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Using Digital Twins for Scenario Planning to Increase Resilience in Supply Chains

J. Chris White

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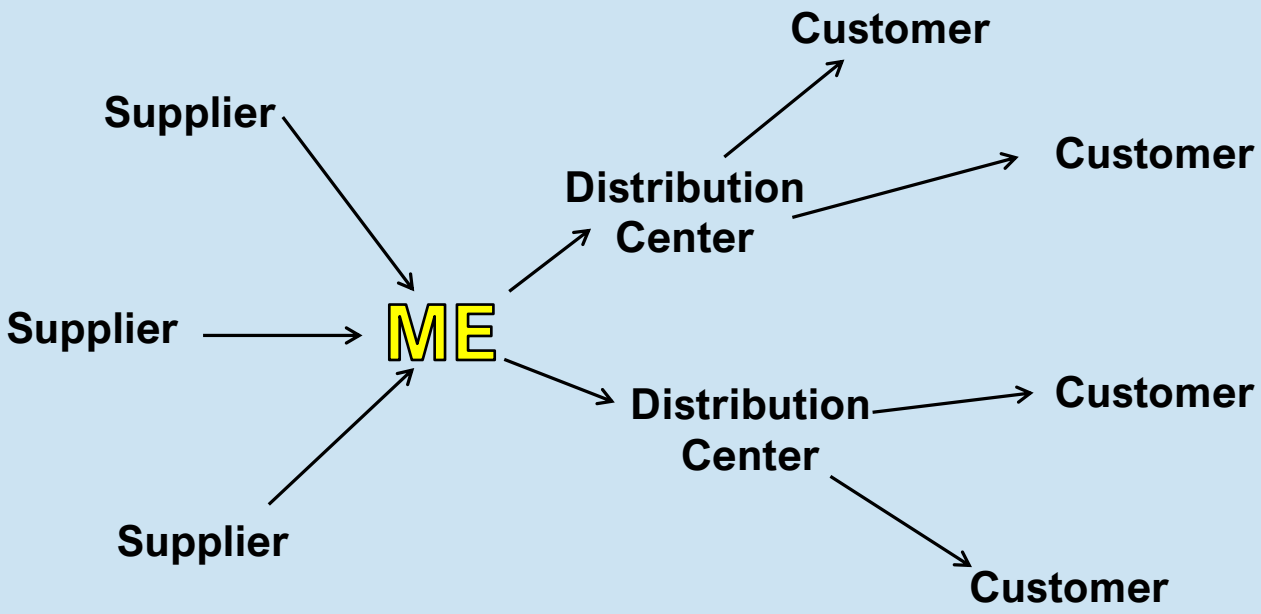
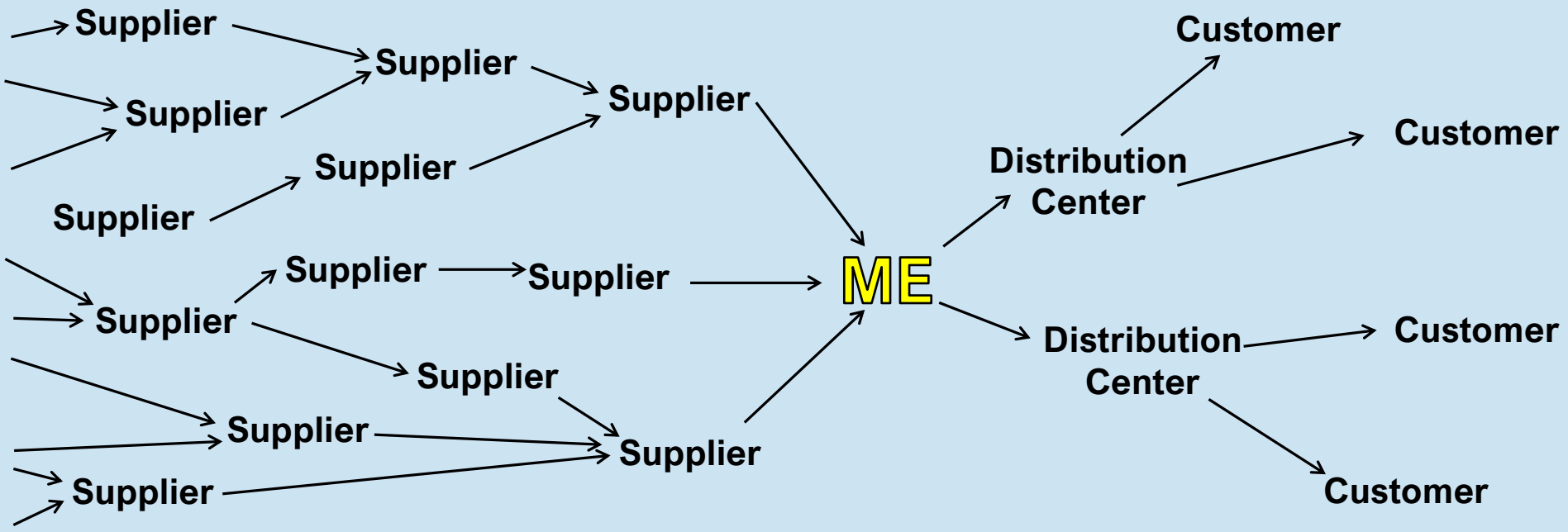
This is not your supply chain . . .



THIS is your supply chain.



We talk a lot about supply chain “resilience.”

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Resilience is a system phenomenon.

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Resilience is a system phenomenon.

The only way to understand and assess resilience is to treat the supply chain as a "system" and conduct what-if scenarios to see how it *reacts*, *responds*, and *recovers* to various changes.

4 Common Methods for Increasing Resiliency

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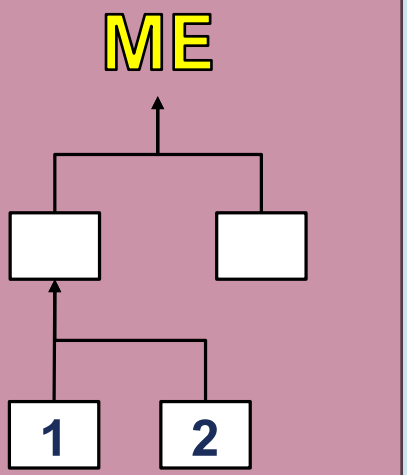
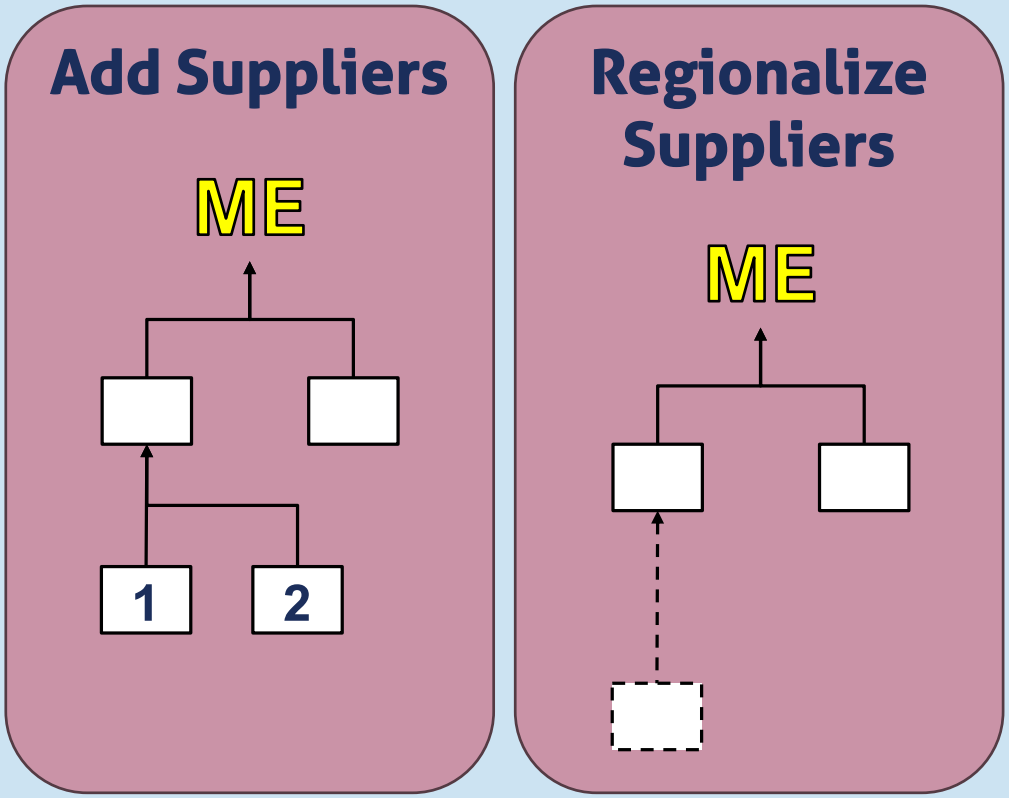
Add Suppliers



4 Common Methods for Increasing Resiliency



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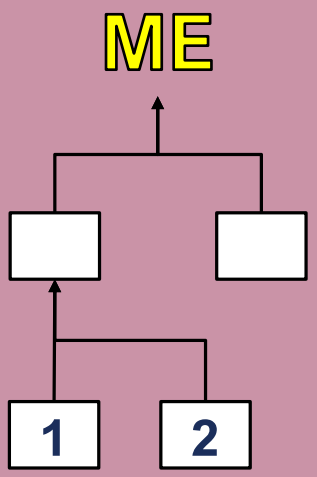
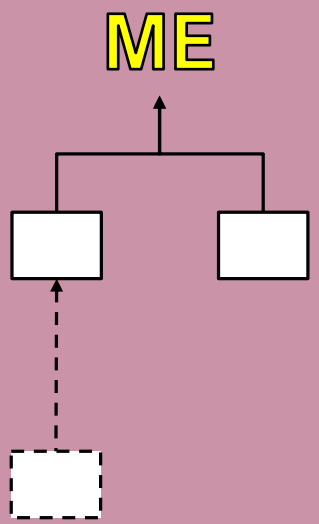
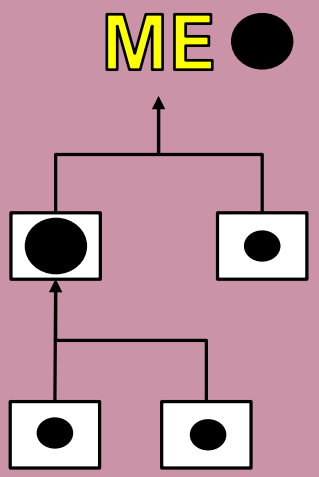


Regionalize Suppliers

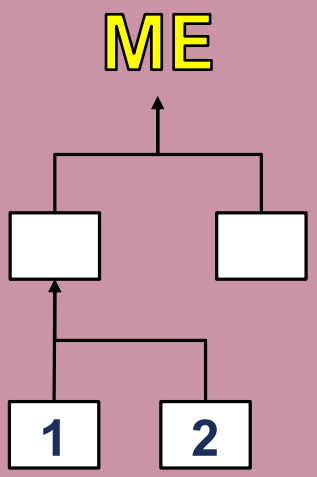


Add Inventory



4 Common Methods for Increasing Resiliency

Add Suppliers



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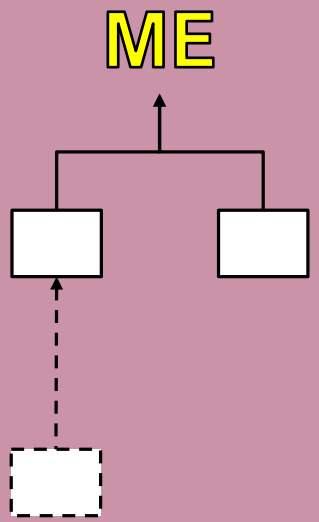

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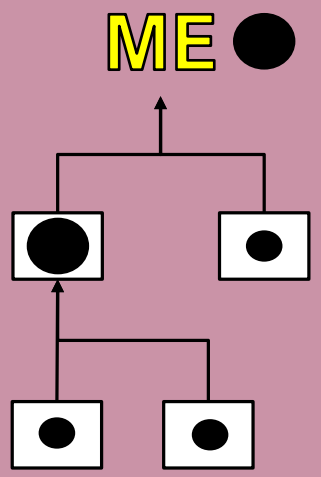
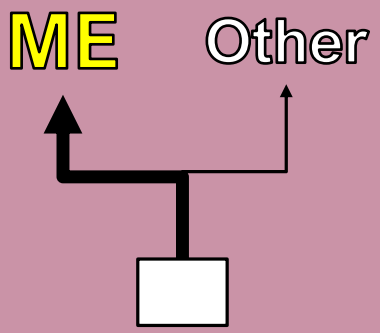


Increase Priority



Let’s walk through a simple what-if scenario.

Should we have 2 suppliers?

Baseline Model:
100 Orders/Week for 2 Years with 4 weeks of RM and FG

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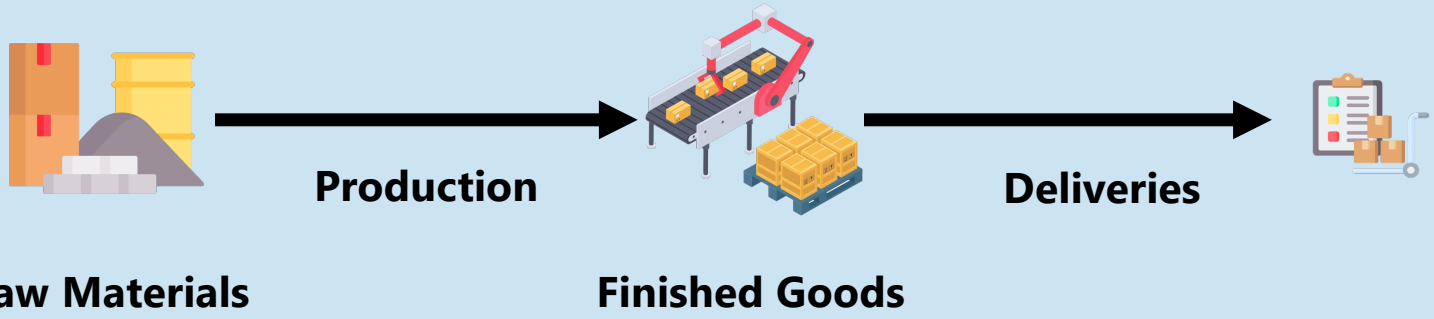
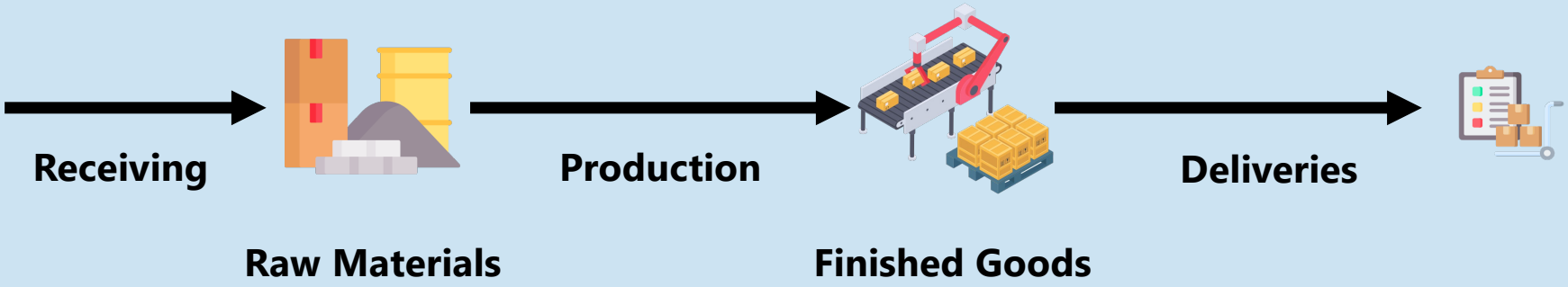
Finished Goods

Baseline Model:
100 Orders/Week for 2 Years with 4 weeks of RM and FG



Baseline Model:
100 Orders/Week for 2 Years with 4 weeks of RM and FG



Baseline Model:
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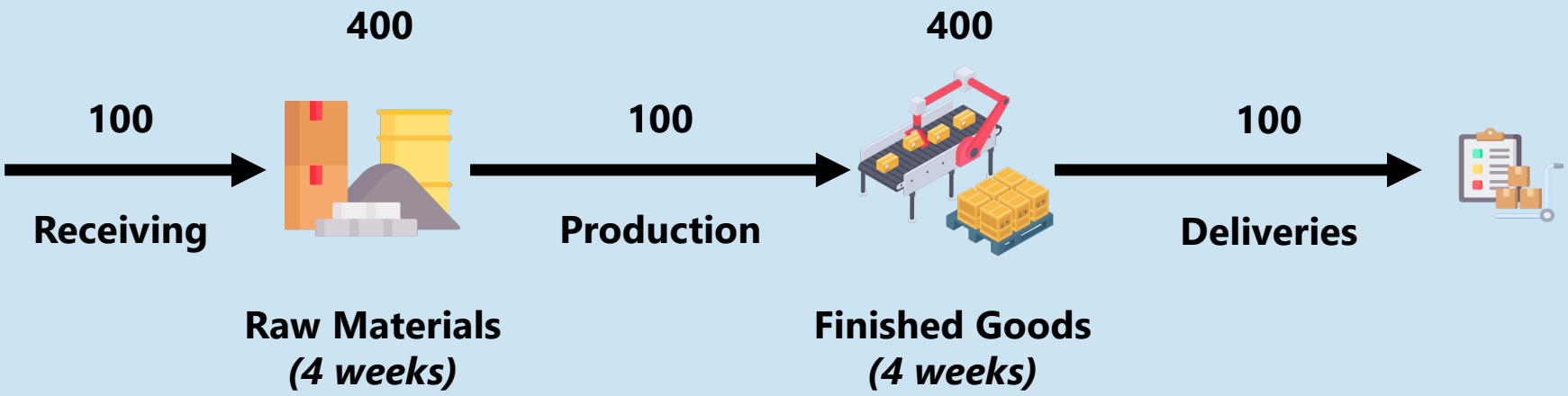
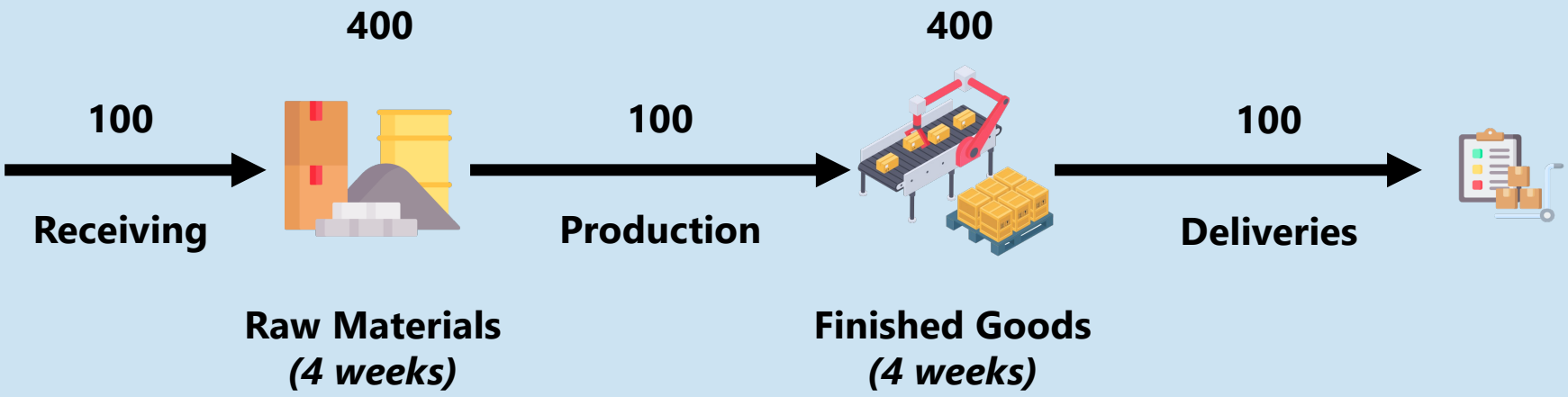
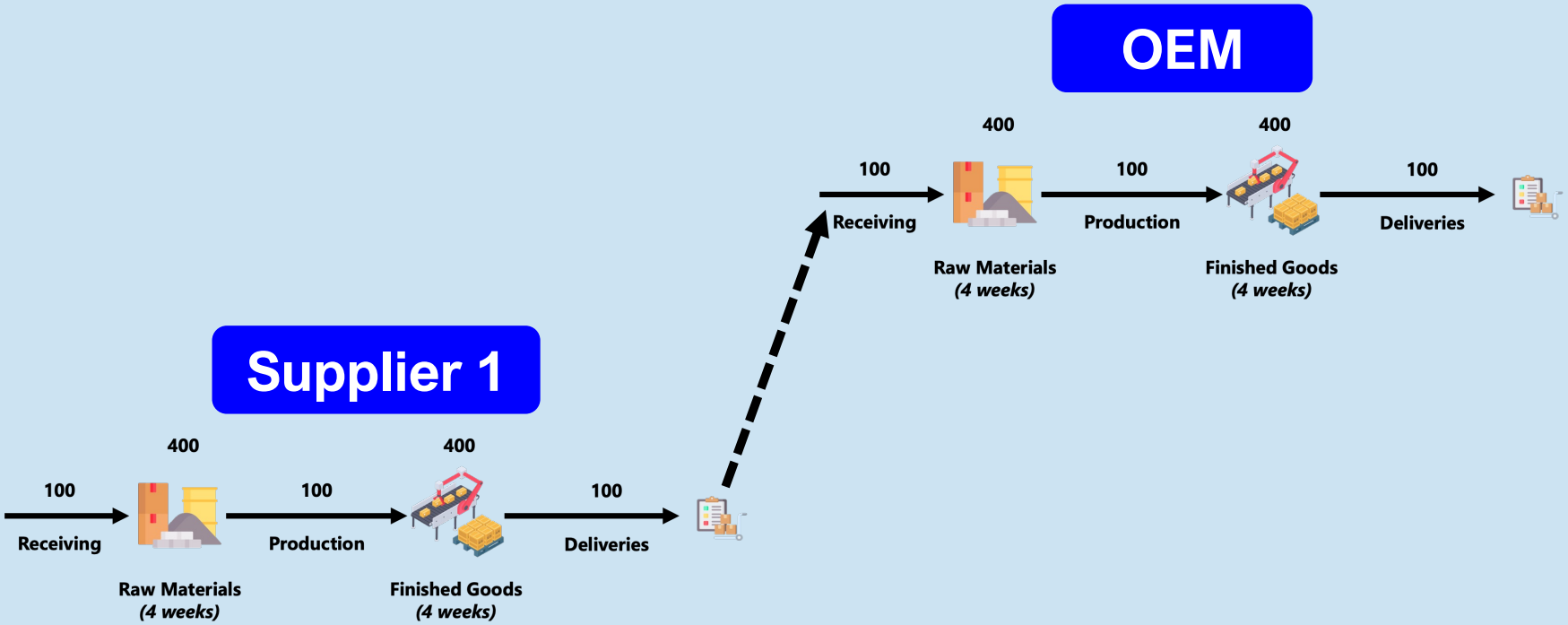


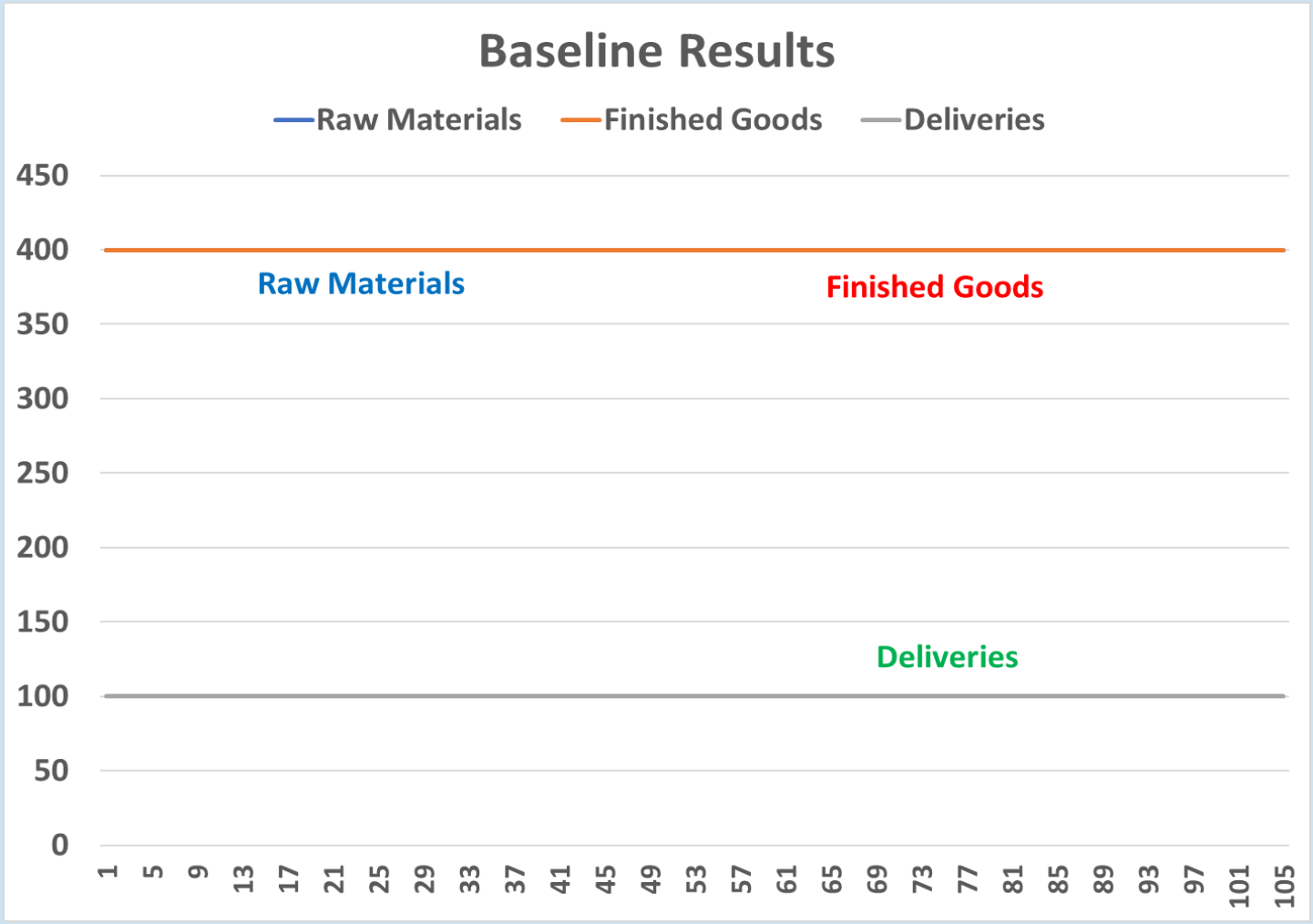
Baseline Model:
100 Orders/Week for 2 Years with 4 weeks of RM and FG



For all scenarios, the graphs show results for the OEM

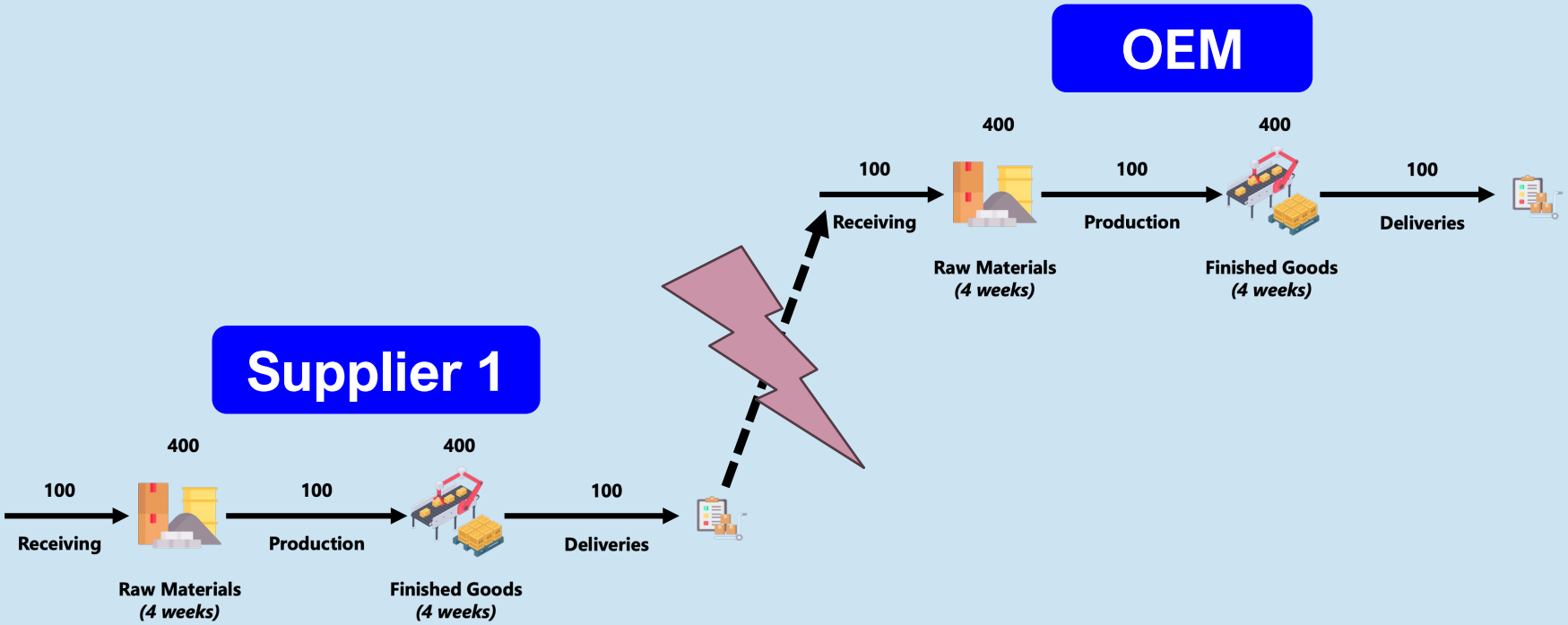
Baseline Scenario:
OEM with single Tier 1 supplier (Supplier 1)

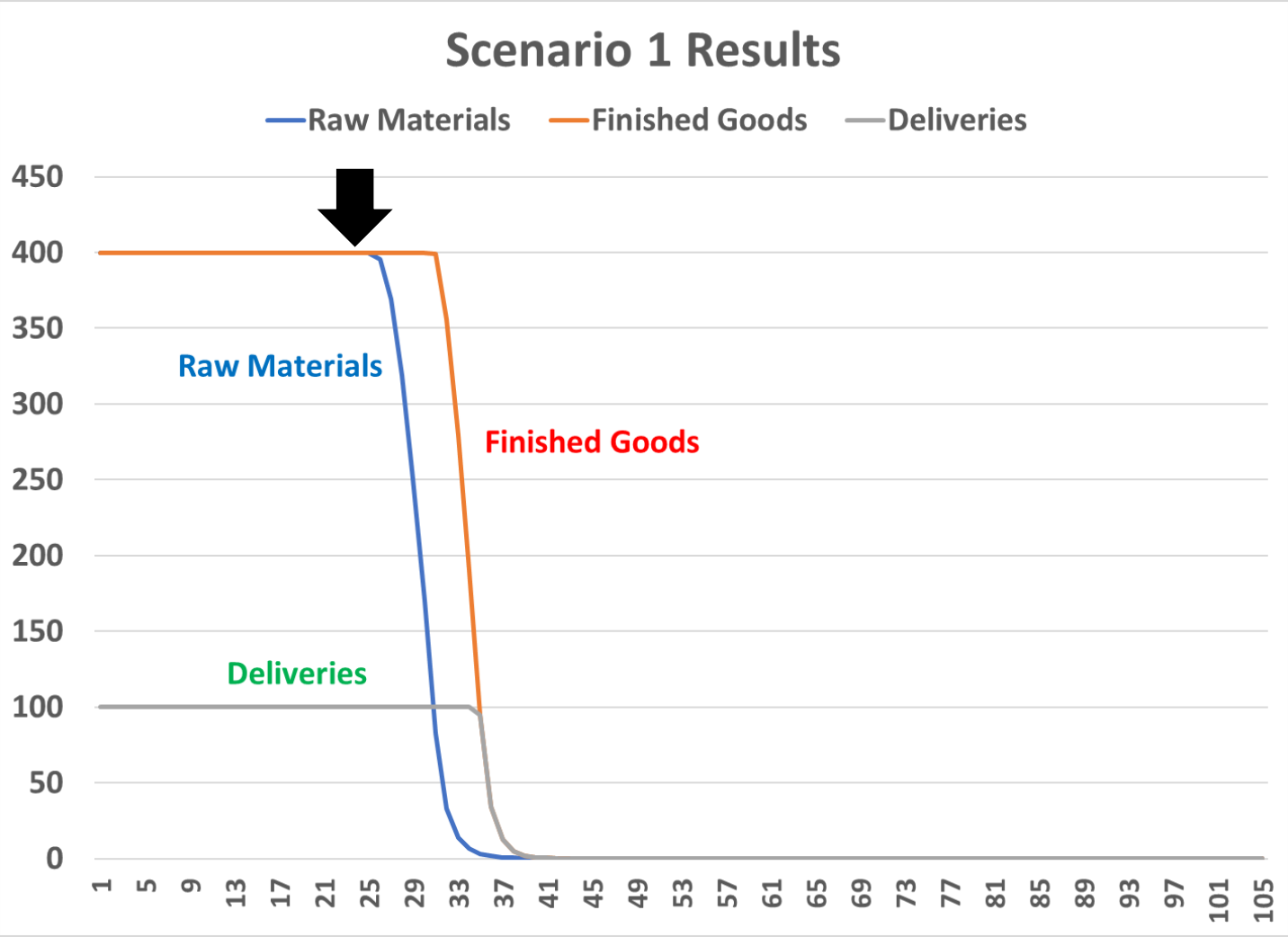




Variable	Baseline
Cash Available	$ 120,800
Cumulative Orders	10,400
Cumulative Deliveries	10,400
MIN Profit Margin	20%

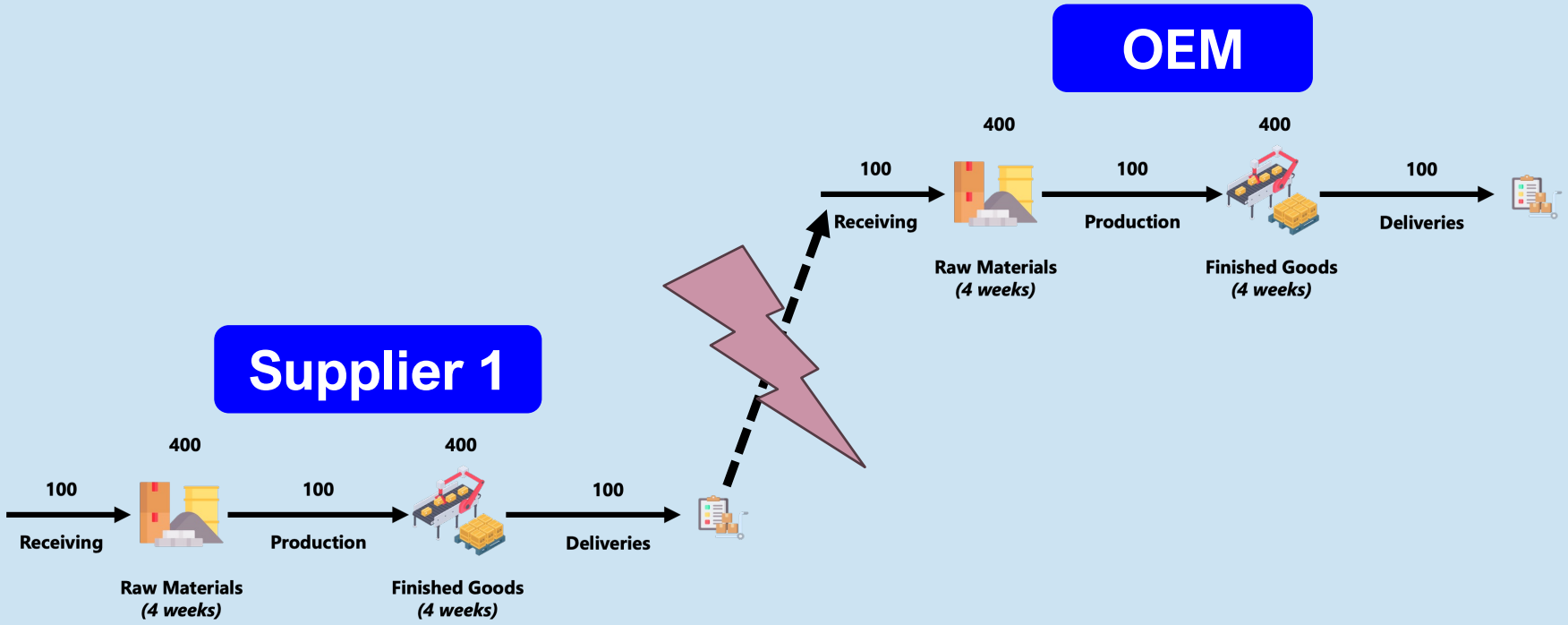
Scenario 1:
Supplier 1 has a disruption starting in Month 6



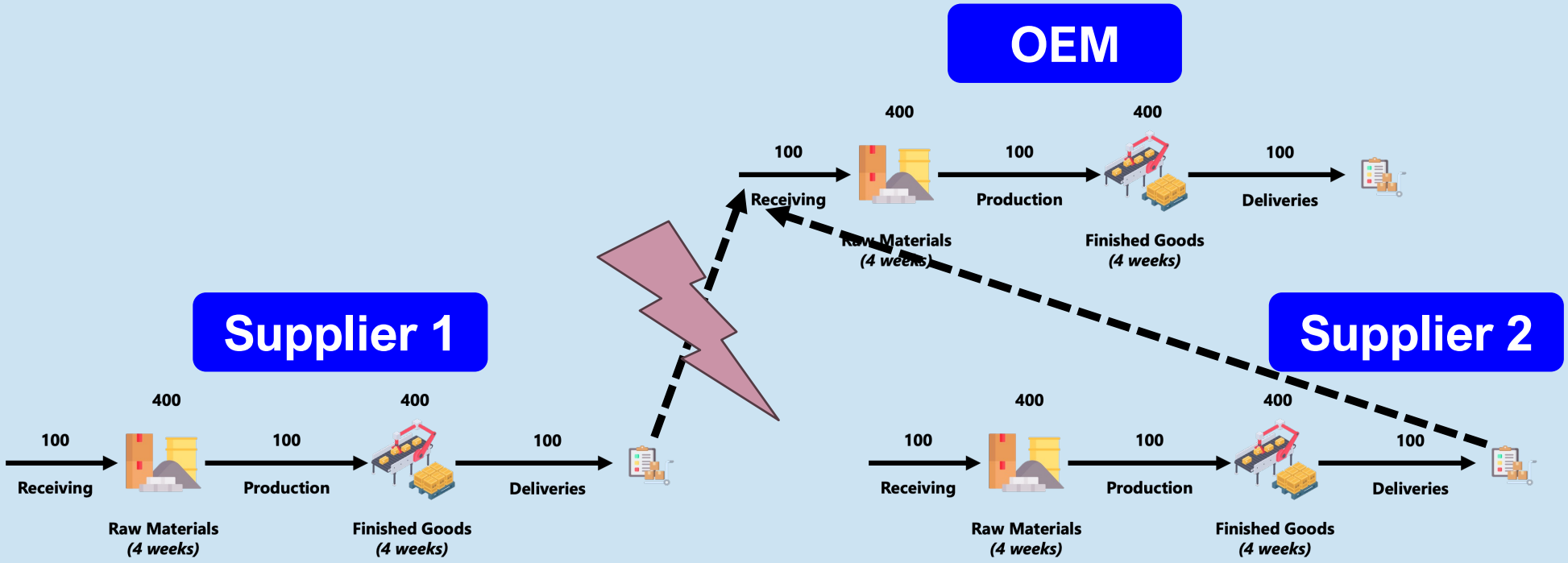


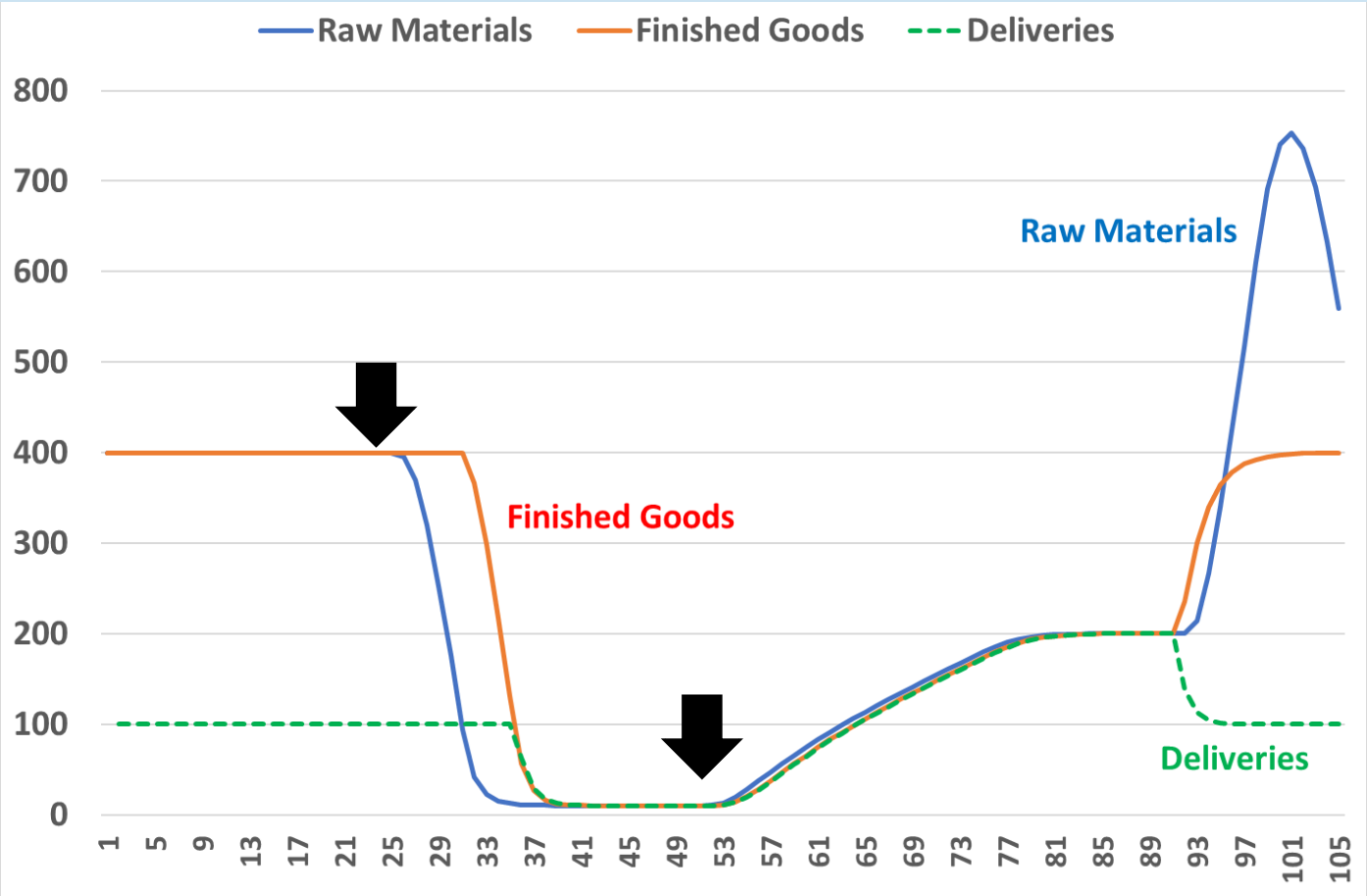
Variable	Baseline	Scenario 1
Cash Available	$ 120,800	- $ 20,687
Cumulative Orders	10,400	10,400
Cumulative Deliveries	10,400	3,500
MIN Profit Margin	20%	- Infinity

Scenario 1A:
Same as Scenario 1, but OEM adds Supplier 2 (4-month setup delay)



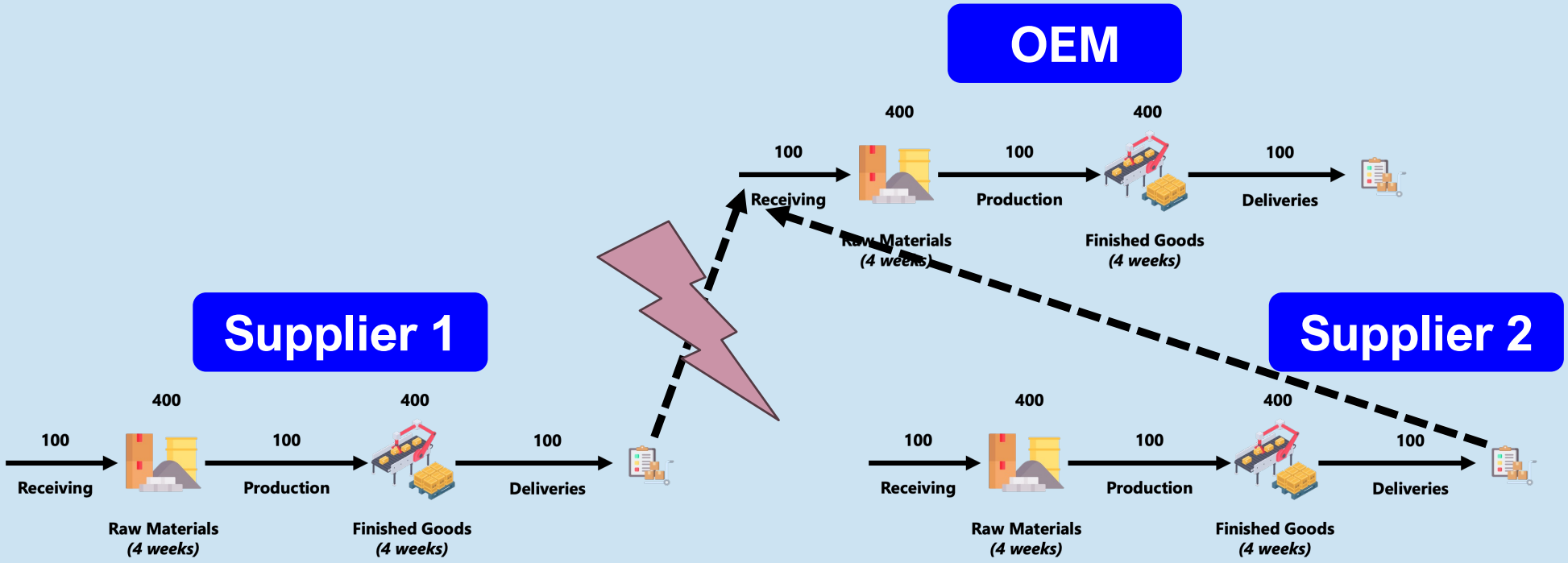
Scenario 1A:
Same as Scenario 1, but OEM adds Supplier 2 (4-month setup delay)

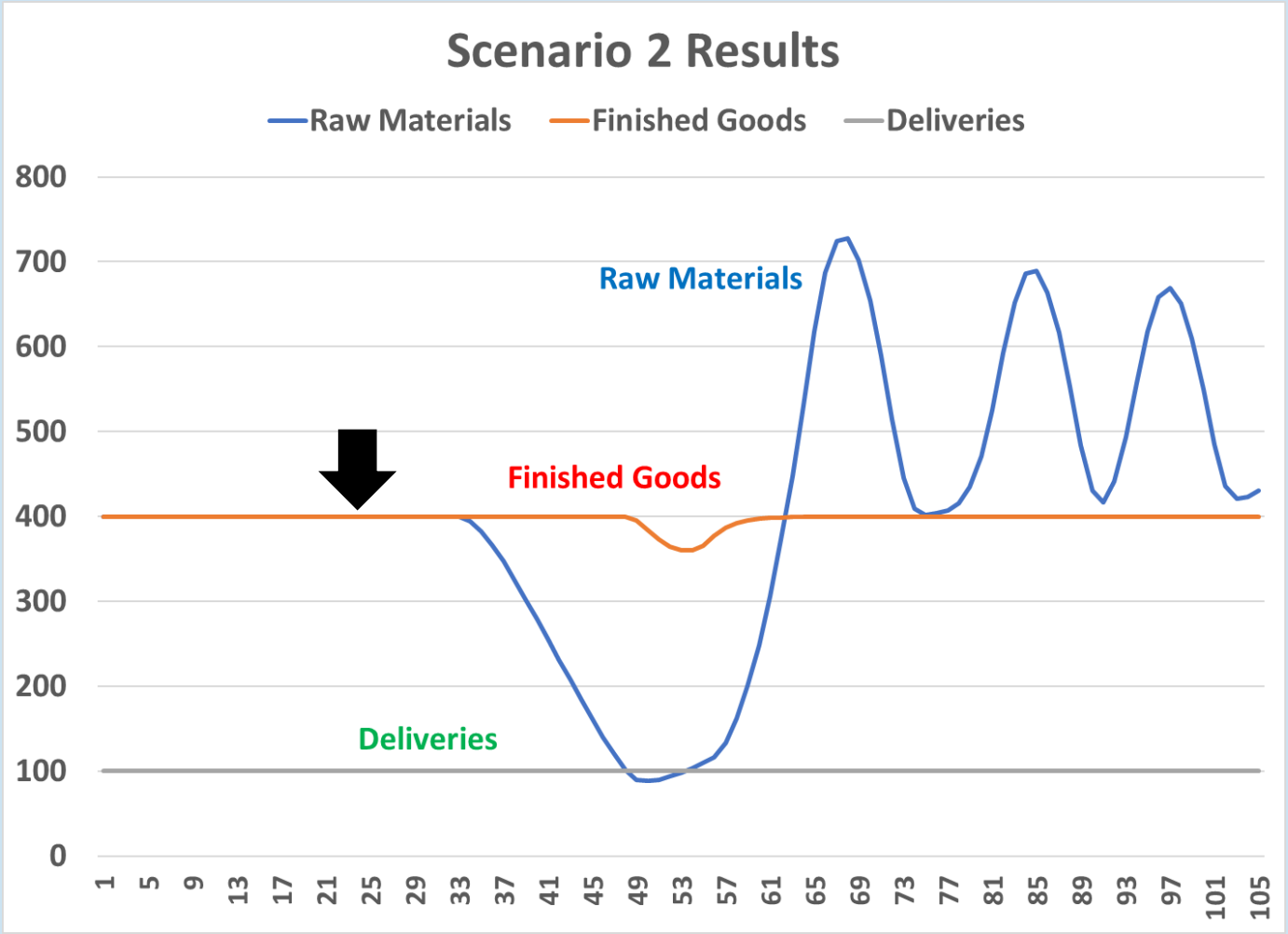


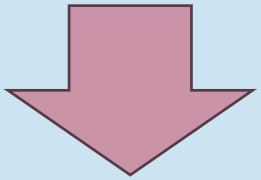


Variable	Baseline	Scenario 1	Scenario 1A
Cash Available	$ 120,800	- $ 20,687	$ 36,865
Cumulative Orders	10,400	10,400	10,400
Cumulative Deliveries	10,400	3,500	10,400
MIN Profit Margin	20%	- Infinity	-1,168%

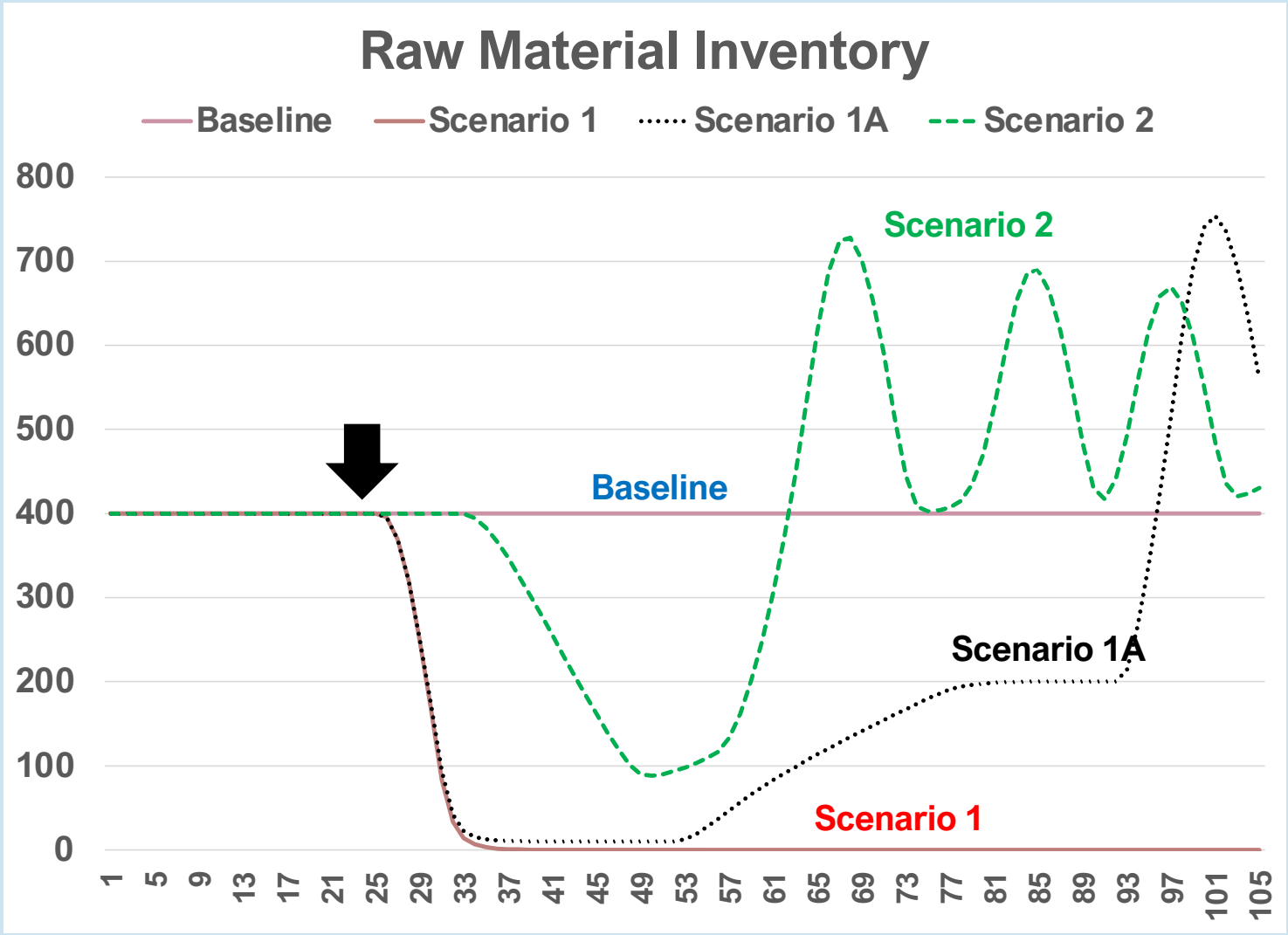
Scenario 2:
Same as Scenario 1, but OEM has 2 suppliers (40/60) and shifts orders (0/100)

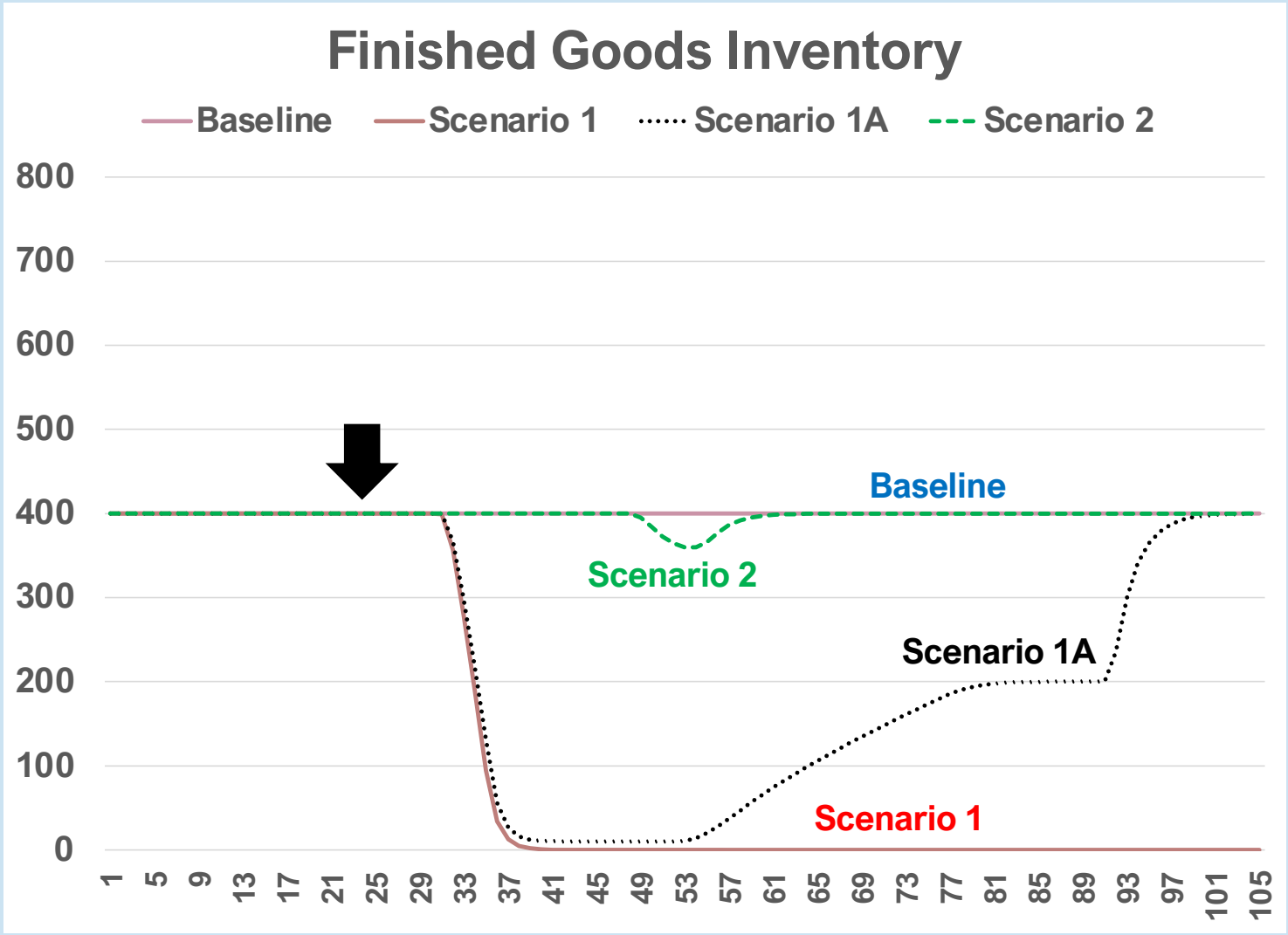


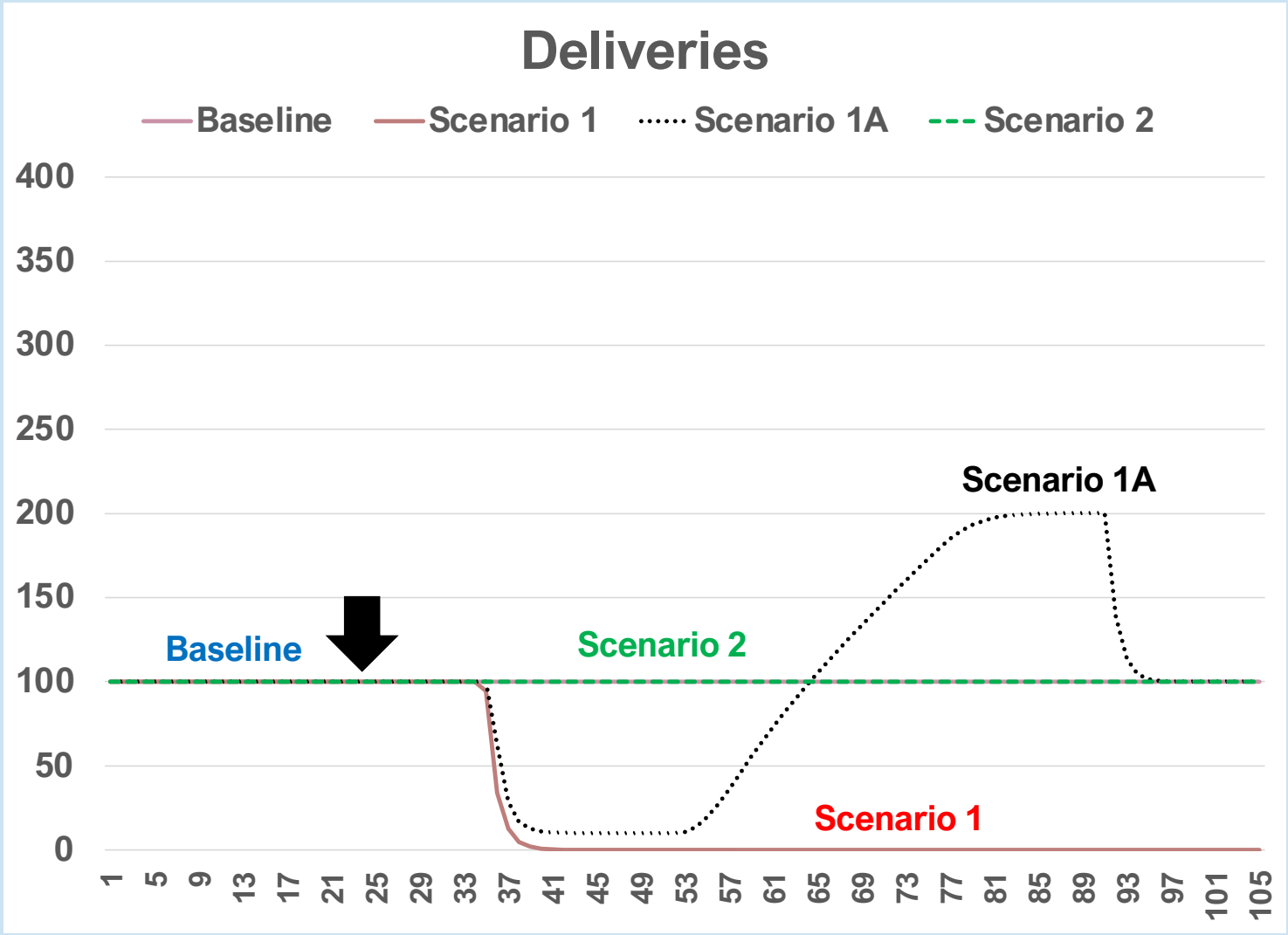


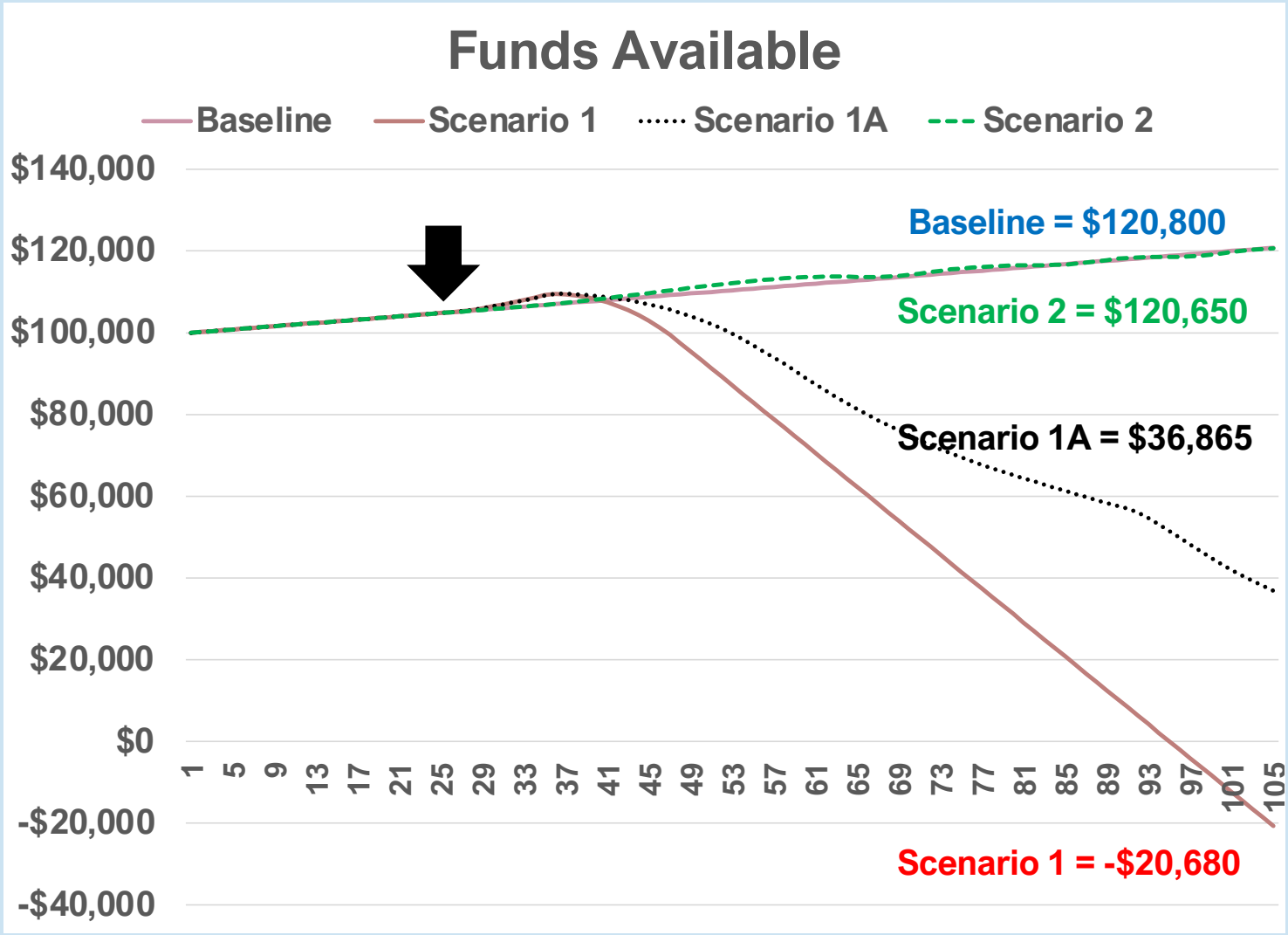


Variable	Baseline	Scenario 1	Scenario 1A	Scenario 2
Cash Available	$ 120,800	- $ 20,687	$ 36,865	$ 120,656
Cumulative Orders	10,400	10,400	10,400	10,400
Cumulative Deliveries	10,400	3,500	10,400	10,400
MIN Profit Margin	20%	- Infinity	-1,168%	- 5%





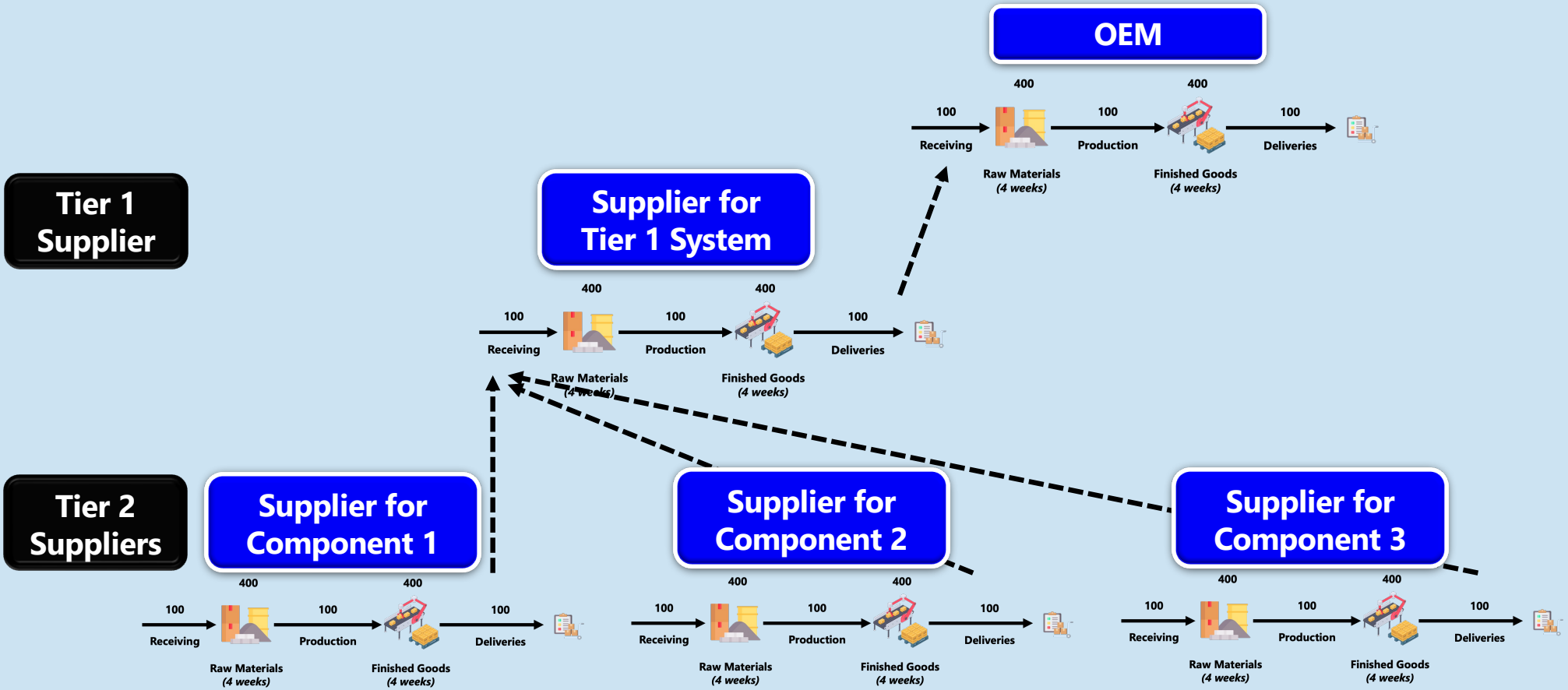




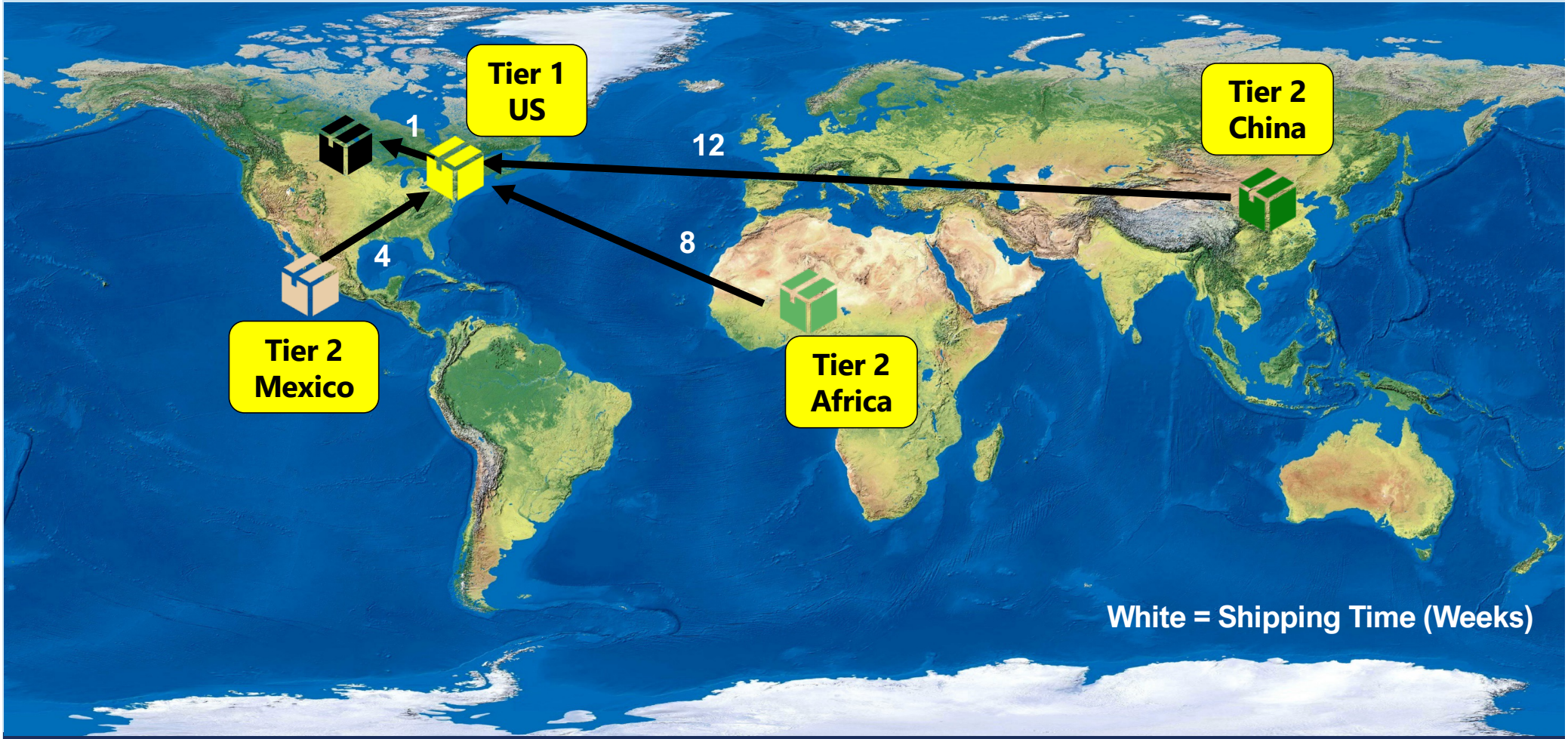
Let’s walk through a more complex example.

Which disruption has the biggest impact on me?

Baseline Model: Supply Chain Structure
3 Key Components Needed to Make Tier 1 System



Baseline Model

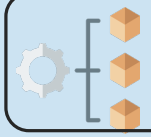


What-If Scenarios

Baseline: Normal steady-state flow of 100 orders/week for 2 years. Tier 1 in US and Tier 2 suppliers in Mexico, Africa, and China.

Scenario 1: Same as Baseline but US Tier 1 shuts down for 2 months due to finances.

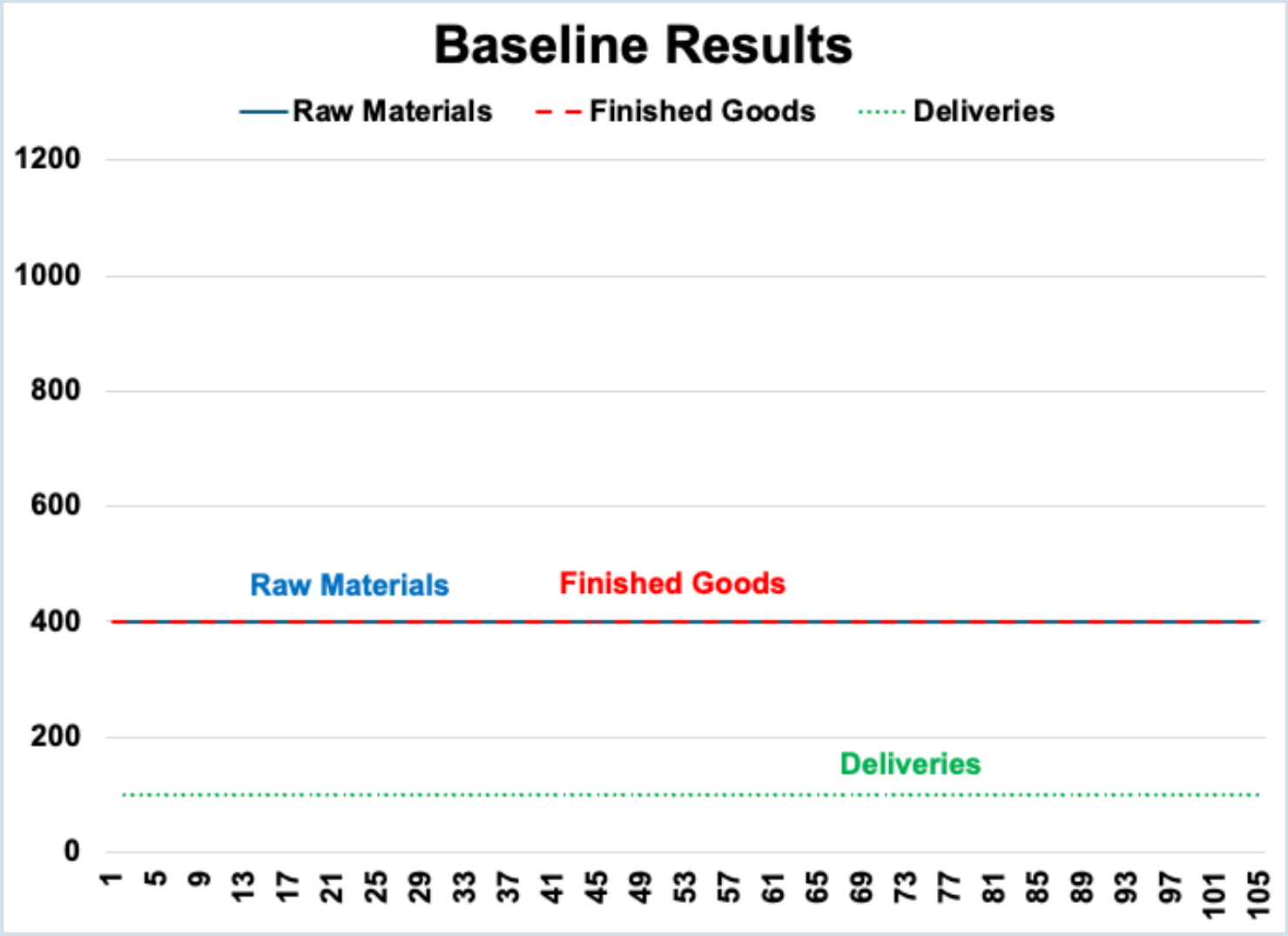
Scenario 2: Same as Baseline but Mexico Tier 2 shuts down for 2 months due to finances.



Scenario 3: Same as Baseline but Africa Tier 2 shuts down for 2 months due to finances.

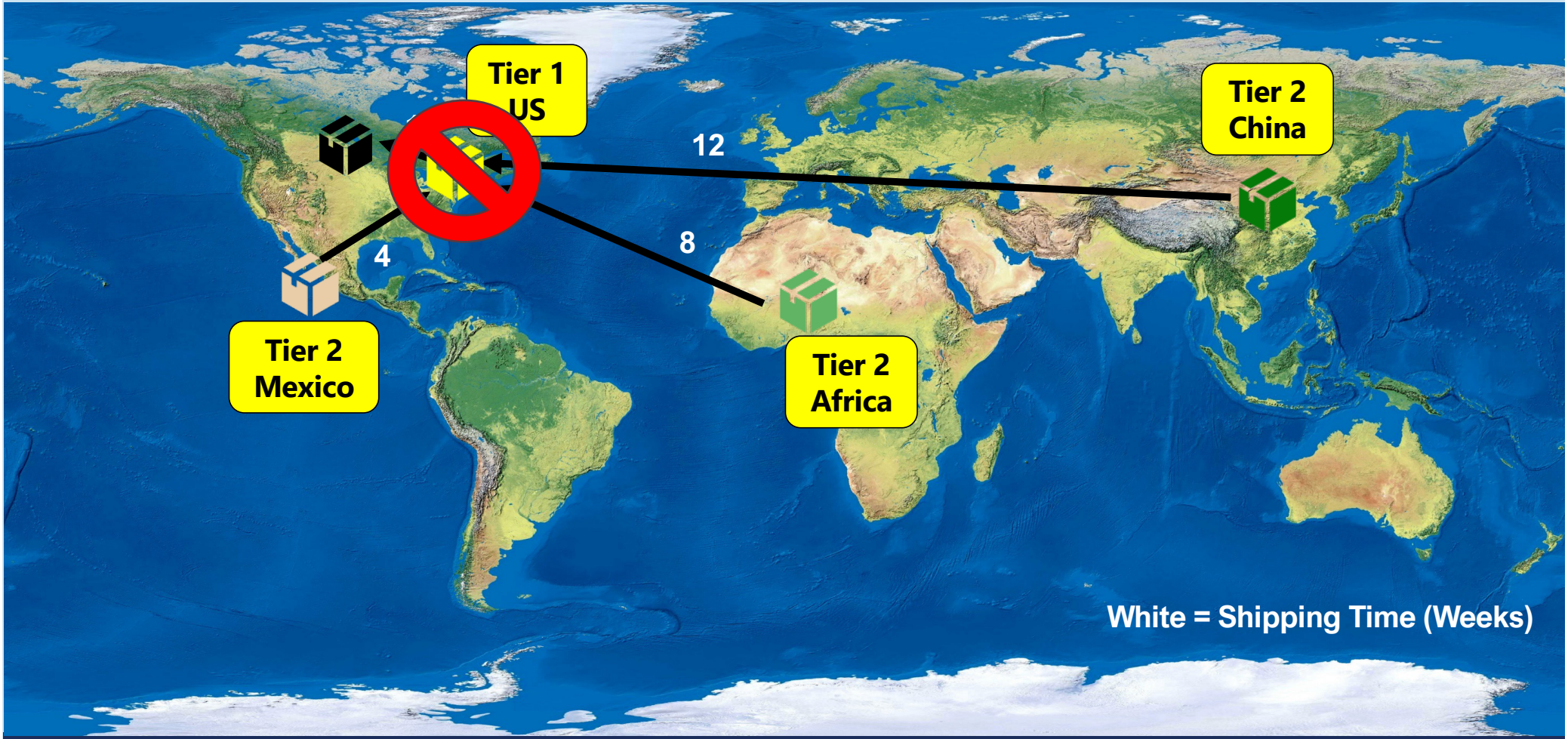
Scenario 4: Same as Baseline but China Tier 2 shuts down for 2 months due to finances.

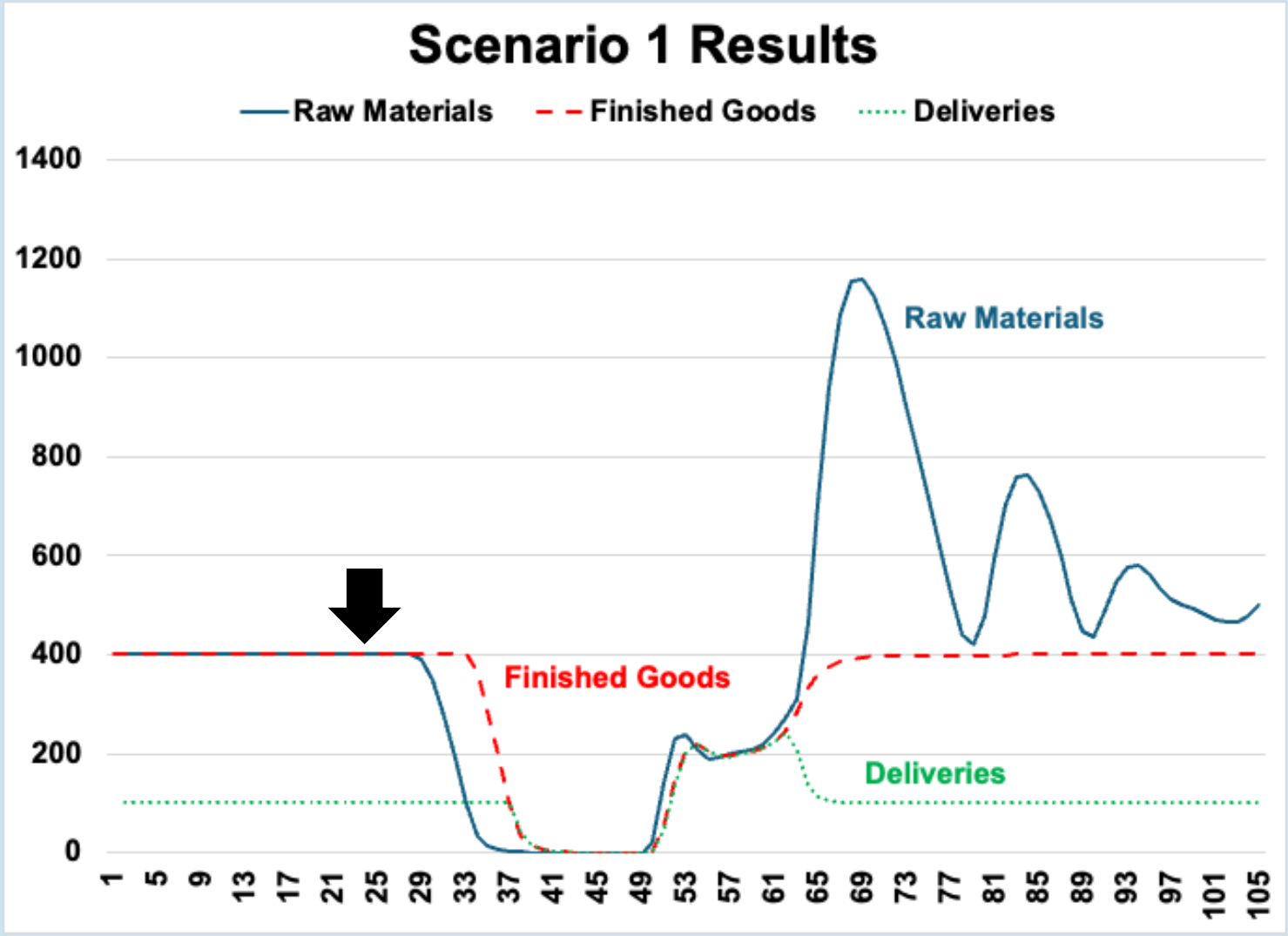
For all scenarios, the graphs show results for the OEM



Variable	Baseline
Cash Available	$ 120,800
Recovery Time to 50% Deliveries	-
Recovery Time to 100% Deliveries	-
Highest/Lowest RM Spikes	-
Highest/Lowest FG Spikes	-
Highest Orders Backlog Spike	-
Longest Lead Time	1 week
% On Time Deliveries	100%
MIN Profit Margin	20%

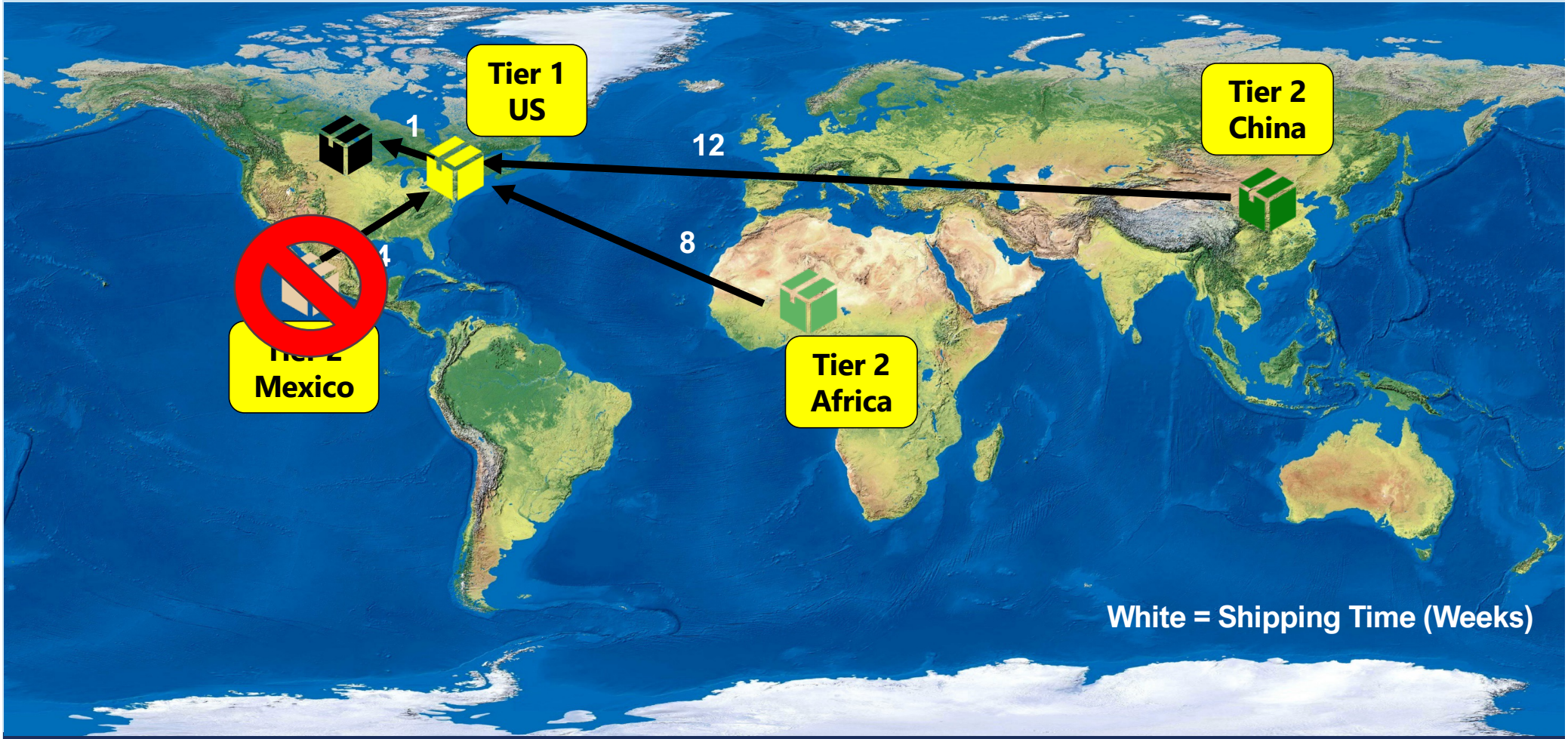
Scenario 1: US Tier 1 out for 2 months

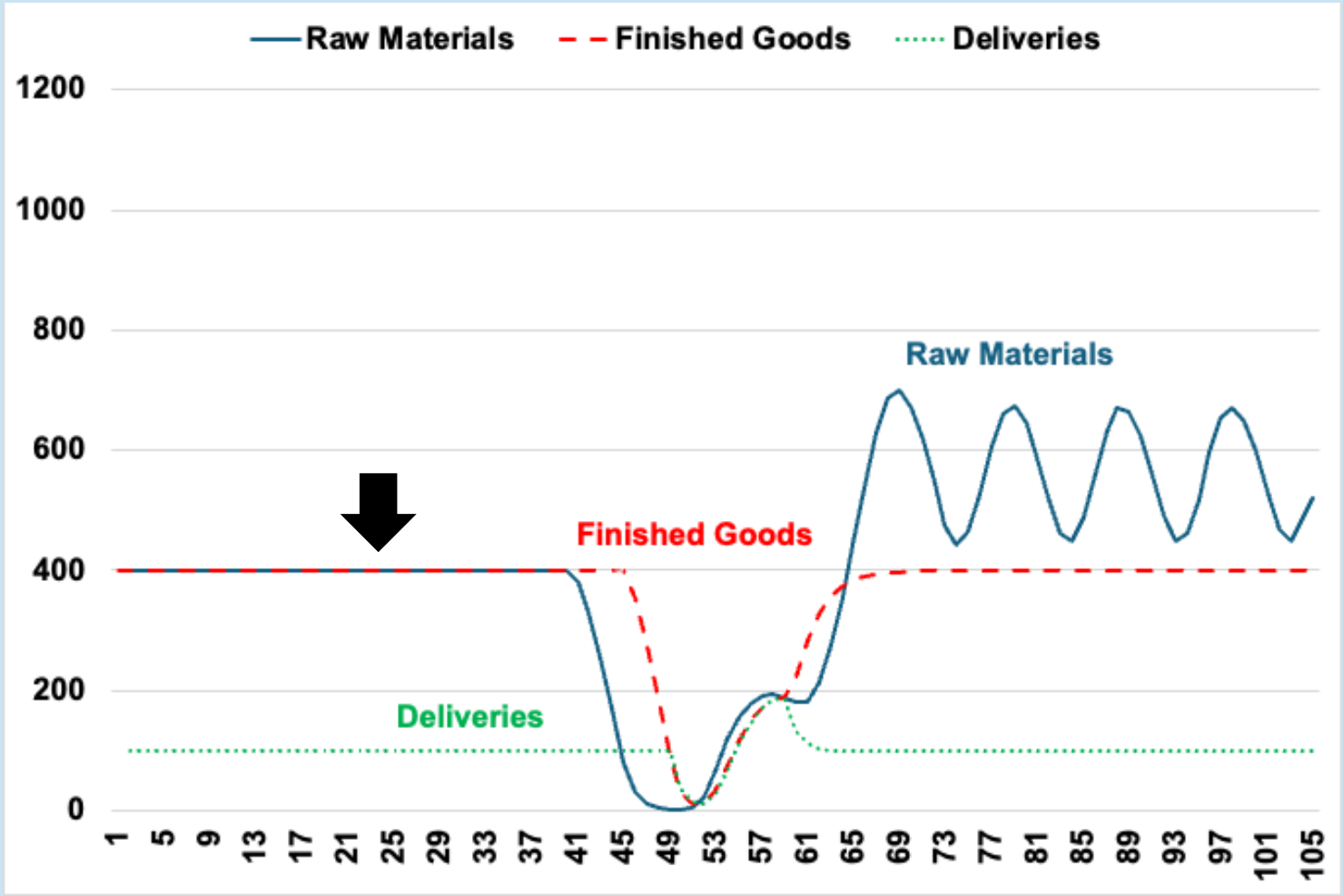




Variable	Baseline	Scenario 1 (US T1 out)
Cash Available	$ 120,800	$ 44,673
Recovery Time to 50% Deliveries	-	13 weeks
Recovery Time to 100% Deliveries	-	15 weeks
High/Low RM Inventory Spikes	-	+165% -100%
High/Low FG Inventory Spikes	-	+0% -100%
Highest Orders Backlog Spike	-	+1,280%
Longest Lead Time	1 week	14 weeks
% On Time Deliveries	100%	71%
MIN Profit Margin	20%	- Infinity

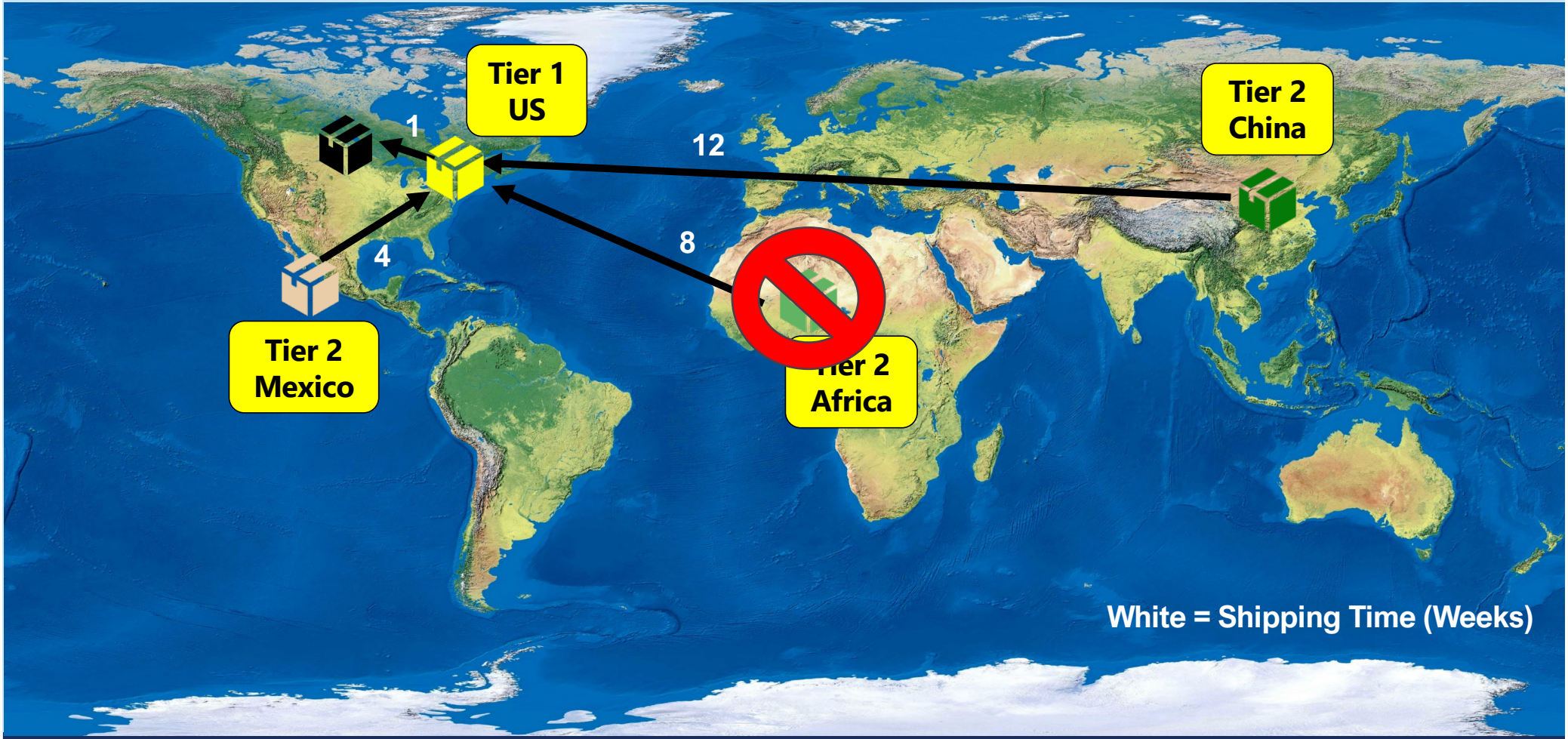
Scenario 2: Mexico Tier 2 out for 2 months

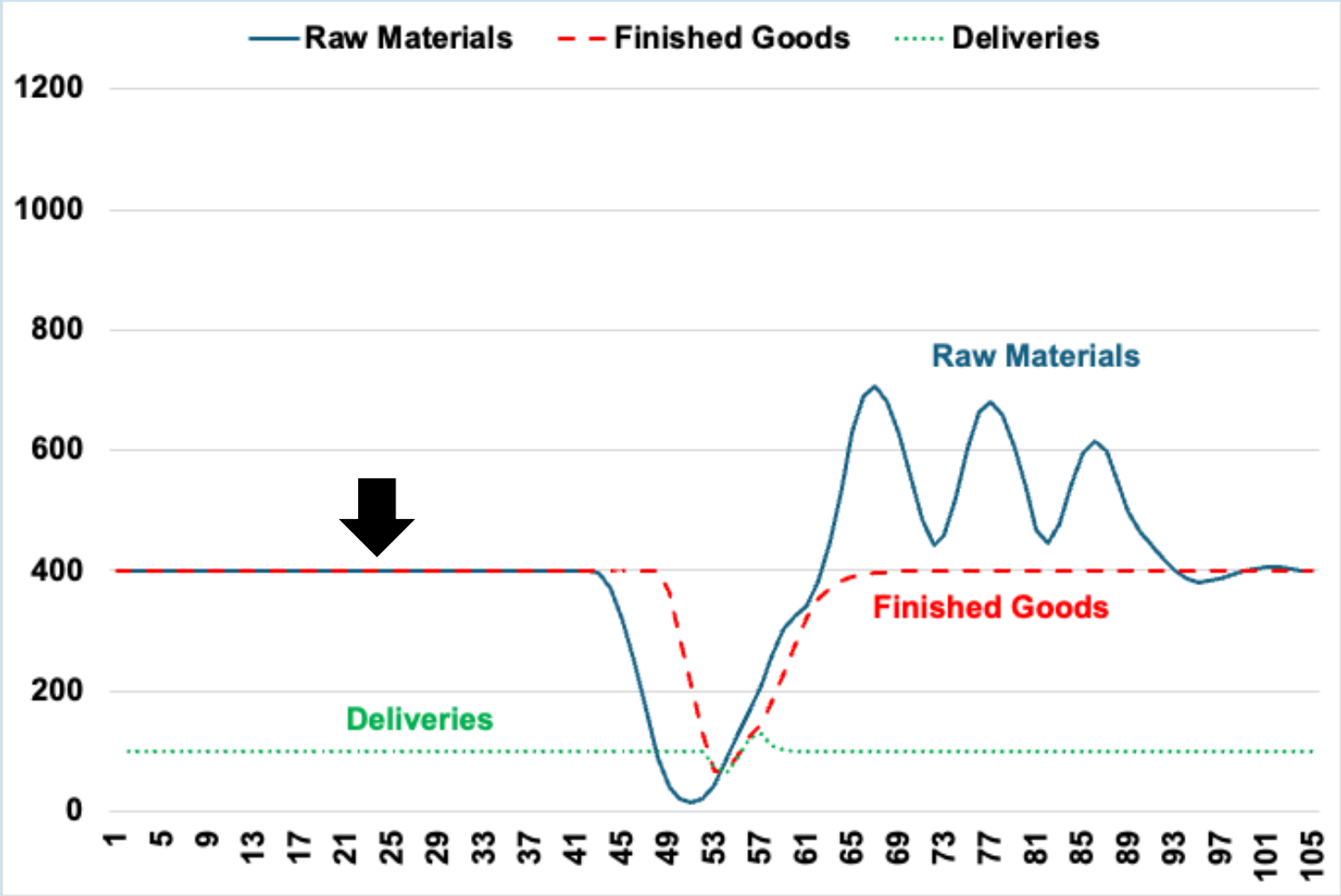




Variable	Baseline	Scenario 1 (US T1 out)	Scenario 2 (MX T2 out)
Cash Available	$ 120,800	$ 44,673	$ 109,454
Recovery Time to 50% Deliveries	-	13 weeks	4 weeks
Recovery Time to 100% Deliveries	-	15 weeks	6 weeks
High/Low RM Inventory Spikes	-	+165% -100%	+ 75% - 99%
High/Low FG Inventory Spikes	-	+0% -100%	+ 0% - 97%
Highest Orders Backlog Spike	-	+1,280%	+ 345%
Longest Lead Time	1 week	14 weeks	4.5 weeks
% On Time Deliveries	100%	71%	87%
MIN Profit Margin	20%	- Infinity	- 375%

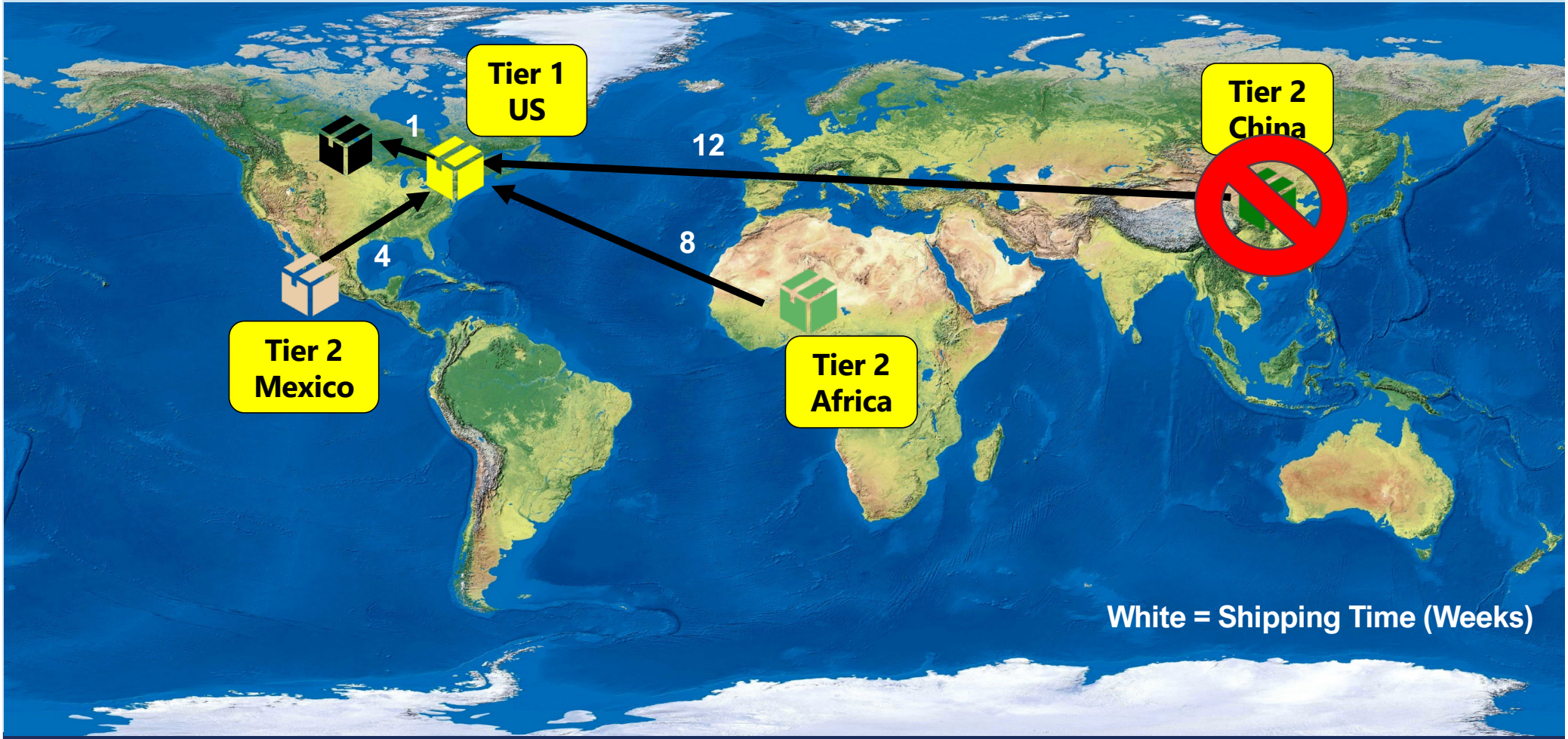
Scenario 3: Africa Tier 2 out for 2 months

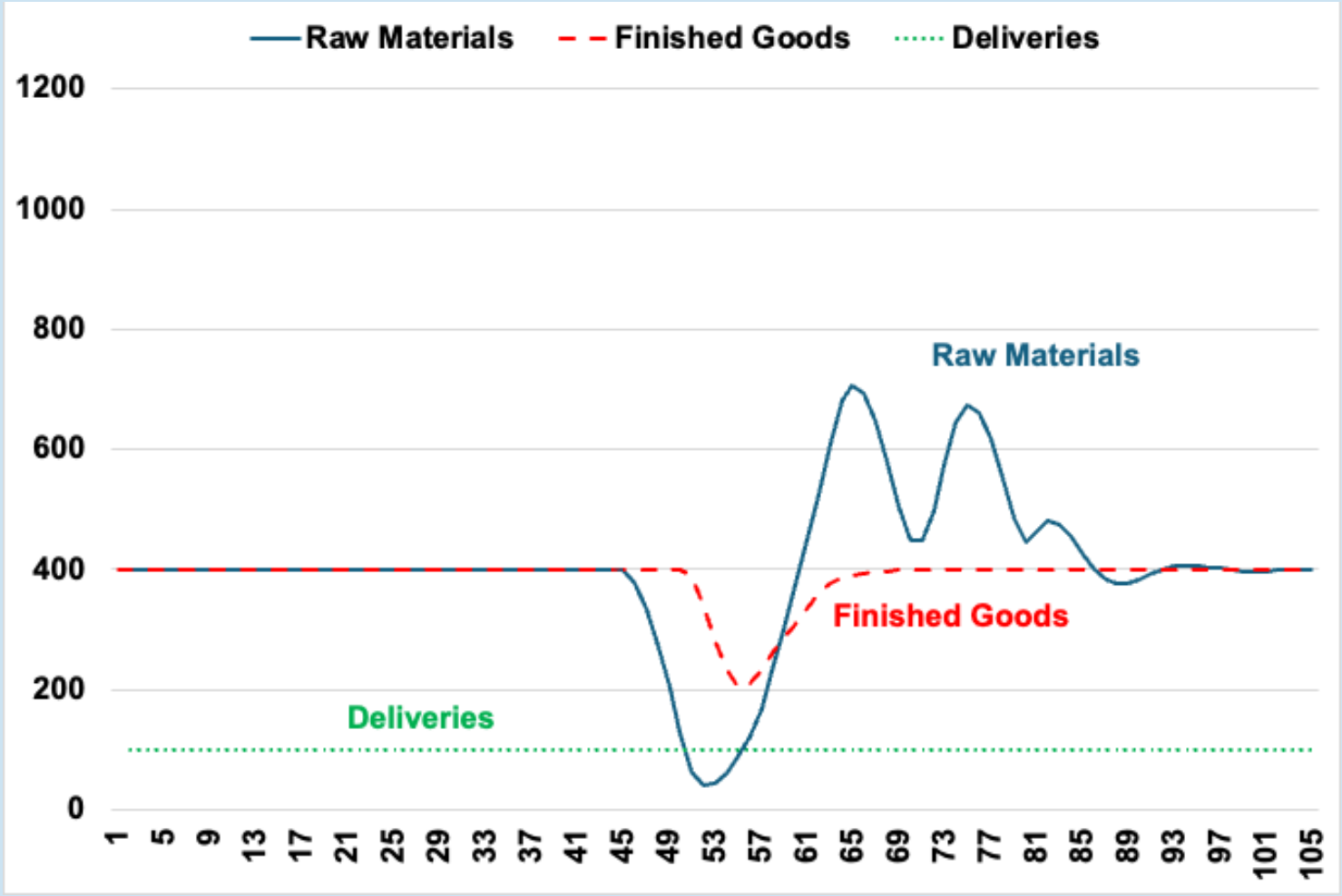




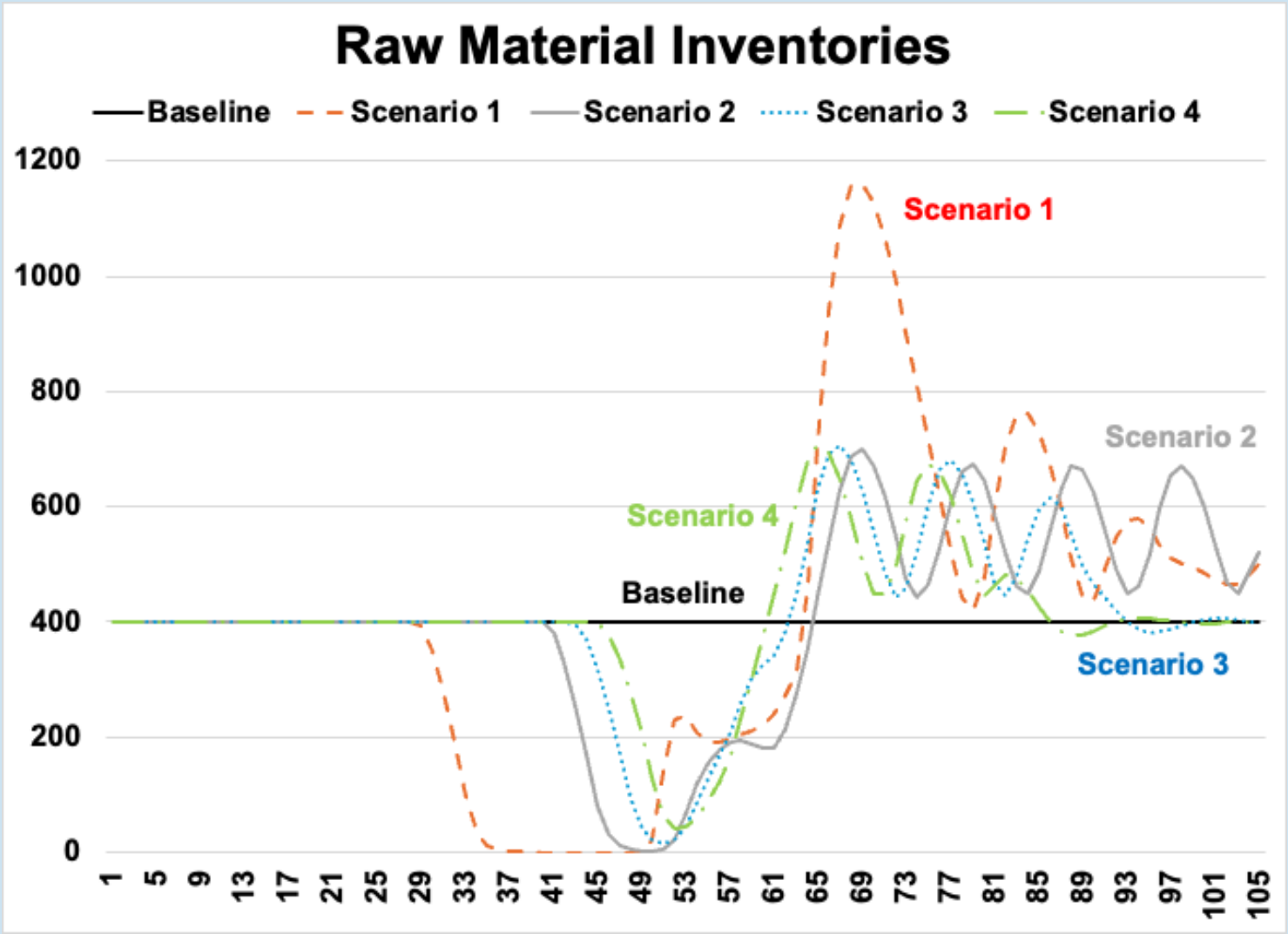
Variable	Baseline	Scenario 1 (US T1 out)	Scenario 2 (MX T2 out)	Scenario 3 (AF T2 out)
Cash Available	$ 120,800	$ 44,673	$ 109,454	$ 120,617
Recovery Time to 50% Deliveries	-	13 weeks	4 weeks	2 weeks
Recovery Time to 100% Deliveries	-	15 weeks	6 weeks	3 weeks
High/Low RM Inventory Spikes	-	+165% -100%	+ 75% - 99%	+75% - 96%
High/Low FG Inventory Spikes	-	+0% -100%	+ 0% - 97%	+ 0% - 83%
Highest Orders Backlog Spike	-	+1,280%	+ 345%	+ 68%
Longest Lead Time	1 week	14 weeks	4.5 weeks	2 weeks
% On Time Deliveries	100%	71%	87%	93%
MIN Profit Margin	20%	- Infinity	- 375%	- 11%

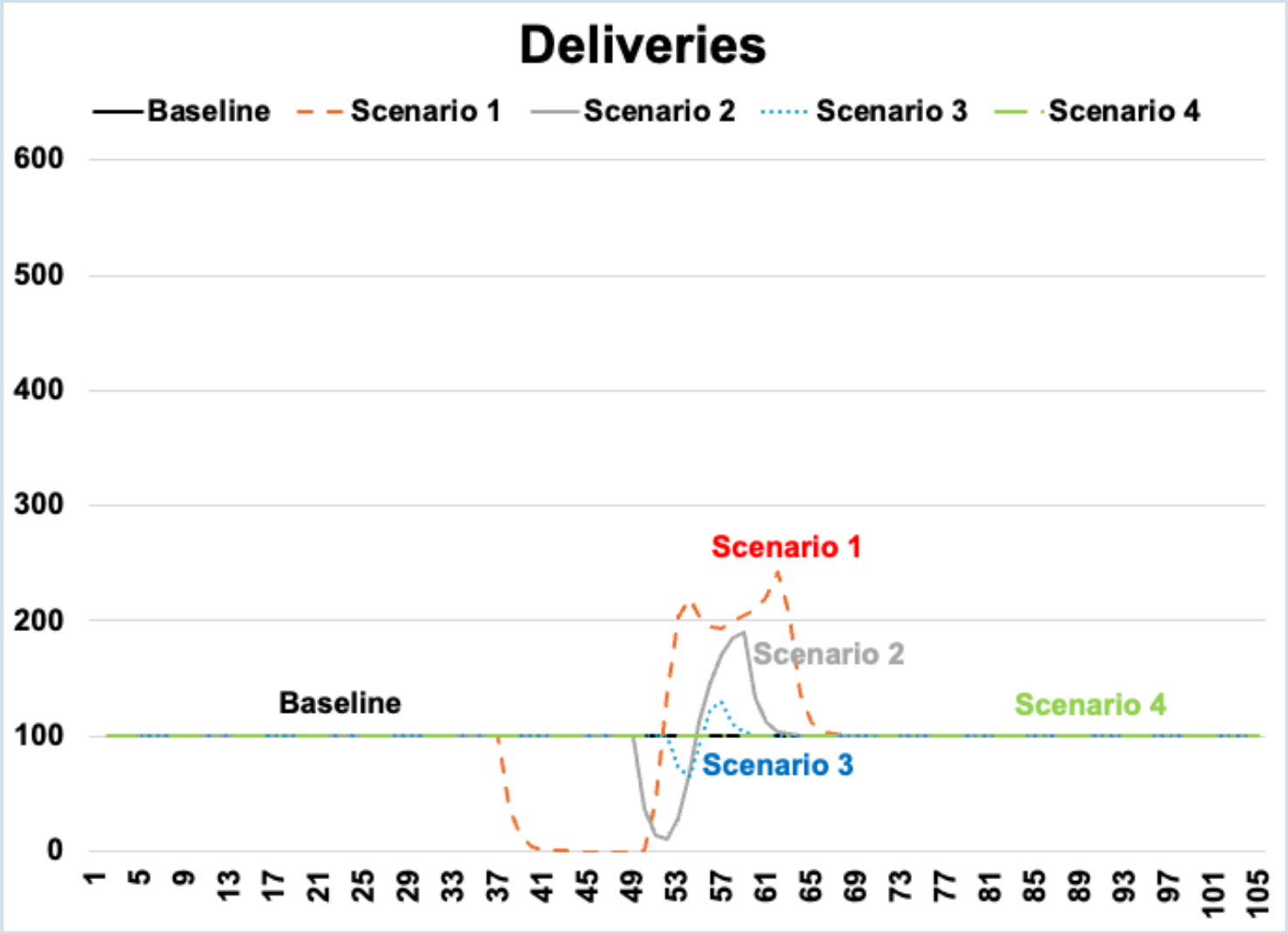
Scenario 4: China Tier 2 out for 2 months





Variable	Baseline	Scenario 1 (US T1 out)	Scenario 2 (MX T2 out)	Scenario 3 (AF T2 out)	Scenario 4 (CH T2 out)
Cash Available	$ 120,800	$ 44,673	$ 109,454	$ 120,617	$ 121,030
Recovery Time to 50% Deliveries	-	13 weeks	4 weeks	2 weeks	-
Recovery Time to 100% Deliveries	-	15 weeks	6 weeks	3 weeks	-
High/Low RM Inventory Spikes	-	+165% -100%	+ 75% - 99%	+75% - 96%	+75% - 90%
High/Low FG Inventory Spikes	-	+0% -100%	+ 0% - 97%	+ 0% - 83%	+ 0% - 48%
Highest Orders Backlog Spike	-	+1,280%	+ 345%	+ 68%	-
Longest Lead Time	1 week	14 weeks	4.5 weeks	2 weeks	1 week
% On Time Deliveries	100%	71%	87%	93%	100%
MIN Profit Margin	20%	- Infinity	- 375%	- 11%	-8%

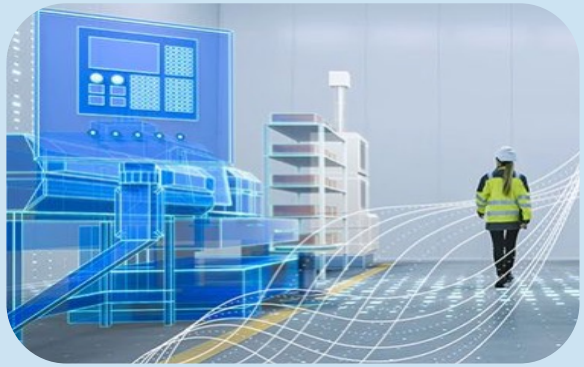




What-If Scenario Conclusions and Observations

Source: https://sloanreview.mit.edu/

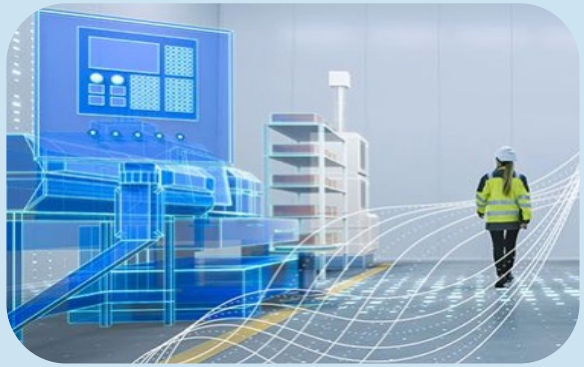
What-If Scenario Conclusions and Observations



Relying on a single supplier can be disastrous

- Risk can be greatly reduced with additional suppliers.

What-If Scenario Conclusions and Observations



Relying on a single supplier can be disastrous

- Risk can be greatly reduced with additional suppliers.

Strategic risks can be analyzed with little or no actual data

- Allows exploration of possible solutions early on before problems arise.
- As more data are collected, solutions can be further refined.

What-If Scenario Conclusions and Observations

Source:
procurious.com

Each supplier has a different operational impact on the chain.

- With the same disruption, each supplier can have different performance results.
- These results can prioritize where more data are needed.

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No company in the supply chain is an island

- The supply chain operates as a "system" with interconnected companies.
- Decisions and actions of one company can greatly impact other companies.

What-If Scenario Conclusions and Observations

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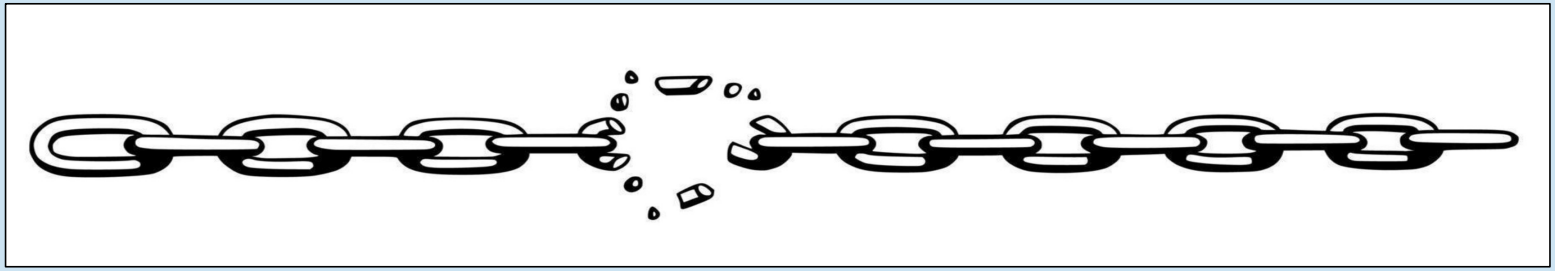
The closer the disruption is geographically (e.g., Mexico, China), the greater the impact (due to lower inventory buffers).



The Challenge:
Balancing Efficiency and Resilience

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What good is optimizing leaves here . . .

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What good is optimizing leaves here . . .

. . . when you should have taken this branch to begin with.

Questions?

The foundation for building resilient supply chains.