1.1 Background
- The client faces challenges in meeting the rapidly increasing demand for Over-The-Counter (OTC) drugs.
- Demand fulfillment can be achieved by improving the agility and flexibility of the production system to address:
  - Unit Fill Rate (UFR) average 80%
  - Client’s Target: 86% - Dissatisfied customers
  - No flexibility in production schedules
  - Unexpected deviations from forecasted demands

1.2 Objectives
- Establish an analytical relationship of how demand variance and production variance affect service levels.
- Quantitatively analyze the production system and its capacity, utilization, and bottlenecks.

Goal
Provided demand and production environment data, propose an actionable step that will potentially increase UFR for high demand OTC products.

2.1 Model Production System
1. Data Collection
   - Production Data
   - Demand Data
   - Machine Data
2. Model the System
   - Simulate system behavior to identify benefits without affecting the real system
   - How: by accurately representing the variability and operating policies of the plant via three main components:
     - System Reliability (Probabilistic)
     - Product Arrival Rate (Probabilistic)
     - Machine run-time (Deterministic)

- Model demand distribution based on 12-week schedule and compare actual machine utilization to simulated data (based on five simulation trials).
- Validate model to ensure accuracy of the real world behavior.

2.2 Discrete Event Simulation Model
- Products Entering Simulation
- Queue for processing 1
- Processing 1
- Queue for processing 2
- Processing 2
- Queue for processing 3
- Processing 3
- Queue for processing 4
- Processing 4

2.3 Analysis
1. Validation
   - Processes based on a 12 week deterministic production schedule.
   - Actual machine utilization rates were compared to the simulated utilization rates.
   - Simulated utilization results over 5 trials were contained in the 99% confidence interval.

2. Analysis
   - Machine 2, 3, 14, and 15 show highest utilization with less idle time.
   - Duplicating these machines or increasing capacity will improve overall UFR.
   - Highly utilized machines result in low production flexibility during demand surges.

3.0 Analysis

4.0 Results
- Current System: Simulation results observed based on demand distribution for one year (74% demand satisfied)
- Sensitivity Analysis: Duplicating machine based on greatest impact
- Singular Addition (adding one machine): Machine 15 – 11% improvement in demand satisfied
- Multiple Addition (adding multiple machines): Machine 2, 14, 15 – 16% improvement

5.1 Recommendations
- Increase capacity at the highest utilized machine—machine 15
  (+90% utilization)
- Add an additional machine 15 to gain an improvement of 11% with highest marginal return.
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- For 2 machines: Machines 2, 15 (13% improvement)
- For 3 machines: Machines 2, 14, 15 (16% improvement)

5.2 Future Work
- Improve Model Accuracy
- Add resource capability to enhance model accuracy
- Add packaging processes to current batch-processing model
- Expand Project Scope
- Implement project on similar facilities
- Incorporate additional categories of products
- Implementation
- Cost/Benefit analysis for alternative solutions

Stage 1: Understand Problem
Stage 2: Model Problem
Stage 3: Analyze Problem
Stage 4: Perform Sensitivity
Stage 5: Recommendations

Team Members: Ali Sohrabi Araghi, Manorah Pais, and Jovan Sardinha

Supervisor: Prof. Chi-Guhn Lee