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Integration of Lean Management Principles into Digital Transformation at Almimi United Company for Wood and Trading

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This thesis was submitted in partial fulfillment of the requirements for the Master's degree in Quality Management

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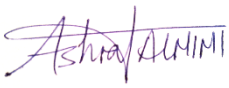
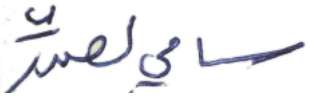
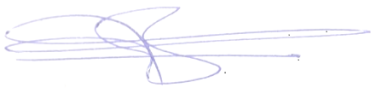
1. Supervisor (Dr. Ashraf AlMimi)	
2. Internal Examiner (Dr. Sami Sader)	
3. External Examiner (Dr. Yahya Salahat)	

Declaration

I declare that no portion of the work referred to in the dissertation has been submitted in support of an application for another degree or qualification of this or any other university or another institute of learning.

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Date: 20/11/2023

Dedication

To the one who gave me everything he possesses so that I can fulfill his hopes, to the one whose love pushed me to achieve the desired, to the only one who stayed up for my knowledge with great sacrifices, translating his sanctification of knowledge and lofty, to the only person who wanted me better than him and redeemed me, to my first example and my first school, my dear father, may God prolong your life and may God bless your goodness.

To the one who gave me all of her giving and the flow of her tenderness and the sincerity of her prayer, and her prayer which always preceded my mistakes until they paved my way, and her smile was my medicine and my cure, my kind mother, may God bless you with us.

To the family, friends, and colleagues who accompanied me and encouraged my steps when the days were overwhelming, you have my love and gratitude.

Acknowledgment

I thank God, Lord of the Worlds, for creating and guiding the steps so that this task may be completed with his assistance and success; I praise him much at the beginning and conclusion.

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I also want to express my heartfelt gratitude to the faculty members in the Master of Quality Management program at The Arab American University-Palestine, each in his name and title, for the abundance of knowledge I gained from them and their rich experience until I reached what I am upon, so may Allah reward you on my behalf with the best reward.

Abstract

Inventory is an important aspect of logistics. It plays a vital role in all fields of logistics; since the inventory levels are closely connected to tied-up capital it has to be well managed. In today's manufacturing climate, there is an increasing focus on eliminating waste and applying Lean principles. Waste can be inventory, waiting, overproduction, transporting, over-processing, moving, and making defective parts and products. On the other hand, digital transformation is becoming one of the key areas of trade innovation in the face of tougher competition. Digital technologies make it possible to reduce costs, achieve sales growth, cover global markets, and quickly meet customer needs through direct contact and constant interaction with participants in the sales process. The main objective of this study is to improve the inventory management system at Almimi United Company for Wood and Trading (AUC-WT) by the integration of both Lean management principles (mainly the 5S methodology) and digitalization technologies (such as traceability technology systems). For this study, the research followed a mixed research approach. The qualitative part of this research included interviews with internal staff such as the CEO of the company, top management, and employees from different departments. In addition, meetings took place with external suppliers such as Bisan Systems Ltd Company (programming company). The researcher also depended on observations to learn about the influence of the physical environment. During the observation, the working process has been carefully documented. The researcher conducted several Gemba walks at AUC-WT, which are one of the lean practices. Also, the researcher relied on the PDSA Cycle (Plan-Do-Study-Act) in applying the barcode system at AUC-WT, to test its effectiveness. On the other hand, in applying the quantitative approach, the researcher used Pareto Analysis. The main results of the study showed that before the

implementation of the 5S lean tool, it is evident that AUC-WT lacked the practices of lean management; a matter which is significantly affecting the workflow and the satisfaction of all stakeholders including the customers. However, after the 5S lean tool was implemented, the area was organized to improve work ergonomics and overall process flow, shelves were created to distribute the items in the form of families, and items were classified at a specific site. Also, cleaning the workspace and a new warehouse manager position has been created in the organizational structure for sustaining the work done. Implementation of automatic identification (Auto-ID) technology. All items have been registered into the Bisan system[1], and each item adopted a specific serial number code. Furthermore, all items were printed on labels including the name of the item and its serial number code, and each label was placed in the right place. This process was done in conjunction with the application of the 5S lean methodology. In the light of the study findings, the researcher suggests the following recommendations; AUC-WT periodically follows up on classifying irrelevant or unnecessary items, constantly follows up a maintenance schedule periodically, reviewing the organizational structure, regularly auditing the checklist compliance, following up on the maintenance and updating of the barcode device, coding any new item, a follow-up to complete re-design the company. After two years from now, the company should conduct a study to show the impact of the various measures recommended by this study, should fully automate its work to benefit from the technological development in the world and continuous training employees on Lean Management principles.

Keywords: Lean Management; 5S Methodology; Gemba walk; PDSA Cycle; Inventory Management System, wood industry, AUC-WT Company in Palestine.

[1] Bisan system: A reliable and comprehensive yet scalable ERP solution for small, medium and large sized enterprises servicing a wide range of business sectors from service oriented to large industrial establishments. Bisan ERP offers customized modules for vertical sectors, providing the ultimate solution for daily business activities anytime and anywhere.

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Chapter One:

Introduction

1.1 Overview

Inventory management is a crucial part of logistics. Inventory management is critical in all domains of logistics since inventory levels are intimately linked to tied-up capital. The elimination of waste and the use of lean concepts are becoming increasingly important in today's production environment. Waste can be inventory, waiting, overproduction, transportation, over-processing, moving, and making defective parts and products (Eskehed, & Krusebrant, 2011).

Inventory flow management in supply chains is one of the most important aspects of any company's success. Krajewski et al. (2013) defined Inventory management as “the planning and controlling of inventories to meet the competitive priorities of the organization and is an important concern for managers in all types of businesses”. Effective inventory management necessitates knowing what is in stock, in what quantity, and where it is kept.

Companies might make huge blunders if they don't have proper inventory information, such as ordering too much, not enough, or sending things to the wrong location. Companies can have big inventories and yet have product stock outs if they have too much of some goods and not enough of others. When dealing with such a large inventory investment, knowing when to replace inventory supplies and how much to order each time is crucial (Krajewski et al, 2013).

Working according to the just-in-time (JIT) principle is one of the cornerstones of Lean thinking. This means that things should be available for consumption when they are required. When attempting to implement a JIT production method, the goal is to keep inventory levels to a minimum. This minimal amount should ensure that there are no

shortages, but the inventory should not retain more items than required to absorb process variance (Liker & Meier, 2006).

Another crucial feature of Lean thinking is autonomy, which ensures that the system is error-proof by preventing machines from making defective parts and stopping production if problems are discovered.

On the importance of Lean Management in a contemporary enterprise, the authors propose the following generalizations (Grzelczak, & Lewandowska, 2016):

- For persons in executive positions, the most important principle of Lean Management today is the fast elimination of errors;
- For persons in managerial positions, the most important principles of Lean Management at present are continuous improvement and fast elimination of errors;
- For personnel of production businesses, the principle of Lean Management that provides for the fast elimination of errors is most important;
- For the staff of trading and service firms, the Lean Management principles of continuous improvement and personal responsibility are most important;
- For administration staff, the fast elimination of errors as the Lean Management principle is very important.

It may be stated that the most significant concept of Lean Management in a contemporary organization is the rapid removal of mistakes. Most employees (in management and executive roles) in both production and administration entities have stated this idea. On the other hand, the principle of continuous improvement dominates as the most important principle of the lean concept among the personnel of trading and service firms as well as among the management, regardless of the type of business activity.

In an increased competition environment, Digital Transformation is emerging as a crucial field of trade innovation. Digital technologies make it possible to reduce costs, achieve

sales growth, reach global markets, and quickly meet customer needs through direct contact and constant interaction with participants in the sales process (Lanenko et al, 2019).

The success plans should be based on an examination of the major trends in the growth of the digital economy, retail trade, and the experience of industry leaders, as well as the selection of successful company development instruments. There are basic concepts that characterize the digital transformation of trade, which are (Lanenko et al, 2019):

1. The digital economy is an economic activity in which data in digital form is a fundamental ingredient in its creation. It contributes to the creation of a new technological foundation for the social and economic sphere by taking into account the needs of citizens and society in obtaining high-quality and reliable information, the development of information infrastructure, and the formation of a new information space. Industry 4.0 Technologies such as Big data, artificial intelligence (AI), the Internet of Things, robots, mobile technology, virtual and augmented reality technologies, and ERP systems are the foundations of the digital economy.
2. The introduction and use of techniques and forms of management based on digital technologies are considered a process of altering the operations of organizations via the introduction and use of digital technologies. Simultaneously, there are changes in the way trade firms are managing, thinking, and foster innovation, as well as the use of digital business models and technology that improve interactions between consumers, suppliers, partners, and staff.

This study investigates the integration of Lean Management Principles into Digital Transformation at Almimi United Company for Wood and Trading (AUC-WT), to improve warehouse management practices.

1.2 Company Profile

Almimi United Company for Wood and Trading (AUC-WT) is a wood and trading company that was established in 1972 as a family business in Ramallah city. Nowadays, the company has two main locations, one in Ramallah's industrial zone and the other in Al-Ram. The main products that the company sells are all types of wood, roof tiles, wood accessories, and all carpentries' needs. The company has 35 employees and its customers are spread in the middle and north of West Bank. Its targeted customers are wholesalers, carpenters, contractors, engineers, and end users. The list of the company's products includes (Baseleh, 2020):

- All types of timber for construction.
- All types of natural wood lumber for kitchens, bed rooms, furniture, ETC.
- Two types of wooden panels (hardwood and softwood plywood).
- Prefinished wood panels.
- Hardwood and softwood veneers.
- Composite Wood Panels.
- Decorative Overlays (Cabinet interiors and door backs, Modesty panels, Desk pedestals, Slot wall, various vertical surfaces, Bookcases, Cabinets, and Shelving).
- Iron corners and Profiles.
- Bricks and brick woods.

Due to an ineffective and inappropriate inventory management system, AUC-WT is facing difficulty in matching its supply with the customers' demand efficiently resulting in both stock-outs and surplus inventory in the firm. The inventory management issue has had a severe impact on company profitability, owing to a lack of inventory control and a lack of knowledge about what prices their rivals are giving. Getting a reliable forecast of the demand is not an easy task in the wholesaling and retail industry because of being

unable to estimate the right quantity of demand during a specific period for each product (Alhaj Hasan, 2018).

1.3 Problem Statement

The problem of this study is the wide gap between the company's current working system and Digital Transformation, the company suffers from several problems concerning inventory management, such as the use of a traditional system for managing and controlling warehouse inventory, lack of tracking the flow of inventory, lack of organization of warehouse stores, and lack of appropriate pricing of products.

The researcher found that there are three main issues facing the AUC-WT:

1. The company is managing and controlling its warehouse inventory in a manual traditional system. There's a lack in tracking its inventory flow, where management and employees do not have digitalized traceability system to know and follow up on what is exactly in the company's stores which also affects the accuracy of orders for more products.
2. Warehouse stores are not appropriately organized, where different items are placed in the same place without differentiating each product from the other, which leads to extra time to reach certain products.
3. Products are not priced appropriately, due to the huge variety of products and the non-availability of a pricing formula and not knowing the prices of competitors, which leads to a reduction in sales and hence a reduction in profit of the company.

The importance of Lean Management in a contemporary business has demonstrated no clear dominance of 'lean' thinking compared to the traditional approach to production in companies. There is no correlation between a position of an employee (managerial or

executive) and a change of approach to production from a traditional to lean mode of thinking (Grzelczak & Lewandowska, 2016).

The use of digitalized technologies such as traceability technologies, including barcoding, radio frequency identification (RFID), Quick Response (QR) codes, or other information communication systems to track inventory and stock levels at stores and warehouses throughout the supply chain, is also important in improving inventory management.

Another important method to manage and control inventory is the ABC analysis by the classification of products or items existing in the inventory warehouse. This method helps procurement and accounting managers to know which items are most demanded from customers, and they will focus more on these items.

The main goal of this study is to integrate Lean Management Principles into Digital Transformation at AUC-WT to improve the effectiveness and efficiency of the inventory management system in the company.

1.4 Research Objectives

The main goal of this research is to improve the inventory management system at AUCWT by merging appropriate lean practices with digitalizing technologies. This can be accomplished by meeting the following objectives:

1. Organizing inventory and work space area.
2. Managing inventory effectively and efficiently
3. Having an effective tracking inventory system
4. Increasing the floor space in the company
5. Changing the employee's way of thinking toward continuous improvement
6. Improving the quality of measuring cost, and price, of various products in the company

1.5 Questions of the Study

Following the above-mentioned objectives, the purpose of this research is to find answers to the following questions:

1. What were the main lessons learned from implementing the 5S Methodology to the management of inventory at AUC-WT?
2. How can the integration of Lean Management Principles into Digital Transformation improve inventory management at AUC-WT?
3. What are the obstacles to the application of 5S Methodology and the integration of Lean Management Principles into Digital Transformation at AUC-WT?

1.6 Research Propositions

Since this study is of a qualitative exploratory nature and is not based on previous models the researcher decided to use research propositions rather than hypotheses to get a more pragmatic view. The following propositions have been formulated within the context of the literature review:

Proposition 1: Implementing 5S Methodology at AUC-WT will successfully and continuously improve the inventory management and control system of materials.

Proposition 2: Implementing 5S Methodology at AUC-WT will successfully reduce waste, and remove unneeded tasks, activities, inefficient floor space utilized, and materials.

Proposition 3: Integrating both Lean Management and Digitalization technologies (such as Traceability Technology systems) at AUC-WT will successfully identify and track products and items available in the warehouse stores, and will be able to quickly and accurately determine the prices of items to help AUC-WT set competitive prices.

1.7 Importance of the Study

The significance of the study is to enhance and increase sales through more precise product pricing, improve the forecasting process for ordering products, build a reliable system for inventory management and replenishment, and organize the workplace, which will lead to the reduction of waste and getting rid of unneeded products and items. Also, better store and display of products and items will lead to fast reaching of the required products, better identification of the products, accurate prices for products, enhanced relationship with a customer, and increased customer satisfaction.

1.8 Thesis Structure

Following the introductory chapter, the following chapters describe the thesis structure starting from chapter two:

- Chapter Two: Literature Review: This chapter illustrates past research and publications relating to the study's objective: Traditional Lean, Lean Tools, 5S Methodology, Digital Lean, Inventory management, Relationships between inventory management and company performance, and related studies in the Palestinian Context.
- Chapter Three: Research Methodology: This chapter illustrates how the research has been conducted, and how the data has been collected and explicated. The methodology is based on a combination of qualitative and quantitative data. This combination provides more techniques and ideas which are directly related to developing an inventory management system.
- Chapter Four: Results and Analysis: The results and analysis are explained in this chapter with detailed clarification and demonstration after using the techniques to find problems and suitable solutions. This chapter illustrates the practical application of the theories presented in the theoretical framework, where the researcher applied the

methodologies explained in the third part. In addition to clarifying the improvement in the areas in which the study methodology was conducted.

⌘ Chapter Five: Results, Conclusions, and Recommendations are discussed. This chapter focuses on the discussion of results, conclusions, and recommendations for future improvements. It discusses the study's achievements and summarizes the outcome in improvements form.

Chapter Two:

Literature Review

2.1 Introduction

Womack, Jones, and Roos coined the term "lean manufacturing" in the early 1990s to define quality and operational management strategy. The lean approach was consolidated at Toyota under the name of “Toyota Production System or TPS”, where Taichi Ohno and Dr. Shigeo Shingo were the pioneers who laid the foundations of this concept in the 1950s (Oakland, 2014). Lean or TPS is designed as a set of tools and methods to eliminate waste and inefficiency in the production system (Lukic, 2012). Womack & Jones (2003) identified 5 lean principles that are fundamental to the elimination of waste, which are: 1. Defining value from a customer perspective 2. Organizing around flow 3. Identifying value streams and removing waste 4. Responding to what customers demand 5. Perfection is a goal.

Traditional Lean, including Lean Tools such as 5S Methodology, Just- in- Time "JIT," and Visual Management, Digital Lean (E-Kanban, Auto-ID Technologies), Inventory Management, Gemba Walks, Cause & Effects Diagram, ABC analysis, 8 wastes, and the relationship between inventory management and corporate performance are also discussed. An overview of similar research in the Palestinian context is presented in the concluding section.

2.2 Lean Tools

The research focuses on two traditional lean tools, which are the 5S, and the Eight wastes or Muda to address the problem to manage inventory.

2.2.1. 5S Methodology

The 5S approach is a system for organizing, cleaning, developing, and maintaining a productive and effective workplace. It is designed to create a self-explaining, self-ordering, and self-improving workplace which is called a visual management workplace (Dennis, 2017; Khan et al., 2019). The name indicates five connected activities that begin with the letter S, which represents workplace habits that support visual controls and lean manufacturing. Table (1) shows the five practices that are interrelated and must all be implemented:

Table (1): 5S Methodology

Term	**Definition**
Sort	Separating needed items from unneeded items.
Straighten	Arranging and organizing needed items in the right place.
Shine	Cleaning and shining of the place.
Standardize	Establishing schedules and methods to perform the sorting, organizing, and cleaning.
Sustain	Sustain Creating discipline to perform the first four S practices.

Source: (Khan et al., 2019).

Many academics believed that the 5S is a critical component of waste reduction and the elimination of unnecessary tasks, activities, and products. It not only gives the operation a sense of order and control, but it may also pave the way for a cultural shift away from firefighting and toward continual development. Some of the most significant advantages of implementing 5S techniques are that it (Krajewski et al., 2013):

- Allow employees to prioritize tasks, adopt a different point of view, and pay closer attention.

- Setting up workspaces, offices, tool rooms, and shop floors, among other things, across a range of manufacturing and service contexts.
- Costs will be cut as a consequence.
- Enhance productivity and delivery punctuality.
- Higher product quality, more efficient floor space use, and a safer working environment.
- Builds the discipline required to make lean systems run smoothly.

Chapman (2005) emphasized that in order to implement lean tools successfully such as standardized work, visual inventory replenishment systems, total productive maintenance, setup reduction, and mistake proofing, an organization will need to address the workplace issues that perpetuate waste in everything they do. Focusing on inventory, the 5S technique assists in the organization and simplification of physical inventory management. By utilizing point-of-use storage and visible replenishment signals, a proper organization will ensure minimal material handling.

In a recent study by Yik & Chin (2019) to resolve issues related to shipment preparation in the finished goods storage of the manufacturing industry, they concluded that the application of the two lean manufacturing tools; 5S and visual management, led to a significant improvement in the shipment time preparation as it was reduced by 50%. Due to that, the inventory was well organized and arranged in the perfect place. Furthermore, the researchers suggested that in the future, a barcode system should be used to regulate the flow of product lots in the completed products shop.

Another study by Gupta and Jain (2015) implemented the 5S technique in an instrument manufacturing company, and the findings revealed that tool-searching time on the shop floor has been reduced from 30 to 5 min and improved overall organization performance.

2.2.2 Just-In-Time "JIT"

JIT is a simple but powerful philosophy that believes that waste can be eliminated by cutting unnecessary capacity or inventory and removing non-value-added activities in operations (Krajewski, et al., 2013). Instead of pushing components through manufacturing based on expected demand, it pulls parts through production depending on customer demand. Its goals are to minimize inventory, enhance cash flow, and save space. The primary principles of JIT are to have only the required inventory when needed; to improve quality to zero defects; to reduce lead times by reducing setup times, queue lengths, and lot sizes; and to accomplish these activities at minimum cost (Toomey, 2000).

The goal of Lean thinking, as is well known, is to reduce or eliminate wastes or muda from all areas, functions, and activities inside the business. To be able to create a successful lean organization, it is important to understand the nature of waste and how to eliminate it (Taylor & Brunt, 2001). The 8-wastes are a tool for identifying "anything in the manufacturing process that does not add value from the customer's perspective" and "identifying concrete solutions of waste removal." (Simona & Cristina, 2015). Table (2) described by Taichi Ohno explains the 8 wastes that must be eliminated in implementing lean thinking (Krajewski et al., 2013):

Table (2): The 8 wastes in Lean Thinking

Waste	Definition
1. Overproduction	Manufacturing an item before it is needed, makes it difficult to detect defects and creates excessive lead times and inventory.
2. Inappropriate Processing	Using expensive high-precision equipment when simpler machines would suffice. It leads to the overutilization of expensive capital assets. Investment in smaller flexible equipment immaculately maintained older machines, and combining process steps where appropriate reduce the waste associated with inappropriate processing.
3. Waiting	Wasteful time incurred when product is not being moved or processed. Long production runs, poor material flows, and processes that are not tightly linked to one another can cause over 90 percent of a product's lead time to be spent waiting.
4. Transportation	Excessive movement and material handling of products between processes can cause damage and deterioration of product quality without adding any significant customer value.
5. Motion	Unnecessary effort related to the ergonomics of bending, stretching, reaching, lifting, and walking. Jobs with excessive motion should be redesigned.
6. Inventory	Excess inventory hides problems on the shop floor, consumes space, increases lead times, and inhibits communication. Work-in-process inventory is a direct result of overproduction and waiting.
7. Defects	Quality defects result in rework and scrap and add wasteful costs to the system in the form of lost capacity, rescheduling effort, increased inspection, and loss of customer good will.
8. Underutilization of Employees	Failure of the firm to learn from and capitalize on its employees' knowledge and creativity impedes long-term efforts to eliminate waste.

Source: (Krajewski et al., 2013).

Mazanai (2012) found that small, and medium enterprises (SMEs) in the manufacturing sector that are not applying JIT inventory management have an uncertain situation. Furthermore, Mazanai (2012) discovered a statistically significant positive relationship between using the JIT inventory management methodology and increased quality and flexibility. Given the obstacles to functioning in the twenty-first-century economy, which is blasted by ever-changing consumer wants and growing levels of competition from both

current and new creative enterprises, such a positive effect may be extremely beneficial to the SME sector.

2.2.3 Visual Management

Visual Management is a management system that attempts to improve organizational performance through connecting and aligning organizational vision, core values, goals, and culture with other management systems, work processes, workplace elements, and stakeholders, utilizing stimuli, which directly address one or more of the five human senses (sight, hearing, feeling, smell and taste) (Liff and Posey, 2004). These stimuli communicate quality information (necessary, relevant, correct, immediate, easy to understand, and stimulating), which helps people make sense of the organizational context at a glance by merely looking around (Greif, 1991). It is a management approach that utilizes either one or more information-giving, signaling, limiting, or guaranteeing visual devices to communicate with "doers", so that places become self-explanatory, self-ordering, self-regulating, and self-improving (Galsworth, 1997).

A comparison to a highway can help you comprehend the topic better. On a highway, driving lanes are marked and divided from one another by painted lines, which also control drivers passing one another (Tezel et al, 2009).

In this subject, there is no standard nomenclature. Some used terms, that refer to more or less the same concept, are Visual Management (Imai, 1997; Liff and Posey, 2004; Denis and Shook, 2007), visual workplace (Greif, 1991; Galsworth, 2005), visual control (Mann, 2005), visual factory (Bilalis et al., 2002; Aik, 2005), shop floor management (Suzaki, 1993), visual tools (Parry and Turner, 2006) and visual communication (Mestre et al., 1999).

Visual management and data visualization has a long and illustrious history. it was initially developed in Ca 2500 B.C since the Egyptian Royal Cubit was extensively used in construction projects and other related areas as the visual measuring standard (Corry, 2002). Around 1935 the JIT thinking, of which Visual Management comprises an important portion (Liker, 2004), In 1953 Toyota applied the Kanban production control and synchronization system in its main machine shop (Ohno, 1988). In the mid-1950s several aspects of workplace structuring, visual control, and housekeeping, what we know today as 5S (sort, set in order, shine, standardize and sustain) implementations started to develop in Japan (Fabrizio & Tapping, 2006). In 1977 Sugimori et al. (1977), the Toyota managers published the first papers in the English language on the Toyota Production System. Some concepts of Visual Management, such as Kanban production control, were also addressed in these early studies.

In the lean production literature, the conventional notion of Visual Management appears to be primarily focused on its transparency and/or disciplinary roles. The described functions appear to be interconnected and interactive, and some of them, such as management by facts, simplification, and unification, appear to be at a more macro or organization-wide level. The interrelationships between the stated functions, as well as how other organizational aspects affect these functions, might be investigated.

It's important to understand the link between Visual Management and other managerial approaches, as well as how Visual Management may help or impede different management activities in an organization. A detailed classification and identification of various Visual Management tools may be useful (Tezel et al, 2009).

Table (3) shows how visual management may help an organization with a variety of activities.

Table (3): The Functions of Visual Management

Function	Definition	Alternative Practice
Transparency	The capacity of a manufacturing process (or one of its components) to interact with humans.	Information that is stored in people's heads and on shelves.
Discipline	Making it a habit to follow the necessary procedures.	Warnings, reprimands, penalties, dismissals, and so on.
Continuous Improvement	A concentrated and sustained incremental innovation approach that spans the whole organization.	Organizations that are stagnant or that have made significant improvements with significant investment.
Job Facilitation	By providing various visual aids, a conscious effort is made to physically and/or psychologically ease people's efforts on routine, already understood chores.	Expecting individuals to do their duties successfully without offering them any assistance.
On-the-Job Training	Learning via experience or combining labor with learning.	Conventional training methods or no training at all.
Creating Shared Ownership	Possessiveness and being mentally attached to something (material or immaterial).	Change attempts, vision, and culture formation are dictated by management.
Management by Facts	Facts and data based on statistics are used.	Subjective judgment or ambiguous terminology are used to manage.
Simplification	Constant attempts to monitor, process, visualize and distribute information throughout the whole system for individuals and teams.	Expecting humans to monitor, analyze, and comprehend complex system-wide data on their own is unrealistic.
Unification	Creating empathy inside an organization by partially reducing the four basic borders (vertical, horizontal, external, and geographic).	Behaviors such as fragmentation or "this is not my duty"

Source: (Tezel et al, 2009).

2.2.4 Gemba Walks

Gemba Walks are made up of three words: Gemba ("the true thing"), Genchi Genbutsu ("see"), and Genjitsu ("real facts"). A Gemba Walk is an essential lean strategy for observing, interacting, gathering information, and understanding how humans and/or robots execute work or co-work. It is a critical component of vertical integration since it strives to promote the methodical growth of an organization by enhancing the human ability to solve issues and find opportunities for progress. Gemba Walks are a core lean management tool since they provide an up-close, detailed view of behaviors in action and context, thus facilitating “understanding by seeing”, and the subsequent identification of process improvement opportunities (Romero et al., 2020).

Furthermore, Gemba Walks are a valuable lean leadership technique because they allow lean managers to interact directly with operators at their actual workplace. By performing regular Gemba Walks, lean managers show appreciation for the work of the employees in creating value, boosting morale with their presence, and gaining their trust to share relevant information for continuous improvement (Aij & Teunissen, (2017).

A Gemba Walk is characterized by four distinctive elements (Romero et al., 2020):

1. Location - Observing an operator, a machine, or a group at "the real place" where the task is being done;
2. Observation: "in-person" observation of an operator, a machine, or a team at work.
3. Teaming - politely "interacting" with an operator, a machine, or a team executing work by asking questions; and
4. Reflecting: what actions are necessary to enable innovation and continuous improvement after "seeing and listening"? the success of Gemba Walks is dependent on the latter portion in particular.

Every Gemba Walk is also a teaching exercise; it is a valuable tool for leaders to achieve organizational alignment and keep the leadership team grounded in reality. When you walk the Gemba, you get the chance to 'See' first-hand with your own eyes and gain a better understanding of what is being done inside your company. Also, how questions are posed has a significant influence on people. People on the job site are also keeping an eye on things. Their minds are always racing with ideas. “What does the leader appear to want to know? If I share something wrong, what will happen? Does this person want to know what is happening?” As a result, how they walk is always significant. There are three key elements to a successful stroll (Bremer, 2021):

Go and see: The main idea of the Gemba walk is for managers and leaders on every level to take regular walks around the shop floor and to be involved in finding wasteful activities.

Ask why: The fundamental goal of a Gemba walk is to investigate the value stream in depth and uncover problematic portions through active discussion. A good leader is always more willing to listen than to speak.

People should be respected: A Gemba stroll is not the same as a "boss walk." You don't have to point fingers and lay blame on others. You aren't there to assess and evaluate outcomes. You've come to work with the team and solve difficulties with them. Instead of focusing on the individuals, try to uncover the flaws in the process.

When going to Gemba Walk, there are seven steps to follow, as illustrated in Figure (1):

Figure (1): Basic steps of Gemba walk.

Source: https://Kanbanize.com/lean-management/improvement/gemba-walk.

In general, Gemba Walks supports organizations' improvement through (Romero et al., 2020):

1. Knowledge development through the integration and exchange of contextualized data
2. Assisting managers in making sound judgments that are based on the circumstances in which they are made.
3. Creating Nemawashi ("consensus") by getting everyone to agree on what the major problem is and how it can be solved via observation and debate.
4. Improving the organization's capacity to capture each human resource's talents through direct connection with individuals when they encounter difficulties. People, on the other hand, are frequently confined to a single spot, limiting their ability to detect issues beyond a certain physical boundary. Traditional Gemba Walks are limited in their utility in increasingly complex commercial contexts, where issues are interrelated and frequently spread internationally. As a result, Gemba Walks should be improved to allow simultaneous trips to several Gembas or easy access to information via augmented realities.

2.2.5. Cause and Effect Diagram

A fishbone diagram (also known as an Ishikawa diagram or a cause-and-effect diagram) is a graphical tool for illustrating the various causes of a certain event or phenomenon. In particular, a fishbone diagram (the shape is similar to a fish skeleton) is a tool used for a cause and effect analysis to identify a complex interplay of causes for a specific problem or event (Coccia, 2017). Also, the fishbone diagram was designed to identify and classify the factors that contribute to a quality issue. The concept has gradually been applied to categorize the sources of different sorts of difficulties that an organization faces. This made the fishbone diagram become a very useful instrument in the risk identification stage (Ilie and Ciocoiu, 2010).

2.3 Digital Lean

Organizations are embracing new technology trends in many capacities in order to improve present ways of doing things and obtain competitive advantages over rivals, owing to the rapidly changing and competitive environment. Industry 4.0, which is built on a technology-driven strategy, has lately developed, causing disruptive changes in production processes. The integration of Lean and Industry 4.0 philosophies to achieve organizational objectives is interesting in order to guarantee competitiveness (Valamede & Akkari, 2020.).

The convergence of lean concepts with digital technology is known as "Digital Lean," and it is a potent combination for reducing waste and unpredictability in operations. Lean concepts are enhanced by digital technology, which makes their use more potent. Its software gives more detailed, timely, and accurate information regarding operations (Laaper & Kiefer, 2020). Figure (2) briefly illustrates how the application of Digital Lean

can benefit any business by improving its asset efficiency, quality, safety, and sustainability and reducing several types of costs.

Figure (2): Digital Lean Business Opportunity and Value.

Source: Deloitte analysis. https://www2.deloitte.com/content/dam/insights/us/articles/6515_CIR-Digital-lean-DSN/DI-Digital-lean-DSN.pdf.

Digital lean advantages in eliminating waste types during manufacturing can be supplemented by digital lean. By providing focused, precise information directly to individuals who can reduce waste, digital lean accelerate waste discovery and mitigation quicker than traditional lean techniques. However, digital lean also gives you the chance to target waste that goes unnoticed, such as information asymmetry and delay, and that adds up to greater support costs, worse efficiency, and lower production, all of which have a concrete impact on the bottom line. Table (4) illustrates how both traditional lean and digital lean processes typically mitigate the seven waste types (Laaper & Kiefer, 2020).

Many researchers emphasized the importance of digitalization in the business context. According to Lorenz et al. (2019), mature lean and digitalization implementers produce higher operational performance thanks to a positive company culture and some specific continuous improvement approaches. Haddud & Khare (2020), found that Industry 4.0 is equipped with high-end solutions which possess the necessary tools to implement lean.

Table (4): How Digital Lean Can Improve on Traditional Lean Waste Reduction

Waste type	What traditional lean identifies and mitigates	How digital lean improves on traditional lean
Overproduction	Traditional lean mitigates the overproduction caused by the asynchronization between demand and supply, including delayed demand signals and rigid processes constraints.	Digital lean can provide real-time visibility into the value stream to proactively adjust capacity, avoiding the building of goods that are not required.
Inventory	Instability across the value stream is often absorbed in additional inventory. Lean methods allow products to be manufactured only in the quantity needed and at the time required.	Digital lean can enhance operations with real-time visibility of the work-in-progress inventory throughout the production process to identify unexpected inventory buildup.
Defects	Poor product design and process control increase defects across the value stream, causing rework or scrap. Traditional lean can help reduce defects by establishing standards in the way assets are maintained, processes are defined, and products are designed.	Digital lean helps identify the precise asset, process step, or product feature that is causing defects and reducing first-pass yield.
Overprocessing	Traditional lean can help avoid processing not required by the customer that is performed across the value stream, such as overinspection or unnecessary high tolerances.	Digital lean connects and integrates the life cycle of a product (and the value stream) through a digital twin: a continuous thread of data mirrors development, production, and use that stretches from the initial design through the lifetime of the product.
Waiting time	Unbalanced operations, bottlenecks, downtime, and poor production planning increase the waiting time along the process, where employees, materials, and assets are not adding value. Traditional lean approaches help mitigate waiting time.	Digital lean reduces waiting through dynamic rerouting of operations based on updates on the real-time status of assets, quick identification of bottlenecks, and multiple simulations of optimized scenarios.
Worker movement	Poor design of production lines and cells increase unnecessary motion for operators to complete value-added tasks. Lean processes address these additional movements that do not add any value to the product and contribute to longer production times.	Digital lean, through analyzing performance data or using augmented and virtual reality simulations, can better inform the design of layouts and equipment to optimize worker movement.
Transport	Lean reduces the nonlinear processes—or processes scattered across the shop floor—that require transportation of materials from distant storage to the point of use.	Digital lean can quantify the amount of transportation time required per product or process, enabling the identification of opportunities to better streamline and organize the shop floor.

Source: Deloitte analysis.

Moreover, future studies should focus on how to apply lean 4.0. Bortolotti & Romano, (2012) concluded that before the automation of any process, the process should be mapped based on lean principles to highlight and eliminate waste than be automated to

avoid any problems that can slow down the flow and increase errors. Kitheka (2010) focused on the following two goals: determining the scope of inventory management automation and the impact of inventory management automation on supermarket performance in Western Kenya. The following recommendations were made based on the data analysis. Supermarkets should automate their inventory management systems to improve customer service delivery levels and reduce operational costs. Supermarkets should decentralize their management structures, encourage specialization of labor, and do enough research before investing in any new technology. Further research should be conducted on the effect of inventory management automation on inventory investment and profits, the effect of automation on demand forecasting accuracy as well as challenges faced by the supermarkets in automating their inventory management systems and how to overcome them.

2.3.1 E-Kanban (Pull System)

The Kanban production system is an old system used for many years since the creation of Lean Manufacturing by Taïchi Ohno after the Second World War, based mainly on the continuous elimination of waste, this production system is the main key to just-in-time JIT (Suprasith et al., 2011), which follows a purely Pull approach (Mayilsamy et Pawan, 2014). Its principle is no one can produce a product until the client asks downstream and thus the beginning of each process is triggered by the fulfillment of another.

The Pull system, often known as Kanban, is a Lean method for controlling buffer stockpiles in the manufacturing process; in other words, it limits production amounts. The conceptualization of Kanban means that a company can achieve minimum inventory at any one time, it has many advantages in managing operations and business in the organization, enhances strategic operational decisions to be used in the production lines,

helps improve the company's productivity and at the same time minimize waste in production (Rahman et al., 2013). Many firms have used Kanban or pull systems in order to satisfy client demand, cut costs, and manage inventories.

Many businesses have changed how they operate as a result of growing global rivalry, extremely unpredictable client demand, and a wider range of items on the market using technological innovations to be more productive, effective, and efficient. The evolution of information systems has created new quality management Lean enterprise resource planning (ERP), for example, is the consequence of a relationship between "ERP" and the Lean Manufacturing strategy. Following the Lean concept, Lean ERP incorporates several new computerized modules. The electronic Kanban production system (E-Kanban) is the logical continuation of the classic traditional Kanban system with cards (Houti, et al., 2017). According to Surendra et al., (1999), it is a technological signaling system to trace the movement of inventory, products, and materials within a manufacturing or production facility. As Drickhamer, (2005) claimed that traditional Kanban has some limitations when applied that the movement of Kanban cards always has some irregularities, since they are not moved at the exact time that the consumption of products, nevertheless while the pace of manufacturing operations increases and the size of the production batch, the number of card movements also increases; which leads to the loss of cards or misplaced sometimes, causing immediate problems in JIT production (Kumar & Panneerselvam, 2007). This is why organizations should apply a better solution by using a computerized system such as the E-Kanban which is more reliable (Graves et al., 2008) and offers many advantages over the traditional Kanban system, such as better transparency, traceability of all movements in the system, and can work with a greater number of materials (Houti, et al., 2017). Moreover, Graves et al. (2008) and Mayilsamy & Pawan (2014) mentioned the following advantages compared

to traditional Kanban cards such as reduction of manual card handling and order entry activities; elimination of the problems of cards lost, fast and efficient optimization of Kanban cards, improved visibility of signals in real-time; accurate communication with suppliers; efficiency of suppliers has always analyzed; efficiency of analysis and adjustment of Kanban quantities; delivery of the request at the right time; and minimization of material shortages. The application of E-Kanban can be implemented using technical elements such as Kanban cards with barcodes, RFID "Radio Frequency Identification" and electronic messages (Surendra et al.,1999). Table (5) shows a comparison between traditional Kanban and E-Kanban:

The reason why a description of the electronic Kanban system, principles, and ideas about its design is necessary and can be presented as follows (Graves et al., 2008):

E- Kanban should follow the principle of the traditional card-based Kanban system. Smoothed and leveled production, for example, is one of these ideas, mixed-model sequencing, stable material flow, operations tight synchronization (takt-time calculations), and pull signals generated by the status of inventory or production system.

E- Kanban should support the continuous improvement that is considered by many authors as one of the most powerful features of the Kanban system. The traditional Kanban system is used to lower inventories and minimize production batches until hidden problems are revealed. After the problems are corrected, the inventories and batch sizes are reduced to reveal new problems. This improvement approach should be included in the Kanban system to obtain most of the advantages of the pull production system. E- Kanban should also support the improvement of the operation by collecting and reporting data about manufacturing operations and material movement and storage.

Table (5): Comparison of Card Kanban and E-Kanban

Comparison Theme	Card Kanban	E- Kanban
Transparent material flow	✓	✓
Control of order material level	✓	✓
Easier and faster ordering of material	✓	✓
Easier work for handlers with material	✓	✓
Regulation and optimization of stock	✓	✓
Simplification of production planning	✓	✓
Works with high amounts of material		✓
Long distances between stations		✓
Quick and precise info		✓
Big financial investment		✓

Source: (Houti, et al., 2017).

The system must be user-friendly and the system interface must be well designed. Despite all the possibilities that information technology offers, the system should be as simple as possible from the point of view of the operator.

E- Kanban can be used to solve card problems. Mixed production, process visibility, system speed, and improved reliability are major challenges for investment in the E-Kanban system. These functions must be taken into considered when planning the control software.

E-Kanban will contribute to filling the gaps in the manufacturing process such as machine failures, quality problems, or material flow problems. E-Kanban acts as a "command panel", which allows real-time visibility of demand signals and gives an overview of the status of each workstation in the system (Muris & Moacir, 2010). All transaction-related information is automatically collected and analyzed at different stages of the manufacturing process to control and make decisions related to the size of production batches, hence the definition of the passage time of the products (Graves et al., 2008; Muris et Moacir, 2010). The E-Kanban system can also help implement a Pull production

system in a manufacturing environment where the traditional Kanban system would face difficulties. It can be used with a mixed production that constantly evolves according to the needs of the customers, as the location and the size of each batch are known and the change of the Kanban cards takes place automatically in the computer system (Graves et al., 2008), which reacts as a basis for mutual communication (Muris et Moacir, 2010) with the stakeholders of the enterprise: customers and suppliers and therefore the communication is more clarified. Quality problems or failures of the machine can also be included in the logic of the computer system so that the influence of failures or quality problems is minimized and recovery is done in a controlled manner (Graves et al., 2008). Therefore, an E-Kanban system can bring visibility and improvement of the production and management of materials into an arrangement where operations are dispersed, and therefore if implemented with care, it can eventually work in an environment where a Kanban-based card would not function properly (Graves et al., 2008). That is, the E-Kanban system can be integrated into enterprise resource planning systems (ERP) that adopt the Lean (Lean ERP) philosophy (Mertins & Lewandrowski, 1999), thanks to their centralized database that gathers all the company's data.

Before applying E-Kanban, an inventory analysis must be made. This analysis must be aligned with the operational requirements of the firm applying the E-Kanban. Additionally, inventory should be categorized according to the function it fulfills, such as; transit inventory (resulting from transporting items from one location to another), buffer inventory (or called safety stock and it's the amount kept on hand which is above the current demand), anticipation inventory (having safety stock for high demand seasons), decoupling inventory (separating inventory within a manufacturing process to have safety stock of sorts), cycle inventory (lot size inventory which depends on order when needed) and MRO Inventory of (maintenance, repair, and operational) commodities

(things used to support and sustain industrial processes, such as oils, lubricants, screws, and so on).

2.3.2 Automatic Identification (Auto-ID) Technologies and Inventory Management

Many enterprises, organizations, manufacturers, retails and warehouses are facing a big challenge in managing their products in inventory stores. Fortunately, due to the innovation in communication and computational technologies, many of these businesses are utilizing and embedding these technologies in their systems to improve their performance efficiently and effectively in order to be able to compete and survive in the congested competitive market (Tzoulis & Andreopoulou, 2013).

Automatic identification (auto-ID) technologies are becoming increasingly important in the management of the supply chain, manufacturing flow management, inventory management, warehousing, and any physical items moving through location in time (Su et al., 2007). Auto-ID is a traceability system that aims at tracking any product, item, etc…that will be used for consumption (Chomba & Phiri, 2016). Under EU law, traceability means "the ability to track any product, through all stages of production, processing, and distribution" (Tzoulis & Andreopoulou, 2013). Tzoulis & Andreopoulou, (2013) stated that the main principles of such systems are the identification of units/batches of all inputs (Product traceability information); lot identification of the processed product (Production records and batch labeling); information on when and where they are moved and/or transformed (Documentation); and a system linking this data (Reconciles product to documentation).

Inventory management is a crucial pillar for a successful organization and is a necessary component for the efficient supply chain management. To have a successful inventory management system, businesses have invested in Automatic Identification and Data Capture (AIDC) systems, which provide real-time information to warehouse managers,

allowing them to make the best decisions for storing and retrieving things. Barcode, Quick Response (QR) code, and Radio Frequency Identification (RFID) are the most prevalent AIDC methods. RFID technology has attracted the greatest attention in recent years from industries such as food, manufacturing, and forest industries for enhancing supply chain monitoring, inventory management efficiency, product traceability, and inventory accuracy (Petersson, 2021).

To address the problem of the research the Auto-ID technology will be applied as an improvement tool to identify and track inventory.

2.4 Inventory Management

Information may take the role of expensive assets like inventory, but the information must be accurate, timely, dependable, and consistent in order to do so. When this happens, you carry fewer inventories, reduce cost and get products to customers faster (David, 1996). As a result, inventory management is critical if a business wishes to strike a balance between efficiency and responsiveness.

Inventory management is described by The American Production and Inventory Control Society (APICS) as “the branch of business management concerned with planning and controlling inventories” (Toomey, 2000). For many companies’ inventory management is set to be a critical issue to be managed since all assets in firms are viewed as an inventory problem where the excessive amount of inventory consumes physical space, creates a financial burden, and increases the possibility of damage, spoilage, and loss (Kitheka, 2012). Inventory management's job is to keep products and related stock at the optimum level. To be able to manage inventory, the classification of items must be considered because it helps to focus on highly prioritized items and reduces the need to

control a large number of items in the inventory, if different items have equal strict control then time and costs are unnecessarily wasted. (Kritchanchai & Meesamut, 2015).

Managing inventory effectively is essential for realizing the full potential of any supply chain and in the operation of any business (Krajewski, et al. 2013). The main challenge in managing inventory is to have the right amount to achieve the competitive priorities of the business most efficiently (Krajewski et al., 2013). Many organizations have placed a greater emphasis on inventories as a balance sheet asset implemented a strategy of decreasing fixed asset investment, and also focused on reducing their inventories. Since inventory levels impact return on asset (ROA), a decrease in inventory will result in a rise in ROA and vice versa (Coyle et al., 2003).

According to many researchers, the challenge that is facing companies in managing their inventory is forecasting demand and expectations of customers about product availability, due to the mismanagement of a large number of different products and items that exist in inventory (Bai & Zhong, 2008).

Stock and Lambert (2001), categorized inventories into six main types, namely:

1. Cycle stock: This is the inventory that is created throughout the replenishment process and is necessary to fulfill demand under particular conditions. That is when the company can accurately forecast demand and supply schedules (lead times).
2. In-transit inventory (pipeline): This is inventory that is being moved from one location to another. Even though it is not ready for sale or shipment until after it reaches the destination, it may be termed cycle stock.
3. Safety or buffer stock: stock stored over cycle stock due to demand or lead time uncertainty. Short-term changes in demand and lead time should be covered by a fraction of typical inventory, according to the theory.

4. Speculative stock refers to inventories retained for reasons other than meeting immediate demand. That is, inventory acquired in anticipation of price increases.
5. Seasonal stock: is a type of speculative stock that involves the accumulation of inventory before the season to maintain a stable labor force and stable production runs, or, in the case of agricultural products, inventory accumulated as a result of a growing season that limits availability throughout the year.
6. Dead (obsolete) stock is a collection of products for which no demand has been documented for a length of time. As a result of technological improvements, they are out of date, deteriorating, or no longer usable.

2.4.1 Inventory Decisions

The term "inventory decisions" relates to the management of inventory. Raw materials, semi-finished items, and final goods all have inventories at various stages of the supply chain management process. It's also worth noting that keeping inventory can cost anywhere from 20% to 40% of the item's value. Therefore, inventory management is crucial in supply chain operations, this is strategic in the sense that senior management sets their objectives after taking it into account. Most researchers, on the other hand, have approached inventory management from an operational standpoint, which includes deployment strategies (pull versus push), control policies, determining optimal levels of order quantities and re-order points, and setting safe stock levels at each stocking location. These stages are of fundamental importance as they are primary determinants of customer services stages (Ganeshan, & Harrison 2002).

Handfield et al. (2011) believed that executive managers have not usually been concerned about the set of key performance indicators as the typical supply chain manager. However, in recent years' senior executives have begun to appreciate the importance of effective inventory management. Many firms in traditionally high-margin industries

(such as energy, utilities, and pharmaceuticals) pay little attention to inventory since the savings associated with inventory reduction exceeded the risk of a missed sale.

2.4.2 Relationships between inventory management and Performance of the Business

The lean production principle was pioneered by Womack et al. (2003). Reduced inventories were connected to this idea. The premise is that by reducing inventory, profits will improve owing to interest savings, as well as lower storage, handling, and disposal costs. These savings have been estimated by literature to be in the range of 20 -30 percent (Brigham & Gapenski, 1996). King and Lenox (2001) concluded that lean production is complementary to improvements in the performance of the procurement function and it often lowers the marginal cost of pollution reduction thus enhancing competitiveness.

Kakuru (2000) indicated that inventory management is the integrated function of purchasing activities to achieve minimum coordination and optimum expenditure. A good inventory management system and control strategies are required for a firm to succeed. In this situation, the firm must regard inventory as a significant aspect that will decide its profitability, and inventories must be obtained ahead of sales in order to optimize profitability, as inventory levels are highly dependent on product sales or demand.

Agus and Noor (2006) examined the relationship between inventory management and the financial performance of the business and they found that inventory management practice has a significant relationship with profitability and return on sales. Lwiki et al. (2013) indicated that inventory management is a “crucial part of a firm because mismanagement of inventory threatens a firm’s viability such as too much inventory consumes physical space, creates a financial burden, and increases the possibility of damage, spoilage, and loss”. Eroglu and Hofer (2011) investigated the link between inventory management and

a company's financial success. Their findings demonstrated that the two factors had a substantial positive association.

Sahari, et al. (2012) empirically examined the relationship between inventory management, firm performance, and capital intensity in a sample of 82 construction firms in Malaysia. Their study revealed that there is a positive correlation between inventory management and financial performance, and that also there is a positive relationship between inventory management and capital intensity. The business manager should aim at maintaining an optimum level of inventory in the right quantity, quality, and at the right time thus maximizing benefits and minimizing losses in funds tied up when over-investment in inventories is done (Kabera, 1996).

2.4.3 Inventory Management System Used by the Firms

Firms should have proper stock levels in order to ensure efficient company operations and accomplish the goal of lowering stock-related costs. To deal with these expenses, a number of strategies have been developed.

Kalyango (2005) stated the following practices that minimize stock-related costs:

- Inventory planning and scheduling: This is the process through which an organization acquires units of stock over a certain period in order to maintain smooth company operations. Planners will be able to set procurement/purchase dates and amounts that are consistent with the plan, avoiding interruptions due to inventory shortages, if they have a sound stock plan in place ahead of time.
- Inventory recording: Stores/warehouse management relies on accurate and up-to-date inventory data. Basic processes include rapidly counting and recording after receipt or manufacturing, and anytime a store transaction occurs, the issuing of stores should be

appropriately authorized and indicate data such as the code number, transaction quantity, and voucher reference.

Kamukama (2013) stated the following documents used in inventory management: Purchase requisition note, goods received note, stock record card/bin cards, materials return note, shortages note, and scrap note.

Inventory valuation is the process of determining the worth of stock and, as a result, the impact on profitability. First in, first out (FIFO), Last in, first out (LIFO), and the average price approach are all stock valuation methodologies.

Counts of physical inventory: Within one week of the fiscal year's conclusion, the inventory value should be reported. Management must properly document adjustments to correct disparities.

Inventory control arranges the availability of products to the organization's clients. To suit marketing demands, it coordinates the purchasing, production, and distribution processes. Current sales goods, new products, consumables, spare parts, obsolescent items, and all other supplies are all part of this position.

Based on the readings of previous studies, articles, books, etc..., many inventory control systems and control techniques were discussed, such as the ABC Analysis, Continuous Review System (Q) or the Reorder Point (ROP) System, Economic Order Quantity (EOQ) Model, Periodic Review System (Krajewski et al. 2013; Bai, & Zhong 2008; Starr & Gupta, 2017). However, in this research context part of the research problem will be addressed using the ABC analysis or classification of items in inventory.

ABC analysis is the most effective method and is based on the idea of selective control. The ABC analysis classifies items according to their significance. Cash flows, lead times, stock-outs, sales volume, and profitability. Break points for

classes A, B, C, and so on are decided once the ranking variables have been determined.

When items are sorted or classed by their sales activity, the 80/20 idea is very beneficial in distribution planning. The top 20% might be classified as “Class A”, the following 30% as “Class B”, and the remaining 50% as “Class C”. Each item type might be allocated differently. For example, Class A may be supplied throughout a large geographic area through several warehouses with high stock availability. In contrast, Class C may be distributed from a single, central stocking point (e.g. a plant) with a lower total stocking level than Class A items. Similarly, Class B items would be distributed in an intermediate manner, with just a few regional warehouses being employed.

Typically, the things or goods kept in inventory are referred to as stock-keeping units (SKU). To enable managers to concentrate on products with the highest dollar value, ABC analysis divides SKUs into three classes (A, B, and C) based on their dollar consumption (Krajewski et al. 2013). The ABC analysis is shown in Figure (3), where Class A items typically represent just 20% of SKUs but 80% of dollar consumption. Despite just making approximately 15% of total consumer spending, class B items account for 30% of SKUs. Lastly, just 5% of all financial use is accounted for by the 50% of SKUs that are classed as class C. A manager usually needs to monitor and oversee Class A products.

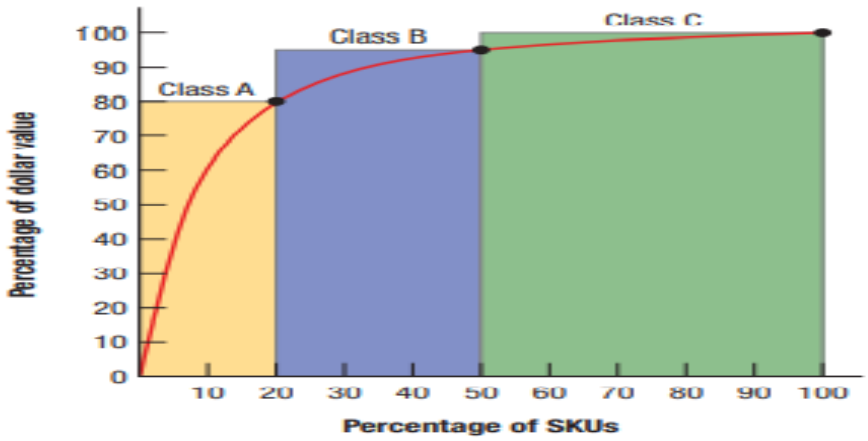

Figure (3): Mechanism of ABC analysis.

Source: (Krajewski et al. 2013).

In a research paper by Onwubolu & Dube, (2006) to improve the inventory control system in a small company, results revealed that by the application of ABC analysis in Bindura Nickel Corporation, Class A which is only 10% of inventory items account for approximately 97% of total annual usage value; Class B which is 10% of inventory items account for approximately 2% of total annual usage value; The remaining 80% of inventory items account for only 1% of total annual usage value of Class C. The results show how important it is to classify products or items to focus on the ones that are going to increase sales and profit.

2.5 Related Studies in the Palestinian Context

In the Palestinian context, rarely related studies were found about inventory management, lean, and digitalization. Accordingly, lean management is practically a new managerial concept for many businesses. Some studies applied the Lean methodology tools with the aim of quality improvements:

Alhaj Hassan, (2018) implemented his study in the same company of this research at AUC-WT aiming to reduce accumulated inactive accessory products and improve the

receiving and storing processes. Upon implementing his research with the use of the 5S tool, the company's storage area was increased by 70 m^2 and he was able to classify items by labeling them to easily find needed items and reducing the time of reaching products. Alhaj Hassan (2018) focused on one area of the company which is the accessories department, this thesis will continue the work started by Alhaj Hasan to automate the storing processes in the accessories section as well as other sections of the business mainly the wood section. Moreover, the 5S tool is applied to other sections of the business to improve the layout and organize the workplace.

Tannous, (2019), aimed to implement the 5S methodology to reduce waste and improve the process in a Palestinian furniture company. The study was able to improve the production process at the company; minimize several types of waste such as bottlenecks, excess employee movements, and surplus and obsolete inventory; enhanced safety, and plant layout improvement. Moreover, the researcher utilized financial accounting software to sustain the newly adopted warehousing managerial procedures.

Baseleh, (2020) aimed to improve the quality of measuring cost, price, and profit of various products at Almimi United Company for Wood and Trading (AUC-WT) through the application of the Activity-Based Costing Model, to provide the company with more accurate costs and prices that have a direct effect on its profitability, competitiveness, and market share.

This study developed an Activity-Based Costing (ABC) Model for AUC-WT. A step-by-step approach was followed to implement ABC including collecting cost data, identifying the main activities performed at AUC-WT, calculating the cost of each activity, computing the activity-based overhead rate, and finally calculating the cost of each cubic meter of wood. The results of ABC implementation were compared to the costs and prices calculated using the current costing system at AUC-WT.

Through a more precise estimation of the cost of 247 items, our research has greatly improved the quality of AUC-WT's pricing procedure, which is located in the natural wood warehouse at the AUC-WT Ramallah's branch. Moreover, it aided AUC-WT's management in better understanding all of the operations involved in purchasing, receiving, inspecting, storing, selling, preparing orders, loading products, and delivering the items to customers. This would help AUC-WT management make better decisions with regard to product pricing and customer profitability at any time in the company's lifetime.

Abu Obaid, (2016) assumed that the building industry in Palestine is one of the most important economic sectors, but it still faces a lot of challenges in terms of timeliness, cost, and quality. To address these issues, the construction industry must embrace a new management trend known as lean construction. The study's major goal is to look at the variables that help with lean adoption, such as management and planning systems, human factors, organizational factors, and contractual factors. Furthermore, defining lean key performance indicators that quantify the effectiveness of this implementation, and lastly tying them to a framework to assist construction organizations in implementing lean in the construction process.

Abdelqader & Abu Saleem (2017) was keen to determine the role of Lean management in achieving creativity, as well as to identify the availability of flexible management tools (worksite organization, continuous improvement, standard work, multi-function workers, Six Sigma) and their ability to achieve creativity in its various dimensions (Problem-solving and decision making, changeability, risk acceptance and encouragement of creativity). The researchers took a descriptive-analytical method to their investigation.

The study's most important findings are that flexible management methods and creative aspects influence Jawwal. The researchers advise that increased emphasis be should be

placed on the use of Lean management methods, particularly continuous improvement, and the availability of multi-function staff.

Dandis, (2018), aimed to know the most important challenges facing the owners of small and medium-sized enterprises in Palestine when applying Lean Manufacturing principles. The study population consists of all enterprises in the West Bank that have implemented the Lean manufacturing system.

The primary elements of the problems of Lean manufacturing were highlighted by the researcher in seven key areas: labor-related issues, educational and cultural issues, management-related issues, organizational-related issues, financial-related issues, government-related issues, and cubic metering issues, and challenges related to the nature of the application of lean manufacturing.

Managers and business owners should use Lean manufacturing methods in their facilities, as well as scientific foundations for management and production processes, as well as strategic planning, according to the researcher's suggestions. Adopt a culture of employee investment by giving lean manufacturing training courses and instilling a waste reduction and lean manufacturing culture in their behaviors. Using the experience and professionals in the use of lean manufacturing methods, managers and business owners may overcome the problems of implementing lean manufacturing.

Chapter Three:

Research Methodology

3.1 Overview

This chapter explains how the study was carried out, as well as how the data was acquired and analyzed. This study is both qualitative and quantitative.

3.2 Research Approach

3.2.1 Qualitative Research

Qualitative Research is an approach that allows researchers to examine people's experiences in detail by using a specific set of research methods such as in-depth interviews, focus group discussions, observation, content analysis, visual methods, and life histories or biographies (Hennink et al, 2020). The goal of qualitative research is to examine people's views, aptitudes, and talents in depth. Hence, qualitative methods are concentrating more on the individual than on the general mass (Mayring 2007).

3.2.2 Quantitative Research

Quantitative research approaches focus on gathering and evaluating structured data that may be represented quantitatively. One of the main objectives is to provide precise and trustworthy measures that can be analyzed statistically. Quantitative research is particularly successful in answering the "what" or "how" of a situation because it focuses on data that can be quantified. Direct and measurable questions frequently include language like what percentage? what proportion? to what extent? how many? and how much? (Goertzen, 2017).

Quantitative research provides for the examination of attitudes and actions, the documentation of patterns, and the explanation of what is known anecdotally.

Frequencies (i.e., counts), percentages, proportions, and relationships are examples of measurements that may be used to quantify and give evidence for the variables in research. The results of quantitative research reveal patterns and behaviors. It's crucial to emphasize, however, that they don't explain why individuals think, feel, or act the way they do. To put it another way, quantitative research identifies patterns across data sets or study groups, but not the motivations underlying observed actions.

This study followed both qualitative and quantitative approaches.

3.2.2.1 Pareto Principle

A typical observation is that in every system containing causes and effects, a tiny fraction of the causes is the majority of the consequences. This concept, known as the Pareto principle, has been popularized as the "80-20 rule," which states that 20% of the causes create 80% of the consequences. This rule is often used to establish the degree of effort to be expended on a particular project; if the rule of thumb is that 80% of the benefit can be achieved with 20% of the work necessary for completion, then the project will go forward, at least until the 80% benefit has been achieved (Loshin, 2011).

In reality, the Pareto principle has a more intriguing use in that it may be used to select which features of a system (data quality) should be included in statistical process control. A Pareto chart is a bar chart that shows how different components of a system are measured. The chart's presentation is based on cumulative frequency measurements of specific metrics, which are arranged from highest to lowest frequency. The chart highlights those areas that are responsible for the greatest percentage of a problem, and which variables are involved in those areas (Loshin, 2011).

3.3 Data Collection

3.3.1 Interviews

All personnel who were involved in the study's problem were interviewed for this study. Internal personnel such as the company's CEO, senior management, and employees from various departments such as accounting, IT, sales, and marketing department employees, as well as warehouse department employees, were interviewed. In addition to external suppliers such as Bisan Systems Ltd. Company, assists companies and institutions by providing them with accounting and managerial systems to improve their efficiency, productivity, and profitability.

The interviews have been conducted at the worksite, and the average period of each interview is twenty to thirty minutes. The main motive of the conducted interviews is to obtain additional data regarding the work process and other major issues restricting the implementation of lean management at the factory. Further data has been collected through daily conversations with low-level employees.

3.3.2 Observations

The researcher also relied on observation to learn about the physical environment's impact. The operating procedure was meticulously documented during the observation. Such primary data is useful because it depicts the real-life circumstances, concerns, and problems that arise in an AUC-WT regularly. Knowledge of the task, on the other hand, was gained through regular interactions with the staff. Information and data were acquired that were not formally reported yet were critical to the study's success. Following up on these initial observations, interviews were conducted to gain a better understanding of the warehouse's operations.

3.3.2.1 Gemba Walk

Dipping on the importance of a Gemba Walk, the researcher did a Gemba walk several times in AUC-WT as part of a Lean approach to watch, engage, acquire information, and understand how personnel in the organization accomplish their work. During which, precise and in-depth questions have been asked about the process being observed.

The researcher asked the questions during a Gemba Walk such as:

- Who – Who are the people involved in the several processes? Who provides input for the processes?
- What – What are the inputs and outputs of the process? What obstacles inhibit the flow or produce waste?
- Where – Does the space where the work is performed conform to 5S? Are necessary materials and equipment conveniently located? Do you notice the waste of motion?
- When – Are process inputs available when needed? Is work from this process being pulled through by the next, or do outputs sit idle? Is the waste of waiting observed?
- Why - What value does this work add for the customer?

Gemba Walks, according to the researcher, assisted AUC-WT by developing knowledge through the integration and exchange of pieces of information. The technique assisted managers in making the best decisions, fostered consensus by getting people to agree on what the main problem is and how it can be addressed through observation and discussion, and improved AUC-WT's ability to capture the skills of each employee resource through direct interaction with employees.

3.3.3 Quantitative data

The researcher applied a quantitative approach by collecting data about all types of products in the AUC-WT, including previous sales reports, end of year stocktaking. This data was extracted from the company's accounting system.

3.3.4 Data Analysis

To address the problem of inventory management, analysis methods such as classic lean tools such as the 5S and the Eight Wastes were used to acquire qualitative data and identify the root causes of the problems to execute the necessary adjustments. E-Kanban is one of the lean and digital tools that was conducted in this study. To address the problem of the research the Auto-ID technology was applied as an improvement tool to identify and track inventory.

3.4 Implementation of 5S Lean Methodology

The researcher emphasized the use of the 5S methodology model and its different phases. A 5S model is a fundamental tool of lean management that benefits any organization by creating order and tidiness in the workplace.

The 5S Phases

Sort:

The main idea in the first phase is to classify the items at a specific site and whether they are relevant and functioning for performing a specific task or not. Irrelevant or unnecessary items must be removed after obtaining approval from the authoritative personnel.

Several steps must be followed in the first phase:

Primarily, a team that will take part in performing this phase is formed. The team consisted of workers from the same area. Involving the employees from the initial phases ensures the longevity of the process.

The second step is to train the team to ensure that the benefits and steps of the sort phase are recognized. All team members must be aware of the needed procedures and methods by which to perform the sorting phase guaranteeing that the entire area will be thoroughly inspected. The team will examine all the items and mark the items with green, yellow, or red tags. The relevant and functioning items will be marked with green tags. The yellow tags will be used for items that are still functioning but unnecessary for the task at hand. As for the malfunctioning items, they will be marked with red tags. The team will then seek approval on how and if to dispose of or relocate the yellow and red-tagged items.

It is essential that before initializing phase one of the 5S model, numerous pictures must be taken in order to document the improvements to be implemented. These pictures will be used to compare the new workplace environment: not only will the pictures aid in visualizing the improvements made but they are constructive in reminding the team of their achievements.

Set in Order:

Upon disposing of all unnecessary items, it is time to start organizing the area to increase the work ergonomics and the overall process flow. During this phase, the newly designated areas will be labeled with special markings to indicate what each area is assigned for. Furthermore, specialized racks or cabinets with visible guidance may be installed in order to organize the items further making the materials and tools easily accessible and organized. This phase is usually the most time-consuming phase of the entire 5S program.

Shine:

This phase consists initially of cleaning the workspace. The employees must perform this phase in order to value the actual process. A maintenance schedule will be drafted in order to maintain cleanliness. It is beneficial to maintain the working area in the same manner daily. This will aid in recognizing any malfunctioning machines and tools, excess items, and factors harming working safety.

Standardize:

A set of procedures detailing how an area should be maintained on a daily basis will be listed in this phase making abnormalities visible. The responsibilities of each employee will be detailed in their job description to facilitate standardization.

Sustain:

It is only when cleanliness and standardized order become part of the work habit and the organizational culture as a whole that the system will be sustainable. Well-defined responsibilities and regular managerial audits will greatly ensure sustainability. The core importance of this phase is to not solely maintain the current environment but to continuously seek improvements.

3.5 The PDSA Cycle

The researcher depends on the PDSA Cycle (Plan-Do-Study-Act) in applying a barcode system in AUC-WT. The PDSA Cycle is a systematic process for gaining valuable learning and knowledge for the continual improvement of a product, process, or service. Also, known as the Deming Wheel, or Deming Cycle, this integrated learning-improvement model was first introduced by W. Edwards Deming[2].

[2] https://deming.org/explore/pdsa/

As shown in Figure (4), The Plan-Do-Check-Act consisted of four phases. “Plan” is the first phase in the cycle, it includes determining a goal or purpose, establishing a theory, defining success measures, and putting a plan into action. These activities are followed by the “Do” phase, in which the plan's components, such as manufacturing a product, are executed. The next phase is “Study”, in which the plan's validity is tested by looking for indicators of progress and success, as well as difficulties and places for improvement. The “Act” stage completes the cycle by incorporating the knowledge gained throughout the process. This knowledge may be utilized to modify the aim, change the methodology, reformulate a theory, or expand the learning–improvement cycle from a small-scale experiment to a broader execution plan. These four processes can be performed indefinitely as part of a never-ending cycle of progress and learning.

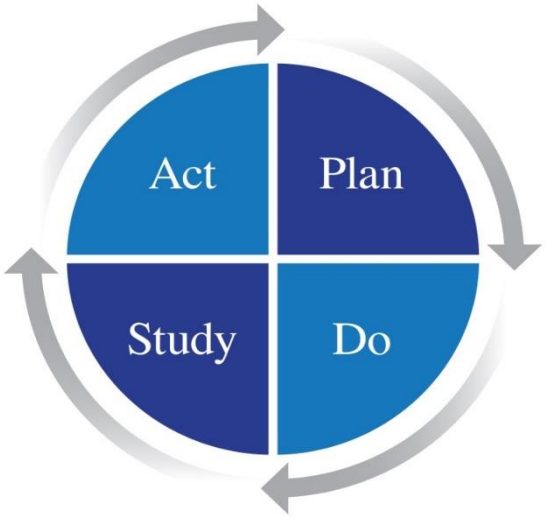

Figure (4): PDSA Cycle.

Source: https://deming.org/explore/pdsa/.

3.6 Monitoring and Evaluation

The sustainability of the 5S lean tool is aimed at continuous improvement, thus a floor check template has been developed to measure the overall organization and cleanliness of the factory. Furthermore, the measurement of success and evaluation of the progress was validated by conducting interviews before and after the implementation of the improvement tools.

Chapter Four:

Data Analysis and Findings

4.1 Overview

This chapter illustrates the practical application of the theories presented in the theoretical framework, where the researcher applied the methodologies explained in the third chapter to clarify the improvement in the areas in which the study methodology was conducted.

4.2 The Situation at the AUC-WT before Implementing the 5S Tool

The researcher made many Gemba Walks in the AUC-WT and interviewed all employees related to the problem of the study. This included internal staff such as the CEO of the company, top management, employees from different departments such as the accounting department, IT department, sales, and marketing department employees, and warehouse department. The researcher also depended on observation to inform about the influence of the physical environment.

AUC-WT lacked the application of lean management; a matter which is significantly affecting the workflow of the company and the satisfaction of all stakeholders including the customers. Several issues must be addressed that are hindering the ability of the company to perform efficiently:

- The lack of a suitable inventory management system is a pronounced financial burden on the company and a major source of waste and inadequate use of space. Also, there are inefficient and undesignated storage areas.
- Raw materials are scattered in the floor space due to the lack of inventory control.
- The company is managing and controlling its warehouse inventory in a manual traditional system. There's a lack in tracking its inventory flow, where management and employees do not have digitalized traceability system to know and follow up on

what is exactly in companies' stores which also affects the accuracy of orders for more products.

- Warehouse stores are not appropriately organized, where different products and materials are placed in the same place without differentiating each product from the other, which leads to extra time to reach certain products.
- Products are not priced appropriately, due to the huge variety of products and the non-availability of a pricing formula and not knowing the prices of competitors, also, not all prices were entered into the system, and the prices of some items were random, such as closet doors or drawer's handles, which leads to a reduction in sales and hence reduction in profit of the company.
- Lack of shelves to arrange the accessories.
- There is no order of items.
- There is no electronic application to organize the different types of goods

This has led to increased production costs, low worker morale, and delays in product delivery.

The researcher photographed the place before applying the 5S Tool, as shown in Figure (5).

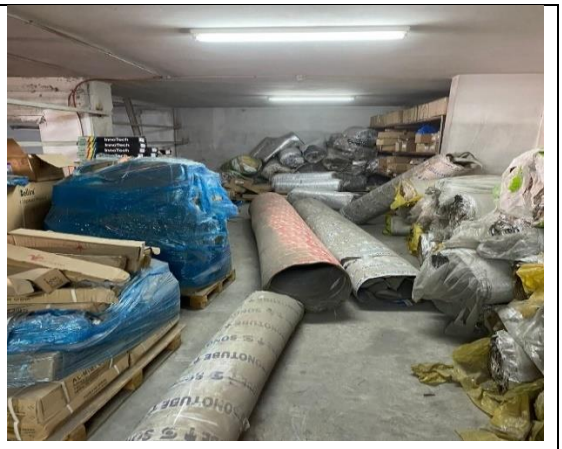


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Figure (5): Photos of AUC-WT before Implementation of the 5S Tool.

4.3 Applying Fishbone Diagram in AUC-WT

The researcher used The Fishbone Diagram to examine the AUC-WT 's warehousing problems. The head of the fish (diagram) enlists the main problem, while the symbolic body of the fish specifies what the causes of the problem and challenges are. As shown in Figure (6), the main problem in AUC-WT is the gap between the company's current working system and Digital Transformation; The company suffers from several problems in inventory management, such as the use of a traditional system for managing and controlling warehouse inventory, lack of tracking the flow of inventory, lack of organization of warehouse stores, and lack of appropriate pricing of products.

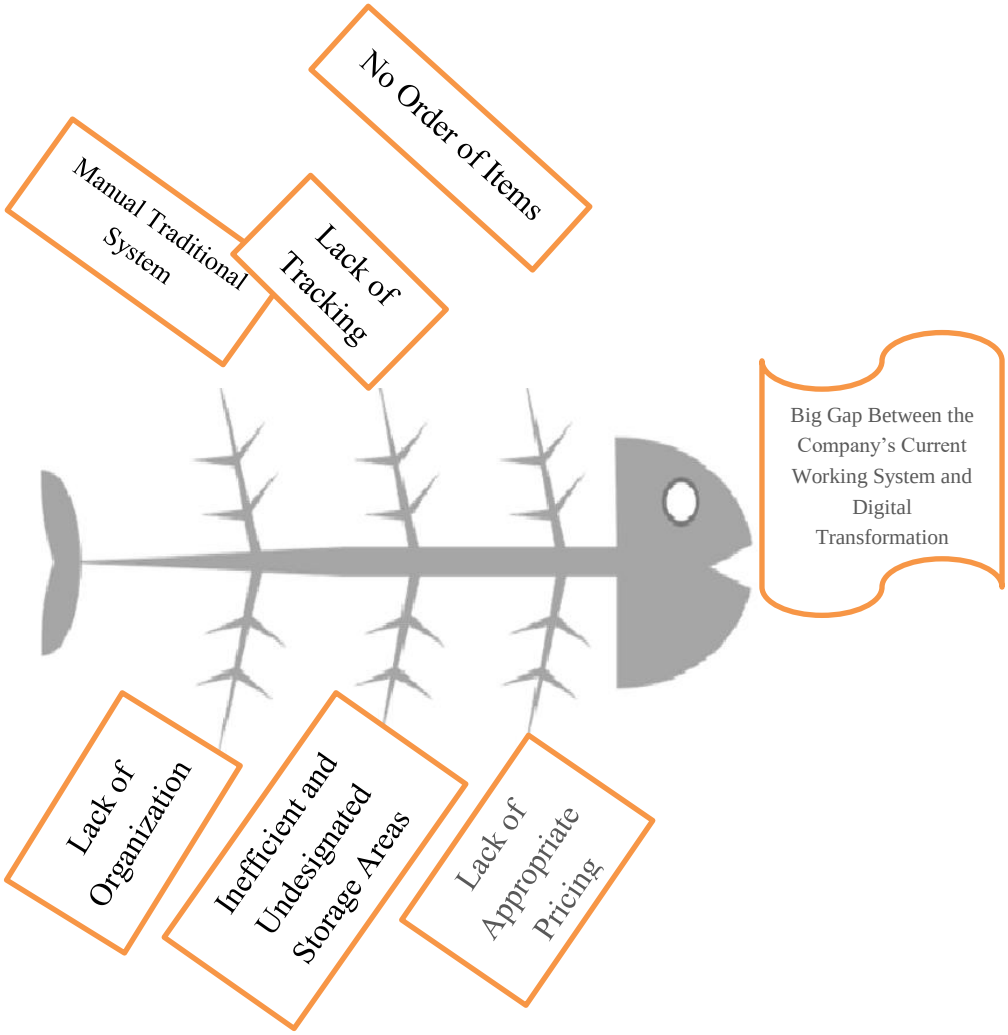


Figure (6): Fishbone Diagram of AUC-WT.

Source: By researcher.

4.4 Implementation of the 5S Tool in AUC-WT

In preparation for implementing 5S, the researcher selected a team that consisted of workers who are responsible for the area and a leader who has the authoritative power to make critical decisions in the AUC-WT. The implementation of 5S requires the understanding of all the related employees, supervisors, and managers. Selecting the team members has been extremely beneficial in obtaining the dedication needed in implementing 5S.

4.4.1 Sort

The main idea in the first phase is to classify the items at a specific site and whether they are relevant and functioning for performing a specific task or not. Irrelevant items must be removed after obtaining approval from the authoritative personnel.

All unnecessary items were collected from Warehouse (1), put in one place, and placed in Warehouse (2), as shown in Figure (7).

Figure (7): Unnecessary items in Warehouse (2).

To carry out this process, two workers were assigned to separate the items to facilitate the inventory process. Each item was placed on wooden boards and raised to the top. As well as arranging the sites for all items, getting rid of the excess, and placing another category as a substitute for it (temporary classification).

As a result, an effort was done to sort the handles into one family in order to make the coding process easier afterward. This is illustrated in Figure (8).

Figure (8): Photos of handles sorting and grouping them into one family.

Also, at this stage, the items that are not sold (obsolete) were disposed of by organizing a campaign to get rid of them.

The staff examined all of the items and tagged them with green, yellow, or red tags to make the work easier. The items (products) that were relevant and functioning were identified with green tags. The yellow tags were used to identify things that were still usable but no longer required for the operation. Red tags are used to identify items that aren't working. As shown in Figure (9), the team will subsequently seek approval on how and if the yellow and red-tagged artifacts should be disposed of or moved.

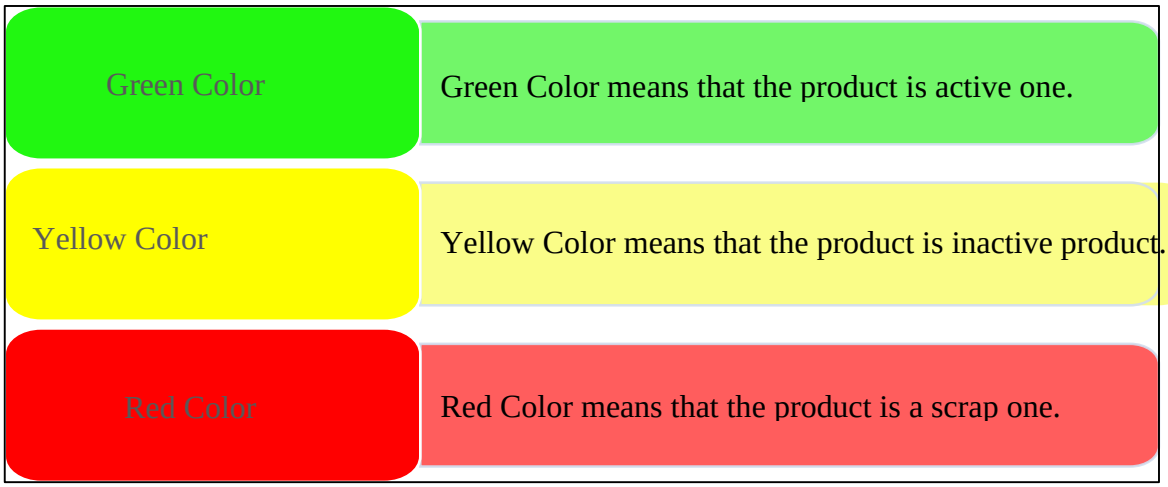


Figure (9): Three-color technique of Sorting.

4.4.2 Set in Order

After disposing of all unnecessary items, the area was organized to improve the work environment and the overall process flow. In this phase, the newly designated areas were labeled with special markings to indicate what each area is assigned for. Furthermore, specialized racks or cabinets with visible guidance may be installed in order to organize the items further making the materials and tools easily accessible and organized. This phase is usually the most time-consuming phase of the entire 5S program (Yik & Chin, 2019).

The researcher prepared a report with the help of the financial employee, showing the most sold goods or the most demanded goods. The goods were classified as families and accordingly PARETO Analysis was done and based on the results, the shelves were designed to distribute the goods in the form of families. Taking into account that to organize the process of arranging the goods, an entire floor was evacuated, were measurements taken of the place and accordingly, shelves were designed.

AUC-WT conducted a study to find out the number of shelves needed to arrange all the items and to determine the cost of these shelves (one shelf at the bottom carries about 450 kilograms, and the shelves at the top can carry 150-200 kilograms), and the cost of each kilogram of shelves is about 4.2 shekels.

The mechanism of arranging items on the shelves: placing the open carton at the top for sale, and the closed carton at the bottom. When the open carton is empty, the closed carton is placed in its place and opened, and a closed carton is brought into its place.

Figure (10) shows shelves before they are filled with items and the implementation of the Set-in-Order technique.

Before Set in Order

Figure (10): Photos of shelves before arranging all the items.

While Figure (11) shows how to arrange the supplies in families on the shelves, put a barcode label on them, and the items that were in great demand were placed in the front, to make it easier for the customer to choose from them. As for the items that had little demand, they were placed in Warehouse (1), Zone (B).

After Set in Order





Figure (11): Photos show how the supplies are arranged in families on the shelves.

In terms of the wood arrangement, the researcher followed up to put labels on the shelves to designate the type of wood panels to be housed in each part after arranging the wood. To improve the process flow, the wood panels are organized on shelves by kind and frequency of usage.

Furthermore, to distinguish it from other woods sold by cubic meter, the wood sold by the piece was put in Warehouse (1), Zone (A), with a label for each type of wood placed for convenience of choosing by customers and staff. Figure (12) illustrates this point.

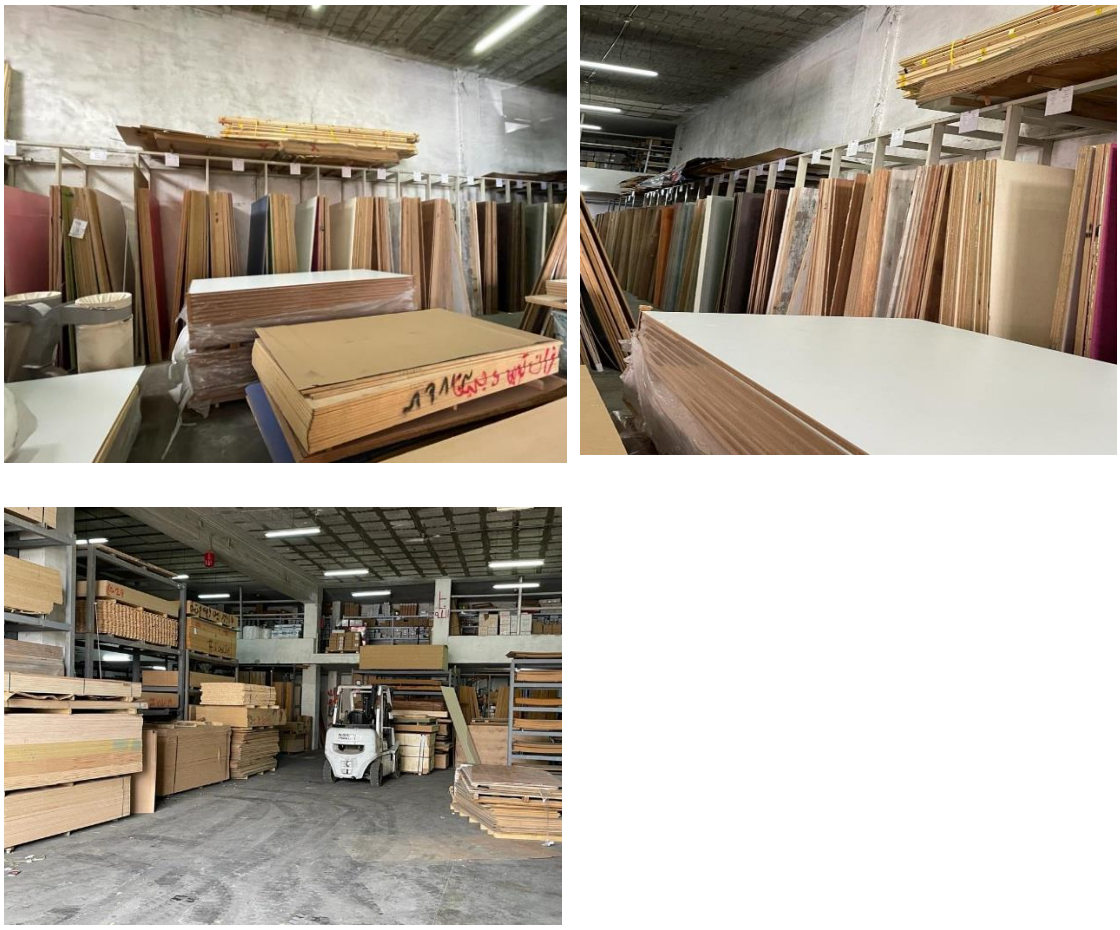


Figure (12): Photos of the woods sold by the piece in Warehouse (1) Zone (A).

The wood that is sold in cubic meter units is stored in Warehouse (2). It requires a lot of space and isn't impacted by the weather. As a result, it is more classed and controlled than other things in the company, as shown in Figure (13).

Figure (13): Photos of the woods sold by the cubic meter in the warehouse (2).

4.4.2.1 Plant Layout

The place was re-designed and restored, as it was agreed to completely re-design the company, as there are complete designs that show what the company will look like in the future to arrange the company better and acquire new spaces to display the items clearly and easily. Taking into account the designs that will be adopted in stages because the project is very expensive, so it can be put as recommendations for the future.

Figure (14) shows how to make use of the space in Warehouse No. (1), Zone (B) which was empty and was cleaned and shelves arranged.

Figure (14): Photos illustrate how the space in Warehouse No. (1), Zone (B) was utilized.

4.4.3 Shine

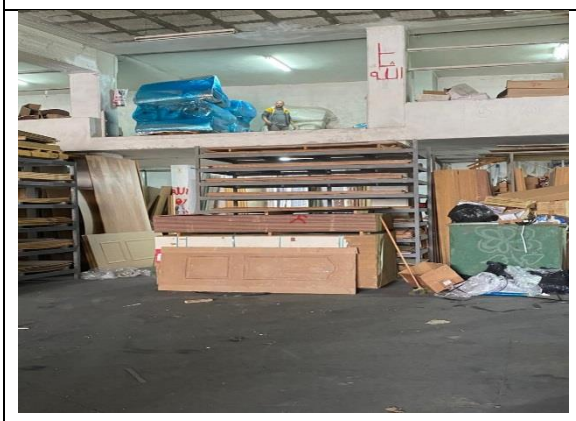
This phase consists of cleaning the workspace. The employees must perform this phase in order to value the actual process. A maintenance schedule was drafted in order to maintain cleanliness. It is beneficial to maintain the working area in the same manner

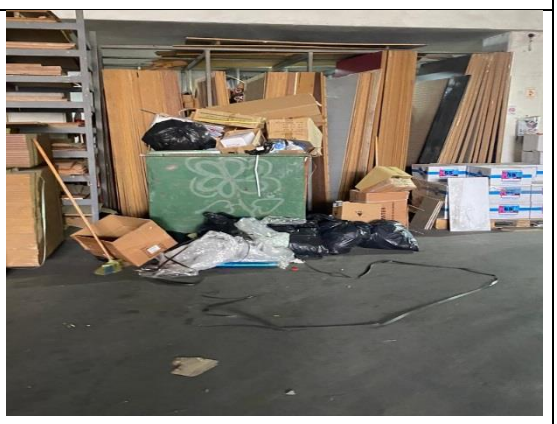
periodically. This aids in recognizing any malfunctioning machines and tools, excess items, and factors harming work safety.

Figure (15) illustrates the workspace before implementing the shine step.

Before Shine






Figures (15): Warehouse before Shine.

Figure (16) illustrates the workspace after implementing the shine step.

After Shine



Figures (16): Warehouse after Shine.

4.4.4 Standardize

Standardize requires a clarification of the responsibilities of each employee to be detailed in their job description to facilitate standardization.

In addition, a new warehouse manager position has been created in the organizational structure, to ensure that the company prevents any clutter in the warehouse. Also, the manager is able to monitor the stock levels of the items avoiding the creation of obsolete items and limiting the financial burden of high inventory.

Because each item has a designated spot on the shelves, and each shelf has a label displaying the products on it, the shelves and labels aid workers in gaining easy access to the items. This makes it easier for employees to complete their tasks and boosts their productivity.

4.4.5 Sustain

Sustaining the work done so far is the final step in the implementation of the 5S tool in order to ensure that the process is to be maintained. So, it was essential to train the warehouse manager on the understanding of the 5S principles and procedures. The general manager will regularly audit the checklist compliance (see Appendix (1)) and conduct periodic meetings with the supervising personnel to ensure adherence to the 5S scheme and discuss further improvements.

4.5 Pareto Analysis

As mentioned before the researcher prepared a report with the help of the financial and purchasing department, showing the most sold items or the most demanded items. The items were classified as families, Tables (6) and (7) illustrate the results.

Table (6) demonstrates that AUC-WT wood sales amounted to about 1.8 million units sold in the year 2021, out of which the Swedish Wood both raw and polished sales constituted the highest percentage of the company's sales 36.8%, followed by the Finnish white wood (Tobar) sales by a percentage of 32.4%, and in the third place is Brick Tiles (Karmeed) by a percentage 20%, then the Sandwich wood and MDF percentage 10.7%, and the lowest percentage was for wood doors sales which are 0.15% as shown in Figure (17).

Figure (17): Percentage Distribution of Wood sales in AUC-WT in 2021.

Table (6): Wood sales in AUC-WT in 2021

Class Family	Sales unit Amount	Percentage	Site	The reason for the site	Notes
Swedish Wood, raw and polished	648943	36.8	Warehouse No. 2	It is in high demand and needs a lot of space. Warehouse No. 2 is large and can accommodate a large number of Swedish wood panels. It is also a natural wood, which is not affected by weather factors such as rain, sun, and humidity.	It is sold by the cubic meter, not by the number, but the number has been calculated for the plates used by multiplying the number by the cubic meter by the number of plates, which is 17539 * 37 "
Finnish white wood (Tobar)	571000	32.4	Warehouse No. 2	It is in high demand and needs a lot of space. Warehouse No. 2 is large and can accommodate a large number of Swedish wood panels. It is also a natural wood, which is not affected by weather factors such as rain, sun, and humidity.	It is sold by the cubic meter, not by the number, but the number has been calculated for the plates used by multiplying the number by the cubic meter by the number of plates, which is 5710*100 "
Kermed	352383	20	Warehouse No. 2	It is usually sold with Tobar wood for	

				construction purposes	
Sandwich wood, MDF	189417	10.7	Warehouse No. 1 Part A	It is in relatively high demand daily. It can be affected by external factors, so it is placed in a closed place, also Warehouse No. 1 is a warehouse for displaying goods in front of the customer through which he can choose what he needs.	
Wood Doors	2610	0.15	Warehouse No. 2	It is on the second floor of Warehouse (2) because the doors are sensitive to anything.	
Total Wood Sales	1,764, 353	100%			

Table (7) shows that overall Supplies and Accessories sales in 2021 were about 600,000 units, with Edge Banding Material accounting for the majority (76.2 percent), while the remaining goods are dispersed in tiny proportions: Screws (8.9%), Hand holders (5.6%), Drawers' Rails (5.3%), Paints (1.3), Scotsh (0.8), Nickel legs (stainless) (0.7), Formaica (0.7), Drawers (0.2), Karnaise (0.1), Mattresses (0.1), Vegetable Baskets (0.1) as shown in Figure (20).

Because of the large number of these items, the researcher suggested that shelves should be installed and that these items be arranged on them, Figure (15) shows how to arrange the supplies in families on the shelves, and put a sticker on them. As for the items that had little demand, they were placed in Warehouse (1), Zone (B).

Table (7): Supplies and accessories unit Sales in AUC-WT in 2021

Class Family	**Sales Amount**	**Percentage**
Edge Banding Material	466924	76.2
Screws	54456	8.9
Hand holders	34380	5.6
Drawers Rails	32636	5.3
Paints	7727	1.3
Scotsh	4845	0.8
Nickel legs (stainless)	4414	0.7
Formaica	4383	0.7
Drawers	1052	0.2
Karnaise	907	0.1
Mattresses	678	0.1
Vegetable Baskets	412	0.1
Dish Racks	286	0.0
Total Supplies Sales	**613100**	100%

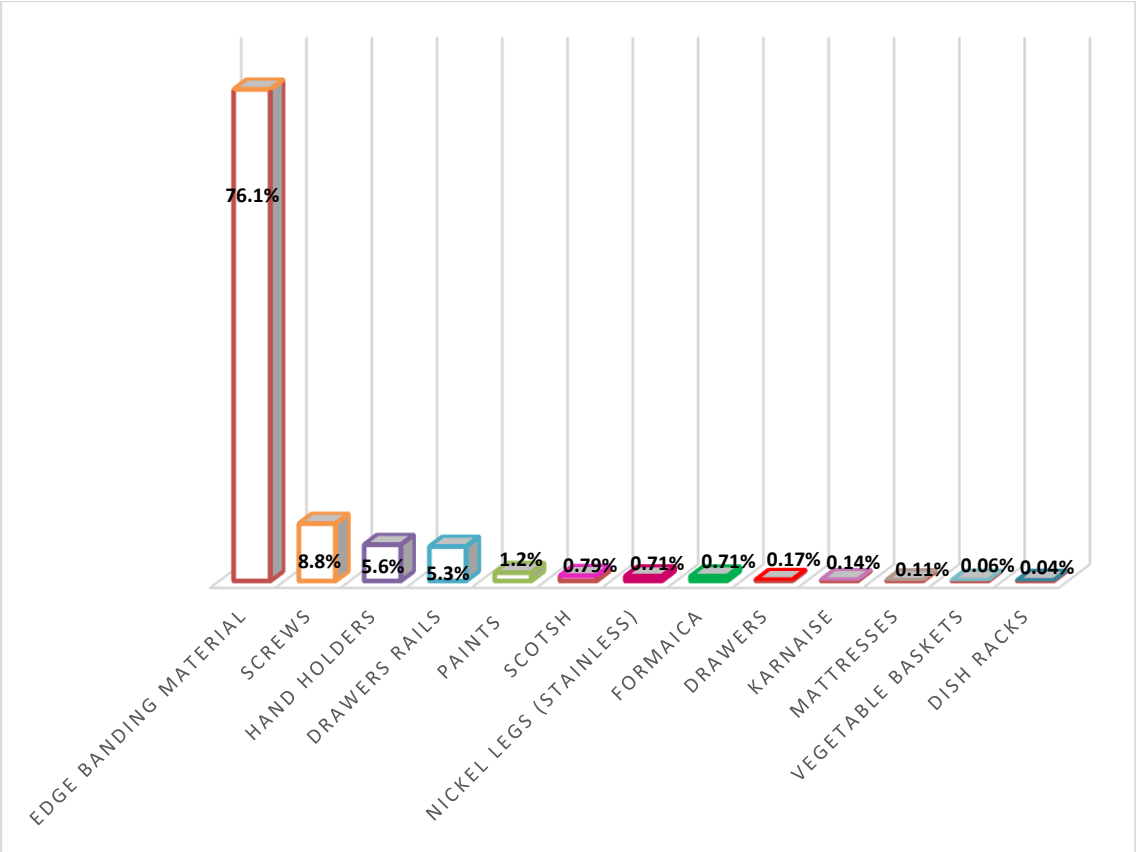


Figure (18): Percentage Distribution of Supplies and Accessories Sales in AUC-WT in 2021.

As can be seen from tables (6) and (7), the company's total sales are about 2.4 million units sold in 2021, about three-quarters of them are Woods, and about one-quarter are supplies and accessories, as shown in Figure (19).

Although wood sales account for the majority of the company's sales, they are simple to organize and sell; as previously said, they are sold by cubic meter, and some are sold by the board. Supplies and accessories, on the other hand, account for a little fraction of sales, but they are numerous and need a significant amount of follow-up effort. Despite this, AUC-WT must continue to offer both sorts (wood and supplies), because each of these two types complements the other on the one hand, and increases the company's sales on the other.

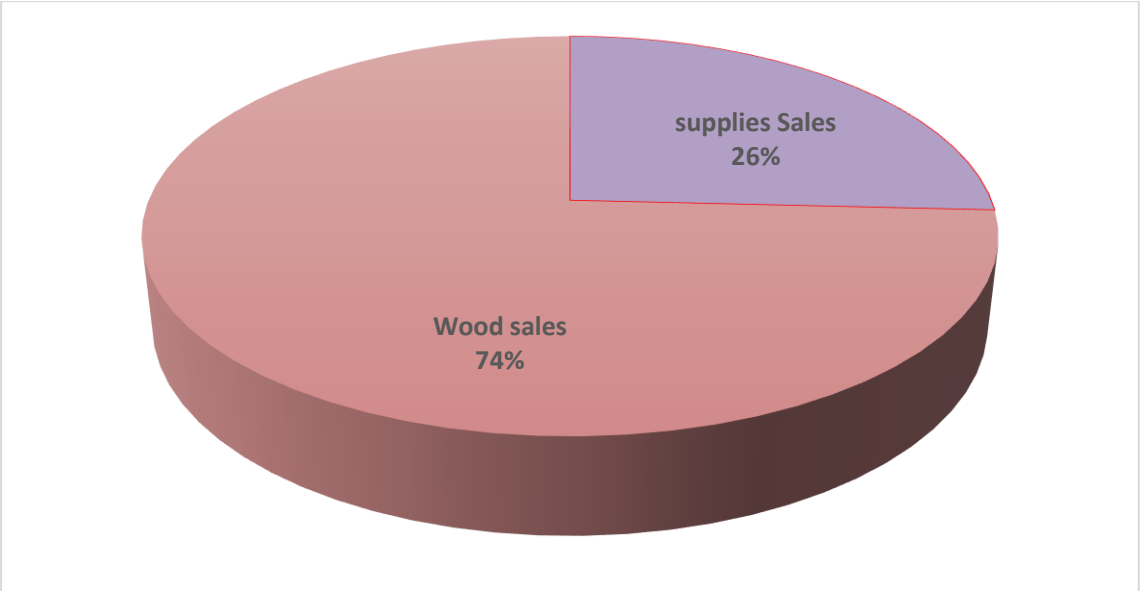


Figure (19): Relative distribution of Sales in AUC-WT in 2021.

4.6 Implementation of the Automatic Identification (Auto-ID) technologies

The researcher worked with the company's personnel one-on-one to put the study's ideas into practice in order to grow and improve the company's performance. The issue was evaluated and followed up on using the PDSA approach, which may be summarized as follows:

4.6.1 Plan

The researcher developed a plan coordinated with the general manager of AUC-WT to purchase the barcode device, as it helps to price items quickly, in addition to clarifying the quantity in stock.

4.6.2. Do

AUC-WT contacted 4 companies specialized in selling barcode devices, 3 tablets were purchased from Al-Jarmaq company for AUC-WT's branches in Al-Ram and Ramallah (Eco1600 8” Rugged Tablet - Android/Win) as shown in Figure (20).

Figure (20): Tablets purchased by AUC-WT.

Also, purchase one printer to print labels (ZEBRA ZD220 4-Inch Value Desktop Printer) as shown in Figure (21). Bearing in mind that before purchasing the devices, a communication was made with Bisan Accounting Company to ascertain the type of devices that apply and be compatible with the company's accounting system.

Figure (21): Printer purchased by AUC-WT.

All items sold were made sure of supplies entered into the system (the focus was on supplies and accessories more than wood because there was a major problem in managing

them), and the serial code was adopted for each item, all items were printed on labels, and each label was placed in the right place. This process was done in conjunction with the application of the 5S Methodology, especially the Sort and Set in order phases.

In practice, the researcher followed up with the company's employees on their use of the barcode device in the sale of various items. Where the workers used barcode devices and tablets, starting from receiving purchase orders and ending with delivering the items to the customer according to the following stages:

In the first stage, the sales representative or the employee in charge of the company registers the order from the customer on the tablet device based on their requirements, by scanning the barcodes of the items.

In the second stage, the order goes electronically to the sales manager (to approve the payment method and quantities that can be delivered to the customer) and sends it to the cashier to give an electronic approval of the order.

In the third stage, the order goes directly to the warehouseman to start processing it.

In the fourth stage, the sales manager checks the order and items, sends a copy to the cashier to prepare the invoice, delivers the existing items and the invoice to the customer and follows up on their delivery to the customer, and the order remains on the system until the rest of the missing items are delivered.

For purchases, the program is designed to give a signal to the warehouseman when the quantity level of goods for each item reaches a certain limit that is determined for each item separately, then the warehouseman orders the needed quantities.

4.6.3 The Study Phase

The researcher worked in coordination with the financial manager and the company’s employees to analyze the sales data in accordance with the previous procedures, as it was

ensured that the objectives of the plan were achieved, in terms of quick pricing, and controlling the quantity of inventory.

The researcher also found, through follow-up with the Director General, that all prices of items have been entered into the system; Selling is based on accurate prices, and the company's prices have become competitive. All this increased the company's profits. This confirms once again that the plan developed by the researcher has succeeded.

4.6.4 The Act Phase

The researcher followed up with the staff to ensure the continuity of the process. In addition to developing the mechanism of action so that it is to purchase quantities of different items according to demand, so that goods do not accumulate in warehouses, intensify supervision of workers to ensure the mechanism of their work, and proceed with work step by step starting from the process of inventorying all items, determining the number of shelves, purchasing them, installing them, arranging items on it, and then start the coding process.

Chapter Five:

Conclusions and Recommendations

5.1 Overview

In this chapter, the conclusion of the study is given, and the main recommendations are provided.

5.1 Conclusions

According to the findings of the analysis, utilizing the 5S Tool at Almimi United Company for Wood and Trading resulted in a suitable inventory management system, improved inventory control, and the removal of irrelevant or unnecessary items, as well as the removal of excess, and the items that were not sold (dead) were disposed of through the organization of a campaign to get rid of them.

In addition, the area was organized to increase the work ergonomics and the overall process flow, and more transparency.

Moreover, a more organized area improved inventory management and control. Cleaning the workspace led to recognizing any malfunctioning machines and tools, removal of unnecessary items (stocks), and factors harming working safety, workspace area increased to fit all items, and all items were categorized based on families, easiness to reach items, and products (improved tool searching time and time preparation for shipment), reduced wastes such as over motion, waiting time, over-processing. Clearing the responsibilities of each employee, the new warehouse manager prevents any clutter in the warehouse.

On the other hand, the implementation of the Automatic Identification (Auto-ID) Technologies in conjunction with the application of the 5S Methodology led to:

All supplies and accessories items were entered into the barcode system of Bissan, and the serial number code was adopted for each item, all items were printed on labels, and each label was placed in the right place, which led to sufficient tracking, increased work efficiency, and reduced wastes such as over processing.

The procedure for accepting purchase orders and delivering items was broken down into steps. In addition, when the number of products in each item hits a particular limit that is calculated for each item independently, the software sends a signal to the warehouseman. The researcher also led the process of entering the prices for all items into the system, which led to more accurate prices (more competitive pricing), and ensured that sales are based on accurate prices and that the company's prices had become competitive. The earnings of the corporation rose as a result of all of this.

The purchased quantities of various items are now done per demand in the right quantities so that items do not accumulate in warehouses; no more counting of supplies intensifies worker supervision to ensure the mechanism of their work; and proceed with work step by step, beginning with inventorying all items, determining the number of shelves, purchasing, installing, and arranging items on them, and then beginning the coding process.

5.2. Recommendations

In the light of the study findings, the researcher suggests the following recommendations:

1. The company’s management meets periodically (for example, every quarter) to ensure the 5S methodology is well managed, follow up on classifying the material as irrelevant or unnecessary items to remove, getting rid of the excess, and items not sold.

2. Inventory management ensures that new items are categorized and distributed into families on the shelves.
3. The inventory manager is constantly following up on a maintenance schedule on a periodical basis, in the order to recognize any malfunctioning machines and tools, excess items, and factors harming the working safety.
4. The company's management Improves organizational structure (make sure that all co-workers have specific tasks and “use unutilized talents”, and this may help to create new jobs that help develop the work in the company.
5. The general manager regularly audits the checklist compliance and conducts periodic meetings with the supervising personnel to ensure adherence to the 5S scheme and discuss further improvements.
6. The company should follow- up on the maintenance and updating of the barcode device.
7. Inventory management Complete coding of all existing items (woods) and any new items.
8. Development of the barcode to include the name of the region and the location of the items.
9. Activate the E-KANBAN system and tracking system.
10. The management of the company continues to work on fully redesigning the company.
11. The company, after a year or two, should conduct a study to show the impact of the various measures recommended by this study, to find out the extent of their impact on reducing costs, facilitating work, and developing the company's performance.
12. The company should fully automate its work to benefit from the technological development in the world.

13. Continuous training for employees on Lean Management, to enhance the concept of Lean Management in the company.
14. Plan to increase the sales of supplies and accessories.
15. Re-design of the company's warehouses (SUITABLE SHOWROOMS).
16. Activate social networks to stay connected to all customers.
17. Applying the results of the study to the Al-Ram branch.

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Appendix (1)

5S Methodology Checklist

Work Area: . . . . . Date: . . . . . .

5S Leader: . . . . . 5S Auditor: . . . . . .

Put ✓or ✗ against each item

S1 - Sort:	
1. No unnecessary items are left or stored in the workplace.	
2. All machines are in use.	
3. All tools are in use.	
4. Standards for eliminating unnecessary and returned finished goods exist and are being followed.	
5. unused equipment and machinery removed from the area	
6. Is there any obsolete inventory (wood panel, accessories)?	
S2 - Set in order	
7. Locations of tools and equipment are clear and well organized.	
8. Locations of accessories, wood panel and wood scrap are clear and well organized.	
9. Labels exist to indicate locations, and shelves.	
10. Are storage places for tools and equipment designated and marked?	
11. Are returned goods placed in there designated area?	
S3 - Shining:	
12. Floors free from dirt and dust.	
13. Racks, cabinets and shelves are kept clean.	
14. Machines, equipment and tools are kept clean.	
15. Stored items, are kept clean.	
16. Cleaning assignments are defined and are being followed.	
S4 - Standardize:	
17. Information displays, signs and other markings are established.	
18. Procedures for maintaining the first three S's are being displayed.	
19. 5S checklists, schedules and routines are defined and being used.	
20. Everyone knows his responsibilities, when and how.	

21. Regular audits are carried out using checklists and measures.	
S5 – Sustain:	
22. 5S seems to be the way of life rather than just a routine.	
23. Success stories are being displayed (i.e. before and after pictures).	
24. Rewards and recognition is part of the 5S system	

Comments……

ملخص

تمثل الهدف الرئيس لهذه الدراسة في تحسين نظام إدارة المخزون في شركة الميمي المتحدة للأخشاب والتجارة (AUC–WT) من خلال دمج كل من تقنيات الإدارة الرشيقة والرقمنة مثل أنظمة تكنولوجيا التتبع.

لتحقيق الغرض من هذه الدراسة، اتبع البحث كلاً من النهج النوعي والنهج الكمي، فقد أجرت الباحثة مقابلات مع جميع الموظفين ذوي الصلة بمشكلة الدراسة. ويشمل الموظفين الداخليين مثل الرئيس التنفيذي للشركة، والإدارة العليا، والموظفين من مختلف الإدارات مثل قسم المحاسبة، وقسم تكنولوجيا المعلومات، والمبيعات، وموظفي قسم التسويق، وقسم المستودعات. بالإضافة إلى الموردين الخارجيين مثل شركة بيسان. كما اعتمدت الباحثة على أسلوب الملاحظة في الاطلاع على بيئة العمل في الشركة عن كثب. وأثناء الملاحظة، تم توثيق آلية العمل بعناية. كما طبقت الباحثة منهجية Gemba Walk عدة مرات في الشركة باعتبارها واحدة من إجراءات تقنية الإدارة الرشيقة للملاحظة والتفاعل وجمع المعلومات وفهم كيفية أداء العمل من قبل الموظفين في الشركة. واعتمدت الباحثة كذلك على منهجية PDSA Cycle (Plan–Do–Study–Act)في تطبيق نظام الباركود في الشركة.

تظهر النتائج الرئيسية للدراسة أنه قبل تنفيذ منهجية 5 S، من الواضح أن AUC–WT تفتقر إلى تطبيق أي فكرة عن الإدارة الرشيقة؛ وهي مسألة تؤثر بشكل كبير على سير العمل ورضا جميع أصحاب المصلحة بما في ذلك العملاء. ولكن بعد تنفيذ أداة 5 S، تم تصنيف المواد في مواقعها الصحيحة سواء كانت ذات صلة وتعمل لأداء مهمة محددة أم لا، وأصبحت منطقة العمل منظمة بهدف تنظيم العمل وتدفق العملية بشكل عام، وتم تصميم الأرفف من أجل توزيع البضائع على شكل عائلات. أيضًا، تنظيف مساحة العمل، وتم إنشاء منصب مدير مستودع جديد في الهيكل التنظيمي، والحفاظ على استمرارية العمل المنجز وهو الخطوة الأخيرة في تنفيذ أداة 5S من أجل ضمان الحفاظ على العملية. كما أدى تنفيذ تقنيات التعرف التلقائي (Auto–ID) إلى قيام شركة AUC–WTبشراء جهاز الباركود، والأجهزة اللوحية، وطابعتين لطباعة الملصقات. تم التأكد من جميع العناصر المباعة من المستلزمات الموجودة على النظام، واعتماد رمز الرقم التسلسلي لكل عنصر،

وتم طباعة جميع العناصر على الملصقات، ووضع كل ملصق في المكان الصحيح. تمت هذه العملية بالتزامن مع تطبيق منهجية 5S.

على ضوء نتائج الدراسة، يقترح الباحث التوصيات التالية: يجب أن تتبع AUC–WT لاستكمال إعادة تصميم الشركة، وأن تقوم بعد عام أو عامين بإعداد دراسة لإظهار تأثير التدابير المختلفة التي أوصت بها هذه الدراسة، لمعرفة مدى تأثيرها في خفض التكاليف، وتسهيل العمل، وتطوير أداء الشركة، والتدريب المستمر للموظفين على أساليب الإدارة الرشيقة. وأن تقوم الجامعات بإعداد العديد من الدراسات على المستوى التفصيلي، كوسيلة لتعزيز الالتزام بمبادئ الإدارة الرشيقة، بما في ذلك: الدراسات القطاعية، على مستوى القطاعات الاقتصادية، وإعداد دراسات لمزيد من الشركات بأسلوب دراسة الحالة، لإنشاء نموذج ناجح للالتزام بمبادئ الإدارة الرشيقة. وأن تنظم الجامعة ورشة عمل في الغرفة التجارية، تُعرض فيها هذه الدراسة لتعميم التجربة على الشركات.

الكلمات المفتاحية: مبادئ الإدارة الرشيقة؛ منهجية 5 S، نظام إدارة المخزون، شركة الميمي المتحدة للأخشاب والتجارة في فلسطين.