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Production Capacity Increase Planning and Strategy – the case study of Wingsys

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November 2021



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Sumário

Numa era de incerteza Global, em que todas as empresas se debatem com uma competição feroz em todas as áreas de negócio, fruto de uma digitalização cada mais democrática e global, é necessário e relevante repensar o conceito de capacidade produção de forma holística.

Sem nunca esquecer os parceiros externos e, naturalmente os clientes, é frequentemente internamente que se encontra a chave para alcançar maiores receitas, ao mesmo tempo que se reduzem custos, e, sobretudo, desperdício.

Baseado no conceito de Produção Lean do Sistema de Produção da Toyota e na técnica de Value Stream Mapping, o objetivo principal deste documento é fornecer à empresa produtora de equipamento interativo *Wingsys* uma estratégia completa e um plano de ação com soluções relevantes que possam ser implementadas de modo a permitir um aumento de capacidade de produção de maneira sustentável, economicamente viável e com benefícios para a empresa, os seus colaboradores e os seus clientes.

Palavras-chave: Capacidade, Produção, Desperdício, Estratégia, Planeamento, Operações, VSM, Lean

Classificação JEL: L23 Organização de Produção e L63 Microeletrónica, Computadores, Equipamento de Comunicação.

Abstract

In times of global uncertainty, when all business areas are dueling with fierce competition, as a result of global and more than ever democratic digitalization, it is necessary and relevant to rethink production capacity in a holistic way.

Without ever forgetting the external stakeholders and naturally the customers, it is often in the internal stakeholders that the key to unlock higher revenues, while reducing costs and waste, can be found.

Based on Lean Manufacturing concepts and Value Stream Mapping technique, the main goal is to provide to Interactive Equipment Manufacturer *Wingsys* a comprehensive strategy and action plan with relevant solutions that can be effectively implemented and that will allow the production capacity to increase in a level that is sustainable, cost-efficient and a win-win between the company, its personnel, and its customers.

Key words: Capacity, Production, Waste, Strategy, Planning, Operations, VSM, Lean manufacturing

JEL classification: L23 Organization of Production, L63 Microelectronics, Computers, Communications Equipment

Table of Contents

| | |
|--|-----|
| Acknowledgements..... | i |
| Sumário | ii |
| Abstract | iii |
| List of Figures and tables..... | v |
| 1. Introduction | 1 |
| 2. Literature Review | 3 |
| 3. Methodology | 11 |
| 4. The case-study Analysis..... | 12 |
| 5. Strategy for Capacity Increase | 30 |
| 5.1. Overview..... | 30 |
| 5.2. Key Performance indicators (KPIs) purposed..... | 33 |
| 5.3. Action plan..... | 35 |
| 6. Conclusion and further recommendations | 47 |
| 7. References..... | 49 |
| 8. Appendix | 52 |

LIST OF FIGURES AND TABLES

| | |
|--|----|
| FIGURE 2-1 SYSTEM CONCEPT OF PRODUCTIVITY | 3 |
| FIGURE 2-2 PORTUGAL´S POSITION VS. COMPETITORS | 4 |
| FIGURE 2-3 PORTUGAL´S PRODUCTIVITY EVOLUTION 1995 – 2017 | 4 |
| FIGURE 2-4 PORTUGAL POSITION OVERVIEW IN THE GCI (2017-2018)..... | 5 |
| FIGURE 2-5 THE CAPACITY FUNNEL | 6 |
| FIGURE 2-6 COMPARISON OF SIMILAR FACTORIES EFFECTIVENESS WITH AND WITHOUT LEAN PRODUCTION..... | 8 |
| FIGURE 4-1 HOUSEHOLD PORTFOLIO, AN OPPORTUNITY FOR WINGSYS..... | 16 |
| FIGURE 4-2 WINGSYS POSITIONING ONLINE | 17 |
| FIGURE 4-3 WINGSYS 2020 CATALOGUE | 18 |
| FIGURE 4-4 WINGSYS POSITION IN TERMS OF PRICE/ QUALITY VS COMPETITORS IN INTERACTIVE SCREENS | 18 |
| FIGURE 4-5 5WS EXERCISE ON WINGSYS PLACE..... | 19 |
| FIGURE 4-6 WINGSYS PORTFOLIO STRUCTURE | 20 |
| FIGURE 4-7 WINGSYS SERVICES PORTFOLIO | 22 |
| FIGURE 4-8 WINGSYS SUPPLY CHAIN | 22 |
| FIGURE 4-9 WINGSYS WAREHOUSE AND STORAGE ORGANIZATION | 24 |
| FIGURE 4-10 LAYOUT DISTRIBUTION AND DYNAMIC WITHIN FACTORY..... | 25 |
| FIGURE 4-11 WINGSYS´ VAN | 27 |
| FIGURE 4-12 WINGSYS CAPACITY BLOCKAGES ACCORDING TO LEAN 8 WASTES | 29 |
| FIGURE 5-1 STRATEGY OVERVIEW FOR CAPACITY INCREASE OVERVIEW | 30 |
| FIGURE 5-2 PROJECT EXPECTED 1 ST LEVEL TIMELINE..... | 32 |
| FIGURE 5-3 DETAILED TIMELINE ACTION 5Ss | 36 |
| FIGURE 5-4 DETAILED TIMELINE ACTION LAYOUT AND FLOW SOURCE: SELF-MADE..... | 37 |
| FIGURE 5-5 NEW PRODUCTION AREA LAYOUT AND DYNAMICS..... | 38 |
| FIGURE 5-6 NEW WAREHOUSE ORGANIZATION PROPOSAL | 39 |
| FIGURE 5-7 DETAILED TIMELINE ACTION SUPPLIERS´ AND INVENTORY REVIEW | 42 |
| FIGURE 5-8 DETAILED TIMELINE ACTION PRODUCT DESIGN PROCESS..... | 43 |
| FIGURE 5-9 DETAILED TIMELINE ACTION TRANSPORT SERVICE | 44 |
| FIGURE 5-10 DETAILED TIMELINE ACTION INTERNAL COMMUNICATION STRATEGY | 44 |
| FIGURE 5-11 DETAILED TIMELINE ACTION MARKETING STRATEGY (SOURCE: SELF-MADE) | 45 |
| FIGURE 5-12 ORDER ONLINE TO BE FLOWCHART | 46 |
| FIGURE 5-13 DETAILED TIMELINE ACTION INTEGRATE CUSTOMER IN WINGSYS OPERATIONS..... | 46 |
| FIGURE 8-1 MHZ SOLUTION..... | 58 |
| FIGURE 8-2 FERROFLEX SOLUTION | 58 |

Production capacity Increase - Wingsys

| | |
|---|----|
| FIGURE 8-3 FLEXIDOOR SOLUTION | 58 |
| FIGURE 8-4 TOYOTA FORKLIFT SOLUTION..... | 59 |
| FIGURE 8-5 YALE FORKLIFT SOLUTION | 59 |
| FIGURE 8-6 LINDE FORKLIFT SOLUTION..... | 59 |
| | |
| TABLE 2-1 CAPACITY LITERATURE TAXONOMY..... | 7 |
| TABLE 4-1 INTERACTIVE TECHNOLOGY PESTEL ANALYSIS FOR WINGSYS | 13 |
| TABLE 4-2 WINGSYS ANALYSIS ON PORTER´S FIVE FORCES | 15 |
| TABLE 4-3 PORTFOLIO DISTRIBUTION PER TYPE OF PRODUCT | 20 |
| TABLE 4-4 WINGSYS SOFTWARE PORTFOLIO | 21 |
| TABLE 4-5 VSM ANALYSIS RESULTS PER TYPE OF EQUIPMENT (LOAD= 1 UNIT)..... | 26 |
| TABLE 5-1 KPIS PURPOSED AND CONNECTION WITH STRATEGY ACTIONS..... | 34 |
| TABLE 5-2 ACTION 5Ss SUMMARY AND TO DO LIST..... | 35 |
| TABLE 5-3 ACTION LAYOUT AND FLOW SUMMARY AND TO DO LIST | 36 |
| TABLE 5-4 ACTION SUPPLIERS´ AND INVENTORY REVIEW SUMMARY AND TO DO LIST | 42 |
| TABLE 5-5 ACTION PRODUCT DESIGN PROCESS SUMMARY AND TO DO LIST | 43 |
| TABLE 5-6 ACTION TRANSPORT SERVICE SUMMARY AND TO DO LIST..... | 43 |
| TABLE 5-7 ACTION INTERNAL COMMUNICATION STRATEGY SUMMARY AND TO DO LIST | 44 |
| TABLE 5-8 ACTION MARKETING STRATEGY SUMMARY AND TO DO LIST..... | 45 |
| TABLE 5-9 ACTION INTEGRATE CUSTOMER IN WINGSYS OPERATIONS SUMMARY AND TO DO LIST..... | 45 |

1. Introduction

In times of global uncertainty, when all business areas are dueling with fierce competition, as a result of global and more than ever democratic digitalization, it is necessary and relevant to rethink production capacity in a holistic way. Without ever forgetting the external stakeholders and naturally the customers, it is often in the internal stakeholders that the key to unlock higher revenues, while reducing costs and waste, can be found. Leveraging the internal competitive advantages, that might be hidden in a loyal employee, and correcting internal weaknesses hidden in a “it has always been like this” comment, are key to develop a well-known brand, that naturally leads to higher demand, and hopefully, higher profits. By using essential concept of *towards Gemba mindset*, or the *Three Reals - Real Place, Real Situation, Real Parts* (Suzaki, 1993) and the Value Stream Mapping lean technique, the potential improvements will be mapped, analyzed, reworked, and tested, to ultimately create a Plan and the Strategy for Capacity Increase in Wingsys. Productivity and competitiveness will be the ultimate targets. This chapter raises the main questions, sets the goals and the main milestones of this thesis. For the sake of organization and information continuity it also clarifies the reasons for the thesis structure.

1.1. Problem statement

In it is 25 years of experience as Famasete, Wingsys, has created a team with competences to build fully interactive solutions that go from simple kiosks to full interactive tables. In today’s context these products are, and will increasingly be, more than relevant to all different kinds of businesses, services and even households. We all want to get and send information as soon as it exists, thus interactive is and will be more and more necessary, and Wingsys has proven that they can make it happen. The problem is that amid so many opportunities, Wingsys is not ready to answer to more demand, production is finding a lot of difficulties to answer an order higher than 20 units per month, leading to very long lead-times and less customers that can be served. The problem that Wingsys has is very complex. It touches concepts as broad as competitiveness, supply chain, operations, and strategy, to very detailed and technical, as how can a factory effectively increase its production capacity, while keeping or improving its quality, time to serve, costs/ savings and price levels. Furthermore Wingsys, is competing with brands as Samsung, Microsoft, Multiclass, C&T, Epson, and many more doing the same kind of products, to the same target population. Thus, adding to the technical question regarding how to increase production capacity in Wingsys, further questions arise, such as: What kind of capacity is needed: people, machines, output rate, competence, all? Is it possible to achieve higher production capacity with the current human resources, processes, and physical space? Can they aspire to answer effectively to industry 4.0 challenges and opportunities? How competitive can Wingsys be? Is Wingsys

ready to compete with other companies doing the same? Which ones? How can Wingsys achieve higher production capacity?

1.2.Objectives e milestones

The main goal is that in the end of this document, Wingsys will find relevant solutions that can be effectively implemented and that will allow the production capacity to increase in a level that is sustainable, cost-efficient and a win-win between the company, its personnel, and its customers.

In this sense, the milestones are: *Know Wingsys and its products*: Map the competition, map using Value Stream Mapping (VSM) technique the production's process and routines based on the company's internal documentation, including the seven wastes of Lean (Suzuki, 1993); *apply towards Gemba mindset and VSM*: use the acquired knowledge during the Master's, do desk research and then apply it to a real-life case; and create a *holistic proposal for capacity improvement* and *Validate the proposal with Wingsys*: includes the order planning, execution, shipping, and overall communication. The proposal will aim to include actions in terms of layout, cycle time, management of waste, flow, and internal and external customers. *All* solutions will be validated in strict collaboration with Wingsys team.

1.3.Thesis organization and structure

To reach the goals the thesis is organized in six chapters, namely:

- Chapter 1 raises the main questions, sets the goals, it also clarifies the reasons for the thesis structure;
- Chapter 2 aims to answer the questions: why Wingsys needs a capacity increase Plan and Strategy, thus will focus on the theoretical part of this thesis, as it consists of the literature revision, the essential concepts and ideas that will be used to identify the challenges and find potential solutions;
- Chapter 3 contains a description of the methodology selected to explore the challenge and reach the results.
- Chapter 4 and chapter 5 include the analysis results and the purposed action plan to reach the needed capacity increase plan and strategy; Chapter 4 corresponds to a full analysis of the case study, exploring all details from products, marketing strategy, supply chain to the internal organization in terms of organogram and of operations. This chapter will answer the questions: what needs to be analyzed. Chapter 5 will present the road map to answer how will the company reach its goal, what parts should be safeguarded and what parts should be under scrutiny, what are the potential impacts of adjust and/ or change?
- Chapter 6 closes the thesis with considerations and recommendations for the next steps, looks on what was and what is still to be done.

2. Literature Review

2.1. Productivity and Competitiveness

Productivity is an overall measure of the ability to produce a good or service. More specifically, productivity is the measure of how specified resources are managed to accomplish timely objectives

as stated in terms of quantity and quality (Yadav et al., 2015). It is a concept that is defined by the resources that are necessary to use (inputs) to achieve a determined process (output). (Dias Lopes et al., 2020). It is always objectively

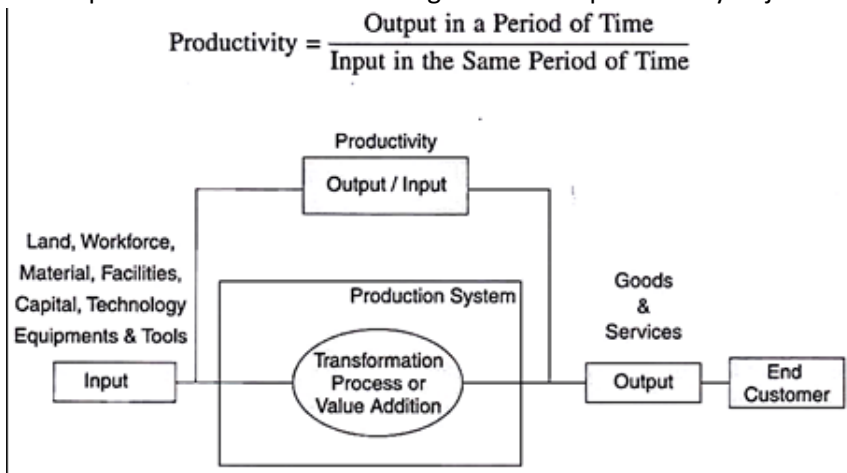


Figure 2-1 System Concept of Productivity
Source: *Economics discussions*

measured, and can be represented in value, volume, quantity, energy consumption, or in a combined unit of measure that results from the combination of factors. It is represented by formula $P(\text{productivity}) = O(\text{output}) / I(\text{input})$. It can appear at a small scale of a production line, to a macro scale of a country, a region, or a continent. Productivity measurement can be, a) partial, if not all inputs and outputs of value creation are considered, and b) total, if all inputs and outputs of value creation are considered when calculating productivity, in which case all parameters must have the same base for calculation. It can be absolute or relative to certain investments or certain context impact. Productivity becomes also more complex to measure in direct proportion of the production operations characteristics.

It is important to investigate this concept, *as productivity values heavily an efficient management of resources (...) and this brings competitive advantages. (...) Bigger productivity means higher capacity to do more with the same resources.* (adapted from Dias Lopes et al., 2020).

Competitiveness is a concept often mixed with productivity, which can be understandable as both are measurement used as a basis for comparison between co-workers, companies, countries, regions, etc. The World Economic Forum has defined it in 1970 as “the set of institutions, policies and factors that determine the level of productivity of a country”. Anca (2012) defines it at micro level as a firm’s ability to compete, to grow and to be profitable, [that is] the firm’s capacity to produce in a profitably manner goods that should correspond to an open market requirement. For the author of Literature Review of The Evolution of Competitiveness Concept, there is still not a common view with respect to

the concept of competitiveness, however there are common features such as: the definition must comprise the *ability of selling on the international markets and the effective competition at a global level*. For all the above the conclusion is while productivity is about internal conditions and capabilities, competitiveness is always a dichotomy between internal capabilities vs. external challenges, being that one of the companies is the target to aim to, competitiveness is an endless marathon to always achieve more and better, even if a certain company is the reference. Furthermore, it is also clear that both concepts are very complex to define, calculate, and especially sensitive as they reflect the value of the subject or company that is being evaluated in terms of wealth and, therefore life expectation.



Figure 2-2 Portugal's position vs. competitors
Source: Portugal Productivity Report (2019)

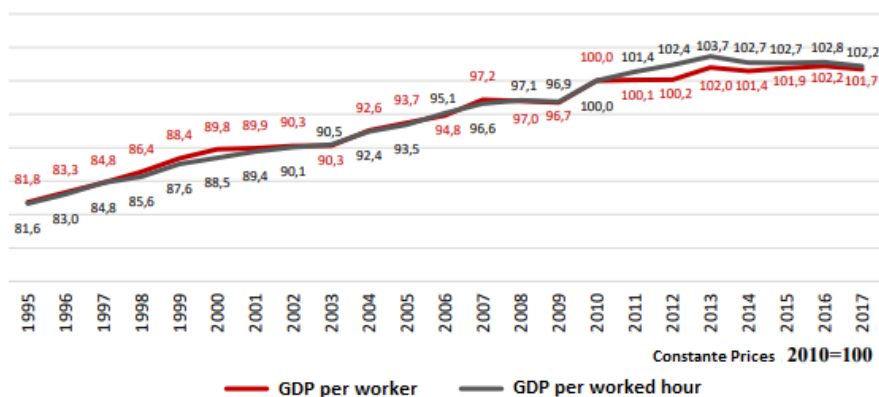


Figure 2-3 Portugal's productivity evolution 1995 – 2017
Source: OCDE and Portugal Productivity Report (2019)

To justify why this thesis is crucial it is also important to understand the status of both concepts in Portuguese economy, and more specifically in the business area of Wingsys.

According to the first Portuguese Productivity report (Deloitte, 2019), in terms of infrastructures, general competences, and abilities to innovate, Portugal has one of the highest readiness ranks to adopt Industry 4.0 from 45 countries analyzed, but its industry has one of the lowest scores in the Manufacturing Global Competitiveness index, which means that its industries are far from ready to be efficient and, therefore, competitive. This is partially explained in the documentary from the Portuguese public media RTP (2000) where it is stated that decades of internal protectionism and dictatorship during the XX century created a delay of decades, excluding some small exceptions, in the industry's processes and creativity to the rest of the developed countries. Analyzing Figure 2-3, the numbers reveal a positive trend in the values of productivity both per worker and per hour worked,

which means Portuguese are creating more value with the same time, if compared with 1995 figures. According to the first productivity report, this growth is above to the Euro average pace, which is crucial due to the distance between the level of other EU countries and Portugal. Looking a bit deeper into the report the important notes are that C26, production of IT equipment, the sector where Wingsys operates, is one of the few in counter cycle and also presents a very high heterogeneity within the sector levels of productivity, which notes a lack of standardization and cooperation between the companies. From the above several conclusions can be reached: the overall positive trend denotes an

investment in people's education and training, but also in the way of producing and the products produced, except in Wingsys business area. Wingsys sector of activity needs common best practices, which

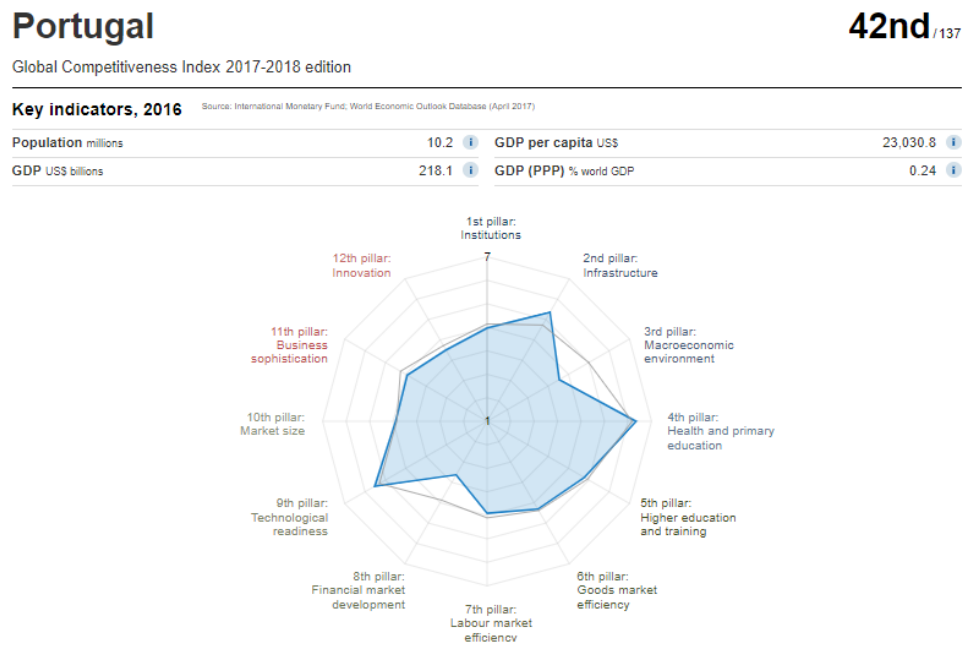


Figure 2-4 Portugal position overview in the GCI (2017-2018)
Source: World economic Forum report

we hope to set a base within this applied management field work. Other conclusion in terms of productivity is that the Portuguese market needs more of the products that Wingsys can produce, therefore the capacity increase is highly relevant and Wingsys products can have a high impact in the Portuguese economy.

In terms of competitiveness, Portugal is found not so high in the Global Competitiveness Index of WEF (42/137) as shown in Figure 2-4, being the areas of *Business Sophistication*, that have countries like Japan in the top spots, and *Innovation*, pulling the scores down. Both, once again, areas that Wingsys products can help with, but for which the internal capabilities must be revised.

It is also important to mention industrialization 4.0, that consists of merging high-technology equipment, with the latest developments in communication and full digitalization of economy and society. The country has a great opportunity to catch up with the latest industrialization era and fulfill a big gap to the most modern ways of producing. This means reach the latest level of communication and cooperation between man and machines, by combining information, equipment, logistics and products systems. It is also a great opportunity for Wingsys to leverage the need for their products

and set an example starting in its own factory. In the actual Covid pandemic, a fast-forward speed has been set, as the confinement obliged all businesses to use digitalization and remote communication to keep close to their latest customers and find new ones. This massive event brought a lot of old-fashioned companies to a closure or a very hard time, but also gave the opportunity of businesses of all sizes to be competitive, find better ways to do their business, revise their position in the market and find how to be more competitive. By looking into their advantages companies are increasing speed, convenience, and good service to their customer – which are increasing as the attention to detail and pressure to get good service from the first contact is highlighted due to scarce access to multiple options and less available monetary resources. Furthermore, to this context and trends, the Portuguese Government has also put in their priority agenda of PRR (*Plano de Recuperação e Resiliência* – Recovery and Resilience Plan) for the next 5 years the digital transition in a clear message that Portugal must speed up the increase of digital competences of its population, and, especially producing enterprises – with special attention to actions for Companies 4.0.

2.2.Capacity

Capacity is the capability of a worker, machine, work center, plant, or organization to produce output during a specific amount of time. Therefore, capacity it is a rate, not a quantity. It can be measured in different phases of the process or the full process. It is defined in two sub parts: the capacity available or installed,

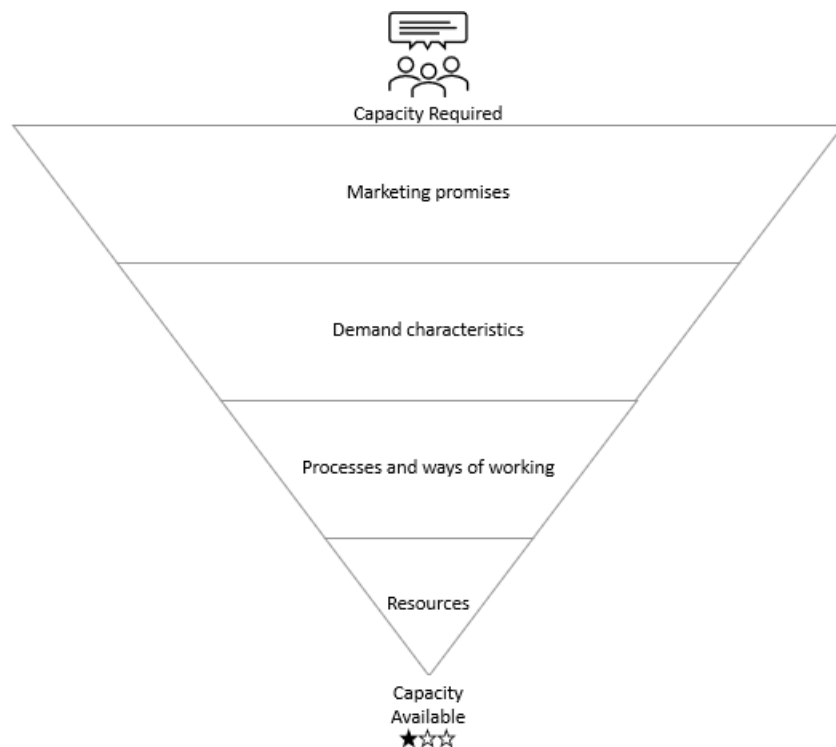


Figure 2-5 The capacity funnel
(self-made based on literature review)

which refers to the capability of a system or resource to produce a quantity output in a particular period; and the capacity required, which is the capability of a system or resource needed to produce a desired output in a particular period (APICS Dictionary, 16th Edition). Production capacity limits the income when the products are in high demand but increases the potential cost during times of low

demand (Xu et al., 2020). From the above we step away from the discussion of what capacity is, to discussions are around *how* to secure that the capacity required is met in the available/ installed capacity, meaning that the discussions around this topic are around: productivity/ efficiency, competitiveness, flexibility, and reduction of bottlenecks as much as possible. These discussions are therefore under not only financial parameters, but also, and mostly, general operations management, specifically capacity planning, and production plans execution.

As the literature around this topic is vast and complex, the summarized taxonomy Table 2-1 was created to list the factors that are being considered essential from different authors in different approaches to the topic. The table shows the crucial factors that must be considered when analyzing the available capacity and the options that exist to reach a new capacity level.

*Table 2-1 Capacity literature taxonomy
(Sources: identified in table)*

| Author | Year | Factors influencing and determining the capacity available | How to solve? |
|------------------------------|-------------|--|---|
| Pinto | 2010 | Installation and equipment (quantity, type, and layout) Human resources (quantity and training level) Product (mix, design, and way of building up) Installed technology (quality and engineering) Organization and Management Know-how and existing experience in the organization Production method maturity Demand characteristics | Production planning Evaluate long-term strategy, impact on employees, and fit with competitive environment Production levelling Change in technology Lease or subcontracting Reschedule orders Increase system and human resources flexibility Differentiate between mature and new materials Evaluate the whip effect on connected production capacities (e.g., Raw material) and equipment Create a continuous evolution rhythm instead of a big-bang effect Synchronize capacity with demand Identify the optimal operational level Eliminate bottlenecks (Theory of constraints) Implement shop floor control systems (e.g. Kanban) Implement Lean Thinking |
| Castelo-Branco Soares | 2010 | Production planning systems Communication between stakeholders Governmental regulations Union agreements Sub-supplier capacity Staff tasks and training Installation and equipment (quantity, type, maintenance needs, and layout) Product (mix, design, and way of building up) Material and quality management systems | Find optimal production levels Leverage economies of scale Identify real capacity utilization percentage and create a buffer percentage Focalize capacity targets (reduce and focus only on a reduced amount of KPIs to achieve) according to the company strategy Capacity levelling Increase flexibility in human and equipment resources Time Study Implement complete quality control systems |
| Chadha | 2017 | Forecast volume Demand characteristics Uncertainty of capacity requirements Time horizon to fulfill demand Human resources (quantity and training level) Installed technology (quality and engineering) Productivity level Overall Business Plan and strategy, such as expansion objectives | Lease or subcontracting Increase Human resources in quantity or in hours laboring Change in technology Alter or level demand (quantity, timing, pattern) Eliminate bottlenecks (Theory of constraints) Identify economies of scale Evaluate long-term strategy, impact on employees, and fit with competitive environment |
| Dias Lopes et al. | 2020 | Demand characteristics Time horizon to fulfill demand Restrictions from both supply and demand sides Division of tasks Human resources (quantity and training level) Production efficiency | Theory of Constraints Sequencing Quality and maintenance control systems |

| | | | |
|-------|------|---|---|
| | | Flexibility of the Production line Coordination between phases of production Idle time management | |
| APICS | 2021 | Manufacturing process layout and type Manufacturing philosophy (set of guiding principles, strategy and attitude when communicating goals, plans and policies) Demand characteristics Time horizon to fulfill demand | Production levelling Lean level scheduling and takt time Theory of Constraints |
| | | Restrictions from both supply and demand sides Flexibility of the Human Resources Possibility to lease more equipment and/ or subcontracting Setup and run time Flexibility to reschedule orders | Lease or subcontracting Increase Human resources in quantity or in hours laboring (over-time) Reschedule orders |

From the analysis of Table 2-1, it is possible to understand that the authors don't have an unique template to follow, however there are some common points that should be highlighted:

- It is important to have a holistic view on the capacity needs - namely integrate it with strategic goals of the company, identifying if the effort to achieve is worth the investment, have more in mind then small silos. Capacity rate is a result of multiple factors as it can be seen in the simplified summary of Figure 2-5.
- Demand planning and control is key - a good follow up on trends, a close connection with the customer to understand the needs and the flexibility, are, ultimately, key factors not only to prepare materials and capacities, but also when dealing with troubleshooting and deviations to initial plans,
- Declared installed capacity doesn't mean that it is the maximum that the company can produce during a period, a deep and detailed analysis of how the production process is defined, how

FIGURE 4.1

General Motors Framingham Assembly Plant Versus Toyota Takaoka Assembly Plant, 1986

| | GM Framingham | Toyota Takaoka |
|---------------------------------|---------------|----------------|
| Gross Assembly Hours per Car | 40.7 | 18.0 |
| Adjusted Assembly Hours per Car | 31 | 16 |
| Assembly Defects per 100 Cars | 130 | 45 |
| Assembly Space per Car | 8.1 | 4.8 |
| Inventories of Parts (average) | 2 weeks | 2 hours |

Note: Gross assembly hours per car are calculated by dividing total hours of effort in the plant by the total number of cars produced.
 "Adjusted assembly hours per car" incorporates the adjustments in standard activities and product attributes described in the text.
 Defects per car were estimated from the J. D. Power Initial Quality Survey for 1987.
 Assembly space per car is square feet per vehicle per year, corrected for vehicle size.
 Inventories are a rough average for major parts.

Source: IMVP World Assembly Plant Survey

resources are allocated, how machines are set to work can identify several potential improvements without massive infrastructural investments.

2.3. Value Stream Mapping (VSM)

Value Stream Mapping is a comprehensive technique that looks both in the detail of the processes and also how the organization is involved in such process. It was created in the scope

Figure 2-6 Comparison of similar factories effectiveness with and without Lean production
 Source: Womack et al. (1990), page 81

of Lean by Toyota. Lean manufacturing or Lean Production concept appeared first time in 1990 by Womack et al. in an investigation to understand the reasons for the World to be facing a massive overcapacity crisis. For this goal the authors looked into the two fundamental ideas regarding automobile manufacturing: United States massive production from Ford and Toyota Production System as known as Lean production system. Lean Manufacturing or Lean Production is a complex set of methods to achieve less waste and costs, maximize productivity and ensure continuous improvement. From the many solutions and methods that are identified in Lean Manufacturing (Pinto, 2010), VSM is chosen as the ultimate visual tool. VSM is generally understood in literature as one of the most complete techniques to identify, analyze, and communicate non-adding value activities in current processes, in this case production processes, but also the potential improvements. The visual manner, resembling a flow chart, of complex processes, including information flows and cycle times per step, can be summarized in a one pager, which makes it a powerful tool to support comprehensive, but also fast and simple, management decisions (Andreadis et al., 2017). To use its specific symbols, ways of displaying information and flows, some training is needed for both the person drawing the chart, but also the ones reading the information and taking decisions. Furthermore, the team drawing the chart must dedicate some time to understand the processes, identify and interview the stakeholders and draw a comprehensive chart to mirror the process as accurate as possible (Helleno et al., 2015). Despite the time and training needs, VSM is considered in the literature, simpler, and easier to learn and use, when compared with some of the most essential lean tools such as JIT, TPM and Jidoka (Rocha-Lona et al., 2013 and Belekoukias et al., 2014). It enables the analyst to move away from big word documents to a tool that can be easily adjusted and that also supports continuous improvements. Dinis-Carvalho et al. (2014) agrees by stating that the aim of VSM is not just to identify the waste shown in the current state map, but also to eliminate it through generating an efficient future state map and implementing its indications.

Despite all the advantages Andreadis et al. (2017), emphasizes that VSM is great at initial stages, but must be used together with other lean techniques to enable understand and solve the root causes of waste, prioritize where to act first and understand the possible consequences, up and downstream, when a part of the process is adjusted. Bjornfot et al. (2011) indicates that VSM cannot handle complex systems, it is for high volume and low variety products, it doesn't give details of the layout and it doesn't support rapid changes on a low budget. As any chart it is not supporting answering the how to solve, but only identifying the what and the where to solve. Helleno et al. (2015) also highlights that VSM must be also read as a screenshot of the factory at a particular moment. However, as a starting point of a continuous improvement process, the initial map is considered the best-known image of the processes as-is, and that the goal is always to make a proposal that is possible to execute with existent resources (technical and human). Dal Forno et al. (2014) calls upon the attention to the fact

that VSM studies often try to create in the first drawing the right map, which emphasizes the need to have an independent person analyzing and drawing the as-is map, to allow to access the many advantages of stepping back from the daily work, having transparency of the state of art, and putting full focus on solving the factors that are not creating value and decreasing competitiveness.

Other warning in literature relates to the need to have management commitment and involvement, training, organizational culture and infrastructure, financial capabilities, and employees' skill and to enable a successful implementation of the findings from the VSM. Which is also true for any type of intervention that is touching the company way of working, there must be a complete involvement of all stakeholders from the way the work is processed to the way the work is thought. Wingsys is checking all the boxes when it comes to the last warning point, thus VSM is considered adequate to analyze, identify and create the steps to reach a higher production capacity.

With all pro's and con's, natural in any kind of technique, the literature shows that VSM has made a substantial contribution to reduce overall waste in processing time, lead time, machine utilization and overall production processes, man power utilization, and also reduces work in process, cost of poor quality, in-process rejections, distance travelled and percentage scrap (Jeyaraj et al., 2012) which will lead to our goal of finding opportunities to increase production capacity, whilst keeping high quality standards and high service level to the end customers.

3. Methodology

To solve the challenge placed by Wingsys four major stages were followed to build up the needed plan and strategy:

1- Analyze the as-is. In this phase a quantitative and qualitative research is pursued. It includes the study of the processes already existing in Wingsys, the organogram and the products in detail. Online information of competition's products is also analyzed to identify where Wingsys is positioned in the market. In this phase, deep research in terms of literature to sustain the thesis is also done. This phase allows to identify the best practices, products, and people, but also to start drawing the initial VSM.

2- Identify the improvement potentials. This phase is initiated with field visits to the Wingsys factory (in Vila Nova de Famalicão) and showroom (in Lisbon). These visits are necessary to practice the most valuable Lean principle, the Gemba walk, or learning by visiting where value is created, asking questions, interact with the people responsible to add value, listening and learning. This step is fundamental to understand phase I analysis, meaning going from paper to reality to understand the infrastructures, the organization, the decisions that created the as-is, know the people face to face, gain trust, and ask for their commitment and support in this transition. The visits allow to carry an intensive hands-on experience in the production area by identifying how the warehouse is organized and the reasons for this organization, carrying several interviews with I&D, Marketing, Commercial and Finance departments that help to clarify several specific questions from phase I and collect more data to answer specific questions towards competition and customer service. During these days there will be also an opportunity to show presentations with the goal, the methods and the intention of the field visits and this applied thesis in their daily work, which supports basic step 1 of lean methodology – involve the people that will be impacted by the proposal/ actions. By the end of these visits a new visit will help to validate the initial VSMS and identify the improvement points. To sustain phase 3, phase II will also include root cause analysis. Techniques 5whys, the fish-bone diagram and layout analysis will be performed to clearly identify the start position of the strategy.

3- Define the road map to solve the challenge. In phase III the solution is drawn to answer Wingsys need for increasing production capacity. Taking as base phase I and II, a comprehensive plan will be created with Specific, Measurable, Achievable, Relevant and Time-bounded (SMART) actions, organized in the order that lean management sets implementation to be done. In this phase a project Gantt chart proposal and the future VSM will be designed.

4- Identify further recommendations to allow continuous improvement. Due to time limitations, most of the proposals will not be possible to implement and monitor until the conclusion of this document, however phase 4 will highlight the recommendations and the further steps to be taken by order of importance to achieve higher productivity and competitiveness.

4. The case-study Analysis

Looking around our daily life of things we all hate: Burocracy, excessive energy consumption, waiting times, outrageous efforts to get simple information and get simple things done, that one's unique needs and preferences are not considered, service is indifferent, as a customer is just one more in the crowd. The answer has been found by IT developers, social media, some services like banks, and some businesses like communication providers: being able to communicate and receive communication anywhere, in the minute it is needed or available to the specific preferences of a customer. The World of industry 4.0 is expected to be decluttered from all extra time to communicate, serve, and be served. But being the Portuguese industrial context one of the most delayed in the World, this chapter links the literature review findings with a deep and holistic analysis of the case study – Wingsys reality.

4.1. Introduction to Wingsys

Famasete, the original name of Wingsys, was born in 1995 as a main national distributor for IT interactive equipment. After a few years, their activities expanded to distributing interactive boards and providing technical assistant to educational institutions. Was only in 2009 that Famasete created the first interactive multi-touch table in Portugal. In 2020, just before changing to Wingsys, Famasete, counted 25 years of experience and existence as a producer in Portugal of multi-touch interactive screens and tables, digital advertising panels and multimedia kiosks. Their I&D activities awarded them several national and international prizes and recognitions, being the biggest one the Best Producer of national interactive systems by the National Innovation Agency (ANI). Since 2012, the brand has reached 8 countries, where they relate to more than 4800 customers.

Wingsys was created by Famasete in 2004 to designate the portfolio of interactive solutions produced internally.

In 2020 Wingsys and Famasete were combined the unique brand name that is the subject of this thesis. The company aims to continue the path of its initial brand name and be continuously recognized by the quality, flexibility, service mindset and passion in each project, which is reflected in its mission: to create innovative technological solutions so that everyone could have access to the advantages and opportunities that these provide; its values: Innovation, Quality, Humanity, Simplicity, Creativity and Sustainability; and its vision: Provide impactful experiences through interactive technology¹.

However, the pandemic context that meanwhile shocked all businesses and countries, and the consequent closure of crucial fairs and innovation events, created challenges to showcase the portfolio and avoided to increase demand for Wingsys production. At the same time this context created a great

¹ Wingsys.pt

opportunity to extend the capabilities of production, Wingsys production and portfolio turned into an interactive technology tailor for its customers.

4.2.Context

The context that Wingsys is operating since the merge of the two brands is, as with many businesses, quite complex and volatile. From one side it has never been more relevant to introduce technology and interaction in all businesses and services, with national and European programs promoting investment in innovation, technology, productivity, and technology. On the other side consumer's behavior is more frequently changing and demanding ever more quality, speed in service and lower prices, which increases uncertainty and risks for any business to invest in any part of the business long-term, let alone produce in advance.

*Table 4-1 Interactive Technology Pestel Analysis for Wingsys
(Source: self-made based on general news and competitors LG and Samsung Pestel analysis)*

| POLITICAL | ECONOMIC | SOCIO-CULTURAL |
|---|---|---|
| <p>Company based in the 4th country in 2021 Global Peace Index</p> <p>Political stability and good international commerce relations with almost all countries in the World</p> <p>Strategic position of Portugal in terms of transport and warehousing, mid-point between America, Africa, and Europe</p> <p>Frequent strikes in ports and outside borders that hinder components and even finished goods from arriving in Wingsys</p> | <p>Worldwide economic crisis out of COVID19 pandemic</p> <p>More need for efficiency in services and businesses, and higher productivity</p> <p>Higher need to customize products due to overall low demand and low available income</p> | <p>The difference in social status affects demand of the products as well as willingness of the people to work</p> <p>Consumer preferences changing in a pace where it can both an opportunity and a threat for this type of business</p> |
| TECHNOLOGICAL | LEGAL | ENVIRONMENTAL |
| <p>Worldwide components scarcity</p> <p>Technology present in all businesses and services</p> <p>Industry 4.0</p> <p>Need for continuous I & D, technology evolving in a very fast pace and becoming obsolete very fast (in a matter of months).</p> | <p>Ethical behaviour more and more relevant in consumer choices</p> <p>Ever increasing need for quality control and certification of technology quality and manufacturing processes</p> <p>Patent based business area, where copies are heavy punished by law</p> <p>Fees and taxes both for trading goods and employees due to EU regulations vs. competition of low income/ low employment protection countries</p> | <p>Sustainability concerns raising to top priorities worldwide from UN to UE forums, overall need consumers prefer brands that continuously work to reduce their carbon footprint and help others do the same</p> <p>Less usage of virgin raw material and support to less usage of paper/ water and electricity both in production, but also in businesses and services in top consumer concerns</p> |

In Appendix A it is clear the importance of the crucial long experience in development of interactive solutions, both software and hardware. The I&D department and the glass lamination chamber are *the* competitive advantages, to guarantee that the company is as agile as a tailor and can answer different kinds of customers and different kinds of needs. This fact was crucial for this company to secure its history and survive the pandemic. The development in record time of the Hygystation is the best proof that this company has all it takes to adapt to changing needs and volatile behavior. On the other side the business model denotes an urgent need to broaden the revenue streams, channels, and customer segment. If Wingsys has secured competitive advantages, it is fundamental to develop the operational structure to gain market share and increase the importance of the brand in the final customer choice, doesn't matter if institutional, corporate, or private.

4.3. Marketing Strategy

From the moment that Wingsys assumed itself as a unique brand, the marketing actions have been expanding towards the best standards in the market. Being present in all most relevant social media platforms and have developed a very high-quality internet page, that is the greeting card of all old and new customers, the company needs to broaden its actions from pure brand communication to specific actions plans towards different segments in the market.

Analyzing Table 4-2 we find that Wingsys is operating in overall a very difficult environment: high competition – with very big companies like LG and Samsung, fast paced and always evolving. In such context, and according to Bolchini et al. (2007), it might be better for companies, institutions, or organizations to produce several low-cost productions in a fast way (in 3-4 weeks), rather than a few expensive ones, perhaps much later (in 8-10 months). *Small, lean, low cost*, hypermedia products can be targeted to different niches of potential users, and/or can deal with *several niches of content*. *Small, fast productions* allow institutions or companies or organizations to react quickly to fresh needs or to catch new opportunities presented by different circumstances and events – e.g., exhibitions for museums, fairs for companies, launch of a brand or new products or service, “just-on-time” promotional tools. Finally, *multimedia productions tend to quickly become obsolete (...)*. Meaning that despite being always relevant in the actual and future context where technology tends to be more and more crucial, the pressure to keep *low prices, high quality, and fast response times are key success factors for supporting Wingsys sustainability for many more years*. However, based on internal documentation and factory visits and interviews, Wingsys has several opportunities to be overall even faster, cheaper, and simpler, especially in their internal manufacturing. The only exception is in the interactive screens, that are sold but are externally produced. Even though this represents circa 50% of Wingsys sales, it also represents low flexibility to tailor-made this solution to the customers' needs, high risk in terms of quality and after-sales needs, and high costs in terms of procurement and storage.

Production capacity Increase - Wingsys

Table 4-2 Wingsys analysis on Porter's five forces

Source: self-made, based on interviews, business area literature and portfolio analysis

| The Threats of Product Substitutes | Bargaining Power of Buyers | The Threat of New Entry | Bargaining Power of Suppliers | Rivalry with existing competitors |
|---|---|--|---|---|
| HIGH | HIGH | HIGH | LOW | HIGH |
| <p>As with the threat of new entry, the threat of having better, faster and leaner solutions is ever present in this industry. Customers are always looking for solutions that can make their life easier, faster, simpler, without spending too much money. When the previous investment is too high and the technology is already not flexible, fast, or has enough features, customers often become frustrated that they couldn't upgrade themselves fast and the brand is often associated to this frustration.</p> | <p>Specially during pandemic times, the buyers had all the power in their hands. Not only competitors existed to serve the customer, but also the demand was very low. In this perspective, Wingsys has a great competitive advantage, the ability to transform itself in "interactive solutions tailor", according to its CEO.</p> | <p>Technology is always evolving; it is one of the fastest growing and changing businesses existing. Also connected with the high rivalry of competitors, this means that Wingsys needs always to be on their top-performance in terms of I&D and response speed. The advantage of the company is that it produces the competitive advantage – the hardware from raw material to finished good, plus the interactive software thus maintaining itself highly relevant for years to come.</p> | <p>Wingsys has maintained its local suppliers of glass and structures for a long time, but the reality is that metal and glass are today common raw materials. Furthermore, such suppliers' are often able to be highly flexible due to the innumerous number of applications of their raw materials. Such suppliers must present high quality and high power of response to Wingsys, which based on interviews during factory visit is not happening</p> | <p>Large number of competitors with much larger bargain power and production volumes, both national and international. Lots of competitors well established in the market, with a very high reputation for developing, delivering, and supporting customers. The only competitive advantage of a company in Portugal vs. an international without national production, would be the transport and border control constraints that in the current context are outstanding.</p> |

4.3.1. Segmentation and Targeting

Looking at the current Segmentation and Targeting strategy in Wingsys, it is important to note that it is not formally defined. According to internal documents, it is based on selective specialization and undifferentiated target marketing. Deriving from traditional business mindset, the main way of reaching the customers is by publicly showing that there are several products available in Wingsys, that can be applied in different contexts (from hospitals to schools and small retail) to try to eventually gain a customer, but without targeting a specific buyer persona. Also being present in education services' tenders, the segmentation of the market is even more crucial to make sure the presence in the market is based on respect for eventual distributors, but also can cater to direct contacts of eventual B2C customers and tenders. The effort since the start was to create a complete offer portfolio



Figure 4-1 Household portfolio, an opportunity for Wingsys
Source: Wingsys catalogue 2020

that can cater to different experiences such as classrooms, *living rooms*, corporate needs, and small businesses. Today online is not being set towards this vision online, which denotes an important improvement potential in the overall marketing strategy and communication. Wingsys' vision is being showcased by a room dedicated to simulating the classroom environment where customers can experience the different dynamics and features of

Wingsys' solutions. However, when customers cannot visit the factory in Vila Nova de Famalicão, or the showroom in Lisbon, there is a risk of losing the customers that cannot see the potential of the portfolio. Especially in a pandemic/ isolation context, where customers are forced or are not comfortable to physically visit facilities and showrooms, it is crucial to increase the customer access to Wingsys, creating experiences online that can showcase the potential of the different products.

Regarding geographical segmentation, there are no specific targets. Wingsys has records of serving customers, both nationally and abroad. Demographically there are niches of customers from Retail to Education customer, both genders and all ages. Despite having household solutions in their portfolio and showroom, private customers are scarce which denote an opportunity to broad the market share and increase demand.

Associated with interactive technology, the psychographic segment of Wingsys' customers is mostly belonging to high education, high social classes and high-income businesses or businessman/women, that are interested in simplifying routines and processes through technology.

Targeting is based mainly on historic public tenders for School's equipment, which represent naturally a high risk in terms of manufacturing as decision and payment processes are long. The marketing material (commercials, mascot, customer's testimony) present online targets mostly

educational usage of equipment, but also supports, with much less volume, businesses with LED, *Hygistations* and Interactive tables. This last target goes from hospitals to fish shops that have investment capabilities to buy such equipment. Wingsys wants to cater to everyone’s needs, and can, but without a specific strategy the portfolio, communication and overall message doesn’t bring special attention from customers, it doesn’t differentiate this company from the many and specially it doesn’t stick in the paying customer’s memory. All great brands are known for something specific, not by their business area, thus it is urgent that Wingsys knows its customers and defines who wants to serve, how and with what. It will bring more effectiveness in marketing campaigns, it will increase customer loyalty and reach more and better feedback, it will support creating/improving the portfolio to serve specific needs from the market and answer the company’s question, what for?

4.3.2. Positioning

The position of Wingsys, derives mostly from most of its values: innovation, quality, humanity, creativity, and sustainability. As a consequence of the lack of Segmentation and Targeting definition, the brand is not on top of customer’s minds, and often is not recognized when referring to interactive technology and solutions. However, there is a great evolution since the beginning of the merged brand in 2020, as the company appears directly in the top search results in google when typing “interactive solutions Portugal”. Due to heavy competition of other brands and no presence in mass retailers, there are several opportunities for Wingsys to be positioned in a higher visibility level.

4.3.2.1. Promotion

The promotion of Wingsys is based on:

- Intensive social media content production ;
- search engine results that lead to Wingsys.pt,



Figure 4-2 Wingsys Positioning online
Source: Wingsys homepage, LinkedIn, Facebook, Instagram and YouTube pages



Figure 4-3 Wingsys 2020 catalogue
Source: Wingsys.pt, after registration

- a printable catalogue, that needs to be ordered with a registry, but also allows to directly have a customer's details for further contacts
- customer's spoken testimony, shared in social media and in the company's official homepage.
- Wingsys also appears in innovation magazines and events, as the unique Portuguese interactive solutions manufacturer.

The effort and intensity of promotion is quite high, with very high professionalism and quality, however as many marketers, like Burkett (2017) would state "everyone" isn't a target audience." In fact, when you target everyone, you're targeting no one. So, it is crucial that general content is transferred to more selected businesses to solve their needs, taking always in consideration the margin and the projection of such project in getting further customers and projects. The goal is continuous

manufacturing.

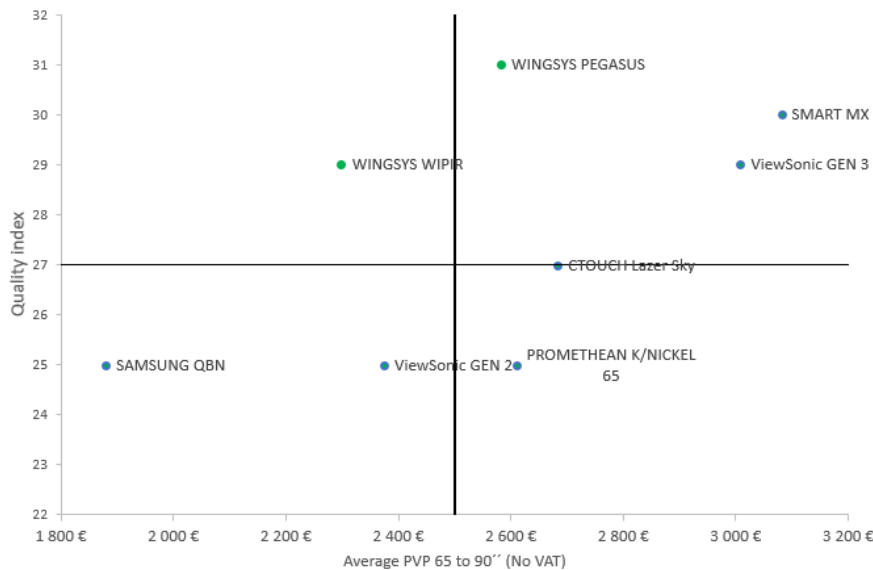


Figure 4-4 Wingsys position in terms of price/ quality vs competitors in Interactive Screens

Source: Wingsys and Intermedia.pt Oct/21)

4.3.2.2. Price

It is very interesting to understand the position that Wingsys products occupy versus the competition in the different equipment types.

In terms of Interactive screens, it is clear by looking at Figure 4-4 how the company

stands out in terms of price/ quality relationship when compared with big brands like Samsung or Promethean. The price is also quite outstanding for all the compared parameters, as it is clear the difference that bringing stock from a far east supplier and then reworking the quality and the software makes in terms of competitiveness.

Regarding Interactive Tables, Kiosks and Advertising Panels, Wingsys is competing with brands like Partteam, Edigma, JCDecaux, NewVision, Esistemas, which have market presence and volumes that are not possible to compare with Wingsys reality. The prices of these brands are not public as most of the solutions are assembled from standard forms and tailor-made to the needs of the customers. In

this type of equipment, the market seems to be very overloaded with aggressive competitors, thus for Wingsys it would be an opportunity to occupy the small businesses segment targeting great customer service and catering to customers that are looking to arrive in industry 4.0 time with fast, simple, and affordable solutions.

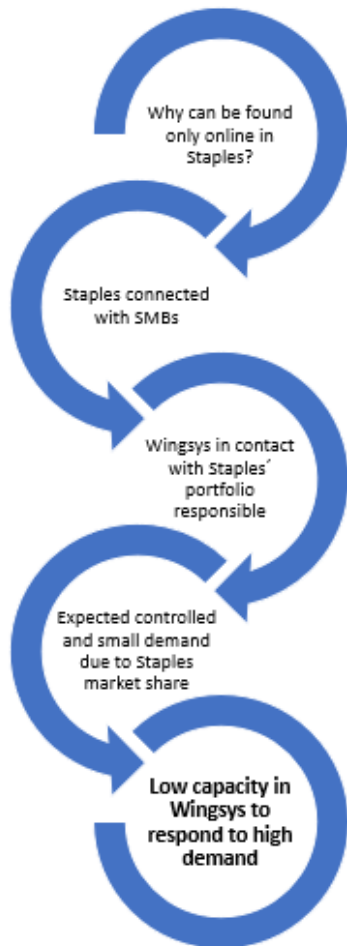


Figure 4-5 5Ws exercise on Wingsys Place
 Source: Self-made based on interviews with CEO and Founder, Oct2021

4.3.2.3. Place

In terms of place, Wingsys cannot be found physically in retail, general or specialized. There is a scarce presence in Staples and Amazon.es, but the products are only possible to order online and are not in stock. The other ways of seeing and experiencing Wingsys portfolio is through a showroom in Vila Nova de Famalicão, a remote industrial village in the North of Portugal, or in Lisbon showroom. When technology fairs were open, these were also crucial events to show case Wingsys portfolio, however with the closure due to the pandemic measures, this important channel was closed. So why aren't Wingsys products in large retail premises? To answer to this question a 5Ws exercise was performed both with the CEO and the Founder of Wingsys, the results can be found in Figure 4-5, where the end point is again the lack of answering capacity from production, validating once again the reason why this department

needs to be analyzed and improved. However, it is important to note that production is not the reason for all, also demand needs to be stabilized in order for production to operate under the most cost-effective mode, thus it is relevant that customer needs are deeply analyzed, and a marketing strategy is built with specific segmentation, targeting, and positioning to aim to.

4.3.2.4. Products

In Figure 4-6 it is possible to understand the multiple functions that the company is catering to with its products. The main portfolio is divided between Interactive devices, LED, and some add-ons. The company is fully focused on its main mission and concentrates 76% of all materials available by Wingsys in interactive solutions, which denotes an effort to stay focused and close to its mission. LED screens and the charging stations are produced externally to Wingsys and after a quality check and a software update to cater to the customers' order, they are directly sold to customers. It is important to

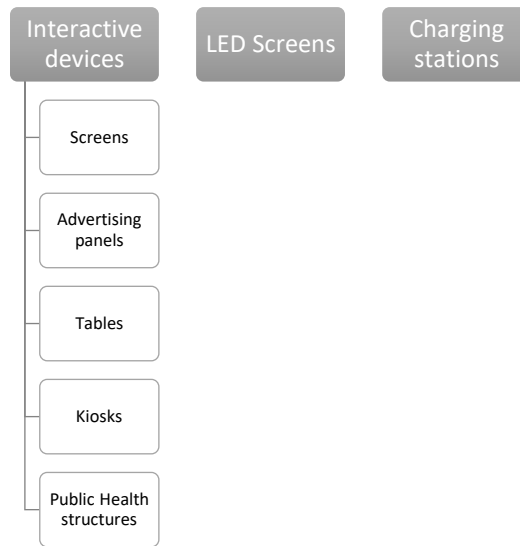


Figure 4-6 Wingsys Portfolio structure
source: 2020 Wingsys customer catalogue

look at the weight per material/ function to understand the complexity, but also the possible interactions between functions and their importance overall in production. As Wingsys wants to cater to all types of businesses and services, it is important to grant the final customer a complete solution, or a solution that is flexible enough to work with other technologies. The company still has room to develop their portfolio in terms of demotics and

Table 4-3 Portfolio distribution per type of product
Source: 2020 Wingsys customer catalogue

interactivity with other apps such as Siri. It is also interesting to understand how the current context has also driven portfolio, with the addition of public health

| Count of Commercial Designation | | |
|---------------------------------|--------------------------|--------|
| Type 1 | Type 2 | Total |
| Interactive device | Kiosk | 12,00% |
| | Public Health structures | 8,00% |
| | Screen | 12,00% |
| | Mupi | 24,00% |
| | Tables | 20,00% |
| LED | Screen | 16,00% |
| Add-on | Charging station | 8,00% |

structures to cater to accesses' control and overall hygiene needs of the public. This shows that Wingsys is once again agile, open, flexible, and very in tune with what the markets needs and wants.

Other than hardware, Wingsys also has an extensive portfolio of software which compliments and supports the customers main needs, this portfolio not only gives purpose to the hardware, but also supports the purchasing process by allowing final users to directly take all the advantages of the hardware with full personalized tailor-made software:

Production capacity Increase - Wingsys

*Table 4-4 Wingsys software portfolio
Source: 2020 Wingsys customer catalogue*

| Designation | Description |
|---------------------------|--|
| <i>Business Composer</i> | <p>Wide variety of configurable options to create interactive experiences</p> <p>Allows to present own content in a multitouch environment, through photos, videos, brochures, and games</p> <p>Allows users to download all content in real time by entering an email contact</p> <p>Wingsys creative department support</p> <p>Can be installed with Wingsys Interactive Tables</p> |
| <i>Smart Point</i> | <p>Interactive information software, with an intuitive and user-friendly system</p> <p>Promotes activities and points of interest such as tourism, culture, local commerce, public services, in any language</p> <p>Can be installed with Wingsys Interactive Screens/ Advertising panels</p> |
| <i>Educational</i> | <p>Ideal for remote or face-to-face classes</p> <p>Offers full access (time and location) to classes developed and prepared by the teacher</p> <p>Only educational software that allows to divide the multi-touch screen into independent zones and multi-custom instructions to the students to improve the collaborative experience</p> <p>Provides a safe environment for online collaboration</p> |
| <i>Object Recognition</i> | <p>Object Recognition Software helps to explore the potential of future retail technologies today. Allows to obtain a presentation through the recognition of pre-programmed objects when they are placed on top of a Wingsys interactive table. The Software identifies the object and opens a specific set of images, videos or catalogs associated with it, in a multitouch environment. Each presentation is completely personalized and customized the business or purpose. The software license includes: four recognizable object bases, four 3D printing product models and content parameterization</p> |
| <i>WayFinding</i> | <p>The Wayfinding software guides the visitor to the intended destination, indicating the best route within a space.</p> <p>Can be installed with Wingsys Advertising Panels or Kiosks</p> <p>Includes quick search features, possibility to add additional interest information, photos, schedules, websites, logos, etc.</p> <p>Can be easily adjusted to match the characteristics and requirements of each company or institution.</p> <p>When on stand-by, the interactive equipment can transmit advertising or other information</p> |
| <i>Digital Signage</i> | <p>Digital Signage Software is a content management solution</p> <p>Supports multiple monitors and accounts, it can be linked to external databases to allow access to the server from mobile devices.</p> <p>Includes a Computer Editor and a Web Editor</p> <p>Simple and intuitive menus and several layout options</p> <p>Supports creating, editing, scheduling, and distributing content on connected interactive screens or Advertising Panels</p> |

The comprehensive service of Wingsys also includes, other than the products, a group of services that are then tailor-made to each customer's needs and budget. This in-house offer of services will support an easy-buy process from the customer, that just needs to choose the product. Further concerns with transport, installation, maintenance, trainings of end-user and after-sales assistant is transferred to Wingsys staff, taking this burden from the customer's shoulders.

Production capacity Increase - Wingsys

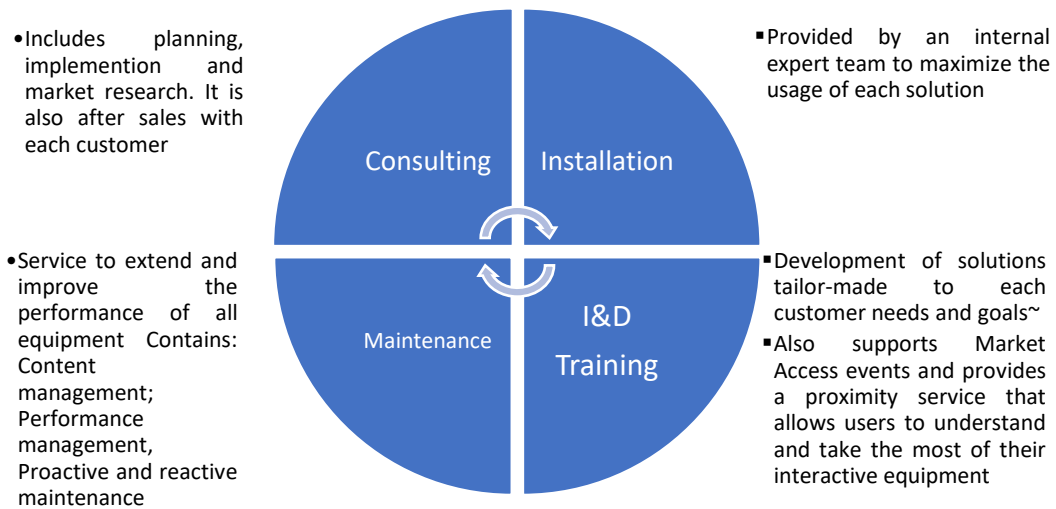


Figure 4-7 Wingsys Services portfolio
Source: 2020 Wingsys customer catalogue

4.4. Operations Management

4.4.1. Supply Chain Overview

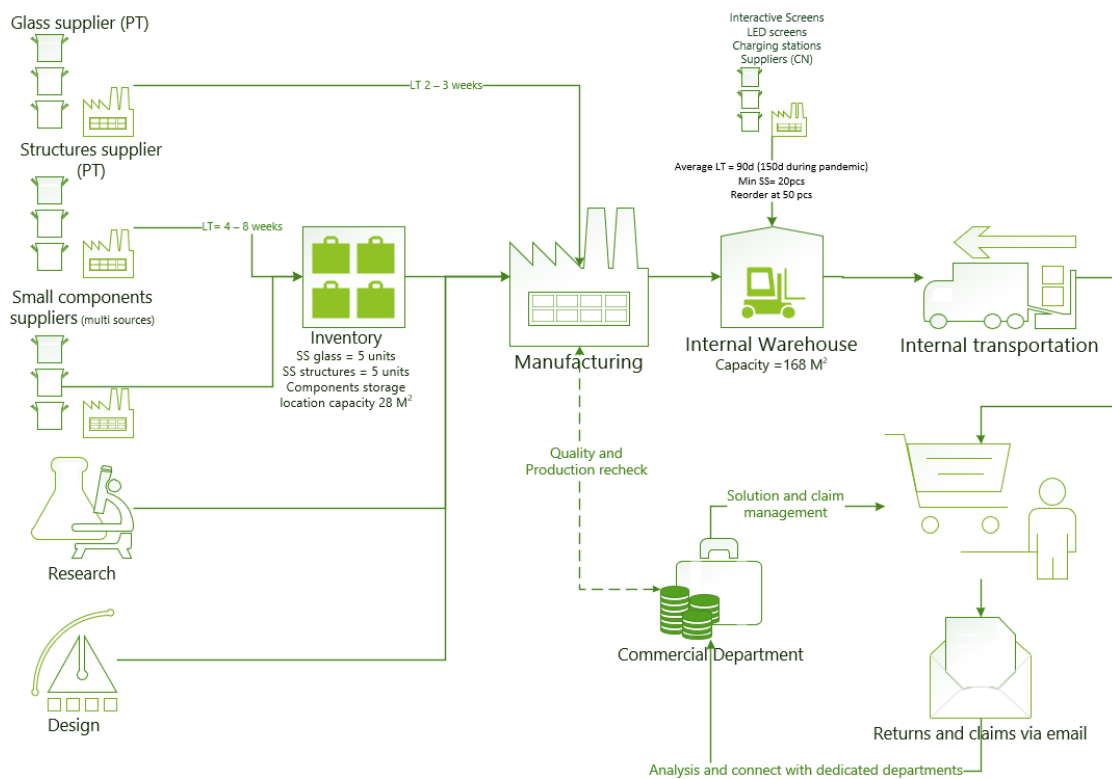


Figure 4-8 Wingsys Supply Chain
Source: Self-made based on factory visit and interviews

Wingsys supply chain is divided in two main groups: one of external sourced finished goods, which supplies the interactive and LED screens and the recharging stations, and one that supports the execution of internally manufactured goods, as Interactive tables, Advertising panels, Kiosks and the *Hygystation*.

The external manufactured goods arrive from China in Vila Nova de Famalicão premises and pass a quality and usability control to ensure that the final customers will receive a proper equipment. The internally manufactured goods have Portuguese suppliers for glass and metal structures (legs, Advertising panels and kiosks bodies).

The Lead time (LT) from the external supplier is in average 90 days, which was extended to 150 days during pandemic confinement period. The internally manufactured goods are supported by local suppliers of glass and structures, which have been designed by Wingsys I&D team, and by several small components' suppliers that support with production raw material like screws, transformers, NUCs, etc. The LT for the glass suppliers is 2 to 3 weeks and for the structures, which include legs for the tables and the Advertising panels and Kiosks bodies, is 4 weeks in case of standards measures, and up to 8 weeks in case of tailor-made projects. The components are bought as needed, in local large retailers according to most immediate needs and availability.

4.4.2. Warehouse and Storage

Wingsys controls and manages their own warehouse and storage where it places not only the externally manufactured goods, but also internal production, material for renting and all components for production.

Wingsys warehouse contains 3 pairs of racks, each with a 7 horizontal x 4 vertical storage location matrix. Other than the warehouse, there are 3 other areas: one for material for rent, another one for packaging that is then subdivided in finished goods to pack, and finished goods packed ready to load to deliver, and the last one where Work in Progress (WIP) like structures are standing by in the floor, between the rack. Regarding the current organization of the warehouse and production area, it is possible to understand that the recent location change, amidst the pandemic time and constraints, and the lack of heavy cargo forklifts to reach the high-level storage locations have created severe constraints in terms of most efficient warehouse organization and floor clearance. Other space that is defined as storage is on the right-side and top right corner of the production area that is dedicated to production components and other small materials, which consists of a rack structure of 7 horizontal x 4 vertical storage locations. Finally, right next to the glass lamination chamber it is possible to find an attempt to create a small supermarket of production components stacked in wall mounted shelves.

In Figure 4-9 it is possible to find the definition of areas in terms of warehouse and storage in Wingsys headquarters.

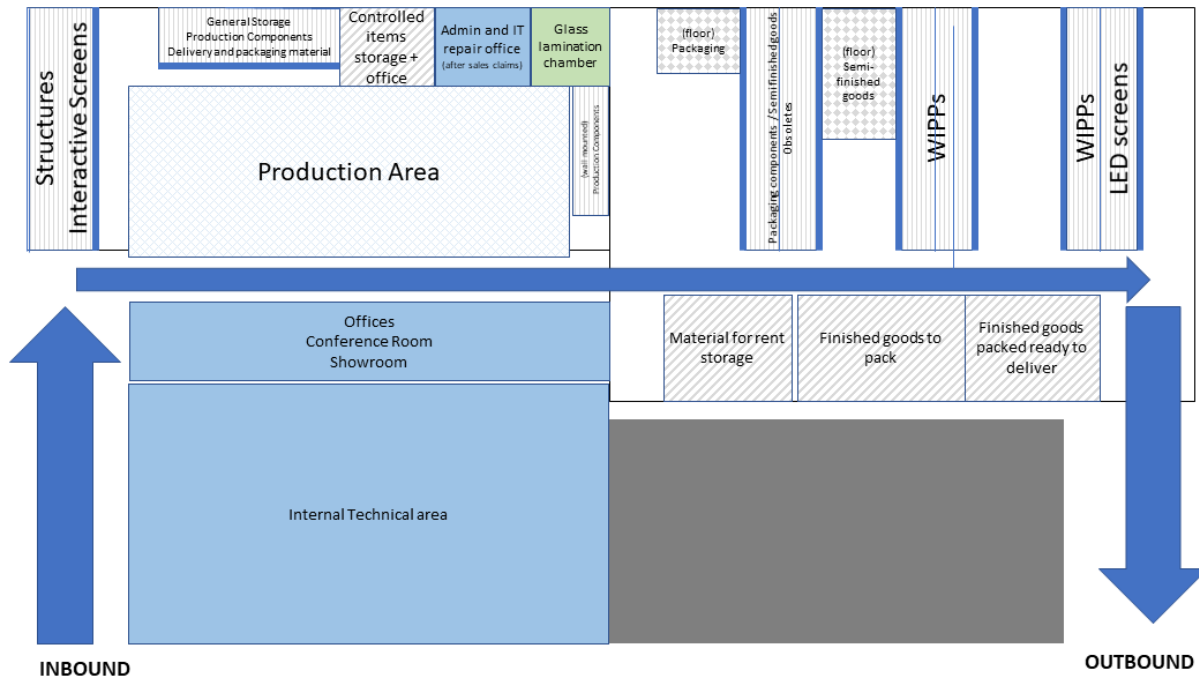


Figure 4-9 Wingsys Warehouse and Storage organization
Source: self-made based on factory visit and interviews

Wingsys keeps a theoretic safety stock of 5 units on glass and 5 pieces of units of structures and 20 pieces on screens, but screen orders are created as soon as stock reaches 50 pieces, which represents a warehouse utilization rate of 30% of the warehouse usage for screens safety stock and 36% of components storage of glass and structures. There is no demand to calculate the coverage that such safety stocks represent, as there is no forecast yet to relate to.

Wingsys doesn't secure an inventory control routine to avoid out of stock risks or too high inventory levels, which creates both a risk of stopping entirely production and increasing Lead time or extraordinary costs both in inventory maintenance and storage.

4.4.3. Production

4.4.3.1. Process type and Layout dynamic

Wingsys has adopted a fixed layout position for its production area, which means that all products are stationed in a particular spot and all activities derive from and to that spot. The process type associated with this layout is frequently of project management, even if the product is standard. This decision has been made due to the very low volumes that need to be handled. As fixed position layout and project management process types are suitable for large production products, like vessels and aircrafts due to

their volume, it is important to note the dynamic that this decision is creating amongst the production area:

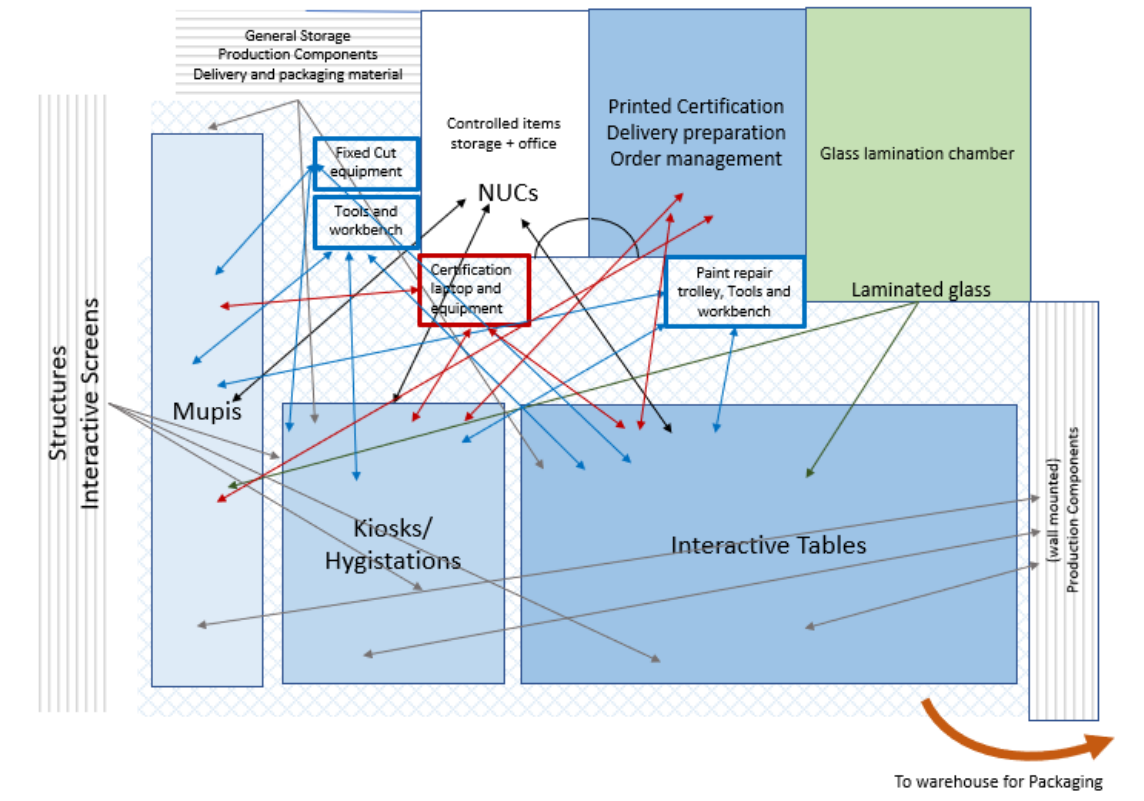


Figure 4-10 Layout distribution and dynamic within factory
(Source: self-made based on factory visits and direct observation)

As possible to understand easily by Figure 4-10 there is very high number of movements and therefore, lost time or according to lean, wasted movement, to pick up the needed components, reach tools or complete tasks. The production areas are informally divided in three subzones according to the product type, which is solid organization and visualization effort. Other important point is that production technicians don't have a zone for components preparation, all work is done by the equipment, which also increases lead-time to finalize the product and increases the number of movements.

The last step is not done within production area: the equipment needs to be moved individually and manually from this area to the warehouse to be packed and moved to the outflow area².

4.4.3.2. Production Process

In this chapter it is possible to understand how chapter 4.4.3.1 reality is impacting the production process times per type of equipment.

² Please refer to Figure 4-9

In Appendix C it is possible to visualize all Value Streams maps per type of product and the gathered idle and active times per process step. In Table 4-5 it is possible to comprehend the needs for production capacity increase. At the present moment Wingsys doesn't have a capability of producing 1 unit per day of any type of equipment based on normal working hours, which means resources are not producing value for customers every day. Which for the type of business that Wingsys is included, it can be understandable given the amount of technical work that needs to happen, but severe more complex products like cars take 17 to 18h to be produced³, thus the results show in Table 4-5 are very critical. It is needed at least between two and three working days to produce a single piece of equipment to deliver to the customers.

*Table 4-5 VSM analysis results per type of equipment (Load= 1 unit)
Source: Mapped from Wingsys Production Team interviews and documentation*

| TYPE OF EQUIPMENT | ACTIVE TIME | IDLE TIME | TOTAL CYCLE TIME |
|---------------------------|-------------|--------------|------------------|
| KIOSKS | 8h10 | 2h35 | 10h45 |
| INTERACTIVE TABLE | 14h42 | 50h00 | 64h42 |
| ADVERTISING PANELS | 14h02 | 50h10 | 64h12 |
| HYGISTATION | 05h23 | 1h52 | 07h15 |

The reasons behind these values are mainly:

- the organization and inexistence of preparation time of production components
- the fixed layout of products
- the lack of automation in any step
- the need to cut, adjust, level, and prepare structures
- in the case of interactive tables and advertising panels, a bottleneck connected with screen drying and gluing process

In this sense it is understandable the decision to have several equipment in work in progress status, to be able to respond to one of the key success factors: speed, quickly respond to any order that might arrive. However, with components that are sensible to exposure (dust, humidity, etc.), expensive and have a high risk of becoming obsolescent in short time (due to market software updates for example), the risk of work in progress quickly becoming a destruction cost is very high. Even though volumes are low for the time being, a bigger order can be received at any point in time, thus the *critical importance to shift the focus from overproduction to the improvement of production times and methods*. This shift will support to decrease its liability risk, save space for needed storage and production, and at the same time improve answer and lead time, with the same or improved quality

³ Source: Toyota.co.jp

level to all customers. On the other hand, it is important that Wingsys justifies the needed investment in time and equipment by securing a steady demand.

4.4.3.3. Manufacturing Environment

The company is operating in a hybrid environment between Engineer-to-order and Make-to-stock as the company at the same time that has no running demand. process times are quite large, but also because the company is able to cater to tailor-made orders by customers. There is a mix of types in the factory floor, namely:

- *Engineer-to-order*: in case a customer would like specific measures, colors, functions, there is the possibility that the in-house industrial designer creates a specific solution from the common baseline of Wingsys products.
- *Make-to-order*: raw materials, such as small quantities of structures and glasses are in-house and can be used to cater to standard products orders. Components such as NUCs, cables, technical rails etc., are then cut and assembled to cater to these orders.
- *Assemble-to-order*: several units of work in progress are standing by in production area or in the warehouse of different types of equipment to be finalized according to the customer's detailed requests. This represents the fastest way, with reduced risk, to cater to customer's orders. Nonetheless, occupy a very high percentage of production and storage area, which can increase the risk not having space if a new order arrives of a large number of units.
- *Make-to-stock*: without having a forecast, but driven by yearly sales goals, several units of internally manufactured goods have been finalized, including the software installation, to answer to customer's requests within two days. As discussed previously, in the specific business area of Wingsys this represents an increased risk of obsolescence. In this category externally manufactures WIPPs, LEDs, and charging structures are also included.

4.4.4. Shipping

The company controls the shipping of its own goods to secure deliveries with maximum quality. The Wingsys team secures transport and assembly at the customer's designed destination when both services are needed, otherwise external transport companies secure the transportation when volumes are higher than 1-2 units. Its own production experts do the low volume service to ally the

need to secure the full integrity of the materials with assembly and potential training of the customer. In the past an external service was contracted to perform the deliveries; however, this has ceased due



Figure 4-11 Wingsys' van
(Source: self-taken during factory visit, Sep21)

to multiple claims and extensive damages and, therefore costs and low service perception. Controlling the shipment also allows for the brand image to travel and be seen, which should support the brand expansion efforts and allows the customer to have a direct connection with the internal team, which presents as an opportunity for Wingsys to be closer to its customers and support a great customer experience from the first moment to the final step. On the negative side, the small van capacity together with the high volume of each of the products (the legs must always be assembled), means that Wingsys faces some challenges to deliver an order bigger than two tables or advertising panels in each delivery attempt.

4.4.5. Quality control

Quality control of products is done along the process time, starting on step 1 when structures are being assembled. During this time, if there are damages or quality incidents with size, color or the integrity of the structures, these issues are reported by Production team to I&D, and I&D department reports to the supplier. The claim is then analyzed and if accepted the product is picked up and repaired. This process takes in average 3 to 5 days to be completed, which creates severe constraints to lead times to the customer, thus the technician has their own inhouse process to repair such situations without claiming to the supplier. During the process there are other control points to make sure the quality of the product is secured, which are also documented internally in process manuals per type of material. In the end of each production, a certification quality test is always performed inhouse to ensure electric, equipment and usability full compliance.

4.5.In Summary

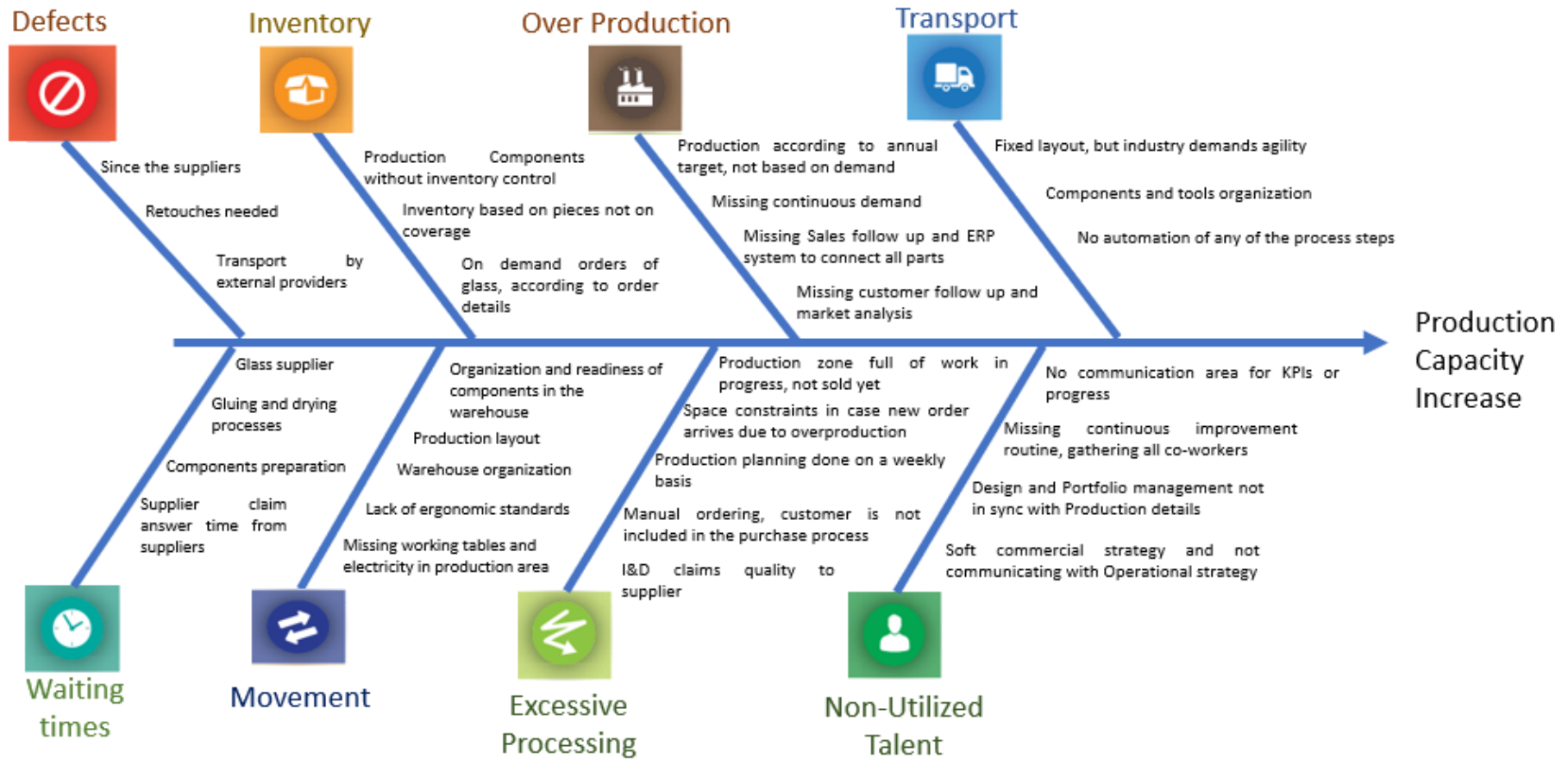


Figure 4-12 Wingsys capacity blockages according to Lean 8 Wastes
 (Source: Self-made based on Ishikawa diagram template, internal documentation, interviews, and field visits)

5. Strategy for Capacity Increase

In this chapter the goal of this document is explored in detail. It starts with a documentation of the Strategy logic for Wingsys to reach a higher capacity level and then follows to deep dive in all actions, connecting chapter 2 and 4 findings to the road map to complete each action successfully. This chapter finishes with the purposed timeline and KPIs to ensure a path of continuous improvement.

5.1. Overview

As mentioned in chapter 4 the challenge from Wingsys is complex to solve as it doesn't only refer to the pure production output rate. As in any strategy to achieve a higher output rate the complete company needs to be aligned in the same goal, working together to achieve it. In chapter 4 it was found that, despite the long history and having several important competitive advantages in-house, several areas in Wingsys must be improved for the company to be able to answer to its customers consistently, with the highest possible quality and with speed.

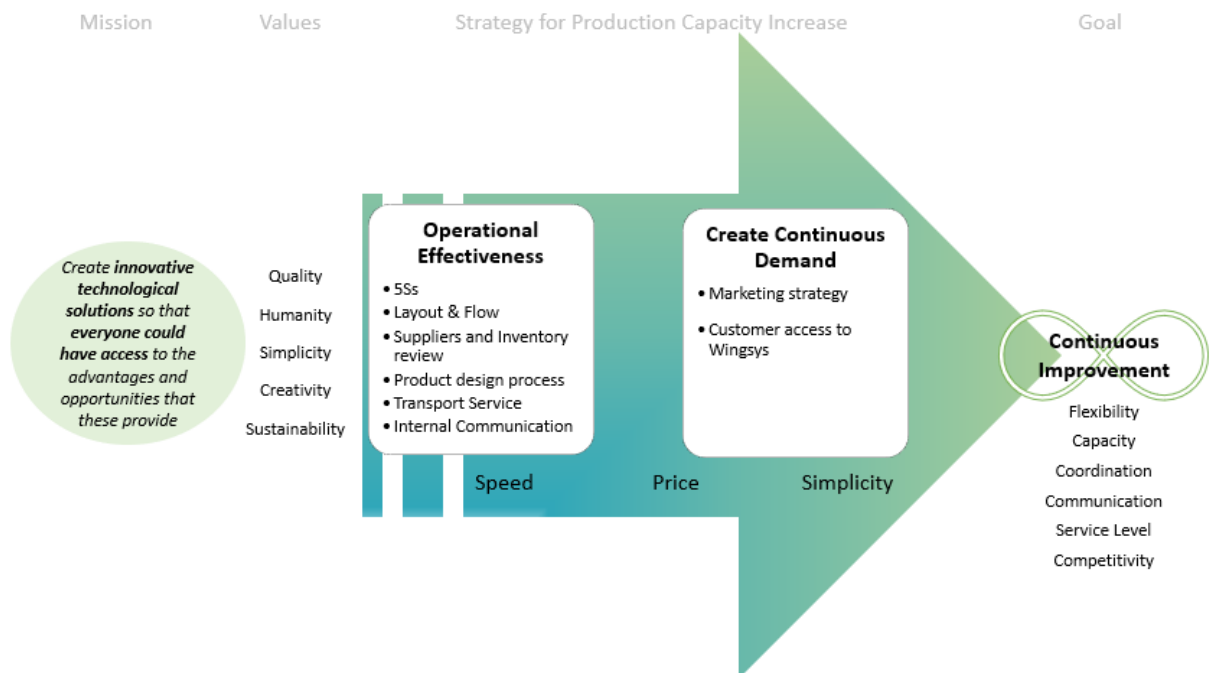


Figure 5-1 Strategy Overview for Capacity Increase overview
(Source: self-made)

The full strategy is also based on continuous improvement, which means that it shouldn't be consider at any point an end upon the completion of the actions, but just the beginning of a continuous cycle that aims to bring Wingsys to a much higher level of productivity and competitiveness. In Figure 5-

1 it is possible to find how all links together from the Mission of the company to the goal of this document.

The strategy is divided in two big groups of actions:

1) the *operations' effectiveness* group that aims to improve the operational execution in the complete process. The goals are:

- improve the process and layout when actual production needs to be executed, decreasing cycle times, improving quality and ergonomic conditions for co-workers, freeing them from unnecessary movements and improving their working conditions.
- set proposals in terms of warehouse organization and dispatch of orders,
- improve the current situation in terms of quality and response time from all suppliers,
- create proposals to improve the lead time and quality of deliveries to the customers;
- close the gap between I&D and Production, bringing the two departments closer to help simultaneously decrease production rework and excessive processing efforts, increase production speed and quality, and decrease overall lead time

2) a group to *create* (, seek and secure) *continuous demand*, as this will be necessary to support capacity increase in a sustainable way, decreasing prices, supporting continuous improvement and effective investments. In this second group the market is the focus, thus the goals are to:

- create a process to know the market and consequently adapt portfolio to the needs,
- seek opportunities to push stock of different products to different distributors to reach the customers more frequently, gaining market share and supporting the financial growth of the company,
- find a way to involve the customer much more in the operation, creating therefore a simplistic way of ordering and giving feedback, but also higher speed to place an order.

In terms of timing, due to the complexity of this plan, it is deeply connected with the power of investment of Wingsys in all the needed resources to bring the company to a different response level.

However, this plan will not complete itself based purely on investments. As any other towards lean project, all actions must involve people in a way that their voices, concerns, fears, and expectations are heard and addressed. Without people, and with just money, the plan is set to fail. As seen before, very specialized knowledge is one of three competitive advantages that Wingsys possesses and cannot survive without. Therefore, it is very important to state that support, training, repetition, showing *how to do* will be key to make this plan as much as a reality as a success. This transformation must be owned by Wingsys staff, bottom-up, and supported, top-down.

In order to allow a sustainable implementation of all actions the plan is divided in 4 phases which correspond to Kubler-Ross (1969) Change Curve:

- I. The introduction phase – due to the long history of Wingsys, it is crucial that this phase exists. It is where shock or denial occur due to the appearance of something new and disruptive. This phase already started in September 2021 when the first visit, and therefore first contact with the team, occurred. It is characterized by intensive communication, where intentions and goals are explained. Where every team member understands their part in the upcoming change and how this will benefit not only their daily life, but also the company overall. This phase is expected to continue until November 15th with the validation of the strategy together with the management team of Wingsys.
- II. The first steps of implementation – when the validation of the road map and KPIs occur, this second phase will start along with the actions’ implementation. Even though the first steps relate to quick wins for different departments to bring visibility and immediate (positive) effects of the change, it is expected this phase to be filled with feelings of fear, uncertainty and anger as old ways of working are starting to be changed, and the first deep changes in daily routines are felt. As according to general literature on change management this is a break point for most companies, this phase is expected to be intensively supported by communication of what is expected, show-and-tell actions, open feedback collection and addressing and road map fine tuning. It is expected to last half a year and it corresponds to the first level plan in Figure 5-2.
- III. Stabilization phase – after 6 months of intense training, test, and fine tuning it is expected

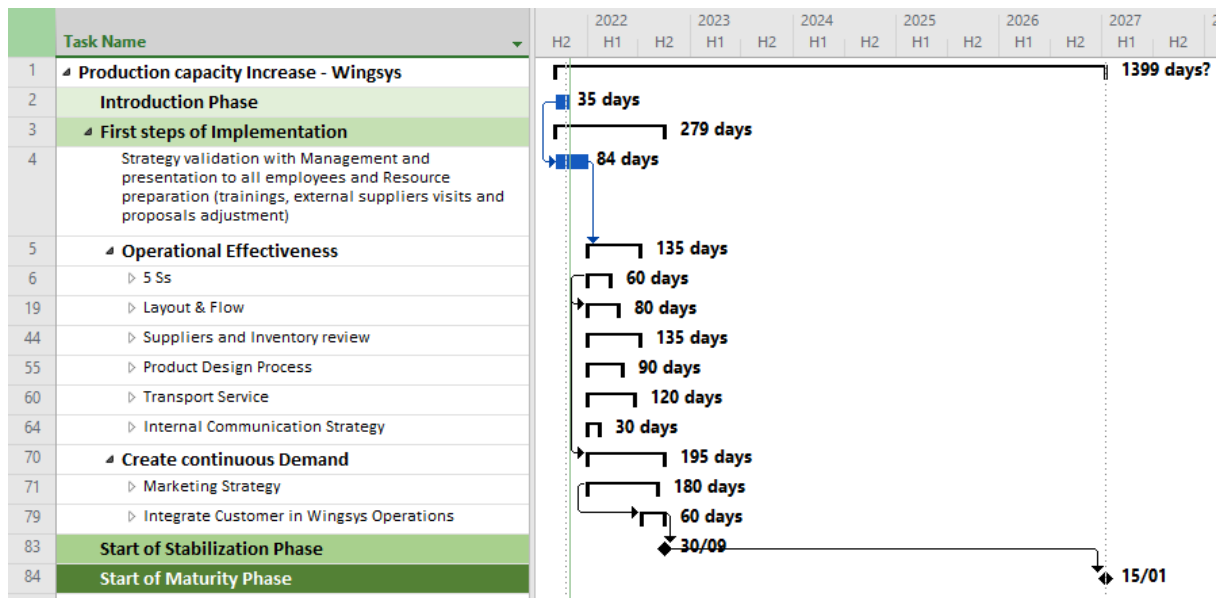


Figure 5-2 Project expected 1st Level Timeline
(Source: Self-made based on Strategic plan)

that the team passes to the third stage of the change cycle – acceptance. This phase will be as long as needed for the new ways to be absorbed by the team and continuously improved. This phased in characterized for frequent, but not intense, support from

management and external consultants to make sure that no further doubts exist, that the daily life can run with the new ways of working. In the worst-case scenario this stage can last up to five years, with several attempts to roll back to the old way of working. It is important at this stage that consistency is practiced, transforming the new into a routine. Trainings, agreements, and documented routines are revisited as many times as needed in order to clarify any questions. Management should practice regular Gemba walks not only in production, but in all departments to make sure that new working methods are respected, and if not, that the root causes are addressed as soon as possible, and corrected.

- IV. Strategy maturity phase – the last phase of the strategy will begin as soon as phase 3 is stabilized, the ways of working are cemented and that the team is comfortable with the changes and have entered a phase of continuous improvement. At this point, KPIs should reflect consistent levels of productivity and efficiency, new opportunities arise both internally and from external partners and stakeholders. People are comfortable with the new way of working and transfer the knowledge to newcomers.

5.2. Key Performance indicators (KPIs) purposed

KPIs are crucial to exist to track the evolution of key processes inside any company. In the case of Wingsys there are no KPIs in place. The goals are set according to the yearly budget, which can create some disruptions specially as parts of the company can be in conflict to achieve these financial goals. In this sense as metrics should relate directly to the strategy purposed in this document, 4 groups of KPIs were created to connect the two main groups of actions, the actions itself and also the stakeholders involved in the completion of the strategy.

In Table 5-1 it is possible to find the connection between the KPIs and the actions. It is intended that KPIs are not only SMART - Specific, Measurable, Achievable, Relevant and Time bounded, but also that they create cooperation, sense of purpose for all departments together, improve overall the capabilities of the company, not only specifically in production execution. The KPIs aim also to secure Wingsys long-term sustainability and growth. The definition of the specific RACI matrix – Responsible, Accountable, Contributor and Informed responsible persons/ functions- per KPI and the goals are scheduled to be defined in phase II of the strategy implementation, when the project charter is set to be signed by Wingsys management.

Production capacity Increase - Wingsys

Table 5-1 KPIs purposed and connection with Strategy actions
(Source: self-made based on Strategic proposal)

| Goal | Strategy KPIs purposed | Operational Effectiveness | | | | | | Create continuous Demand |
|--|--|---------------------------|---------------|--------------------------------|------------------------|-------------------|---------------------------------|--|
| | | 5 Ss | Layout & Flow | Suppliers and Inventory review | Product Design Process | Transport Service | Internal Communication Strategy | Integrate Customer in Wingsys Operations |
| Do things right from the start | No. of Quality incidents during Inflow | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| | Lead time reduction Supplier to Wingsys YTD | | | ✓ | ✓ | | ✓ | ✓ |
| Contribute to the Success factors Speed & Simplicity | Cycle time reduction YTD | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| | No. of Quality incidents Inhouse YTD | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| | Red tag resolution time YTD | ✓ | ✓ | | ✓ | | ✓ | |
| Keep costs to the minimum E2E | Improvements implemented vs identified, progress per month (in number and savings) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Warehouse capacity usage | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | No. of Quality incidents during transport | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Lead time reduction Wingsys to Customer YTD | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Quality claims value reduction YTD | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Customer Price reduction (vs. margin increase) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Profit development per month (Revenue/ Costs) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Focus on Customer | Service level % | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Customer trust level (1-5) YTD | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | No. of Actions implemented from valid feedback | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Increase in no. of Customers per month | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

5.3. Action plan

The goal of this section is to answer the question “how to?”. In the next paragraphs a proposal of the steps needed to reach the strategic plan goals are organized in the most logical sequence, and include the sub-actions to be developed, investments and resources needed.

Operational Effectiveness

*Table 5-2 Action 5Ss summary and To do List
(Source: self-made)*

| | | | |
|--|------------------------|---|---|
| [Implement] 5Ss | Objectives | Increase Operational Speed across all departments; Sort, organize & clean all departments of Wingsys; Create an easy-to-work environment for everyone in the company; | |
| | Waste reduction | Movement Waiting Time Defects Transport | Non-Utilized Talent Overproduction Overprocessing |
| | Estimated Duration | 60 days to implement initial phase in all departments, then part of Continuous Improvement cycle | |
| | Lead | Management Team | |
| | Departments Involved | All | |
| | External Stakeholders | Consultant/ Advisor for Lean Manufacturing (LM) | |
| | Estimated total budget | LM consultant – 400 €/ hour | |
| To Do List | | | |
| Sort Tools, equipment, documents between: <ul style="list-style-type: none"> <input type="checkbox"/> is needed for daily work; <input type="checkbox"/> must be archived (for legal reasons for example), <input type="checkbox"/> is not used today but can be useful for the future, <input type="checkbox"/> is to be repaired, <input type="checkbox"/> must be scrapped | | | |
| Define a place for each of piles and each of the items | | | |
| (If not possible to achieve with the existing resources inside the company), create a shopping list of needed equipment/ tools to allow the sorted items to be organized, register the benefits of the investment per item | | | |
| Give shopping list for approval to management | | | |
| Get approval from management | | | |
| Shop for items at the lowest possible cost and as sustainable as possible | | | |
| Create visible communication (label, mark, delimit all work areas, tools, equipment, file cabinets and folders) | | | |
| Set in order using the new equipment/ tools | | | |
| Clean and make all work areas Shine | | | |
| During the sort and set in order document how to Standardize, what goes where and why | | | |
| During the sort, set and standardize create a routine, which includes control timing, to Sustain the work done | | | |
| Review work done, are all areas under 5Ss, what is missing? | | | |

Production capacity Increase - Wingsys

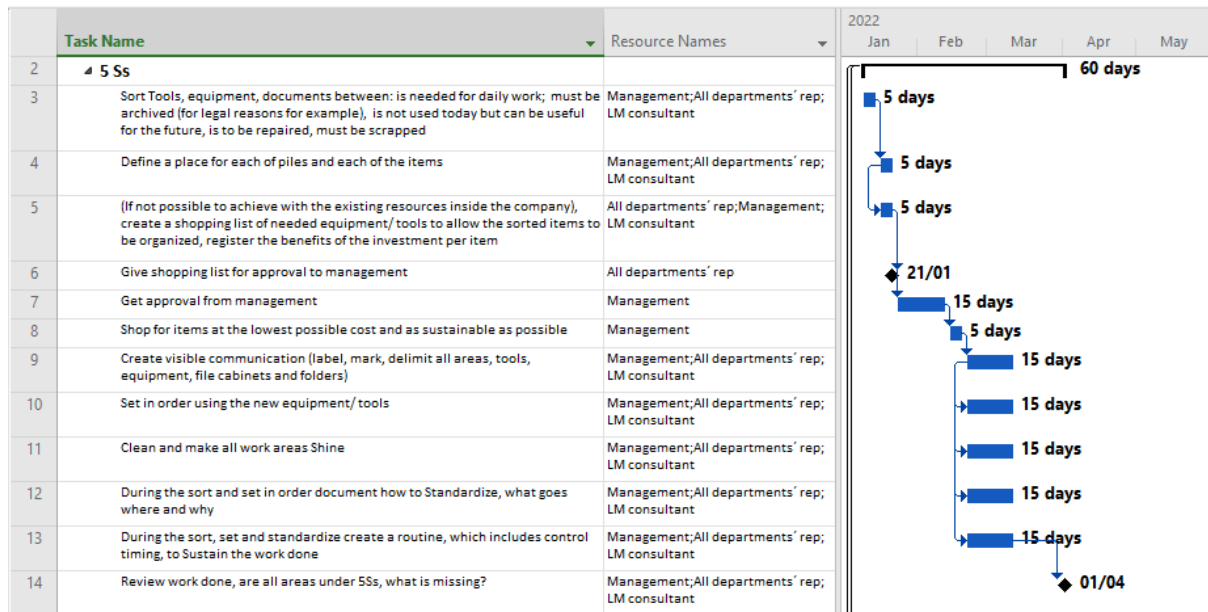


Figure 5-3 Detailed timeline action 5Ss
(Source: self-made)

Table 5-3 Action Layout and Flow summary and To do List
(Source: self-made)

| | | | |
|------------------------|---|--|---|
| Layout and Flow | Objectives | Increase agility and speed in case of an order is received Reduce obsolescence risk Decrease non-adding value activities | |
| | Waste reduction | Movement Waiting Time Defects Transport | Non-Utilized Talent Overproduction Overprocessing |
| | Estimated Duration | 80 days to implement initial phase, then part of Continuous Improvement cycle | |
| | Lead | Management Team | |
| | Departments Involved | Production Technicians | Internal Electrical Engineer |
| | External Stakeholders | Industrial Solutions supplier Rack supplier Safety consultant | Forklift supplier Sealing door supplier Consultant/ Advisor for Lean Manufacturing (LM) |
| Estimated Budget | Lean Carts – 400€/ each (Item Portugal) Roll Door – 1785€ (Flexidoor) LM consultant – 400€/ h | Forklift – 25-58k € (depending if used or new) Automatic Load Carrier -5000€ ((Item Portugal) | |

| To Do List | |
|-----------------------------------|---|
| Reorganize production area | |
| | Analyze and evaluate external supplier proposal for production line automation |
| | Analyze and evaluate external supplier proposal for packaging automation |
| | Analyze and evaluate external supplier proposal for automatic door to isolate production area |
| | Reorganize Rack display with external supplier |
| | Insert safety nets in all Rack levels |
| | Create inflow/ outflow quality control area |
| | Create components preparation area (feeding the supermarket) |
| | Install power plugs in production area |
| | Improve lamination chamber quality control |
| | Create packaging area |

Production capacity Increase - Wingsys

| |
|---|
| Seal production area from warehouse |
| Reorganize warehouse |
| Reorganize Rack height organization with external supplier |
| Analyze and evaluate external supplier proposal for forklift |
| Decision and order for 1 forklift (heavy weights and able to reach level 3) of warehouse |
| Search the market for safety consultant, evaluate proposals and decide on which to contract |
| Create safety routine per product to allow all products to be stacked in height |
| Create visual identifications of storage areas to support team according to layout proposal |
| Clear floor and put to storage all products in height according to area locations |
| Create Continuous improvement routine |
| Test new cycle times |
| Create Continuous improvement checklist and routine |
| Start Continuous Improvement Routine in Warehouse |

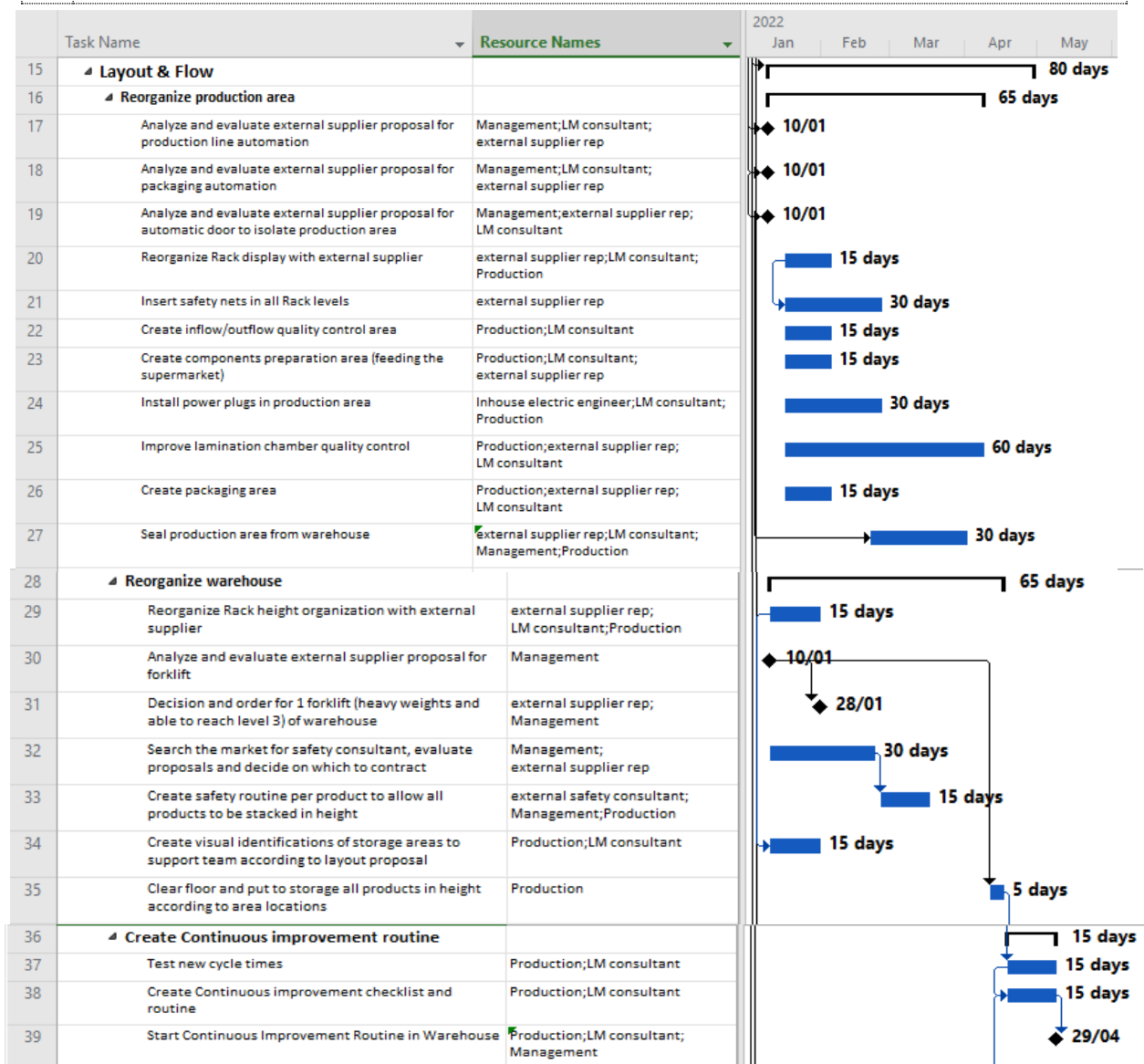


Figure 5-4 Detailed timeline action Layout and Flow (Source: self-made)

Production capacity Increase - Wingsys

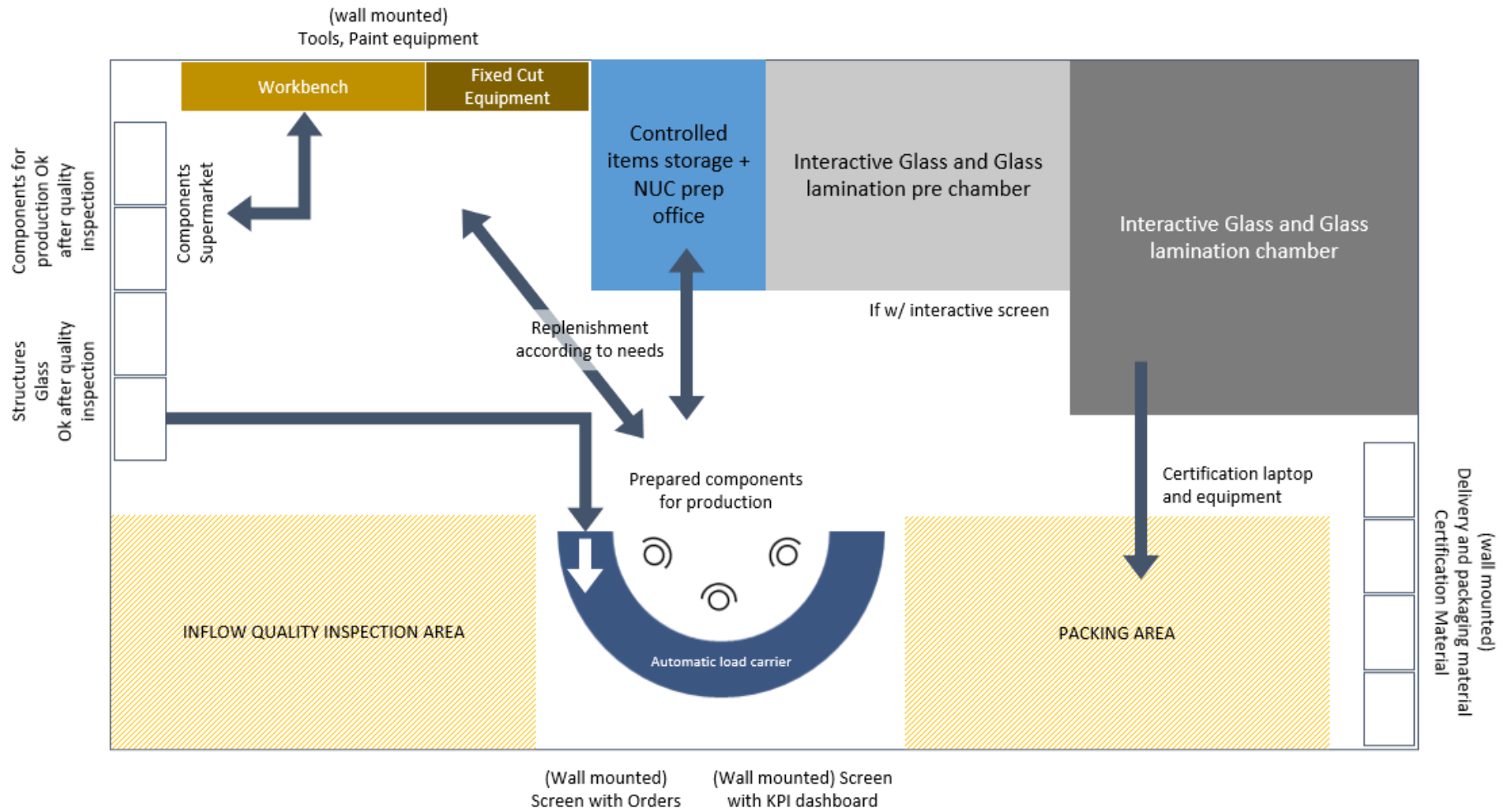


Figure 5-5 New Production Area layout and Dynamics
(Source: self-made)

Production capacity Increase - Wingsys

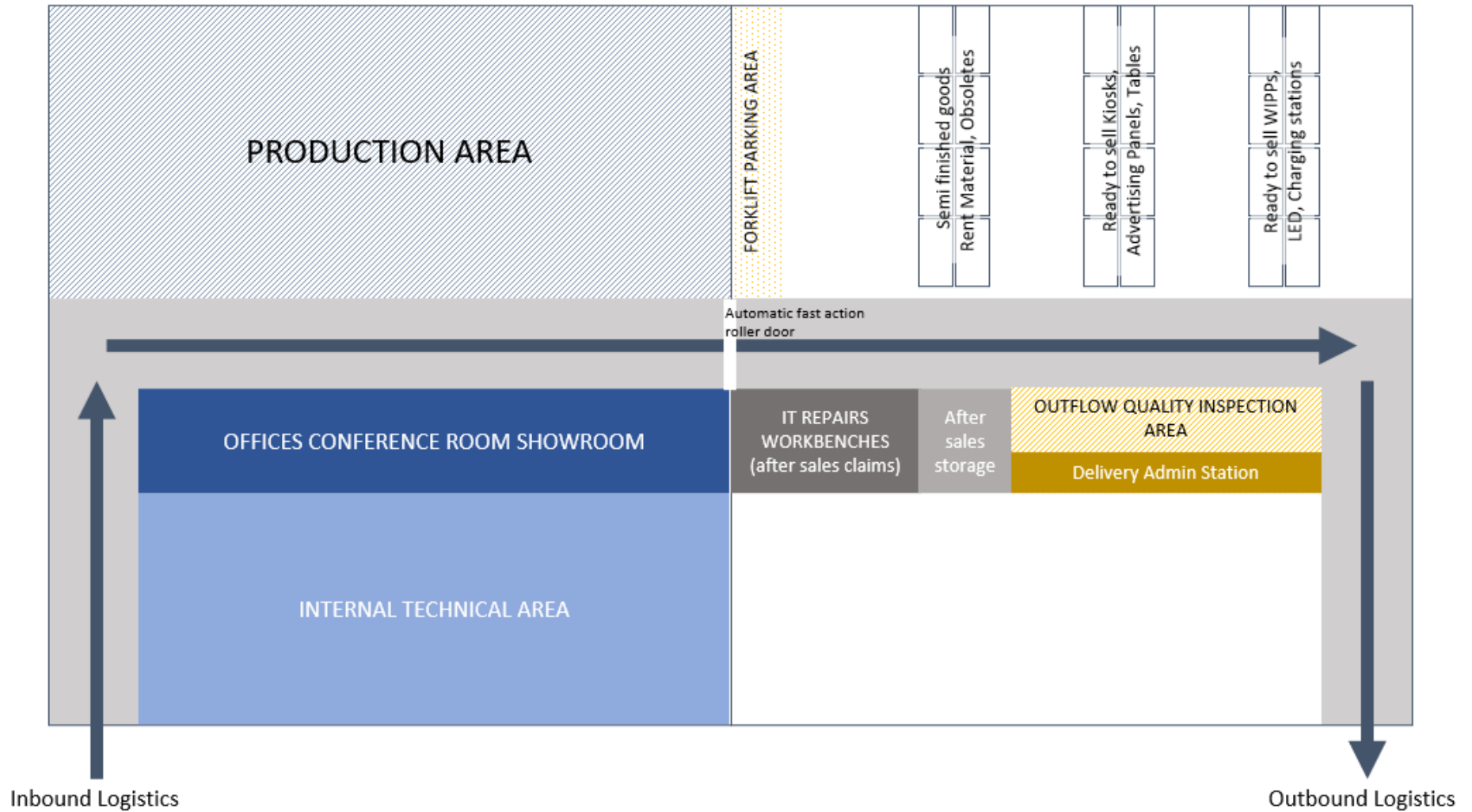


Figure 5-6 New warehouse organization proposal
(Source: self-made)

New Rack Layout

- **Production rack for quality approved Structures and Components** – closer to Production and Components preparation area

| | | | |
|-------------------|-------------------------------|-------|-------------------------|
| Kiosks Structures | Hygistations Structures | | Production Components |
| Table Structures | Advertising Panels Structures | | Production Components |
| Table Structures | Advertising Panels Structures | | Production Components |
| WIPPs | Glass | Glass | Components' supermarket |

- **Semi-finished (SF) goods, Rent Material, obsoletes** – SF closer to production, obsoletes and rent material in the coldest zone from order are

a) Facing Production

| | | | |
|------------------------------|------------------------------|-------------------------|-------------------------|
| SF Tables | SF Tables | SF Tables | SF Tables |
| SF Tables | SF Tables | SF Tables | SF Tables |
| SF Kiosks/Advertising Panels | SF Kiosks/Advertising Panels | SF Kiosks/ Hygistations | SF Kiosks/ Hygistations |

b) Facing Warehouse

| | | | |
|--------------------------------|--------------------------------|---------------------------|---------------------------|
| Rent Tables | Rent Tables | Obsoletes | Obsoletes |
| Rent Tables | Rent Tables | Rent Tables | Rent Tables |
| Rent Kiosks/Advertising Panels | Rent Kiosks/Advertising Panels | Rent Kiosks/ Hygistations | Rent Kiosks/ Hygistations |

Production capacity Increase - Wingsys

- **Ready to sell (RTS) Kiosks, Advertising Panels, Tables** – slow movers, warm zone between production and delivery area (Both sides):

| | | | |
|-------------------------------|-------------------------------|--------------------------|--------------------------|
| RTS Tables | RTS Tables | RTS Tables | RTS Tables |
| RTS Tables | RTS Tables | RTS Tables | RTS Tables |
| RTS Kiosks/Advertising Panels | RTS Kiosks/Advertising Panels | RTS Kiosks/ Hygistations | RTS Kiosks/ Hygistations |

- **Ready to sell (RTS) WIPPs, LED, Charging stations** – fast movers, hot zone closer to delivery area (Both sides):

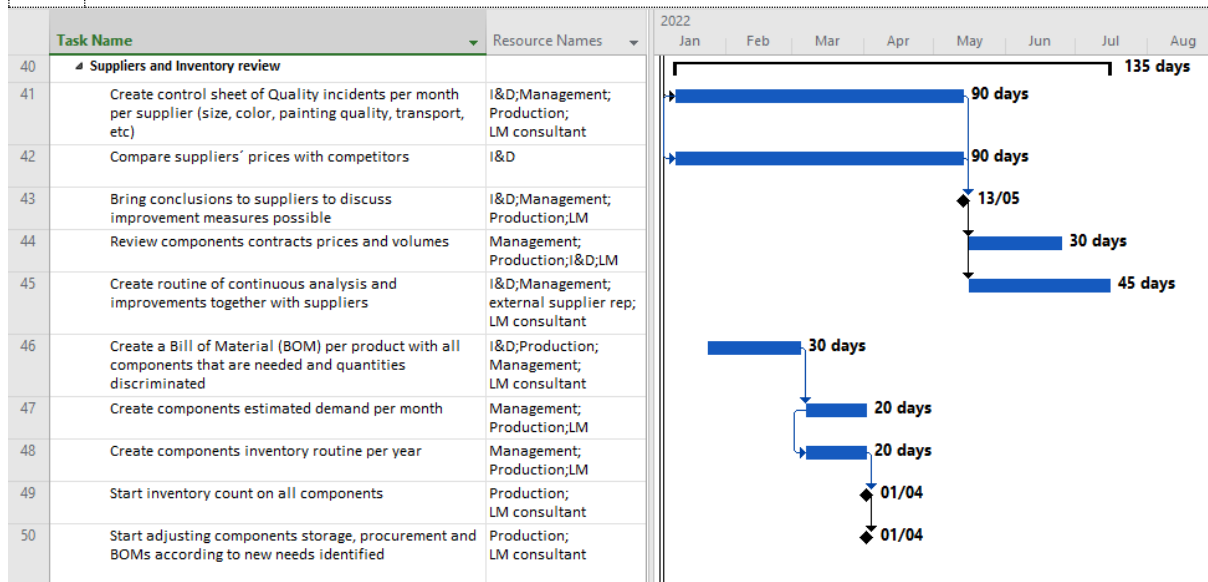
| | | | |
|-----------|-----------|-----------|-----------------------|
| RTS LEDs | RTS LEDs | RTS LEDs | RTS Charging Stations |
| RTS WIPPs | RTS WIPPs | RTS WIPPs | RTS WIPPs |
| RTS WIPPs | RTS WIPPs | RTS WIPPs | RTS WIPPs |
| RTS WIPPs | RTS WIPPs | RTS WIPPs | RTS WIPPs |

Production capacity Increase - Wingsys

*Table 5-4 Action Suppliers' and Inventory review summary and To do List
(Source: self-made)*

| | | |
|--|-----------------------|--|
| Suppliers' and Inventory review | Objectives | Decrease quality incidents and costs Decrease costs for stored stock and risk of write off finished goods Decrease non-adding value activities, such as rework |
| | Waste reduction | Inventory Waiting Time Defects Transport |
| | Estimated Duration | 135 days, then part of Continuous Improvement cycle |
| | Lead | I&D |
| | Departments Involved | Production Management |
| | External Stakeholders | Components' suppliers Consultant/ Advisor for Lean Manufacturing (LM) |
| | Budget | LM consultant – 400€/ h |
| | | |

| To Do List | |
|------------|---|
| | Create control sheet of Quality incidents per month per supplier (size, color, painting quality, transport, etc.) |
| | Compare suppliers' prices with competitors |
| | Bring conclusions to suppliers to discuss improvement measures possible |
| | Review components contracts prices and volumes |
| | Create routine of continuous analysis and improvements together with suppliers |
| | Create a Bill of Material (BOM) per product with all components that are needed, and quantities discriminated |
| | Create components estimated demand per month |
| | Create components inventory routine per year |
| | Start inventory count on all components |
| | Start adjusting components storage, procurement and BOMs according to new needs identified |



*Figure 5-7 Detailed timeline action Suppliers' and Inventory Review
(Source: self-made)*

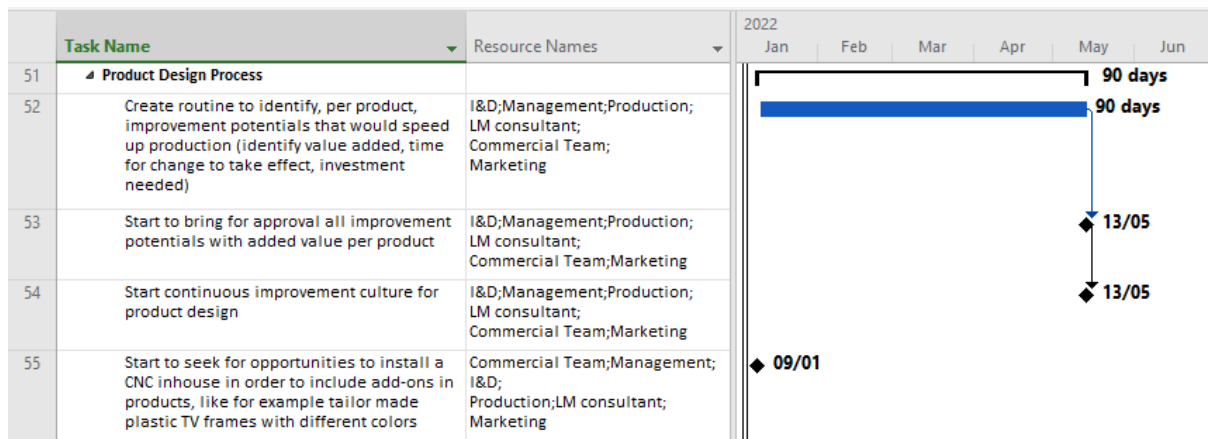
Production capacity Increase - Wingsys

*Table 5-5 Action Product Design Process summary and To do List
(Source: self-made)*

| | | |
|-------------------------------|-----------------------|--|
| Product Design Process | Objectives | Increase Operational Speed Decrease the need for Excessive Processing in all equipment Support Assemble-to-order manufacturing environment |
| | Waste reduction | Excessive Processing Non-Utilized Talent Defects |
| | Estimated Duration | 90 days for first phase, then part of Continuous Improvement cycle |
| | Lead | I&D |
| | Departments Involved | Production Marketing Commercial Team Management |
| | External Stakeholders | Consultant/ Advisor for Lean Manufacturing (LM) |
| | Budget | LM consultant – 400€/ h |

To Do List

| |
|--|
| Create routine to identify, per product, improvement potentials that would speed up production (identify value added, time for change to take effect, investment needed) |
| Start to bring for approval all improvement potentials with added value per product |
| Start continuous improvement culture for product design |
| Seek for opportunities to install a CNC inhouse in order to include add-ons in products, like for example tailor made plastic TV frames with different colors |



*Figure 5-8 Detailed timeline action Product Design Process
(Source: self-made)*

*Table 5-6 Action Transport Service summary and To do List
(Source: self-made)*

| | | |
|--------------------------|-----------------------|--|
| Transport Service | Objectives | Outsource Transport and Assembly services Free production technicians Decrease current quality incidents |
| | Waste reduction | Transport Waiting Time |
| | Estimated Duration | 120 days to implement, then part of Continuous Improvement cycle |
| | Lead | Management |
| | Departments Involved | Production |
| | External Stakeholders | Transport providers Consultant/ Advisor for Lean Manufacturing (LM) |
| | Budget | LM consultant – 400€/ h |

To Do List

| |
|---|
| Control current service quality |
| Review offers for transport and assembly |
| Verify possibility of service in case of retail sales |

Create continuous Demand

Table 5-8 Action Marketing Strategy summary and To do List
(Source: self-made)

| | | |
|---------------------------|-----------------------|--|
| Marketing Strategy | Objectives | Increase market relevancy and presence Align portfolio and production rhythm with market needs Reduce inventory and procurement costs, and therefore production costs Reduce business uncertainty Ensure profit to justify investment in production, transport |
| | Waste reduction | Overproduction Inventory Waiting Time Movement Non-utilized Talent Transport |
| | Estimated Duration | 180 days to implement, then part of Continuous Improvement cycle |
| | Lead | Commercial Department |
| | Departments Involved | Marketing Production Management |
| | External Stakeholders | Consultant/ Advisor for Lean Manufacturing (LM) |
| | Budget | LM consultant – 400€/ h Commercial/ Marketing strategist consultant – 495€/ h, if freelancer 250€/ h |

To Do List

| |
|--|
| From customer portfolio use HubSpot to develop automatic mails to get customers feedback and further needs |
| Create Marketing strategy in strict coordination with production capabilities |
| Find main markets needs that Wingsys can solve |
| Give more highlight to website needs/ solutions dropdown |
| Reorganize website to answer primarily to specific needs |
| Approach market segments with the intent to create continuous demand for as many products as possible |
| Create routine to follow up production capacity and adapt actions dynamic to production capacity |

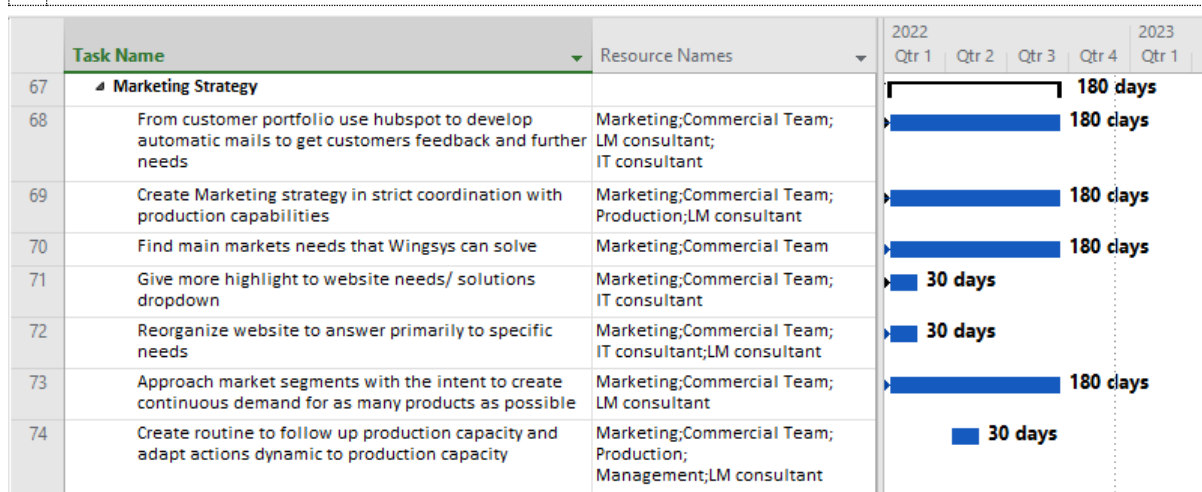


Figure 5-11 Detailed timeline action Marketing Strategy (Source: Self-made)

Table 5-9 Action Integrate Customer in Wingsys Operations summary and To do List
(Source: self-made)

| | | |
|---|--------------------|---|
| Integrate Customer in Wingsys Operations | Objectives | Reduce waiting time and overall admin work Create transparency and Inform customer of prices, stock available and lead time Reduce order processing time Use opportunities to get direct orders with customers that already know the technology and don't have any question Create mechanism for direct payment Allow customer to follow up order status and lead time until arrives |
| | Waste reduction | Waiting times Inventory Over production Movement Transport Non-Utilized Talent |
| | Estimated Duration | 60 days to implement, then part of Continuous Improvement cycle |

Production capacity Increase - Wingsys

| | | | | |
|--|-----------------------|---|------------|---------------|
| | Lead | Commercial Team | | |
| | Departments Involved | Marketing | Production | Management |
| | External Stakeholders | IT consultant | | LM Consultant |
| | Budget | LM consultant – 400€/ h Online Cloud Shopping Platform – 70 €/ Month | | |

To Do List

- Create an online shop with standard products and budget simulation tool where customer can tailor made solution, directly know the estimated price, lead time, and place the order
- Create tracking tool of order and possibilities to directly communicate with Wingsys in a specific order
- Analyze possibility to offer assembly, small introduction, or a trial version of software (if not bought from start)

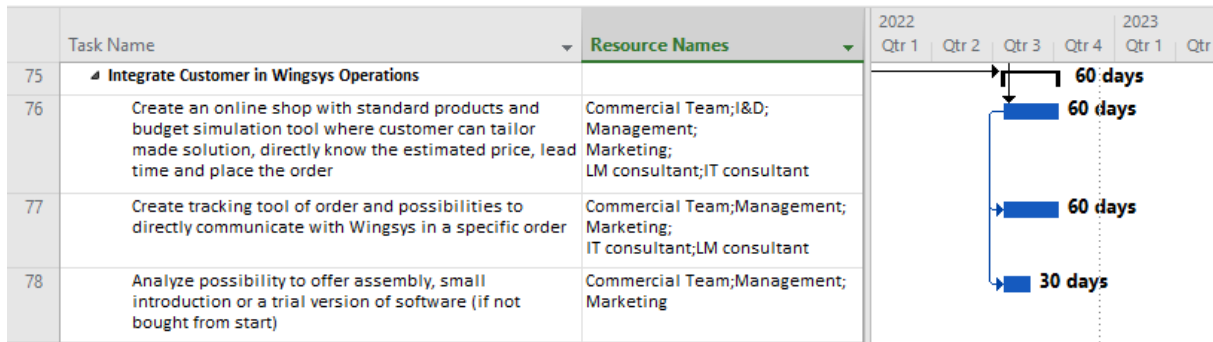


Figure 5-13 Detailed timeline action Integrate Customer in Wingsys Operations
(Source: Self-made)

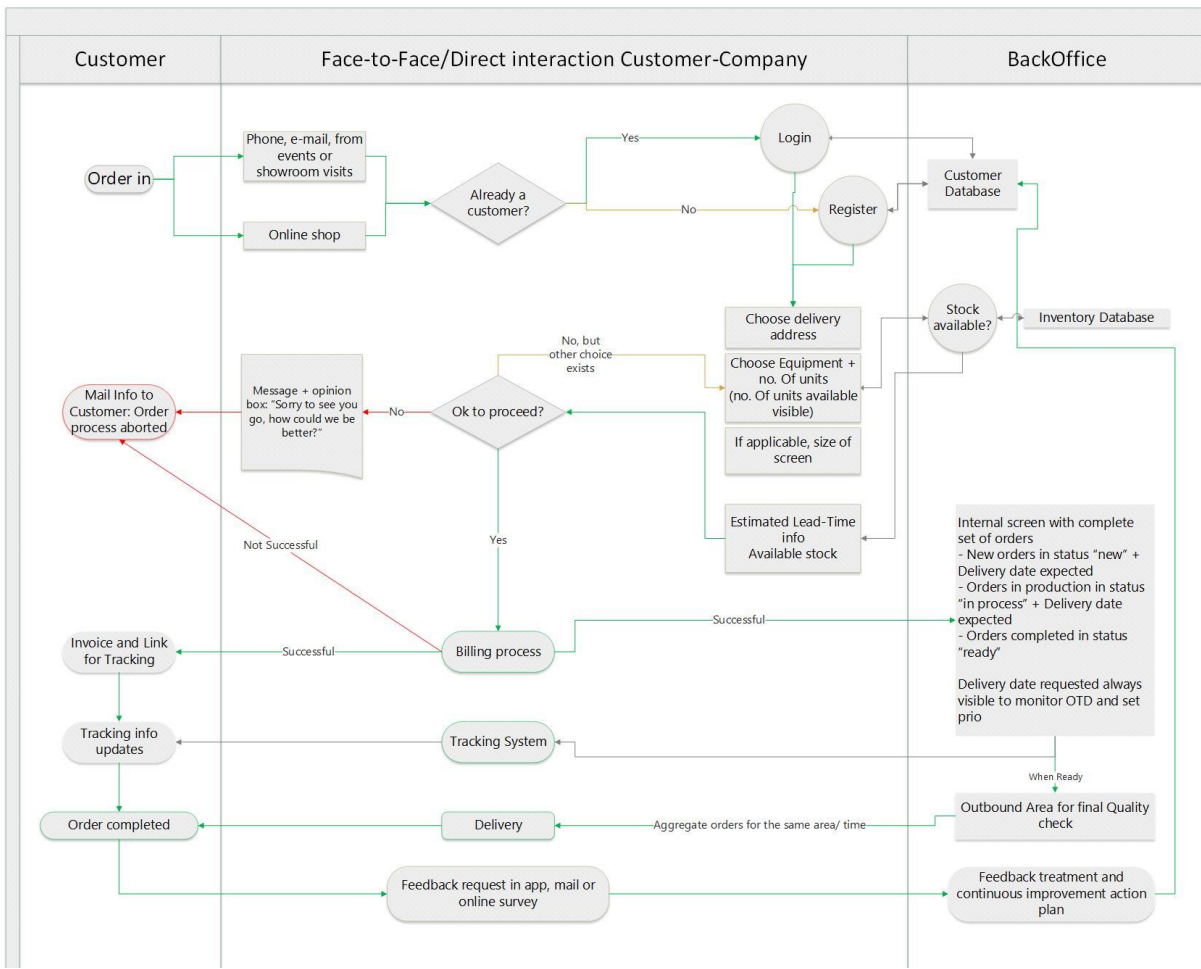


Figure 5-12 Order Online to be Flowchart
(Source: self-made)

6. Conclusion and further recommendations

The challenge to create a strategic plan to increase production capacity in Wingsys has been placed to MGA students in a context that is highly volatile, not only in terms of resources available but also connected with demand from the few customers. Nevertheless interactive equipments will continue to be increasingly relevant for all kinds of markets, thus the need to increase the capacities to answer to higher volumes than twenty units is urgent.

Given this context, a methodology based on desk research was followed initially in order to build up a baseline composed of general concepts such as productivity and competitiveness, previous experiments concerning capacity increases, as well as detailed knowledge of the status quo in the target company. As Wingsys provided the production procedure, the first drafts of the Value Stream Mapping per product could be designed as well. But as theory is often not enough to know the specificities and create a strategy that is highly relevant and possible to implement in the company, in a second stage, visits to the factory were arranged. These visits were aiming to validate the desk research results and understand if the initial drafts of the VSMs and strategic solution corresponded with the reality of daily operations. The first and second stages created the basis for a comprehensive analysis that went from understanding the history of the company, the values, mission, marketing strategy, operations management, including production cycle times. This analysis were matched with the eight types of wastes of Lean concept, because as this is a small company resources and investment capabilities are limited, thus doing more with what was existing was of paramount importance. Lean Theory was the connector between the analysis of the case study and the creation of the goal of this work: the strategy and the action plan.

The strategy and action plan by action and time, as well as the KPIs for the most relevant productivity key have been detailed in order to support the direct implementation by Wingsys team. In the plan and strategy chapter, it was also identified several investments that would be necessary to allow the expected improvements in cycle times, resource usage and increase in service level to occur.

Regardless of the final decision from Wingsys management to implement the actions proposal, it is recommended that going forward:

- People are valued, they are the biggest competitive advantage of Wingsys. Losing any of them is losing know-how, passion, courage, and commitment that no temporary co-worker or machine can replace, and also risking that Wingsys key production procedures and elements are repeated elsewhere.
- ways of reducing manual/ repetitive actions and replacing them with as much automation as possible are found. Lack of human resources to deal with what is needed is a common complaint that prevent strategic plans and actions to be created, tested, and implemented;

- That customers are heard and have answers from Wingsys. One-time event can be either a multiplier if the experience is good, or a destroyer if the experience was not to be repeated. All departments must unite to support and protect their customers' experience;
- Understand that Wingsys has several market opportunities that can still be explored, especially in terms of B2B and B2C, namely IT consultants and professional retail, architects' offices, high-end households, and overall small and medium businesses that crave to give a different experience but lack the resources and the courage to address Wingsys' competitors. Wingsys has several competitive advantages, but its dimension and capabilities simply cannot compete with aggressive sharks that are since many more years successfully in the market, are faster, have name in the market, automation, and mature processes to answer to new orders. Wingsys needs to find a way to explore the calmer waters of the market, with exquisite, reliable, close service to the customer wants, preferences and needs.
- To grow, Wingsys needs to reduce the write off risks and stop producing without having an order in hand. "Just in case" mindset in the business area of Wingsys will never be a competitive advantage, as both equipment and software evolve at a very high speed and producing to store is an equivalent of wasting time, components, space, and technicians. On the other side if speed is one of the key success factors, it is crucial that preparation and cycle times are under strict discipline to be constantly reduced and change of strategy to assemble-to order is the baseline to be as fast as possible to respond as soon as orders appear.
 - As seen in chapter 4.3 Wingsys is facing very intense competition in all its products, thus demand control and marketing strategies are crucial to find Wingsys place in the market and settle its name in a particular segment and target. Investment in Resources is fundamental to identify and prepare strategy that will lead to Wingsys to find its position in the market and develop the portfolio from that point on.

This thesis was developed between September and December of 2021, in strict cooperation with Wingsys team and under supervision of Professor Susana Ratinho. Given the time limitations there was no possibility to test the proposal, but the complete analysis and validation was done, preparing a direct implementation of all actions in a sustainable way, taking in consideration change management life-cycle.

The risks that are implied in missing to implement the action plan proposal are connected with missing the opportunity to serve high overall market needs for interactive and simplified equipments, continue to miss opportunities to gain market visibility and consequently orders, and ultimately write off of components, work in progress and finished goods, along with less need for human resources.

7. References

- Achanga et al. (2005). Critical success factors for lean implementation within SMEs. *Journal of Manufacturing Technology Management* Vol. 17 No. 4, 2006 pp. 460-471 Emerald Group Publishing Limited
- Andreadis et al. (2017). Towards a conceptual framework for value stream mapping (VSM) implementation: an investigation of managerial factors. *International Journal of Production Research*
- Antos et al. (2016). Lean Philosophy Implementation in SMEs – Study Results 7th International Conference on Engineering, Project, and Production Management. Elsevier Ltd.
- APIC (2021). CPIM – Certified in Planning and Inventory Management Part 1.ASCM
- Björnfot et al. (2011). Lessons Learned from Successful Value Stream Mapping (VSM). Luleå University of Technology
- Burkett (2019). “Everyone” Isn’t a Target Audience. LinkedIn
- Cann (2016). What is competitiveness?. World Economic Forum. <https://www.weforum.org/agenda/2016/09/what-is-competitiveness/>
- Carvalho Amorim (2014). Análise e Aplicação de Técnicas Lean na Produção de Transformadores do Tipo Shell. Universidade do Minho
- Chadha (2017). *Production and Operation Management: Theory and Practice*. McGraw-Hill/Irwin
- Chen et al. (2010). From value stream mapping toward a lean/sigma continuous improvement process: an industrial case study. *International Journal of Production Research*
- Conselho para a Produtividade (2019). A Produtividade da Economia Português - 1.º Relatório do Conselho para a Produtividade. Conselho para a Produtividade
- Dadashnejad et al. (2019). Investigating the effect of value stream mapping on overall equipment effectiveness: a case study. *Total Quality Management & Business Excellence*
- Dal Forno et al. (2014). *Value Stream Mapping: a study about the problems and challenges found in the literature from the past 15 years about application of Lean tools*. Springer-Verlag London
- Davide Bolchini et al. (2007). Simple, Fast, Cheap: Success Factors for Interactive Multimedia Tools. *PsychNology Journal*, 2007 Volume 5, Number 3, 253 – 269
- Dias Lopes et al. (2020). *Gestão da Produção e Operações – Teoria e casos práticos resolvidos*. Escolar Editora
- Dinis-Carvalho et. al. (2018). Waste identification diagram and value stream mapping- A comparative analysis. Universidade do Minho
- Ferreira de Almeida (2015). *Metodologia Lean Manufacturing no Processo Produtivo de capas para Assentos de Automóvel*. Universidade de Aveiro
- Girdler (2020). How to Value Stream Map. YouTube. <https://www.youtube.com/watch?v=7wD7R6x3Pv4>
- Hategan (2012). Literature Review Of The Evolution Of Competitiveness Concept, *Annals of Faculty of Economics* vol. 1(1), pages 41-46. University of Oradea, Faculty of Economics
- Hawkins (2006). The concept of competitiveness. Academia. https://www.academia.edu/16552059/The_concept_of_competitiveness
- Helleno et al. (2015). Integrating value stream mapping and discrete events simulation as decision making tools in operation management. *Int J Adv Manuf Technol & Springer-Verlag London*

Hines et al. (1997). The seven value stream mapping tools, Lean Enterprise Research Centre. International Journal of Operations & Production Management, Vol. 17 No. 1, 1997, pp. 46-64. MCB University Press

Invensis Learning (2021). Value Stream Mapping Tutorial | Value Stream Mapping Symbols Explained | Invensis Learning. YouTube. <https://www.youtube.com/watch?v=C3LbbgRYBws>

Jeyaraj et al. (2013). Applying Value Stream Mapping Technique for Production Improvement in a Manufacturing Company: A Case Study. The Institution of Engineers (India)

Kübler-Ross (1969). On Death and Dying. Scribner

MBA Skool Team (2019). Samsung PESTLE Analysis. MBA Skool. <https://www.mbaskool.com/pestle-analysis/companies/17946-samsung.html#:~:text=PESTLE%20Analysis%20of%20Samsung%20analyses%20the%20brand%20on,its%20business%20along%20with%20legal%20%26%20environmental%20factors.>

MBA Skool Team (2020). LG PESTLE Analysis. MBA Skool. <https://www.mbaskool.com/pestle-analysis/companies/18070-lg.html>

National Institute of Standards and Technology (2021). Lean Strategy Increases Throughput and Capacity. NIST. <https://www.nist.gov/mep/successstories/2017/lean-strategy-increases-throughput-and-capacity>

Page (2021). Why You Need To Effectively Plan Capacity Throughout The Entire Supply Chain. Forbes. <https://www.forbes.com/sites/forbesbusinesscouncil/2021/04/20/why-you-need-to-effectively-plan-capacity-throughout-the-entire-supply-chain/?sh=1757e52838c7>

Pinto (2010). Gestão de Operações na Indústria e Serviços. Lidel

Porter (1990). The Competitive Advantage of Nations. Harvard Business Review. <https://hbr.org/1990/03/the-competitive-advantage-of-nations>

Rahani et al. (2012). Production Flow Analysis through Value Stream Mapping: A Lean Manufacturing Process Case Study, Elsevier Ltd. Selection & Centre of Humanoid Robots and Bio-Sensor (HuRoBs). Faculty of Mechanical Engineering, Universiti Teknologi MARA

Rother et al.(1998). Learning to See. Lean Enterprise Institute

Russkikh et al. (2019). Value stream mapping method for development of a dynamic model of capacity utilization. J. Phys..Conf. Ser. 1353 012111

Schwarz et al. (2011). Lean processes for optimizing or capacity utilization: prospective analysis before and after implementation of value stream mapping (VSM). Springer-Verlag

Shital (2021). Productivity: Meaning, Concept, Formulas, Techniques, Measurement and Advantages. Economicsdiscussion.net. <https://www.economicsdiscussion.net/management/productivity-meaning-concept-formulas/32324>

Six Sigma Academy Amsterdam (2017). Lean Manufacturing Methods to Maximise Productivity. Youtube. <https://www.youtube.com/watch?v=cOsnd4v85as>

Six Sigma Academy Amsterdam (2017). Lean Six Sigma: Value Stream Mapping. YouTube. <https://www.youtube.com/watch?v=cOsnd4v85as>

Smart Cities Network (2019). Famasete lança nova mesa interativa portátil na Web Summit!. Smart Cities. <https://smart-cities.pt/smn/famasete-1211novidade/>

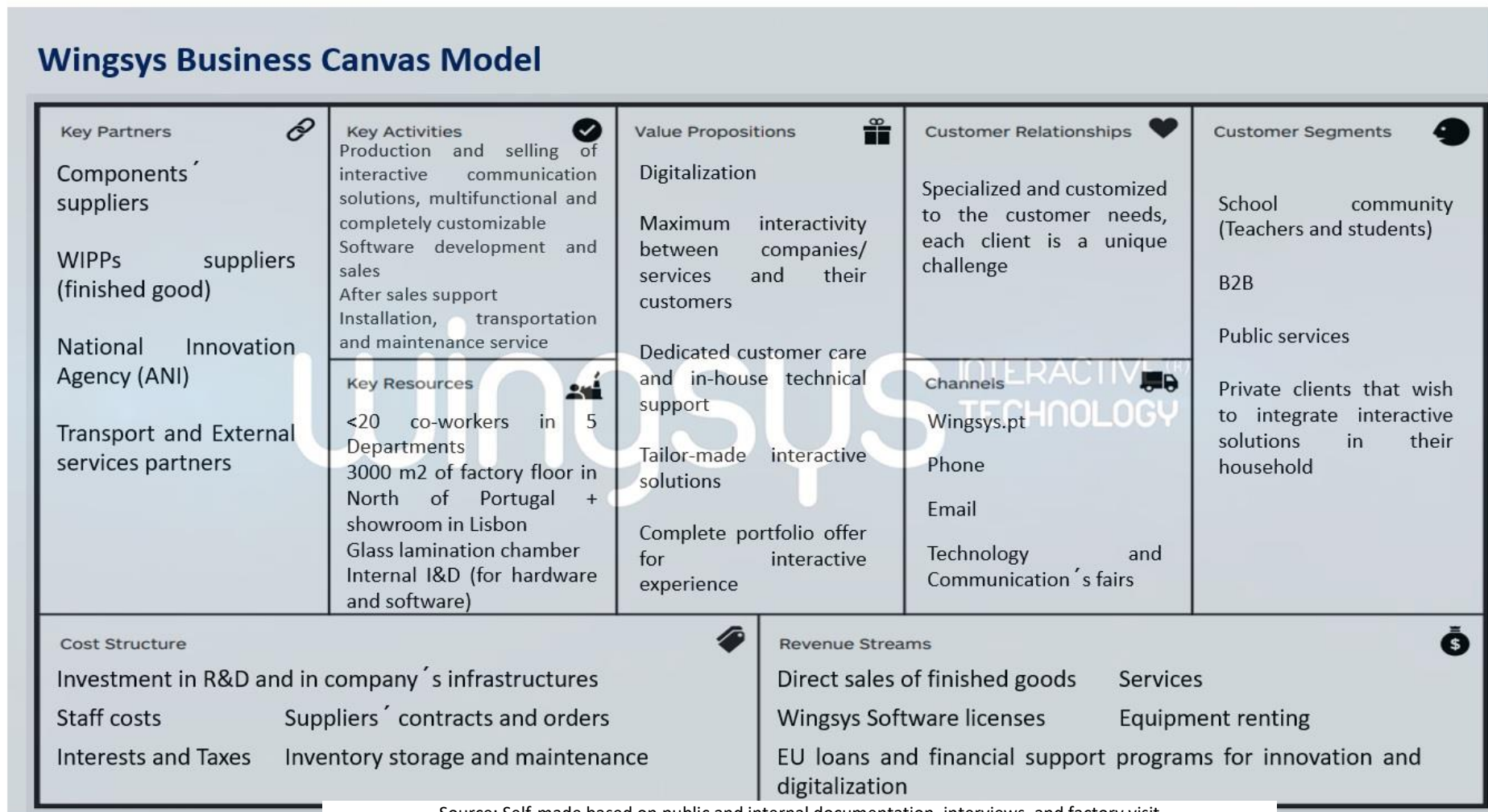
Vorne (2021). Increase Manufacturing Production Capacity. Vorne. <https://www.vorne.com/solutions/increase-manufacturing-production-capacity.html>

Womack et al. (1990). *The Machine That Changed the World*. Rawson Associates & Macmillan Publishing Company

Xu et. al. (2020). *Integrated optimization for production capacity, raw material ordering and production planning under time and quantity uncertainties based on two case studies*. Springer

8. Appendix

A. Summary of Wingsys business model



Source: Self-made based on public and internal documentation, interviews, and factory visit

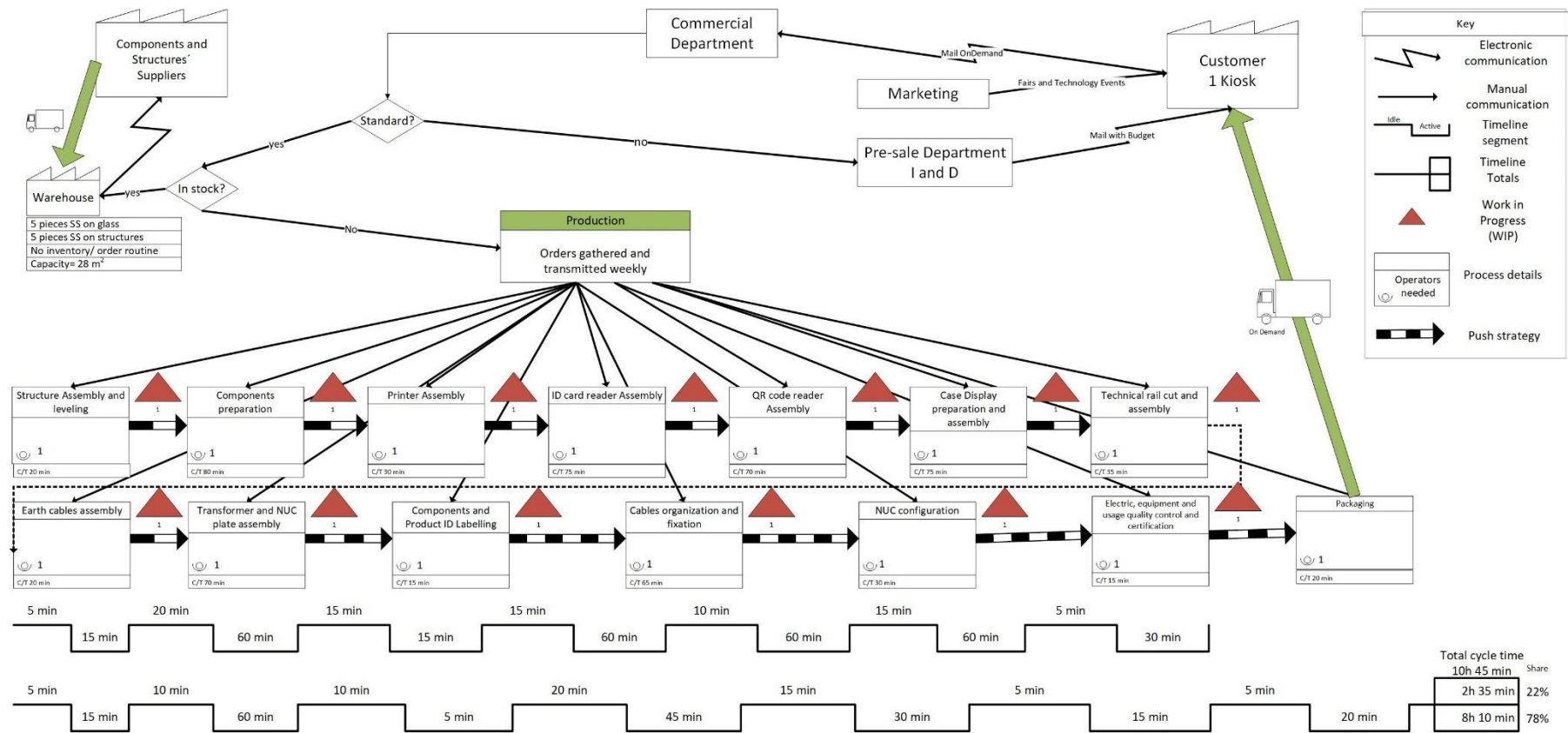
B. Price/ quality evaluation of Interactive Screens

| Brand | WINGSYS | WINGSYS | PROMETHEAN | ViewSonic | ViewSonic | CTOUCH | SMART | SAMSUNG |
|---------------------------------|---------------|------------|-------------|-----------------|----------------|-----------|---------|---------|
| Model | WIPIRxx VPRO2 | PEGASUS xx | K/NICKEL xx | IFPxxxx - GEN 2 | IFPxxx - GEN 3 | Lazer Sky | MXxx | QBxxN |
| Average PVP 65 to 90'' (No VAT) | 2 299 € | 2 582 € | 2 609 € | 2 375 € | 3 008 € | 2 683 € | 3 081 € | 1 880 € |
| Touch precision | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 3 |
| Touch Points | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| Contrast | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 3 |
| Touch Response time | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 |
| Native OS | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 |
| CPU | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 |
| RAM | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 2 |
| ROM | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 1 |
| Panel Lifetime | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| Wireless Sharing | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Digital Pens included | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |
| Built-in speakers | 2 | 2 | 1 | 3 | 3 | 4 | 1 | 1 |
| Score | 29 | 31 | 25 | 25 | 29 | 27 | 30 | 25 |

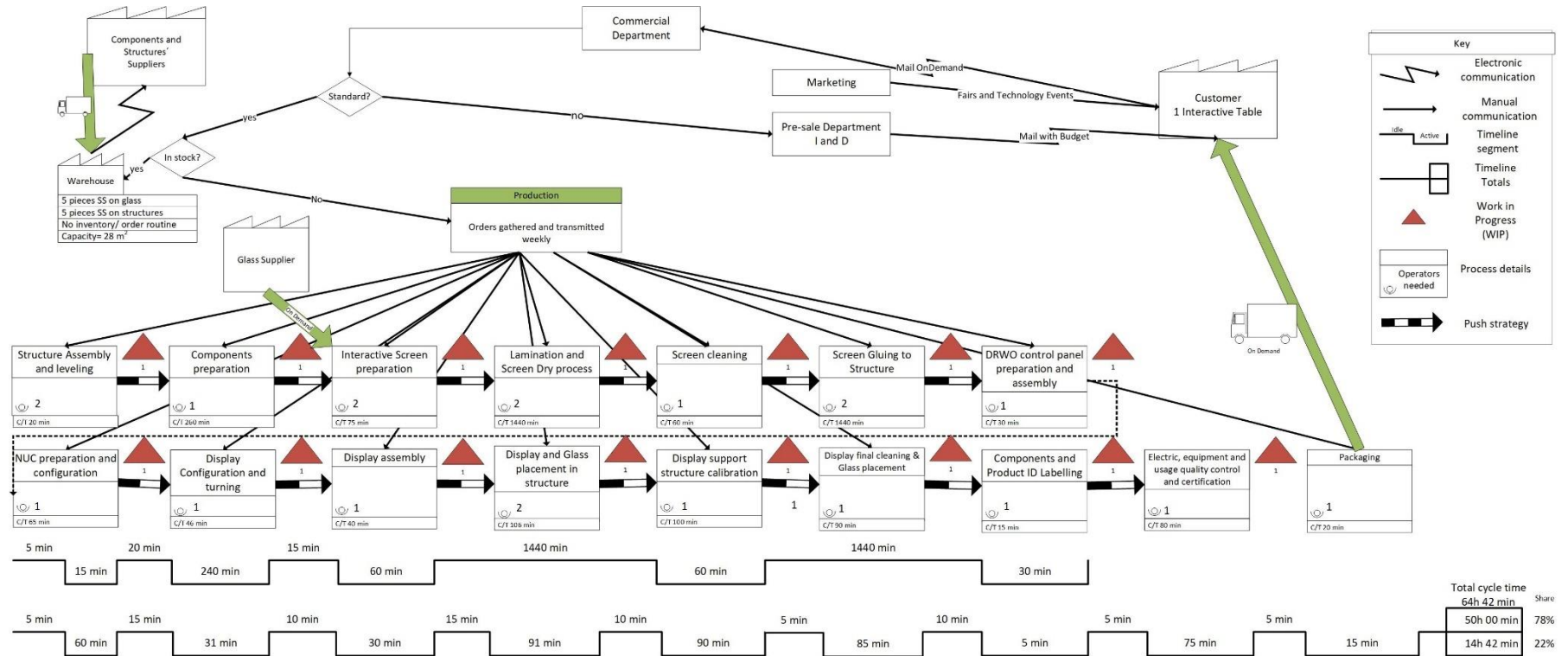
Source: Wingsys and Infomedia.pt (Oct/21). Key: 1 – Lowest score 3 – Highest score

C. Value Stream Maps per equipment type

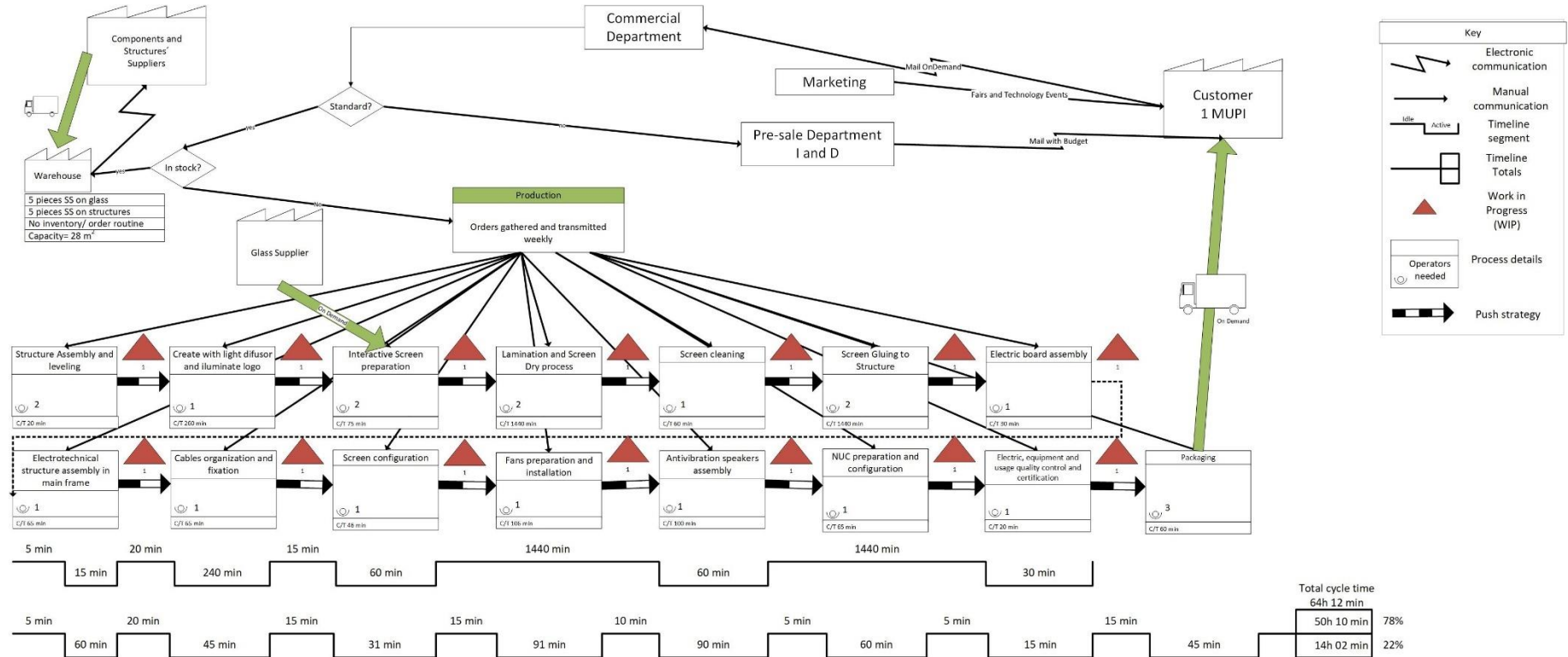
C.1. Kiosks (As-Is)



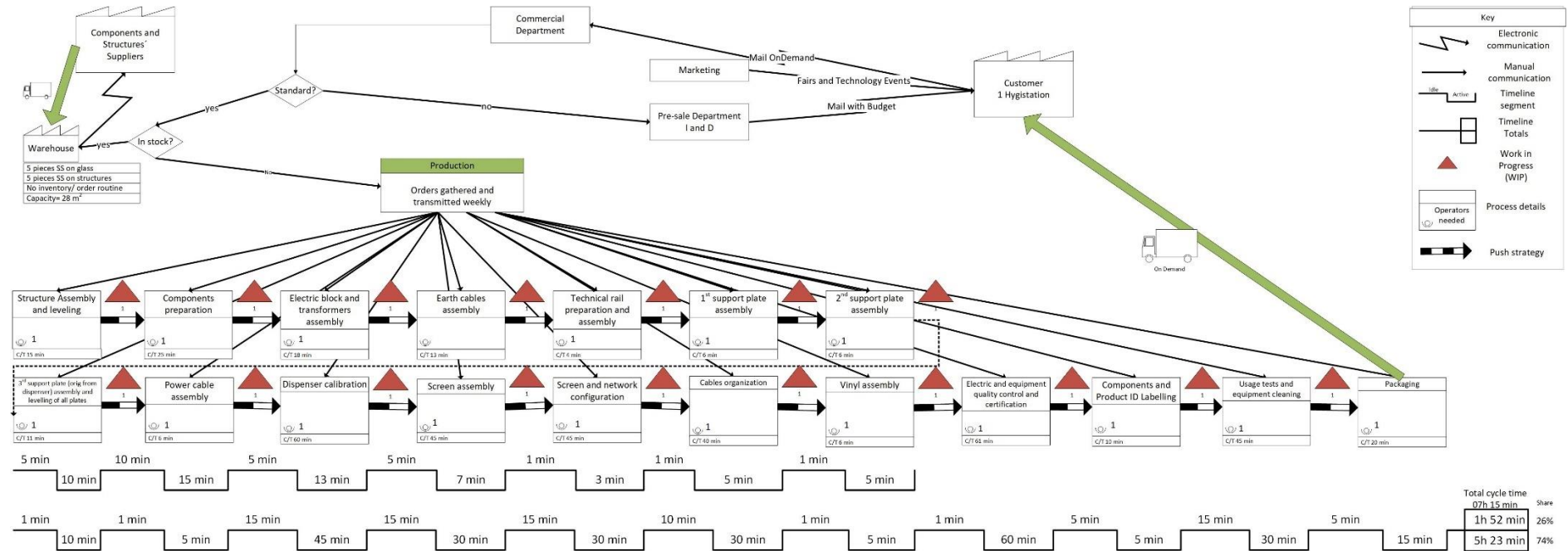
C.2. Interactive Tables (As-is)



C.3. Advertising panels (As-Is)



C.4. Hygystation (As-Is)



D. Production – Warehouse Isolation solution



Figure 8-1 MHZ solution

Source: [Porta Rápida Enrolar em Tela / Lona - Portugal](#)

MHZ



Figure 8-2 Ferroflex solution

Source: [Porta rápida de enrolar de alumínio para interiores | Ferroflex \(manusa.com\)](#)



Figure 8-3 Flexidoor solution

Source: [Portas Rápidas - Portas Rápidas de Enrolar - Produtos - Flexidoor](#)

E. Production/ Warehouse management –Forklift solutions



Figure 8-6 Linde Forklift solution
Source: <https://www.empilhoelectrico.pt/empilhador-linde-r20-active>

MR14-25



Figure 8-5 Yale Forklift solution
Source: [https://yale.ascendummaquinas.pt/Nossos-produtos/Empilhadores-retrateis/\(product\)/MR14-25](https://yale.ascendummaquinas.pt/Nossos-produtos/Empilhadores-retrateis/(product)/MR14-25)



BT Reflex 2.5t Alta performance

- Empilhador retrátil de grande alcance para aplicações exigentes



Figure 8-4 Toyota Forklift solution
Source: <https://empilhadores.toyota.pt/produtos/empilhadores-retrateis/>