Lean Services: Creating JIT Services Through Customer Input

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MANAGEMENT

Outline

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- Conclusions
- Next Steps
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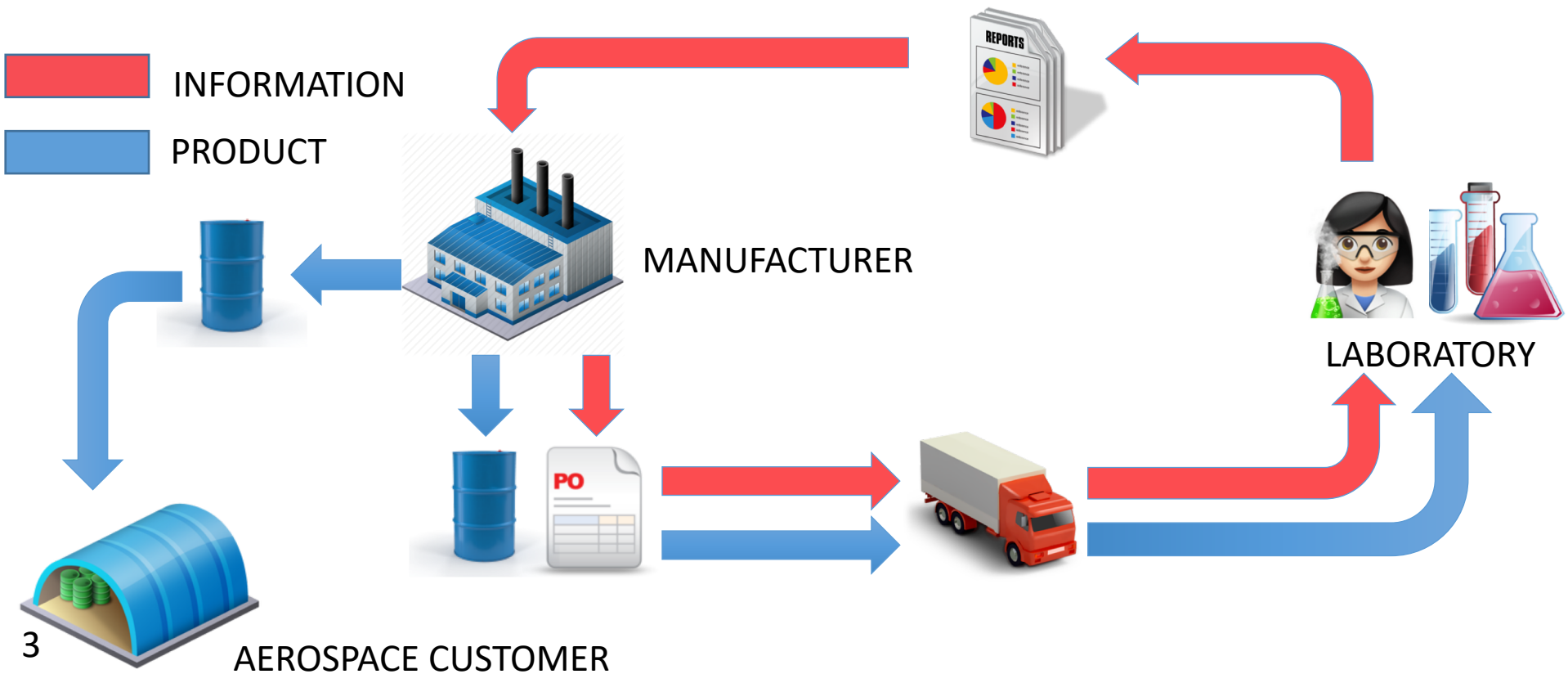
The Supply Chain

- Chemical Manufacturers require their products to pass regulatory testing prior to sale.
- Manufacturers ship samples of a product batch to Testing Laboratories with an attached purchase order.
- Laboratories receive samples, enter PO on sample log, test samples, and send a report.



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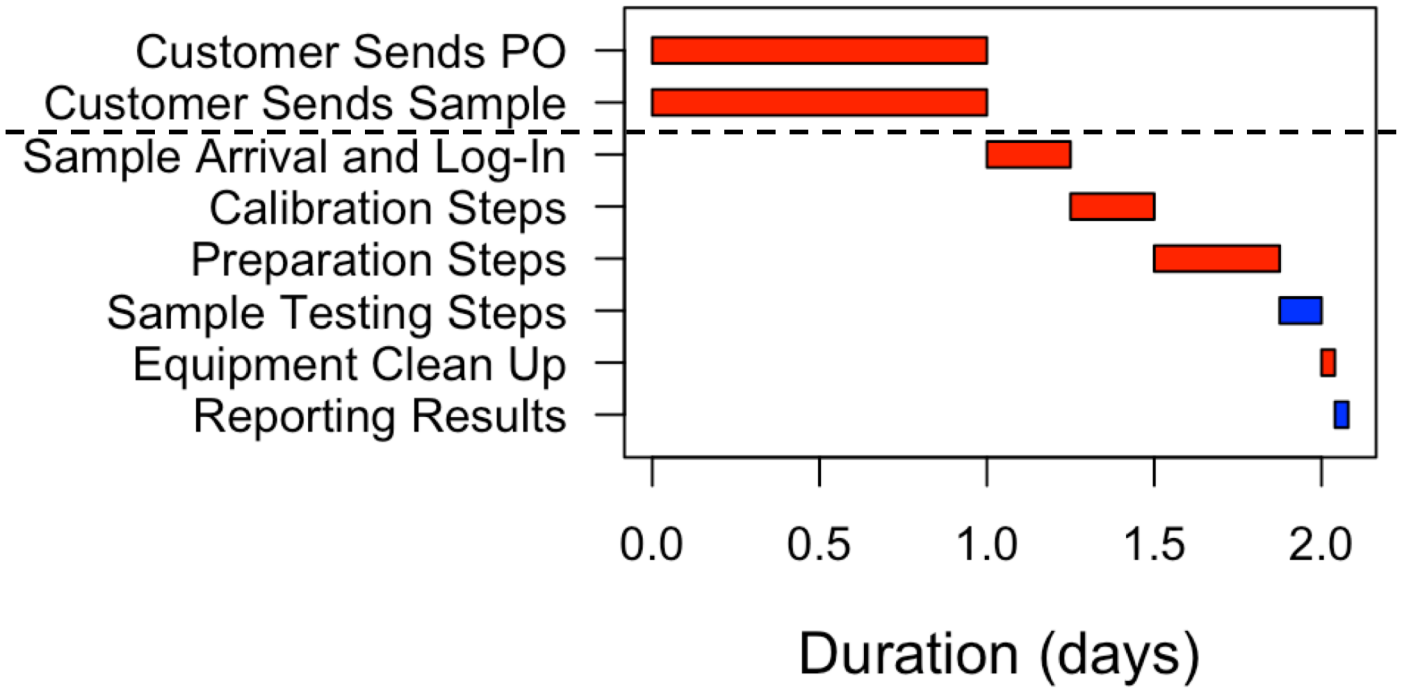
Issues in the Supply Chain

CUSTOMER

LABORATORY



- Customer experiences long lead times
- Laboratory demand planning is challenging, wasteful, and inefficient
- Minimal coordination between lab & customer

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Research Question

Can service lead times be reduced by following a concurrent strategy where the service provider starts the process at the same time the customer sends the purchase order and sample?

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Methodology

Data Collection & Pre-Analysis

- Sources of Data
- Characteristics of Samples
- Survey Design
- Description of KPIs

Clustering

- Clustering Techniques
- Clustering Analysis

Project Evaluation & Review Techniques

- Expert estimations of activity durations
- Networks of historical test methods on each sample

Monte Carlo Simulations

- Design
- Analysis

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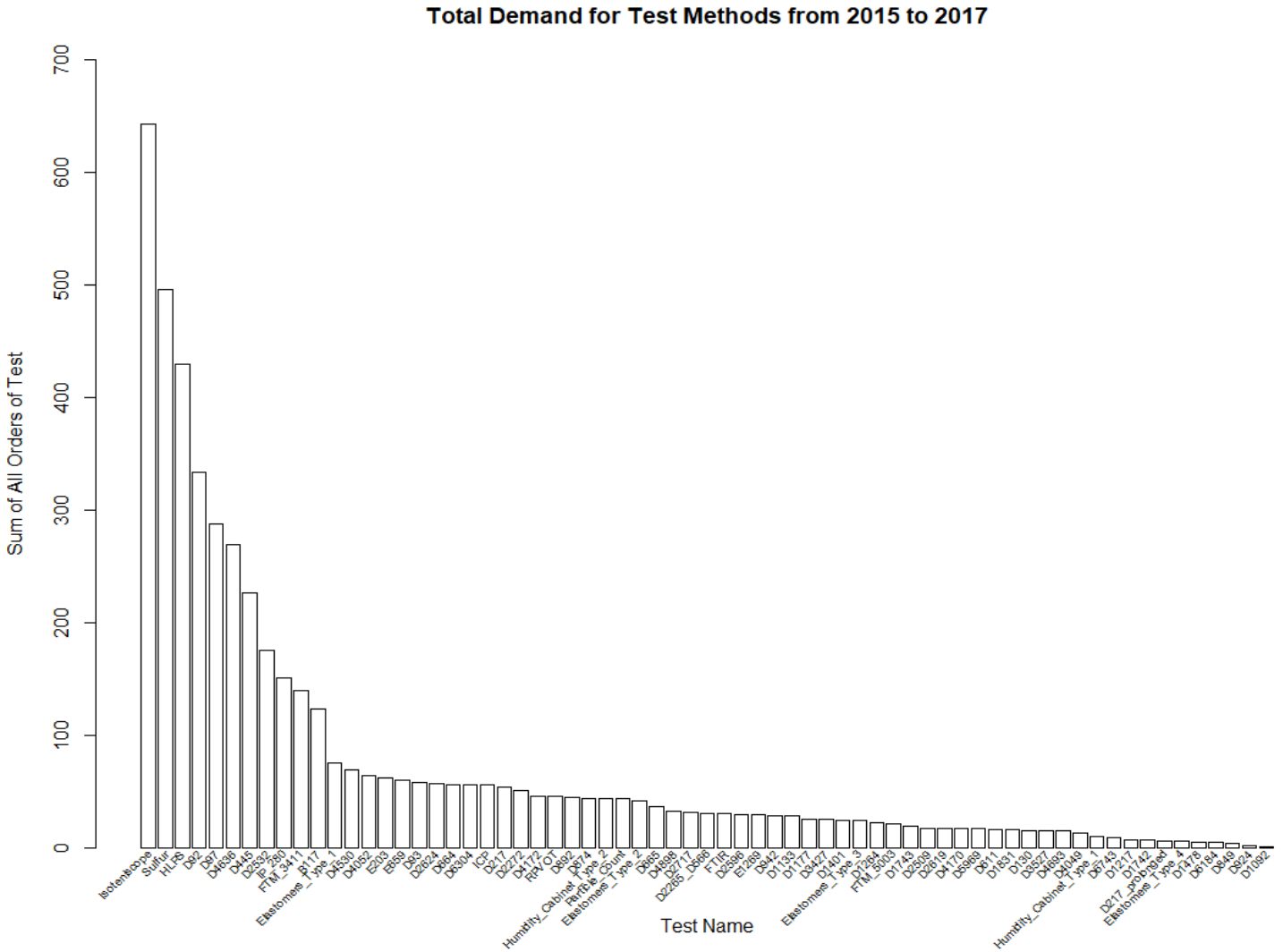
Data Collection



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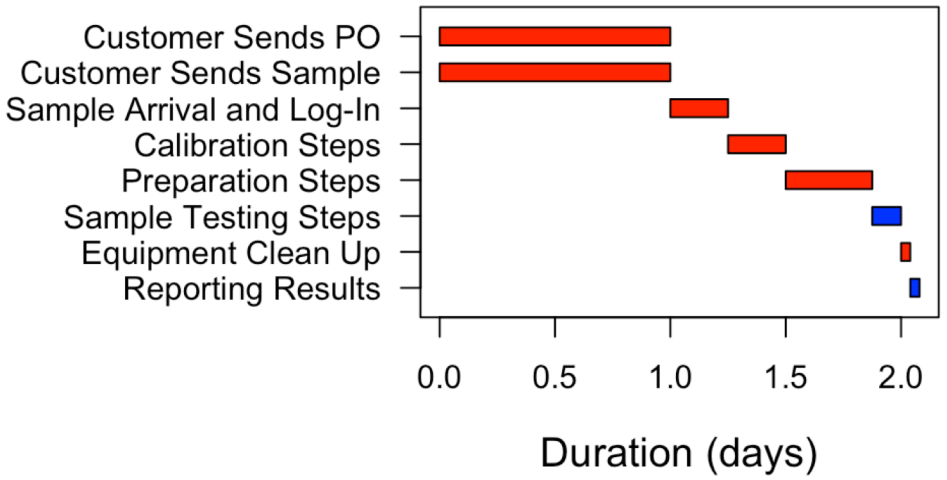
Test Cycle Time

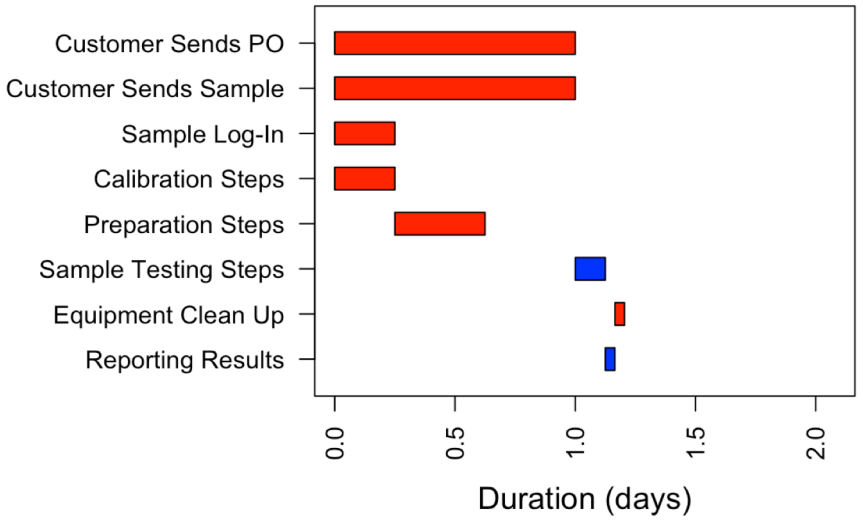
Can be performed before sample arrival

Can only be performed after sample arrival

Extended Cycle Time through Postponement



Reduced Cycle Time through Concurrency



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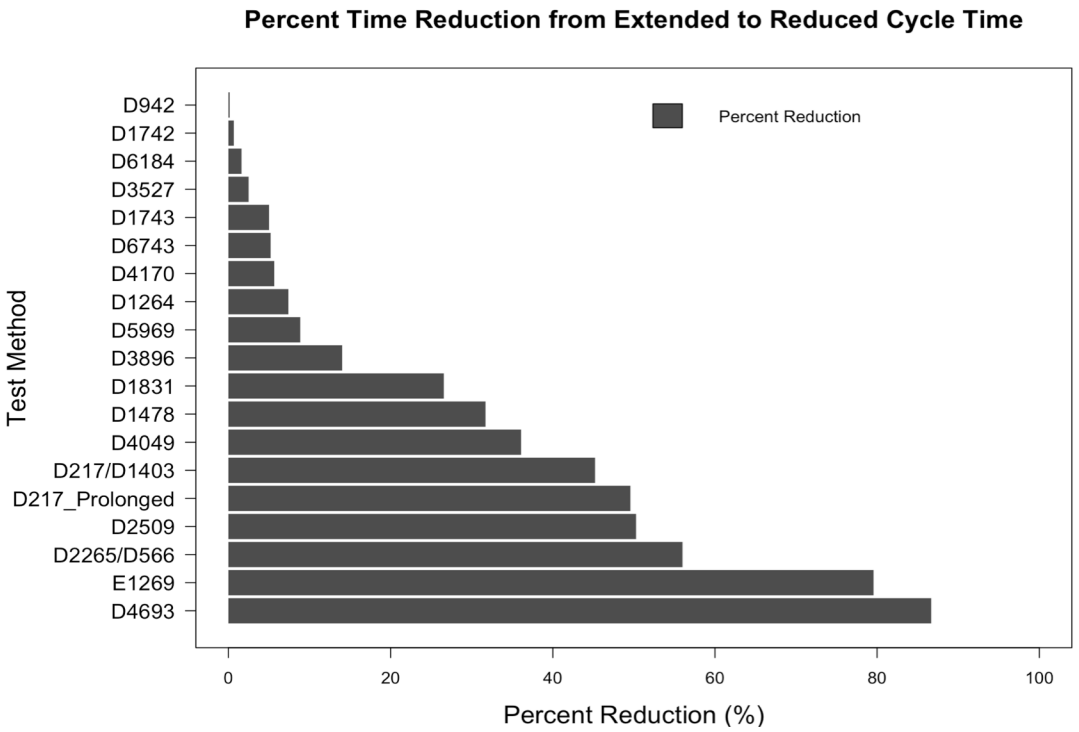
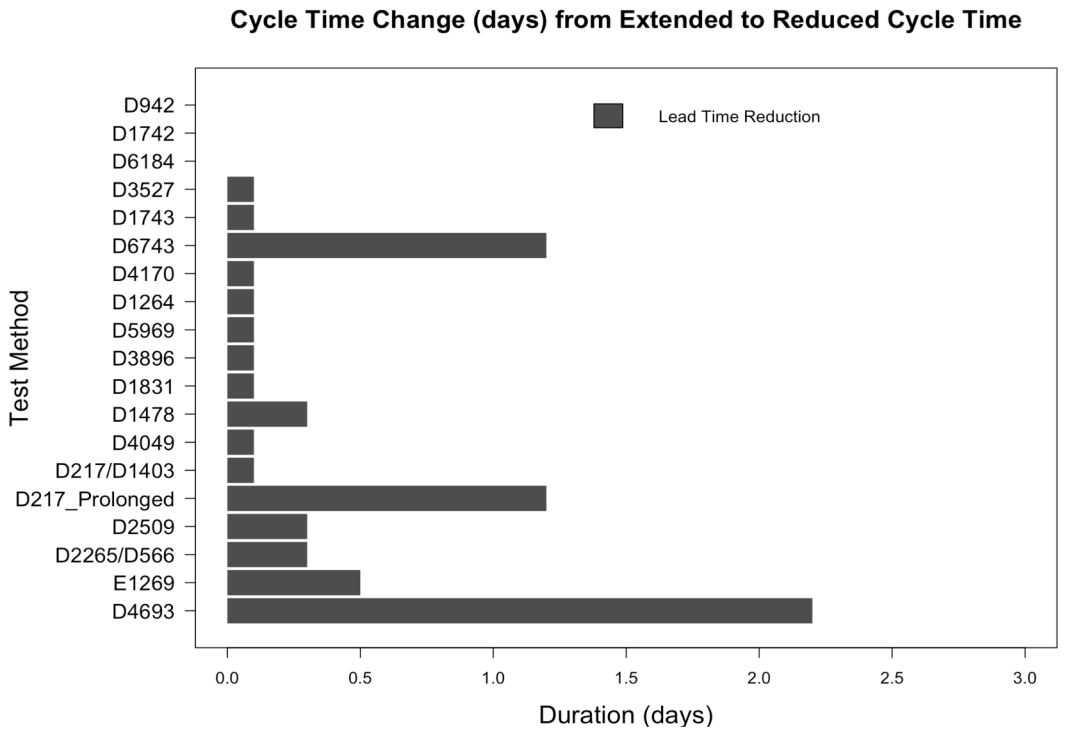
Representative Lead Times





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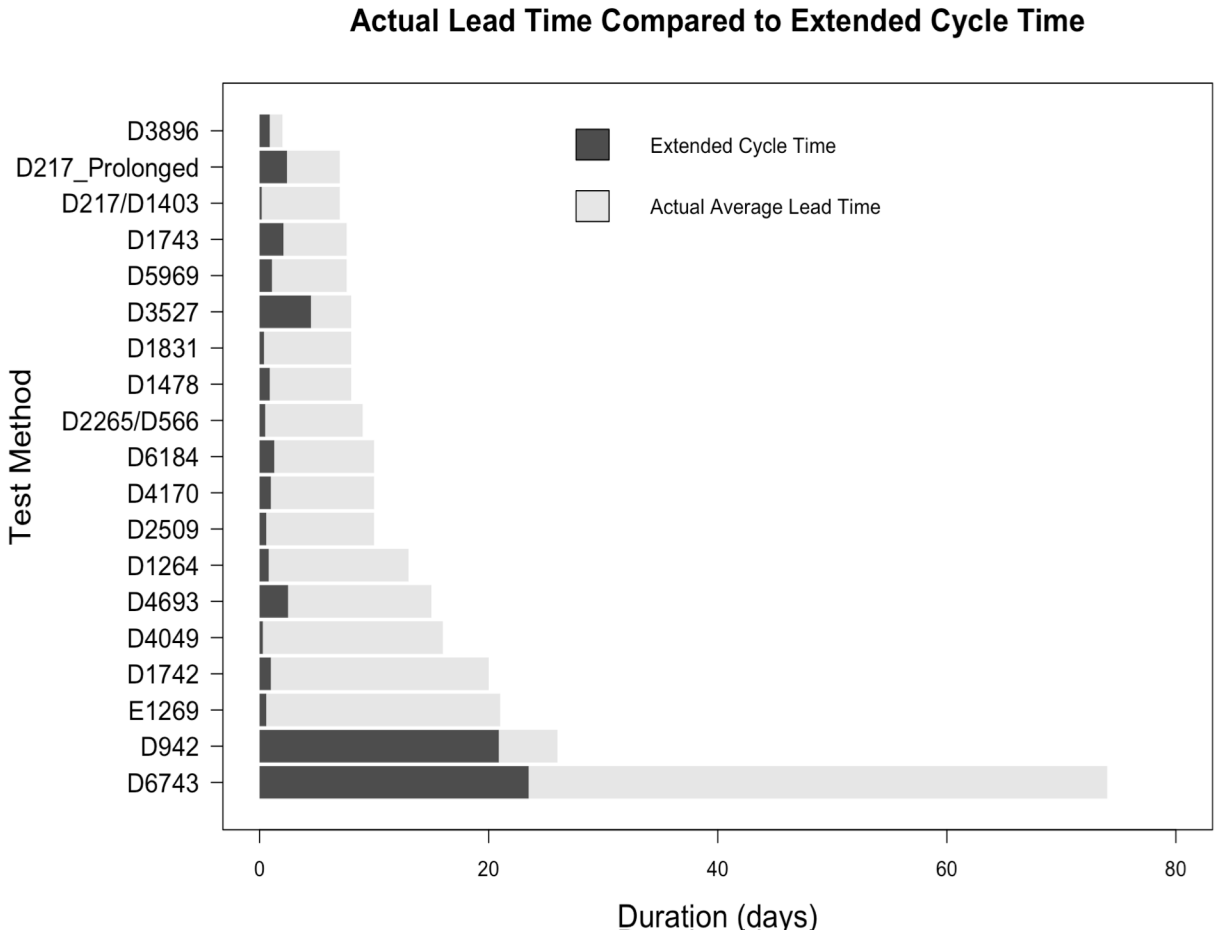
Process Complexity



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Cluster Analysis

	Cluster Type	Test Types
CLUSTER 1	Turbine Oil Tests	22
CLUSTER 2	Petroleum and Synthetic Oil Tests	22
CLUSTER 3	Grease Tests	13
CLUSTER 4	Hydrocarbon Solvent Tests	7
CLUSTER 5	Extreme Environment Grease Tests	2
CLUSTER 6	Historically Run Once as Only Test on a Sample	1
		67

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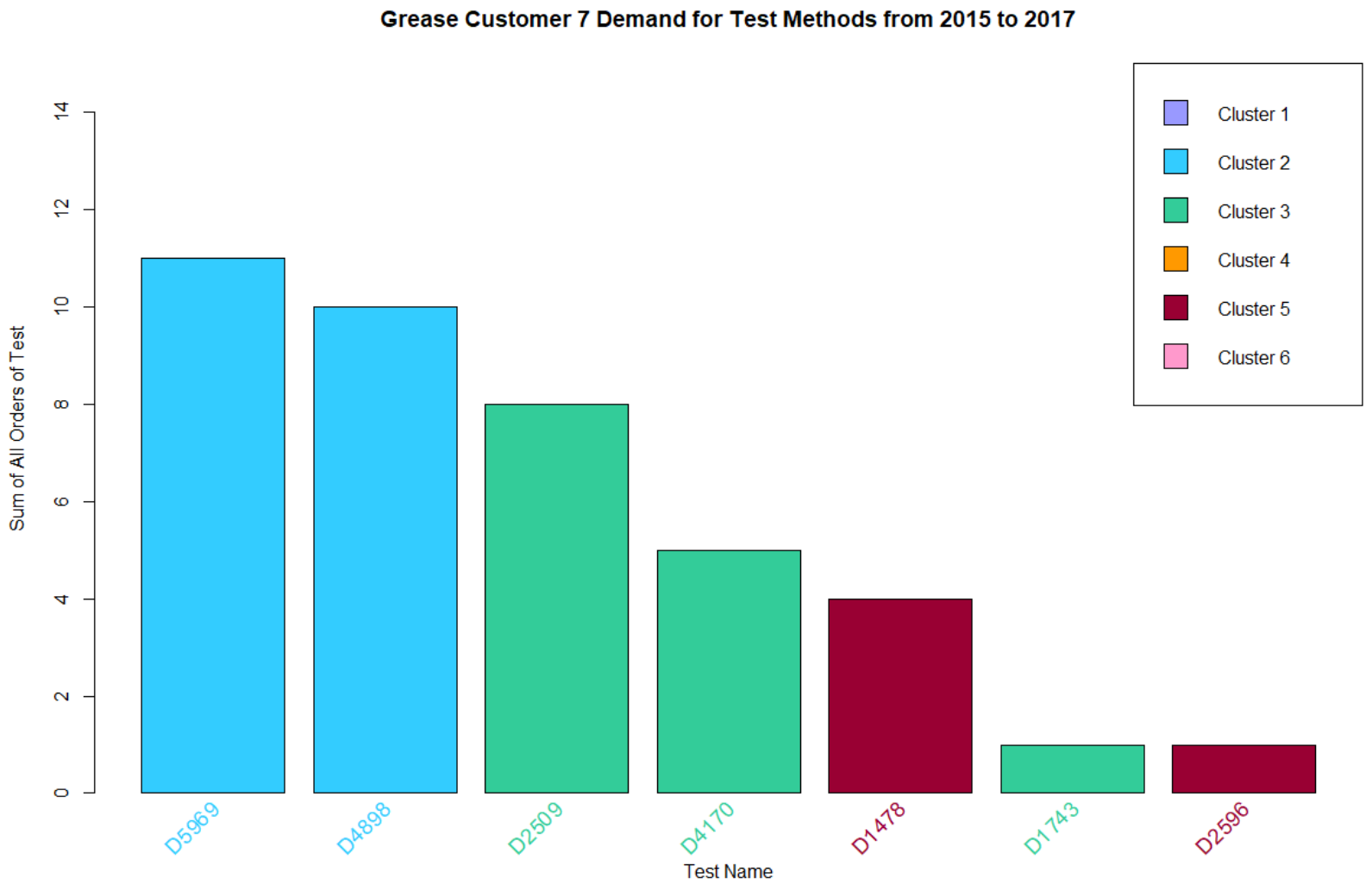
Cluster Analysis



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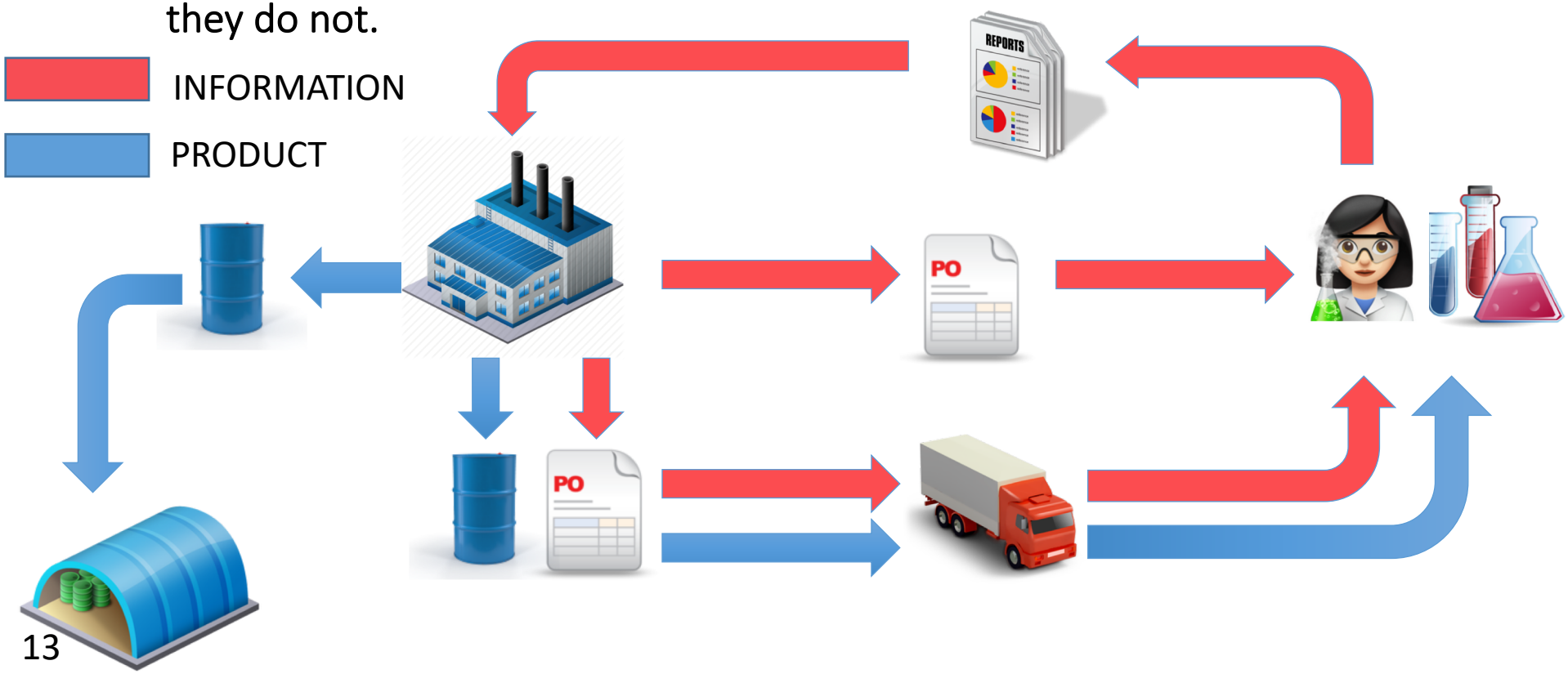
Scenarios

- Samples and Purchase Orders arrive simultaneously, without prior warning.
- Demand for testing arrives in surges, causing high capacity utilization, backlogged tests, longer lead times, and higher rates of human error.
- Manufacturers could send Purchase Orders ahead of time to allow for set up time, but they do not.



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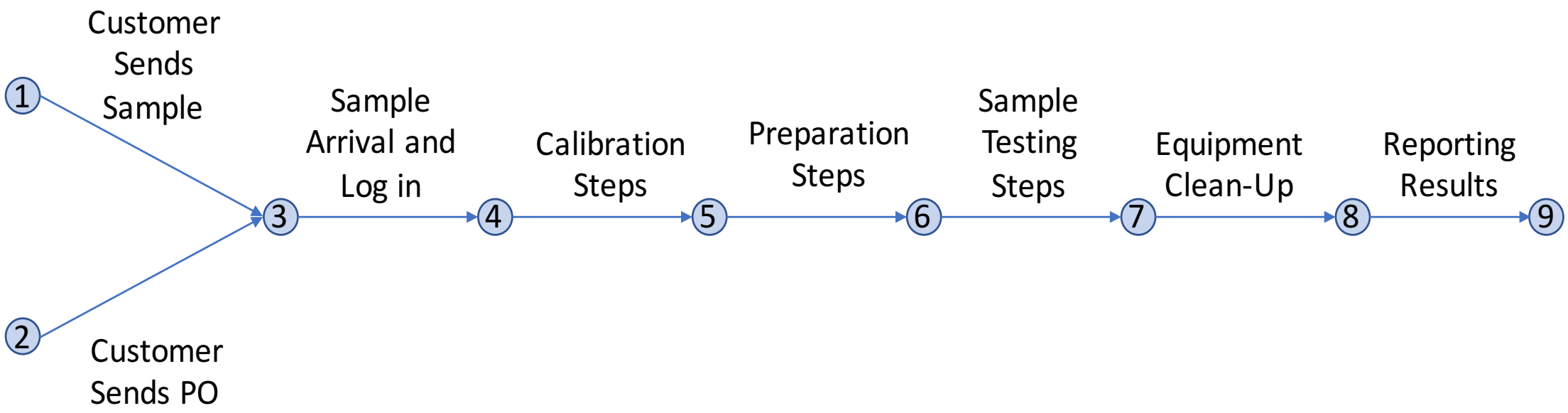
Scenarios

Concurrent Process Step Scenarios		
Scenario	Processes Steps Performed After Sample Arrival	Process Steps Performed During Sample Transit Time
Scenario 1	Dependent Process Steps	Independent Process Steps
Scenario 2	Independent and Dependent Process Steps	None
Scenario 3	Dependent Process Steps	Independent Process Steps and Calibration Steps
Scenario 4	Independent, Dependent, and Calibration Process Steps	None

Project Evaluation & Review Techniques



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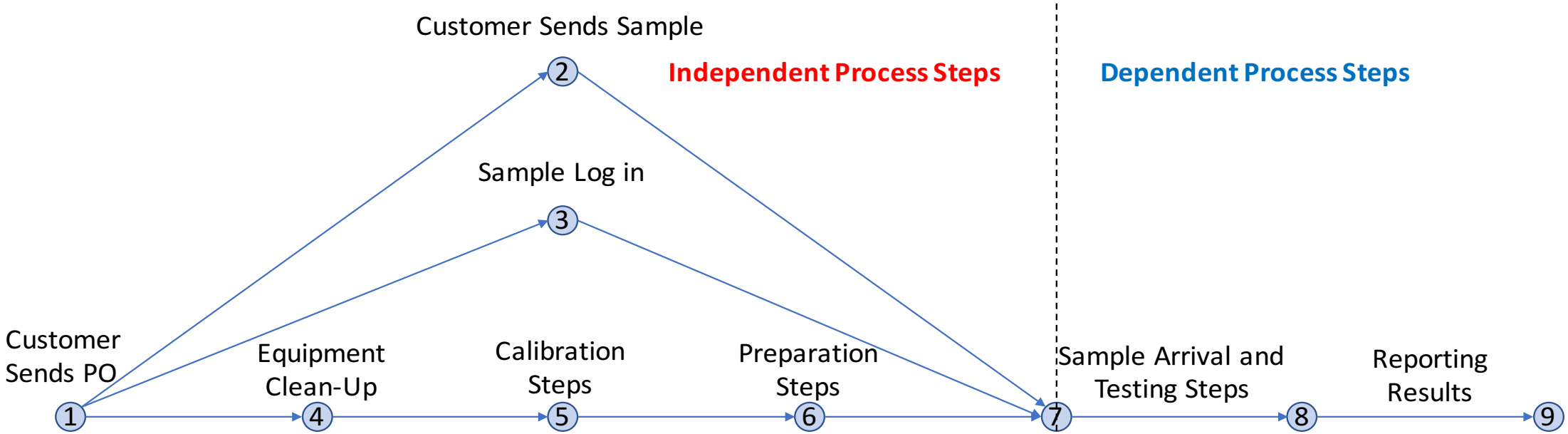
Project Evaluation & Review Techniques



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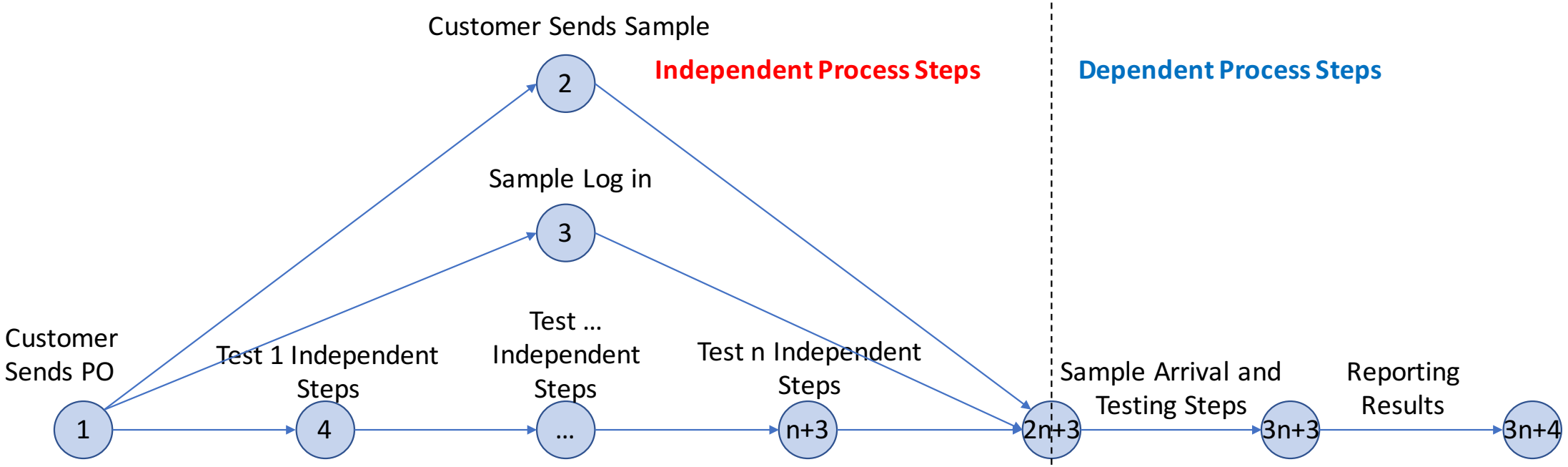

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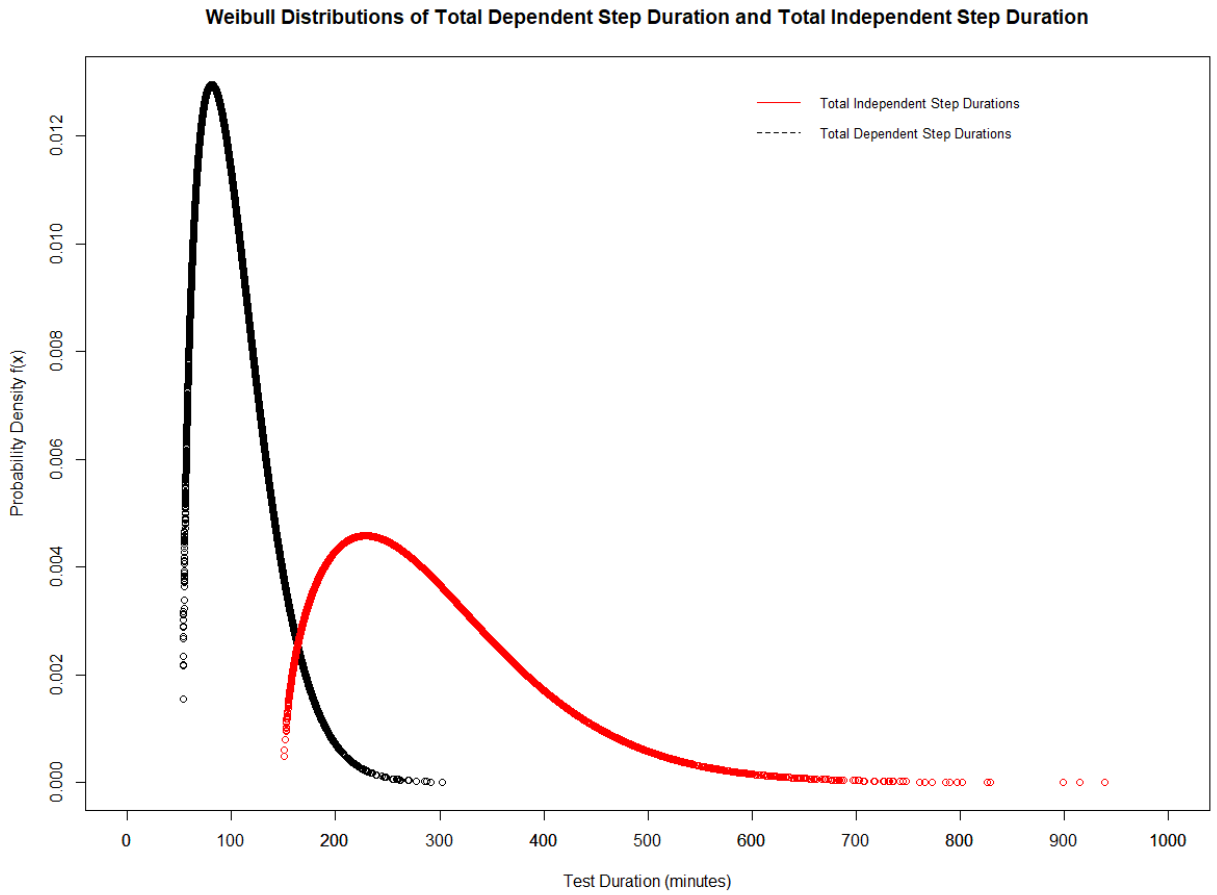

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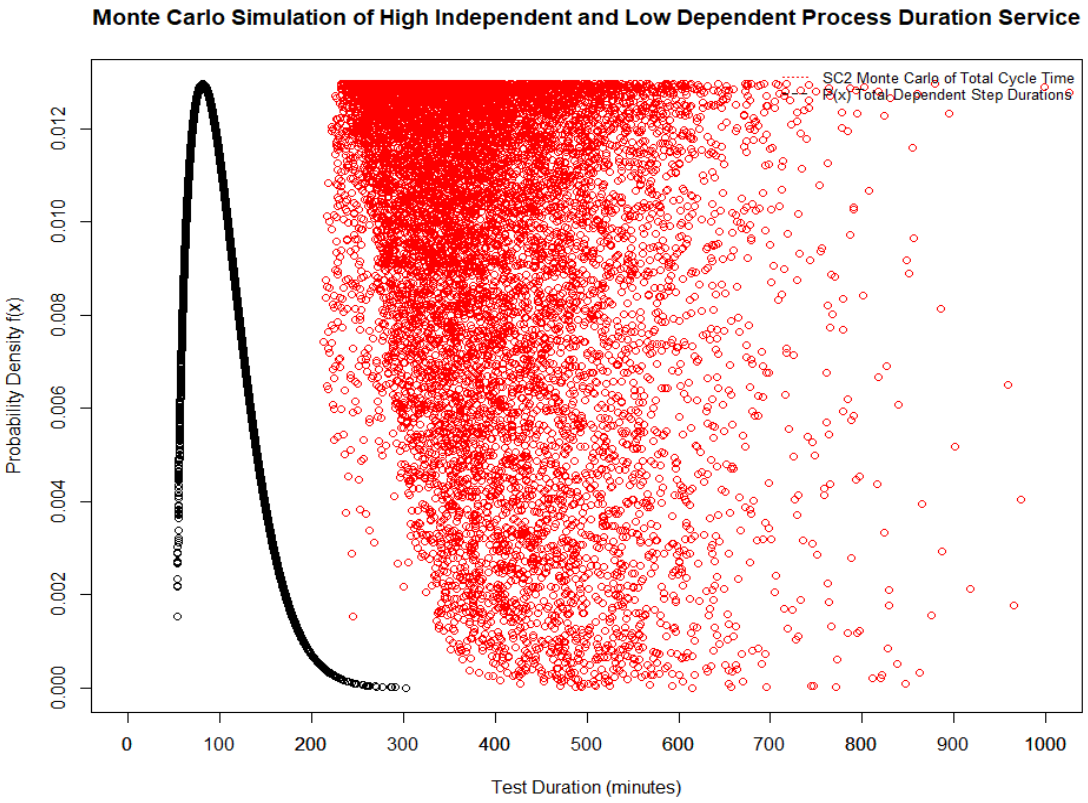
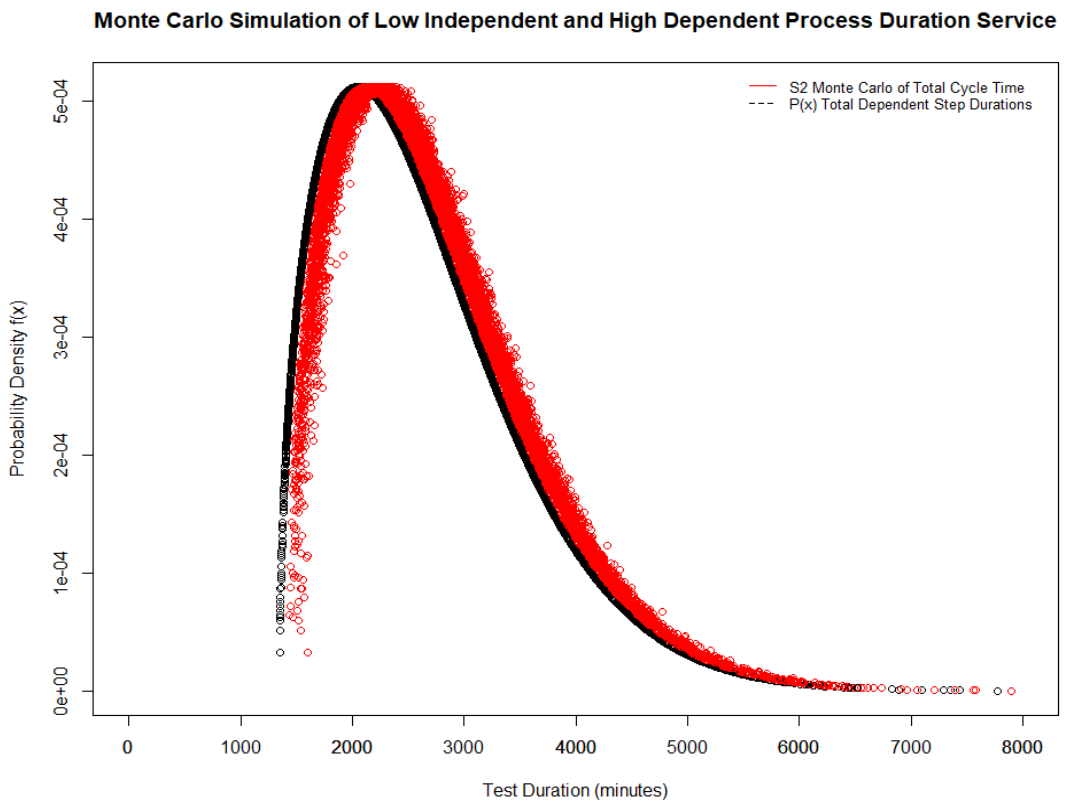
Monte Carlo Simulations





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Results

Scenario (2000 Runs)	Samples (number of samples in run)	Average Days Reduced Lead Time (days)	Average Percent Reduced Lead Time	Average Percent of Reduced Lead Time Tests Longer than Critical Path	Average P-Value Two-Sided Paired T-Test TCT Reduced and Normal (p-value)	Number of Runs with Paired T-Test P-Value Less Than 0.05 (p-value < 0.05)
	Cluster 3					
Scenario 1 and 2	119	0.26	14%	27%	0.39	130/2000
Scenario 3 and 4	119	1.43	26%	19%	0.37	270/2000
	Customer 7					
Scenario 1 and 2	29	0.41	18%	25%	0.34	260/2000
Scenario 3 and 4	29	0.52	23%	23%	0.24	590/2000
	ASTM D2509					
Scenario 1 and 2	14	0.32	36%	5%	0.15	1350/2000
Scenario 3 and 4	14	0.52	50%	0.04%	2.14E-05	2000/2000

Results

Collaborate with Customers to Perform Independent Steps of Services Concurrent with Transit Time of Customer Inputs?

Proportion of Lead Time Coming from Independent Process Time within Service (%)	Duration of Dependent Process Time within Service (Days): Low	Duration of Dependent Process Time within Service (Days): High
High	Yes	Yes
Low	Yes, if high demand volume and non-negligible independent process time.	No

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Conclusion

- **Large proportions of independent process time have greater potential for lead time reduction**
- **Collaborating with specific customers that meet the criteria of our first finding will yield the most effective results**
- **Customers must be responsive enough to engage in the behavior**
- **If independent process time and dependent process time are low, then benefits will only be noticed if there is a large volume of demand**

Next Steps

- **Just-in-time consumables: Can laboratories drastically reduce inventory on hand by utilizing better information?**
- **Labor Efficiency: Can labor be scheduled more efficiently to better accommodate arrival of test samples?**
- **Machine Learning for Predicting Lead Times: Can the prediction of lead times improve using machine learning?**

THANK YOU
&
QUESTIONS