Achieving Profitability by Design: An Integrated System Approach (PT. PST Case Study)

In the fiercely competitive landscape of modern manufacturing, strategic planning is paramount. Companies, regardless of their scale, constantly face the challenge of optimizing resources to maximize efficiency and productivity. A well-designed facility layout and robust financial planning are not just theoretical concepts; they are critical determinants of operational flow, inter-departmental communication, material handling efficiency, and ultimately, a company's financial health.

To apply these principles in a practical context, I led a comprehensive project to develop a strategic blueprint for PT. PST. **It is important to note that PT. PST was a fictitious company, serving as a case study provided by my university for this learning experience.** The company was conceived to innovate the market with its flexible and ergonomic folding tables. My role was to act as the lead planner, ensuring that every investment decision, particularly in factory and office infrastructure, would yield maximum value and sustainable growth. This was achieved by meticulously designing capacity, optimizing the facilities layout, conducting thorough cost analysis, and performing a rigorous investment analysis.

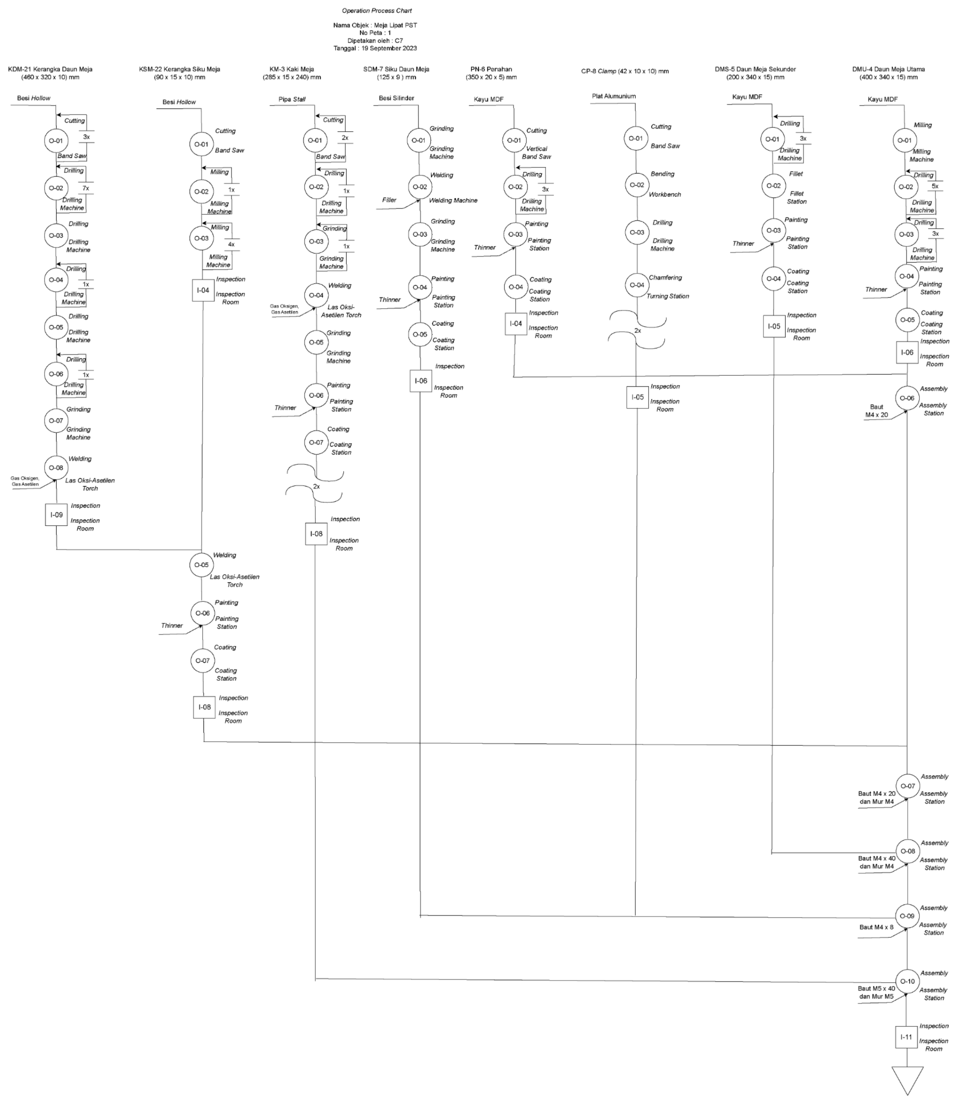
A Holistic Approach to Manufacturing System Design

This extensive project involved a multi-faceted approach to design and optimize an entire manufacturing system. My responsibilities spanned from defining fundamental production processes and designing ergonomic workstations to comprehensive material and capacity planning, strategic facilities layout, and a detailed financial feasibility assessment. The objective was to create an integrated system that ensures efficiency, cost-effectiveness, and responsiveness to market demands for PT. PST's flagship product, the "Meja Lipat PST."

I. Product Definition & Process Foundation

The foundation of the project involved a deep dive into the product itself and its manufacturing processes. The "Meja Lipat PST" is designed to meet the growing demand for flexible workspaces, boasting varied colors, ergonomic design, and features tailored for Work From Home (WFH) professionals. PT. PST aims to produce up to 95,733 units annually.

To understand the entire manufacturing flow, I first developed an **Operation Process Chart (OPC)**. This chart provided a macroscopic view of all operations and inspections involved in producing the folding table, from raw materials like hollow iron, stall pipes, and MDF wood, through various processes like cutting, drilling, milling, welding, grinding, painting, and assembly.



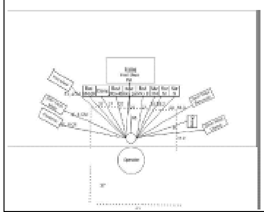
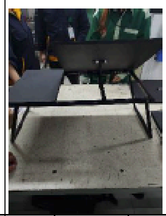
- **Operation Process Chart for Meja Lipat PST:** *An excerpt of the Operation Process Chart for Meja Lipat PST, mapping all operations and inspections from raw materials to final product.*

Complementing the OPC, an **Assembly Chart** was constructed, illustrating the hierarchical structure of how individual components and sub-assemblies come together to form the final product. This defined the bill of materials (BOM) and the sequence of assembly operations. Further detailing the manufacturing steps, **Routing Files** were developed, which specified each operation, its corresponding work center, and crucial time data such as setup time and run time per unit. These routing files were essential inputs for all subsequent planning activities.

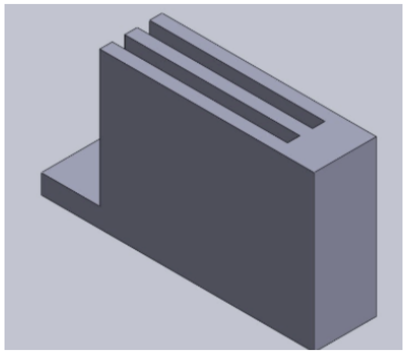
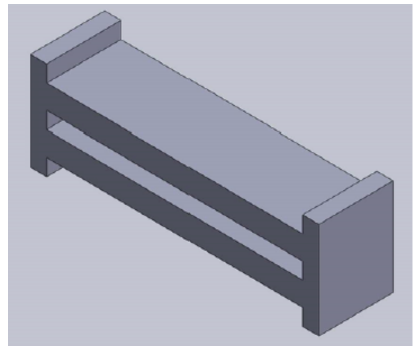
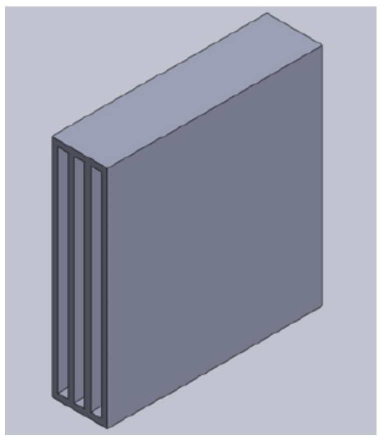
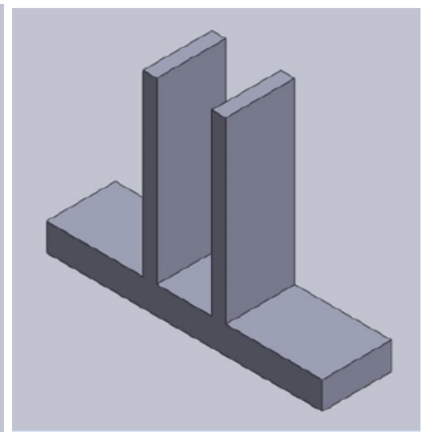
II. Optimizing Work Systems: Ergonomics and Micro-Efficiency

To ensure efficiency at the granular level, I focused on designing optimal work systems that prioritize operator well-being and productivity.

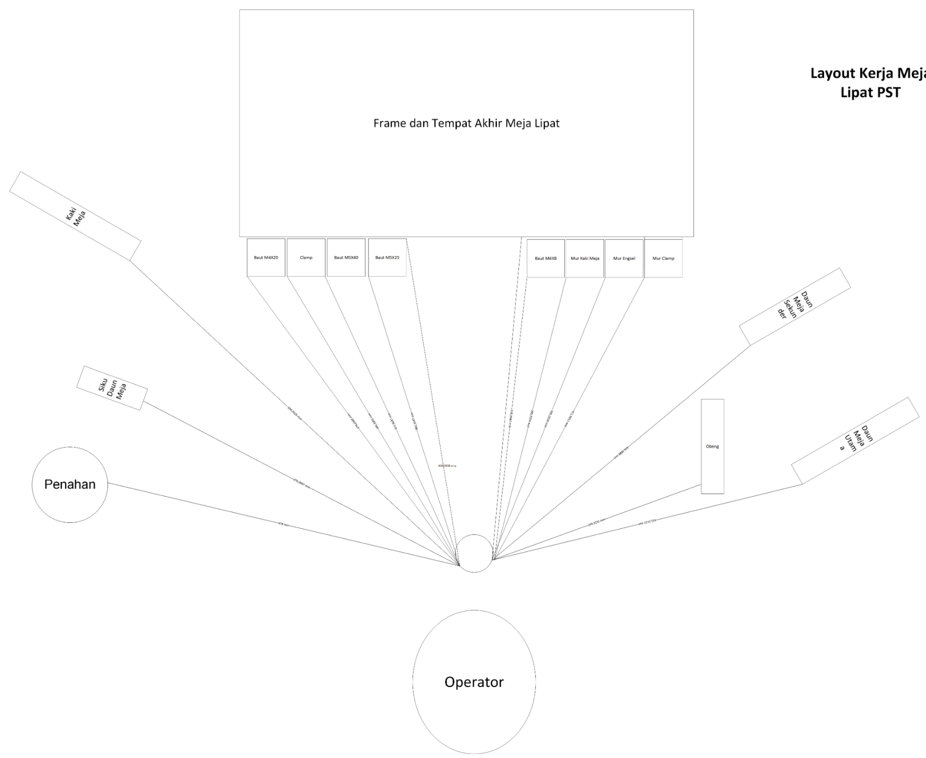
- **Workstation Design:** I analyzed initial assembly workstation layouts and identified inefficiencies like excessive reach distances. I then iteratively designed improved layouts, culminating in a semi-circular arrangement (Layout 3) that placed components within optimal reach. This ergonomic redesign significantly reduced assembly time from 11 minutes 4 seconds to **7 minutes 14 seconds**.
  - **Layout Kerja Meja Lipat PST (Proposed Layout 3):** *The final proposed workstation layout for Meja Lipat PST assembly, designed for optimal operator reach and component placement.*
- **Method Study (SIMO Chart Analysis):** I utilized SIMO (Simultaneous Motion) Charts to perform a detailed breakdown of operator hand movements. By comparing initial and proposed charts, I eliminated non-value-added motions (e.g., "avoidable delay") and refined the sequence of operations, leading to more active and less idle hand movements for operators and a substantial reduction in assembly duration.

							
Tangan Kiri	Jarak (cm)	Waktu (s)	Lambang		Waktu (s)	Jarak (cm)	Tangan Kanan
1. Memasang penahan pada daun meja utama dengan sekrup							
Mengambil penahan	47.8	2	Re G M	Re G M	2	41.2	Mengambil daun meja utama
Memposisikan daun meja utama dan penahan	0	3	P RI	P RI	3	0	Memposisikan daun meja utama dan penahan
Mengambil sekrup 1	27	1.2	Re G M	H	8	0	Memegang kesatuan daun meja utama dan penahan
Memasang sekrup 1	0	7	P A RI				
Memegang kesatuan daun meja utama dan penahan	0	8	H RI	Re G M	1.2	15	Mengambil Obeng
				P U A RI	7	0	Mengencangkan sekrup 1
Mengambil sekrup 2	27	1.2	P A RI	H	10.2	0	Memegang kesatuan daun meja utama dan penahan
Memasang sekrup 2	0	9	Re G M				
Mengambil sekrup 3	27	1.2	P A RI	M	1.2	0	Menggerakkan tangan
Memasang sekrup 3	0	4	Re G M	H	11.2	0	Memegang kesatuan daun meja utama dan penahan
Mengambil sekrup 4	27	1.2	P A				

- **Tool Aids Design:** To further streamline assembly, I designed five specific tool aids, including holders for table leaves, frames, and legs. These tools were designed to position components optimally, reducing manual effort and ensuring consistent quality.

- **Physical Work Environment Design:** I conducted a controlled experiment to measure the impact of lighting and noise on assembly performance. Statistical analysis using Minitab (including normality, homogeneity, and ANOVA tests) revealed that bright lighting and quiet conditions significantly improved assembly speed. The optimal environment was identified as **bright and quiet**, leading to assembly times between 330-358 seconds.
- **Standard Time Determination:** I performed a detailed time study using the stopwatch method, collecting 30 data samples for each of the 8 assembly elements.
    - **Data Validation:** All data were validated for normality and sufficiency.
    - **Cycle Time (Ws):** Calculated the average time for each element.
    - **Normal Time (Wn):** Derived by multiplying cycle time by a performance rating factor, which was determined using a dual approach (subjective Westinghouse Method and objective Objective Method) to minimize bias.
    - **Standard Time (Wb):** Calculated by adding allowances for personal needs, fatigue, and delays to the normal time. For example, the standard time for Element 1 was calculated to be **89.706 seconds**. This established a realistic benchmark for labor capacity.



III. Production Planning & Capacity Management: Macro-Level Orchestration

Building upon the detailed process analyses, I designed robust production planning and capacity management strategies.

- **Sales and Operations Planning (SOP):** I developed and compared three aggregate production plans: Chase, Level, and Mixed. The **Chase Strategy was selected** as the most cost-effective approach, with the lowest annual aggregate cost of `Rp 14,672,166,000` by aligning production rates with fluctuating demand, thereby minimizing inventory costs.
- **Master Production Schedule (MPS):** Using the Chase Strategy, I created a detailed MPS for each product variant, defining precisely what and when to produce to meet monthly sales targets (e.g., 5,420 units in January, 10,480 in June).
- **Material Requirement Planning (MRP):** To support the MPS, I implemented MRP to manage all 'make' and 'buy' components, raw materials, and auxiliary materials. I calculated Gross Requirements, Projected Available Balance, and Planned Order Releases across all Bill of Material (BOM) levels, considering specific lead times and lot-sizing rules to ensure timely material availability.
- **Capacity Requirement Planning (CRP):** I validated the MPS by comparing required capacity against available capacity at each work center. This analysis identified a critical bottleneck: the **Drilling Machine showed insufficient capacity** in 9 out of 12 periods. Based on this, I provided a concrete recommendation to **increase the number of drilling machines from 2 to 9**, ensuring the production plan was practically achievable.

- **Drilling Machine Capacity Comparison (Initial):** *A graph illustrating the initial capacity required vs. capacity available for the Drilling Machine, highlighting periods of insufficient capacity.*
- **Perbandingan Capacity Requirements dengan Capacity Available (Rekomendasi):** *A chart showing the improved capacity balance after implementing recommendations, demonstrating sufficiency across all work centers.*

IV. Facilities Layout & Financial Viability: Strategic Integration

Project Conclusion: Tangible Impact and Developed Competencies

The overarching conclusion is that the implementation of the **Group Technology (GT) Layout is the optimal strategic choice for PT. PST**, delivering superior financial returns and operational efficiency. This integrated project, from micro-level ergonomics to macro-level financial strategy, provided a complete and actionable blueprint for the company.

From this project, I gained and honed the following skills:

- **Facilities Layout Design & Optimization:** Expertise in designing comprehensive office and factory layouts to optimize space, material flow, and inter-departmental relationships.
- **Capacity Planning:** Ability to determine precise production capacity, identify bottlenecks using CRP, and design facilities to support target production volumes.
- **Cost Accounting & Analysis:** Proficiency in projecting all cost components to calculate the Cost of Goods Sold (HPP) and inform pricing strategies..
- **Production Planning & Control:** Practical experience in developing SOP, MPS, and MRP, and validating plans through CRP.
- **Work System Design & Ergonomics:** Skills in optimizing work processes using SIMO Charts, designing ergonomic workstations, and assessing the impact of the physical work environment.
- **Strategic Planning:** Ability to integrate various industrial engineering disciplines into a cohesive strategic plan for an entire business.
- **Problem Solving & Optimization:** Applied analytical thinking to identify optimal solutions for complex operational and financial challenges.
- **Technical Communication:** Effectively translated complex technical and financial analyses into clear, actionable business recommendations.

This comprehensive project represents an invaluable practical experience in applying integrated industrial engineering principles to solve complex business challenges, underscoring my dedication to operational excellence and my capability to deliver solutions that drive efficiency and profitability.