures a strong quality culture and effective quality management. ISO 9001's Clauses 5.2 (Quality Policy), 9.3 (Management Review), and other relevant clauses apply. Compliance demonstrates commitment to quality, enhances employee capabilities, and fosters continuous improvement.
19. Clause 8.5.3, titled "Control of customer-supplied product," is a vital component of the ISO 9001 standard. This clause mandates that organizations must establish robust procedures to effectively control and manage customer-supplied products. These procedures encompass various aspects such as handling, storage, and preservation, ensuring that the

products maintain their intended quality and functionality throughout the entire process.

20. Control charts, graphs, and analysis methods assess process performance, aligning with ISO 9001's Clause 9.1.3 on Analysis and Evaluation. They support nonconformity management (Clause 10.2) and continual improvement (Clause 10.3), enhancing decision-making and driving process enhancements.

