Simulation Driven Insights for Strategic Growth and Quality Leadership

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Meet the Presenter

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About Cargill

Learn about the people, organization and values that help us nourish the world in a safe, responsible and sustainable way.

Nourishing the world in a safe, responsible and sustainable way

Cargill is a family company committed to providing food, ingredients, agricultural solutions and industrial products to nourish the world in a safe, responsible and sustainable way.

We sit at the heart of the agricultural supply chain, partnering with producers and customers to source, make and deliver products that are vital for living.

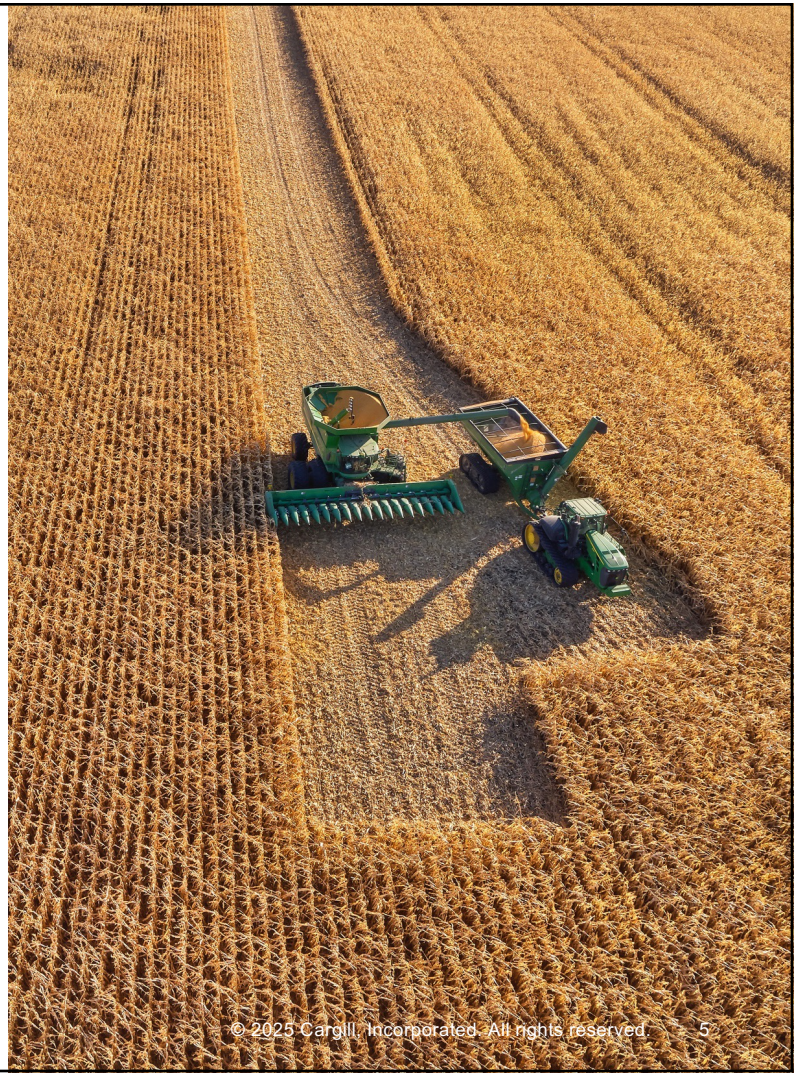
We are…

155K+
Employees

70
Countries

125
Markets

160
Years old



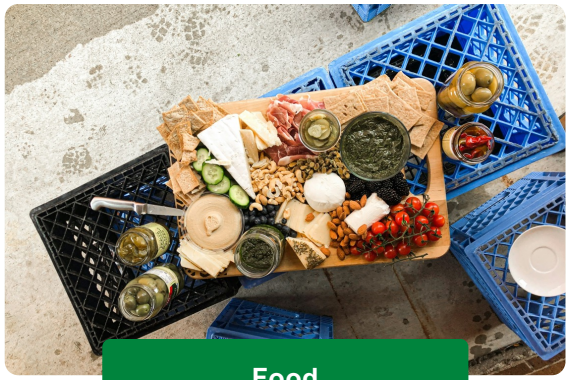
Cargill

65%

EMPLOYEES WORK IN PLANTS

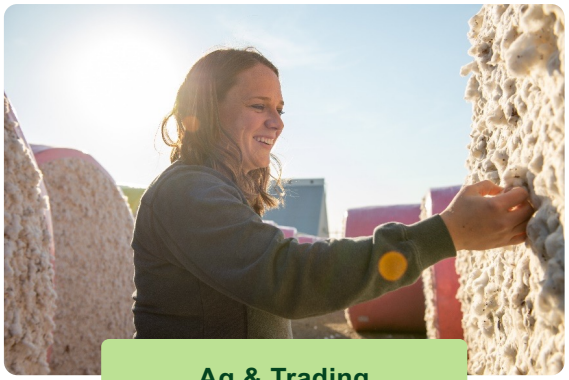
Our 155K+ employees are helping address the largest global challenges in food and agriculture.

Our enterprises: Sourcing, making and delivering vital products



Food

Providing manufacturers, foodservice customers, retailers and consumers with protein products and a range of ingredients and solutions.



Ag & Trading

Connecting farmers and users of grains and oilseeds through sourcing, processing and distribution while providing trading and risk management solutions.

Specialized Portfolio

Serving diverse businesses serving unique customers or markets, including animal nutrition and health, bioindustrial, deicing solutions, and Cargill joint ventures.

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Our customers

Farmers and ranchers

- Crop farmers
- Livestock producers
- Aquaculture farmers
- Distributors

Manufacturers

- Food and beverage
- Feed and pet food
- Industrial
- Cosmetics
- Pharmaceutical

Foodservice

- Chain restaurants
- Independent restaurants
- Distributors
- Non-commercial operators

Retailers

- Grocery store
- Industrial retailers
- Distributors and buying groups
- Small independents
- Online retailers

Consumers

Cargill makes products that touch billions of consumers' lives every day—from food to fibers to flooring.

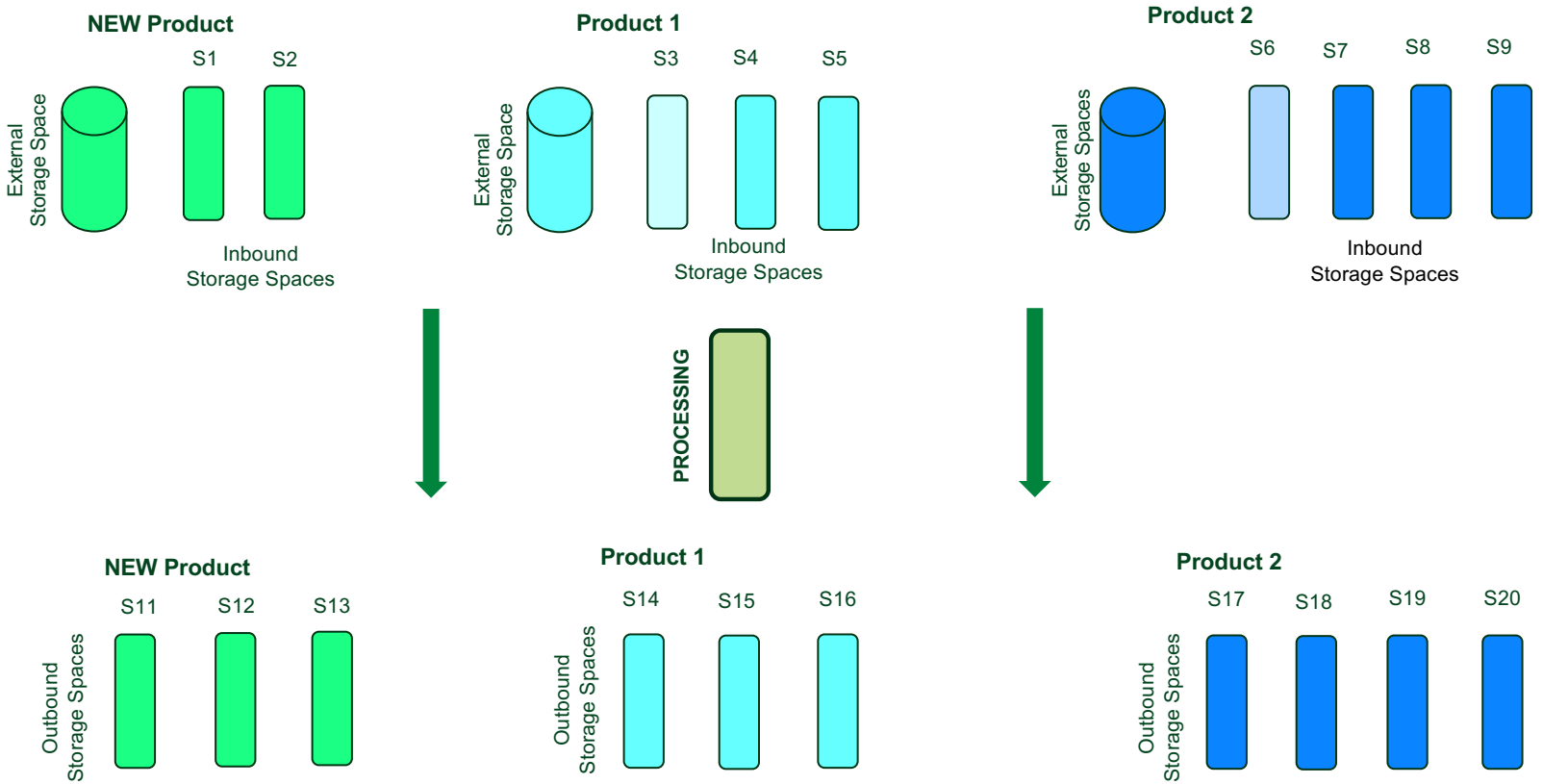
Cargill

Introduction

About Facility

- Current products consistently solve key customer challenges
- Enhancing product quality to exceed customer expectations
- Currently processes two products
  - Infrequently switch between products
- Potential need to run an additional product in the future
- Base decision on simulation results to potentially build additional storage space
  - Inbound raw material and outbound finished product

Facility's Proposed Layout

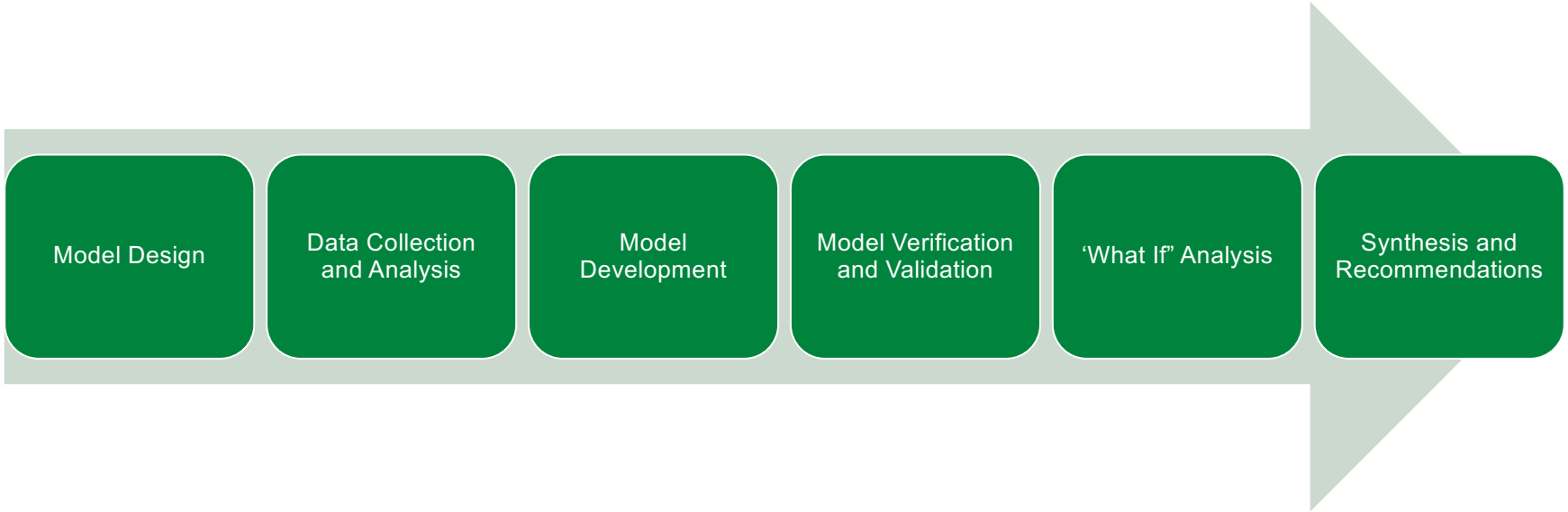


Simulation Objective

- Current inbound raw material and outbound finished material storage spaces are for two products
- Simulate and analyze impact of
  - transitioning from two to three products
  - downtime, scheduled disruption, changes to raw material arrival and dispatch schedule
- Evaluate additional storage spaces and their size required to increase sales and decrease customer disruption risk

Simulation Model Development

Simulation Model Development



Agree on use cases that model will be used for. Decide on scope and level of granularity of simulation model.

Explore the data visually and understand linkages.

Collect data required to populate model. Process and analyze data to transform it into the desired form for the model.

Develop the model code base leveraging existing libraries or writing custom code and then configuring the model to reflect actual operations on the ground and study objectives.

Confirm that model captures relevant system features at agreed upon level of granularity. Run baseline scenario representing historical performance.

Run scenarios individually and jointly to understand impact of changes on system performance in a controlled manner. Run experiments to test improvement hypotheses.

Transparently use the model with the study team to determine how we can most effectively improve system performance and to identify best paths to achieve target results.

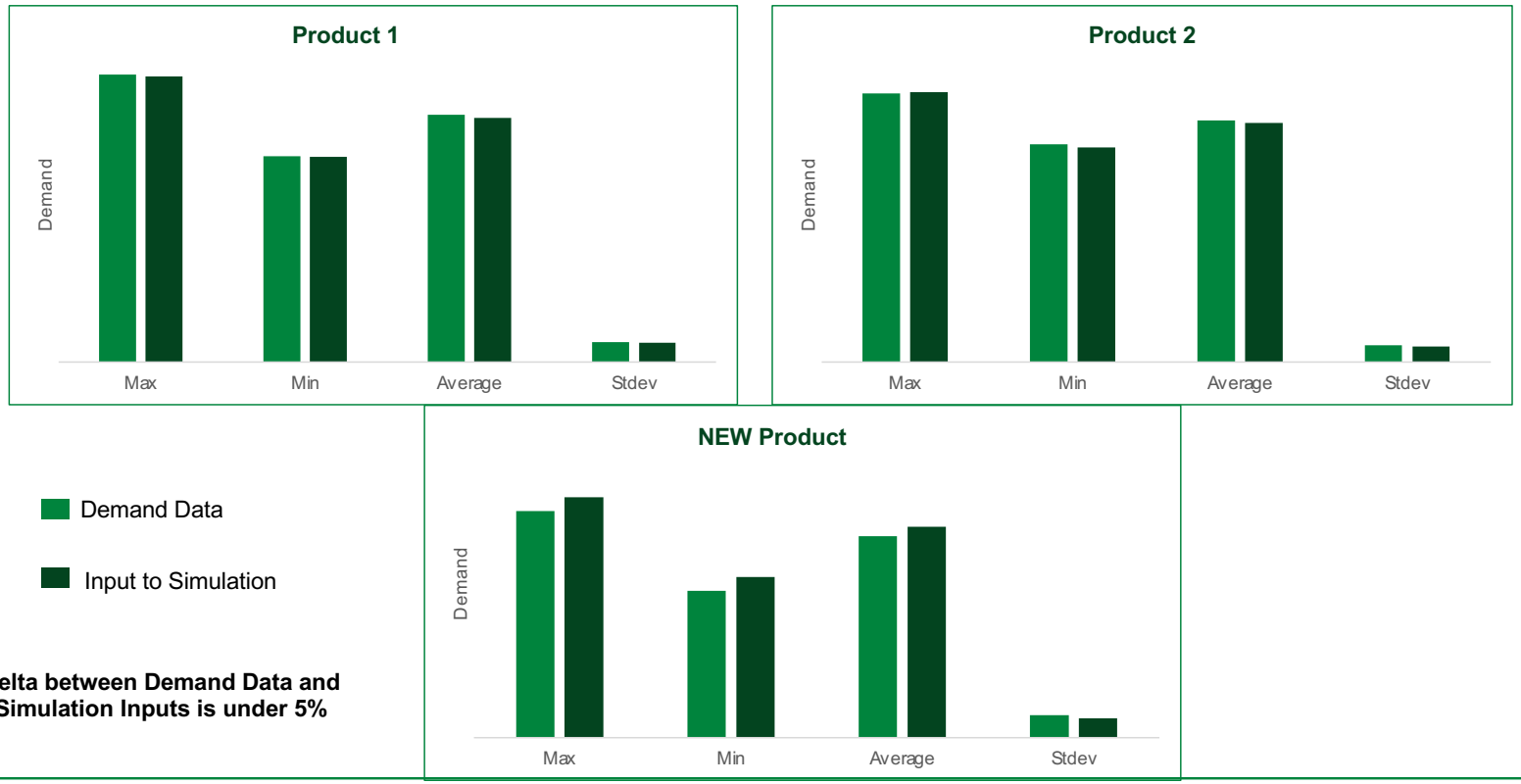
Data Pre-Processing

Input Data

- **Future State Layout – inbound & outbound storages**
- **Inbound Raw Material Arrival Schedule**
- **Monthly Customer Demand**
  - Historical customer demand (used for simulation model validation)
  - Projected monthly customer demand
  - Data Pre-processing – *Day-to-day demand variability built into the data*
- **Processing Rates**
- **Equipment Downtime**
  - Actual downtime data
  - Data cleaning - Downtime removed from data
    - Unscheduled < 10 mins.
    - Scheduled downtimes

Demand Data

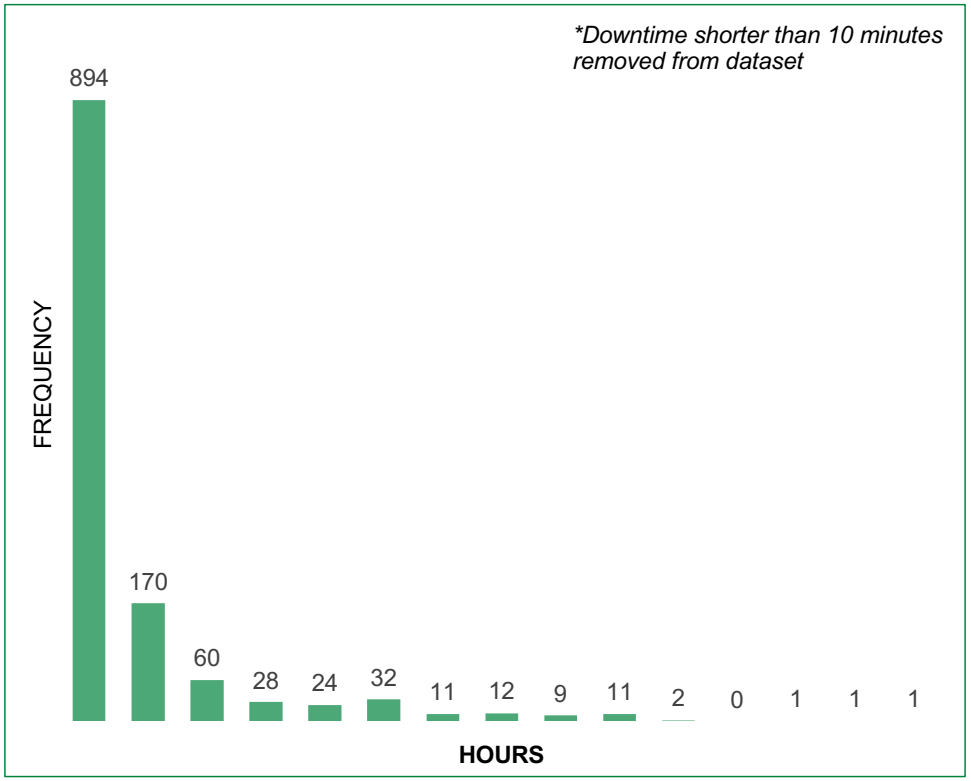
Comparison of weekly projected demand data vs input to simulation model



Delta between Demand Data and Simulation Inputs is under 5%

Equipment Downtime Distribution

Based on historical data



Downtime and Changeover Logics

- **Product goes to reprocessing after downtime**
  - **> 2 hours && < 4 hours**
    - **X** MT product will be sent to reprocessing – during this time, no product will be processed
  - **> 4 hours**
    - **4X** MT product will be sent to reprocessing– during this time, no product will be processed

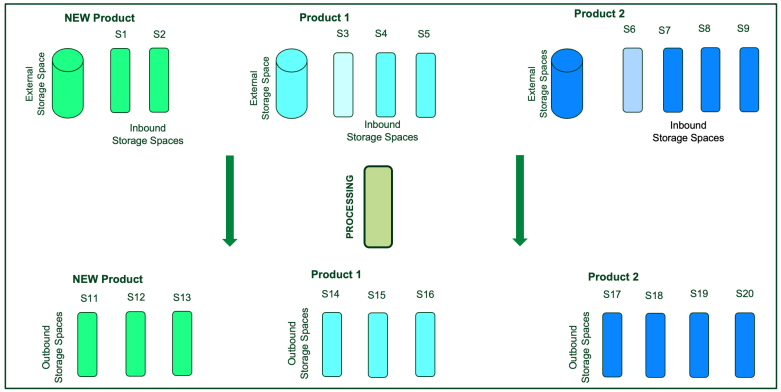
- **Changeover logic**

  After every changeover, last **~Y** MT product in processing will be downgraded with exception of Product 2

  - New Product changeovers to Product 1,
    New Product → Product 1 outbound storage
  - Product 1 changeovers to Product 2,
    Product 1 → Product 2 outbound storage
  - Product 2 changeovers to New Product,
    initial Y MT New Product → Product 2 outbound storage

Dispatch Assumptions

- No outbound storage spaces will receive and dispatch products at the same time
  - Storage spaces will start dispatch only after it is at capacity OR will start receiving only after it is empty
    - There can be exception to these assumptions
- Product dispatch occurs more frequently in the morning than evening
- Carriers for product dispatch are always available



Model Development Using AnyLogic

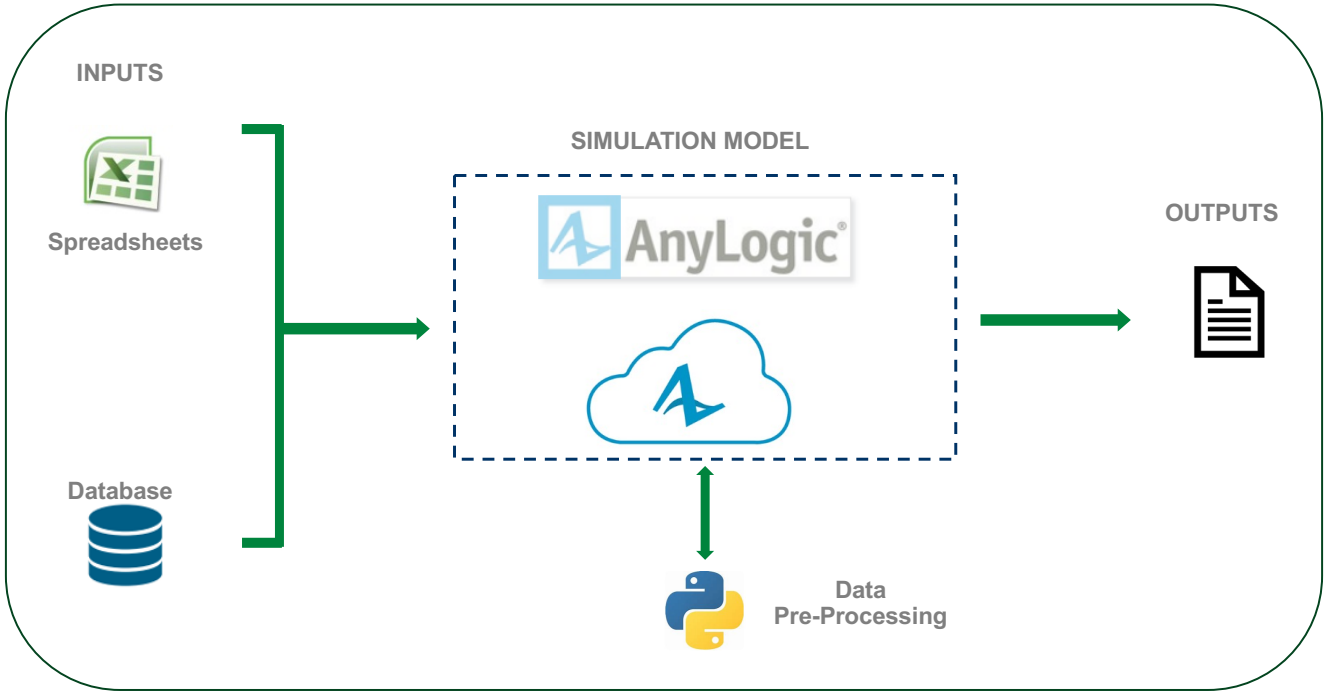
Functionalities

1. **Input data pre-processing**
    1. Python
    2. AnyLogic database

2. **Reading and updating data in AnyLogic**
    1. Inbuilt Java
    2. Query builder

3. **AnyLogic Modeling**
    1. Fluids library
    2. Events
    3. Collections
    4. Datasets

Simulation Model Architecture

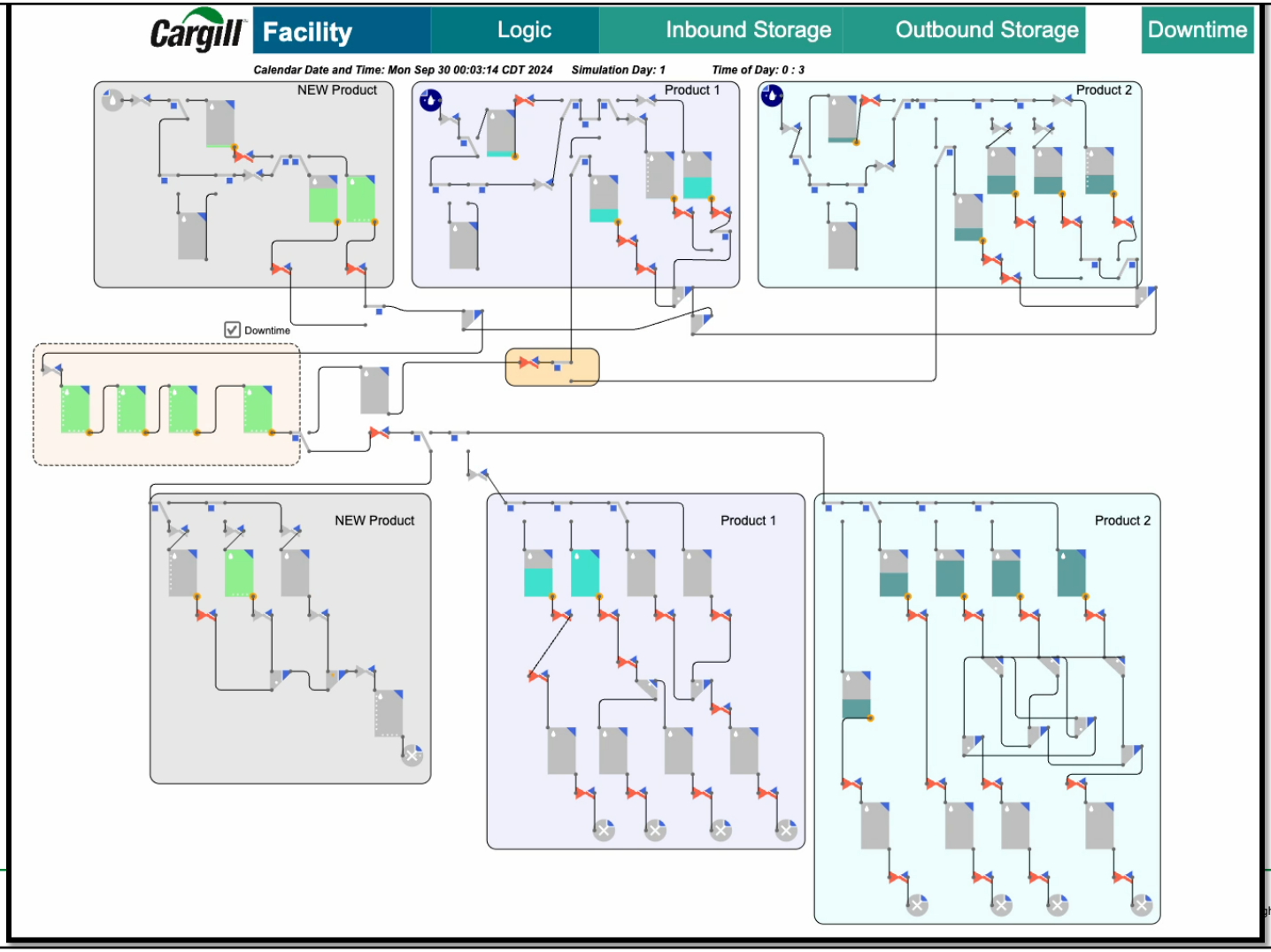


Model Demo

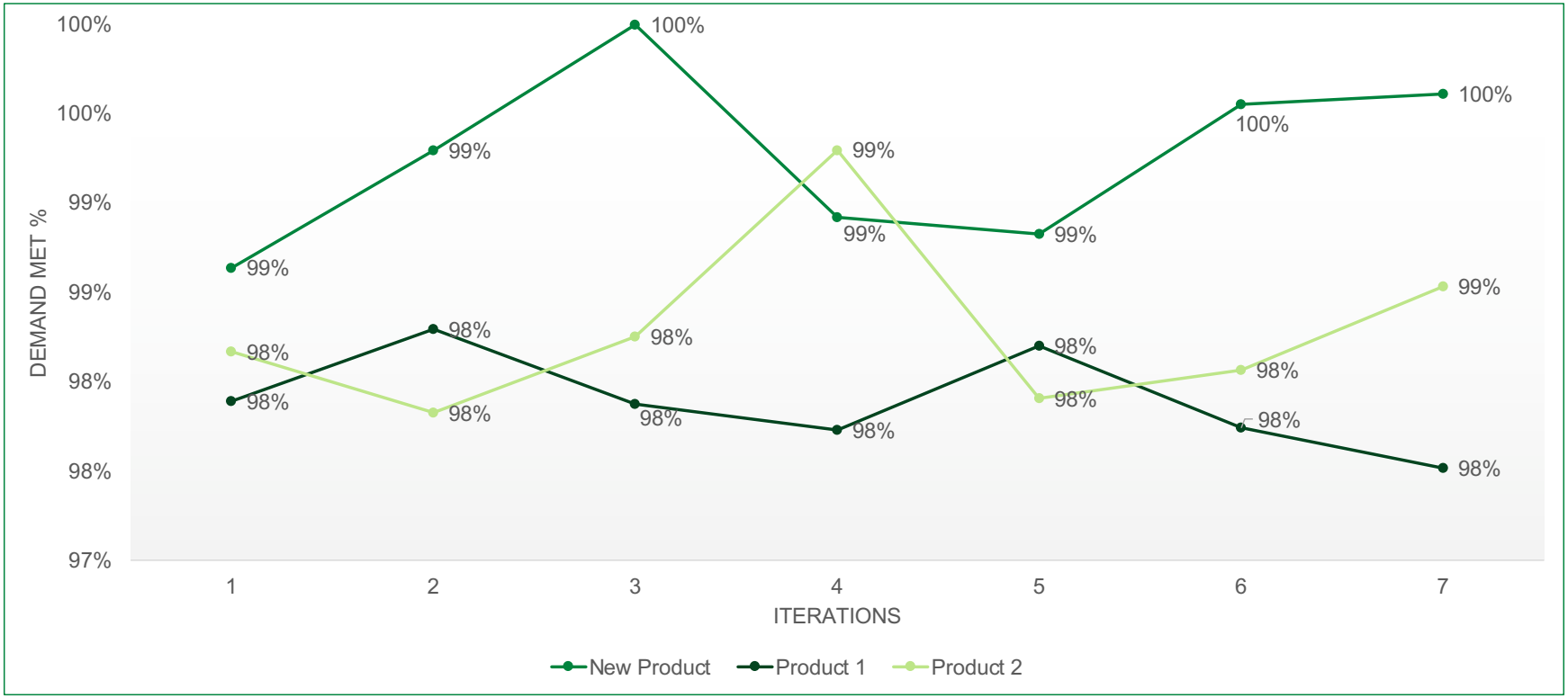
Inbound

Processing

Outbound



Results



Conclusion

- **System Scalability**
  - Third product can be introduced into the system
- **Downtime Sensitivity**
  - Frequent and longer downtimes could impact customer demand
  - Reliability is critical to maintain service levels
- **Changeover Impact**
  - Increased changeover frequency would affect customer demand
- **Storage Capacity Constraint**
  - Facility could benefit from additional storage space for Product 1

Observations on Fluid Library

- Improved Unit Handling
- Enhanced Batch Tracking
- Performance Optimization
- Event Handling in Fluid Systems
- Programmatic Model Expansion
- Hybrid Modeling Challenges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