Models of the manufacturing system components: SD - VSM integration

Paweł Litwin
Rzeszów University of Technology

Co-funded by the European Union

TET - The Evolving Textbook
Project no: 2022-1-SI01-KA220-HED-000088975

Presentation Overview

Agenda:

1. Introduction: the importance of cost reduction and efficiency in industries.
2. Value Stream Mapping (VSM)
3. System Dynamics (SD)
4. Integration of VSM and SD
5. Case Study: A real-world application in the automotive industry.
6. Benefits, Challenges, and Future Applications

Introduction

- **Why Efficiency Matters**:
  - Manufacturing competitiveness relies heavily on **cost control and process efficiency**.
  - Examples: Industries face high inventory holding costs and production delays due to bottlenecks.
- **Challenges**:
  - Overproduction: Making more than needed.
  - Long Lead Times: Delays in production due to inefficiencies.
- **Role of VSM and SD**:
  - VSM visualizes and identifies waste.
  - SD models dynamic changes to improve predictions and outcomes.

What is Value Stream Mapping (VSM)?

- **Definition**: VSM is a lean tool that maps all steps in a process, from start to finish, to identify and eliminate inefficiencies.
- **Key Components**:
  - **Current State Map (CSMap)**: Highlights bottlenecks, waste, and delays.
  - **Future State Map (FSMap)**: Proposes an ideal, optimized process.
- **Purpose**: Simplifies complex workflows by offering a clear visualization.
- **Example**: A VSM of a manufacturing line may reveal that excessive WIP (Work-In-Progress) slows down overall production.

Applications of VSM

WASTE IDENTIFICATION: OVERPRODUCTION, WAITING, ETC.

OPTIMIZING INVENTORY LEAD TIMES AND FLOW.

IMPROVING MANUFACTURING PROCESSES.

System Dynamics (SD) Overview

- **Definition**: SD is a methodology to model, simulate, and analyze systems where variables interact over time.
- **Core Concepts**:
  - **Stocks**: Resources or accumulations (e.g., inventory).
  - **Flows**: Changes in stocks (e.g., production rate).
  - **Feedback Loops**: Reinforcing or balancing mechanisms driving system behavior.
- **Why SD?**: Allows analysis of **time-dependent changes** often missed in static methods like VSM.

Applications of SD

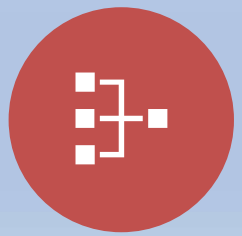
- Dynamic Analysis:
  - Models how systems behave over time, including delays and oscillations.
  - Example: In supply chains, simulating demand fluctuations helps prevent stockouts.
- Operational Change Prediction:
  - Testing the effect of policy changes (e.g., reducing safety stock).
  - Example: A factory changing shift patterns to optimize production.
- Inventory and Production Modeling:
  - Tracks dynamic interactions between production, sales, and inventory.

Integration of VSM and SD

Why Integrate?:

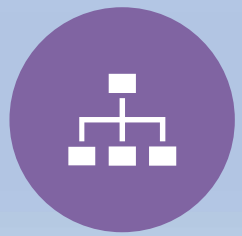
- VSM provides a static snapshot; SD adds a dynamic, predictive layer.
- Combined, they help answer "what if" scenarios for better decision-making.

Example: Enhancing inventory management by combining VSM's flow optimization with SD's simulation of future demand.



COMBINING STATIC AND DYNAMIC ANALYSIS.

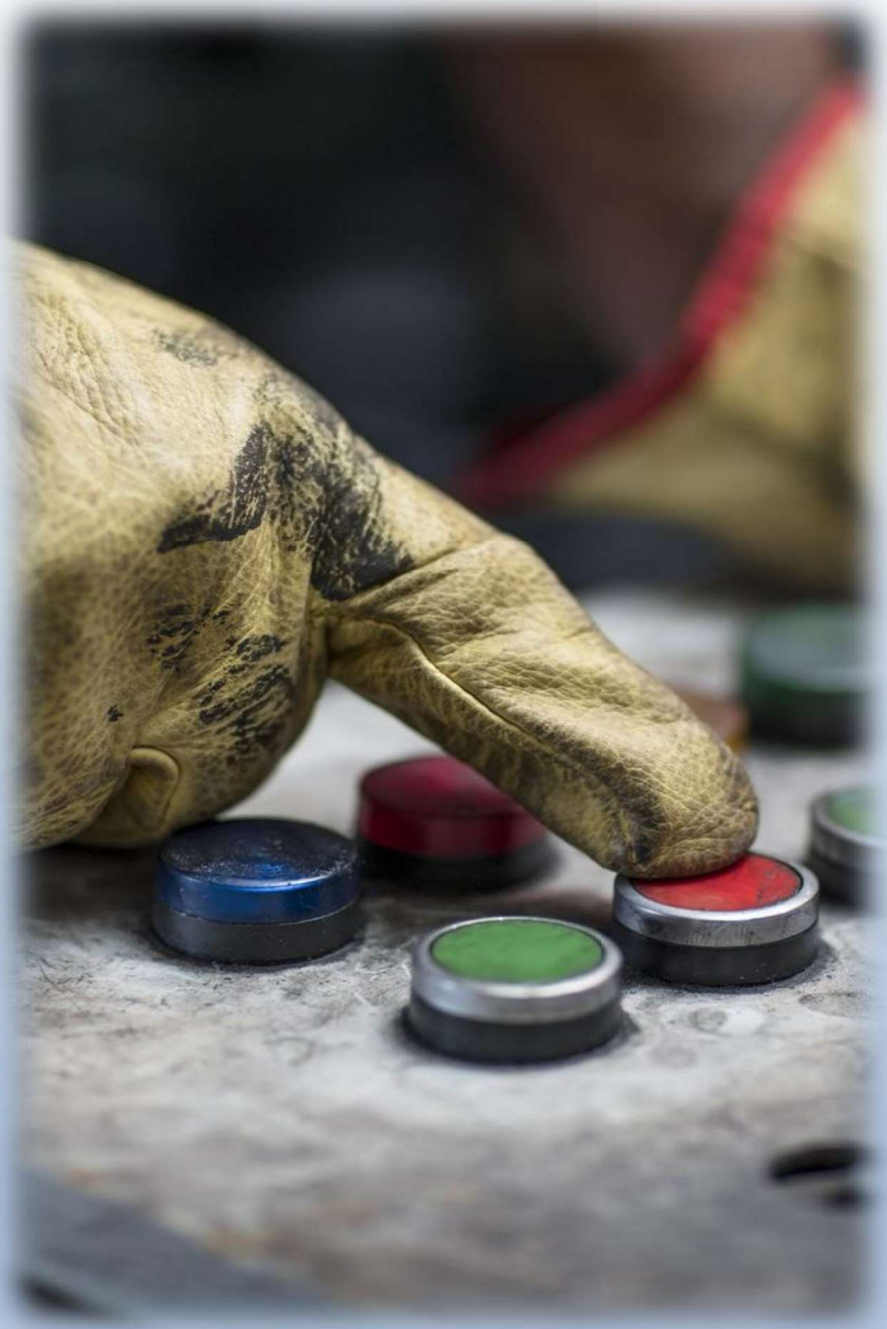
BENEFITS OF INTEGRATION FOR PREDICTIVE ACCURACY AND DECISION-MAKING.



EXAMPLE: ENHANCING INVENTORY MANAGEMENT STRATEGIES.

Case Study
Automotive Industry

- Scenario: Manufacturing door seals for automobiles.
- Objective: Reduce excessive inventory while ensuring consistent production flow.
- Approach: Use VSM to map inefficiencies and SD to model dynamic inventory fluctuations.
- Outcome: Improved scheduling and reduced waste

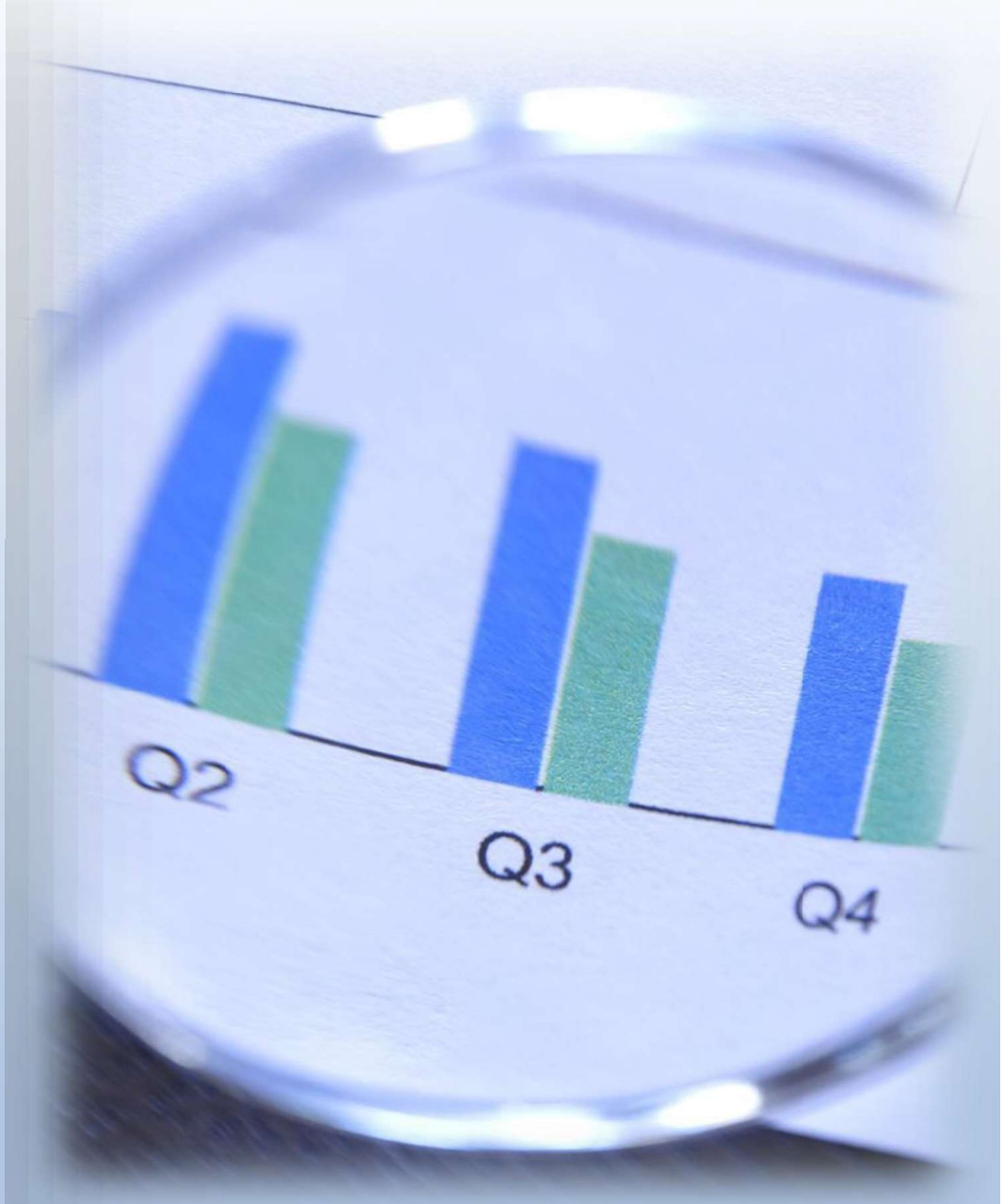


Current State Value Stream Map

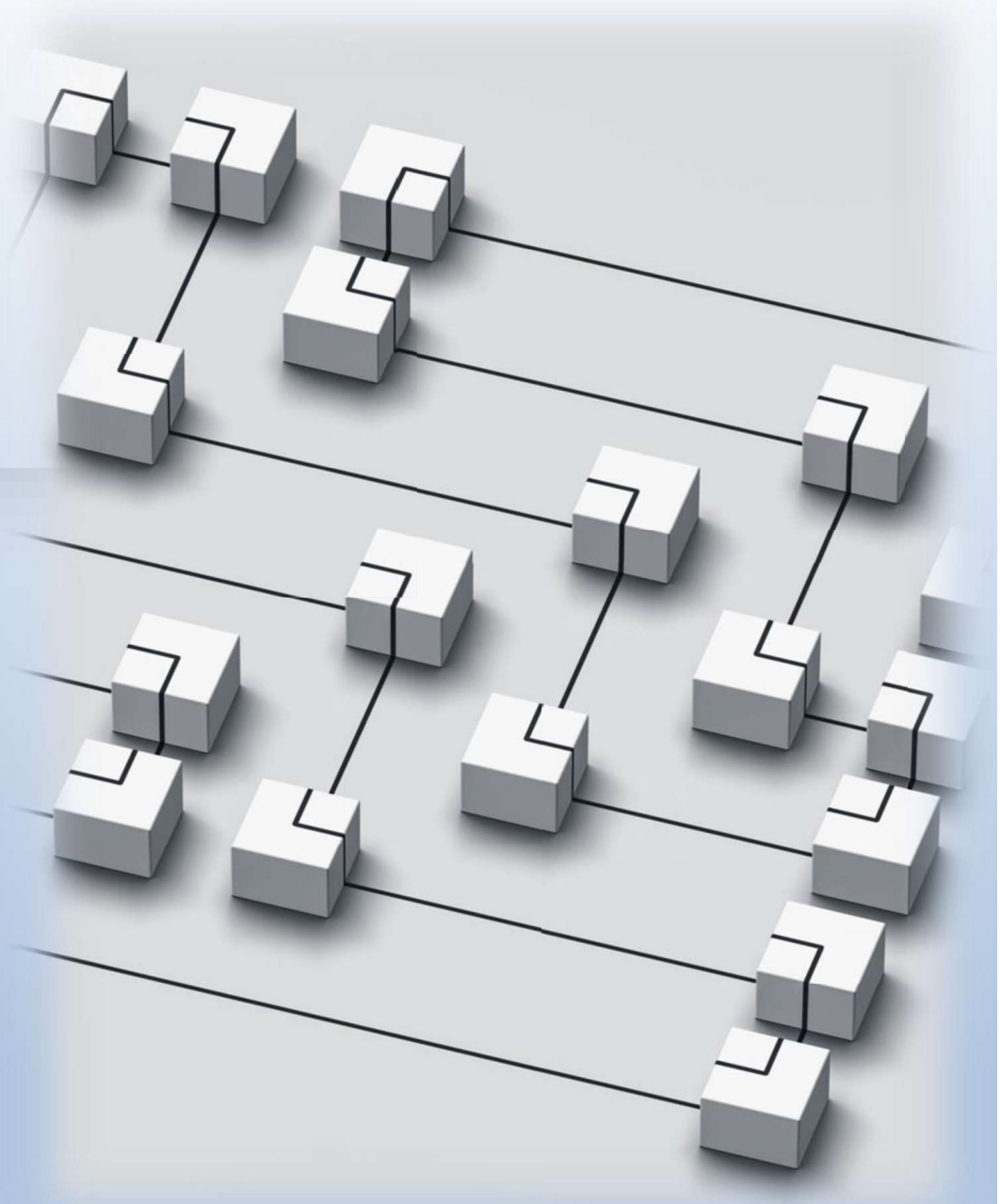
- **Purpose**: Represents the current manufacturing process.
- **Example**: Highlights bottlenecks where machines are underutilized or materials pile up.
- **Insights from CSMap**:
  - Cycle time (time taken to complete a task) might be inconsistent.
  - Excess WIP indicates inefficiency.
  - Example: A bottleneck caused by insufficient capacity of a critical machine.

From Static to Dynamic Analysis

- Limitations of static analysis with VSM.
  - Cannot model time-based variations. Need for dynamic analysis to capture time-based variations.
- Transition to SD modeling for a comprehensive approach.

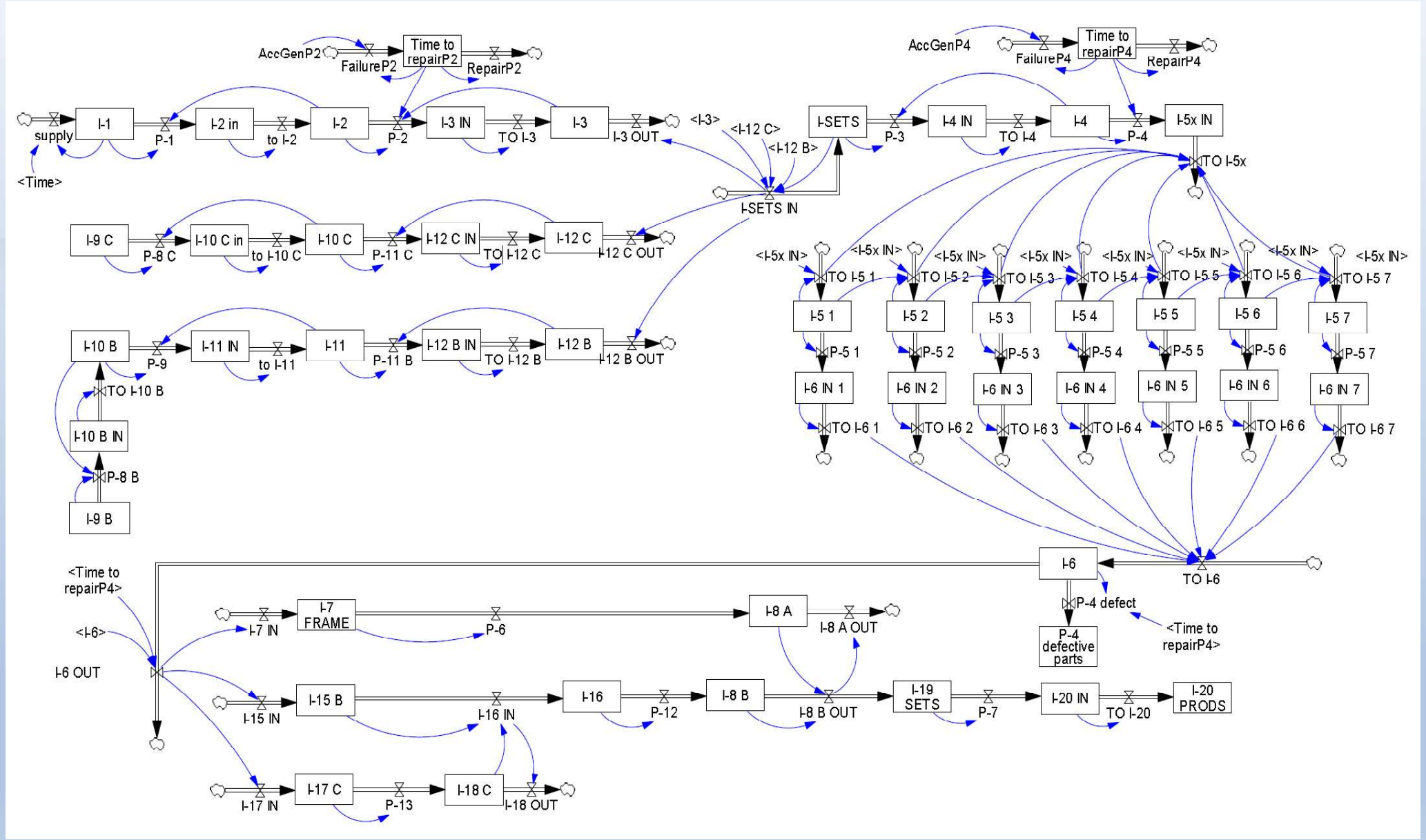


System Dynamics Model for the Case Study



- Structure of the SD model: stocks, flows, and feedback loops.
- Tools like Vensim used for creating and simulating the model.
- Mapping inventory and production dynamics.

System Dynamics Model for the Case Study



Simulation Results: Current State

- Visualization of inventory fluctuations over time.
- Key inefficiencies revealed through simulation.
- Impact of delays on production and costs.

Simulation Results: Future State

- Comparison of current and future state results.
- Reduced inventory fluctuations and lead times.
- Validation of FSMap improvements through simulation.

Future State Value Stream Map

Proposed improvements shown in the FSMap.

Reduced WIP, streamlined workflows.

Techniques like SMED and Kanban for optimization.

Benefits of SD – VSM Integration

- Enhanced decision-making and planning.
- Reduction of waste and improved process visibility.
- Identification of key processes for uninterrupted production flow.

Challenges and Considerations

- Barriers:
  - Model complexity
  - Collecting accurate data set for SD modeling.
  - Example: Errors in cycle time measurement can misguide predictions.
- Solutions:
  - Start with smaller pilot projects
  - Train stakeholders for smoother adoption.

Broader Applications

- Beyond Manufacturing:
  - Healthcare: Optimizing patient flow in hospitals.
  - Retail: Balancing inventory levels in stores.
  - Logistics: Enhancing warehouse management systems.

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