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Faculty of Engineering and Information Technology

Industrial Engineering Department

A study for implementing production tools management system at Al-Hijjawi Company - Al-Naser Press

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Abstract:

Al-Hijjawi Company consider as one of the largest companies in the west bank in the field of printing and its services, pre- and post- press works, printing works and techniques, hard covering, and designing various publications used in a number of businesses such as (publicity and announcement, food packaging, the banking sector...etc).

There are several production lines and advanced printing machines that work with the latest printing technologies used in the world, these techniques depend on die cut and tools that are specially manufactured for each different type of print. These tools (diecut, plates & cliché) can be used several times.

The goal of this project is to create a management system for customized tools (diecuts, plates & cliché), as the loss of these tools or the use of one of them instead of the other costs the company money and time to fix the problem, and in some times when these tools are lost, the company is forced to make new tools and this may increase the price at the expense of the customer. Also finding a solution for finding an area to properly store these tools, and apply principles of industrial engineering specially in storage to ensure easy access, prevent the loss of these tools and to provide inventory control of them, also preserve them from deterioration and damage.

Chapter 1

Introduction

This project will discuss the problem and the proposed solutions for Al-hijjawi company, all the sides of the problem were studied. the main issue they are dealing with is the lack of management for the tools used in the production process, which as a result led to a complete random storing process of tools and even not using the correct tool for the production, it is a serious problem that then led to the consequences of taking the responsibility of reproducing orders if there were any mistake in the process of choosing which tool is the correct and needed , as a result the Subsequent costs of reproducing that the company have to deal with.

This project will study the problem from all its dimensions and then present the solutions proposed to solve the problem, which will concentrate on creating a storage system that would arrange all types of tools in a way that makes it easy to reach and identify, as well as creating a way that could make it possible to distinguish between all kind of tools.

When creating the storage system and the way of clarifying each and every tool, we needed a way that could combine these two aspects together so it could be a fixed criteria for classification that does not depend on the workers expertise.

1.1 Background:

Al-Hijjawi Company founded by Mr. Abdul Rahman Hijjawi in 1935 as a printing press called Al-Nasir located in the old city of Nablus, next to Al-Nasr Mosque, after the success of his business he decided to grow up in his work by creating new production lines with advanced technologies using efficient and quality printing machines that compete at the local and regional market level, The main printing house was moved to the industrial zone in Nablus, near Balata refugee camp. The building contains administrative offices, sales and accounting, design department, digital printing department, multiple production lines, in addition to stores. As he grows, his business has turned in to a family business heredity.

Figure 1: logo of the company

1.2 Problem Statement

The importance of this project lies in the importance of these tools (diecut, plates & cliché) and their main role in the production process, the problem here that there is no management and storing systems of these tools which makes them loss in a place that no one knows, as a result the stacking of these tools with no real benefit of them, also in case of the disappearance of plates after they were used in the production work and the customer wanted to reprint another quantity, he would have to pay the costs of implementing new plates, although the life

cycle of the pallets exceeds 100,000 copies and the cost of one pallet is about 60 shekels, as a result the customer dear these extra avoidable expenses.

There are two types of problems related to the diecuts used in producing (boxes, labels in large quantities and wedding cards), the first problem is represented in that there is no system to store, manage and recover the files that comes from the diecut designer and are used by graphic designers to install the design on them to ensure the design is printed in the right place and then cut as required.

The second problem is that after implementing the diecut and using it in production, there is no management system for these diecuts and no specific place to store them, so they are being stored in random places with no management for them, and the loss of these tools, whether they are in the form of files or diecuts, causes many problems including errors in the design department due to the use of the wrong file of the diecut, as the error is discovered at a late stage after completing the printing stage and reaching the cutting stage also knowing that the diecut used in the design is different from the correct diecut installed on the cutting machine. Another aspect of the mentioned problem is the loss and damage of diecuts inside the production line as in the production process the diecut turned to be lost or damaged.

These problems cost the company large amounts of money, sometimes represented in the rejecting of some publications after the printing process due to the discovery of errors in the use of diecuts, and sometimes the company is forced to manufacture new diecuts despite their presence, due to the impossibility of access to them and the cost of re-manufacturing these lost or damaged diecuts, which the company is required to cover in sometimes and other times it is required to cover by the customer if its loss is discovered in synchronism with the customer's request for another patch, and this reduces customer satisfaction as the cost of one diecut ranges between (400-1000 ₪), in addition to the time taken to produce one mold (a week to 10 days), which increases the time required to deliver customer orders and this affects the company's competitive advantage.

The company owns several production lines to meet the needs of the market, as the type of products produced by the company is varied in specifications and characteristics based on the customer's request, as the company does not produce large quantities of a specific product and then sell it, but rather produces according to demand, specifications and quantities specified by the customer.

In addition, the company's reliance on the workers' experiences and their knowledge of the required manufacturing tools constituted a burden on them in addition to the burden of the production process they are responsible of.

A production company like this must be responsible and create a system that facilitates work and does not depend on workers. In the end, this is considered as production system for the company, and this puts the company on the burden of its inability to abandon experienced workers, even if they are old and poor in their performance, because the production process depends on them mainly.

In addition to the costs that the company incurs from errors resulting from the workers' lack of clarity of the tools that should be used.

Pictures showing Random storage and stacking of Diecuts with no sorting criteria:

Figure 2: Random stacking sized (70×100) of Diecuts

Figure 3: Random storage of different sized Diecuts

Figure 7: Small Diecuts in Random places

Figure 4: Random placing of different sized Diecuts

Figure 6: Different sized Diecuts together

Figure 5: Diecuts in every corner

Figure 8: Bad quality and random storage of Diecuts

Figure 9: Storage without specific way of sorting

Figure 10: Different sized random sorted Diecuts

Pictures showing Random storage and stacking of Plates with no sorting criteria:

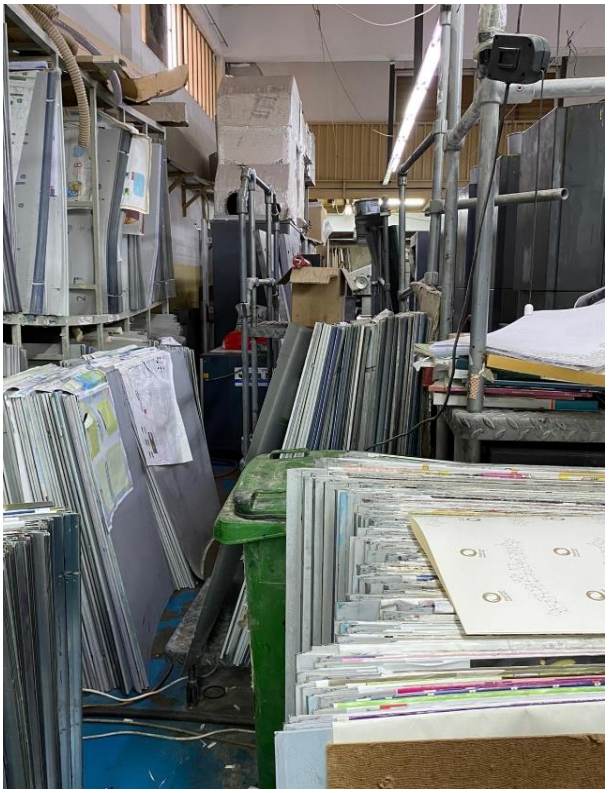


Figure 12: Random placing of plates

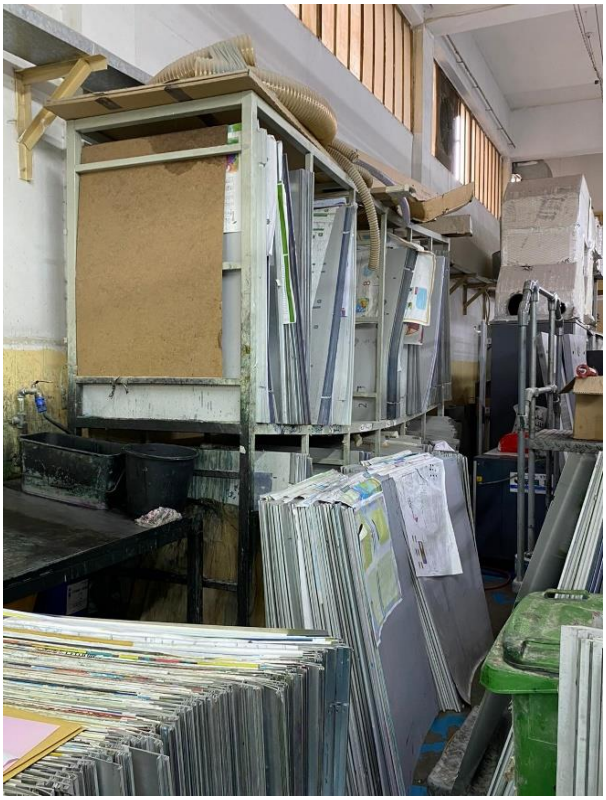


Figure 11: Random placing of plates

Figure 13: Plates in random places

Figure 14:Bad storing condition (next to the window)

Figure 16: Plates in random places

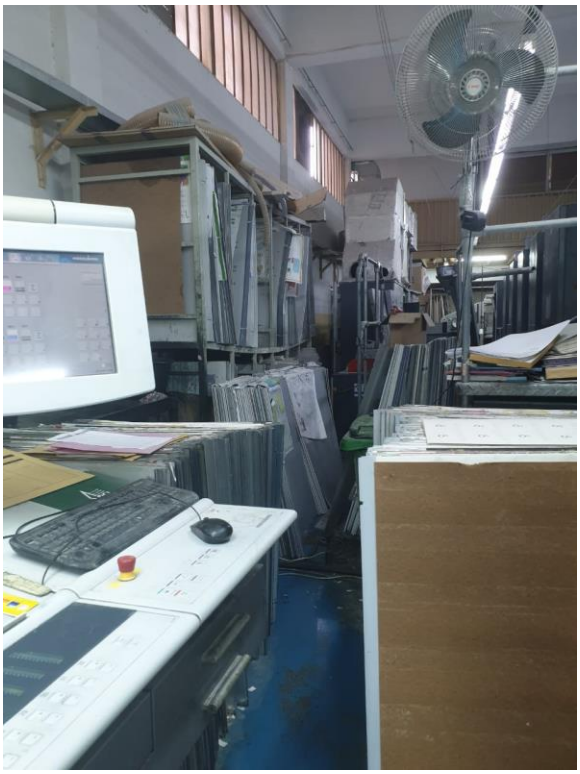


Figure 15: Random sorting of plates

Figure 18: Plates in random places

Figure 17: plates in bad storing condition (exposed to light)

Figure 20: Random sorting of plates

Figure 19: Random sorting of plates

Pictures showing Random storage and stacking of Cliché with no sorting criteria:

Figure 22: Cliché in random rack

Figure 21: Cliché with no sorting

Figure 24: Cliché with no sorting

Figure 23: Cliché in random places

Closer look to the Pictures of the Diecuts:

Figure 26: Front side of the Diecut

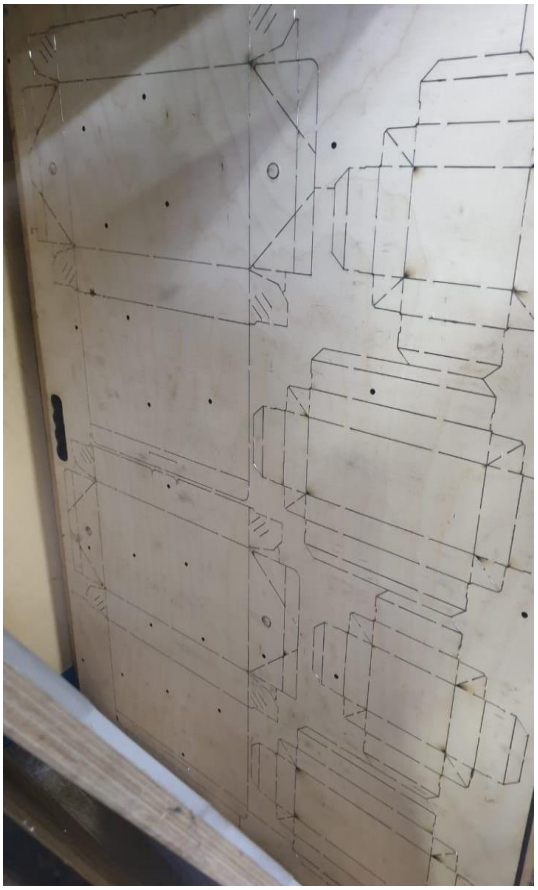


Figure 25: : Back side of the Diecut

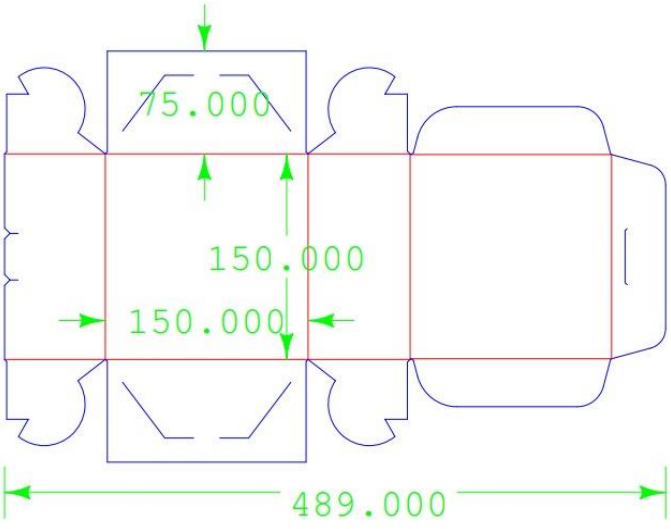


Figure 28: Diecut design file

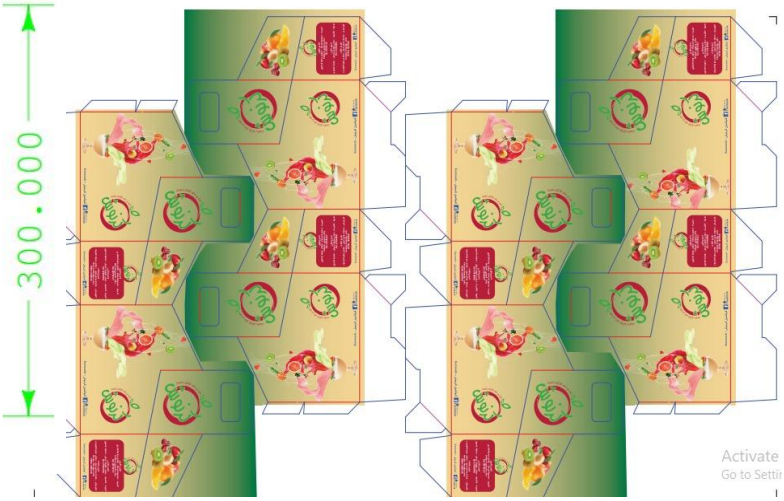


Figure 27: The design after being installed on the diecut

1.3 Printing techniques:

There are several basic technologies used in Printing process depends on the type of product needed, the quantity required, size, product specifications and the number of colors in the print, for example there are machines that caries one ink color, and other machines with multi-coloring inks capacities.

As so there are four main printing technologies used:

1. **Offset printing**: The offset system is based on the indirect printing procedure whereby the paper is run through an intermediate rubber roller. The offset is based on the physical principle of water-oil repulsion (immiscibility), hence the use of oil-based and water-based inks in this method. The printing elements accept oily ink and reject water, and the blank spaces reject the ink and accept the water. The offset system is the most widely used system in graphic-arts workshops because of the combination of good quality and savings. this type of printing includes using a plate that will be placed in the cylinder inside the printing machine; as just one ink color can be included; the ink comes throw the cylinder to the plate. Printing machines with the offset system may use one or more colors. This printing system can be used with paper sheets or reels, in the latter case being fitted with a cutter and folder.

Figure 29: Offset printing machine

2. **Flexo printing:** usually used when required a high-speed production and overall good quality, this technique can be performed on different types of materials, this type of printing include using a cliché. Printing with flexible plates and fluid inks that dry by means of evaporation is called flexography. This is a direct system, as the flexographic plate, once inked, transfers the ink straight to the medium. Therefore, when looking at this plate, the image text reads backwards so that the printed medium is read correctly. The plates have a relief area that prints directly onto the substrate with light pressure known as "kiss pressure". Unlike the heavy metal plates used in the offset printing system, flexographic plates are adaptable and portable. The risk of fire in flexographic rotary presses is somewhat less, due to the low working speed.

3. **Digital printing:** Digital printing is a method of printing from a digital-based image directly to a variety of media. It usually refers to professional printing where small-run jobs from desktop publishing and other digital sources are printed using large-format and/or high-volume laser or inkjet printers.

1.4 production lines

The company owns 4 main production lines:

1. **Packaging line**: This line specializes in the production of boxes used in various fields, including: restaurants, dates, cosmetics, sweets boxes, tissue boxes.....etc.

   This section is divided into 3 categories:

   a) Flexible.
   b) Hard packaging.
   c) Eflot.

2. **Publication line**: This line is concerned with printing books of all kinds, including academic, scientific or cultural books.....etc.
3. **Commercial line**: The output of this line is generally represented by commercial and government publications such as bank publications, tax books, folders, bond books, wedding cards....etc.
4. **Advertising line**: through which promotional materials are manufactured such as: posters, shelf talkers, brochures, roll-ups, menus, ...etc.

1.5 Project Description

In this project some tools will be used as methods engineering and 5S (Sort, Set in order, Shine, Standardize, Sustain) to help Al-Hijjawi Company to improve their management system specially in the field of managing some manufacturing tools used in some of their manufacturing processes (diecut, plates & cliché).

1.6 Scope of work

This project aims to create a management system for tools (diecut, plates & cliché) used in the production process in order to ensure that they are preserved from loss and damage, which reduces additional costs incurred by the company as a result of the loss of these tools

In addition to increasing productivity by reducing the time needed to access these tools, as well as increasing customer satisfaction due to reducing reprint costs.

1.7 Project Objectives

The main step every company must take for the sake of the endurance and continuity of their work is keeping up with every day's increasing pace and technologies , and work permanently to develop the followed system the use. So, this project aims to improve the operation on Al-hijjawi printing house Company by using the tools and techniques that we have learned in our field. We aspire to achieve the following:

1. Finding a solution to the problem of losing tools and Providing a management system for them.
2. Finding a solution to lack of space for storing tools.
3. Finding a solution to the problem of losing tool files and Providing an archiving system for them.
4. Providing a management system for tools facilitate the process of retrieving these tools and use them again.
5. Reducing costs resulting from Remanufacturing tools due to loss of these tools or their files.

1.8 Implementation Methodology

1. Data Collection and Analysis.
2. Literature Review.
3. finding proper solution to implement the management system suggested.
4. suggestions for future work.

Chapter 2

Constraint, Earlier Coursework and Standards/Codes

2.1 Earlier Coursework

This project will be accomplished using industrial engineering concepts that us as students have learned throughout the gurney of the major.

These concepts came from different courses that will be mentioned as follows:

1. **Total Quality Management (TQM):** this course emphasis that all members of an organization are a good participant in improving processes, products, services, and the culture in which they work, as concepts as 5S, and lean are part of the improvement process.
2. **Methods Engineering**: this course topics take about cost reduction and quality improvement while working with reduced labor forces, as well as different types of tools used for problem solving (Exploratory Tools, Recording and Analysis Tools ,….etc)
3. **Planning:** organization and functions of manufacturing planning and control, including forecasting theory, capacity planning, MPS & MRP systems, scheduling, and inventory control.
4. **Special topics in industrial engineering.1**: this course takes about industry 4.0 and how to evolve and improve any system by introducing the industry 4.0 elements to it, as it is important to start involving these elements to the current management system as the world is in competition and everyone has to evolve in order not to lag behind the rest.
5. **Introduction to engineering management**: this course takes about Management, Planning and Controlling (Information and Decision Making, Planning Processes and Techniques, Control Processes and Systems, Strategy and Strategic Management), Organizing, Leading (Motivation Theory and Practice).

6. Computer Integrated Manufacturing (CIM):

"SS" Storage Systems Used in factories, warehouses, distribution centers, wholesale dealerships, and retail stores, "SS" serves the purpose of storing materials (such as parts, work-in-process, and finished goods) for a length of time and allowing retrieval when necessary. Automation is possible to increase efficiency.

System Performance of Storage system performance metrics: There are two techniques to measure storage capacity: Storage density is the ratio of volumetric space used for actual storage to total volumetric space in a storage facility. It is determined by total volumetric space, total number of storage compartments (such as unit loads), and storage density Accessibility is the ability to get to any object stored away. System throughput is the volume of storage/retrieval (S/R) transactions processed per hour. Utilization and availability (only with automated "SS") The "SS" must be designed for the highest throughput necessary during the day. Utilization is the ratio of the amount of time the automated system is really being used for S/R tasks versus the total amount of time it is accessible. Should fall between 80 and 90%.

2.2 Constrains:

During our work in this project, we have faced many challenges and constraints which impeded our progress. But through teamwork and guidance from supervisor we were able to overcome those impedances. However, here are some of the difficulties and challenges that we faced:

1. Difficulty finding a place to store tools close to the production line due to limited space.
2. The lack of accurate data on costs caused by problems related to the lack of a clear system for managing these tools.
3. Resistance to change: Since the company is a family business and there is no administrative board that takes a firm decision to implement the solution, In addition to the weakness of the top management in applying suitable principles to manage these tools .

4. The absence of references or previous research that dealt with the problem that we chose to address in the project because of its specificity and that it is related to a specific field of work (printing presses) and is not a general problem.

2.3 Standards/codes:

A standard is a written description of the standards, guidelines, specifications, or other features that can be applied consistently to guarantee the fitness of materials, products, processes, and services.

1. **5S:**

   5S is a system for setting up workplaces so that work may be done effectively, safely, and efficiently. This system emphasizes placing everything in its proper place and maintaining a tidy workplace, which makes it simpler for individuals to execute their jobs without wasting time or running the danger of getting hurt.

The term 5S comes from five Japanese words:

- Seiri
- Seiton
- Seiso
- Seiketsu
- Shitsuke

In English :

- Sort
- Set in Order
- Shine

- Standardize
- Sustain

- Sort : The first step of 5S, involves going through all the tools, materials, equipment, etc. in a work area to determine what needs to be present and what can be removed

- Set in Order : It is simpler to distinguish between things after the extra clutter is gone. The remaining items can now be sorted using the strategies developed by the task groups.

- Shine : Shine also entails routinely maintaining machines and equipment. By planning maintenance needs, firms may identify issues and avoid breakdowns. That means there will be less time wasted and no lost revenue as a result of job interruptions.

- Standardize : Everything that just occurred is systematized by standardization, which also creates habits out of one-time actions. By standardizing, you can make sure that routine tasks are assigned, schedules are made, and instructions are posted.

- Sustain : The term "sustain" describes the procedure for maintaining 5S operational as well as for keeping everyone in the organization active. Employees in the office, in the warehouse, and on the production line all need to participate. Making 5S a long-term program rather than a one-time event or quick endeavor is what sustain is all about. 5S should ideally become established in an organization's culture. Businesses will begin to realize consistent positive benefits when 5S is sustained over time.

The benefits of 5S methodology :

- ✓ Reduced costs
- ✓ Higher quality
- ✓ Increased productivity
- ✓ Greater employee satisfaction
- ✓ A safer work environment

(Szewieczek, 2007)

2. Toolkit:

The toolkit that was used to evaluate the company's current status was created by a group of students as part of their graduation project to help companies identify areas that could use improvement, questions concerning are also included in the toolkit about reduce costs and eliminating waste and manage the tools.

Chapter 3 literature Review

3.1 Management system:

Organizations that produce products or services aim to maximize customer satisfaction and minimize production and delivery costs through a process called Quality Management. To successfully implement Quality Management, organizations follow a set of guidelines called a Quality Management System, which relies on accurate, reliable, and up-to-date documentation of processes that contribute to the final product or service. This documentation must include a document control scheme to regulate its creation, modification, circulation, and disposal. It is important to ensure that circulated documents are always updated with new versions to prevent the dissemination of outdated information. As more organizations switch to storing their documents electronically, Quality Management Systems must adapt to new challenges related to these requirements.

The goal of this thesis is to design an implementation for two document control features in the ISO 9001:2008-compliant electronic Quality Management System called M-Files QMS. The first feature is controlled printing, which allows for the restriction of printing specific documents to authorized personnel and the creation of traceable, watermarked printouts. The second feature is copy prevention, which prevents users from copying regulated content outside of the system and from printing unauthorized copies of documents. These features allow document managers to effectively monitor the circulation of printed versions of regulated documents and recall them when necessary.

Quality management is the process of managing a business's processes in order to achieve maximum customer satisfaction at the lowest cost to the organization, while continuously improving those processes. This involves not just ensuring that products and services are of good quality, but also ensuring that an organization's management, products, and services are consistent. Consistency is achieved by focusing on the quality of the end product, but also by planning and controlling the process to ensure that it is followed and reviewed. If the plan is found to be inadequate, necessary improvements are made. (VIRMO, March 2014)

3.2 Control of Documents:

Control of documents is the responsibility of controlling an organization's documentation. According to the ISO 9001:2008 standard, documents required for the quality management system must be controlled. Implementing a strict document control process is a significant part of obtaining ISO 9001:2008 certification for a quality management system. Quality managers must determine which types of documents are included in the process, how they are maintained, and how nonconformities are handled in the quality management processes.

Document control is the process of managing an organization's documents by defining the steps for their development, approval, issuance, modification, distribution, maintenance, use, storage, security, obsolescence, and disposal. This process aims to ensure that documents serve a purpose in the quality system, that non-essential material is not distributed, that employees have access to necessary information related to their work, that access to classified information is restricted, and that distributed material stays up-to-date. (VIRMO, March 2014)

3.3 Storage Systems:

Warehouses may use a single type of warehouse storage system or a variety of them. Warehouses can significantly enhance their order fulfillment and picking procedures based on the system's effectiveness. Another important factor in fostering a safer workplace environment is an orderly storage system. It aids in preventing any potential dangers that can jeopardize warehouse workers as they operate heavy equipment and move around the facility.

the different types of warehouse storage systems is :

1. Storage cabinet
2. Pallet storage system
3. Static shelving
4. Multi-tier racking
5. Double-deep racking
6. Mobile shelving (Zaerpour, 2013)

Storage Cabinet

One of the simplest methods of inventory management is a cabinet system. Depending on their capacity, cabinets can house a lot of materials. Larger storage cabinets may be necessary for warehouses that frequently store larger items; the same is true for the substitute.

Depending on the type of things they need to house, storage cabinets can be altered. For instance, smaller items of the same sort can be neatly placed in a storage cabinet divider with longer packages. Any material kept in a cabinet is also less vulnerable to environmental factors, extending the shelf life of the items. (zheng, 2020)

Pallet Storage System

Pallet storage systems, as the name implies, employ pallets to stack several packages at once. These heavy-duty pallets are typically made of wood, plywood, or plastic, but logistics facilities are significantly more likely to use the latter two materials.

For warehouses that don't necessarily have a lot of square footage, this method is a fantastic space-saving choice. This is made possible by the pallets' ability to be piled on top of one another without tipping over. Pallets can be safely loaded and unloaded onto the rack by forklift operators.

In pallet storage or pallet racking systems, the pallets are supported by the entire framework of the rack. You'll find essential components like wire decks, beam connectors, posts, and bracings. They're made of durable materials like steel to ensure that the structure doesn't just topple over when packages are being rearranged. (Volbeda, 2019)

Figure 30: Pallet Storage System

Static Shelving

Comparatively speaking to storage cabinets or pallet storage systems, static shelving offers far less flexibility. This is due to the fact that they are confined to a particular space inside a warehouse building. While finding SKUs of the same type may be made easier with this arrangement, it is challenging to change.

Static shelving, however, differs from other storage solutions in that it is more stable. Its basic design enables it to support additional static shelves that can be positioned close together. Particularly when handling only light-to-medium goods that can be physically organized on each shelf, it aids warehouses in making the best use of their available space. (STANDARD)

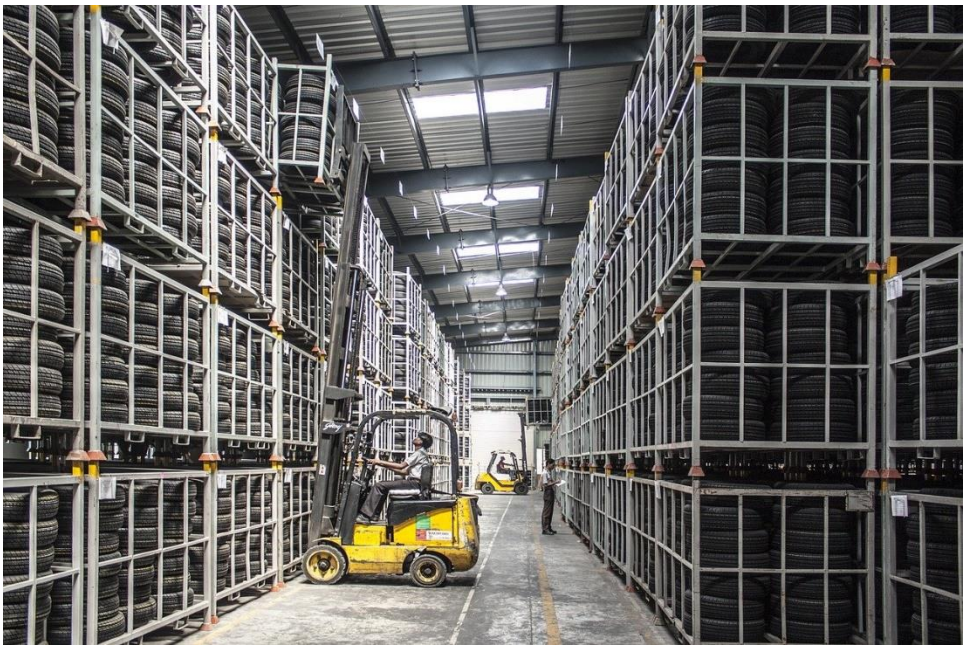


Figure 31: Multi-Tier Racking

Ever wanted to get the most storage space possible out of your warehouse without having to do any construction work? The multi-tier racking system might then be something to think about. Multi-tier racking structures stand out for their vast proportions. This indicates that parcels in the medium to large size range are appropriate for multi-level deck organization.

Similar SKUs might be kept at one or two tiers of the system by warehouse managers. Multi-tier racking, on the other hand, provides relatively little mobility in relation to the weight of the packages it is carrying, much like the static shelving system. They do, however, provide a greater degree of accessibility. Aisles, ramps, and staircases that are thoughtfully positioned all around each level make it simple for warehouse workers to access each level. Additionally, these accessibility features are designed to provide sufficient traction for utility carts and other wheeled vehicles. (Jernigan, 2004)

Double-Deep Racking

Pallet racking and double-deep racking are comparable, but pallet racking has more storage space. Two standard-sized pallet racks are placed back-to-back in this storage structure. This technique is typically used in warehouses with limited floor space but huge inventory volumes.

The LIFO (last in, first out) inventory system is mostly employed in double-deep racking. As a result, this isn't particularly meant for perishable stock. Instead, they are utilized for things like clothing, appliances, or electrical gadgets.

Inventory management with double-deep racking enables warehouses to more effectively rank SKUs in order of value. A double-deep racking system can be used to securely store items that could increase in value over time. However, this can also make it more likely that a warehouse will overflow. As a result, warehouses should consider their choices before deciding whether to employ double-deep racking for SKU organization. (Vujanac, 2020)

Figure 32: Mobile Shelving

A mobile rack system, which is also known as mobile shelving, has more storage space than a static shelf. A track is attached to each end of the rack in movable shelving. Except for the addition of a chassis that allows the system to be moved in a lateral, sliding motion, each rack system is robustly supported by traditional parts like decking and bracings.

Mobile shelves not only provide extra storage but also improve warehouse space utilization by more than 40%. As a result, forklifts and other transport equipment can navigate more easily. With the additional room, it's conceivable to add yet another kind of storage system in addition to the mobile shelves. (Watts-Williams, 1999)

3.4 5S:

Total quality management is gaining the continuous improvement not just the quality management system that is based on the ISO series 9000:2000 standards so when applying these modern management systems like the 5S methodology, some major differences will accrue in the company, as increasing of effectiveness and efficiency of the processes, cost reduction accomplished by the improvement of the process, increasing the safety, and improvement of the machines' efficiency.

The Practical implications is to train workers on the 5s rules as it is essential to gain continuous improvement of the process as it is divided in to steps. (J. Michalska*, October 2007)

Tools of implementing the 5S lean method:

Auditing is a standard tool used for

A common instrument for periodic or ongoing assessment and verification of the 5S technique is the 5S audit. Lean management, not the auditor, is in charge of developing, implementing, and continuously monitoring the 5S implementation. After a 5S audit evaluation, it is possible to determine whether the situation has gotten better or worse in comparison to earlier auditing. A

standard sheet designed for use in designating the production regions is another tool used to apply the 5S lean method.

Implementing the 5S technique entails giving the team involved in adhering to the particular process activities some tasks and responsibilities.

It was necessary to create the standardization form to do the process confirmation to all workplaces (automated and manual), as a tool in implementing the 5S, after establishing the specific tasks and responsibilities of implementing the 5S. (Marascu-Klein1, 2015)

3.5 Visual control:

A classification makes it easier to see how various visualization techniques differ and are similar. Comparing various types according to relevant criteria is helpful.

According to Bailey, a classification is the grouping or classifying of things based on how similar they are. Classifications maximize variance between groups while minimizing variance within groups. (Platts, 2007)

VISUAL MANAGEMENT IN INDUSTRIAL CONSTRUCTION:

A CASE STUDY OF VISUAL MANAGEMENT IN INDUSTRIAL CONSTRUCTION

An essential component of the Toyota Production System, Visible Management (VM) produces highly visual (sensory) information fields from which employees can extract information.

Increased process transparency, which is defined as the ability of process elements to communicate, is one of the direct benefits of VM. Its other effects could include improved job facilitation, continuous improvement, and workplace discipline.

The report describes an exploratory VM study in a construction project for a natural gas desulphurization (purification) and liquidation facility in the Karakum desert, Central Asia, which is home to one of the greatest natural gas resources in the world.

The general site standardization techniques used by the principal contractor were mandated by contract onto the subcontractors. As a result, all stakeholders maintained a certain level of visual site standardization with comparable procedures.

The walkways were clearly marked, and various site areas (such as smoking areas, material/waste collecting areas, welding schools, scaffolding schools, workshops, pipe-spool fabrication units, construction areas, site warehouses, offices, and bus stops, etc.) used color-coded helmets and ID cards for different work trades.

On the site, material name identifications and material/tool grouping were noted. For better on-site material distribution/management, the major contractor mandated a common practice of color-coding material identification (by the location that the material would be used; for example, a big red circle or a yellow square on a material container identifies a specific area on the site)

Figure 33: Standardization of Workplace Elements: Example Applications

HEALTH AND SAFETY MANAGEMENT:

The primary focus of the main contractor, and subsequently the subcontractor, was on health and safety (HSE) issues. The primary contractor tightly enforced its standard operating procedures on the subcontractors. Static and moving safety signs, visual cues, a color-coded equipment checking system (each month, a color would be chosen to identify the equipment that had been safety checked), scaffolding safety tags, and other safety measures (a colourcoded tag that determines if a scaffolding is safe to use or not)

boards to monitor workers in tight locations, especially in tanks and manholes. Welding and several installation processes that take place in restricted places produce deadly inert gases.

Human presence is therefore frequently limited under certain circumstances. When a member of staff enters the work area, their entrance is noted and their ID card is hung on a board nearby the confined space where they want to operate.

Figure 34: The Confined Space Tracking Boards

(Tezel, 2013)

EXPLORING THE ROLE OF VISUAL CONTROLS ON MOBILE CELL MANUFACTURING

DEFINITION OF PROCESS TRANSPARENCY:

Process transparency refers to the ability of a production process to communicate effectively with people. It involves the organization and accessibility of information, allowing it to be easily "pulled" by anyone at any time. A transparent process is self-explanatory, self-ordering, self-regulating, and self-improving, and should be able to inform its own state without requiring people to ask questions or spend time processing information. A transparent workplace or process also communicates both internally to a group's needs and externally to people outside the workplace. It should be easy for even a lay visitor to understand what is happening in the process and identify any problems. This approach goes against the traditional thinking that customers should not be aware of what goes on within an organization.

IMPACT ON PRODUCTION SYSTEMS:

Transparency can have a number of positive impacts on production systems. It can increase the motivation of workers to improve and reduce the likelihood of errors, as well as increasing the visibility of errors that do occur. Other benefits of transparency in manufacturing include

simplification and coherence in decision making, stimulation of informal contacts across different levels of the organization, support for decentralization policies, increased employee participation and autonomy in management, more effective distribution of responsibilities, improved employee morale, more effective production scheduling, simpler production control systems, and faster comprehension and response to problems.

USE OF VISUAL CONTROLS TO INCREASE TRANSPARENCY:

Visual controls can be used to increase transparency and improve the efficiency of production systems. Visual controls can take many forms, including Kanban cards, call lights, Andon boards, digital display panels, mistake-proofing devices, and visual markers such as borders, home addresses, and identification labels. These controls can help people quickly identify and address problems or waste in the production process, leading to continuous improvement. The use of color in visual controls is important, as it can help convey information and guide actions. For example, standard specifications such as OSHA and ANSI provide guidelines on the use of specific colors for different purposes. Visual controls can also help improve communication and collaboration within the organization, as they allow people to share information and ideas more easily. In addition, visual controls can help ensure that production processes are consistent, as they provide clear instructions and expectations for how tasks should be completed. Overall, the use of visual controls can help increase transparency and improve the efficiency and effectiveness of production systems. (Santos)

3.6 Layout:

Metalfab Hightech Private Limited, Nagpur factory use the 5S technique to improvement the plant Layout and the utilization of storage space

In this industry, MS plate is used as raw materials, and then these materials are converted into the final product. The process is summarized as follows: First, the raw materials are stored in the warehouse, then the materials are checked visually by the quality inspector. If a problem is found, these materials are either sent or salvage. Then it is sent to the CNC department to complete the cutting process, then to the integrated machine, then it is transferred to the second stage of welding,

which is arc welding, then the product is sent to the straitening section, then to the grinding machine to clean the beam, then to the sand slapping machine, then paint the beam and finally to the store

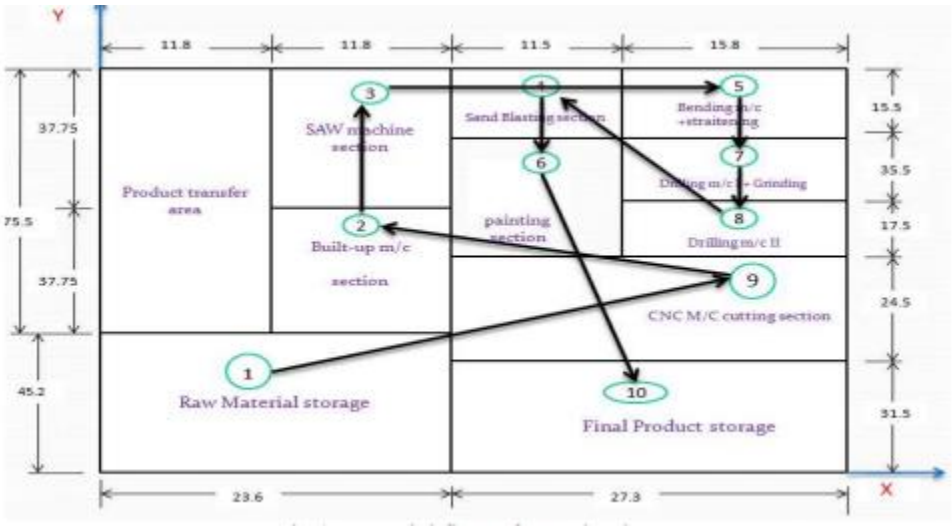


Figure 35: material flow before improvement

The problems were identified, which are the waiting time between tensioning and grinding, and the presence of scrap storage bins inside the factory, which occupies additional space, so the movement of materials becomes difficult, and also the movement of materials is not within a standard system. The field of work in development is to arrange the sections in the best sequence and the correct use of storage space, And then the 5S technology was applied so the results were represented in increasing the use of space, increasing the rate of production due to the organized arrangement, facilitating handling and operating each material, increasing the storage space within the same area, a good impression on customers, reducing lead time and improving morale. (N.Shende, 2014)

V. Comparison Of Existing Layout And Improved Layout

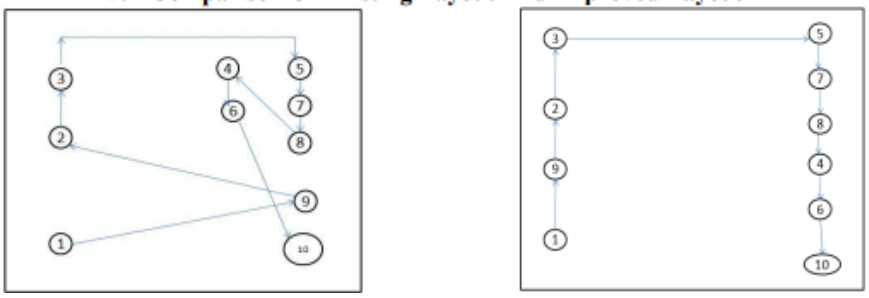


Figure 36: comparison of existing layout and improved layout

EFFICIENT PLANT LAYOUT DESIGN

The most famous method that was discussed in this research is the assessment of factory planning, such as TABU search (TS), Simulated Softening (SA) and Genetic Algorithms (GA), for example (TS) is a mathematical method of optimization and it is one of the categories that use local search techniques as it depends on memory so that if a possible solution is identified it is distinguished so that it does not return to this solution in any way. Iterative, but the (GA) is one of the developmental algorithms that uses strategies from evolutionary biology such as inheritance, mutation, etc. It is a research strategy used in computing to obtain accurate solutions to optimization problems. As for (SA), it is a probability that is used for the global optimization problem of applied mathematics, that is, to locate a good approximation to the global minimum for a function in large search spaces. Simulation technology has also been used in factory or company planning, as It is used to help identify storage spaces for the assembly system when parts are queued before entering the assembly area. Popular simulation tools are ProModel and Flexsim, a software used for plant planning, warehousing, evaluation, and etc .

Some of the work done by some researchers :

Item and researcher	Methodology	Results and finding
Solve multi line layout problem by genetic algorithm Amir Sadrzadeh	Genetic Algorithm based meta heuristic to solve facility layout problem	The efficiency of the proposed method was reached by solving the examples and comparing its results with the other algorithm, namely Computerized Relative Allocation of Facilities Technique (CRAFT)
Facility design by simulation Greasley, 2008	improve a discrete event simulation model to be used to estimate the required storage space for a proposed outdoor textile manufacturing facility	The simulation efficiency has been reached, as it has the ability to show the queue levels at the individual product level, and it is also useful in relation to the operation of the facility.

Using some measures based on distance and shape as a methodology for solving asymmetric area planning problems R. Logendran	A nonlinear mixed binary programming model has been formulated	The distance and the effect of the shape of the sections were determined in the formulation of the model, and based on the concept of (TS), an algorithm was proposed to detect heuristic at a higher level, and its effectiveness was proven
Overcoming the problem of incompatibility with the factory layout by changing the sizes and shapes of the department Lin et al, 1996	Apply Artificial intelligence (AI) to facility layout problem	AI maybe solve the scenario of failure-to- fit solutions, when no feasible layouts are generated

(Kallirkar, 2016)

Productivity Improvement by Optimum Utilization of Plant Layout

Attempting to improve the factory's layout to facilitate the flow of materials and thus increase productivity, taking into account the difficulty in improvement due to some factors such as workflow, machine locations, and the relationships between machines and work, and studying tools, methods, and the physical arrangement of equipment and facilities inside the factory , Systematic Layout Planning (SLP) was used in this research, it begins by defining the flow of materials and then defining the activity relationship based on the first and second steps, and on the basis of space to develop alternatives for planning so that all alternatives are evaluated and the best is chosen. And the available space, then moving to the search for solutions by drawing a diagram of the space relationship, from which the planning is developed, and then choosing the best analyzed diagram

The elements of the (SLP) used in the solution are:

Product (P) includes machinery components, raw materials, and the final product. This factor affects the relationship between facilities, equipment, and the way materials are handled

Quantity (Q) includes information about the production census and can be represented by weight, volume and price

route(R) can be represented by a plant diagram and a diagram of the path and flow of operations, this affects the way materials are handled and the relationships between the work unit and the warehouse location and stores

Supporting (S) is represented in the public service, such as maintenance of sanitary stations, toilets, canteens, tools, and others

Time (T) expresses the time and length of production and the running time for each process

The (SLP) was applied to a milk factory, so that the current factory was studied and its divisions were seen, as the production was in one location and one room, which was causing an increase in material handling and the incorrect use of space. Through the application of the SLP, the best layout for the factory was chosen, as the distances traveled were reduced from 102 meters to 57 meters, and the waste resulting from movement and transportation was reduced, so that all separate areas were established as one unit to achieve a good flow of materials. (S.Shahare, 2017)

3.7 Tools:

In order to achieve adequate productivity, tool management in production entails timely resource availability, as well as accepting cost-related constraints (time and material overcapacitation). The term "tool management" refers to the planning and execution of a continuous activity monitoring system, which is implemented on two levels:

- material flow
- information flow (monitoring of the use of resources)

Let's take the topic of cutting tools as an example. Appropriate cutting tool management benefits the bottom line by lowering expenses over time. Using tools with improved cutting qualities can reduce the amount of time spent cutting. The manufacturing time can also be reduced by multipurpose processing (parallel processing), with quick tool changes using tools stored in the machine tool magazines. Unfavorable future results from poor application of manufacturing resources (machine tools and methods) or improper usage of these resources. (Harburg-Freudenberger, 2007)

The first stage in implementing tool management is to create a database of cutting instruments and to ensure communication between computers and staff who deal with tools and are dispersed throughout the company's many departments. Every cutting tool has a code that serves as a classification key for communication and access to specific tool data. To address the lack of tools, there are various models for supplying tools to a set of machines. It is suggested that the ideal ordering cycle and distribution frequencies be used as decision factors for the tool supply to a set of machines based on the depot system.

Cutting tools, participates with about 2-4% in the structure of the production costs, so it can be concluded that the result of cutting tools savings by 30-50% contributes by only 1% in the total cost . Oppositely, if machining parameters increase with 20%, the cutting costs will decrease with 15 %.

According to Weinert and Ravel, increased machining parameters might, under some circumstances, accelerate non-uniform wear of the cutting edge, which lowers beneficiary costs. A new monitoring technique is consequently introduced by Barry as a result of adequate tool management.

A research paper titled Implementation of cutting tool management system was published in 2007. Identification of the existing state and operational circumstances of cutting tools on lathes and milling machines, as well as the arrangement of the departments and other services directly connected to the cutting tools management system, comprised the technique used in this study.

According to the researchers, the costs of cutting tools study results supported the necessity to apply a systematic tool management approach as well as specific operations with an emphasis on rationalization. Without a well-established database and a computer backup, several departments find it challenging to carry out the tasks related to tool management. A certain number of drawbacks have been identified in departments without computer assistance or another streamlined management system, which either directly or indirectly contribute to an increase in the overall production cost due to improper use of the cutting instruments. The actions involved in borrowing tools from the tool shop should be highlighted, as well as returning those tools to the tool shop after the machining operation is complete. There is no accountability that follows from borrowing tools from the tool shop because there is no program for doing so. Additionally, it should be noted that grinding can be used to renew the cutting qualities, which might increase tool durability by

more than 20% and lower the overall cost of the cutting tools. The ways in which cutting tools are used are crucial for the tool management process as well as being signs that the machines are in good working order. It is common knowledge that the savings from reduced machining regimes due to the limitations of cutting tolls machines are negligible (-1%) in comparison to the savings realized on current machines using suggested machining regimes (-15%). The cutting tool machines are continually being modernized in order to introduce improvements. More than 2% of the workforce is involved in tool management, and less than optimal use of their cutting capabilities results in a 12% increase in production costs, which is an indirect cost, according to data from the analysis of the conditions under which cutting tools are used in this company. These data indicate that there is still room for improvement that can be used by the company.

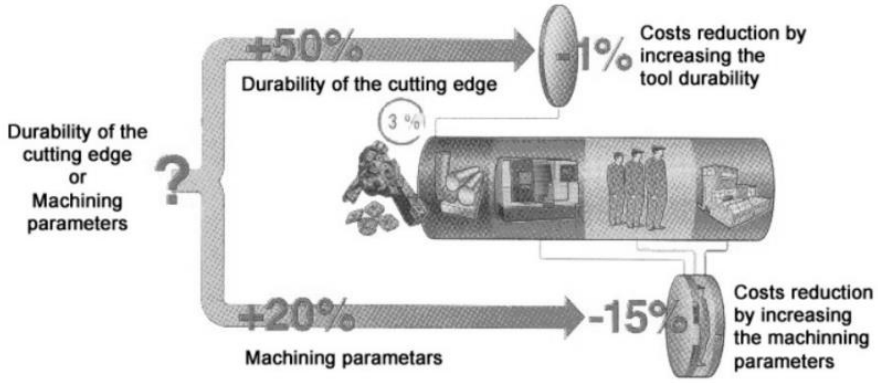


Figure 37: Possible savings which are directly connected with cutting tools

Life Cycle Management of Cutting Tools: Comprehensive Acquisition and Aggregation of Tool Life Data is the title of another paper. By describing the use of enabling technologies like identification and tool and process monitoring systems and outlining the development of a comprehensive and generic process model of tool life cycle, this paper introduces a method to identify crucial tool history data and information for a tool life cycle management approach. The general tool history data collection is produced with the aid of a thorough investigation of the process model. This data pool, which is divided into six different data kinds, can serve as the starting point for additional historical analysis within the tool life cycle management. It is necessary to define the relevant data structure (using, for example, UML) and link it to the data

source in order to automatically extract tool history data (IT systems). Data analysis algorithms and business intelligence techniques can be used to store historical data in data warehouses (DW), where it is available for historical analysis. By taking into consideration life cycle costs (LCC) for certain processes, the established process model and the tool history data pool can enable the discovery of pertinent history data and evaluations of business models. Insofar as precise information is available to all partners, the comprehensive data base promotes cross-company collaborations (e.g. using the internet). By analyzing the comprehensive, extensive data pool and modifying process requirements, the reconditioning methods should be tailored to extend the tool life. (Kleinert, 2017)

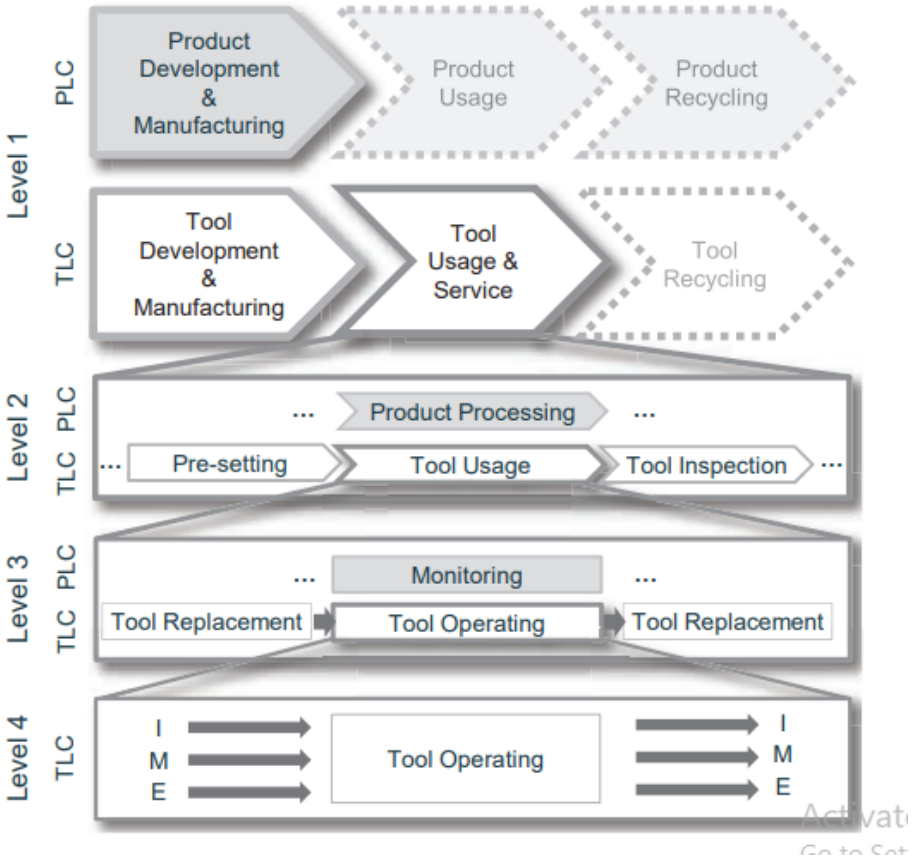


Figure 38: Structure of process model

Chapter 4

Methodology

4.1 Current Situation:

In this part, we will talk about describing the operations within the company from the beginning of the customer's request to print a specific publication to the final delivery stage. We will also talk about the process of ordering and manufacturing tools.

4.1.1 Current process of ordering

Sales Department:

Work begins on manufacturing customer orders and converting them from their specifications and needs into real products from the sales department, this is done by following the following procedures:

1- Editing the operation order by writing the customer's name, the customer's account number, if any, and the business name. And write the representative's name and mobile number, so that he can be contacted in case of any inquiries during the production stages.

2- In the event that there are several items in large quantities, even if the implementation is on the same machine, each item is separated into a separate operating order to be implemented easily, in a practical way, and first-hand.

3- Writing the operating order based on the specifications of the quotation request and the price offer approved by the customer. And an indication of how to adopt the colors with the Pantone number, or its attached. And the serial number on your parents' commercial carburetor. Attach a copy of the pricing study (without amounts) for implementation according to pricing specifications.

4- In the event that there are commas, coupons, or other things attached to the work, this shall be clarified in separate clauses with complete specifications, and the location of these appendices in the book or magazine shall be determined by the page number preceding and following the separator or coupon, and specifying the location of the insert.

5- Mention any other additional specifications for the work, in order and in detail. In the event of a request to change the design within the printing press, this will be indicated in the relevant field.

6- In the case of periodical publications, the last issue or print is attached to the run order for comparison with the specifications mentioned in the run order, such as size, paper type, color matching, cellophane, and others.

7- Writing the attachments of the operation order on the same order, such as CDs, a white and black proof, a color proof (from the client / from the printing house), a page arrangement chart, so that these attachments are used to check all stages of production

8- Delivery of a final full rehearsal after the last modification approved by the customer or his representative containing the cover and heels if any / all the inner pages / spacers / and the inner coupon / in the real and actual form. The need is to make additional copies of the cover, coupon, and spacers.

The problem that we are trying to highlight in order to find the appropriate solution is based on the sales department, where the diecut number is not attached or the plates number within the work order if the order requires the use of these tools to be produced and this causes errors in production due to the use of wrong tools, Or it is possible, due to the lack of proper management of these tools, that these tools will be re-manufactured again despite their existence, and these costs are borne by customers or the company, as the case may be. Or, problems may occur due to the loss of deicuts design files used in the prepress design process.

Planning Department:

After releasing the operation order from the sales department, the planning department continues to work according to the following procedures:

1. Ascertain receipt of the operation order and the approved attachments with full specifications, the basic rehearsal/ any sample from the customer (a previous product sample, a color sample, or a paper sample), and these attachments are recorded in the operation order. If any data or attachments are missing, the operation order should be returned to the representative to be filled out.

2. Use the system to create an order with all the necessary information, including the type of binding montage and the names of the machines needed for the bindings or the item's components so that the items can be identified during printing, and then send a request to the warehouses to obtain the necessary materials.

3. Use the remarks section on the order creation form, which is attached to the operation order, to include important instructions and directives for all involved departments, particularly the process for approving colors, the kind of printing, the inks, the type of pallet used and whether it has been heat treated or not, and the delivery date. If a supervisor anticipates a delay, they should let the department know in advance so they can prepare.

4. Scheduling work for all departments and all machines, by calculating the time and date of the beginning and end of the production phase for each process separately as follows:

    - Pre-Printing Section
    - Digital section: 4 colors / 1 color
    - Blotters Department
    - CTP department
    - Flexo printing department

- Offset printing section: 5 colors / 1 color / 2 colors GTO / 4 colors GTO / 2 colors GTO / 4 colors /
- Department of cans: diecut machines / gluing machine.
- Cellophane machines
- Spiral wire machines
- Thermal fingerprinting machines
- Sewing machine
- Commercial binding work
- Artistic binding works
- Glue binding machines
- Pin binding machines
- Web printing machine

5. To identify the reference in the event of a follow-up inquiry, write the name of the production stage (planning stage), the recipient's name from the planning department, his signature, and the date on the operating order envelope.
6. Give the prepress department the operation order and all of its attachments.
7. Supplying all materials needed for manufacturing (paper, inks, cutting template, clichés, etc.).
8. Follow-up on all tasks for all production stages, including the supply department and raw material warehouses. In the event of a delay, the stage supervisor is notified via phone follow-up in addition to email follow-up and a carbon copy sent to all relevant departments.
9. Willingness to communicate with the sales department on the job state, stage of completion, and delivery date.

Follow the sales department:

- The stage of delivery to the customer, indicating the method and quantity of packaging according to the customer's request / date, method and place of delivery / name and address of the person responsible for receiving
- In the event of any problem in the publications, a report is prepared and sent to the quality department for follow-up with other departments.

production department (Offset printing department)

Instructions to be followed to ensure the success of the printing process :

1- Ensure that the operating order envelope and its attachments are received from the Planning Department or the CTP Department:
   - Operating order
   - Planning department report
   - Cut command
   - Technical report for the pre-press section
   - CTP Technical Report
   - Rehearsal (Hala) complete and undivided
   - (Sherpa rehearsal and client rehearsal) inside a special envelope
   - Reports (auditing PDF files / auditing Sherpas)

➢ In case of inquiries, follow up with the printing and planning supervisor.

2- Receipt of the plates, and the film of the cutting template in case the work needs that. As they can receive the wrong plates or the wrong cutting templates as well not finding the previous worked plates because of the wrong way of storing these tools and as a result the company is responsible of paying off these extra avoidable costs.

3- Allocating a box for incoming operating orders, a box for running orders under operation, and a box for finished running orders, at each machine, to facilitate the process of auditing and follow-up.

4- Writing all printed works, first by the operator, in the special notebook for each machine, to be used by those concerned, permanently and continuously.

5- Receipt of the required paper, and the number of the operation order number and the number of the paper request are affixed to the paper packages, then the type, size, unit of color, texture and quantity are checked.

6- Examination of the operation order data and its attachments, to know all the details of the work for execution, especially the approved basis for colors, such as:
   a. Original copy attached
   b. Color printer copy
   c. Standard machine colorimeter

d. Or others

- In case of inquiries, follow up with the Planning Department.

7- Preparing the printing machine, plate pressure, feeding unit, delivery unit, heat treatment, moisturizing water, alcohol percentage, and powder unit.

8- The playback and comparison between the copy of the machine and (Hala rehearsal), not the Sherpa rehearsal, because it does not differ from the plate and the possibility of an error in it, has begun. Checking (paper type, size, binding type, colors, writing, varnish, especially in places of binding and pasting, drying, heel thickness), and in case of difference from what is required, the supervisor is contacted immediately.

9- Ensure that the printing on paper is compatible with all post-press stages, such as (the presence of a thermal stamp / compressor / cutting film / UV / cover size with the size of the binding glue binding / the paper distance required for pin binding / the distance required in the case of cellophane.

10- Preparing a sample for approval and signature by the printing supervisor and then the quality supervisor, to be a reference for checking by the operator and the quality inspector, and upon completion of printing, put the approved sample in the operation order.

11- Putting another approved sample of the next clamp in front of the (machine operator) as a reference for comparison with the second clamp or the inside of the cover in case of the same design. He also placed the second fascicle in front of him as a reference for comparison with the third fascicle. And so on until the completion of printing all the lieutenant.

12- Turn on the machine counter and start production, and during that repeated checking on the print to make sure that there are no stains or greasing of inks, color difference, dryness, etc.

13- In the event that there is some damage to the printed copies, the damaged part is separated from the damaged completely, and an identification card is placed for each case.

14- Sending a color sample to the cover printing machine or vice versa to make a color comparison. (It is better to print the cover first)

15- After completion, the plates are cleaned, glued and delivered to the plate warehouse with UV planchet and polymer plate.

16- Attach a card to the finished printing, numbered in sequence (customer name, work name, operation order number, clamp number, quantity, machine name, printing period, operator name, date).
17- Writing on the envelope of the operation order / the name of the operation, the name of the operator, his signature, and the date, for each production stage.
18- Sending the printed work, the operating order and its attachments to the post-press department.

4.1.2 Current way of storing the tools

First, it should be clarified how these tools (diecut, plates & cliché) are manufactured. When a customer places an order in the sales department, the sales employee determines the tools to be provided to complete the work based on the specifications requested by the customer. When the print needs a special Diecut, the sales employee fills out a Diecut request and sends it to a person responsible for making Diecuts outside the company.

If the product needs to be printed using offset machines, then the number of plates will be made according to the number of colors entered into the printing from 1-4, and their size is either 35 * 50 cm or 70 * 100 cm, depending on the size of the machine that will be used to carry out the offset printing process.

each plates work as an image carrier for one color of the printing colors (CMYK) (blue, yellow, red, black) they are manufactured using aluminum plate as a raw material using special machine.

Figure 40: Plates machine

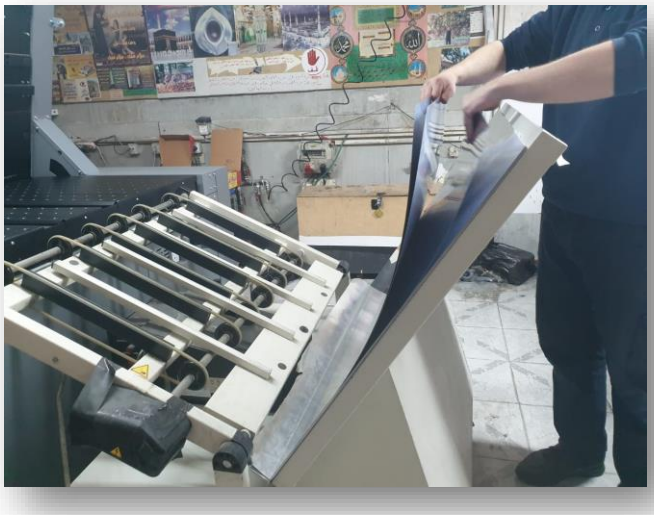


Figure 39: side view of the Plates machine

Figure 41: Plates machine

When talking about the places where these tools (diecut, plates & cliché) are placed and how to retrieve them, we find that the current situation is a state of randomness, as these tools are accumulated in random places within the production without a place designated for them.

In addition, it is not stored in the correct way to ensure that it is not damaged, as the plates need to be stored away from light and heat in a way that ensures that no scratching occurs to them, because this leads to damage.

As for the diecuts, they must be stored in a dry place to ensure that they do not rot because their base is made of wood. They must also be stored in a specific way to ensure that the cutting blades are not damaged.

All these things are not taken into account, in addition to the lack of a system to manage these tools and ensure their easy retrieval, as workers throw them anywhere within production, which leads to damage or loss, which costs the company huge sums, as the price of one cutting mold ranges between 400-1000 shekels According to its size and the price of one plate, its price ranges between 40-60 shekels, depending on its size, and the price of one cliché ranges between 600-1200 shekels, depending on the size.

These costs are borne by the company sometimes and the customer at other times, in addition to the costs of errors that occur due to not using the correct tools.

As for the files of these tools, they are also stored randomly inside the devices of the design department without a correct name, which sometimes leads to their loss and the designer is forced to re-design or use the wrong file.

flow process chart

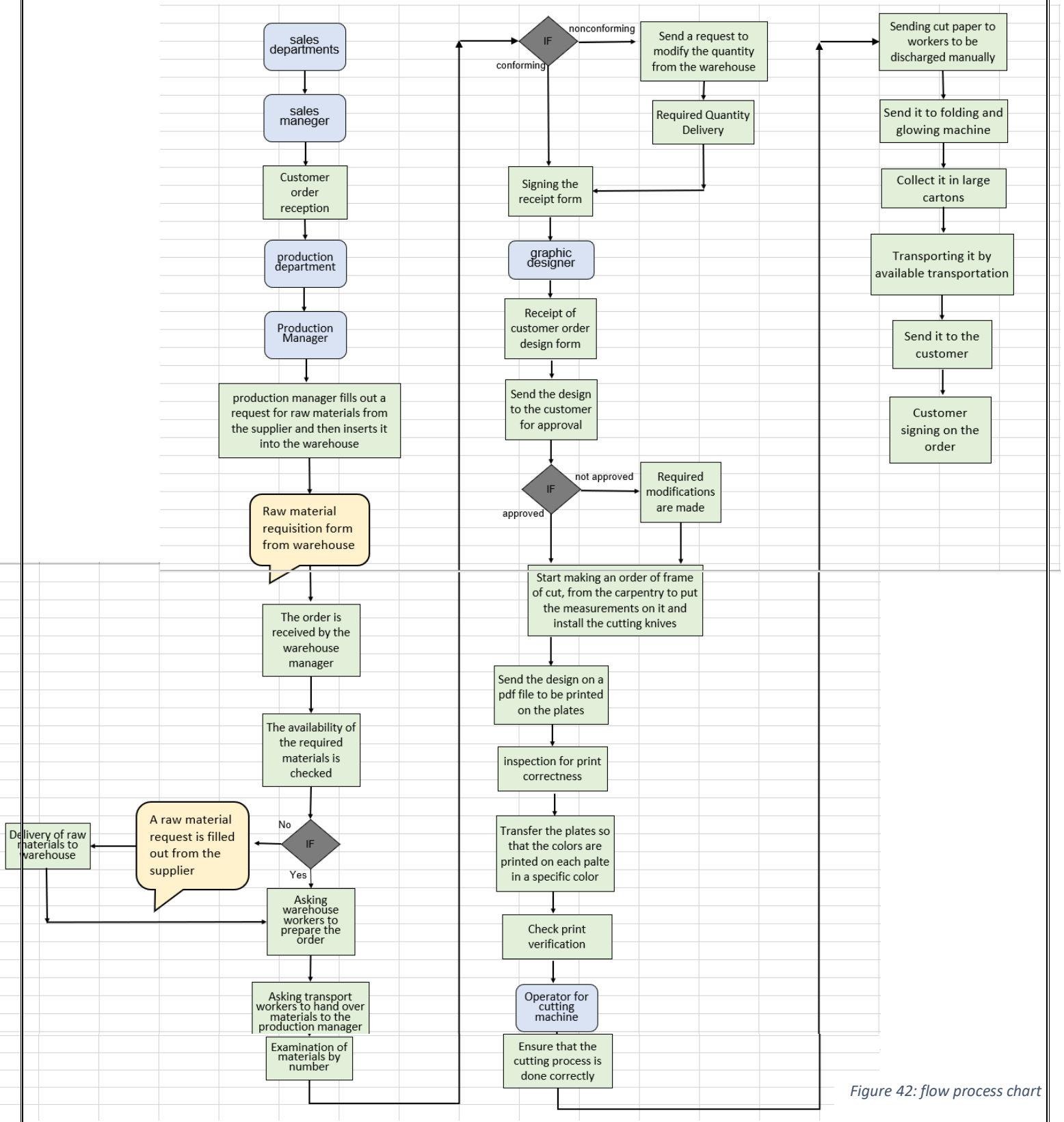


Figure 42: flow process chart

Fish Diagram:

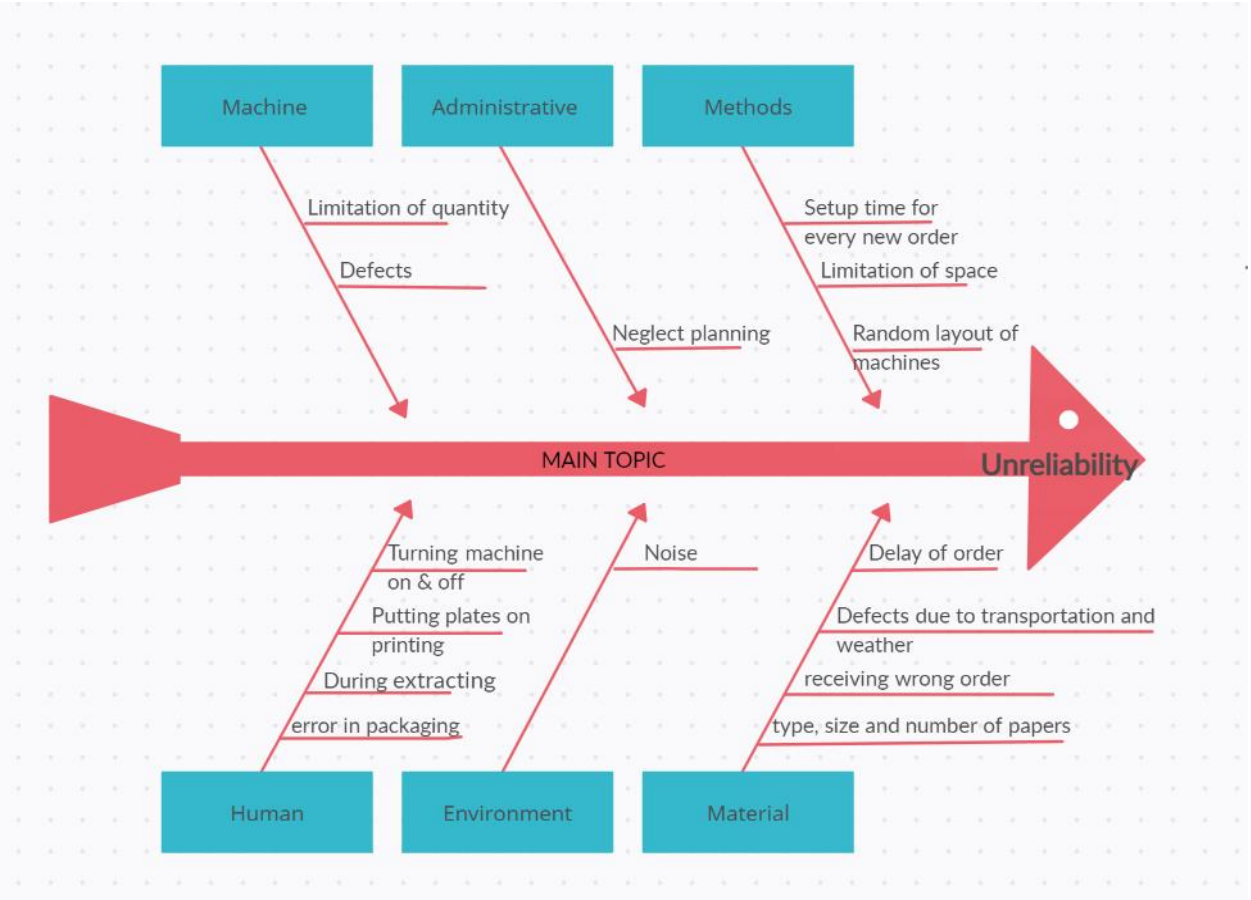


Figure 43: Fish diagram

4.2 Methodology:

Step.1: Data collection & Problem selection

The problem that we are studying in this project was observed during the practical training period for a group student at Hijjawi Company. The problem is clear to everyone who walks around the production line and learns about the operations and their sequence within the company. The problem was discussed among the team members, field visits to the company and production lines were conducted, interviews were conducted with some of the company's employees, and then the problem was discussed with the supervisor Dr.

Step.2: Problem verification

This situation has been in the company since it was established, so the workers are fully aware of the situation, as we went to held interviews with the workers to ask them about the extent of the impact of this randomness on their performance and how they deal with the current situation because they are considered the main factor that is affected by this problem since they are the ones who perform the various production processes.

In general, the responses were negative about the current situation, because the blame is often placed on them if any manufacturing process is corrupted as a result of a mistake in using the correct tools for the required production process.

Along with the load of the production process they are in charge of, the workers were also burdened by the company's reliance on their prior experiences and knowledge of the necessary manufacturing tools.

A responsible production business would design a system that makes work easier and doesn't rely on employees. In the end, this is seen as the firm's production system, and because the production process mostly rely on experienced personnel, even if they are aging and performing poorly, the corporation is burdened with the inability to let go of them.

In addition to the expenses the business bears as a result of errors brought on by staff who are unclear about the proper tools to use.

Step.3: Information analysis

The approach was made to accurately determine the existing problem from several aspects, starting with the causes leading to it, to the effects of this problem on the company ,In the beginning, work was done to collect information related to this subject from several sources, including the engineer who works in the company, where he was interviewed several times, he explained the situation of the company in a way, mentioned the existing problems, and took accurate inquiries from him, Also, the company was visited several times and saw the working method in detail, while taking a tour of the production lines and seeking the help of the workers responsible for some of the machines to explain the details of the operations that are carried out on the machines and what they think about the general situation in the general area and what they notice and face from problems ,After seeing the general situation, complete randomness and lack of order were noticed, especially for the tools. After these steps, all the information was collected and analyzed in detail to determine the problem that will be worked on, which is the problem of randomness and the lack of arrangement and storage system for the tools because of their problems and negative effects on the company and the customer in terms of the additional costs that may be caused by the occurrence of this problem and seeing some cases that have already occurred and resulted in costs after sitting with a sales employee and talking to him about this.

Step.4: Problem solving suggestions

Through research and study, we tried to identify the problems accurately, starting with the causes of these problems and how they got to the effects of these problems on the company, and from here we started working to find possible solutions for them, and we were keen to match the situation of the company and its available capabilities.

The proposed solution is about managing the tools using a software application that has lots of properties that will be explained later and connect it to the storage system.

Chapter.5 Suggested Solution

5.1 5S

The application of the 5S system in Al-Hijjawi printing:

We will reorganize the tools in the factory after following the 5s system steps:

1- Firstly, Sort: where we will separate the valid tools that can be used from the damaged or duplicate tools that are not needed in the printing press.

2- Set in Order: We will arrange and organize the tools in a logical and effective way for ease of access and use. After all the damaged or duplicate tools have been eliminated, the usable tools will remain, so we will have statistics on their number and type, and then we will rearrange them within the new storage system (in general):We will divide the tools into four areas (diecut area, plate area, cliché area, jop envelop area), and one area will be divided according to size, and each size will be in a corridor dedicated to it and a specific sector of the sectors (restaurants, pharmaceuticals, banks, education ...) Of course, there will be slight differences between each region and region, which will be explained later.

3- Shine: We will clean and maintain the workplace regularly to ensure safety and a safe and healthy work environment.

4- Standardize: There will be consistent procedures and standards to organize the workplace and cleanliness, and to maintain the effectiveness of the new system in the printing press so that randomness in storage does not return.

5- Sustain: We will try to raise awareness to follow 5S practices continuously and improve them over time and provide a systematic approach to developing and maintaining a productive work environment.

Implementing a 5S approach can significantly reduce the space required for current operations, as well as the organization of tools and materials in storage locations.

How to attach the name and RFID chips on the tools:

1- diecuts : The name will be engraved on the tool because it is made of wood and the chips will be attached to it from the outside.

2- plates: The name will be printed on the backside as well as the design because it is made of aluminum, and the flat slide will be installed on it due to its very thin thickness.

3- Cliches: The name will be attached to a small piece of aluminum with a chip attached to it, and since the cliches are made of rubber, the piece will be placed inside the rubber during the manufacture of the cliche, so the piece will be as if it was implanted inside the cliche.

5.2 Selected Area

The factory suffers from the random arrangement of the machines, and therefore the process of storing the tools near these machines is a difficult task without changing the arrangement of the machines because placing the tools near the machines will greatly affect the manufacturing process, as a result of the numbers of the manufacturing tools that need to be stored, in addition to the lack of sufficient empty space to accommodate all these tools in one place, and therefore random, impeding the manufacturing process and impeding the movement of workers within the production lines.

Our proposal was taking into account all manufacturing conditions, which consisted of taking the roof of the factory with an area of (1,344) m^2 as a suitable place in which the storage process for the tools took place, and therefore a suitable place was taken with the addition of a suitable cover for the surface to prevent the sun and rain from reaching the tools to preserve them from damage.

Figure 44: Roof Area

Reasons for choosing a storage location:

As for the storage spaces used on the ground floor, they were not chosen because they are used in the process of storing raw materials such as printing paper, cartons, and finished products ready for delivery. As storing these materials on the ground floor is better because it is easy to place them directly from trucks to storage without the need to move them to another place and therefore considered an exploited space for storing raw materials and others.

In addition, the place is considered invalid and does not take into account the storage conditions required to store these tools, because the place is damp as a result of the arrival of rain water.

Dividing the basement floor will hinder the possibility of using the system in place as a result of the need to have a large empty space without obstructing the foundation pillars of the building because the system will need a large connected empty space and therefore the choice of the roof area supports requirements of that system more.

In addition to the need for the tools to be in one place and not to be divided into different places and sections within the production lines because the required area is as mentioned before is to be full empty space for storage.

The layout of the different areas of the company:

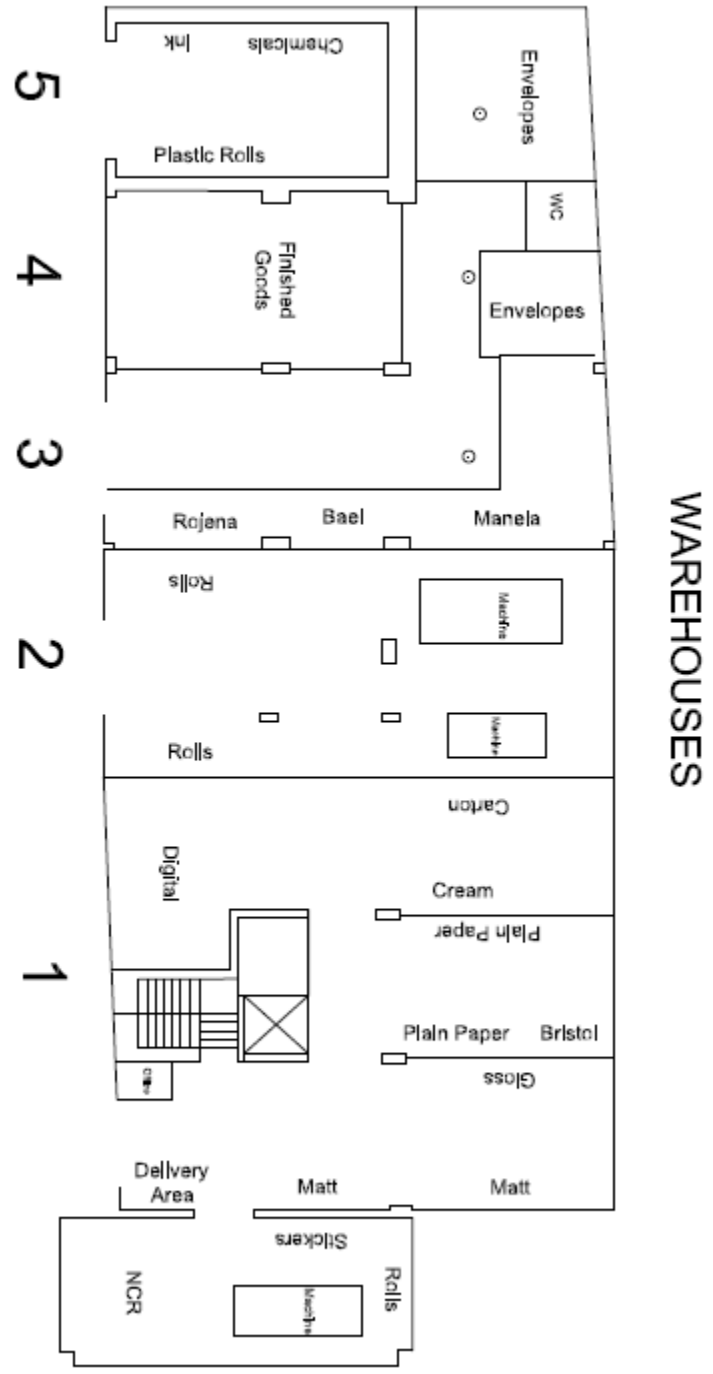


Figure 44: warehouses layout

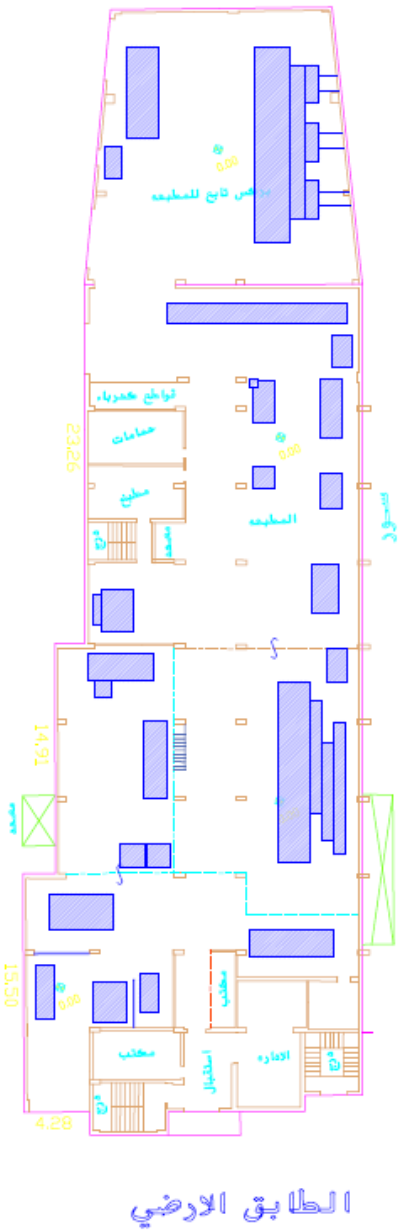


Figure 45: ground floor layout

This layout shows the ground floor of the company, where it represents the main entrance to enter it, and the rest of the company's floors are similar to this floor, where each floor is concerned with a specific function. For example, there are several offices, design areas, manufacturing areas, etc. Thus, we cannot use them as a place to store tools because there is no empty and sufficient space inside them.

Ease of reach

Our choice of the roof to store the tools does not interfere with the ease of access to the tools, as there is an external elevator in the building that can be modified to reach the roof so that it can be used for the process of transporting tools.

Roof covering:

- ✓ sandwich panel

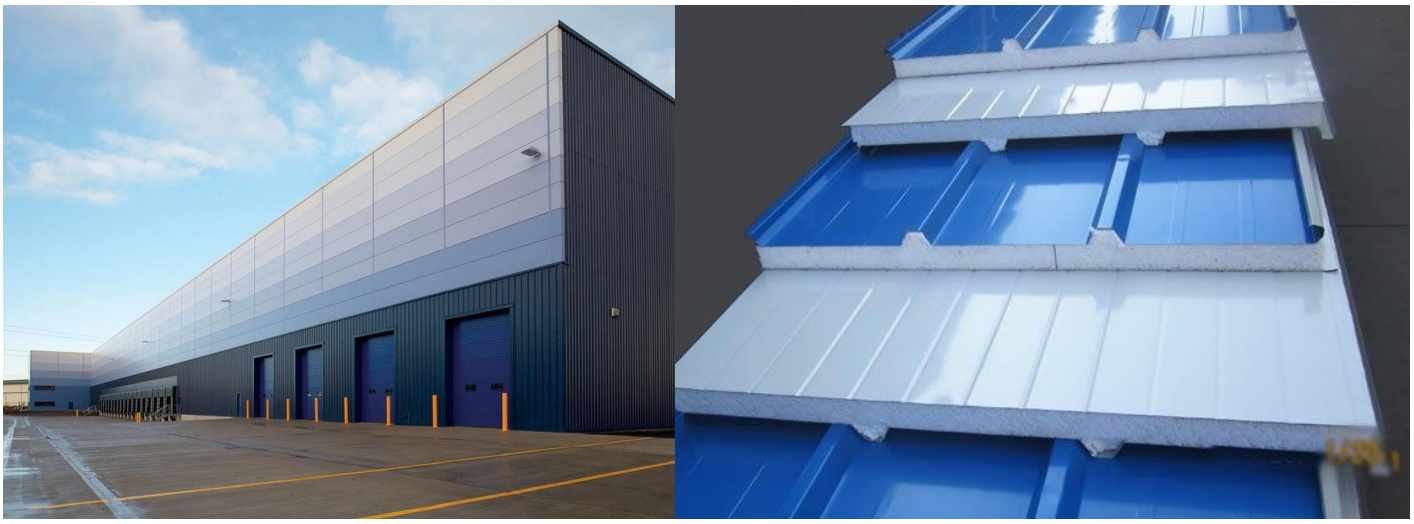


Figure 46: sandwich panel

Since the roof is exposed, it is necessary to choose a suitable cover for it that prevents the arrival of water, rain, sun heat, or moisture to become suitable as a place to store tools. Therefore, the best option for that was the sandwich panel, which is galvanized sheet sheets stuffed with insulating material. The sandwich panel consists of materials Light and composite, which is surrounded by two layers on both sides of iron or aluminum, in the middle of which an insulating layer is placed, and this insulating layer is a special, soft and flexible foam , It consists of materials such as polyurethane, polystyrene, rock wool and glass wool, which are placed and glued with the lower and upper sheets (galvanized, corrugated or aluminum).

Among the advantages of the sandwich panel, which is suitable for being a cover for the place chosen for storing tools, is

1. Perfect heat insulation

The goal of thermal insulation is to take measures that prevent heat transfer, with the aim of Protecting the die cuts from water reaching it so that it does not cause damage to it because it is made of wood and has iron blades and protecting the plates from sunlight and heat reaching it so that it causes damage to the colors on it, as well as reducing energy, and living in a comfortable environment. The sandwich panel is the optimal material for thermal insulation in buildings. The sandwich panel also prevents mold or moisture resulting from condensation with insulation and thermal movements. It helps the buildings to remain durable and extends their lifespan. The thickness of the insulation materials in the sandwich panel varies according to the weight-bearing capacity, the environmental conditions in the region, the purpose of using the building, and the thermal insulation value.

2. Economic investment

It is easy to disassemble and install the panels easily thanks to its economy and practicality. In addition, its maintenance costs are very low thanks to its strong and resistant structure. In short, the sandwich panels offer practical, fast, aesthetic, economical and durable solutions.

3. High fire resistance

4. The property of not leaking air and water

5. Noiseless buildings

(Siregar, 2021)

5.3 Storage system

What is a warehouse storage system?

A warehouse storage system is a collection of actual buildings that were created with the specific purpose of assisting you in making the best use of your warehouse area. A warehouse storage system, in particular, makes sure that your available space is used as effectively as possible by improving organization and facilitating access to all of your goods.

Deciding on or developing a warehouse storage system is foundational to running a successful third-party logistics (3PL) warehouse. When correctly implemented, these systems will significantly increase the efficiency of your warehouse and give you the assistance you need to scale effectively.

What to consider when choosing a storing system and why:

Optimize the space you have while also increasing the efficiency of your team.

The most common criteria used by warehouses to select systems are flexibility, weight restrictions, and whether or not a shift in infrastructure is necessary.

Finding the ideal warehouse storage system requires some science because you must take into account a variety of factors, including product size, packing, and turnover ratio. Additionally, the number of SKUs you're managing has a big impact on the storage system you choose because some techniques are better suitable for lower inventory levels.

Improved safety:

The significance of warehouse safety cannot be overstated. Your team's safety and well-being are at danger if the appropriate safety precautions aren't in place. Thankfully, warehouse storage systems increase the safety of everyone and everything there—including your workers, merchandise, and any machinery you might be employing.

Improved efficiency:

Warehouse staff can locate the inventory required much more quickly and effectively with the correct storage system. This is primarily due to the fact that the warehouse layout is taken into account when planning or choosing the storage solutions. In other words, you can alter your structures to meet your own storage requirements.

There are many storage systems used nowadays so here are some of them:

1. Horizontal Carousel Storage System:

This system is used when there is no vertical space in the storage area but there is a horizontal one that must be optimized, given that it is an automated horizontal carousel that transports goods to a person in a picking area by rotating a series of containers (bins) horizontally on a stainless-steel track, or "goods to man,".

What is a horizontal carousel system?

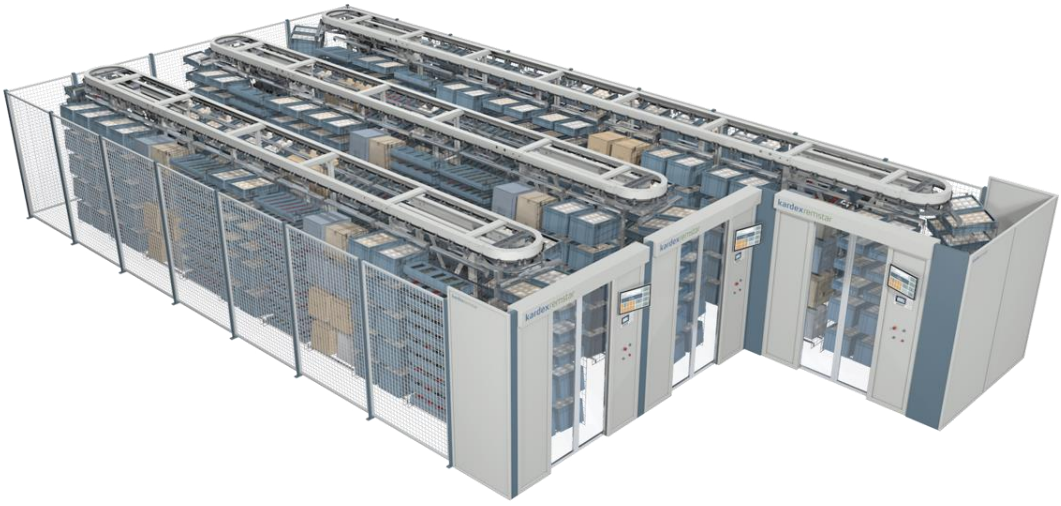


Figure 47: horizontal carousel system

A horizontal carousel conveys shelves filled with product to the operator as a person-to-person material handler. A horizontal carousel, as its name suggests, rotates horizontally, like a merry-go-round, and the majority of applications involve several units feeding each actuator.

The operator can select items from multiple baskets at once, and is usually directed by lights that display the appropriate items and amount. As a result, operators can select multiple work orders at once and hundreds of items per hour.

Working mechanism:

The horizontal shelving units consist of an oval track that supports rotating shelves and boxes. Conveyors are carried around the oval track horizontally by a motor located within it; They stop at a predetermined point of arrival for cargo storage or retrieval, a welded steel frame supports the oval rail system in a horizontal circular storage system. A carousel can be either a floor-mounted system or an overhead system (known as a top-driven unit) (termed as a bottom-driven unit). In a top-driven unit, the upper trolley system is driven by a motorized pulley system that is positioned at the top of the structure. Carts are used as supports for the boxes. In the bottom-driven unit, the trolley system is supported by a rail at the base, and the pulley drive system is fixed at the base of the frame.

Carousel applications:

Carousel storage systems are popular because they frequently have a high throughput. Carousel storage systems are frequently used for processes like storage and retrieval, transport and accumulation, work-in-process, and specialized usage. When individual items need to be chosen from storage groupings of goods, carousels are an efficient way to store and retrieve items. Order picking of tools in a tool room, raw materials in a stockroom, service parts or other things in a wholesale firm, and work-in-progress in a factory are all examples of what are known as "pick and load" processes. Carousels are used in small electronics assembly to kit items for delivery to assembly workstations. The carousel is utilized in transport and accumulation applications to move and/or sort goods as they are stored.

benefits of this system:

The carousel now has more load-carrying capacity. In addition, it solves the problem of dust and oil falling on storage elements in push-top systems from the overhead trolley system, and the standard containers are made of steel wire to increase operator visibility. The main benefits of this system are: higher productivity, higher precision and reduced personnel.
A Horizontal Carousel provides organisations significant levels of increased productivity, space savings and increased accuracy for storage and retrieval applications of small parts, items, and case handling. The Horizontal Carousel (HC) system is a reliable and low maintenance automated storage machine.

The Horizontal Carousel's and Industrial Engineering Solutions Remote Support Service can reduce long wait times in repairs when issues arise. Pro-active servicing helps assure increased system up time, unit longevity and faster Return on In- vestment (ROI). A full range of carousel bin sizes, lengths and heights are available to meet virtually all applications.

The automated storage and retrieval horizontal carousel system increases productivity and reduces labour by up to 2/3 by bringing items to the operator and eliminating wasted walking, searching activities. Every carousel is designed using quick adjustable shelves in metal bins which rotate horizontally on a track. A push of a button, scan of a barcode, foot pedal or touchscreen will rotate the carousels to the nose end to be picked by an operator.

Additional aids of an integrated pick to-light, voice directed picking and I/E' Systems can be designed with a full suite of inventory management software which can be integrated into existing WMS and ERP systems. (Higginbothem, 2022) (Kardex Horizontal Carousel) (T. LeBaron, December 1998)

2. Mobile Shelving

Mobile shelving is storage cabinets or racks mounted on carriages on wheels that move across a floor track to avoid fixed Aisles that waste space, allowing you greater file capacity within the same footprint.

To better utilize workplace space and get twice as much storage of documents and files in an existing area, mobile shelf units offer a space-saving storage solution. With controls that allow Aisle mobility, opening and closing the compactable shelves is simple. To increase efficiency, use a push-button or turn handle to remove unused space and store more in a footprint half the size.

How Mobile Shelving Systems Work?

Mobile shelving systems contain rows that slide along floor rails until compacted into a smaller-size footprint, providing you more space to store excess paperwork. When not in use, close the rows by pressing them together while leaving a few Aisles open. It helps maintain user accessibility without sacrificing the confidentiality of stored material. Use the ergonomic handles or push-button controls to move up to six Aisles at once if you need quick Aisle access. When you're busy, it takes little physical effort and helps you save time, you won't waste important floor space by having fewer Aisles to maintain, and you can utilize the entire footprint to meet rising production demands. The simple controls on the carriage make it possible to shift it quickly to increase capacity or reduce space by half. Mobile shelving can consolidate paper documents in one convenient location and helps prevent wasting usable storage. Employee irritation during retrieval has been eliminated thanks to improved organization and accessibility.

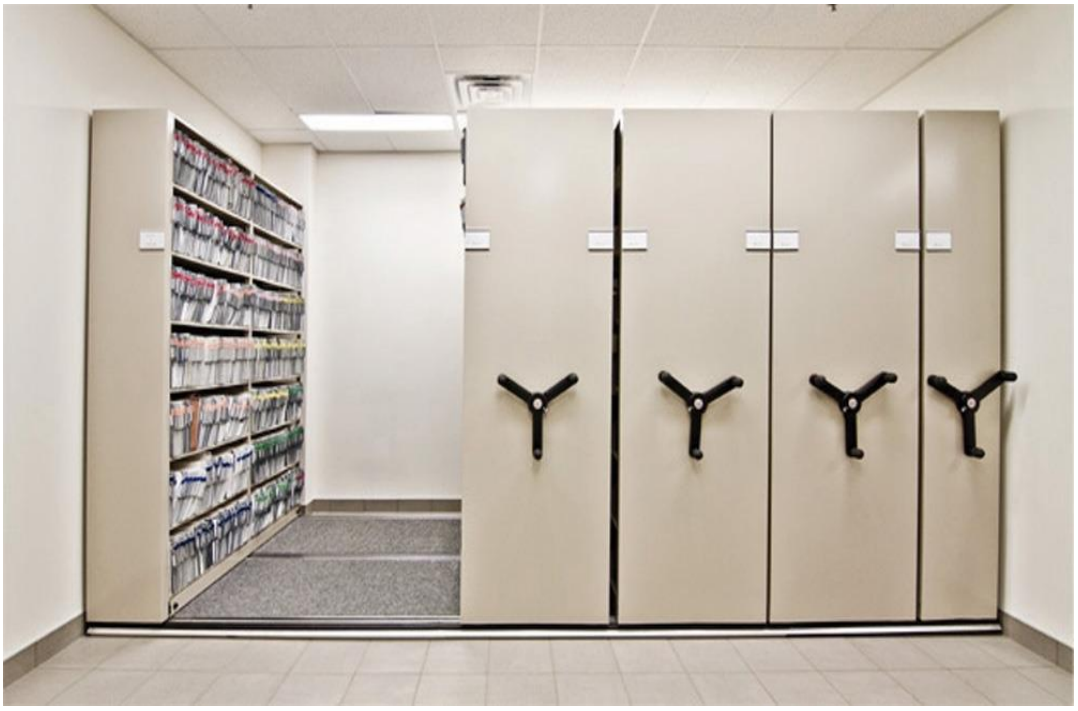


Figure 48:Mobile Shelving

This storage may be useful in terms of the small space it needs, but it is useless for storing the tools in Hijjawi Company, because this system stores the tools side by side in a compact manner without having a specific place only for each tool, for example when we need a tool specific and we take it from its place, this may cause the tool located next to it to fall because it is based on it, thus there becomes an error in the places of some tools. In addition to that, the tools in the company are of various sizes, so they need a more flexible system than this because it is dominated by stability in the sizes of the shelves.

3. Rack systems

Unit loads can be stacked vertically using rack systems without the need for support from the loads themselves. The pallet rack, which is one of the most widely used rack systems, is made comprised of a frame with horizontal load-supporting beams. These horizontal beams are used to store pallet loads. An alternative to storage racks is Cantilever racks, which resemble pallet racks except that the center vertical frame cantilevers out from the supporting horizontal beams. Unobstructed spans are created by getting rid of the vertical beams at the front of the frame, which makes it easier to store long materials like rods, bars, and pipelines.

Racks that circulate, the flow-through rack employs long conveyor tracks that can hold a row of unit loads in place of the horizontal load-supporting beams in a typical rack system. First-in-first-out stock rotation is achieved because the unit loads are added from one side of the rack and unloaded from the other. To help the loads travel toward the output side of the rack system, the conveyor tracks are slightly angled

Figure 49:Rack systems

This system is not suitable because the storage in it is vertical and the company does not have enough space for vertical storage, the storage is often stacked on top of each other, so it may lead to damage to some tools in this way.

4. Stacker-Bot

The Stacker-bot storage system is a type of automated storage and retrieval system (ASRS) that is commonly used in warehouses and distribution centers. This system uses a combination of robotics, conveyors, and software to automate the storage and retrieval of products.

The system consists of a vertical structure that is comprised of several levels of shelves, each of which is designed to hold a specific type of product. The shelves are accessed by a series of robotic cranes, which are controlled by a central computer system.

When a product needs to be retrieved from the system, the computer system sends a signal to the appropriate robotic crane, which then moves along the shelves to retrieve the product.

The product is then transported via a conveyor system to a designated location for further processing or shipping.

Similarly, when a product needs to be stored in the system, the computer system sends a signal to the appropriate robotic crane, which then retrieves the product from its designated location and places it on the appropriate shelf.

The Stacker-bot storage system offers several advantages over traditional storage systems. It allows for a much higher density of storage, as products can be stacked much higher and closer together than in traditional shelving systems. It also allows for faster and more accurate retrieval of products, as the robotic cranes are able to quickly locate and retrieve the correct product from its designated location.

Overall, the Stacker-bot storage system is a highly efficient and effective way to store and retrieve products in a warehouse or distribution center setting.

Figure 50:Stacker-Bot

(Groover, 2015)

Application of Stacker-bot storage systems

Stacker-bot storage systems are commonly used in warehouses, distribution centers, and manufacturing facilities to automate the storage and retrieval of goods. The system consists of a series of vertical storage units that can be configured to accommodate different sizes and types of products. Here are some common applications of Stacker-bot storage systems:

1. E-commerce fulfillment centers: With the rise of online shopping, e-commerce companies need to process and ship large volumes of orders quickly and accurately. Stacker-bot storage systems can be used to store and retrieve products efficiently, reducing the time it takes to pick and pack orders.

2. Manufacturing facilities: Stacker-bot storage systems can be used to store raw materials and finished goods in a manufacturing facility. This can help to improve inventory management and reduce the risk of product damage or loss.
3. Cold storage facilities: Stacker-bot storage systems can be used in cold storage facilities to automate the storage and retrieval of temperature-sensitive products such as food, pharmaceuticals, and chemicals. This can help to reduce the risk of product spoilage and improve safety for workers.
4. Automotive parts storage: Stacker-bot storage systems can be used to store and retrieve automotive parts in an organized and efficient manner. This can help to improve inventory management and reduce the time it takes to locate and retrieve parts for assembly.
5. Libraries and archives: Stacker-bot storage systems can be used to store and retrieve books, documents, and other materials in libraries and archives. This can help to maximize the use of available space and improve accessibility to the stored materials.

Overall, the Stacker-bot storage system can be a valuable asset for any business that needs to manage and store large volumes of products or materials in an organized and efficient manner.

This system was not chosen because the system is a vertical one and the space, we have is a horizontal one as well as the shelves can't carry a heavy weighted tools which prevent us from choosing it because the tools in the factory are heavy and in addition to the robot used in the system is expensive.

5.3.1 Selected Storage System:

Because of the special case of the tools used in the company, it was necessary to come up with a storage system that is specially designed for this case, so all the information and variables were collected to come up with this system to suit the tools.

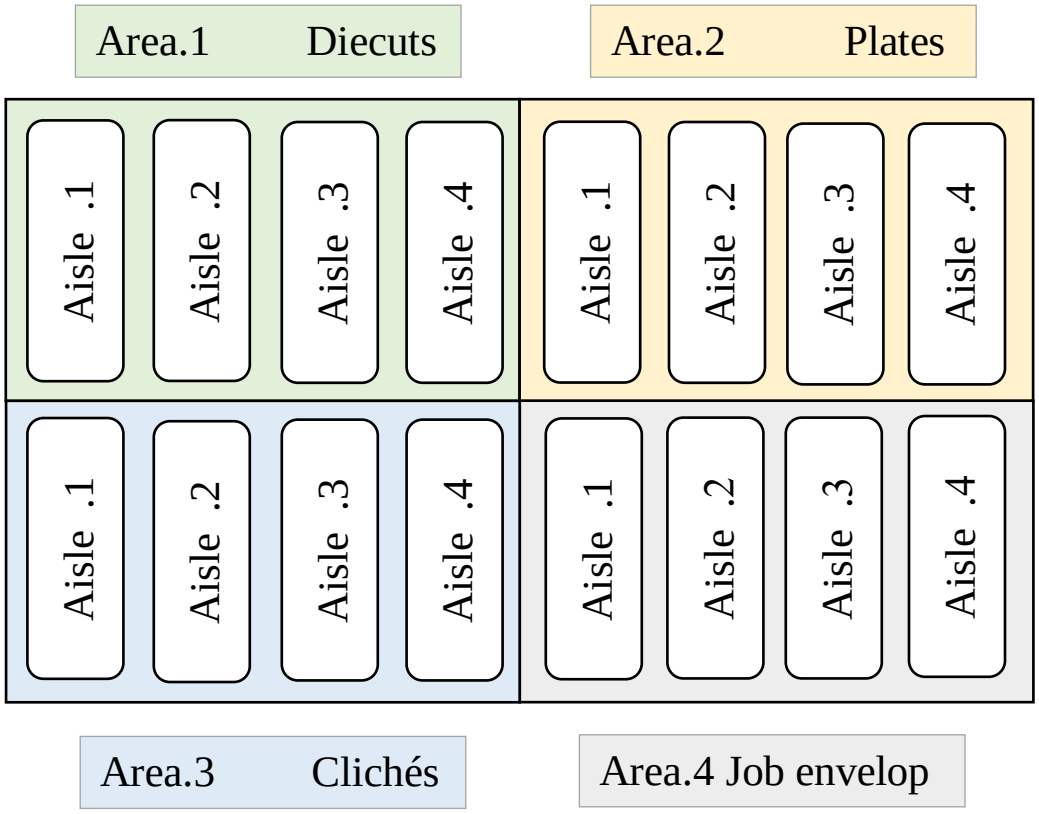


Figure 51:Aisles Sectioning

Every kind of tool has two main constants characters, the first is the size and the second is the sector it used in, as the sector was excluded as the main way of classifying tools because there are unlimited sectors that they produce for so it will be difficult or mainly unreasonable, as a result the size was the main method for classifying these tools according to the known and popular used sizes.

As for the system used, it was created specifically for this company and it tools, so it can be an easy process of finding the tools in the storage system and depending on the code that has been created specifically for each and every tool in the storage. And it also depends on the method of naming the attached tools (code) which will be explained later, to make it easy for naming tools and finding them on the storage area.

The storage area will be divided into 4 different areas, each will be specialized for a different kind of tool (Area.1 will store Diecuts, Area.2 will store Plates, Area.3 will store Clichés, Area.4 will store Job envelops) and each area will be divided into 4 different Aisles each Aisle will present different type of the tool in that area. As for area 4 will be divided into 4 aisles (the first will present files that has used a diecut as a production tool, the second is plates, the third is cliché, and since there are some orders which need both diecut and plate its files will be in asile.4).

As for the sectors selected, the most sectors that the compony deal with are chosen, as they present the majority of fields, and a sector of the remaining sectors named with (others).

As there are two main popular dimensions in case of Diecut and cliché (70 × 100) cm & (30 × 50) cm and the remained dimensions are made by the customer order and its can be any size between (10 × 10) cm to (70 × 100) cm, but in the case of plates there are only two dimensions because they are manufactured in the company itself and they are (70 × 100) cm & (30 × 50) cm, as a result they should be taken in to account when dividing the areas.

So in case of the Diecut and cliché (Aisle.1 will be presenting the largest size which is 70 × 100, Aisle.2 will be presenting the second largest size which is 30 × 50, Aisle.3 will be presenting the sizes that are customized and are in the sector of Restaurants and Medicine, Aisle.4 will be presenting the sizes that are customized and are in the sector of Banks and Education and others).

And in the case of Plates (Aisle.1 and Aisle.2 will be presenting the largest size which is 70 × 100 but Aisle.1 will be specified for Restaurants and Medications, Aisle.2 will be specified for Banks and Education and others, Aisle.3 and Aisle.4 will be presenting the second largest size which is 30 × 50 but Aisle.3 will be specified for Restaurants and Medications, Aisle.4 will be specified for Banks and Education and others)

After that each Aisle will be divided in to sections according to the selected criteria sectors except for the Aisles which are already specified above (section.1 will present the Restaurants sector, section.2 will present the Medications sector, section.3 will present the Bank sector, section.4 will present the Education other unmentioned sectors, section.5 will present the other unmentioned sectors).

So mainly the method that was followed to build the storage system is to divide aisles based on size, and when the size is similar in two aisles then we differentiate them based on the sectors.

Tool ➡ **Size** ➡ **Aisle** ➡ **Sector**

Diecuts and Clichés ➡ 70 × 100 ➡ Aisle.1 ➡ All Sectors
➡ 30 × 50 ➡ Aisle.2 ➡ All Sectors
➡ Others ➡ Aisle.3 ➡ Restaurants and Medications
➡ Others ➡ Aisle.4 ➡ Banks and Education and others

plates ➡ 70 × 100 ➡ Aisle.1 or Aisle.2
➡ 30 × 50 ➡ Aisle.3 or Aisle.4
……
➡ 70 × 100 ➡ Aisle.1 ➡ Restaurants and Medications
➡ Aisle.2 ➡ Banks and Education and others
➡ 50 × 30 ➡ Aisle.3 ➡ Restaurants and Medications
➡ Aisle.4 ➡ Banks and Education and others

Job envelops ➡ Diecut ➡ Aisle.1
➡ Plate ➡ Aisle.2
➡ Cliché ➡ Aisle.3
➡ Diecut &Plate ➡ Aisle.4

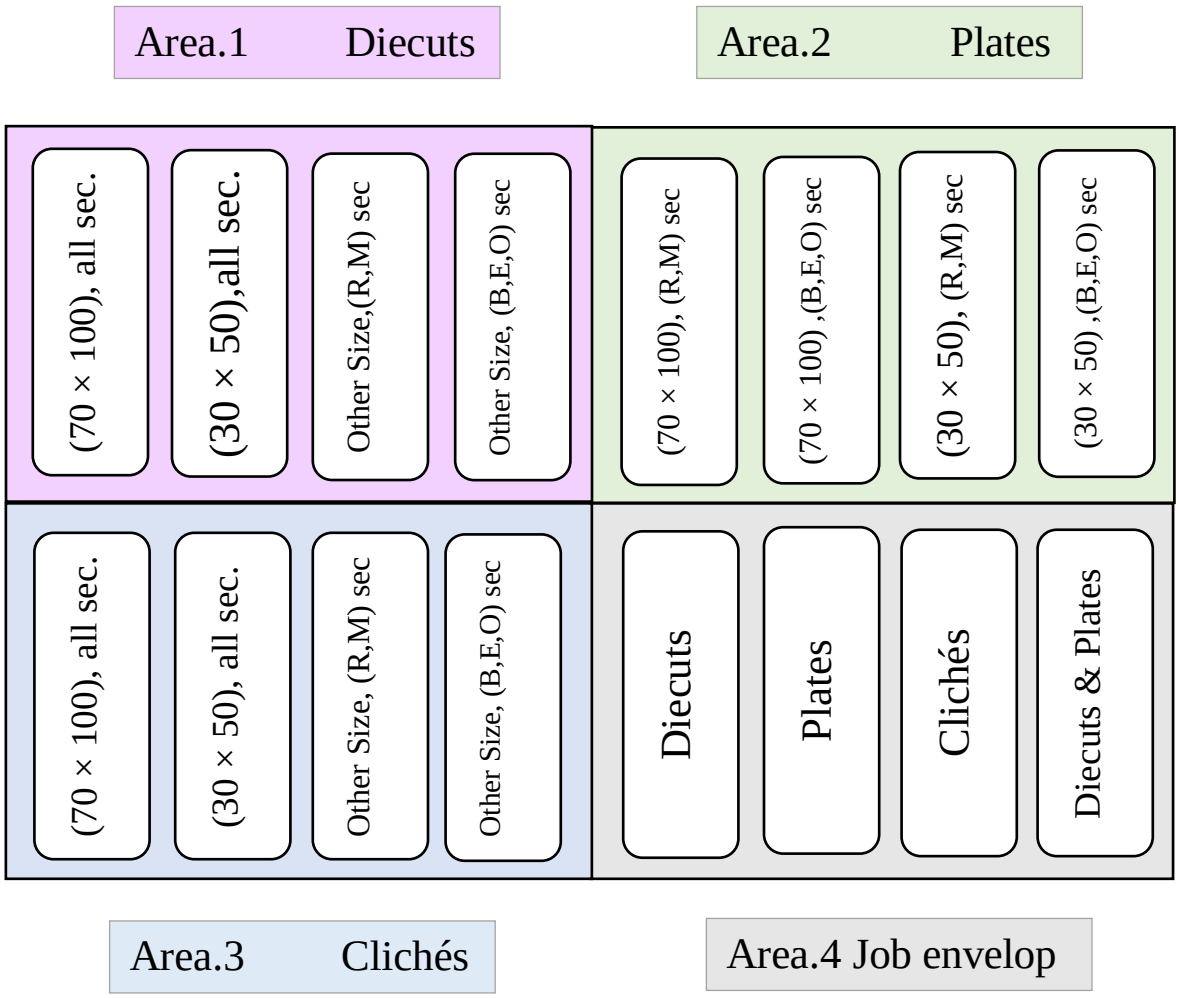


Figure 52: Sectors Sectioning

Abbreviations:

Sec. ➡ sectors

sectors (R,M,B,E,O) ➡ (Restaurants, Medicine, Banks, Education, Others)

Diecut Aisles as shown in graph above:

Aisle.1 ➡ (70 × 100) all sec. ➡ (70 × 100) cm size, all sectors (R,M,B,E,O)

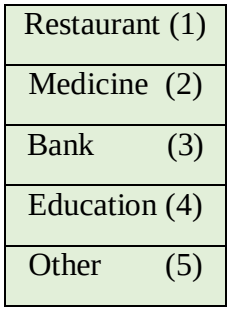
Aisle.2 ➡ (30 × 50) all sec. ➡ (30 × 50) cm size, all sectors (R,M,B,E,O)

Aisle.3 ➡ Other Size (R,M) sec ➡ other sizes, sectors (R,M)

Aisle.4 ➡ Other Size (B,E,O) sec ➡ other sizes, sectors (B,E,O)

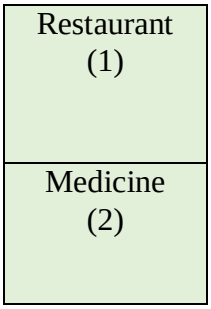
Diecut and Cliché division of sectors in Aisles:

(70 × 100) & (30 × 50) sizes



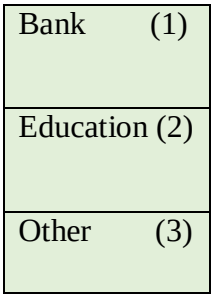
The first and second Aisle sectors

(Other) size



The third Aisle sectors

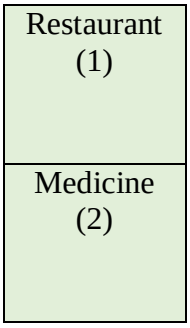
(Other) size



The forth Aisle sectors

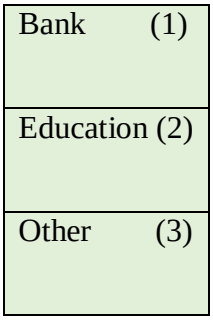
Plates division of sectors in Aisles:

(70 × 100) & (30 × 50) sizes



The first and third Aisle sectors

(70 × 100) & (30 × 50) sizes



The second and forth Aisles sectors

The final shape of the storage system:

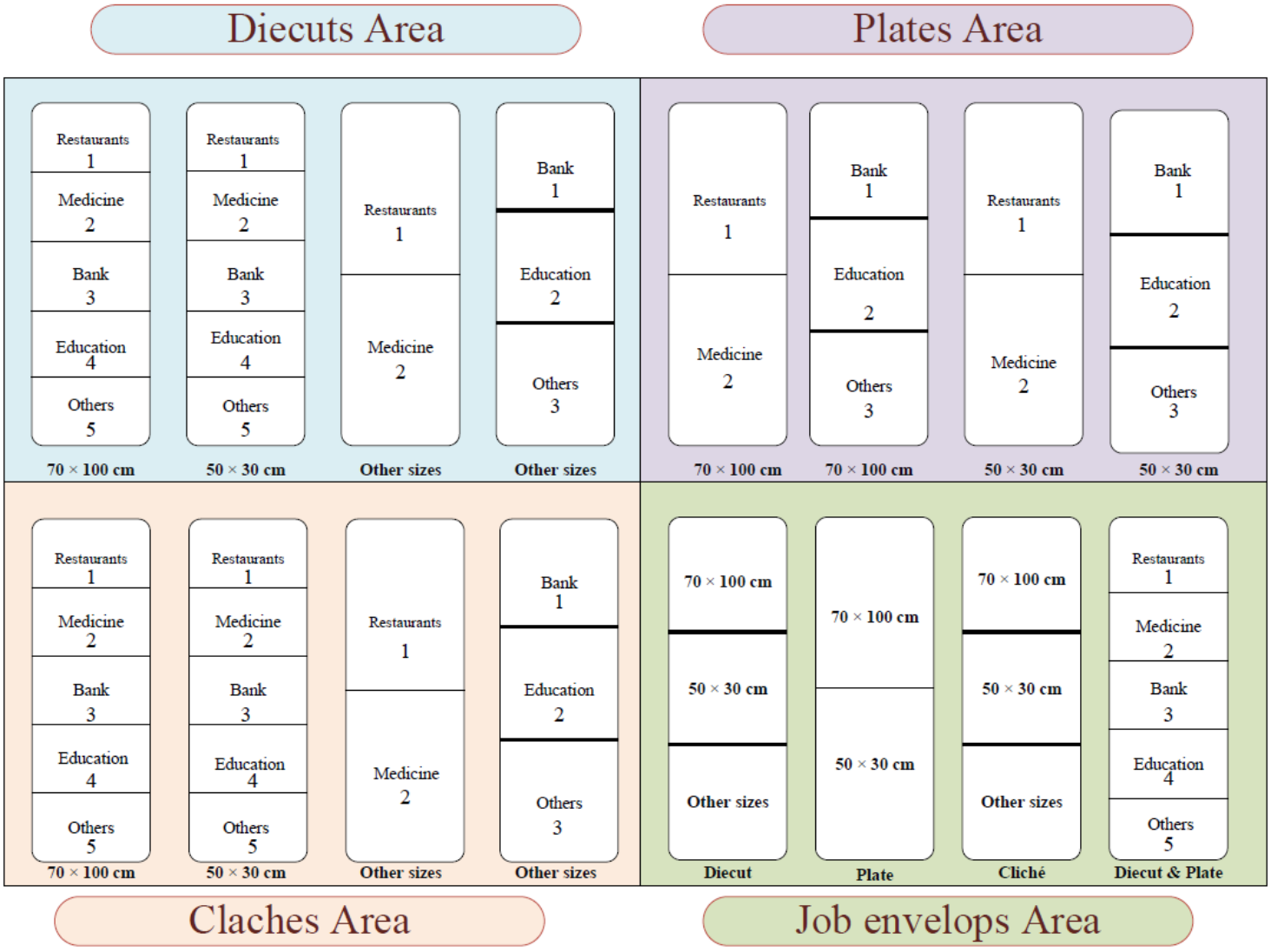


Figure 53: Storage System Details

In the beginning, the surface area is 1,242 m^2 and it is a relatively large area, so it would be a perfect place to store all of these tools as there are thousands of them, but these numbers are approximated and after applying the 5S Method to get rid of any damaged tools before starting the classification and counting process and taking in to consideration leaving an additional space empty for tools that will be manufactured and stored in the future, it would be the perfect choice in this case, and to mention that there is an external elevator that reaches the area so it will be easy to reach.

After selecting the required and appropriate area, a roof covering will be made using sandwich panel because it is a cheaper method instead of building with stone, which will raise the costs. In addition, building with stone requires a permit from the municipalities, as this will make things more difficult. After covering the roof, shelves for tools will be installed, taking into account a special design for the shelves for each type of stored tools. For example, the type of shelves that will be used for the die cut must bear heavy weights as it is made of wood. In addition, taking in to account, the different sizes of the Diecuts will have a different design for the shelves based on each size.

First, the Diecut, and the plates..... The shelves will be sectioned in to two sections only due to their large size, and each tool will be suspended from the other using special tweezers or carriers to hang them up, each of which bears a number to be distinguished from the others (and this number is in an ascending sequence within one section of the sectors) bear the heavy weight in the case of die cut and the aim is to save the location of the tool and reduce the layering method of the tools to avoid damage to the iron blades in addition to the ease of locating them when needed instead of being stacked directly on top of each other or having its designated place by placing it in a groove area for each tool.

Figure 54: Current way of storing Diecuts

Figure 55: (70×100)cm Diecut

Figure 56:The small sizes of diecut

Figure 57: (70×100) cm Plates

Figure 58:Plates with the 4 colors

Figure 60: current way of storing plates

Figure 59: current way of storing plates

** The carrier will hold a number to present the tool that it carries**

the numbers ascends in every section

Figure 61:The carrier used to carry the diecuts and plates

Other carriers suggestions:

Figure 63:Other carriers suggestions

Figure 62:Other carriers suggestions

Figure 64:Other carriers suggestions

As for the cliche, they will be stored on shelves divided into lower heights, and thus more shelves, and small boxes will be used in which the tools will be lined up in.

Figure 66:cliché

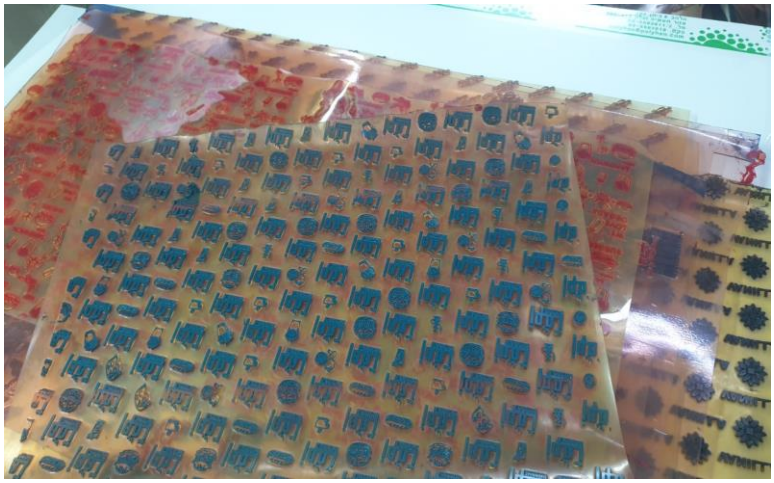


Figure 65: cliché

Figure 67: current way of storing cliché

Figure 68:current way of storing cliché

The storage method of clichés:

Figure 69:The method of storing clichés

The Job envelop storage method:

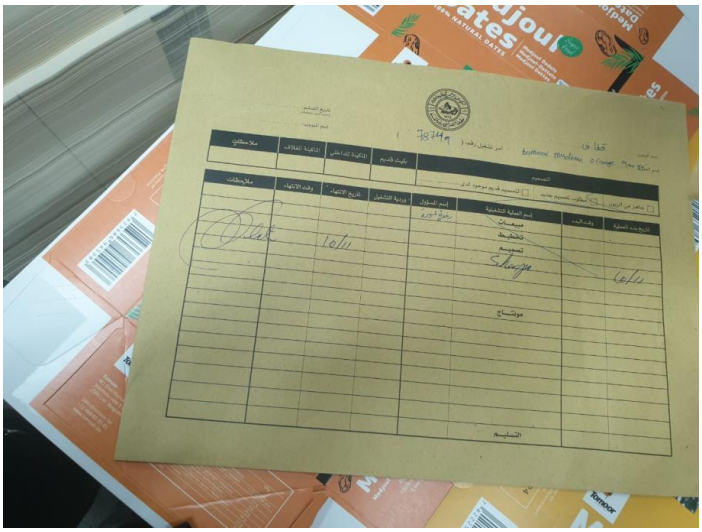


Figure 70: job envelop

Figure 71:suggested method of storing job envelop

And now that the appropriate place for storage has been determined and a suitable cover has been made, in addition to attaching the shelves and their accessories for each type of tools, and after making sure that the (5S) method was applied, the process of placing the remaining and good tools to those shelves designated for them, and after explaining how to organize the tools, these tools are arranged inside the shelves based on the used arrangement method. For example, with regard to the die cut tool, first they are separated according to their sizes. Secondly, each size is separated based on the function used in it or the sector, and are applied This technique is arranged on all types of tools. As for the Job envelope, it is named with the same name of the tool, and the customer's name is written on it from the outside. The files of each tool are collected separately in its own drawer.

The new way to manage orders and operations on the new system of storage and application:

1. The customer reaches the sales department, which collects the request details from the customer and sends the request to the Planning Department for its study.

2. The planning department studies the file, determines the details and requirements of the order, then distributes the tasks to the departments for manufacturing and attaches the tool number (in case it existed and manufactured before by searching for its name by coding and classification method, so that the planner chooses the required tool and then the application shows its characteristics and storage location and knows if It was in storage, and in the case it was a new tool, after entering its information, the application gives it the required name, planner prepares the order file, takes the file from the designer, puts them in a folder, and uploads it to the application.

3. The planning department uploads the folder to the application's database.

4. The storage department reviews the attached folders after uploading them by the planning department, so the storage worker opens the file and extracts the tool number from the file attached by the planning department, and attaches the number in the search field within the application (search by name).

5. The tool then is selected and all its information, images, folder and location are shown within the storage system.

The application of storing and retrieving these tools will still continue to do its job whether the company chooses to install the RFID system or not, but the RFID system will provide them specific information about the tools such as (Track the tools inside the production lines and read the number of copies made by the tool in addition to reading the data directly about the manufacturing process and the possibility of calculating the wear of the tools)

6. The storage worker takes the required tool that contains a chip installed in it to start tracking it from the moment it leaves its storage place through the RFID system, which classifies that the tool is no longer in its place and in turn enters data directly to the application about the tool and the manufacturing process related to it.

5.4 Coding and Classifications:

1) Classification definition:

The term classifying has two different meanings:

- the process of designing a classification
- the coding or description of an object by using codes or terms that are designators of the concepts in a classification.

<u>The purpose & concepts of classification are:</u>

❖ (Example) to support counting the number of instruments in stock or to facilitate research. An example is the classification of tools that need two coolers of ink.

❖ Categories contain concepts within a specific domain.

Domain can be defined as follows:

The set of elements to which a variable or function is confined.

Any area of interest can be designed, for example, to create an information system.

Classification in industry:

The systematic separation, grouping, or categorization of materials or objects into different categories is known as classification.

Materials can be categorized using a variety of methods (e.g., nature, manufacturing process, value, and purpose).

It is important to classify materials correctly in order to identify those that are bought and kept for commercial use.

The storage department should closely examine and monitor the materials to ensure their careful treatment, safe custody, and protection from damage, fire, pilferage, and spoilage.

Below is a list of materials that have been broadly categorized based on their nature, function, and use.

- Raw Materials
- Consumable Stores
- Machinery and Plant
- Factory and Office Equipment
- Inflammable Stores
- Chemicals
- Furniture and Fixtures
- Scrap Materials
- Packaging Materials
- General Stores

The criteria used to classify materials:

Materials are categorized on the basis of their nature, manufacturing process, and value, among other factors.

- Basis Nature

Materials can be categorized as follows according to their nature:

1. Direct Materials : are things that can be easily measured and charged directly into a product and can be associated with a product or a group of products.

These materials are included in the finished product (e.g., timber in furniture).

2. indirect materials : materials that cannot be directly linked to a particular product or traced to that product.

There is no indirect material in the product. Repair and maintenance shops, lubricating oils, and cleaning materials are a few examples.

- Basis of Manufacturing Process

The following categories of stores are based on the manufacturing process:

1. Pre-process Stock: Items acquired before the commencement of production that have not yet been utilized in the manufacturing process.

They consist of raw materials, purchased components and assemblies, and stock in the pipeline of materials in transit.

2. Intermediate Stock: The components or assemblies produced in the factory for use in the finished product are referred to as intermediate stock.

3. Finished goods, also known as finished products, are items that have been properly made in the factory and are prepared for transportation or sale to the customers.

- Basis of Value

Stores can be categorized as follows based on value:

1. Category A: Materials in Category A make up 5% to 10% of all products in stores and account for 70% to 85% of the value of all stores.

2. Category B: Materials that make up 10%–20% of the total inventory and 10%–20% of the total worth of the stores are included in this category.

3. Category C: Made up of low-cost materials, it accounts for 5% to 10% of the value of all the stores' purchases and 70% to 85% of their overall inventory.

Costly Category A goods require a higher degree of control to protect them.

- Basis of Movement of stores

Store items can be categorized into the following groups according to how quickly they travel through stores (or the rate of consumption):

1. Fast Moving Stock: Due to high demand from production divisions, fast moving stock is quickly depleted.
2. Slow Moving Stock: Products in this group are used up slowly because there isn't much demand from the production departments.
3. Dormant Stock: Items in this group are not currently in demand but may become so in the future. This group contains materials that are only necessary during particular seasons.

Advantages of Material Categorization:

The benefits of classifying the products a company keeps in its stores are numerous. These consist of:

1. Classification Aids in Grouping of Store Goods: Classification aids in grouping various store goods. It is possible to consolidate the storage of items that belong to the same group in one place.

2. easy Location: Organizing store items into categories that make them simple to find is helpful. When needed, storekeepers can quickly locate materials in the production areas.

3. Accurate Accounting: When items are correctly classified, record-keeping procedures are simpler. The precision of posting receipts and issues in the stores' records is also ensured by simplified record-keeping.

4. Care: Storekeepers can determine the relative significance of items by classifying them according to their value. As a result, an appropriate level of supervision and control that is proportional to the value of each item can be applied.

5. Avoiding Duplication: Correct classification reduces the likelihood of having duplicate materials and inventories.

6. Standardization: Classification aids in the standardization of various retail products. By reducing variety with fixed sizes and types, standardization creates uniform standards for comparable products.

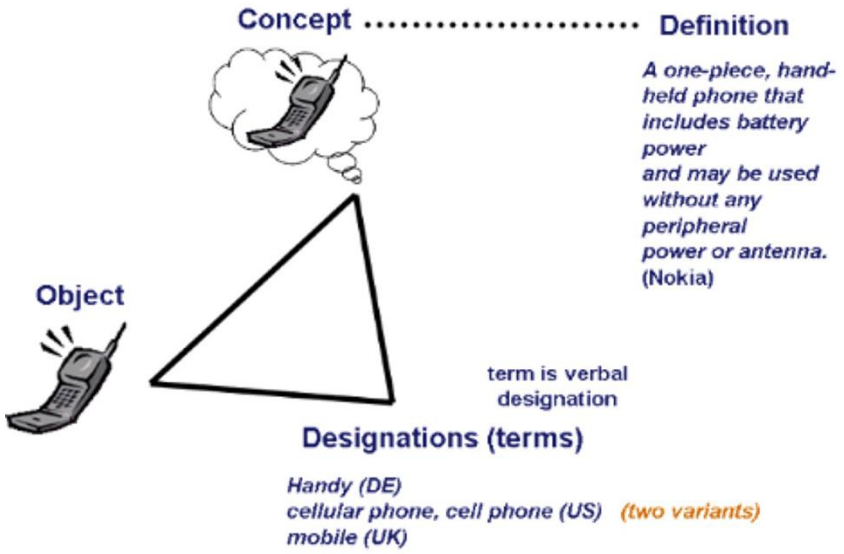
2) The code:

Terminology for coding means that three basic elements are used in the so-called semantic triangle: (1) object, (2) concept, and (3) term.

Objects, also called referents, are particular things in reality, and they are concrete, as well as abstract.

A concept is a unit of thought formed by using the common properties of a set of objects.

A term is a designation by a linguistic expression of a concept or an object in a specific language.



Coding is the process of assigning an individual object or case to a class, or to a set of classes in the case of a multi axial classification.

In most classifications, classes are designated by codes.

Coding is, in fact, interpretation of the aspects of an object.

Example: coding gender

Male = m Female = f

Different types of codes included:

- Number codes may be issued sequentially. This means that each new class will be given the next unused number. The advantage is that new classes can easily be added.
- Numbers could be issued at random.
- Series of numbers can be reserved for sets of classes. Issuing this type of number is only of use with a fixed set of classes, that is, when no expansion of the set of classes is expected.

A mnemonic code consists of one or more letters of the classification model of the relevant category.

- ❖ Advantages: This helps users to save codes.
- ❖ Disadvantages: For taxonomies with many classes, this can lead to either long codes or codes that are not similar to the classification rules.
- ❖ Used for limited lists of categories.
  Example in the medical field - Hospital departments are often indicated with a mnemonic symbol: ENT - ear, nose, and throat department, CAR - cardiology, OB-GYN - obstetrics and gynaecology department.

Hierarchical codes are formed by extending an existing code with one or more additional characters for each additional level of detail.

Thus, the hierarchical code carries information about the level of detail of the related class and the hierarchical relationship to its parent class.

This coding method is similar to the structure of hierarchical databases.

This means that data can be retrieved using hierarchical codes at a certain level, even when significant extensions or modifications are made at lower levels.

Juxtaposition codes are composite codes consisting of segments. Each segment provides a characteristic of the associated class. for each additional level of detail.

(Robbins, 2016) (Groover, 2015) (Coding & Classification, n.d.)

Coding in industry:

The coding of materials:

It is helpful to codify the different products in a company's stores after classifying and organizing them.

Codification is the process of giving each item in a store a number or symbol in addition to its name so that it will be simple and quick to recognize.

Thus, the codification of store products results in labor and time savings.

Today, various shop codes are utilized. The majority have been specifically created to meet the needs of a specific group.

These codes may be determined by the nature of stock items, the intended use of the items, or any other factor considered appropriate in light of local conditions.

Also, the accurate identification of the materials may require a lengthy description. This can be complicated and, hence, may add to the confusion.

Codification is necessary because it involves the assignment of logical and systematic numbers or alphabets (or both) to help in the simple but accurate identification of the materials.

The advantages of codification:

Codification has several key benefits, including:

1. Avoidance of long and unwieldy descriptions

2. Accurate and logical identification of items

3. Avoidance of duplication

4. Standardization of purchasing and storage

5. Reduction of variety

6. Effective planning and high-quality production

Moreover, codification increases efficiency in the following areas:

Purchasing , Accounting , Recording , Computerizing pricing , Costing , Indexing , Inspection. (tamplin, 3023)

5.4.1 Selected Naming and classification method:

The method of arranging the tools used in manufacturing will depend on several factors that are basic and critical to distinguish between the tools. Therefore, each type of tool will determine the most important characteristics that will be taken as a way to name these tools.

As for the die cut, the classification method will depend on the place of manufacture of the tool (Supplier is Ramallah or Nablus), its dimensions and the sector in which it is used (Restaurants, Banks...etc.)

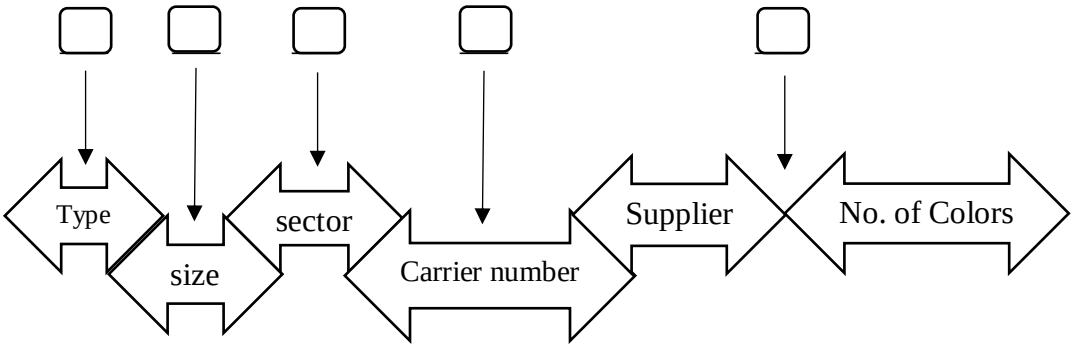
As for the pallet, the method of classification will depend on its dimensions, the sector used (Restaurants, Medicine…etc.) and the number of basic colors used in every order (Blue, Yellow, Red, Black)

As for the cliché, the classification method will depend on its dimensions and the sector used (restaurants, banks...) and the number of colors used in every order (unlimited).

Therefore, this will lead to the adoption of a method in which the tools will be named in ways that depend on their most important characteristics. Naming methods that will be adopted is that the name of the tool is composed of several characters

and each field represents one of the characteristics of this tool to distinguish it from others.

There will be five digits on the naming criteria selected according to specific features and classifications that could differentiate between tools and their sub categories and they will be as follows:



- In the first part the type of the tool will be mentioned as a letter to express the type of tool selected and it will be in 4 different letters to present them as follows:
  - If D then the tool is Diecut and it is stored in Area .1
  - If P then the tool is Plate and it is stored in Area .2
  - If C then the tool is Cliché and it is stored in Area .3
  - If J then the tool is Job envelop and it is stored in Area .4

- In the second part the Size of the selected tool above is then determined according to the known popular sizes and it indicates the Aisle number
  - If the tool is Diecut or Cliché then there will be 3 different sizes to select from:
    - ✓ (70 × 100) cm is the biggest size then the number 1 will be on the name and it means that it's in the first Aisle of the Diecut or Cliché Area.
    - ✓ (50 × 30) cm is the next biggest size then the number 2 will be on the name and it means that it's in the second Aisle of the Diecut or Cliché Area.
    - ✓ Other is any size rather than the sizes mentioned above, then the number 3 will be on the name and its either on Aisle.3 or Aisle.4.

  The Aisle number indicated when select size Other depends on the sector selected next (if the sectors are Restaurants or Medicine then the Aisle will be number 3 and they will be organized from the largest to smallest) and (if the sectors are Bank, Education or Other then the Aisle will be number 4 and they will be organized from the largest to smallest).

- If the tool is Plate then there will be 2 different sizes to select from and indicates the Aisle number:
  - ✓ (70 × 100) cm is the first and biggest size then the number 1 will be on the name and it will be on Aisle.1 or Aisle.2 depending on sector selected next.
  - ✓ (50 × 35) cm is the second and last size then the number 2 will be on the name and it will be on Aisle.3 or Aisle.4 depending on sector selected next.

  The Aisle selected depends on the sector (if the sectors are Restaurants or Medicine then the Aisle will be number 1 in case of biggest size and Aisle.3 in case of second size) and (if the sectors are Bank, Education or other then the Aisle will be number 2 in case of biggest size and Aisle.4 in case of second size).

- In the third part the job of the tool is determined according to the known popular districts and will Indicate the section that it is stored on the Aisle
  - If the tool is in the Restaurants sector, then R will be on the name.
  - If the tool is in the Medicine sector, then M will be on the name.
  - If the tool is in the Banking sector, then B will be on the name.
  - If the tool is in the Educational sector, then E will be on the name.
  - If the tool is in any Other sector, then O will be on the name.

As explained before in the sectors division in the Aisles, the meaning of sectors:

❖ In case of all sectors in one Aisle:

Restaurants section.1, Medicine section.2, Bank section.3, Education section.4, Other section.5

❖ In case of 2 or 3 sectors in one Aisle:

Two sectors……Restaurants section.1, Medicine section.2

Three sector…...Bank section.1, Education section.2, Other section.3

- In the fourth part (carrier number) there will be the place of the tool on that selected Aisle and section, the numbers will be started from 1 which will indicate carrier number .1 and continues to increase till the last place of storage on that area (last carrier number) and the application will give the storage manager the next number available to put on the name (generate the number), and in the case of destroyed tool after damage the number that will be available again (its carrier number) will be given to the first tool that comes new and matches the description of that section.

- In the fifth part it will be different according to the type of tool selected
  - If the selected tool was a Diecut then there will be 2 options of the suppliers that could be selected
    - ✓ If the supplier is Ramallah, then a letter R will be on the name
    - ✓ If the supplier is Nablus, then a letter N will be on the name

  - And If the selected tool was a plate then there will be 4 options of the colors that could be selected from (select 1 minimum and 4 maximum) as there is 4 basic colors and they are (blue ,yellow, red, black)
    - ✓ The number of selected colors will be on the name, if 3 colors were selected then the number 3 will be printed on the name…etc.

  - And If the selected tool was a Cliché then there will be no options of the colors that could be selected (as the colors are unlimited)
    - ✓ The number of the colors will be printed by the worker, if 5 colors were printed then the number 5 will be printed on the name…etc.

Example when tool is a Diecut:

D ➡ Diecut ➡ Area.1

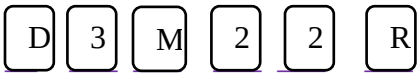
1 ➡ Biggest size (100 × 70) ➡ Aisle.1

R ➡ Restaurant sector ➡ section.1

50➡ Carrier number 50 in that section selected

N ➡ Supplier is Nablus

Another Example when tool is a Diecut:



D ➡ Diecut ➡ Area.1

3 ➡ size other ➡ Aisle.3 (since sector is M)

M ➡ Medicine sector ➡ section.2……if R then section.1

22➡ Carrier number 22 in that section selected

R ➡ Supplier is Ramallah

Another Example when tool is a Diecut:

D ➡ Diecut ➡ Area.1

3 ➡ size other ➡ Aisle.4 (since sector is O)

O ➡ Other sectors ➡ section.3

71➡ Carrier number 71 in that section selected

R ➡ Supplier is Ramallah

Example when tool is a plate:

P ➡ Plate ➡ Area.2

2 ➡ Second Biggest size (50 × 30) ➡ Aisle.4

E ➡ Education sector ➡ section.2

66➡ Carrier number 66 in that section selected

2 ➡ There are two colors in this group of plates ➡ two plates

Example when tool is a Cliché:

C ➡ Cliché ➡ Area.3

3 ➡ Other size ➡ Aisle.4

E ➡ Education sector ➡ section.2

76➡ Carrier number 76 in that section selected

2 ➡ There are two colors in this group of Cliché ➡ two Cliché

Job envelops:

It is a file with the printed sale order Inside, as well as a copy of the final product, the purpose of it is for archiving the products that they produced in order to reference to it when necessary or when required by the customer, as the Color concentration and accuracy would be more specified and clearer for the eye of customer on the product than it on the screen. It will be stored in area 4 according to the criteria mentioned before.

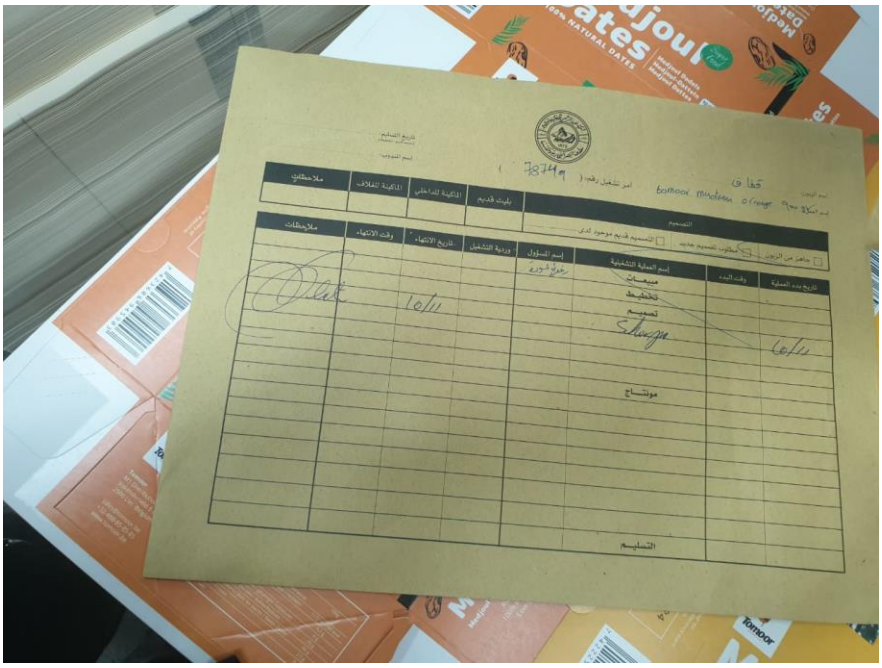


Figure 72: job envelop

5.5 RFID System

This project considers the company's financial conditions in to account, as so there was two proposed solutions in every stage (selected warehouse, selected features included in the application) as the company in responsible of their decisions according to their willing to innovate.

Selected system proposed solutions were discussed before so for now here is the selected features included in the application proposal:

The features of the application were discussed before so there were two options to select from and in every one of them the system will stay to do its job at full condition.

The system will stay the same as discussed before in the fist condition, but in the second the RFID system will be included.

The difference between them is that the RFID system will offer extra and advanced features that will make them able to track the tools where ever they were, and collect real online data about the printing process and about the performance of the tool, it will calculate the worn percentage of the tool, and number of copies allowed depending on the worn percentage on iron blades on the Diecut and number of copies printed for the plates and the Cliché.

Introduction to RFID:

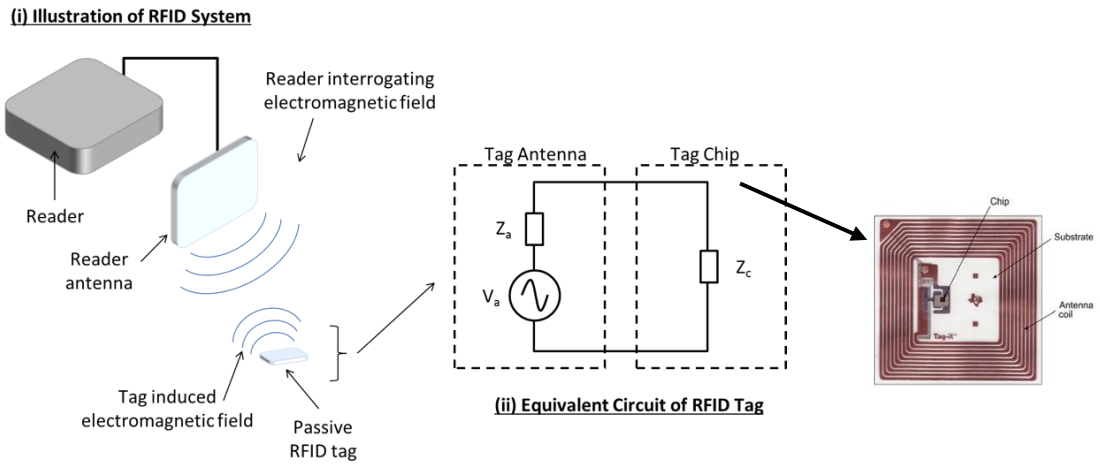
RFID (Radio Frequency Identification) is a technology that uses radio waves to wirelessly identify and track objects, animals or people. It consists of two main components: a tag (also known as transponder) and a reader (also known as interrogator).

The tag is a small electronic device that is attached to or embedded into the object being tracked. It contains a microchip that stores information about the object, and an antenna that allows it to communicate with the reader.

The reader is a device that emits a radio frequency signal and receives the response from the tag. It may be handheld or fixed, and it can be connected to a computer or a network to process and store the information collected from the tags.

When the reader sends a signal to the tag, the tag's antenna receives the signal and activates the microchip. The microchip then modulates the signal and sends back a response signal to the reader. The reader receives the response signal, decodes the information stored on the tag, and sends it to the computer or network for processing and storage.

RFID system components:



RFID systems consist of three main components:

1. RFID Tag/Transponder
2. RFID Reader/Interrogator
3. Backend System:

   The backend system consists of the software and database that manages the data collected from the RFID system. The system processes the data and provides insights into the objects' movements and locations in real-time.

   The backend system can also integrate with other systems to provide automated processes and decision-making capabilities.

Overall, the RFID system components work together to enable the tracking and identification of objects in various applications, such as inventory management, supply chain logistics, and asset tracking.

RFID system work:

RFID (Radio Frequency Identification) systems work by using radio waves to communicate between an RFID tag and a reader. Here are the basic steps of how an RFID system works:

1. An RFID tag or transponder is attached to an object or embedded within it. The tag contains a microchip with a unique identifier code and an antenna that enables it to communicate with RFID readers.
2. When an RFID tag comes into the range of an RFID reader, the reader sends out a radio signal to the tag.
3. The RFID tag receives the radio signal and uses the energy from the signal to power its microchip.
4. The tag then sends back its unique identifier code to the RFID reader using the same radio frequency.
5. The RFID reader receives the signal and interprets the data sent by the tag.
6. The reader then sends the data collected from the tag to a backend system, which processes and manages the data collected from the RFID system.

RFID systems can use different frequencies and ranges of radio waves, depending on the application. Some RFID systems can read multiple tags simultaneously, and some can track the movement and location of objects in real-time. Overall, RFID systems provide a way to identify and track objects automatically and efficiently, without the need for manual scanning or input.

RFID system benefits:

RFID systems offer several benefits and advantages, including:

1. Real-Time Tracking: RFID systems can track the movement and location of objects in real-time, providing up-to-date information about inventory levels, delivery status, and asset locations. This can help businesses make faster and more informed decisions.
2. Increased Accuracy: RFID systems can provide accurate and reliable data, reducing errors that can occur in manual tracking systems. This can improve inventory accuracy, reduce inventory carrying costs, and minimize product stockouts.
3. Scalability: RFID systems can be easily scaled to meet the needs of businesses of all sizes. Whether a business has a few items to track or thousands, RFID technology can be adapted to meet its needs.

Overall, RFID systems can offer significant benefits and advantages for businesses and organizations looking to improve efficiency, accuracy, and security in their operations.
(Aguirre, June 2007) (group 2 (Diane Ward, Fall 2009) (Misra, 2021)

RFID features:

1. **A unique ID**

   RFID makes it possible to precisely identify individual components, material batches, and other items. The ID can then be used by the computer systems to automatically update the records with data like location, temperature, date, and time.

2. Automatic recognition

   Items are provided tags, which transmit the stored ID to readers. The readers may be placed at fixed places. As each item passes by, the reader will automatically scan the ID.

3. Can detect 'hidden' objects

   With RFID, the object being scanned does not always need to be in the direct line of sight like it does with barcodes. Simply by placing the reader in the proper position, it is possible to identify items moving along a conveyor belt or files in racks.

4. Multiple tags can be read at once

   A one RFID reader may gather data from a huge number of tags at once, as opposed to barcodes where each item must be scanned individually. RFID readers enable the mass collection of data, reducing the amount of time required for stock checks.

5. Rugged and weatherproof

   RFID tags are more robust than barcodes and can be used in challenging environments.

Applications of RFID technology:

1. Logistics and shipping

   RFID tags were primarily developed to improve shipping and logistics effectiveness. Larger quantities of things from the warehouse, the manufacturing facility, and the storage area cannot be manually recorded as inventory movements.

   RFID readers can quickly and accurately detect hundreds of tags in a matter of seconds. Data will automatically be updated in the database once the items leave the warehouse.

   In large warehouse storage spaces, RFID gates are used for inventory control. Inventory movement into and out of a warehouse site will be tracked by RFID readers put in place on the gates.

2. Automation of manufacturing

   One of the key components of the smart factory idea that helps automate different manufacturing stages is RFID technology. RFID readers will record product movement throughout each step of manufacturing and update the database without further operator input.

   RFID technology is appropriate for large-scale manufacturing facilities where hundreds of thousands of products are being monitored and real-time status data is being recorded. This information must be updated manually, which takes time and increases the risk of data entry errors.

Figure 73: RFID Readers

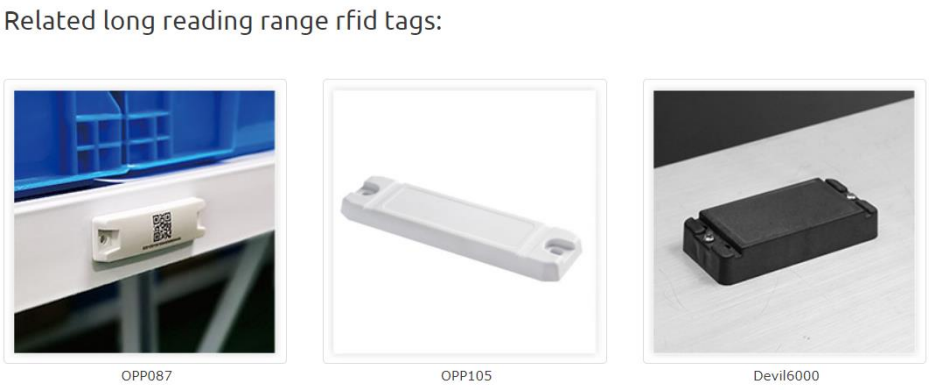


Figure 74: RFID Tages

Why RFID?

1. Without having to count each individual tool, RFID devices provide a quick and accurate method of tracking them, even when they are in the production lines, to make it easy for the storage worker to collect each and every tool in the production line when its work is done, as well as not the need to enter the data manually, RFID applications can upload the information to the ERP or financial management system and track the movement of the commodities automatically.

2. You can track items from the time they are received in stores, from the time they are issued to manufacture and use in a finished item. This makes it easy to manage inventory, this is important to us in our project as it helps us count the number of tools and know if the tool is in the production line or in the warehouse, With RFID applications, you can quickly determine how many tools of a particular sort as well as their location or where they are in the process.

3. RFID can also help find items on the site that have been misplaced, and this is one of the most important features that concern us in our system, as the main problem is based on losing the tool as a result of random storage and not finding it, with this feature we will be able to locate it wherever She was.

4. RFID applications can automatically track movement and upload information to electronic files, so they can remove the need to fill in the form manually and replace outdated spreadsheets, and this helps us with periodic statistics that are made in the printing press for the number of tools and for good and damaged ones and this information is stored in an electronic system located on Desktop of staff responsible for search and storage.

5. Because RFID can identify individual items or components, it is ideal for complex or customized manufacturing processes – for example, to ensure that specific molds are filled with the correct volume of liquids and fired for the correct period of time, or specific components end up on the right production line. This helps reduce waste and improve efficiency.

   It can be in the production lines of the printing press, so that the number of products that are supposed to be present within each package or order is determined, and it can be in the place where the tools are stored, so that all the existing tools and their number are known, and when any tool is released and when it is requested, this is to ensure that it is not lost and that any scribble occurs.

6. RFID systems can also help ensure that items have passed through all the correct checks and processes

   It can be useful in the place of production when examining, for example, its conformity with the request in terms of quantity, color, and the correctness of the design, and thus ensuring that there is no human error.
7. service that creates competitive differentiation and promotes increased customer satisfaction with the opportunities for higher sales and better margins

When the RFID is present in the company, this will reduce the possibility of errors, especially those that require human intervention, with its existence, there will be no need for human intervention, whether in determining the validity of quantities for orders or using the correct tool for the required process. Thus, the chance of making mistakes that increase costs, or delaying the customer's receipt of his order, or receiving new orders, is reduced. Thus, accuracy is maintained and developments occur in the company in terms of reputation and improvement in work and income. (Mandeep Kaur, 2011)

8. RFID is a cost-effective technology, and the money saved and revenue growth attained can quickly pay for the initial investment.

   Businesses can benefit from RFID systems, which automate operations, increase asset utilization, and improve quality to quickly increase productivity and cut costs. RFID is at the core of the Internet of Things and can serve as the foundation of a successful asset management system.

9. It is possible to rewrite and reuse RFID tags.

5.6 Software engineering report

5.6.1 Introduction:

Vision

In this project we aim to develop a web application called Tool Storage (TS), which allow workers to store and retrieve production tools in the Wearhouse, so it will be connected to a large database to hold different information. In this client-server web application, an Agile mode will be implemented.

What is our project?

The goal of our project is to establish an effective storage system in Al-Hijjawi Company that helps store and retrieve the tools used in the various printing operations in order to preserve them from damage or loss, thus increasing productivity, saving time, reducing the costs resulting from their loss, and reducing the error rate resulting from the use of the tool in the wrong place. Through this system, the mechanism of work that we will carry out in terms of naming, storing and retrieving tools is explained in an automated manner.

Why we chose this project ?

After what was noticed of the randomness and lack of arrangement of the tools in Al-Hijjawi Company, one of the suggestions for solutions that would help in the process of arranging and organizing the existing tools was to create an application for it that contains all the information related to these tools and also to be linked to the storage system to get a comprehensive system integrated.

About application ?

This application will be specified to the tools so that it will contain the information that pertains to it, and the application will show the location of the tool, whether it is in the storage place or in the production lines, in addition to entering any data related to the tool and has a relation with the production process and helps in the process of storage and retrieval. The goal of this application is to facilitate Access and handle the storage process for these tools.

Characteristic features

Since this application is about storing and retrieving production tools it will be attached to a large database about the detailed information for each and every tool excited, so the search about the tool to find it details and location is the most important feature to be considered.

5.6.2 Requirements

This part will explain each and every feature that have been created to match the goal of our desktop application to store and retrieve tools in the storage system used for manufacturing as well as its related files and details.

At first there will be four administers that are allowed to access the site and have a special account in it as they are the responsible about the orders and tools and they are:

- Management
- Storage Department
- Planning Department
- Sales Department

Each department is responsible about part of the order as their authorities, as a result the application will give different authorities depending on the Job title as shown below.

Table 1: Authority Distribution Table

Management	Storage Department	Planning Department	Sales Department
Search tools	Search tools	Search tools	Search tools
Search an employee			
Add an employee account		Add an employee account	
Delete worker account			
Modify employee account password		Modify employee account password	
		Place new order	
Review orders	Review orders	Review orders	
Search orders	Search orders	Search orders	
		Delete order	
	place a new tool		
	Review the list of Damaged tools		
Number and list of tools	Number and list of tools	Number and list of tools	
	Operations on the tools: ▪ Borrow an existing tool. ▪ Returns a tool that has been used. ▪ Put a tool in the list of damaged. ▪ Delete damaged tools.		

❖ Carrier number:

It is a unique sequential ascending number that increases within the sector in one aisle within the area. It is the number that indicates the name of the stored tool, and is used when searching for the tool.

When a tool is deleted from the application and disposed of, the name of this tool (the serial number) remains vacant, and until a new tool is added, the program checks and finds that this name is vacant as a result of a void in the sequence of storage places, so it gives an order to add the new tool to this empty place and gives the tool this serial number whose old tool has been deleted.

5.6.3 Features needed to create the desktop application:

log in.….log out

log in : using an ID and Password

log out of account

Sign up: it is done only by management or planning departments

Attach a new tool

It is done by entering the properties and files of the tool, and thus a name is suggested for the tool based on its properties by the application itself using the method of naming used based on the details that were attached from the method of storage and naming of the tools. After the identification and naming process, the application gives detailed directions for the user to reach the proposed storage location to place the tool in it.

And in case of using the RFID alternative, the tool is attached to a tracking system and a chip for the RFID system. Once the tool is out of storage, it calculates the number of copies and prints made by the tool, to show directly to the official performance of the tool, and works to track and calculate wearing and show any other details related to the tool

Operations on the tools

Borrow an existing tool

Returns a tool that has been used

Put a tool in the list of damaged

Delete damaged tools

- Borrow an existing tool: After attaching the sale order by the planning department, the warehouse worker opens the order file and takes the name of the tool, put it in the search box, search is done through the search field with the name of the tool (or the name of the tool without the carrier number, so the options for the tools that have the same name appear, so that the needed tool is chosen after), next all information related to the tool appears (its type, size, supplier, number of colors...etc.) and the storage location, then the storage worker takes it from its place and enters that it was borrowed on the application.

  in case of the RFID system, the tracking system senses that tool is no longer in its place and enters into the system that the tool is no longer in storage and starts the process of tracking the location of the tool and its performance and any other required data until it is used and returned to its place

- Returning a tool that has been used: After the order that uses the tool is ready, the worker return the tool to the storage area, by reading the code (tool name) placed on the tool, then enters it into the application on the search bar, and the place where the tool was stored appears, so he returns it to its place and enters into the application that the tool has been returned to its place.

  in case of the RFID system, It appears through the tracking system that the tool has been returned to its place and the data immediately goes to the application without the need of worker to input this data

- Put a tool in the list of damaged: it is done by the storage worker when he notices the tool is no longer in proper shape to be used or it has been long enough time to put it on the list of damaged so it can be deleted and thrown out later.

  **in case of the RFID system, Information is entered in the data base that states how to identify the tool if it is damaged by entering an expected period of time for the tool to be

damaged by entering the date of manufacture of the tool and entering, for example, a certain number of years (10 years for example) for the period which this tool is allowed to be used or a certain number of allowed editions can a tool print, and it appears on the application when one of the two factors approaches the end, with a warning indicating that the life of this tool is approaching and that it is necessary to get rid of it and puts it on the damaged tools list so it cant be used**

- Delete damaged tools: after noticing the damaged tool and putting it in the list of damaged tools, the storage administrator gets rid of the tool and enters the data in the application so that the tool is deleted from the list of tools and the name of the tool is made available to be given to another tool and its place of storage is used to store another tool, in other words showing that its storage place and its name (code) have become available.

Search bar

This bar is used to search about the tools by writing the tool name, and then the all the information about this tool will appear, a folder will open than contains all of the sale orders done by this tool, information about the type of tool, its diminution, supplier and colors, as well as the information's about its location on the storage system so it can be easily reached.

The search bar has also a feature that if the worker doesn't know the carrier number, he can easily skip this information when writing the name to be searched, and a list of all similar names with different carrier numbers will appears to make the worker chose the one he wants, and when clicking on it the folder of the tool will open so he can see which tool he chose.

in case of the RFID system, there will be a Real time data collection (number of copies, manufacturing and expiration date of the tool, warrantee rate, quality of performance…etc.), and all of the information collected will appear when searching about the tool

Add Order & list of orders

Add order

When a new order arrives at the planning department, the planning employee makes the order file by attaching the name of the tool and the sales order number, and attaching the order file in addition to the date of receipt and delivery of the order, and then the order is transferred to the order list so that the warehousing employee can open the order and take the required tool using the system to find it in the storage.

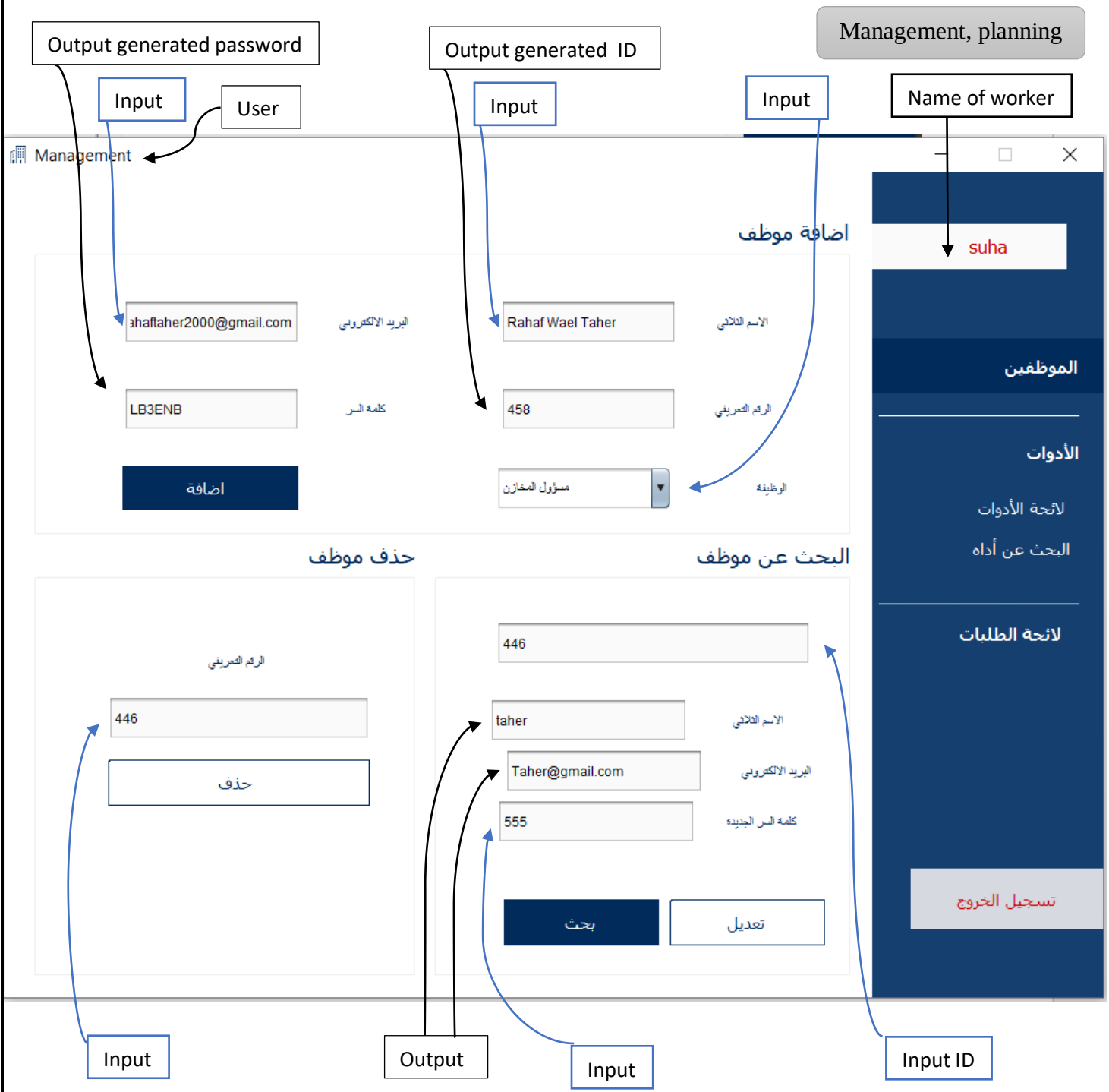
list of orders

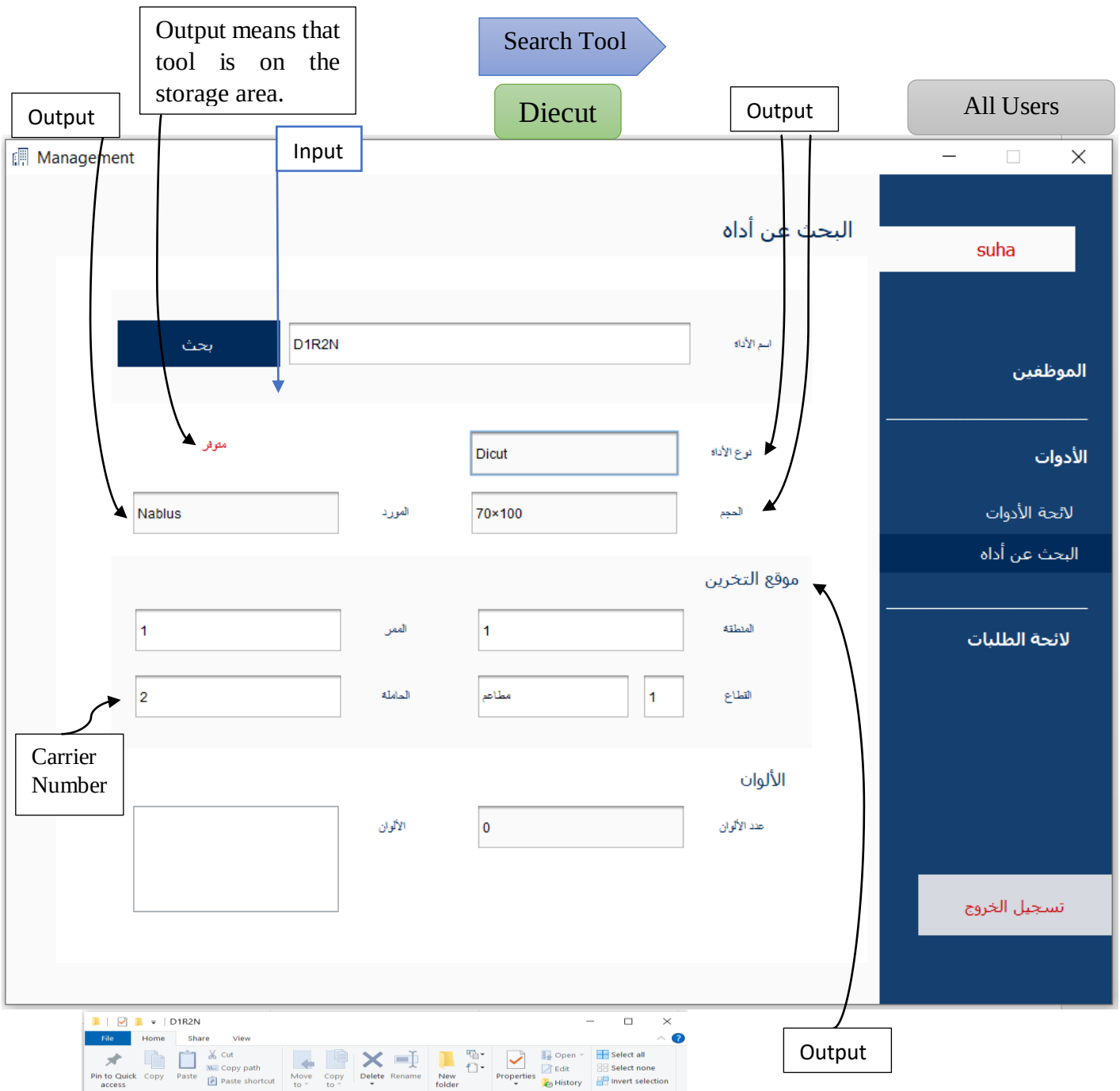
As for viewing orders, there will be a field that shows all the orders that are being worked on in the factory, and it is possible to open and see each order, as any finished order will be removed from the list of orders for the storage worker.

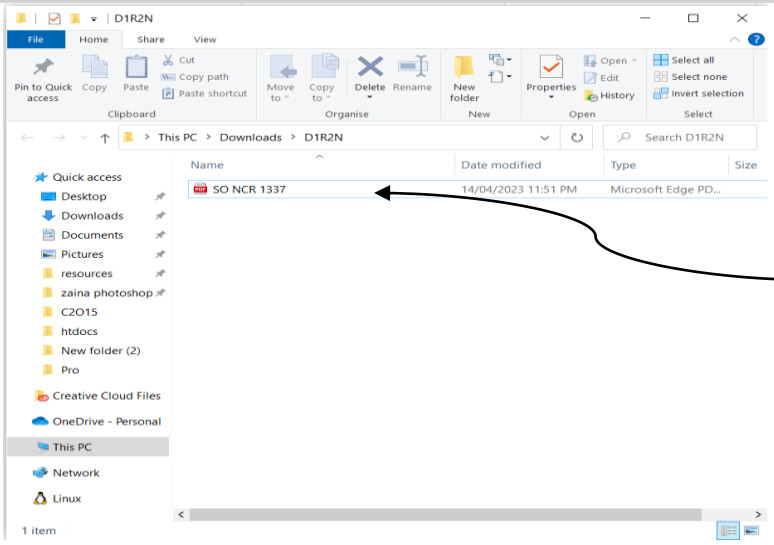
5.6.4 Application

Log In

Add, Search & Deleat Employee



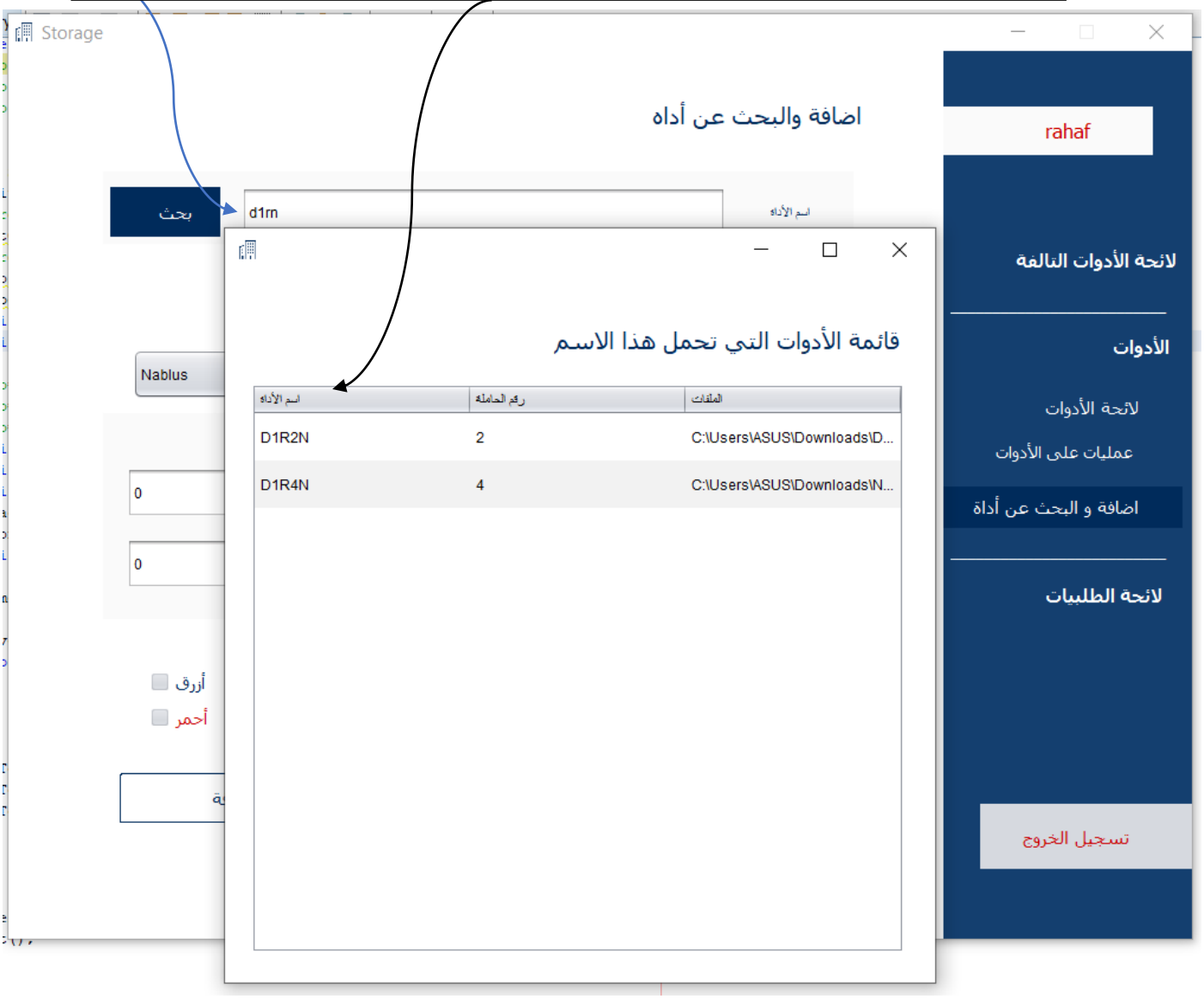




When searching the name of tool, the folder that contains all the sale orders used that tool opens directly.

Search Tool

In case of not knowing the carrier number by the one who search, s/he can search the name without including the carrier number, as a result a list of the names with different carrier numbers will appear and s/he get to chose the one requires, also s/he can click on the name to open the folder that contains the sales order to unsure that is the correct

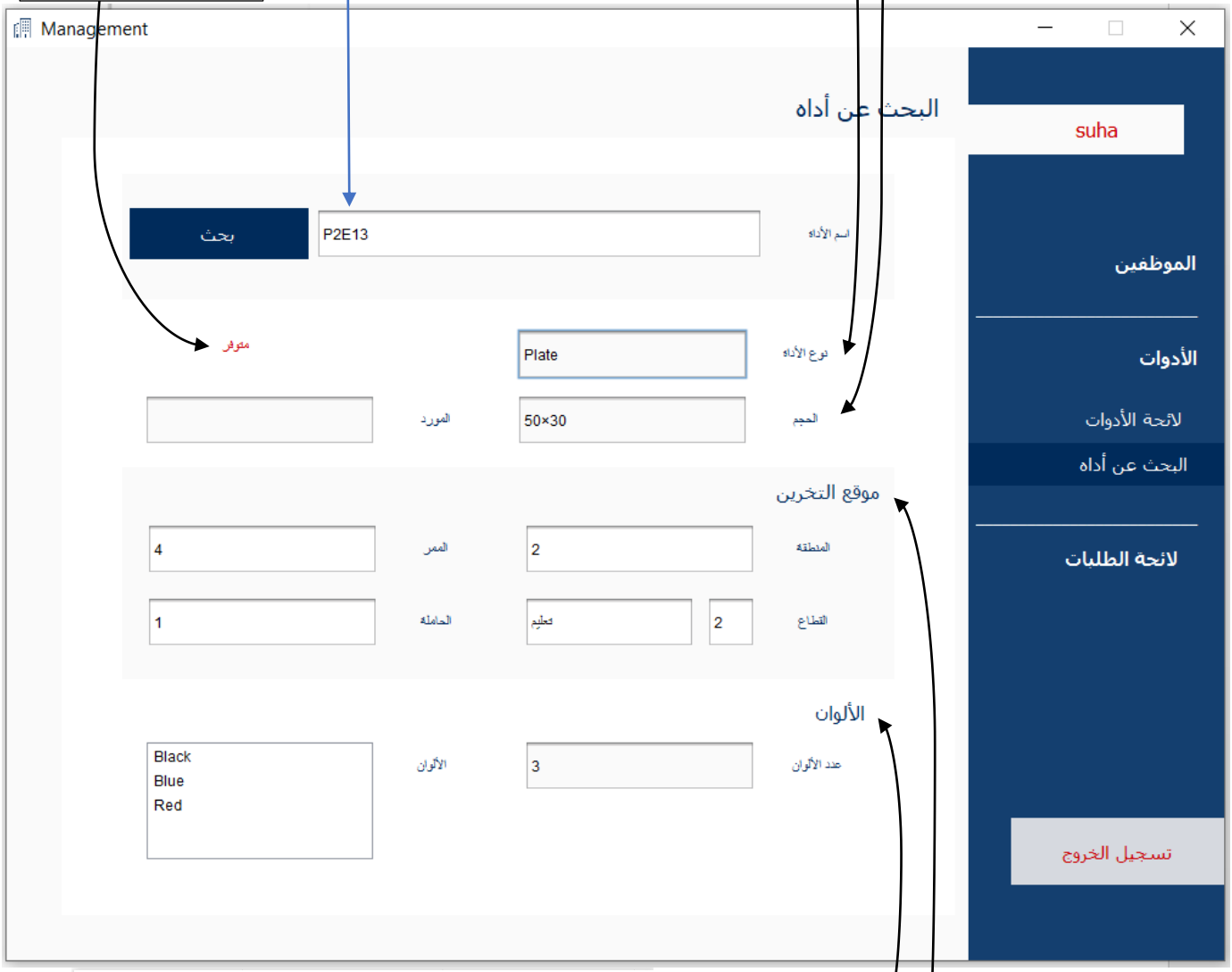


Output means that tool is on the storage area.

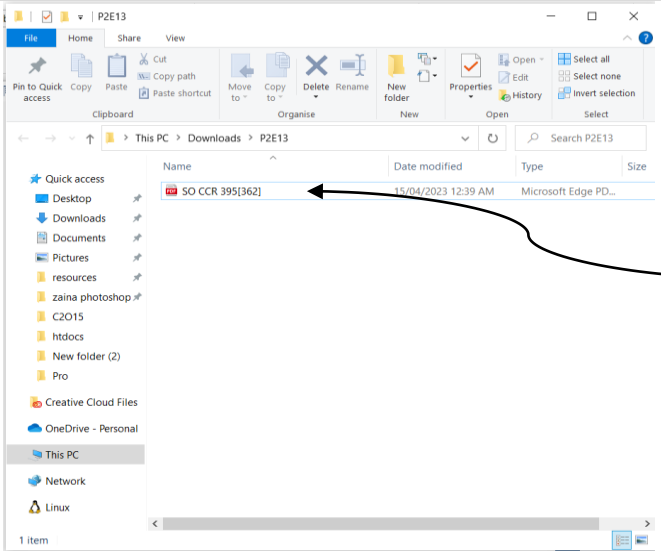
Input

Plate

Output



Output



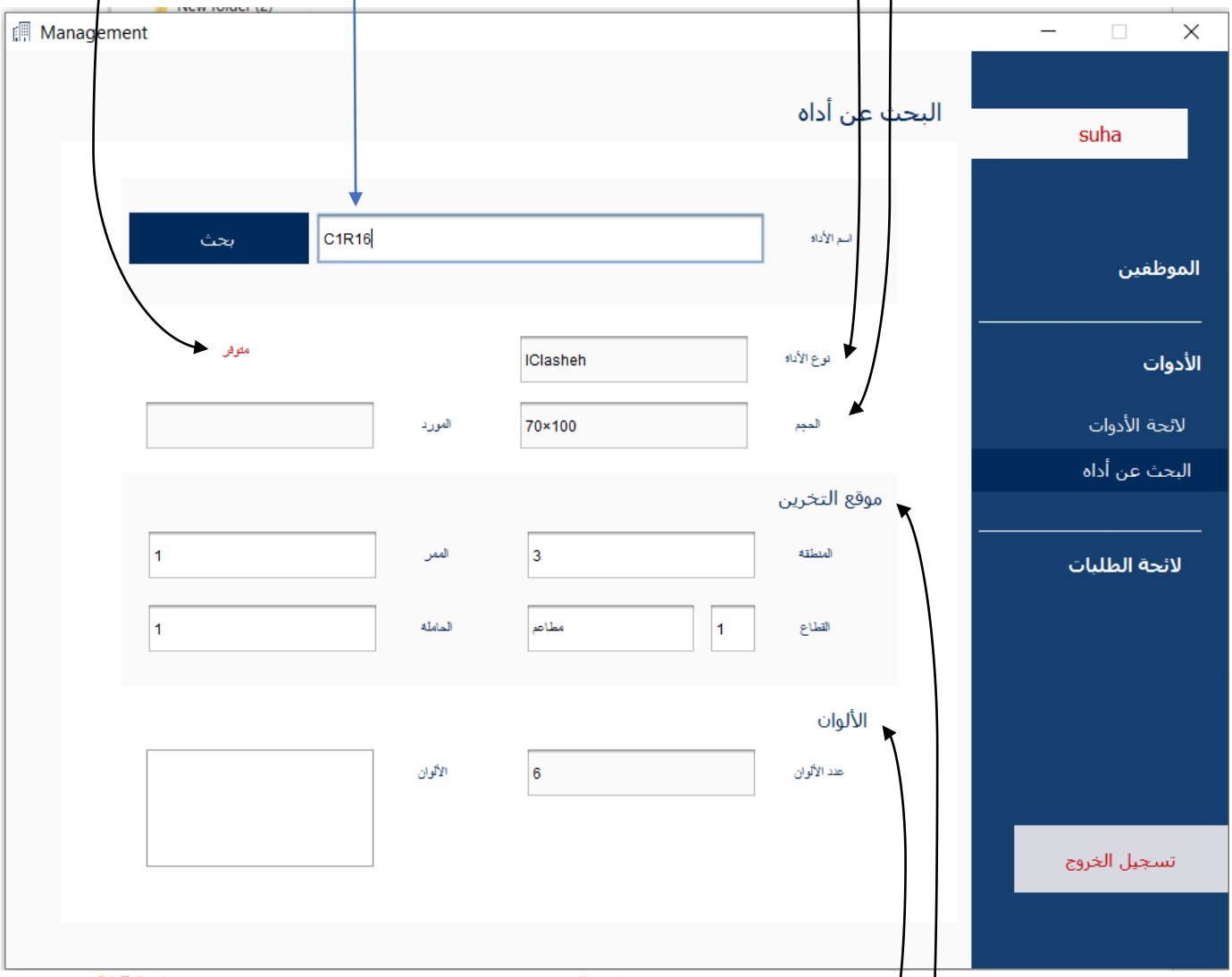
When searching the name of tool, the folder that contains all the sale orders used that tool opens directly.

Cliché

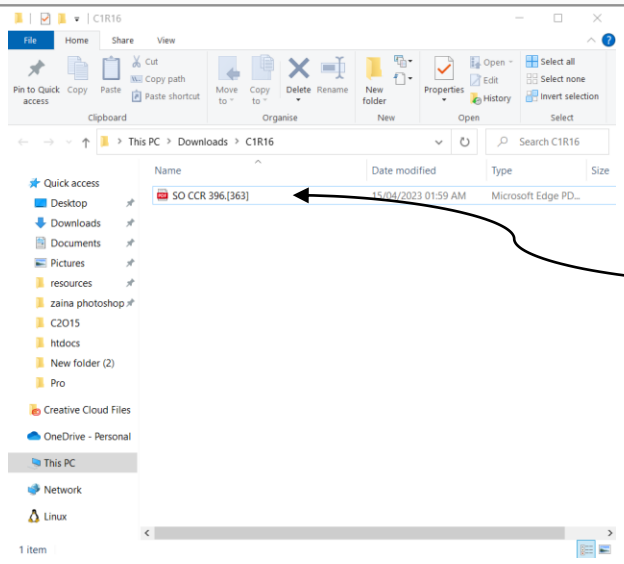
Output means that tool is on the storage area.

Input

Output



Output

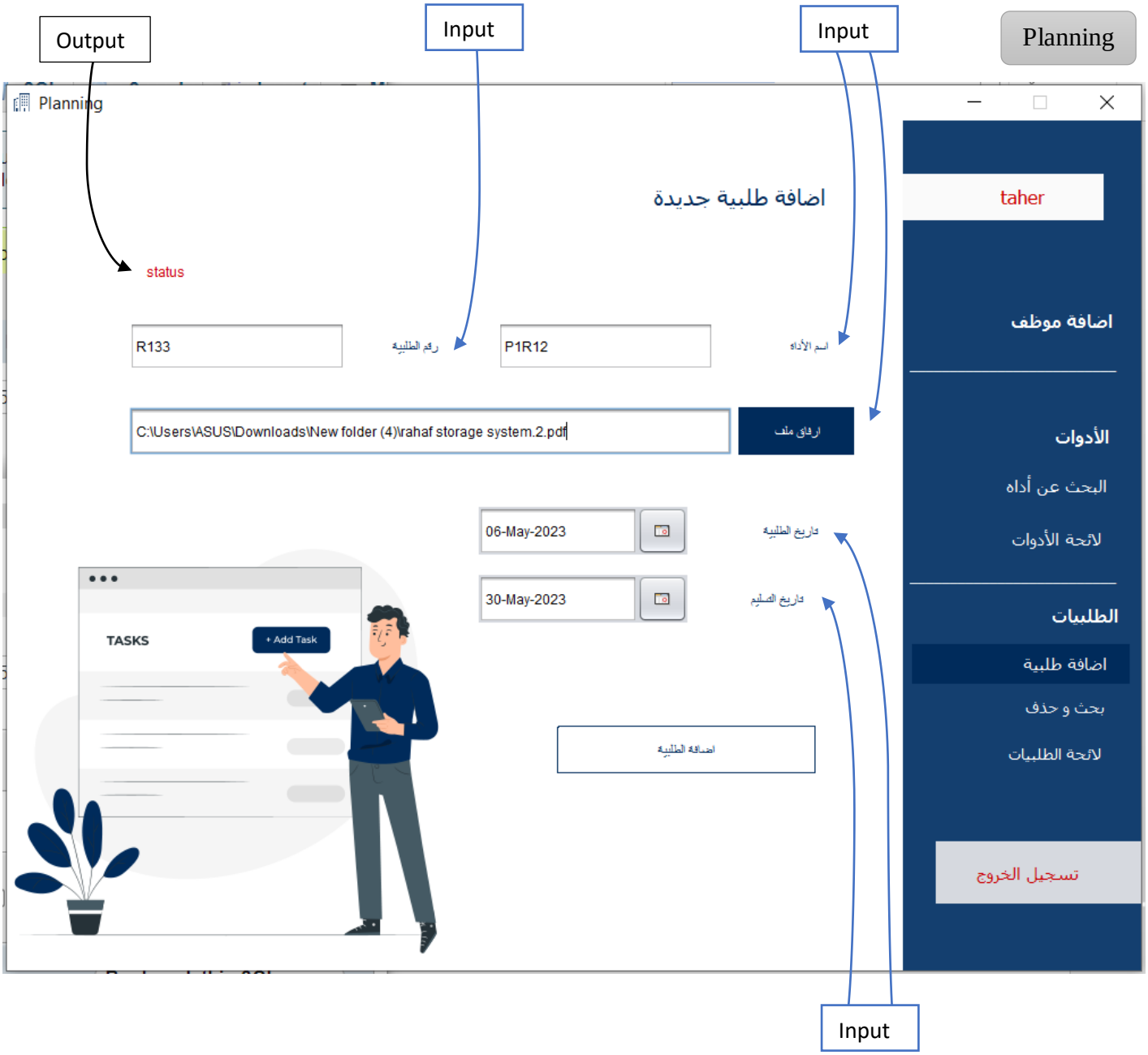


When searching the name of tool, the folder that contains all the sale orders used that tool opens directly.

List of Orders

With every new order that is entered by the planning department, it directly goes to the list of orders with the most important details attached, as well the files related to them, click on the bar and the file opens directly.

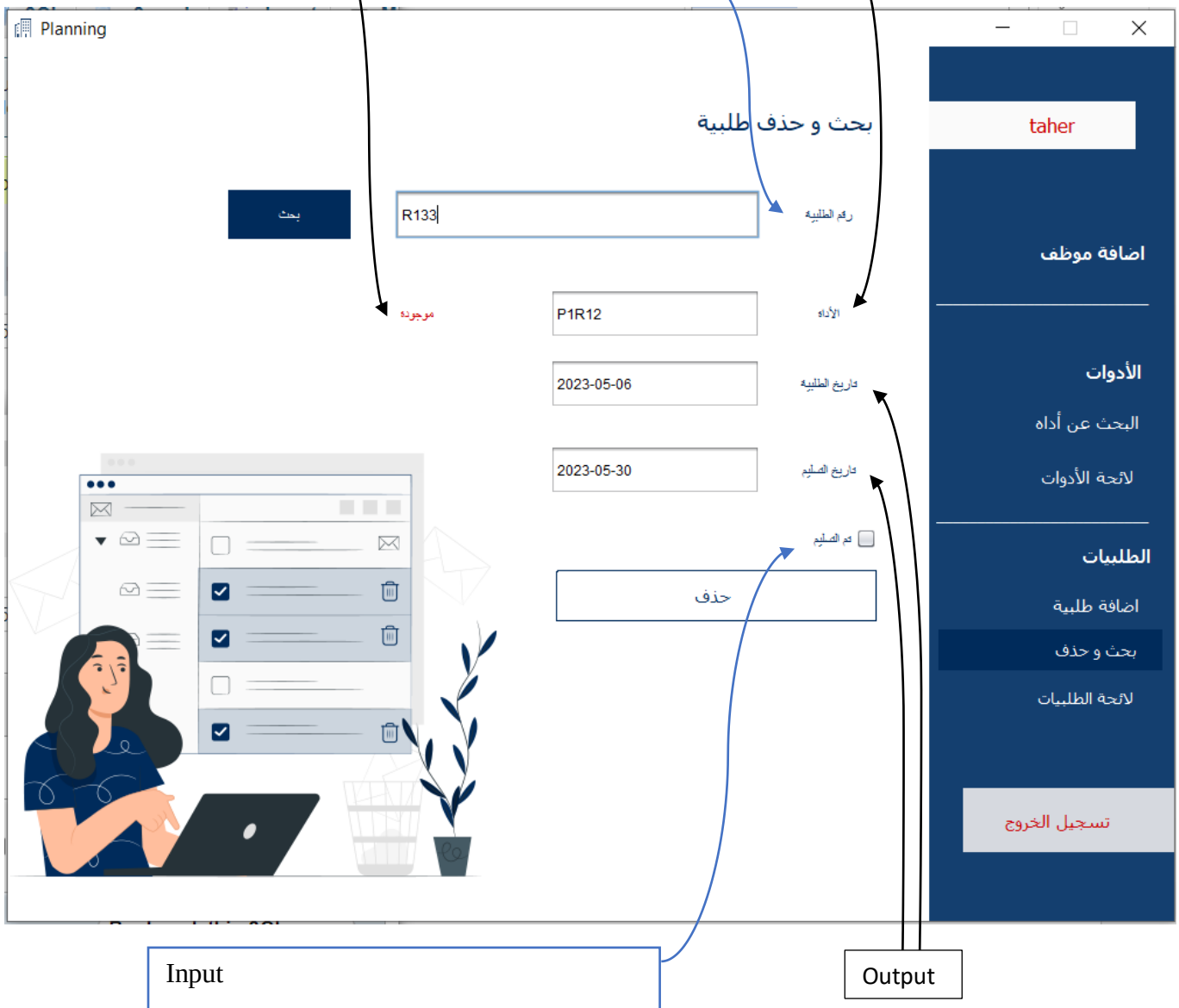
Place New Order



Search & Delete Orders

Planning, Storage & Management

*Delete only for planning

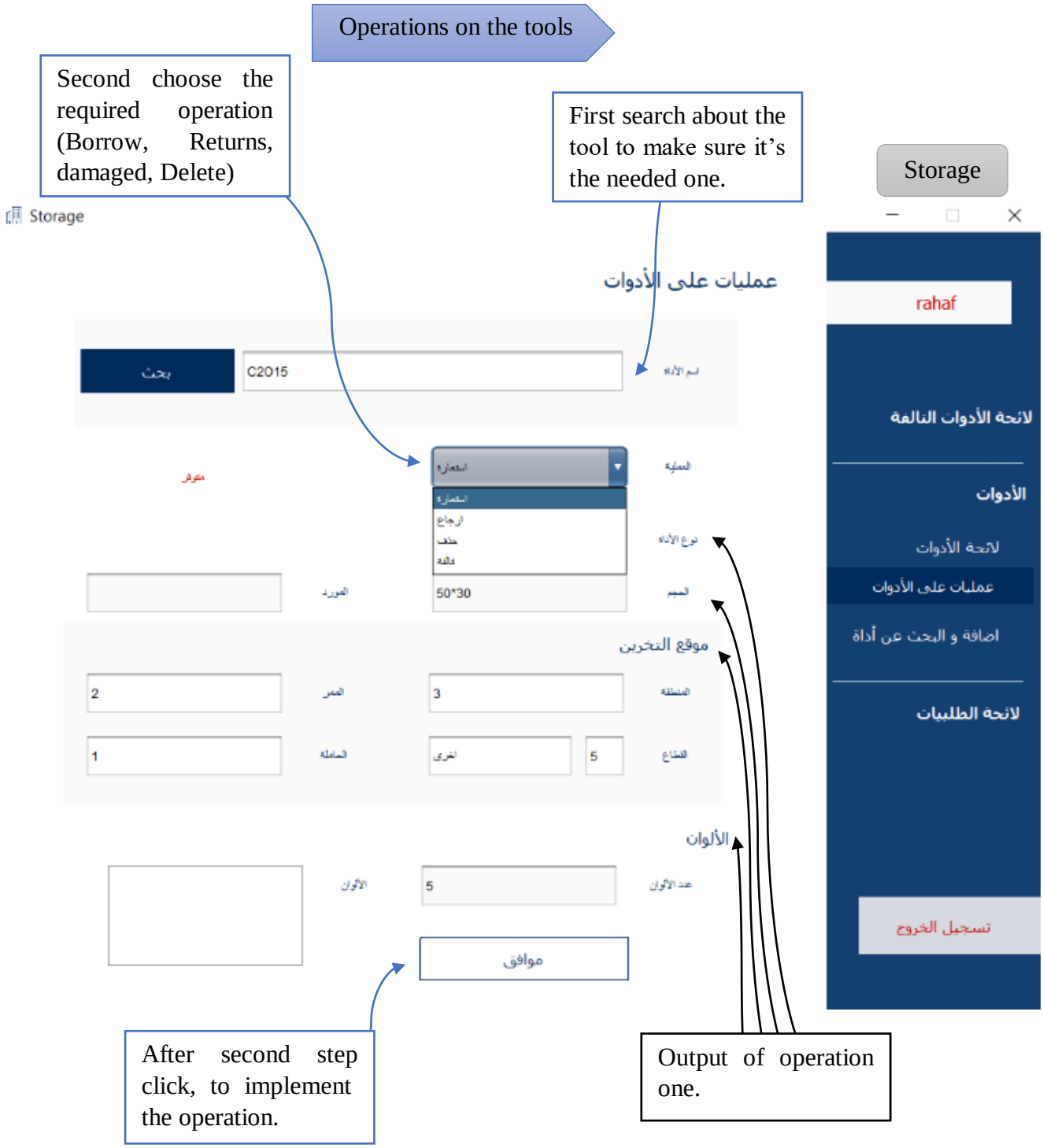


Input

Checked only by the planning department, and checking it means the order is done and immediately removes the order from the storage orders list.

list of Damaged tools

Storage


Operations on the tools
Second choose the required operation (Borrow, Returns, damaged, Delete)
First search about the tool to make sure it's the needed one.
Storage
عمليات على الأدوات
بحث
C2015
اسم الأداة
العملية
نوع الأداة
الحجم
50*30
موقع التخزين
الألوان
موافق
rahaf
لائحة الأدوات التالفة
الأدوات
لائحة الأدوات
عمليات على الأدوات
اضافة و البحث عن أداة
لائحة الطلبيات
تسجيل الخروج
After second step click, to implement the operation.
Output of operation one.

Search & place a new tool

Incase of the need to search any tool, and the output will appear as the usual search.

Storage

In case the tool was plate choose the colors, or in case of cliché just write the number of colors.

The output of the operation is the name of the tool and the place where to store it.

In case of add new tool, specify this information.

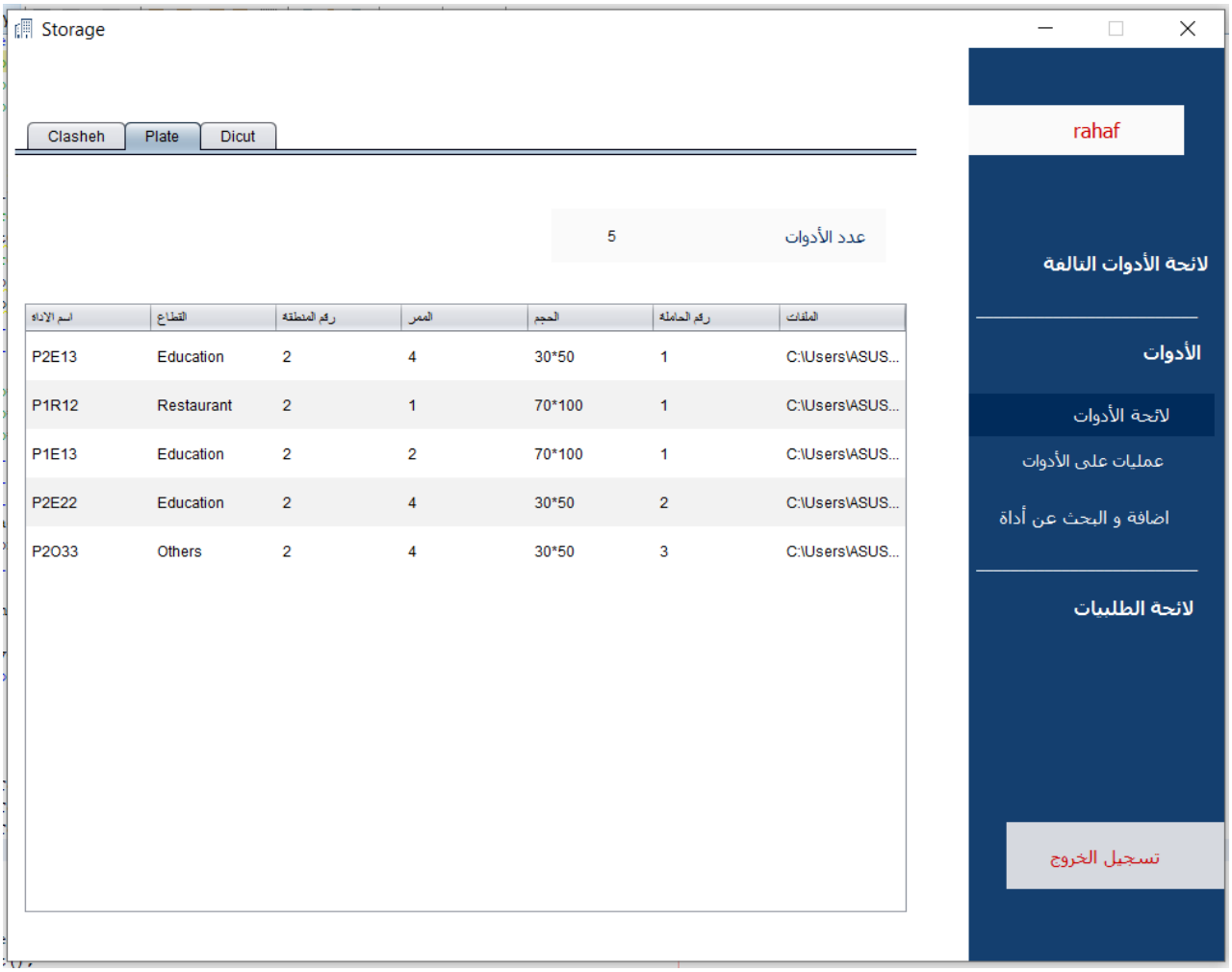
Number and list of tools

Cliché

Management, Planning, Storage

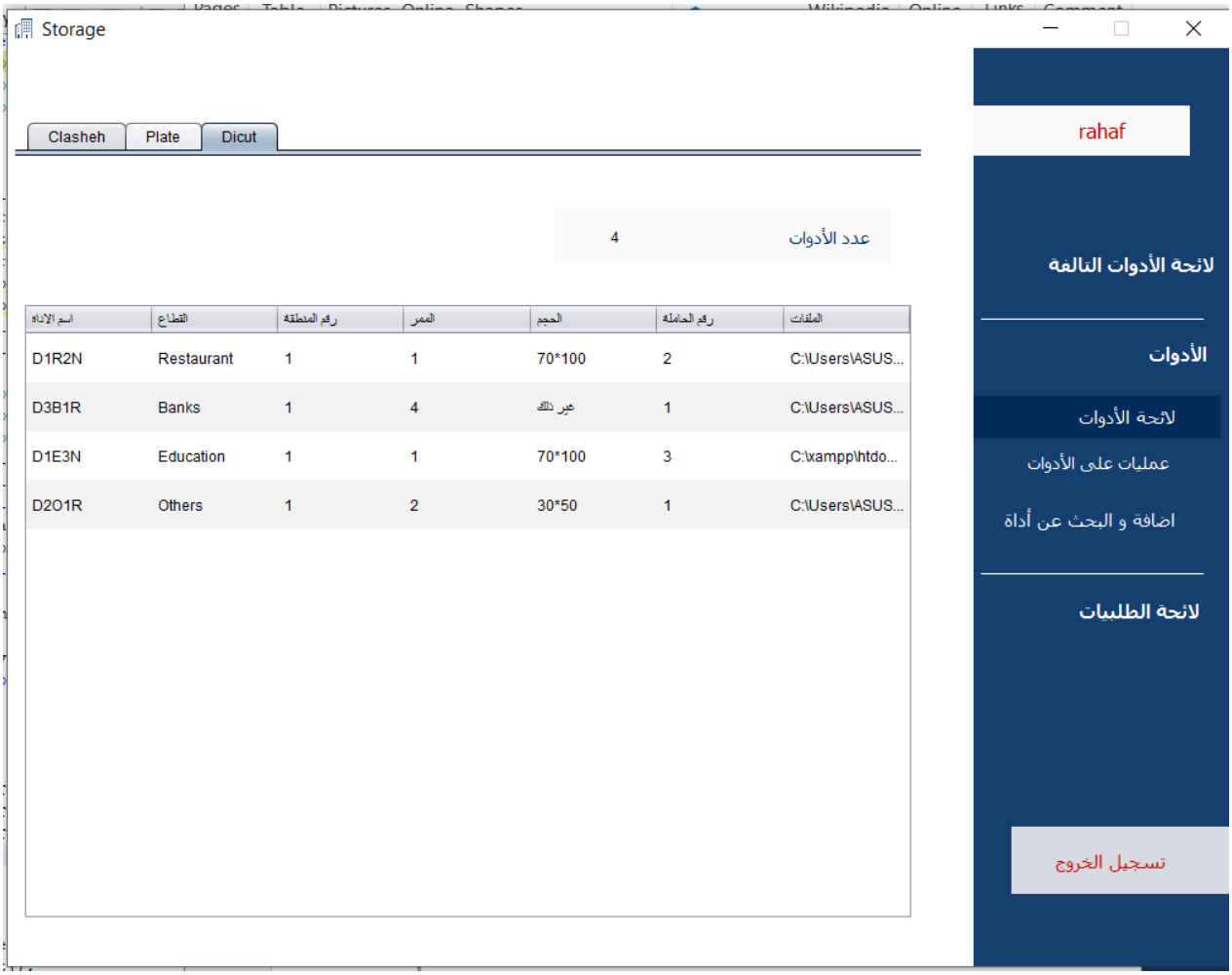
Number and list of tools

Plate



Number and list of tools

Diecut



Chapter .6
Conclusion

6.1Conclusion

The company has been dealing with this problem for 83 years, but the impact left by these problems without solutions is increasing as a result of the accumulated costs incurred by the company as an outcome of poor management and organization of these tools, which affects in addition to that the extent of customer satisfaction.

Therefore, solving to this problem will greatly affect the company by reducing the costs resulting from errors, increasing productivity, improving the level of organization of operations within the company, in addition to getting rid of the tools that were manufactured more than once as a result of not finding them due to poor organization, and thus we give the company a special system that enables it to manage these tools without the need for experienced workers.

Then, solutions were presented to this main issue that Al- Hijjawi company has been dealing with, as there were three main choices, they can choose from depending on their amount of money they are willing to pay and the different characteristics they want in their new system, taking in to account their ability to transform from zero organization and automation to full automation.

There were three main choices to choose from as explained before:

First, the Horizontal Carousal System as it is a fully automated system that will solve all their problems but the limitation here is the amount of money needed to buy the system.

Second, which is the main and preferable solution is to execute the selected storage system that was prepared specifically for these tools, and their related code name and application that also were designed specifically for these tools.

Third, is to use the same second choice but adding in to it the RFID system that will help giving them additional information related to tools and the production process, it will be more expensive but cost-effective.

As a result, all three of these solutions would work perfectly and do the main purpose of them, but there always has to be more than one solution and choice to give to guarantee that all scenarios were given to the company to choose from, and that doesn't prevent to give more credit and highlight to the solution that we think is the best with the proper reasoning.

DISCLAIMER

This report was written by students (Rahaf Al-Taher, Jana Masri, Raha Awwad, Samar Masri) at the Industrial Engineering Department, Faculty of Engineering, An-Najah National University. It has not been altered or corrected, other than editorial corrections, as a result of assessment and it may contain language as well as content errors. The views expressed in it together with any outcomes and recommendations are solely those of the students. An-Najah National University accepts no responsibility or liability for the consequences of this report being used for a purpose other than the purpose for which it was commissioned.

Appendix

System Models (UML Diagram)

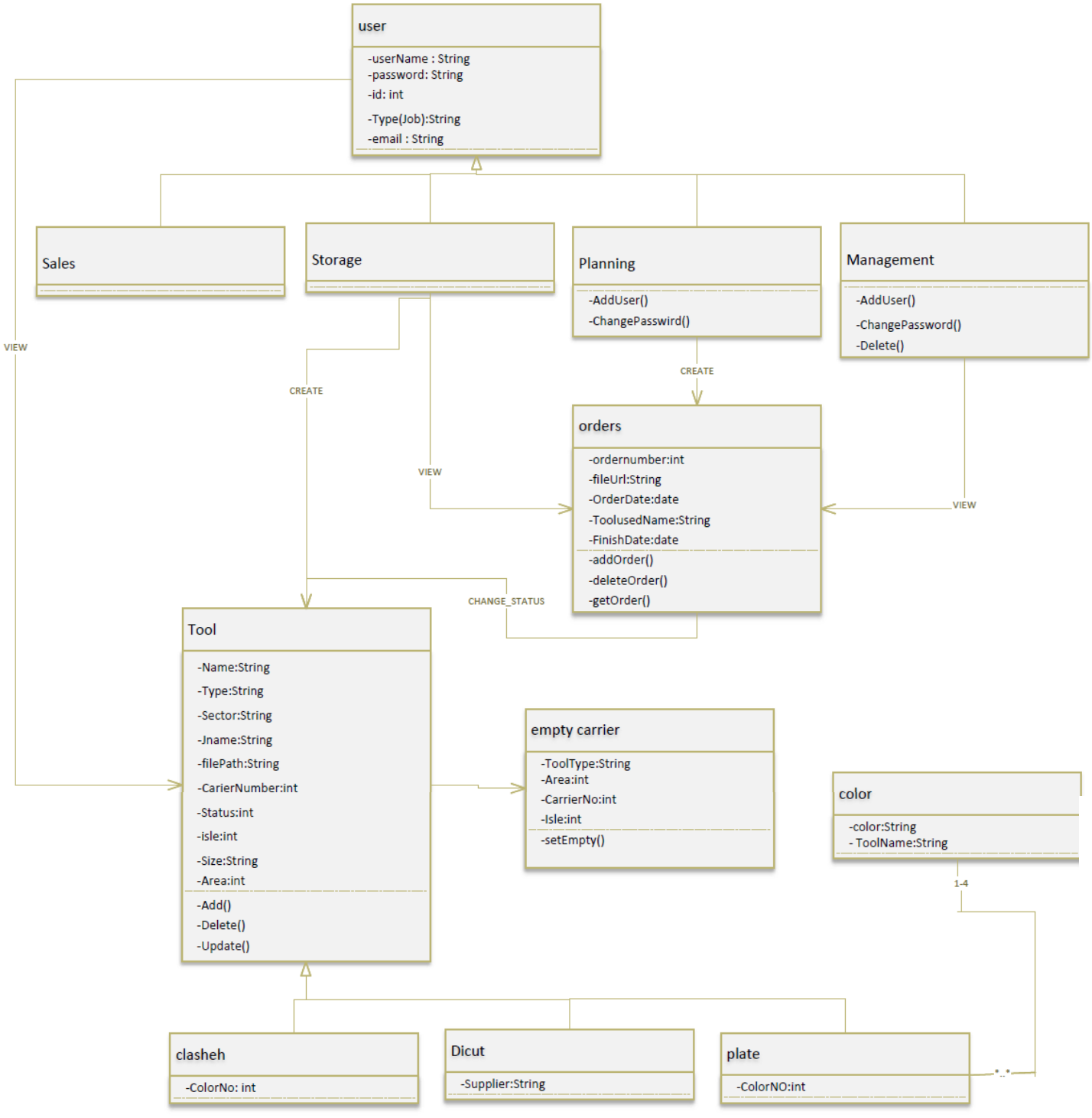


Figure 75: UML Diagram

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