Production System Engineering – Group 7

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Problem Analysis

Morocant Drives is a specialist in driving technology for over 50 years. They are specialized in manufacturing components and products for propulsion systems used in the automotive, airplane, energy and agriculture sectors. Currently, all their products are designed, manufactured and assembled in their production facility in Breda. A way in which they distinguish themselves is that many of their products are made to order [1].

Morocant Drives is growing rapidly, and their current building does not have sufficient space to keep up with their current order pattern and the new orders they received from a company called Sali. Therefore, the company decided to relocate and expand by buying a piece of land at the Rithmeesterpark in Breda. The task is to design a production system that can produce the current order pattern and the additional orders coming from Sali. Additionally, the current production line and machinery should be analyzed to find points to be optimized. This analysis should then function as a basis for the layout of the new building, possibly supported by new machinery to meet the additional demand by Sali. This is done by performing a stakeholder analysis, setting up requirements and determining the subsystems and the architecture.

Stakeholder Analysis

The interest and influence on the relocation and expansion of Morocant Drives is analyzed and illustrated in a Power-Interest plot in figure 1.

Overview of stakeholders:
A. Morocant Drives
B. Customers
C. Employees
D. Suppliers
E. Local population/neighboring companies
F. Environmental organizations
G. Shareholders/investors
H. Government

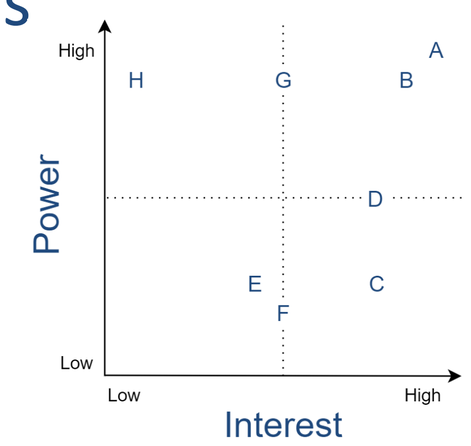

Figure 1: Power-Interest plot of chosen stakeholders.

Requirements

The requirements embody the instructions given by Morocant Drive and are the basis on which the new facility will be designed. Wishes from all stakeholders are considered however it should not come as a surprise that most wishes originate at the client. Hence starting from the wishes of the client a set of more concrete specifications is constructed, these are elaborated in Table 1. Some specifications fulfill only one wish, while others fulfill several. Consequently, the complete system will be divided into several subsystems where the specifications are further detailed on a subsystem level. This will result in a set of technical and quantifiable requirements.

Table 1: Connection between the wishes and specifications.

Wishes	Subsystems		Specifications
Safe work environment	PC		Meet working condition act [2]
Reliable	P&S		Compact factory layout
Efficient operation	FC, P&S, PC		Satisfy current order pattern plus room for future growth
Cost-effective	L&F		2 shifts/day, 48 weeks/year
Sustainable	FC, P&S		Meet ISO quality standards
Deliver in time	L&F, P&S		Recycle waste materials

Performance Objectives

Polar diagrams are used to indicate the relative importance of each individual performance objective [3]. The polar diagram for Morocant Drives can be seen in figure 2. Quality was determined to be the most important performance index, since the parts Morocant Drives produces are very specific and have a high expectancy on tolerances and reliability. The single most valued stakeholder is the customer and for them quality is of the utmost importance. Keeping existing clients on board is vital for the company hence a high quality is essential. Immediately an inevitable trade-off appears at the expense of the speed and costs. However, because the order pattern is not considered to be very fluctuating over the year and orders can be predicted reasonably soon, speed is not of the highest importance. The same reasoning can be applied to the flexibility. On the other hand, a higher value is given to the dependability, because again satisfying the current clientele is of great importance to the business model. Obviously, cost is also a considerable factor for customers nevertheless the dependability and quality are believed to be more decisive.

1 = Least important, 5 = Most important

Figure 2: Polar plot for Morocant Drives.

Subsystems

Using the requirements and knowledge obtained in production management and systems engineering, the necessary subsystems can be defined. It should be noted that the different subsystems could also be defined differently, however, the current division was chosen as it seemed the most optimal. The different subsystems were assigned to the requirements (Table 1), such that in the end all requirements are covered with (multiple) subsystems. An overview of all the subgroups can be seen in figure 3.

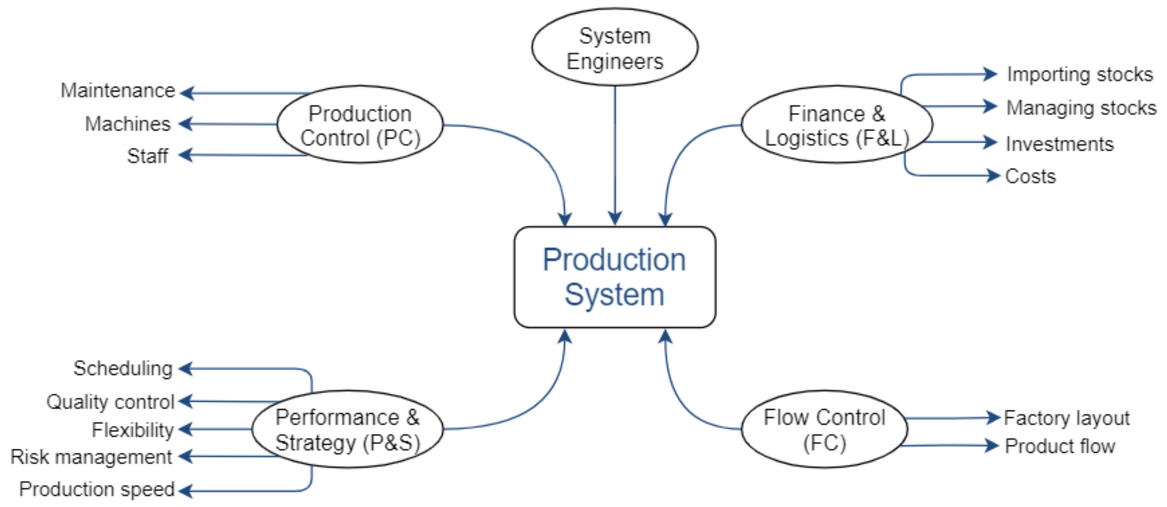

Figure 3: Overview of tasks per subgroup.

The system engineers oversee combining all the subsystems into a complete working production system and facilitating the interfaces between the subsystems.

Architecture

To determine the architecture of the production system, an N^2-diagram has been made. Using an N^2-diagram, the different inputs and outputs of each subsystem are related to other subsystems. The outputs of a subsystem are described in the horizontal row of that subsystem, while the inputs for a subsystem are in its vertical column [4].

As described in the section subsystems, these identical systems are used in the N^2-diagram illustrated below.

Finance & Logistics (F&L)	1.Budget	2. Imported materials for production	
3. Transport/delivery information	**Performance & Strategy (P&S)**	4. Production plan/schedule	
5. Machines and staff costs	6. Product quality data	**Production control (PC)**	7. Number and type of machines used 8. Data gathered by production
9. Layout	10. Flow efficiency		**Flow control (FC)**

output (→) / input (↓) / input (↑) / output (→)

Figure 4: N^2-diagram for the chosen subgroups.

Explanation for the individual inputs and outputs:
1. A budget is created by **F&L** which **P&S** can use to create a production plan/schedule.
2. **F&L** handles the transportation of materials that are used in production.
3. **P&S** has information on which materials/machines need to be delivered/transported.
4. A production plan/schedule is shared with **PC** with information on how many production hours are needed.
5. **PC** determines what machines are needed and how much staff is needed to operate them, these costs are the responsibility of **F&L**.
6. Products are checked for quality in production and the data is shared with **P&S** where the quality data is stored and evaluated.
7. Using the production plan, **PC** determines the number and type of machines needed which can be used by **FC** to design a layout. The flow and number of workers, with focus on their safety, will also be considered when designing the layout of the machines.
8. Data gathered from **PC** is shared with **FC** to optimize the layout design.
9. The layout design is used by **F&L** to show where deliveries and storage take place.
10. Flow efficiency can be improved by sharing data with **P&S** so adequate strategies can be made.

References:
[1] PRODUCTION SYSTEMS ENGINEERING, Project Description 2021
[2] EU-OSHA, Dutch working legislation, 2017
[3] Slack, N. and Brandon-Jones, A., n.d. *Operations management*.
[4] Bonnema, G., Veenvliet, K. and Broenink, J., 2017. SYSTEMS DESIGN AND ENGINEERING. n.d.: CRC Press.

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