27th annual INCOSE international symposium

Adelaide, Australia

July 15 - 20, 2017

Volvo Construction Equipment

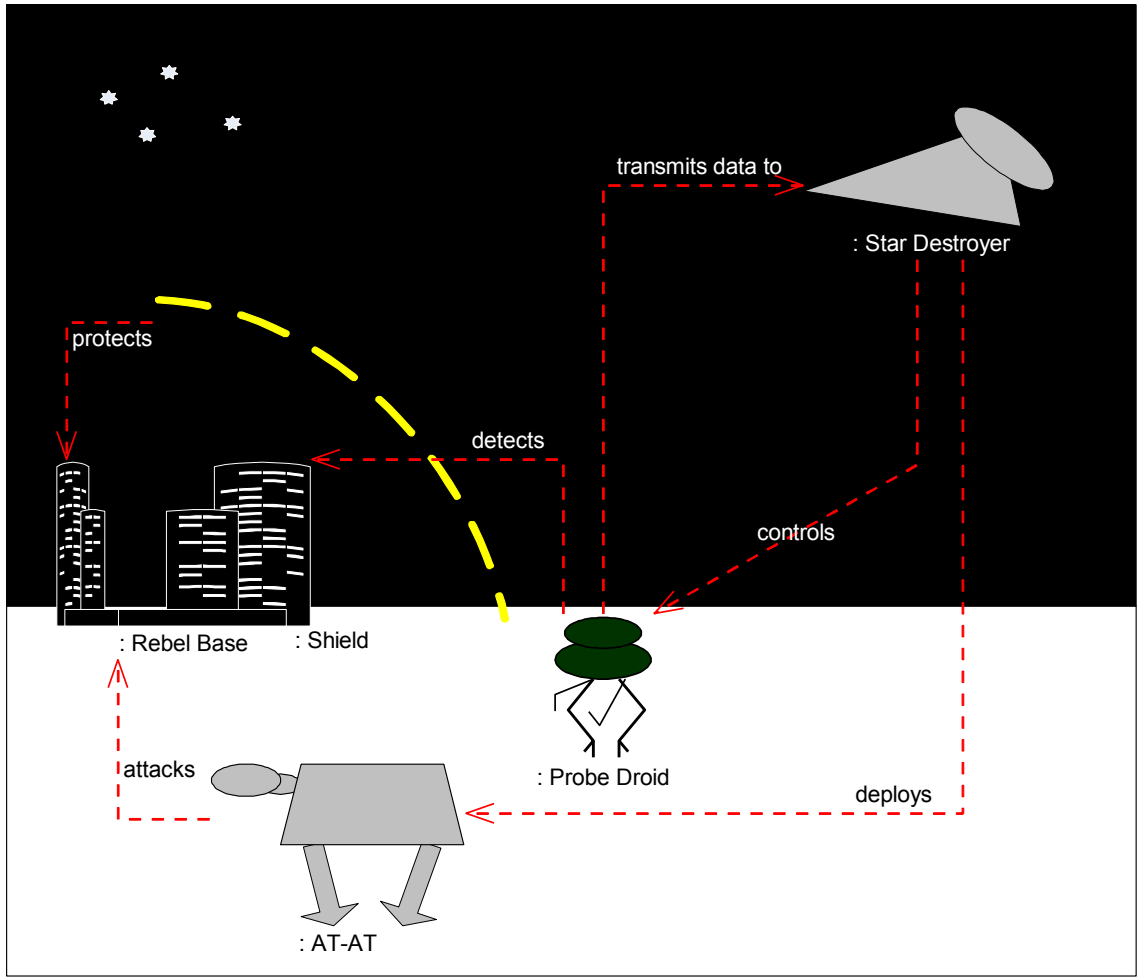
From Empire Strikes Back to Electric Site

An industrial example of using Enterprise Architecture to speed up systems development

www.incose.org/symp2017

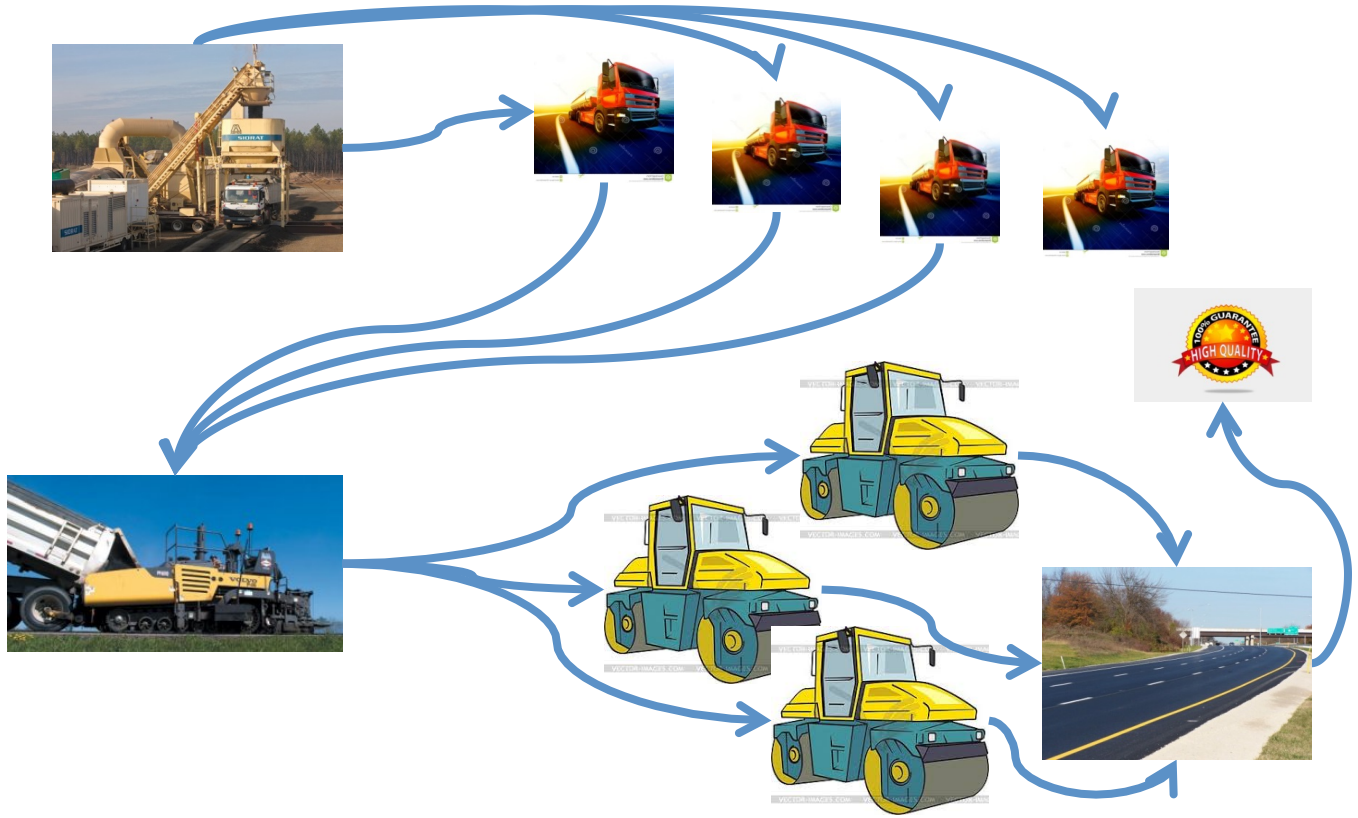
Starting point

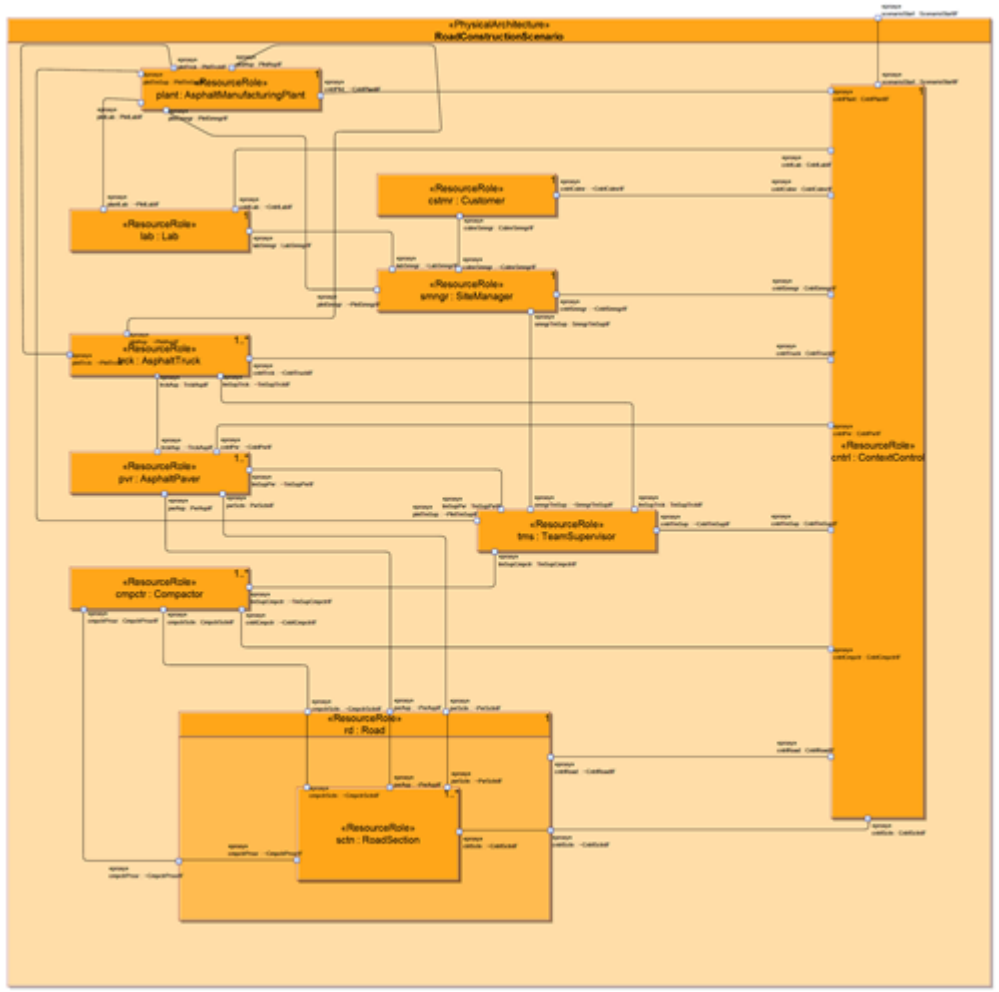
OV-1a [High Level Operational Concept] Planetary Assault - Graphic Version [OV-1a]



For a non-graphic version see [High Level Operational Concept] Planetary Assault [OV-1a]

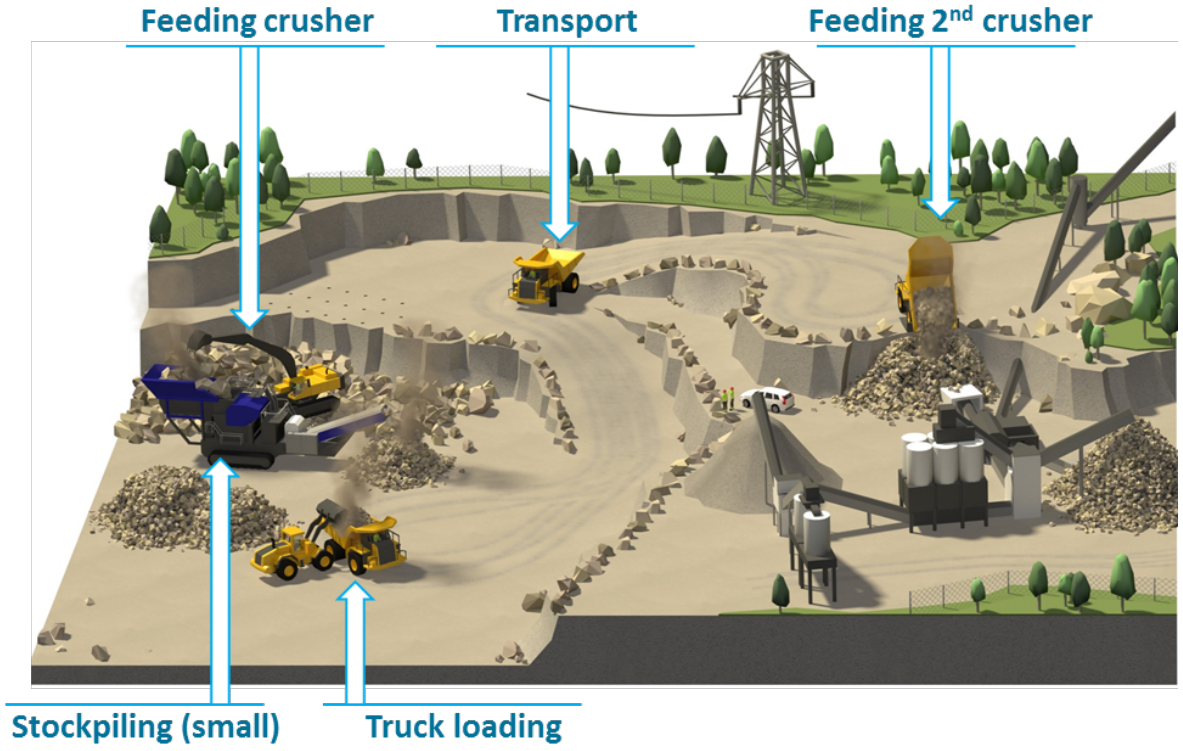
First try at Volvo CE, Rock to Road

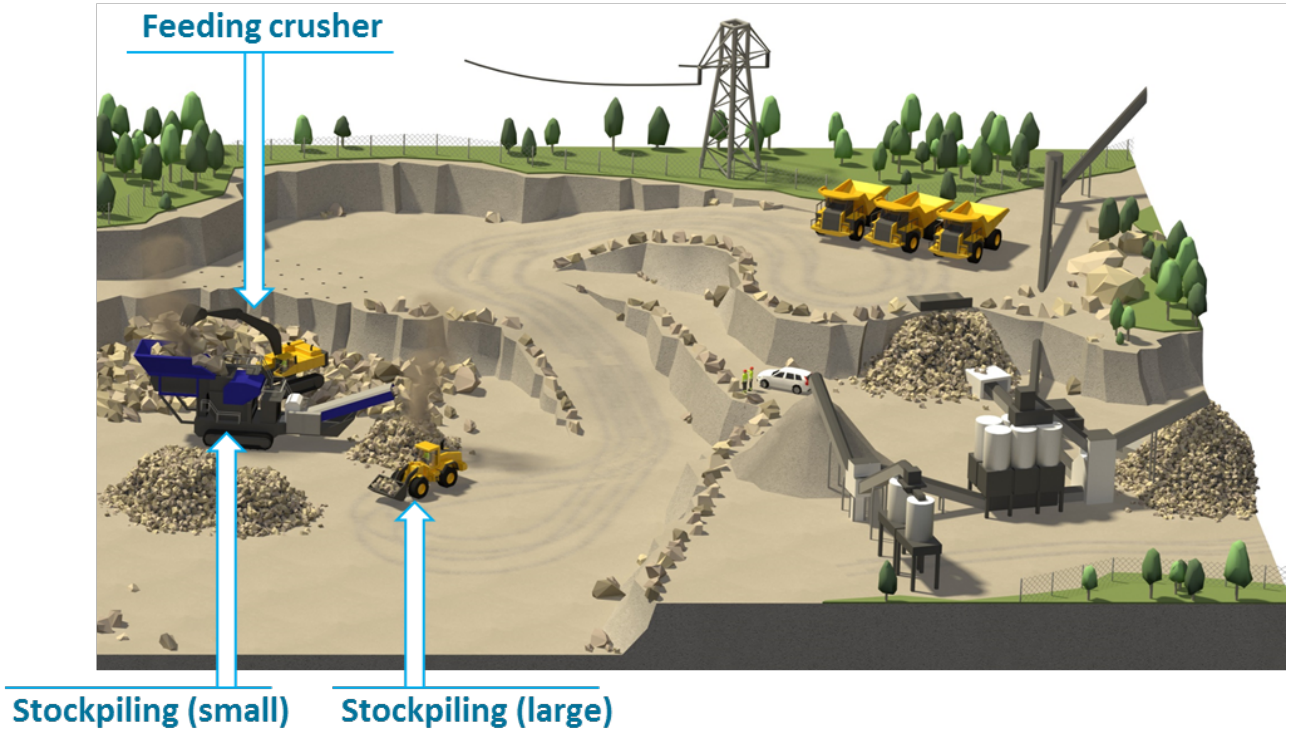




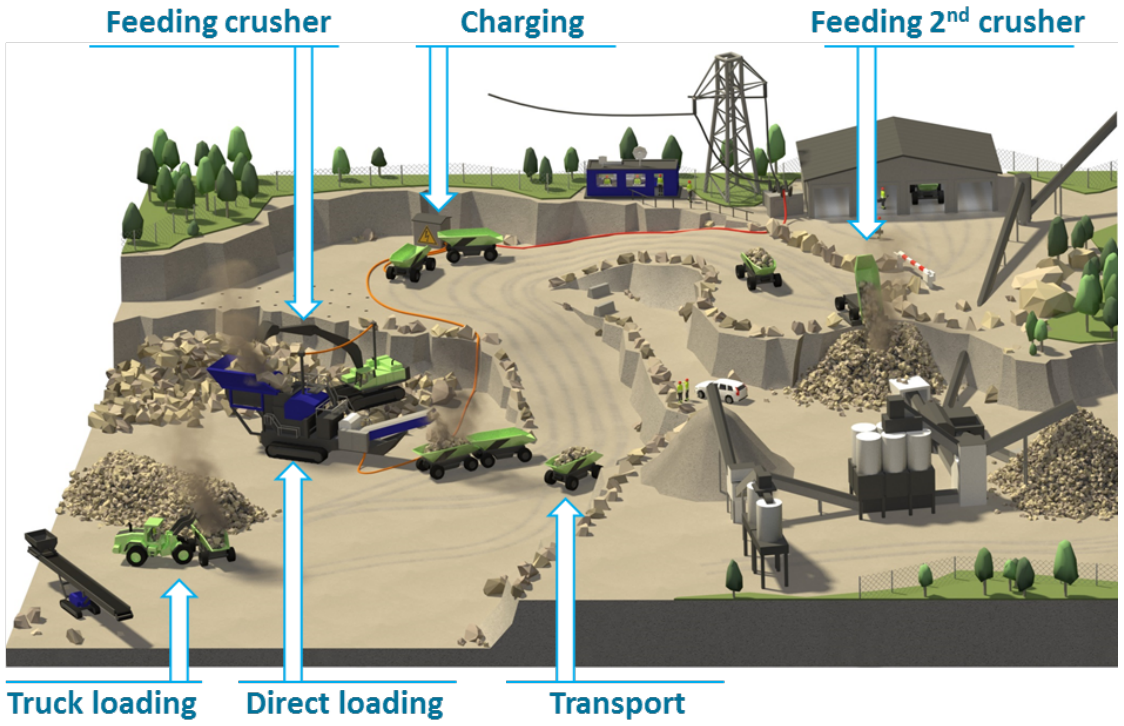
Electric Site, background

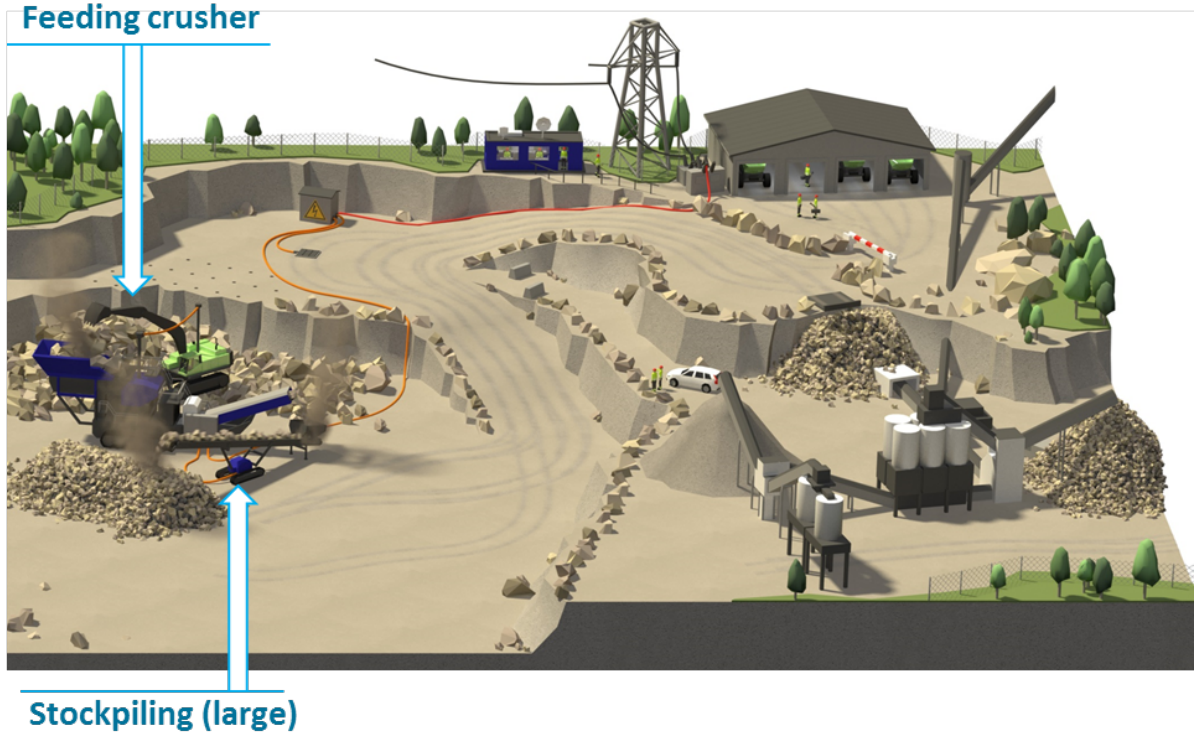
Electric Site, Today





Electric Site, Fall 2018





The Modeling Approach

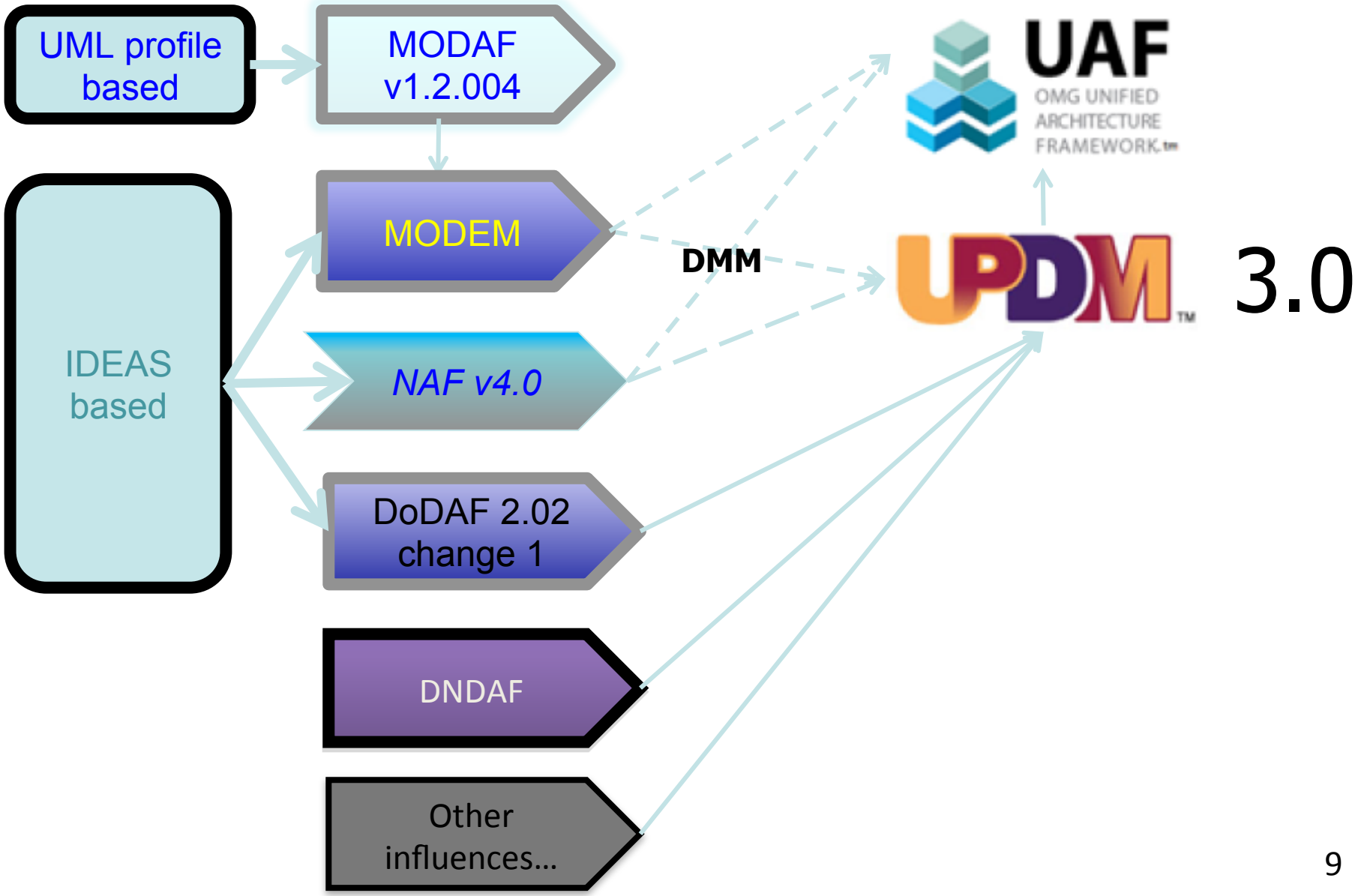
Questions to be Answered, in order to make the model provide the expected benefit

- What is the purpose of the project and the model?
- What are the constraints that need to be considered?
- How should the model be structured?

UPDM 3 Requirements

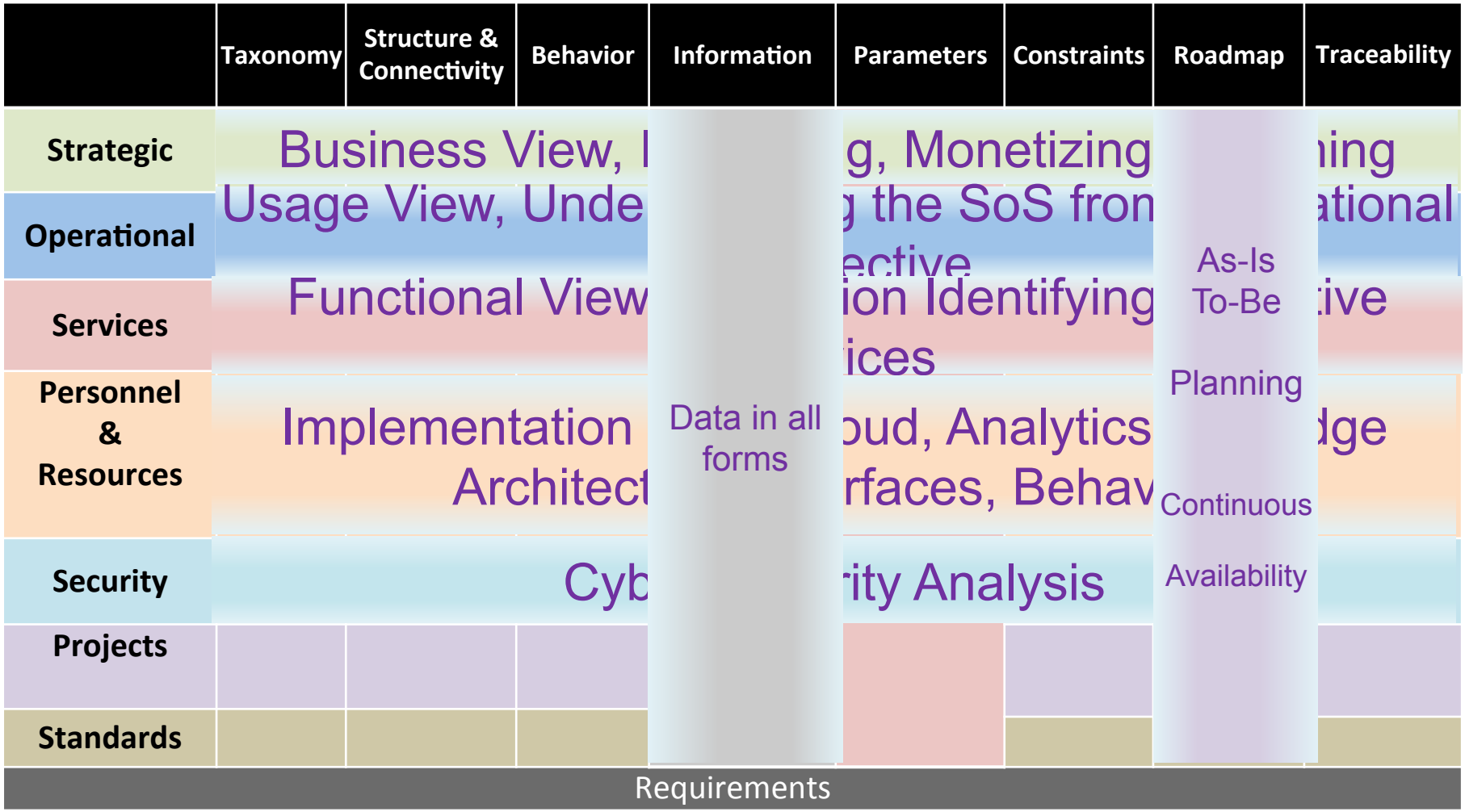
- UPDM RFP requirement: ” The UPDM V3.0 domain metamodel shall be derived from MODEM and DM2, both of which are based upon the International Defence Enterprise Architecture Specification Foundation [IDEAS].”
  - Mandatory requirements:
    - √ Provide Domain Metamodel derived from MODEM and DM2
    - √ An Architecture Framework Profile Using SysML
    - √ Supports BPMN 2.0
    - √ Use of SysML Requirements Elements and Diagrams
    - √ Use of SysML Parametrics Elements and Diagrams Mapped to Measurements
    - √ Traceability Matrix to Supported Frameworks
    - √ Support for data and information viewpoints
    - √ Traceability to UPDM 2.x for backward compatibility
    - √ An example architecture
    - √ A matrix for applicable elements for each presentation artifact
    - √ Support for XMI model interchange
    - √ Extensibility for custom views

UPDM 3.0->UAFP 1.0



The Unified Architecture Framework Grid

- Rows map to different levels of focus
- Columns relate to standard means of expression
- IIC RA and some sub views can be mapped onto it

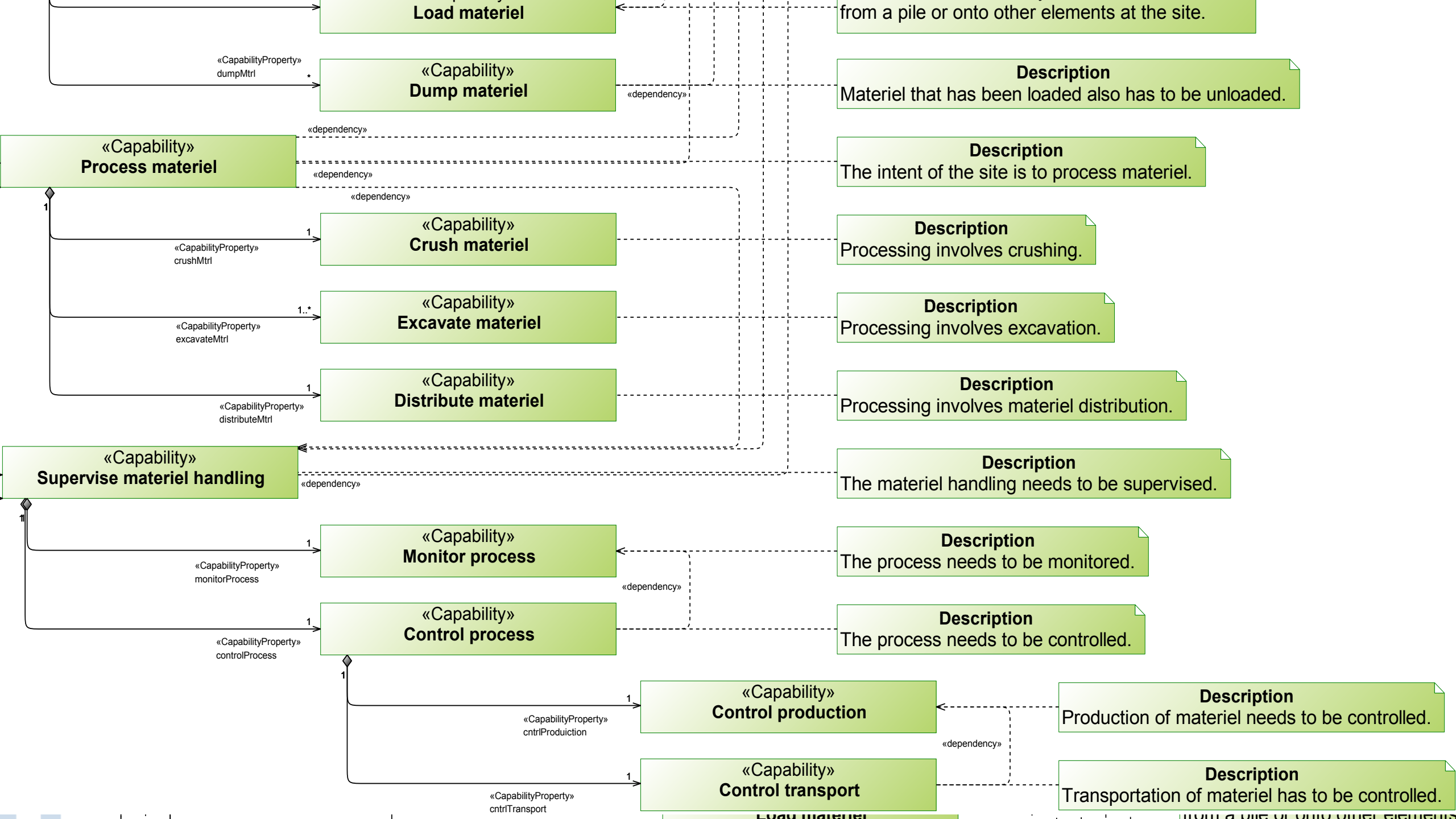


Grid Overview

- Perspectives (Rows)
  - Metadata (Md)
  - Strategic (St)
  - Operational (Op)
  - Services(Sv)
  - Personnel(Pr)
  - Resources(Rs)
  - Security(Sc)
  - Projects(Pj)
  - Standards(Sd)
  - Actual Resources(Ar)
  - Dictionary (Dc)
  - Summary and Overview (SmOv)
  - Requirements (Rq)
- Representation (Columns)
  - Taxonomy (Tx)
  - Structure(Sr)
  - Connectivity(Cn)
  - Processes (Pr)
  - States(St)
  - Interactions Scenarios (Is)
  - Constraints (Ct)
  - Traceability (Tr)
  - Roadmap (Rm)
- Cross cutting concerns
  - Information (If)
  - Parameters (Pm)
- View Specifications exist at the intersections

UAF
OMG UNIFIED ARCHITECTURE FRAMEWORK™

	Taxonomy Tx	Structure Sr	Connectivity Cn	Processes Pr	States St	Interaction Scenarios Is	Information If	Parameters Pm	Constraints Ct	Roadmap Rm	Traceability Tr
Metadata Md	Metadata Taxonomy Md-Tx	Architecture Viewpoints [a] Md-Sr	Metadata Connectivity Md-Cn	Metadata Processes [a] Md-Pr	-	-			Metadata Constraints [a] Md-Ct		Metadata Traceability Md-Tr
Strategic St	Strategic Taxonomy St-Tx	Strategic Structure St-Sr	Strategic Connectivity St-Cn	-	Strategic States St-St	-			Strategic Constraints St-Ct	Strategic Deployment, St-Rm Strategic Phasing St-Rm	Strategic Traceability St-Tr
Operational 0p	Operational Taxonomy Op-Tx	Operational Structure Op-Sr	Operational Connectivity Op-Cn	Operational Processes Op-Pr	Operational States Op-St	Operational Interaction Scenarios Op-Is			Operational Constraints Op-Ct	-	-
Services Sv	Service Taxonomy Sv-Tx	Service Structure Sv-Sr	Service Connectivity Sv-Cn	Service Processes Sv-Pr	Service States Sv-St	Service Interaction Scenarios Sv-Is	Conceptual Data Model,	Environment Pm-En	Service Constraints Sv-Ct	Service Roadmap Sv-Rm	Service Traceability Sv-Tr
Personnel Pr	Personnel Taxonomy Pr-Tx	Personnel Structure Pr-Sr	Personnel Connectivity Pr-Cn	Personnel Processes Pr-Pr	Personnel States Pr-St	Personnel Interaction Scenarios Pr-Is	Logical Data Model,		Competence, Drivers, Performance Pr-Ct	Personnel Availability, Personnel Evolution, Personnel Forecast Pr-Rm	Personnel Traceability Pr-Tr
Resources Rs	Resource Taxonomy Rs-Tx	Resource Structure Rs-Sr	Resource Connectivity Rs-Cn	Resource Processes Rs-Pr	Resource States Rs-St	Resource Interaction Scenarios Rs-Is	Physical schema, real world results	Measurements Pm-Me	Resource Constraints Rs-Ct	Resource evolution, Resource forecast Rs-Rm	Resource Traceability Rs-Tr
Security Sc	Security Taxonomy Sc-Tx	Security Structure Sc-Sr	Security Connectivity Sc-Cn	Security Processes Sc-Pr	-	-			Security Constraints Sc-Ct	-	-
Projects Pj	Project Taxonomy Pj-Tx	Project Structure Pj-Sr	Project Connectivity Pj-Cn	-	-	-			-	Project Roadmap Pj-Rm	Project Traceability Pj-Tr
Standards Sd	Standard Taxonomy Sd-Tx	Standards Structure Sd-Sr	-	-	-	-			-	Standards Roadmap Sr-Rm	Standards Traceability Sr-Tr
Actuals Resources Ar		Actual Resources Structure, Ar-Sr	Actual Resources Connectivity, Ar-Cn	Simulation [b]					Parametric Execution/ Evaluation [b]	-	-
Dictionary * Dc											
Summary & Overview SmOv											
Requirements Rq											


Load materiel
from a pile or onto other elements at the site.
«CapabilityProperty»
dumpMtrl
*
«Capability»
Dump materiel
«dependency»
Description
Materiel that has been loaded also has to be unloaded.
«dependency»
«Capability»
Process materiel
«dependency»
Description
The intent of the site is to process materiel.
«dependency»
1
1
«CapabilityProperty»
crushMtrl
«Capability»
Crush materiel
Description
Processing involves crushing.
1..*
«CapabilityProperty»
excavateMtrl
«Capability»
Excavate materiel
Description
Processing involves excavation.
1
«CapabilityProperty»
distributeMtrl
«Capability»
Distribute materiel
Description
Processing involves materiel distribution.
«Capability»
Supervise materiel handling
«dependency»
Description
The materiel handling needs to be supervised.
1
1
«CapabilityProperty»
monitorProcess
«Capability»
Monitor process
Description
The process needs to be monitored.
«dependency»
1
«CapabilityProperty»
controlProcess
«Capability»
Control process
Description
The process needs to be controlled.
1
1
«CapabilityProperty»
cntrlProduiction
«Capability»
Control production
Description
Production of materiel needs to be controlled.
«dependency»
1
«CapabilityProperty»
cntrlTransport
«Capability»
Control transport
Description
Transportation of materiel has to be controlled.

«KnownResourceRole»
rd : Road

1..*

1

«KnownResourceRole»
dist : DistributedMaterial

1

«KnownResourceRole»
crshdMtrl : CrushedMaterial

1..*

1

«OperationalRole»
sprvs : SupervisionAndControl

1

«OperationalRole»
ld : Loading

1..*

1

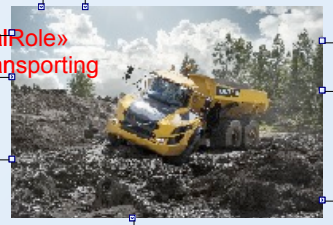
«KnownResourceRole»
whtr : Weather

1

«OperationalRole»
chrg : Charging

1

«OperationalRole»
infra : ElectricalInfraStructure



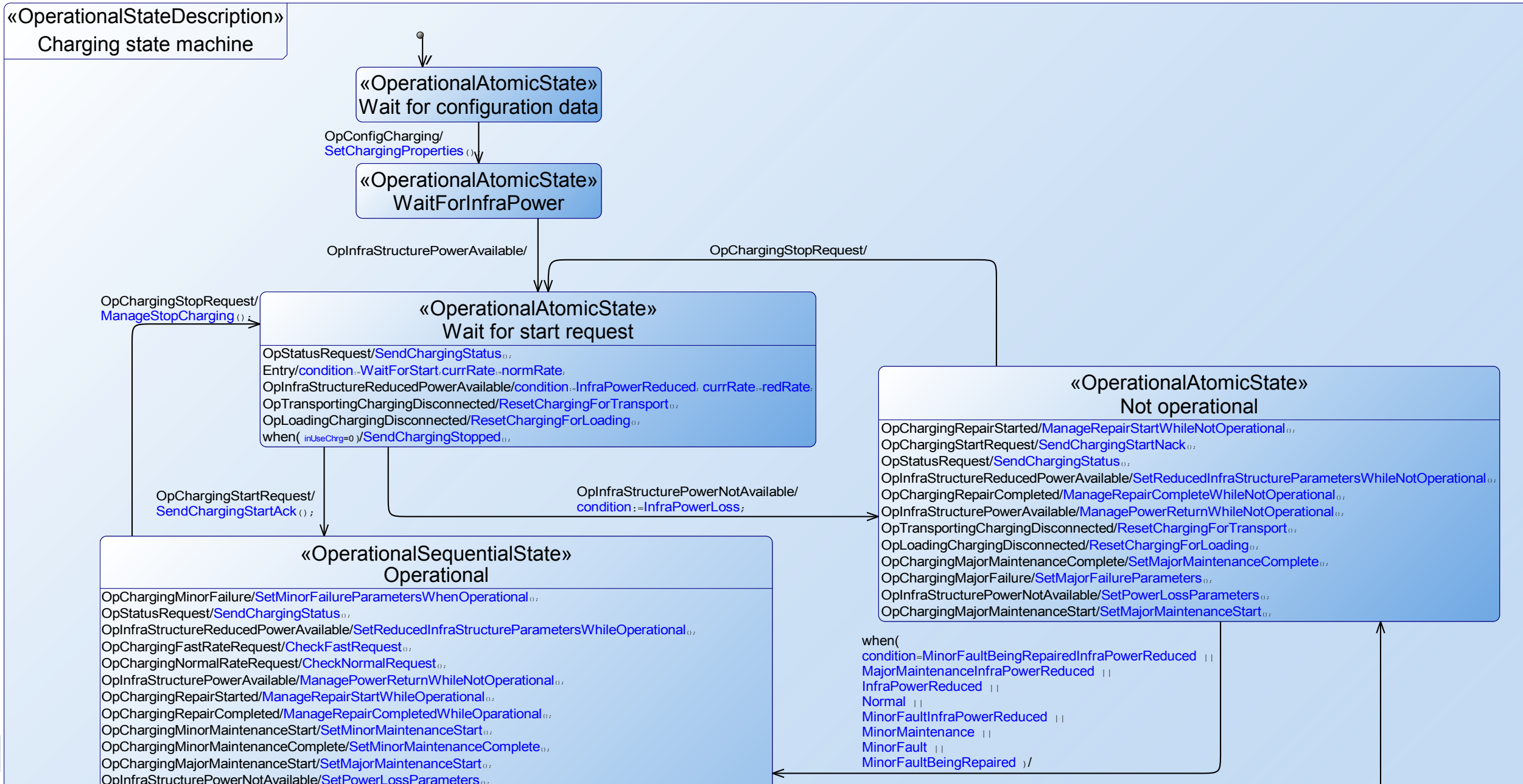
«OperationalRole»
trnsprtr : Transporting

1

«OperationalRole»
lgstcs : LogisticsSupport

«KnownResourceRole»
grid : ExternalElectricityGrid

The Behavior, State Machine, Charging



«ResourceArtifactRole»
rd : Road

1

«NaturalResourceRole»
whtr : Weather

1

1..*

«ResourceRole»
wl : WheelLoader

«ResourceRole»
mgmt : SiteManagement

1

«ResourceArtifactRole»
extComm : ExternalCommunications

1

«ResourceArtifactRole»
siteComm : SiteCommunicationResource

1

«ResourceRole»
chrg : ChargingStation

1

1

«ResourceArtifactRole»
infra : SiteElectricityInfrastructure

1

1..*

«ResourceRole»
lgstcs : LogisticsSupport

«ResourceRole»
xa : XA15

«ResourceArtifactRole»
grid : ElectricityGrid

«ResourceRole»
fac : MaterielFacility

1

«NaturalResourceRole»
facStrg : FacilityStorage

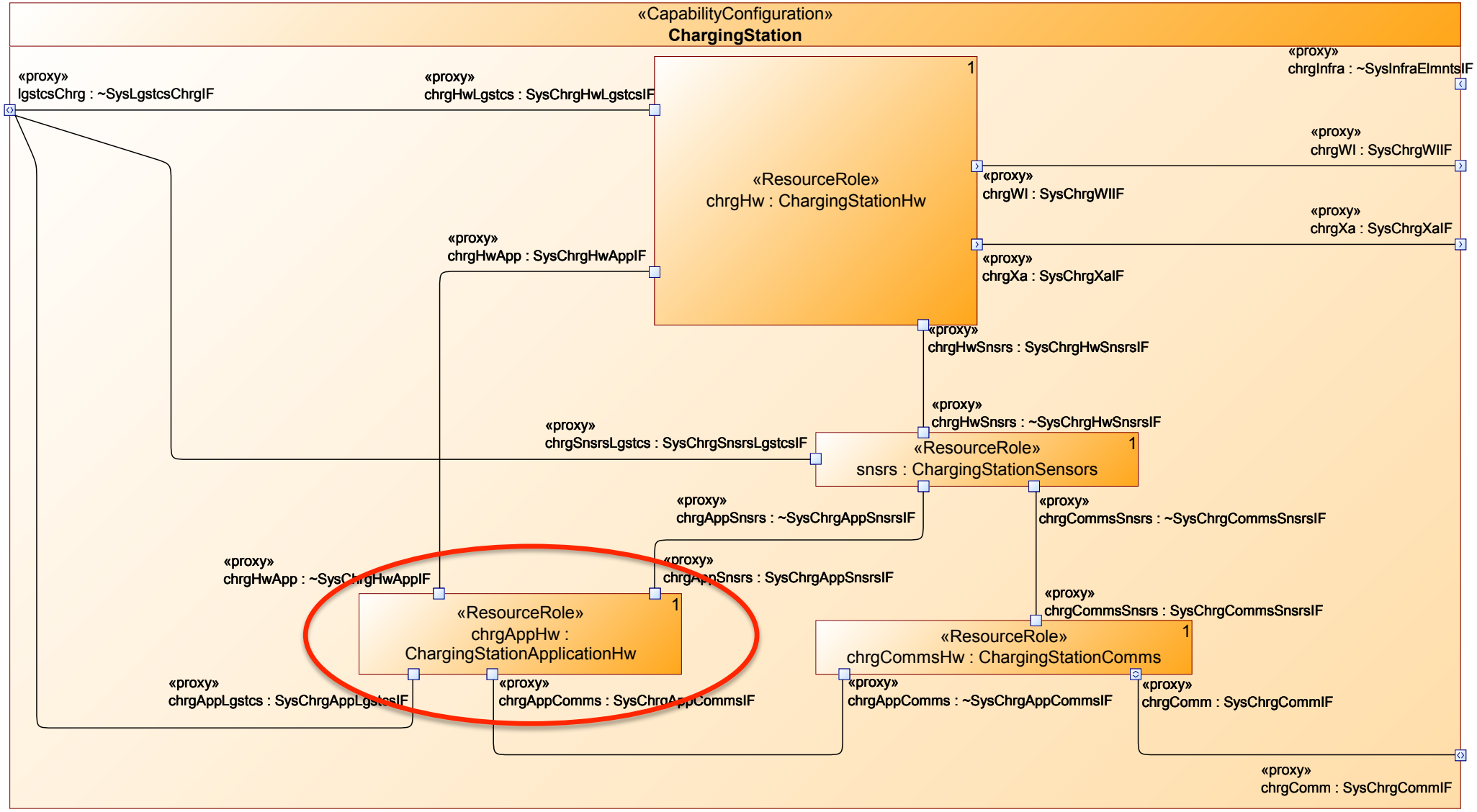
1

«NaturalResourceRole»
dscrdfac : DiscardMaterielFacility

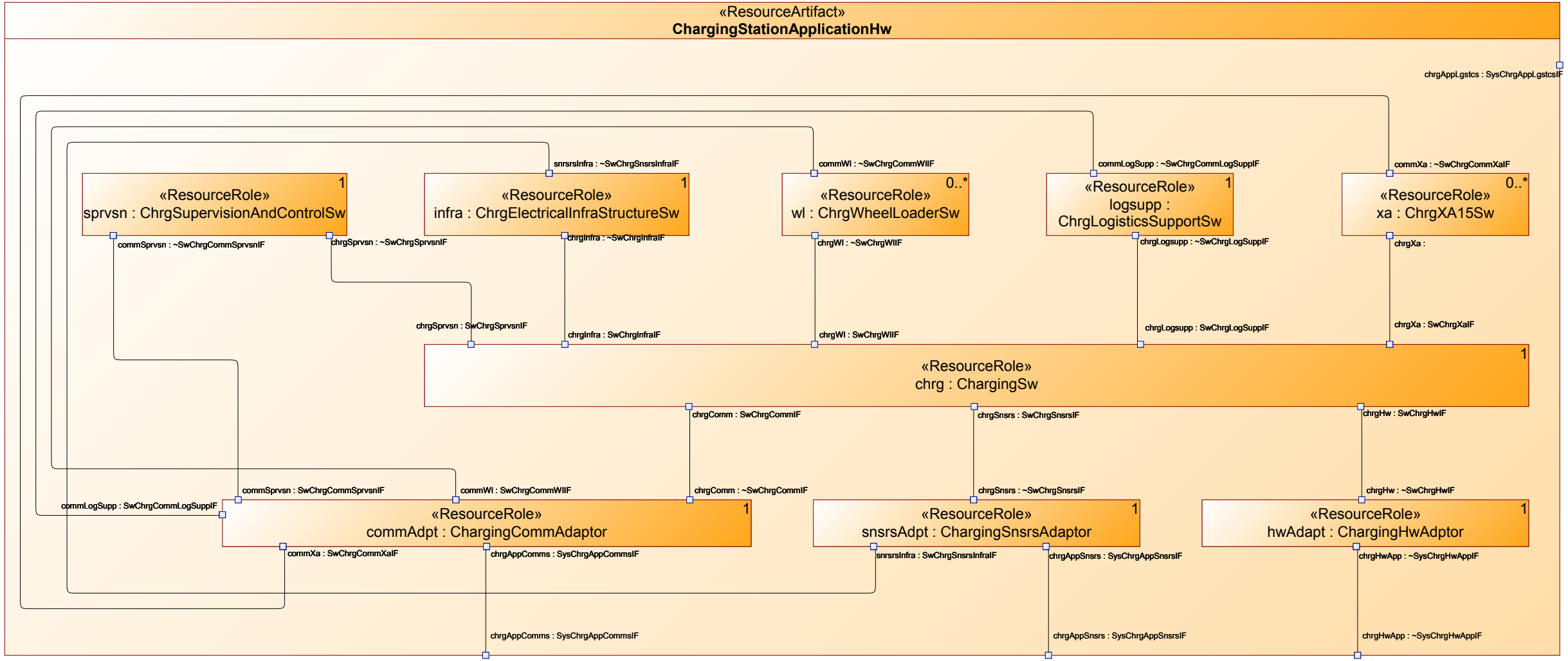
1

From Site Solution to Software Solution

Charging Station Architecture



Charging Station Software Architecture



Conclusions and Ways Forward

- Significant insights that form part of the detailed development can be reached based on a developed architecture dealing with a defined logical scenario.
- A significantly increased knowledge of the actual behavior that has to be managed for the scenario is made available through the separation of logical and realization models.
- There is an uncanny resemblance between the software architecture structure and the logical model. This goes far beyond the superficial resemblance and is essentially true throughout all software architectures for the applications dealing with the total site.
- Therefore, UAF can be used as a shortcut in not only systems development but also software development and seamlessly transfer from system of systems considerations to relatively detailed design.

https://www.youtube.com/watch?v=FRh2QZaVwoQ&t=22s

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ptc

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