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TECHNOLOGY, COMMUNICATION AND TRANSPORT

# Updating the Layouts of Moilas Bakery Ltd Factories for Improved Efficiency and Customer Experience

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<p>This thesis work aimed to optimise layouts design of Moilas Bakery Ltd factories to improve both efficiency and customer experience by using a 2D CAD computer software. From the current layout, the company recognized that there are inefficiencies which can lead to suboptimal customers experiences.</p> <p>By incorporating Lean principles within upgraded design, it was decided to optimize new updated layouts to improve production process, efficiency for the whole bakery factory and increase customer satisfaction. Consequently, by focusing on program software functionality, its importance in enhancing the manufacturing layout design, 2D CAD computer program was used to improve the current layout of Moilas Bakery Ltd.</p> <p>The implementation part featured the analysis of the current layout, zone by zone, the creation and justification of a proposed design and the ongoing collaboration with the company administration and other stakeholders such as Savonia University of Applied Science in order to adjust the proposed design and develop the final design, still reflecting the company's operational needs and customers' expectations. The execution part encompassed the translation of the final proposed design into a working layout, the fitting of the modified layout into the bakery's daily operations.</p>	
Keywords layout, efficiency, satisfaction, design, 2D CAD, workflow, bakery, optimization, implementation.	

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**ABBREVIATIONS**

AutoCAD	Automatic Computer Aided Design
CAD	Computer Aided Design
D.G	Diesel Generator
DWG	DraWinG
GF	Gluten Free
KPIs	Key Performance Indicators
KVA	KiloVoltAmpere
Ltd	Limited
n.d	not defined
OY	Osakeyhtiö (Finnish Abbreviation) =Limited Company
SLP	Systematic Layout Planning
UAS	University of Applied Science
2D	Two Dimensional
2D CAD	Two-Dimensional Computer Aided Design
3D	Three Dimensional
3D CAD	Three-Dimensional Computer Aided Design

# 1 INTRODUCTION

## 1.1 Background of the Thesis Project

Realizing that a proper layout brings operational efficacy and raises client satisfaction, Moilas Bakery Ltd began thinking on how their plant layout plan should be improved. The decision to use a 2D CAD program was a step on the way to come up with a reimagination of improved layout that could bring changes in response to industry best practices and innovation. In a time when every actor in the bakery business impacts both the bottom-line performance and customer perception positively or negatively, the importance of an optimised layout cannot be overemphasized. The suggested update-design activity not only presents an opportunity for a streamlined inner structure but also speaks volumes on the attention of the bakery to bringing an unparalleled experience to its consumers, signalling what a new arrangement for a sustained rise to the top of the game would look like.

Having a solid grasp in the key success factor of layout plan, in contributing to driving the rates of productivity and consumer engagement, this thesis project strives to embark in detail on the finer locales of bakery operations at Moils Bakery factory Ltd. By undertaking a sharp scrutiny on the pre-existing layout and concretely providing feedback to implemented interventions, what the project seeks is to arrive at synergy optimising workflow alongside enhancing client journey. In the midst of the progressing trade of the bakery industry with shifting consumer behaviour and advertise flow, the presumable widespread adoptions of CAD based layout plans designs become all the more a critical competitive advantage for winning the race economically .Through the lens of experimental research, pragmatic interventions, and critical analysis, what this project suggests is to pierce the sunlight for optimising layout, to press the suggestions beyond the Moilas Bakery Ltd, into wider domains of bakery operations.

## 1.2 Commissioner

Moilas Bakery Ltd needed to handle ongoing demands for increasing its effectiveness and customer satisfaction. As an enterprise, Moilas Bakery Ltd is one of the biggest bakery organisations in Finland that makes this project a priority. Moilas Bakery Ltd has been to produce healthy and delicious bread and pastry products by taking initiative to ascend their production operation to compete and give suitable service for their customers (Moilas | Moilas as a Company, n.d.).

To that end, they decided to undertake this project, propelled by Moilas Bakery Ltd's desire for continual improvement and development, to harness state-of-the-art technological innovation and expertise to help streamline operations and create an atmosphere that bolsters efficiency and client satisfaction (Davis et al., 2019). Also, Moilas Bakery Ltd had supported the project along its length, offering access to key information. Through its dynamic relationship with my research, the project was adapted to its goals and needs, so that a permanent dialog existed between my research and the administration. (Unrein, 2022).

### 1.3 Problem Statement

Despite the effectiveness of the Moilas Bakery Ltd company, issues within the arrangement of the bakery production plant were detected. These issues complicate the efficient work by causing delays and increment costs. To preserve and improve the competitive advantage of this company within the advertise, it is exceptionally imperative to unravel these issues.

### 1.4 Objectives of the project

The project targets were a multifaceted approach to commencing with the careful investigation and documenting of the present layout plan so that after having the present layout plan, areas for change can be identified and filtered, hence the basis for an organised and functional layout plan can be diagrammed. By using the 2D CAD computer software the proposed upgrade layout plan produced consolidating information gathered in the research to provide for better workflow and maximisation on floor space accommodation. Collaboration with the Moilas bakery Ltd's management was an essential factor in the project to make sure that arrangements were materialised corresponding to the organisational goals and the operational necessities.

Clearly explaining the advances, effective picks up and improved client involvement were the expected benefits. The job done to ascertain its effectiveness in driving proficiency measurement (efficiency and asset utilization), and its effect upon utilization of space to please factory staff and clients throughout the length of their encounters. This comprehensive approach delivered unequivocal changes in operational excellence and appeal to clients at Moilas Bakery Ltd.

### 1.5 Scope and Structure of the project

The work encompassed a detailed survey of the current spatial layout of Moilas Bakery in the attempt to find openings for better spatial workflow configurations, and a fine-grained examination of spatial arrangements and bottlenecks. It also included the creation of a detailed 2D CAD drawing of the bakery floor plan, aiding to accurate quantification and spatial resolution. The scale aimed to promote efficiency and increase vision stemmed directly from the act of making design plans conversant with the specificities of practical bakery operations (Chun, 2023).



## 2 LITERATURE REVIEW AND THEORETICAL BACKGROUND

### 2.1 Factory Layout Design Principles

A modernized bakery processing plant and its layout design plan demonstrate main principles regarding the optimal organisation of workflows, placement of machineries, utilisation of the space, and the management of client stream affairs. Primarily, those principles aid in achieving optimal productivity of process operations, maintaining required quality of the products, and ensuring the high level of client satisfaction. By deliberately orchestrating apparatus, workstations, and capacity zones, businesses can streamline generation forms and minimize squandered assets. Among those crucial factors that any good plant layout design should consider should include the process analysis as well. The correct placement of machinery and apparatus, workstations and storage areas will help industries to improve the shape of their products and reduce waste (Chun, 2023a).

#### 2.1.1 Optimisation of workflow

The bakery should be designed in a manner that favours unimpeded workflow from raw material processing to the final packaging. In other words, different production zones (mixing, forming, sealing, baking and packing) should be arranged in a sequence that facilitates material and production staff flow to minimise unnecessary movement.

#### 2.1.2 Machinery Placement

Machinery and hardware must be appropriately placed in the arrangement of the bakery so that the flow of production is not hindered and there is no backlog. Machines should run at their full potential in their designated space and their output should allow consistency in the movement of production.

#### 2.1.3 Space Utilisation

In order to optimise use of limited space within available floor area, Bakery design must prioritise use of vertical space to maximum capacity with mezzanine floors or overhead arrangement to optimise capacity and use valuable floor space for production activity.

### 2.2 Customer Stream Management

For retail bakery facility, managing client stream is imperative to offer an incredible shopping experience and empower deals via the layout design. Proper placing of display shelves, checkout counters and seating ranges can direct purchasers through client stream and empower motivation deals.

### 2.3 CAD Software Utilization in Bakery Plant Layout Design

The CAD computer programme converts the bakery layout plan into an intellectual rendition, which grants the designer and the maker a mix of tools designed to their requirements. The ability of CAD

to compute time frames and provide progressively linear 2D or 3D modelling structures, grants experts the ability to plan out designs demonstrating maximum utilisation of space, improving the functional effectiveness of the industry.

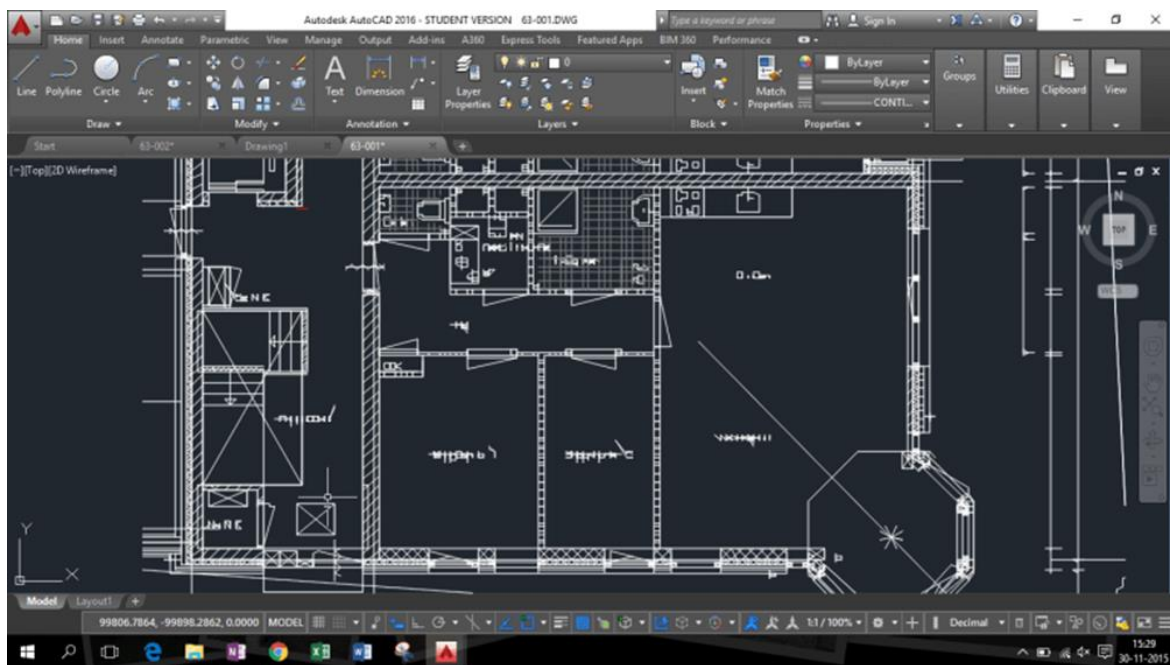


Figure 1. Workspace screenshot of CAD design Computer Program illustrating combination of tools (features) with mathematical equations to get the design done in precise measurements (Advantages and Disadvantages of Using Computer Aided Design (CAD) |, 2018).

Unlike manually hand drawn images, with the CAD computer program a designer can make considerable iterative improvements to the plan of the layout, before giving any implementing commands. This project goes with 2D CAD offers DWG files format simply because it has more benefits of functionality, and it is easier to use. DWG is a file format produced by AutoCAD software that provides a design environment that is reliable and constant. Along with design devices that are precise at measurement, the plans are intuitive that delivers a sense of spatial arrangements and workflow optimizations. Spatial arrangements that give a better visualisation of the movement of the plans (Advantages and Disadvantages of Using Computer Aided Design (CAD) |, 2018).

In short, 2D CAD computer program gives various advantage for layout design, there are important AutoCAD's useful features that offer easy measurements, simply adjustments and the overall view of the drawing or plan, counting exact estimations, simple alteration, and comprehensive apprehension. Its advanced nature permits for fast cycles and simulations, encouraging genuine decision making

and improving design effectiveness. Moilas Bakery Ltd layout with the use of AutoCAD computational programme engages me to produce effective layouts where traffic flow increases and give room for better user experience.

#### 2.4 Case Studies on the Layout Optimization of Moilas Bakery

To testify their sincere quality commitment and their establishments, Moilas Bakery Ltd has been raised from the homebased old traditional basic bakery to the largest private company. Day after day in Finland, despite the world recession level Moilas Bakery Ltd has committed to produce quality items and they hope to get the best standard because of specific commitment to produce gluten free items. While the company's consent is to use as it were the best ingredients available, the management at Moilas Bakery Ltd intends to wrap the company with clean production lines enough to see what they produce and their body of food safety. With regard to their process, they intend to meet maximum acceptance of customers by use mechanization as elevated level produced by their company within the layout design optimization to the production of items highly needed in the market and 45 percent of their production rushes over Europe by exportation (Moilas | Quality, n.d.).

However, the research on the designing of the bakery layout suggests that an advanced layout of Moilas Bakery Ltd would be more profitable after we have compiled the factory discoveries which incorporate inefficiency and the issues of workflow optimization, upgrading Moilas Bakery layout is a good way of special optimization by appropriately arranging different machinery and equipment with regard to the actual place to ameliorate both workflow and material flow which maximize hygiene in the bakery factory (Tulip Interfaces, 2024).

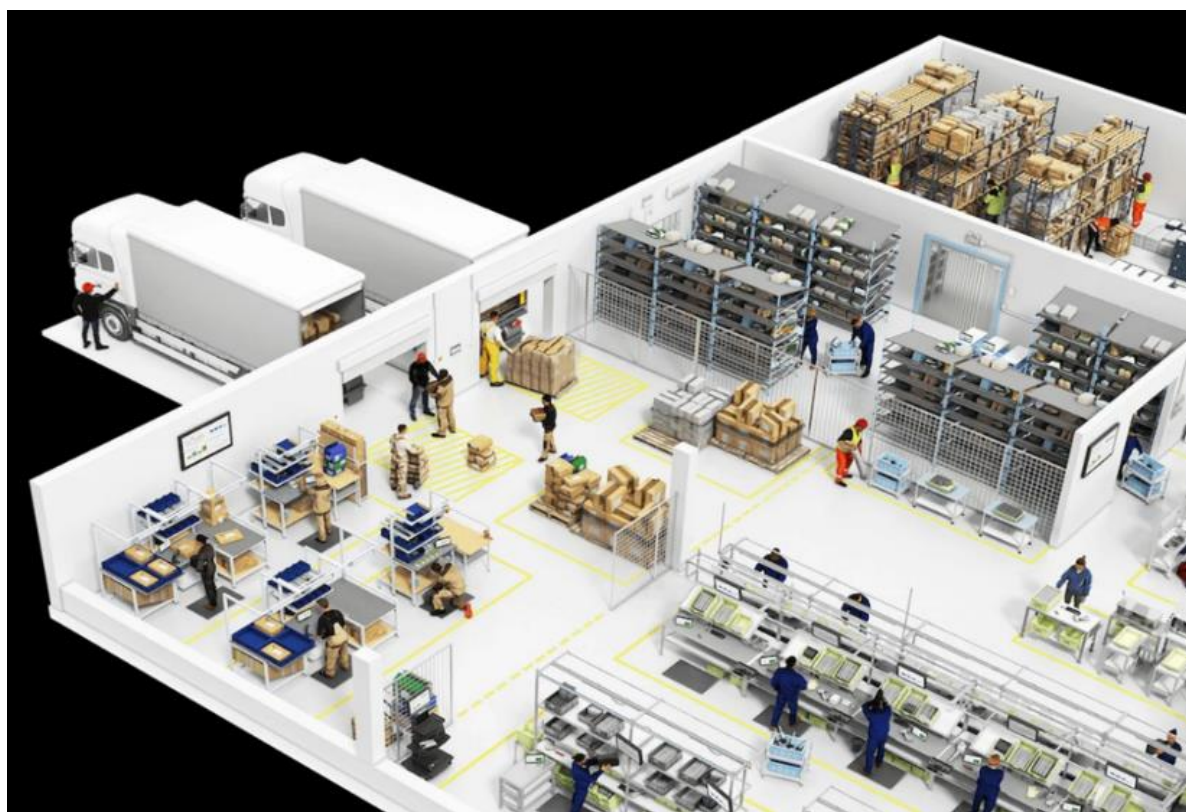


Figure 2. Above image illustrates the improvement of factory production tracking and visualization to help automate data collection and real-time production trucking metrics (Tulip Interfaces, 2024).

The research on the designs of bakery layout is an illustration and only indicates that the issue of workflow, placement of equipment and issues of hygiene are more important, and we can convert this knowledge into profitable knowledge and then describe further about the advancement of the layout designing of the bakery. Nanotechnology sensing data collector equipment such as metal detector, and nanosensor are very important in Quality control. That can be provided for every step of food production by means of monitoring any possible metal within food, microbes, toxins and contaminants using nanotechnology. Mechanical actions in control and documentation would be made through food packaging to monitor the quality of food throughout the food logistic chain. Nanotechnology helps to implement low-cost nanosensors in food packaging (Neethirajan & Jayas, 2010).



Figure 3. Representation of a 3-dimensional CAD scheme of the Flexco Bakery Layout Design carefully organised arrangement of production zones, manipulation of the machinery placement effective use of space, and customer flows management (Industrial Baking Map Bread, 2024).

Dry and liquid ingredients reside in allotted dispensers to minimize tidy scattering. Dry components are transferred to mixers through a tube mechanical framework via vacuum or air pressure, while liquid ingredients such as oil and water pass through pumps powered by computers and easily controllable the amounts to each recipe. Every amount of each fluid is custom calculated and controlled per each recipe (Industrial Baking Process Map - Bread, n.d.).

### 3 METHODOLOGIES

Switching from layout analysis to action of upgrading the factory layout design of Moilas Bakery Limited, various methods were applied. The methods such as data collection, current layout analysis, collaboration with company management, 2D CAD software applications and evaluation were conducted and research on collected information was to the provision to allow the execution of upgraded layout design (Pérez-Gosende et al., 2021).

#### 3.1 Data Collection

Data collection approach was started with site visits, interviews with staff (Moilas Bakery Ltd's Administration) and consultation of existing documentations which were done to gather more information and understand the current layout. Many types of equipment and materials are desirable during the first stage of the extension project to ensure sufficient information are collected about the existing information on Moilas Bakery Ltd's layout design and operating processes (Adosi, 2020). Obtaining information about Moilas Bakery Ltd's layout design and operating processes is central to the first stage of the extension project where observational studies give the first-person evaluation of the workflow dynamics and spatial requirements of the unit.

Another type of source – conversations with the administrative staff of the bakery – provides subjective information in a less refined form, which can help to identify critical problems and goals in the operational context of the existing bakery facilities. In the concurrent task, the documents related to the bakery: hardware manuals and engineering drawings offer documentary evidence that verifies certain contextual details and settings. Data from these sources has been used to generate a cumulative representation of context, a preliminary understanding of the current state of the layout and operational flows, to guide further investigations of the system and design needs.

#### 3.2 Current Layout Analysis

The data also helps identify bottlenecks and areas of inefficiency with Moilas Bakery Ltd's layout and process of manufacture, because of the analysis made to identify inefficiencies exhibited with the existing design layout, using techniques such as mapping and time motion studies. A modern design, using advance 2D CAD software, is centred on improved use of space, user experience, and process efficiency (Nalini, 2023).

#### 3.3 Updated Layout Design

The new proposed layout was overlaid and superimposed to enhance factory efficiency, and it significantly reduces production time for workers and other employees working in the factory. The new diagram was designed by shortening the flow paths and redesigning the workstations. The new 2D CAD layout depicted the optimised machinery, workstations, material flow paths, travel path, minimum space occupied in the factory and the terrain level, all of which comes under one efficient layout. It could be concluded that the new improved layout has addressed the inefficiencies and has optimized material flow paths, and space has been rearranged according to the requirements and nature of production which has improved the factory's operations (ResearchGate, 2021).

### 3.4 Collaboration with Management

There was no communication breakdown with the management throughout the life of the thesis project and this was achieved by giving in to the objectives and goals of Moilas Bakery Ltd. There were frequent meetings and presentations to show the proposed design, it sought for feedback and got approval on implementation.

### 3.5 Implementation

The implementation plan consisted of the activities (the approach, the equipment, the material used and the way of executing the plans) that has been carried out in remodelling the layout design of Moilas Bakery Ltd with the use of 2D CAD software. The drafting features of the software were used to identify areas of improvement, by creating a layout design that could improve the production lines, the raw material flow, and the personnel flow. These plans have been edited to suit the operational goals of the bakery, while a simulating feature of the software was used to virtually test of the proposed changes (CAD Pro, 2016).

### 3.6 Evaluation

As used by many organizations, the Key Performance Indicators (KPIs) would function as the method that enables to assess and gauge the efficiency, effectiveness and productivity of a process in the defined area of operations with absolute clarity and objectivity. They are important indicators that help in measuring performance or success, track progress and pinpoint areas for improvement (Croft, 2023). At the re-evaluation, key performance metrics such as throughput, cycle time and asset productivity had to be estimated, and the mentors' subjective feedback regarding the impact of the new layout setting on satisfaction and motivation was requested.



## 4 CURRENT LAYOUT ANALYSIS

### 4.1 Analysis of the existing layout

This process was complemented by interviews and observations with Moilas Bakery's administration staff to go deeper into the inefficiencies and about details of equipment usage and what exact work-flow related information is needed; as well as by archival information from before, such as diary entries, technical specifications, etc, which also added to the present data base and provided knowledge, context and understanding of the situation. This is most crucial step, as it provided understanding of inefficiencies and how they could be solved in the design phase in the form of a specific design avenue (Odhiambo, 2018).

### 4.2 Layout Overview

Moilas Bakery Ltd is organised in the discrete brewery departments of warehouse, production, packing and shipping rooms. There are inefficiencies in some zones of current layout, deadlock in other areas, flow congestion and bottlenecks of flow in other zones. The new layout aims to resolve all the problems. The following are two separate existing layout designs for Moilas Bakery Ltd located in Pieksämäki/Finland.

The following is the Virallinen GF (or OY MOILAS GF LTD) site which specializes in the production of gluten-free bread and bakery products renowned for their crispy crust and soft interior. Noteworthy offerings include Moilas Ciabatta and Moilas Rouhea, the first gluten-free breads baked in Finland, packed in a modified atmosphere for freshness (adapted from Moilas | Perheyritys Vuodesta 1955, n.d.).

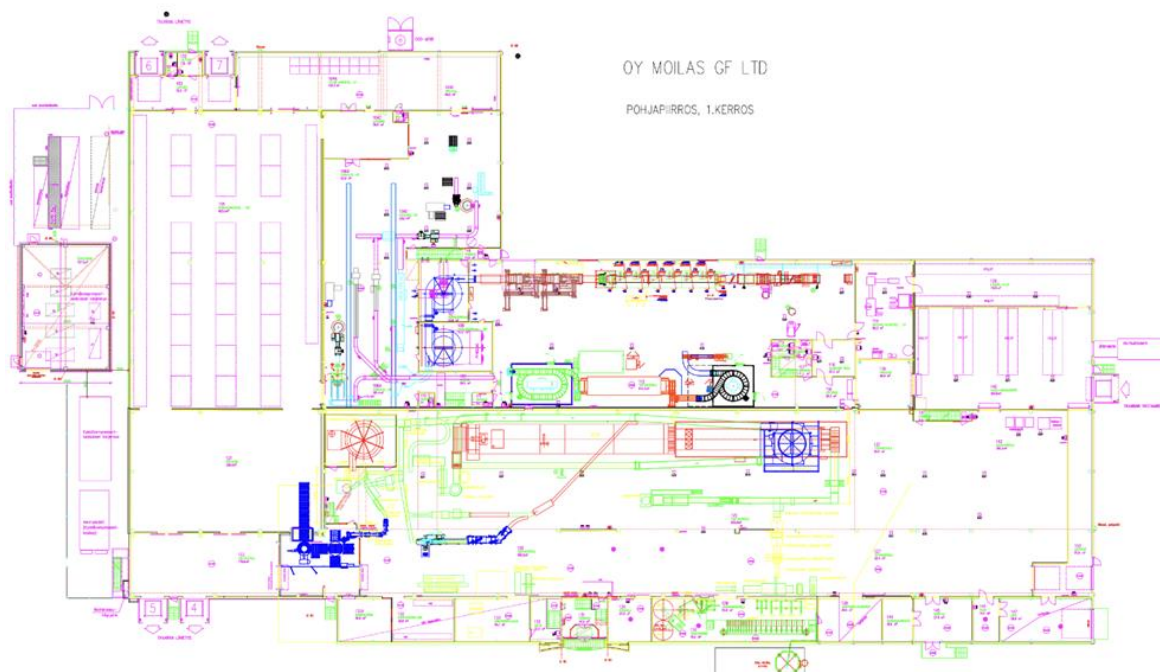


Figure 4. Current layout of Virallinen GF Layout, illustrating existing spatial arrangement (Aki, 2024).

Shown figure below is current Moilas Leipomo Oy situated in Pieksämäki. This facility offers a menu of typical bakery goods, such as gluten free products as well as classics like pastries. The company's identity has been constructed around the taste profile and quality of their products, which must be able to accommodate the palates of a diverse consumer base (Moilas | Perheyritys Vuodesta 1955, n.d.).

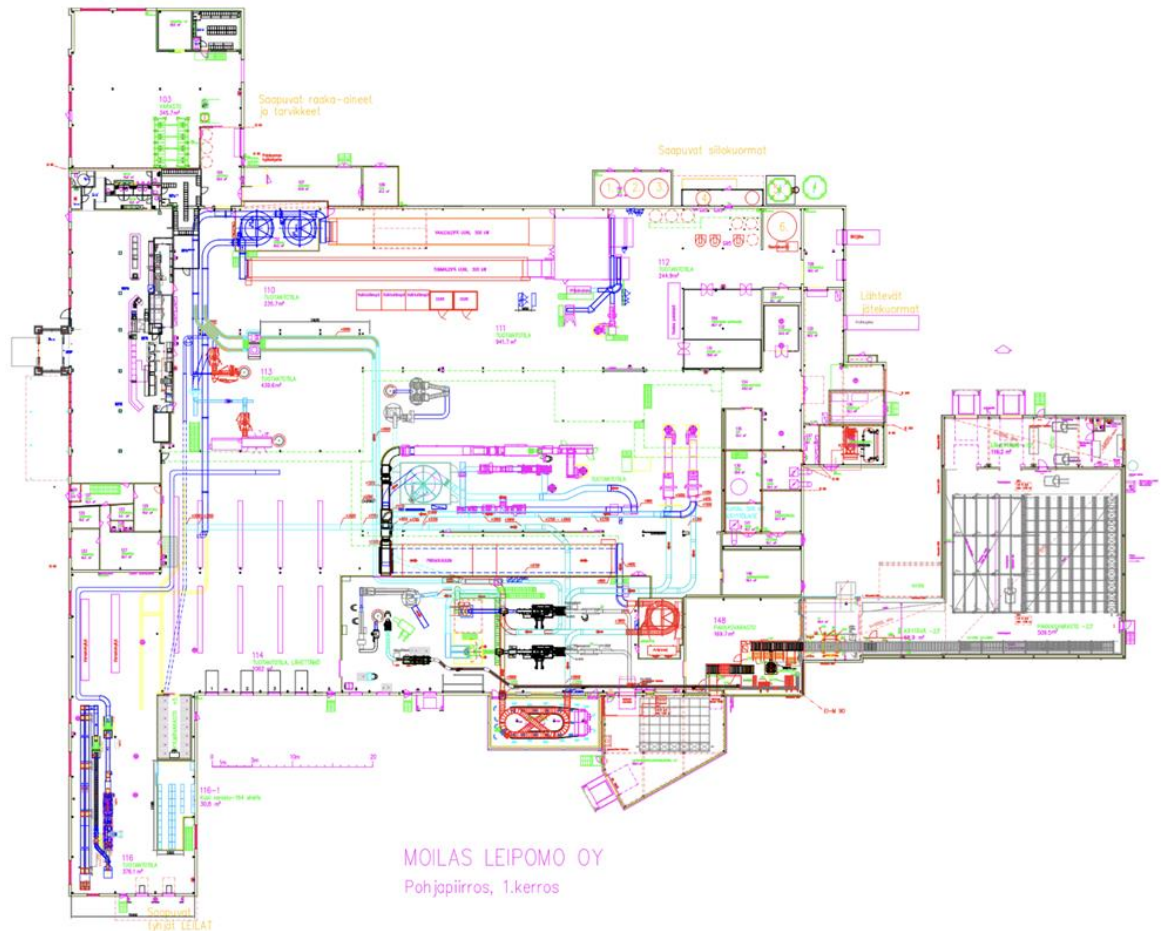


Figure 5. Current layout of Moilas Leipomo, illustrating existing spatial arrangement (Aki, 2024).

#### 4.3 Identified Inefficiencies

From the analysis, it showed that there were some inefficiencies in the current layout which include the material handling paths, the arrangement of workstations, and physical layout of working space which could be avoided because they are unnecessary as they reduce the productivity and increase the operational cost (Klausnitzer & Lasch, 2019).



The following figure is the Moilas Leipomo Oy's Layout with Rectangle marked with crossing sign as pointed by arrows to show zones of inefficiencies and their corresponding required tasks to be sorted in upgrading layout by either adding new equipment or removing current equipment which might have disadvantages in production line.

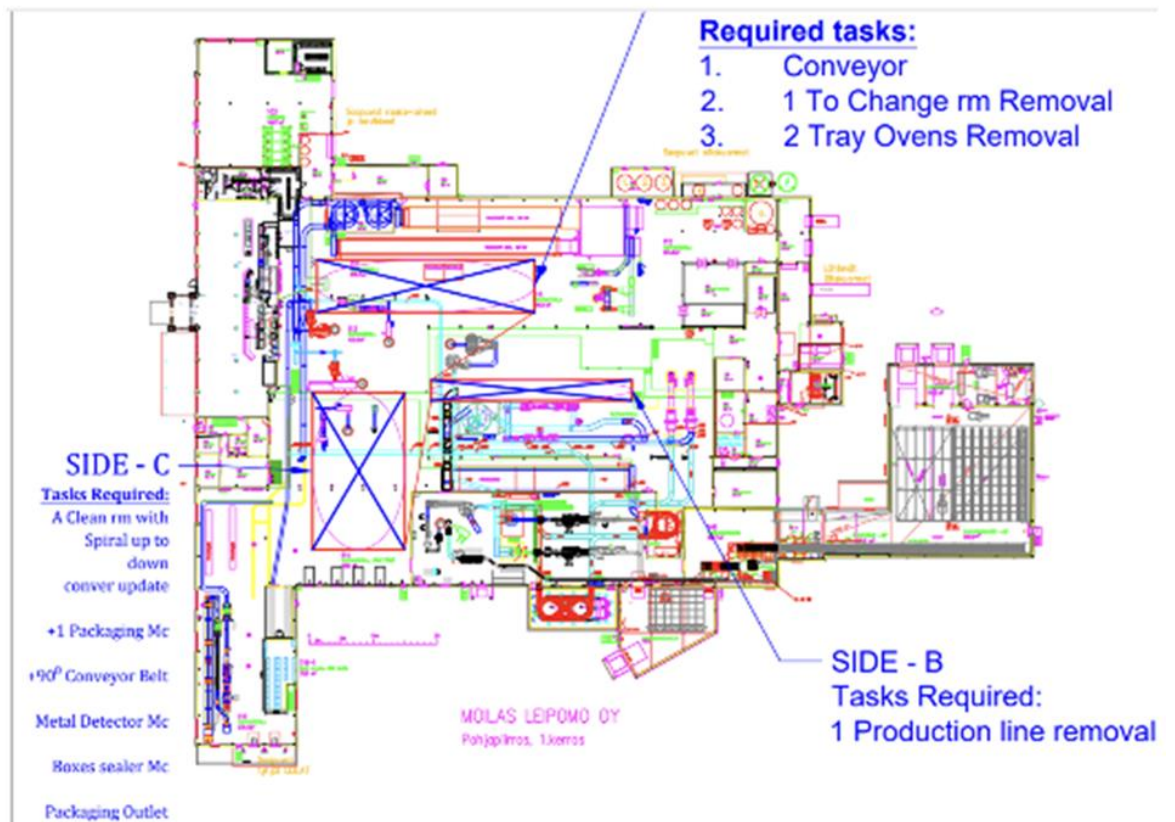


Figure 6. Infographic summarizing key findings from literature review with regard to the area of inefficiencies and tasks required for updates at Moilas Leipomo Oy's facility (Habamungu, 2024).

The following figure shows Virallinen GF (OY MOILAS GF LTD) layout with white zones (undashed) indicated by arrows to show areas of inefficiencies and their corresponding 2 categories of tasks such as outdated equipment removal tasks (1 production line, rice powdered machine, conveyor) and new equipment installation tasks (shelves updated, temperature change room, filter, Generator, Mixer and Metal detector). To optimize this facility, these tasks stated above needed to be done during the period of thesis project of upgrading bakery layout by either adding new equipment or removing current equipment which might have disadvantages in production line.

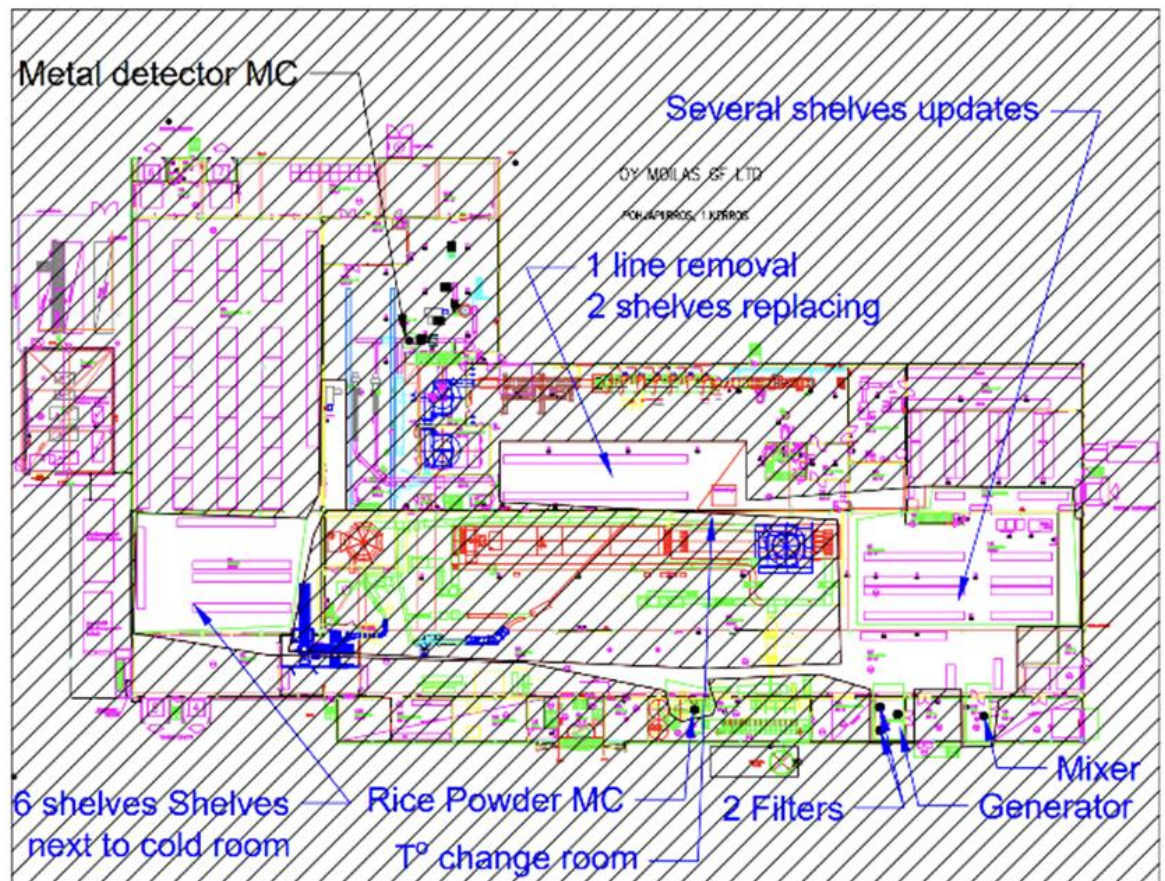


Figure 7. Infographic summarizing key findings from literature review with regard to the area of inefficiencies and tasks required for updates at Moilas GF Ltd's facility (Habamungu, 2024).

#### 4.4 Data and Metrics

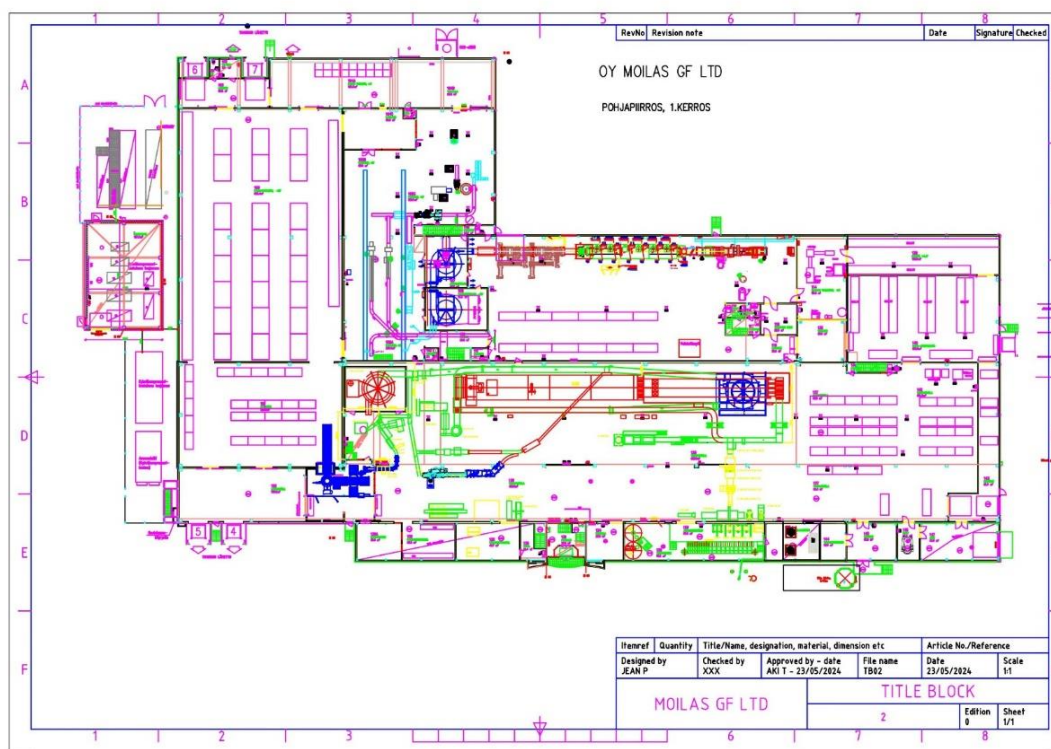
The quantitative data consists of the specific figures for production throughput or cycle times, resource utilisation rates and the grounded observations. Viewed in terms of conventional throughput or cycle-time metrics, the specifics of the measurements showed the net effects of the posited inefficiencies in operation. These quantitative ratios quantitatively estimated how the current layout design impacted overall operational performance (adapted from Subramaniyan et al., 2021).

## 5 UPDATED LAYOUT DESIGN

### 5.1 Design Principles

The basic design principles of the thesis work on Moilas Bakery Ltd layout design upgrade emphasized the stages and strategic approach towards spatial utilization. For instance, rigorous analysis in terms of the spatial availability of the bakery and occupying this space judiciously and distributing their set up efficiently was an important aspect for further renovation which was the core objective of the thesis work. Workflow efficiency depends heavily on the arrangement of occupational zones in the bakery. In doing so, the staging or layout was being informed strategically. The layout design emphasised on welcome space for employees and customers alike for a multitude of reasons including employee comfort and stimulation and reducing customer turn-off. The spatial utilisation was the factor in ergonomic design for workstations ensuring the comfortability of workers and the performance of their duties efficiently in simultaneous way, to increase overall work productivity and cut labour costs through reducing turnover rate. Moreover, combining the aspects of branding into the design concept gave an effective perception of an outlet, reflecting the appearance and established brand identity of Moils Bakery Ltd. Targeting the principle of efficiency and productivity within the duration and process of each round of productions, was the notion of stay and converse with each customer (DIVA Portal, n.d.).

The following figure shows Virallinen GF Bakery Layout without inefficiencies. This updated layout has been obtained after fulfilling all the tasks stated in figure 7 to optimize factory special workflow

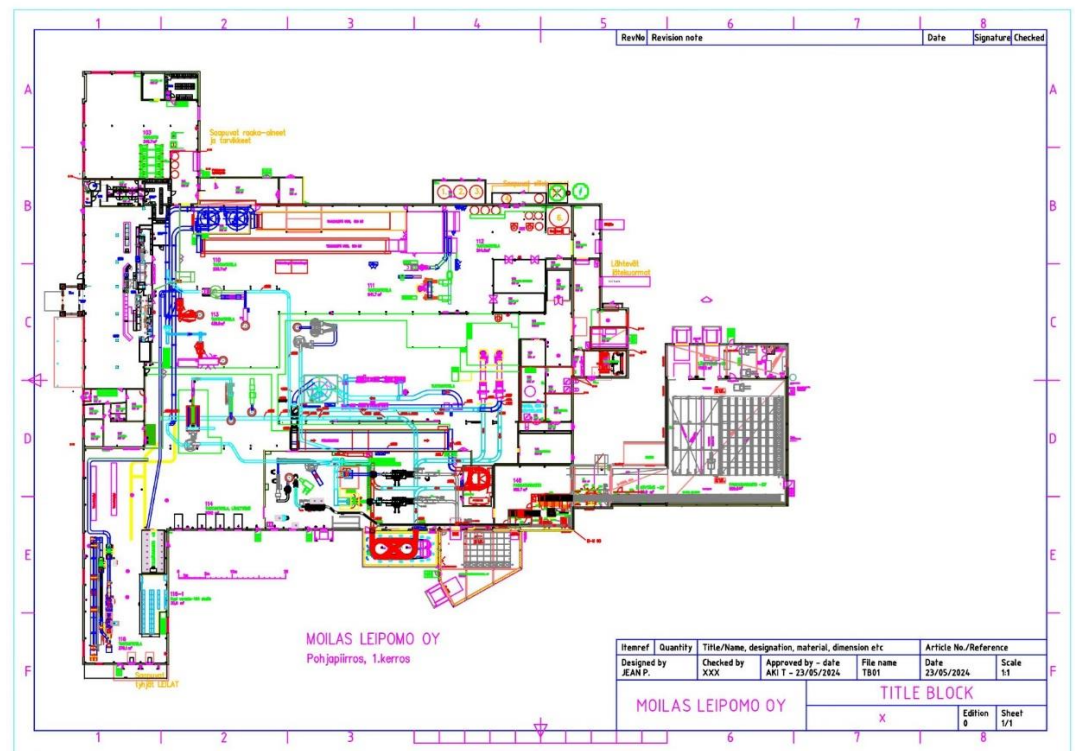


C:\Users\s730346\Documents\JP THESIS PROJECT\Encour Virallinen GF Layout - 22.1.201

Figure 8. Updated Moilas Bakery Ltd, Virallinen GF's site (HABAMUNGU, 2024).



The following figure shows upgraded Moilas Leipomo Bakery Layout after accomplishing all the tasks stated in figure 6 to optimize factory special workflow and customer satisfaction.



C:\Users\s730346\Documents\JP THESIS PROJECT\In progress Moilas Leipomo Oy layout

Figure 9. Updated Moilas Bakery Ltd/Moilas Leipomo Oy's site (HABAMUNGU,2024).

## 5.2 Visualization of the layout

The amended 2D CAD layout visualisation of the proposed plan incorporates the optimised arrangement of machinery, workstations, material flow paths, path travel and minimum space occupancy (visualisation).

## 5.3 Justification

The proposed layout takes into account identified inefficiencies in the current design. Sequence has been redesigned to optimise material flow paths, and space has been shifted based on production requirements. Through elimination of bottlenecks and improved resource utilisation, the new design significantly improved operational effectiveness (Heller, 2023).

## 6 COLLABORATION WITH MANAGEMENT

Moilas Bakery Administration was a crucial part of the success of the layout update project by contributing actively and providing valuable information with successful ideas and proposals during the design process. This collaboration guaranteed that the final layout design was tweaked to bakery's operational requirements and goals. The administration's approval was fundamental having the opportunity to run the project execution phase and setting up a sense of involvement. This collaborative space is beneficial not only for the better moment of the update but also for the establishment of the success full execution and continuous support (O, 2023b).

### 6.1 Communication

When working with management of Moilas Bakery Ltd, the communication was significant factor addressing all queries. Besides regarding this project, common vision contributed to the updates of the factory layout design. Communication was set to all the best to suggest the necessary changes and agreements (Ballard, 2024). Thanks to regular communication, personal experience and specific information could be included into the suggested agreements. The common vision of the project helped in having regular updates on the layout design, as well.

### 6.2 Feedback and Revision

Management feedback helped refine the proposed layout design to be more reflective of organisational target and operational requirements. Feedback was incorporated into the design incrementally to further develop it to meet functional and strategic objectives. Routine meetings from introduction periods were organised to understand the challenges faced, and feedback was received from the participants, who were involved the project which made the process of implementation a remarkable success.

## 7 IMPLEMENTATIONS

Utilizing 2D CAD software, an improved layout design drawing was created using results from the examination phase. Functions in the software such as drafting features were utilized to indicate areas of improvement and create a layout design to improve materials and personnel flow throughout bakery facilities. Specific dimensions and placement of equipment and/or workflow changes were made to ensure consistent integration of changes proposed. The plan was refined repeatedly to fit Moilas Bakery's operational goals. The functions such as simulation features created within the CAD software were able to facilitate virtual testing of proposed changes to prove effectiveness before physically using them. By utilizing CAD software with simulation features, an efficient and effective layout plan was created and utilized moving forward (Fuentes, 2024).

### 7.1 Planning

The implementation plan outlined the sequence of activities, resources required and how long each activity was going to take for the new layout to be executed. Precaution was taken to the minimum disruption to the continuous operation of checkout queues. After the design proposal of the new layout was discussed, execution planning began by reiterating the main points of the project to ensure its smooth transition to the upgraded layout. The physical execution was conducted when the different equipment was arranged to flow with the proposed layout design and changed the workflow according to it (Eby, 2019). Project due dates and timelines were set and overseen diligently during the execution process to ensure that the delivery to the overall project was successful.

### 7.2 Equipment and Materials

The tools and materials utilised for layout design are different from existing or integrated bakery equipment. In my point of view, when designing a bakery layout, to determinate design tools and material that can be used to upgrade the layout design, it is important to distinguish between integrated bakery equipment and design tools and materials required for execution phase.

In terms of the design, the tools and materials such as pencils, pens, toolkits, math sets, CAD software, notebooks and cameras are often used to draw ideas, process, draft and photograph the scene. For the integrated bakery equipment (inside the bakery), machinery such as automated baking ovens, various robots, conveyor systems and packaging equipment have the function to improve the production of the process of the bakery production scenario and keep the fresh and high quality of food products (Chun, 2023).

Table 1. Tools used with their significances (Habamungu, 2024).

Utilised Tool	Significance
<b>Measuring Tape</b>	Basic for measuring distances precisely inside the factory premises, counting the measurements of rooms, machinery, and other important spaces.
<b>Printed Facilities Layout Plans</b>	Utilized as sketching drafts for noting down observations and measurements during on-site survey
<b>Notebook</b>	Used for documenting measurements, observations, and insights gathered during data collection sessions.
<b>Savonia Library Resources</b>	Utilized borrowed books and used e-books from the Savonia library to gather relevant literature and references on bakery layout design principles.
<b>ChatGPT Usage</b>	Leveraged ChatGPT to brainstorm ideas, clarify concepts, and seek guidance on optimizing bakery layout design.
<b>CAD Tutorials</b>	Referred to CAD tutorials to enhance proficiency in CAD software for layout design and modelling.
<b>CAD Software (Designer)</b>	Employed CAD software for designing 2D bakery layout updates.
<b>CAD Measuring features</b>	Utilized CAD software to measure and simulate material flow and employee movements within the bakery environment.
<b>Digital Camera or Smartphone</b>	Utilized to capture visual information of the current layout design, giving point by point symbolism for analysis and reference during the re-design process.
<b>Notebooks and Pens</b>	To record qualitative perceptions, interview responses, and other fundamental data accumulated during location visits and gatherings with stakeholders.
<b>Survey Questionnaires</b>	Arranged to assemble quantitative information needed for the current layout inefficiencies and potential regions for improvement.
<b>Laser Distance Meter</b>	Gives exact measurements of distances especially valuable for huge or complex spaces where manual estimations may be challenging.
<b>Computer</b>	Utilized for organizing and analysing collected information
<b>Voice Recorder</b>	Valuable for capturing verbal feedback and talks during gatherings with administration and other partners, guaranteeing exact documentation of thoughts and suggestions.
<b>Scanner or Printer</b>	Encourages the replication of significant records and floor plans for dissemination among projects.

### 7.3 Execution

The implementation was done by physically sketching and modelling bakery layout updates utilizing CAD computer program and virtually rearranging the machinery, work areas and storage within created updated layout. It was important to make sure that things were done according to the new layout planning and the implementation plan.

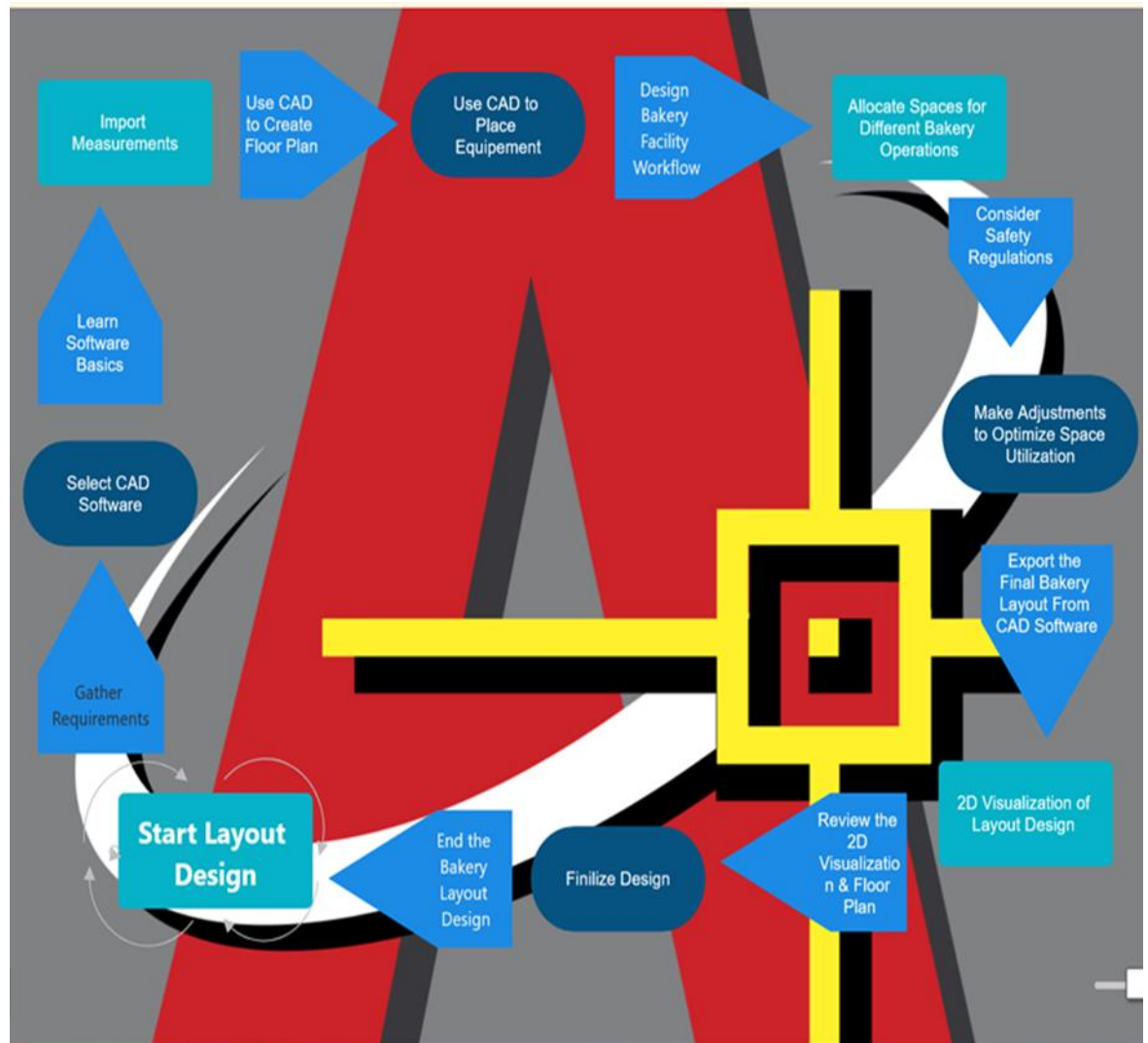


Figure 10. Flowchart depicting techniques utilized in CAD software for bakery layout design (Habamungu, 2024).

**Start Layout Design:** As a designer, you may need to open a new worksheet to start the 2D layout design project in the selected CAD software, setting the working space, and other stuff, such as the drawing bar scale, units etc. This is the foundation of the whole project, where the drawing bar serves as the digital on which you get to do the designing from there.



**Gather Requirements:** Before we even draft a design, we need to figure out what should be designed for, we must talk to stakeholders (Company managers or other staff) about the current situation and learn about it (interview, survey, inspection of the current layout at least through site visits) to figure out what does the current layout do well, and what can be currently improved and focus on what are the go/no go criteria of the layout (requirements and goals) (Patel, 2019).

**Select CAD Software:** Selection of appropriate CAD software should ensure the management process of drawing bakery layout design effectiveness. It is implied by the context that there will be a comparison of different CAD-systems, organised in a list matrix with some correlation in terms of different CAD-options, relying on the reason CAD-software should be chosen (Nguyen, 2021).

**Learn Software Basics:** You have really got to know how to use the basic tools (i.e., drawing tools, how to navigate, how to dimension) and not think 'how do i do this on paper, what do i do first.' Just before start drawings. So, making sure you know the tools and that you just get comfortable playing with it. Study tutorials embedded within software or go online and look at lots of stuff before you get comfortable drawing in it (Wilson & Adams, 2018).

**Import Measurements:** A matter of being able to interface with the CAD application — consists of importing inputs from the measurements and data gathered through the requirements gathering process such as dimensions of the floorplan, the specifications of the factory equipment, the workflow paths, and so on (Thompson, 2020).

**Use CAD to Create Floor Plan:** Draw with various lines, and other interior architectural elements needed for representing the physical space using your CAD software drafting tools and create the scaled drawing layout of a bakery. Remember to learn how use scale and proportion (King, 2019).

**Use CAD to Place Equipment:** After you make the basic floor plan, then using the computer aided design programming, you can put in things such as machinery and other equipment, conveyors, mixers, workstations, storage units, etc, while being able to see at one glance if the traffic flow is correct and workflow is efficient and productive.

**Design Bakery Facility Workflow:** The workflow design is about planning or organising the flow of workers and raw materials at the facility. Plan the flow diagrams using CAD tools to help establish traffic flows across the bakery to make the process of baked goods creation from dough to the neatly packed finished products, flow as smoothly as possible (Carter & Roberts, 2021).

**Allocate Spaces for Different Bakery Operations:** Create a walled space for each separate operation required for running a bakery, for example a space for mixing, another for baking, yet another for decorating and packaging give dedicated spaces using CAD to each activity shown in the layout and draw a line around it to show the designated zone to make sure you don't end up with any congestion or bottlenecks in utilizing your space .

**Consider Safety Regulations:** Mention safety aspects of the layout design by making sure it meets requirements of safety regulations and standards (e.g., emergency exit, fire safety equipment

etc), make sure the items placed on the work space are in proportion to and the size of the work-space (so that you don't injure yourself by lifting something heavy)make sure that work surfaces are not at an awkward height or your back might become injured.

**Adjust Optimize Space Utilization:** Continuously iterate and improve the form and layout design until the most efficient use of the space is reached. For instance, this would involve rearranging the form of the installations, the flow paths, or the space targets according to feedback from stakeholders and the iterative design reviews.

**Export the Final Bakery Layout from CAD Software:** After completing the layout design, export the design from the CAD software into the format in which it can be used for the presentation and implementation of the project. This will make the design usable for sharing with stakeholders and for creating further drawings and construction purposes.

**2D Visualization of Layout Design:** Create 2D drawings of your final layout design for the bakery, as this will help company better understand and verify the spatial relationships, equipment and workflow paths and placement, as well as the overall floor plan design.

**Review the 2D Visualization & Floor Plan:** Review the 2D drawings and the floor plan to ensure visualisations are correct and adhere to project requirements. Once dimensions, placement of equipment and compliance with safety standards are confirmed, finalise the visualisation.

**Finalize Design:** Revise and optimize design with comments from stakeholders and two-dimensional design images Check the equipment installation positions, workflow route and the safe operation area to see whether the design meets the overall project plan and requirements.

**End the Bakery Layout Design:** Now, we are ready to finish detailed bakery layout. Firstly, we need to formalise the documentation, each item on the layout has to be validated.

## 8 EVALUATIONS

After finishing the draft of the new layout design, measurement of its effect followed to examine the efficiency and client experience with the perception and feedback collection. The method of information collection included observing the production process and workers flow at that time to check the effectiveness of the upgraded layout. In the real practice, collected feedback from the staff helped to understand the unspoken experiences of the staff to reflect on their suggestions. Thanks to the assessment that helped in identification of the remaining inefficiencies and ensuring the continuous improvement to optimize Moilas Bakery's operational processes and layout design (Feedback Loops: The Key to Continuous Improvement in Customer Service, n.d.).

After improvement, the reassessment shows that implementation led to the real increases in efficiency, including decreased production time and an improved material flow. These observations would show how updated layout was crucial in improving operational execution and customer satisfaction, justifying extensive planning and collaboration before implementation.

### 8.1 Efficiency Metrics

In a process called post-implementation, key efficiency indicators such as production throughput, cycle times and resource utilisation rates were addressed in comprehensive way to clarify the influence of the new layout on operational performance.

### 8.2 Management Reflection

Qualitative feedback in the form of post-implementation surveys and interviews captured from Bakery staffs' perceptions and experience during the interview and prior to hearing management team, their point of view on the success of the new layout led the thesis project to gain positive insights on improved layout and benefiting from its execution. The approval from each of the stakeholders is essential. In other words, the updating design part is done, and it is ready step by step towards the bakery layout to be implemented.

## 9 RESULTS AND FINDINGS

### 9.1 Identification of Inefficiencies in Existing Layout

According to the research done at Moilas Bakery Facilities, the former set up for bakery had some inefficient; therefore, the company has to seek for new layouts by updating the existing bakery layout designs, which will incorporate latest improvements. By now, the business has come up with quite new ideas, resulting from a thorough analysis of different moving and combining principles and methods.

### 9.2 Objective of Efficiency Improvement and Customer Engagement

The main objectives of this hypothetical retrospective study were to improve the working facilities and also increase customer interaction in compared to the previous bakery layout. The innovative design suggested for modernization of Virallinen GF Layout and Moilas Leipomo to address the existing issues within the working area and make it visually appealing for the employees and customers (Pérez-Gosende et al. 2021).

### 9.3 Optimization of Material and Spatial Flow

The whole-bakery perspective of the new plan considered material streams and paths of motion. This analysis resulted in a re-design of equipment placement, elimination of redundancies and the integration of new machinery to smooth out bottlenecks in the process.

### 9.4 Streamlined Operations and Improved Workflow

Besides improvements helping to avoid existing bottlenecks, the new layout helped to make operations flow more smoothly. The modifications made to the design layout encouraged a smoother and quicker workflow, which led to an overall improvement in the bakery's productivity and an increased satisfaction for its customers.

### 9.5 Integration of Customer-Centric Design Elements

The revised layout design promotes customer centric principles that will enhance customers' satisfaction and participation. This is through the integration of customer-flow, client needs (final product flow for easy shipment), efficient logistic, inventory equipment accessibility and aesthetics of the company's sales space (Team, 2024).

## 10 CONCLUSIONS

An optimised bakery floor plan establishment is particularly important in all bakery enterprises growth and development as it facilitates movement around the space, ensures the proper utilisation of the floor area, and promotes staff and customer-friendly environment (Chun, 2023c). The role of mathematical and computational models in layout optimisation has been highlighted in executing this project to achieve its objectives. These models were developed with the aim of improving layout design, and consequently, to enhance the operational productivity (Anjos & Vieira, 2020). In order to achieve smooth production processes, a strategic business plan that included the enormity of work function, building layout construction, floors to be built, and the number of buildings of the factory facilities must be controlled in a way that processes proceeded efficiently according to the approach of Systematic Layout Planning (SLP), which is an important figure in the field of contributing in the company's performance (Naqvi et al., 2016).

The project of improving factory layout design for Moilas Bakery Ltd has been beneficial in terms of operational productivity and customer experience. At the beginning of the project, the analysis of the existing layout provided the base of work done. Collaboration with the administration enabled me to understand the gaps within the existing bakery layouts and how the new upgraded layout could address the gaps. Consistent improvement in following up with the new layout and administrative follow up approves the efficiency of the project in achieving its objectives. Positive feedback gained from Moilas Bakery administration proved how much the project's importance should be approved and how beneficial it is to improve the layout of the operational procedures and gains higher engagement from their partners. The main objective of the project was achieved since the new layout upgrade has been beneficial in terms of operational productivity and customer experience (Naqvi et al., 2016). Being able to use a 2D CAD computer programme facilitates design by improving layout efficiency.

Finally, a major benefit was the healthy working relationship with the company administration during the project's life cycle. Looking ahead, the learnings from this trip will be useful for drawing up a diagram for other organisations aiming to improve operational processes. Businesses that maximise innovation will be adaptable and ready to respond to changing display flows, leading to sustainable development and competitiveness in the long term.

## 11 RECOMMENDATIONS

Using mathematical and computational models to optimise layout for maximising operational effectiveness has been seen as a core recommendation but manufacturing concerns should also take a more proactive approach to layout improvement based on anticipating and staying in line with ever-changing client needs and desires. Secondly, a culture of continuous improvement helps to ensure the layout matches operational objectives and client demands while leaving room for flexibility so that the layout can shift with changes in the market and open up opportunities to take advantage of growth. A Lean facility layout establishes faster and more efficient flows of people, material and information by making obstructing objects more visible with visual controls (McLean, 2024b).

As the needs of generation are everchanging and client desires constantly evolving, Moilas Bakery Ltd and other manufacturing concern must take a proactive view toward improving layout. By cultivating a culture of continued improvement, the bakery can ensure that its layout remains aligned with its operational goals and client requirements. Additionally, this builds the ability to be nimble as well, allowing the bakery to pivot in response to changes in the market and seize new opportunities for growth. The involvement of strategically arranging production by Facility Layout Planning (FLP) is the key factor to efficiently align with organizational objectives, making it a crucial design decision (Pérez-Gosende et al., 2021).

In addition, the use of new instruments such as 2D CAD computer program must be considered in advance layout design undertaking. While the project successfully adopted 2D CAD to iterate Moilas Bakery's layout, investigation of its potential and the integration of more innovative setups can yield even more benefits. The understanding of creative tools will enable the bakery to conduct more thorough experiments, create more advanced designs and execute the process more effectively. As the progress of technology continues, Moilas Bakery Ltd must keep up with these advances to maintain competitiveness.

Prior to start the factory layout design, it is important for food processing industries to note that nanosensors such as metal detectors and others sort of sensors are responsible for quality control, tracing microbes, toxins and dangerous contaminants along the food processing chain by constantly monitoring food quality as it moves throughout the logistic chain, to assure it meets best standards until it reaches the consumer's table. It is by means of these nanosensors that quality can be maintained throughout the processing chain, every step of the way, which can be linked to the Moilas Bakery Ltd where customer satisfaction can be further enhanced by the correct layout design so as to ensure not only efficient processes but also quality control (Neethirajan & Jayas, 2010b).

## 12 ACKNOWLEDGMENTS

I firstly send my thanks to many individuals and institutions whose encouragement and guidance were indispensable in the completion of this thesis project. I also express my sincere thanks to the Moilas Bakery Ltd's administrative staff, professors and advisers whose knowledge and assistance guided me all throughout the study and completion of this thesis project. Their valuable advice and insightful feedback have been instrumental in shaping the outline of the design and developing the approach regarding this thesis.

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Secondly, to the members who freely gave their time and expertise for the data collection stage of the project, i am thankful for their knowledge and experience which added relevant context and depth broadened my understanding of the challenges and opportunities inherent in the optimisation of plant design.

Finally, to my peers and colleagues, i applaud the support and faith in me throughout this project journey, their contributions and collaboration in my area of study made the difference in my physical and mental disposition throughout the study and made precious sharing of knowledge in productive exchanges.

To sum, it is the collective support and efforts of these people mentioned above that has allowed the successful completion of this thesis project.

I say a big thank you!

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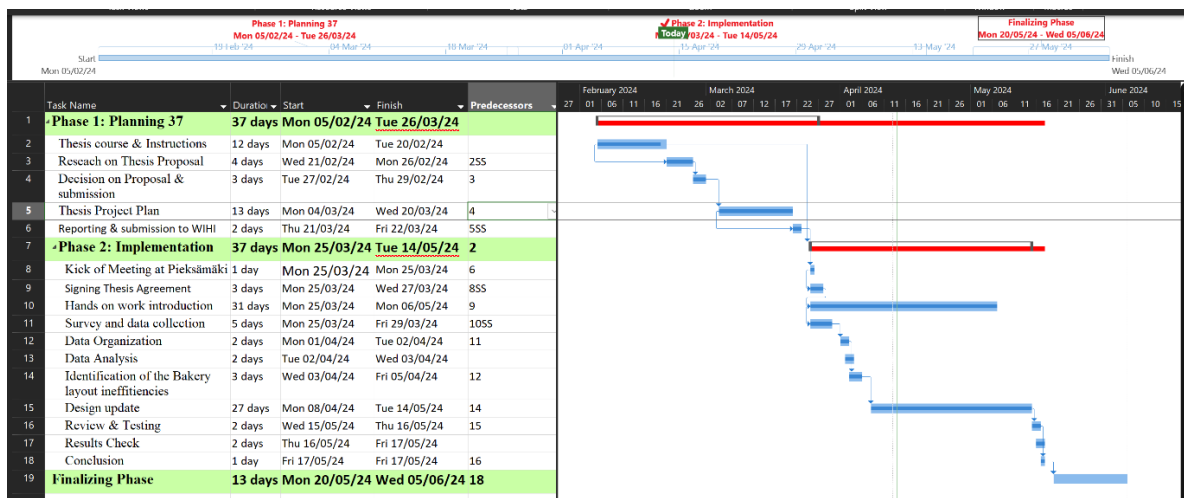
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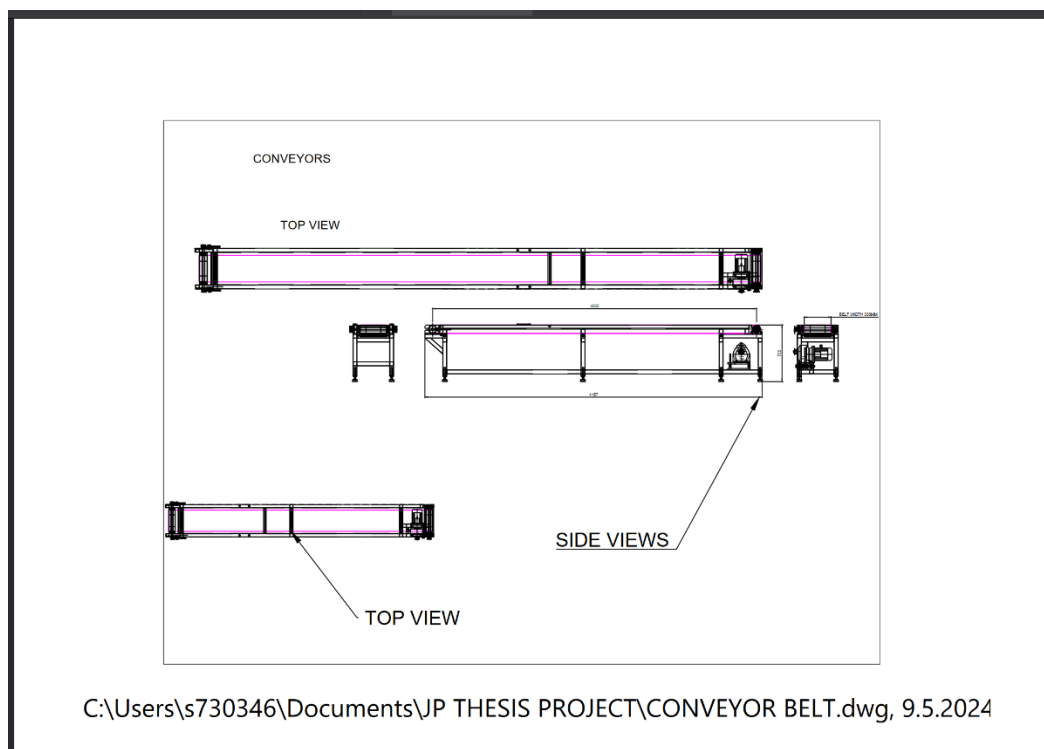
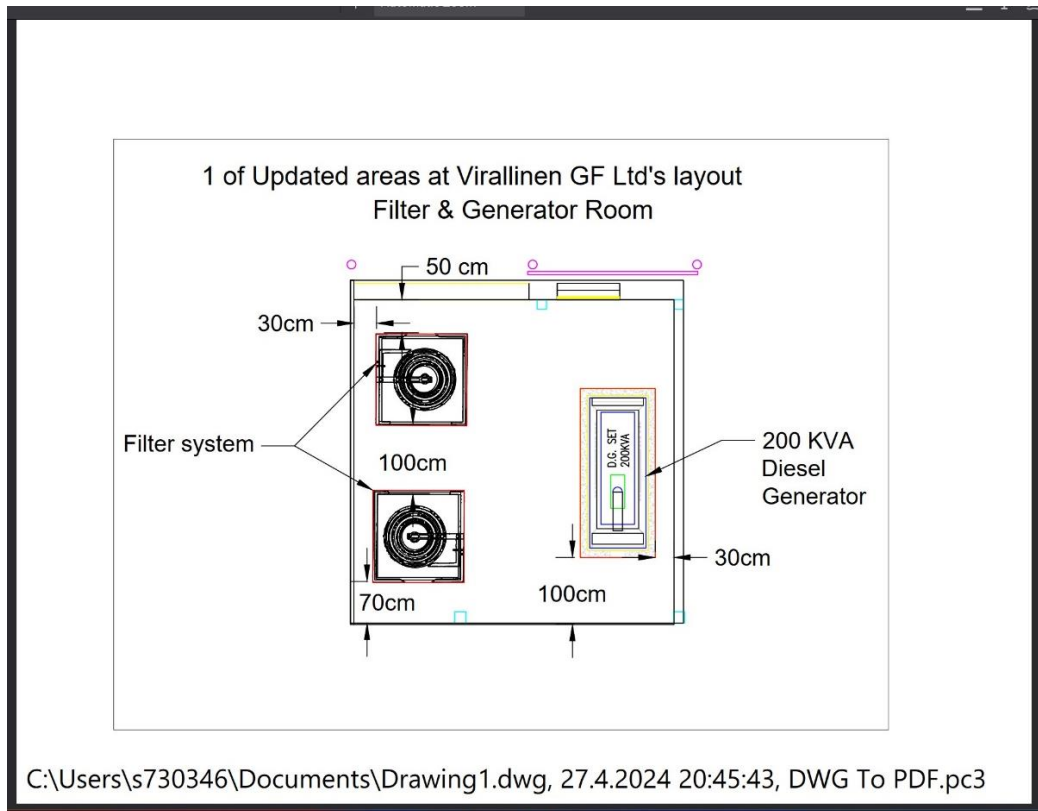
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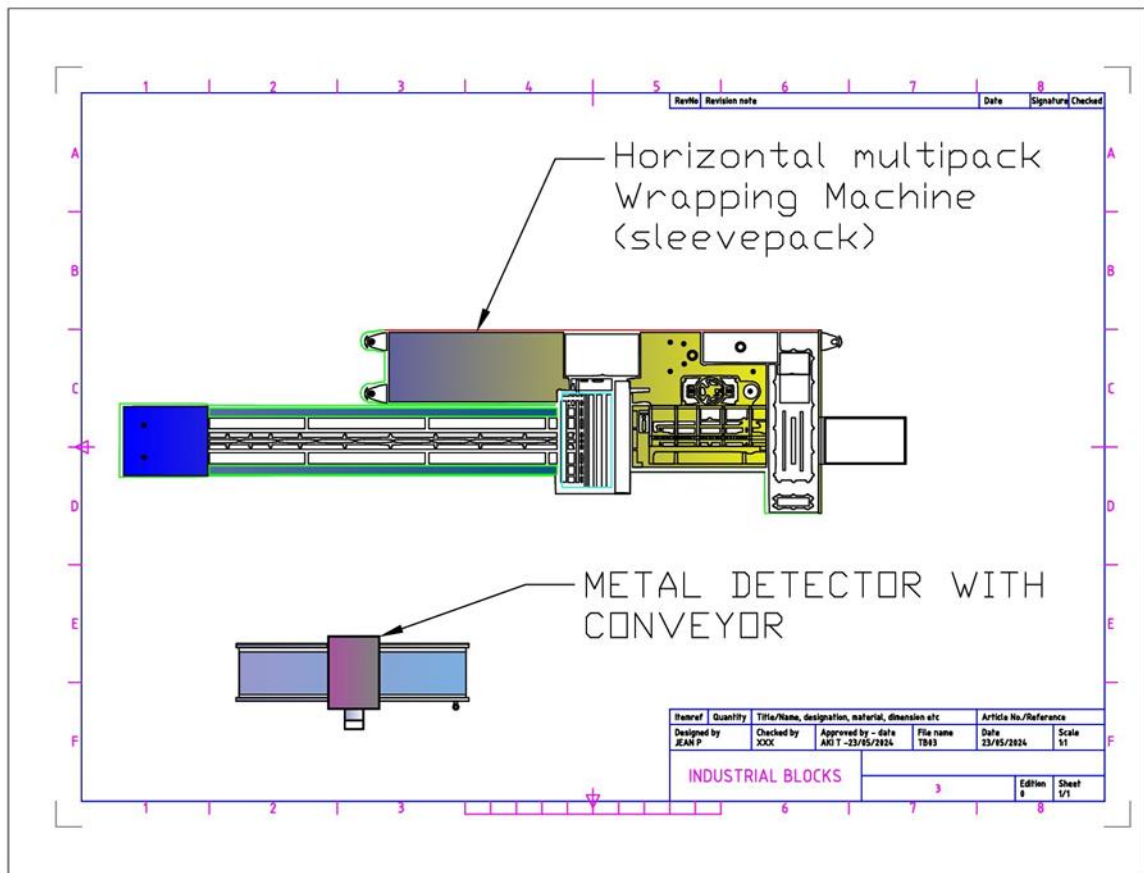
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APPENDIX 1: MS PROJECT

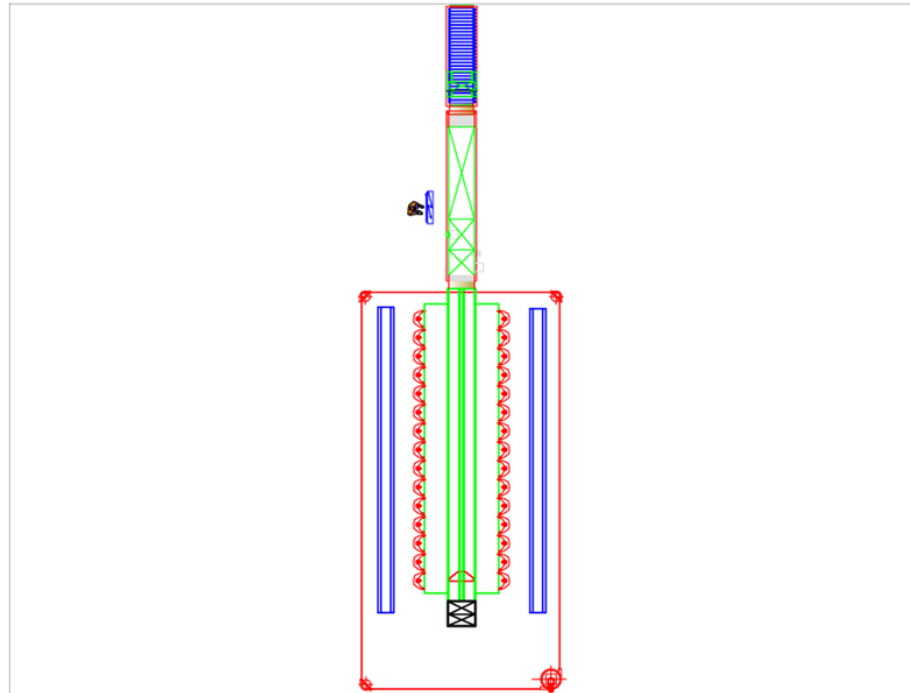


APPENDIX 2: CAD DRAWINGS

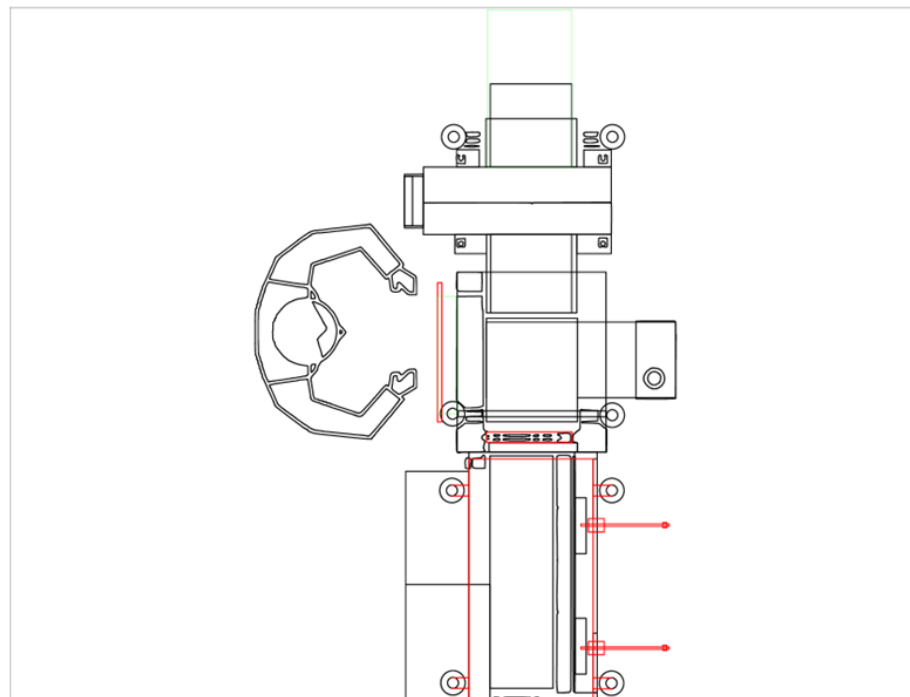




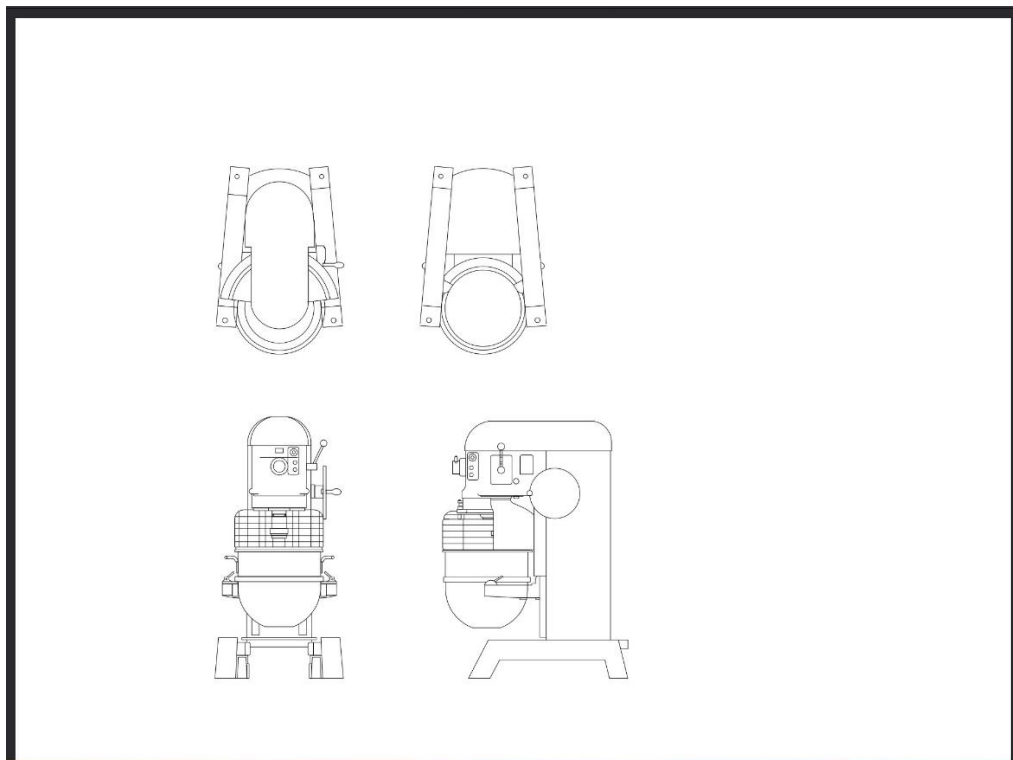
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## APPENDIX 3: THE QUESTIONNAIRE OF FACTORY LAYOUT DESIGN

Week 16/2024

### Factory Layout Design Questionnaire

All the questions listed below have been answered during the first and second meeting with company's representative while discussion held on the floorplan of a factory and its required improvements. Please note that additional questions have been directly asked on site visits basis through the discussion with Moilas Bakery Ltd's staff concerning Virallinen GF facilities and Moilas leipomo Oy facilities.

#### Introduction

Thank you for agreeing to answer some questions. This is a part of a study into the possible use of 2D CAD to implement layout in the factory of Moilas Bakery Ltd. As part of the study, please take some of your time to answer the questions below, accurately and as honestly as you can. All answers will be treated as strictly confidential information and will be used only for research purposes.

#### Section 1. Current Factory Layout Design

1. How is the bakery factory set up right now?
2. Is the way the factory is organised at the best moment for the work to be done as quickly and efficiently as possible? Explain your answer.
3. Which parts of its design structure have proven most difficult or not to work at all?

#### Section 2. Challenges and Problems

4. What are the significant problems or deficiencies that you face when you are taking care of your current factory layout?
5. What aspect of this factory do you think we should change or fix first if you think it is necessary? If yes, please note here.

#### Section 3. Ways to Make Things Better

6. If you had a few minutes to think about how the factory could be made to look better and run more efficiently/quickly, what would you suggest?
7. If while updating the factory layout design and workflow 2D CAD technology will involve, what would I think about it?
8. What components would you suggest incorporating in a new layout of a factory on CAD?

#### Section 4. Demographic Information

9. Which job did you do at Moilas bakery ltd and how many years you have been working there from now?
10. Which department do you mainly work in at the factory?

#### Conclusion

Thank you so much for contributing to this survey. Your opinion truly matters so much, we really appreciate your time in helping fill this questionnaire. This helps a lot with us in our thesis project consisting of acquiring the factory design layout.