Construction Engineering Management (CEM)

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Topics

- Distributed Discrete Event Simulation
- The High Level Architecture
- COSYE Framework
- The Tunneling Federation
- Lessons Learned
- Questions?

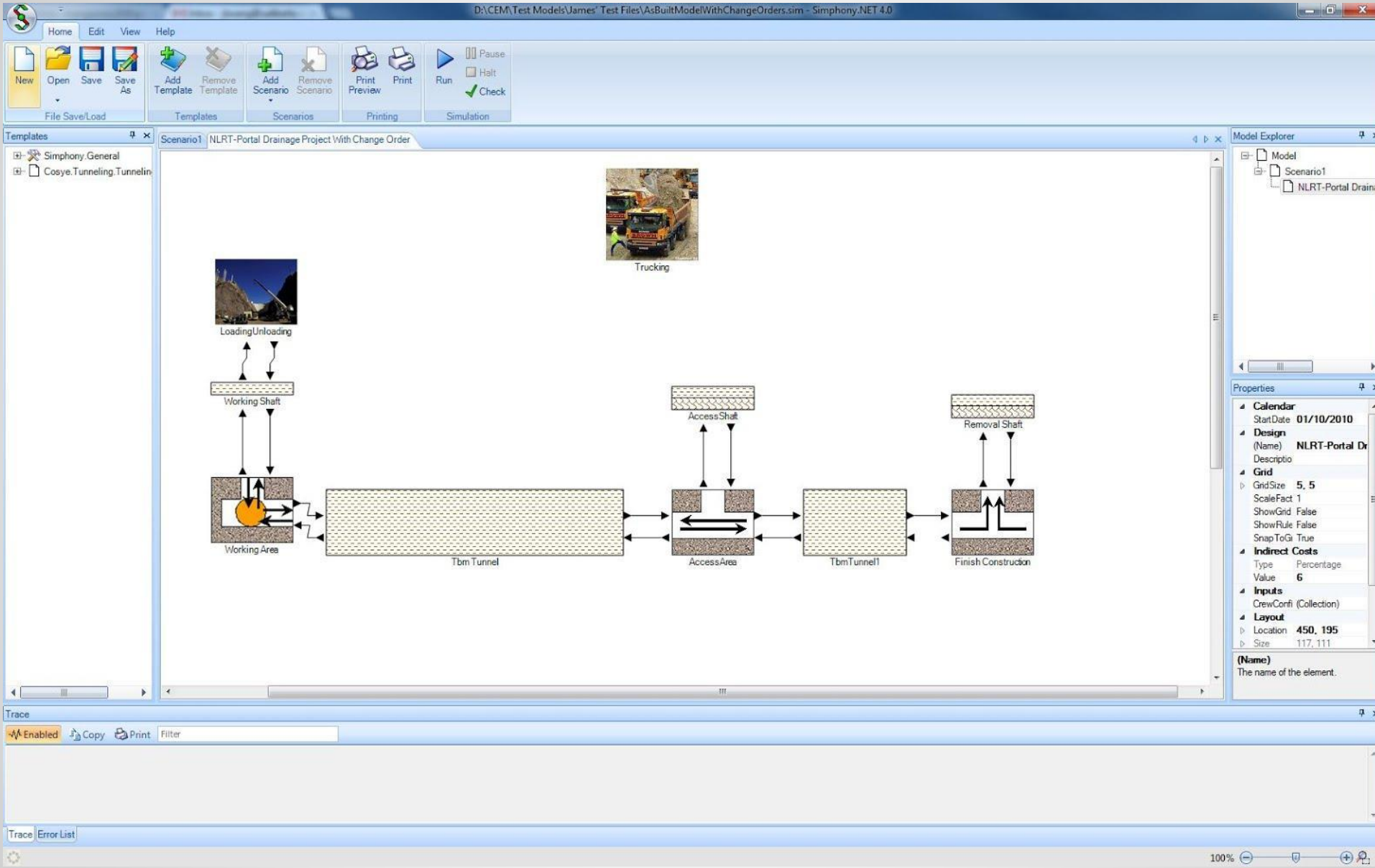
Motivations For Distributed Simulations

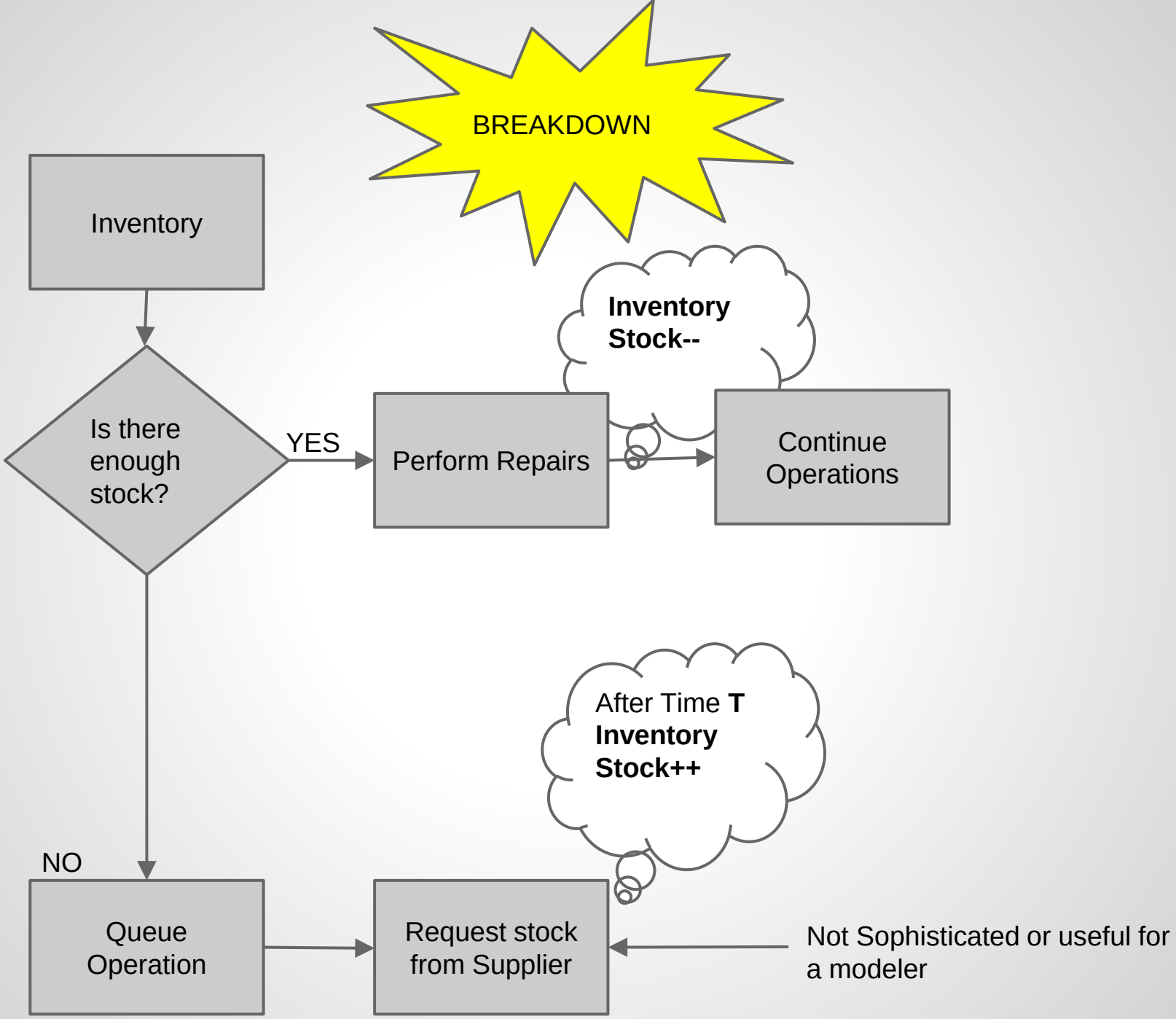
- Simulations can grow large and have many concurrent events being processed.
- A sign of over-complex modeling (attempting to model too much)
- Want more flexibility

Example

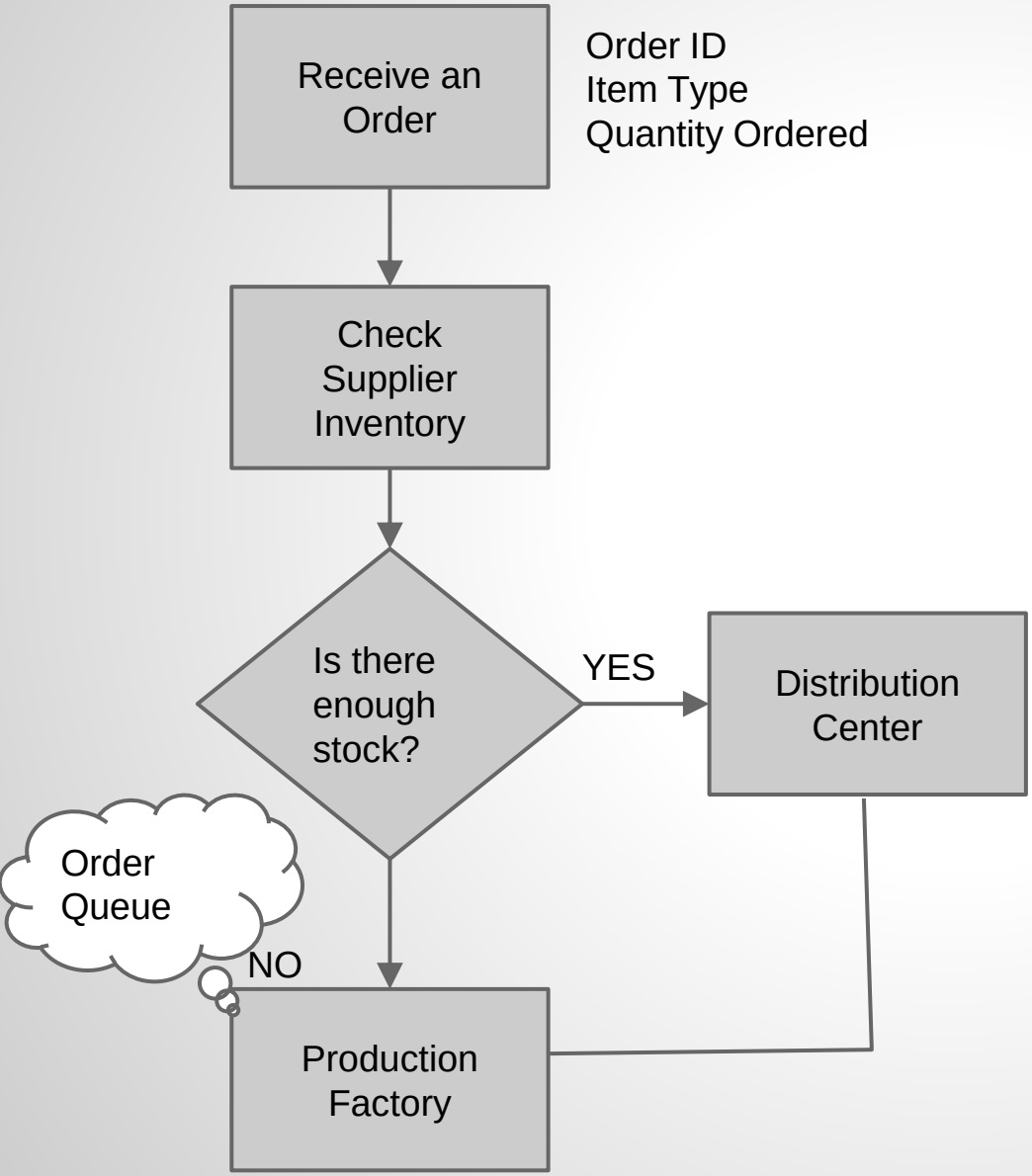
Examine: Tunnel Construction and the *Supplier*

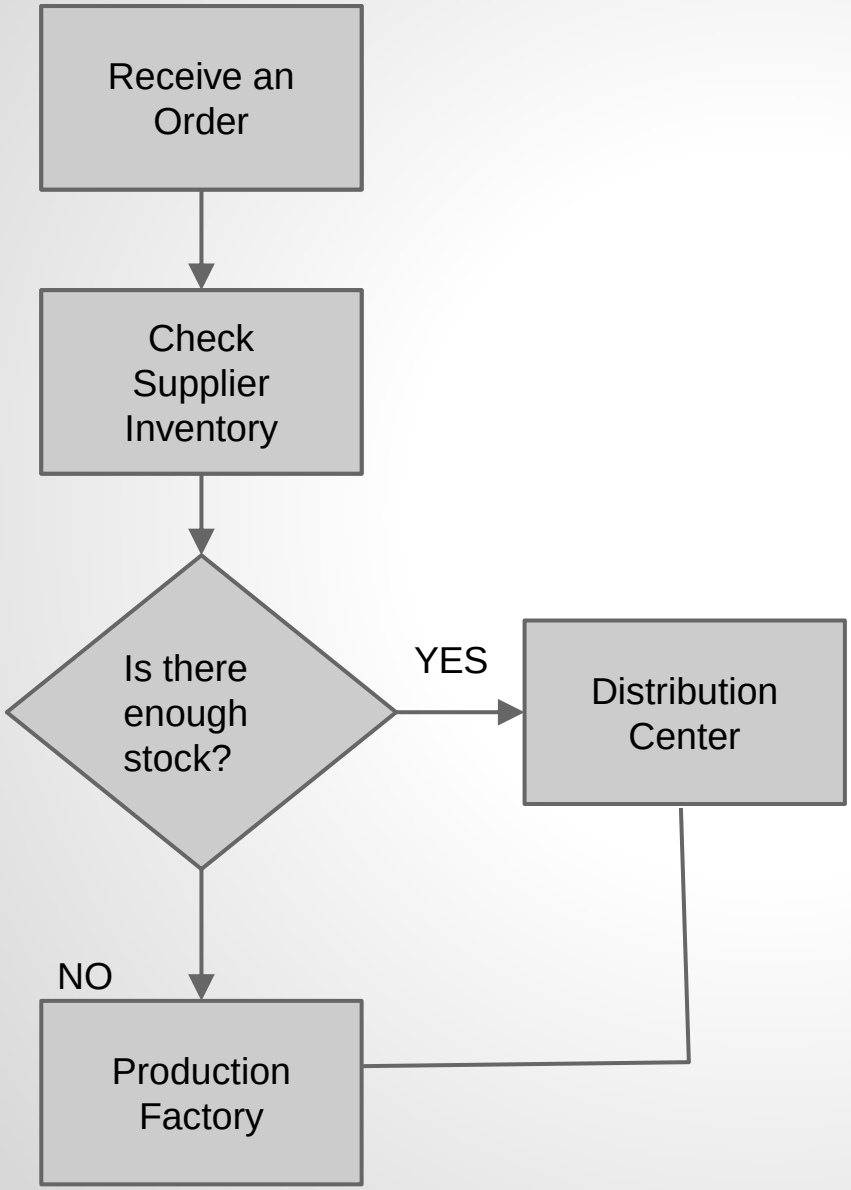
- Some type of machine or equipment breakdown (ie. Crane or TBM Breakdown)
- The process or operation may be halted
- We need repair or find replacement parts


D:\CEM\Test Models\James' Test Files\AsBuiltModelWithChangeOrders.sim - Simphony.NET 4.0
Home
Edit
View
Help
New
Open
Save
Save As
File Save/Load
Add Template
Remove Template
Templates
Add Scenario
Remove Scenario
Scenarios
Print Preview
Print
Printing
Run
Pause
Halt
Check
Simulation
Templates
Simphony.General
Cosye.Tunneling.Tunnelin
Scenario1
NLRT-Portal Drainage Project With Change Order
Trucking
LoadingUnloading
Working Shaft
Working Area
Tbm Tunnel
Access Shaft
Access Area
Tbm Tunnel1
Removal Shaft
Finish Construction
Model Explorer
Model
Scenario1
NLRT-Portal Drain
Properties
Calendar
StartDate 01/10/2010
Design
(Name) NLRT-Portal Dr
Descriptio
Grid
GridSize 5, 5
ScaleFact 1
ShowGrid False
ShowRule False
SnapToGi True
Indirect Costs
Type Percentage
Value 6
Inputs
CrewConfi (Collection)
Layout
Location 450, 195
Size 117, 111
(Name)
The name of the element.
Trace
Enabled
Copy
Print
Filter
Trace
Error List
100%


BREAKDOWN
Inventory
Inventory Stock--
Is there enough stock?
YES
Perform Repairs
Continue Operations
After Time T Inventory Stock++
NO
Queue Operation
Request stock from Supplier
Not Sophisticated or useful for a modeler

The Supplier Template





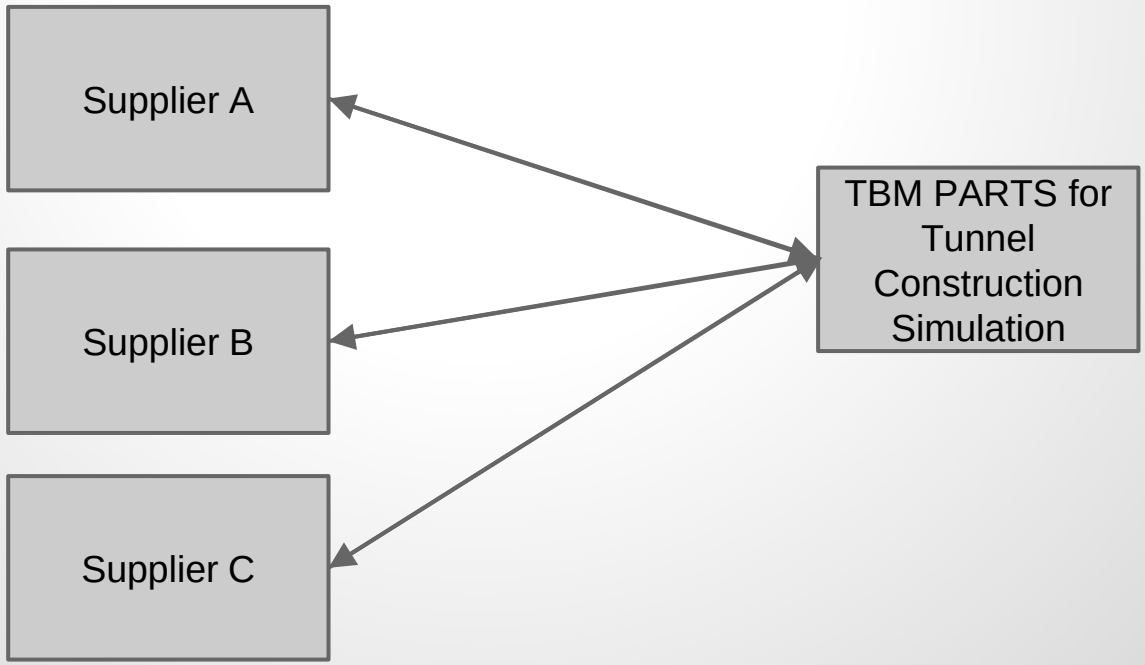
TBM PARTS for Tunnel Construction Simulation

TRUCK PARTS for Earthmoving Simulation

Pipeline Construction Simulation

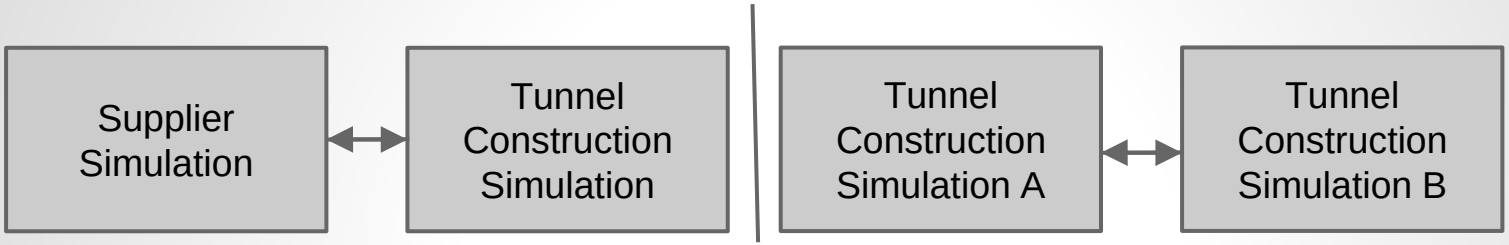
Distributed Simulation

- Run multiple simulations.
- Simulations and components modularized.
  - Separate Logic
  - Reusable and interchangeable

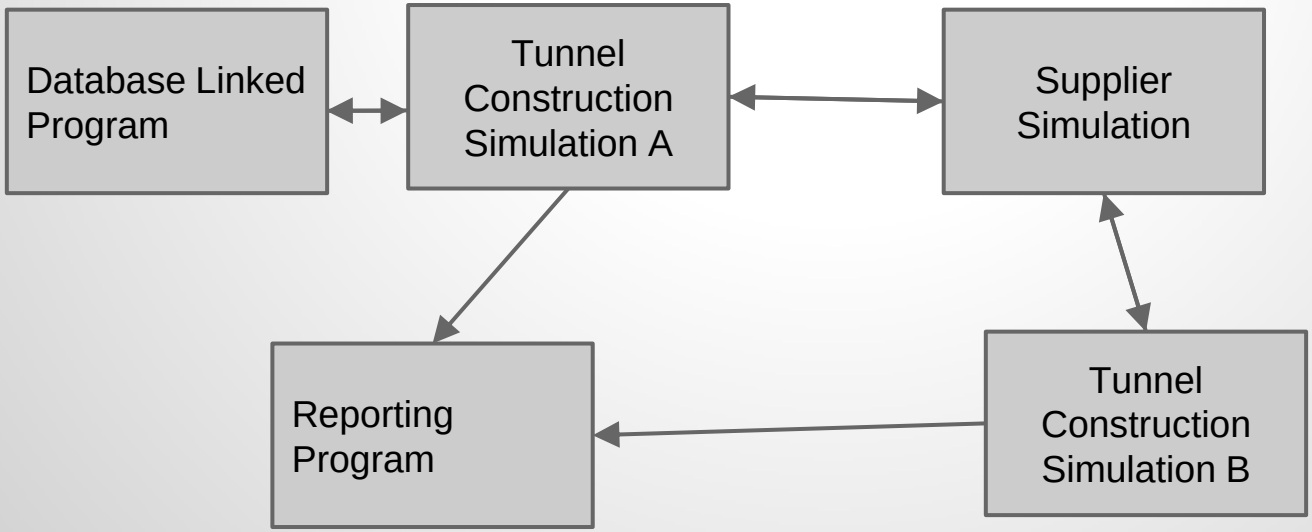


How to have Simulations talk to other Simulations or Components?

Separate Synchronized Simphony Processes (Executables)



Or even different programs



High Level Architecture (HLA)

- Developed by the US Department of Defense
- Defines a set of rules and specifications on how simulations can communicate with each other.
- Communications between simulations are managed by the Runtime Infrastructure (RTI)

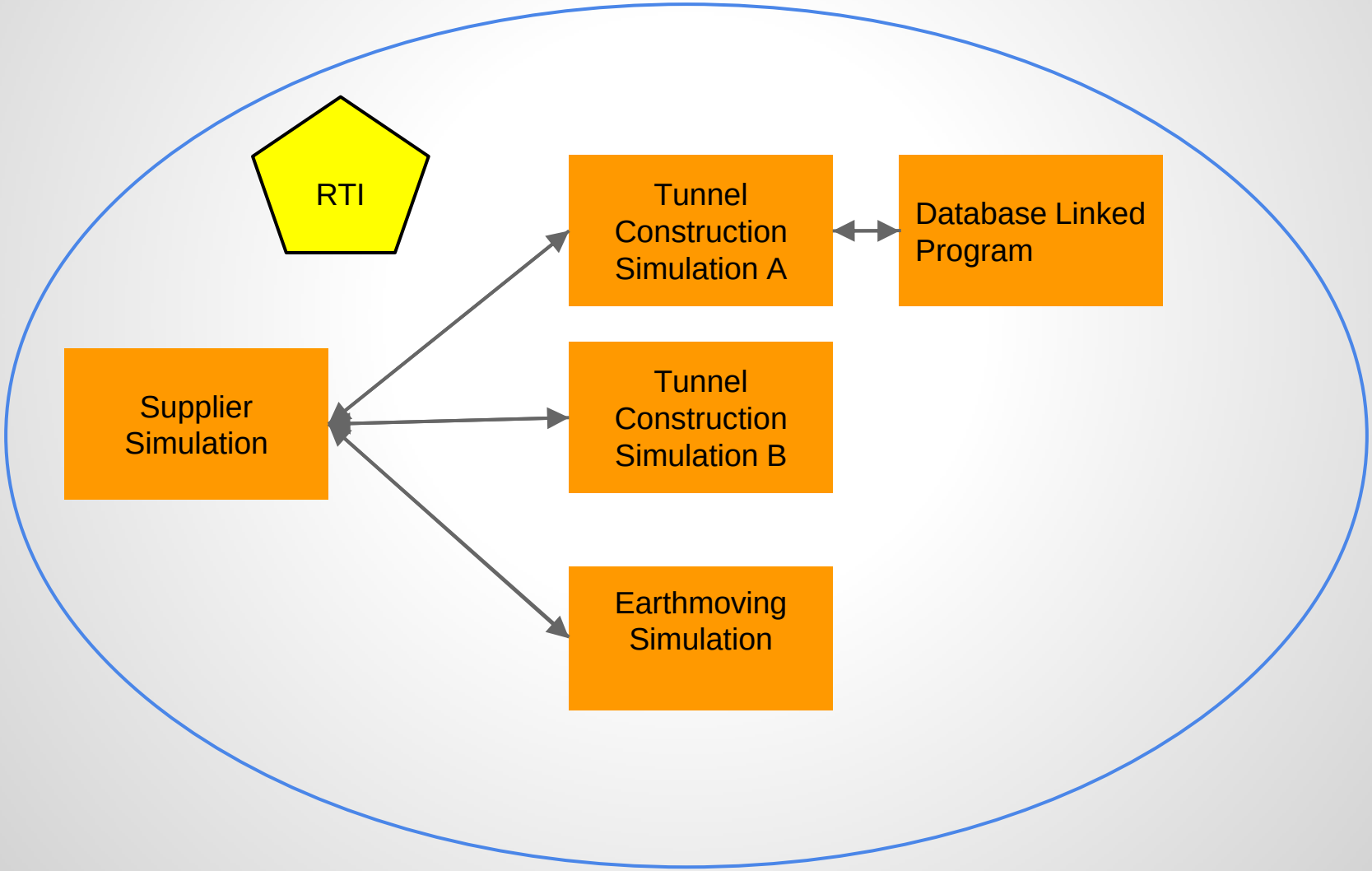
HLA Components

1. The RTI specification of the interface in which the simulations will communicate with each other.
2. An Object Model which describes the data and information communicated to the simulations.
3. A set of rules in which all simulations must follow.

COSYE Framework

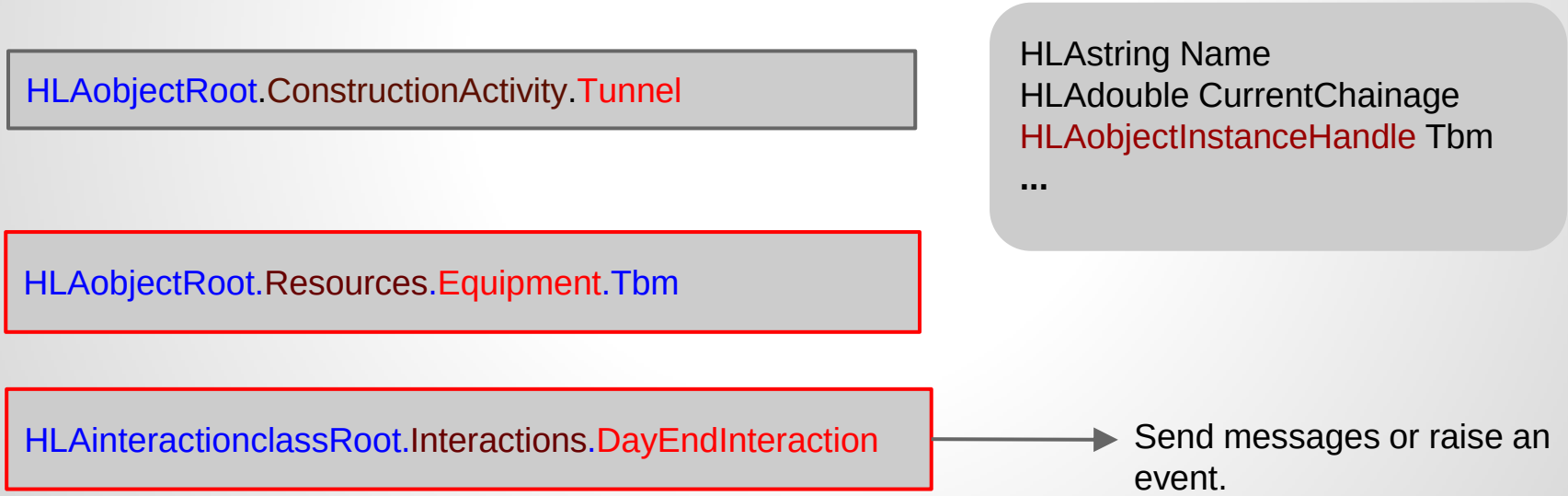
- Implementation of the HLA.
- Written in C# with and .NET Framework.
- .NET Remoting as an application layer on-top of network communication protocols.
- Defines the Federate Object Model (FOM) as xml document.

Federates within a Federation



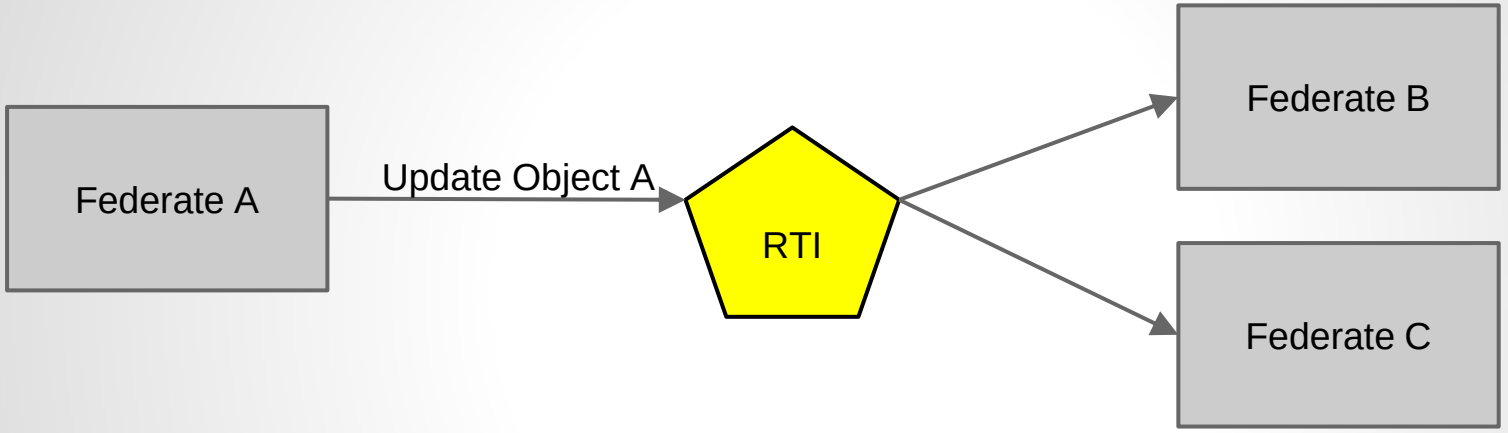
What Federates Communicate

FOM defines a common set of objects, attributes and interactions in which all federates joined in a federation know about.



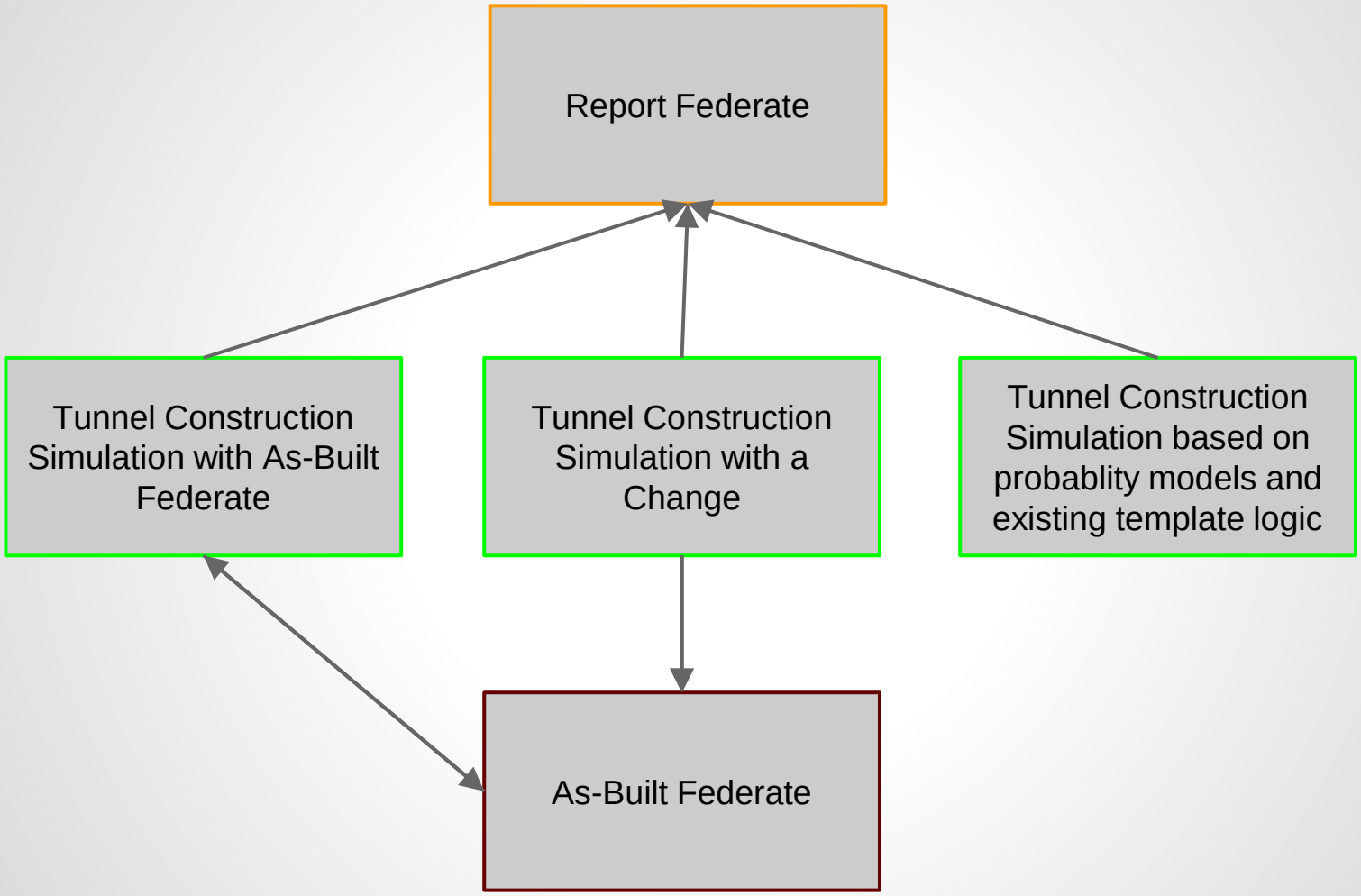
Defined in a xml document that is shared amongst all federates via the RTI

RTI Manager



Object A - Updated Attribute A
Object A - Updated Attribute B
...

The Tunneling Federation with As-Built Communication:



Challenges

- Rapidly Changing Use Cases

Example :

"I want the template to do this..."

"I think I would rather have this..."

"Well actually, the thing we had before was better"

Challenges

- Taking a simulation based on modelling events and assumptions and applying "actual data".
- Tunneling logic needed to be redesigned
- Tunneling Template lots of legacy code that was rushed or undocumented.

Lessons Learned

- Keep your code simple and clean for maintenance sake.
- Code conventions and commenting code is important.
- Communication is key.

Questions?