



ENG-411

Concurrent Engineering of Space Missions

Source: ESA



Lecture 7 - Setting up the model in COMET

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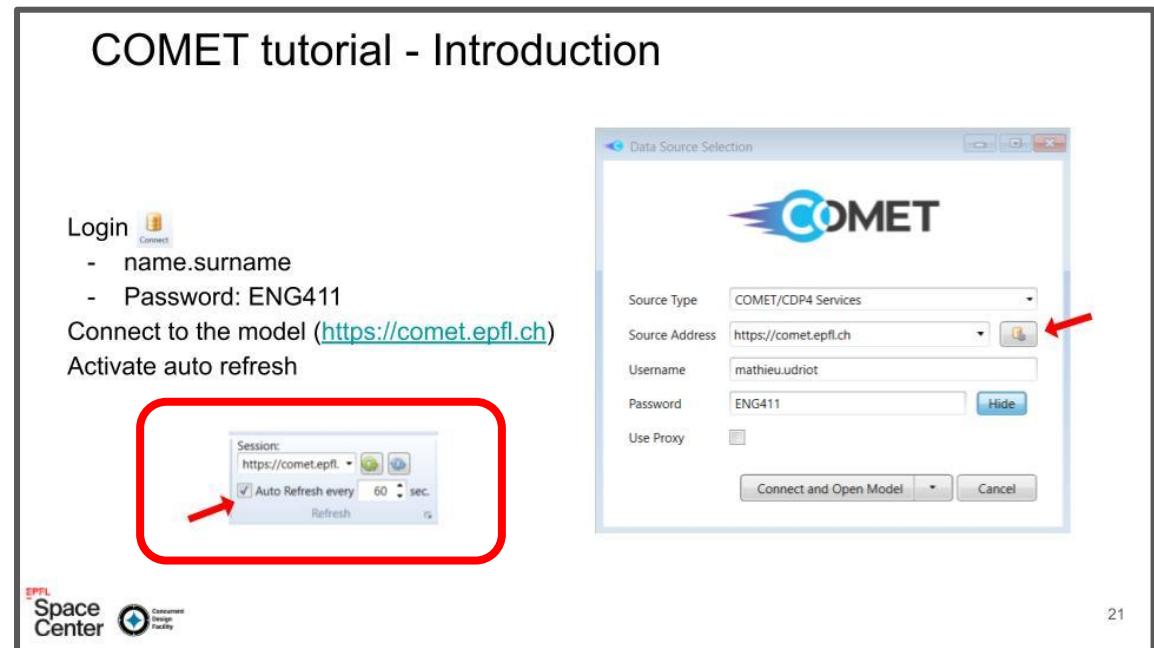


Reminder: Auto-refresh !!

It must be a reflex:

1. Start COMET
2. Clicking on Auto refresh.

Otherwise, you may not get updates from other people.



Basic building blocks in COMET

Any questions about
“Element Definition” and
“Element usage” ?

→ They form the basis of
COMET

COMET tutorial - Models & building blocks

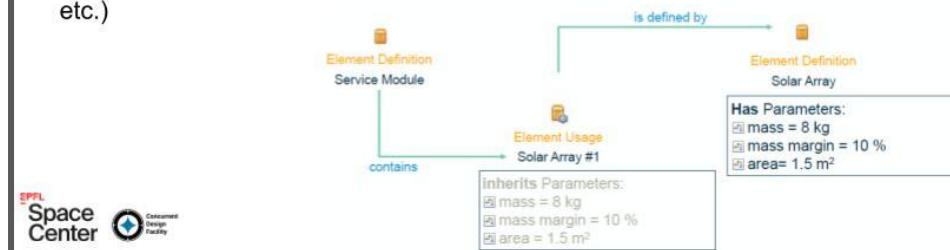
“Model” = “physical or abstract representation used for calculations, predictions or further assessment”
- ECSS-S-ST-00-01C

In COMET: a model is made with **elements definitions** (=~classes)

Elements definitions are characterized by **parameters** (type mass, volume, etc. and unit)

There can be several similar elements used in a model (**element usage** in the product tree =~instances)

Reference data library (RDL) to hold predefined generic data (types, units, scales, categories, etc.)



Let's build the model of your first concept.

1. Start with the main segments
2. Define the different systems of interest within the segment
3. Add the relevant parameters.
4. Ensure that the ownership is correct.
5. Potentially make some Options

Using Element Definitions from the Catalogue

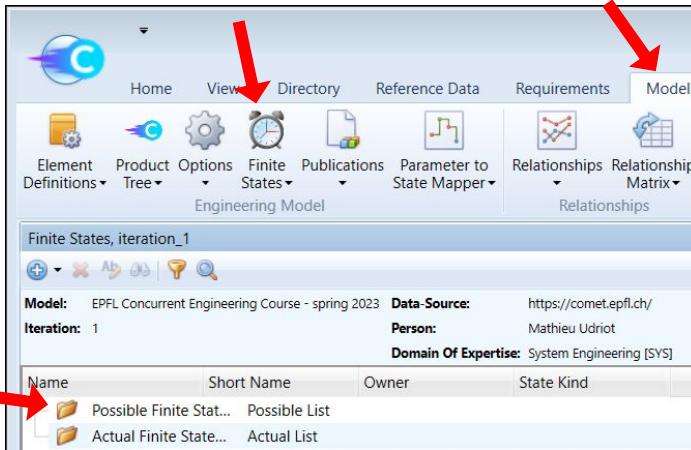
Drag & Drop + no key → copy without values and modified Owner to your own Domain of Expertise

Drag & Drop + CTRL → Copy with values and modified Owner to your own Domain of Expertise

Drag & Drop + SHIFT → Copy without values and preserved Owner's Domain of Expertise

Drag & Drop + SHIFT + CTRL → Copy with values and preserved Owner's Domain of Expertise

States



The screenshot shows the software interface for the EPFL Concurrent Engineering Course. The top navigation bar includes 'Home', 'View', 'Directory', 'Reference Data', 'Requirements', and 'Model'. The 'Model' tab is selected, indicated by a red arrow. Below the navigation bar is a toolbar with icons for 'Element Definitions', 'Product Tree', 'Options', 'Finite States', 'Publications', 'Parameter to State Mapper', 'Relationships', and 'Relationship Matrix'. The 'Finite States' icon is highlighted with a red arrow. The main workspace is titled 'Finite States, iteration_1' and displays model information: 'Model: EPFL Concurrent Engineering Course - spring 2023', 'Data-Source: https://comet.epfl.ch', 'Iteration: 1', 'Person: Mathieu Udrict', and 'Domain Of Expertise: System Engineering [SYS]'. At the bottom, a table lists 'Name', 'Short Name', 'Owner', and 'State Kind'. Two entries are shown: 'Possible Finite Stat...' (Possible List) and 'Actual Finite State...' (Actual List). A red arrow points to the 'Actual Finite State...' entry.

Parameters can be given states, allowing different values to be imputed.

Very useful for budget calculations etc.

Possible Finite State List: All possible states (e.g. mission phases, modes, etc).

Actual Finite State List: All the real states used for parameters.

- These can include a combination of Possible Finite state Lists or only one such list. Each state can be Allowed or Forbidden
- e.g. the combination of “ground operations phase” and “science mode” would not make sense and should be Forbidden
- Note: limit the size of the liste to one that is manageable.

Steps:

1. Define list of **possible** finite states
2. Define list of **actual** finite states
 - a. Select 2 or more possible finite state lists
 - b. Change state kind to “forbidden” if it is not allowed
3. Define **parameter** state-dependant value

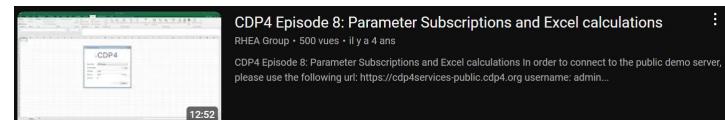
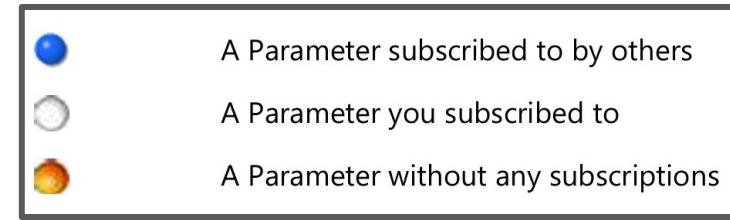
A note on Parameter Subscriptions

When you subscribe to a parameter, its icon becomes white

Subscriptions will appear when building the Excel

Much more uses:

- It allows you to temporarily change the value during your spreadsheet calculations
 - Normally, only the Domain of Expertise who owns it can do so!
- This enables your to work with the other Domain of Expertise's best estimate before their Publication!
 - Enables quick iterations and first guesses!



See [RHEA Group's video here](#)
(also listed on Moodle)

A note on Publications



Gate (systems engineer verification)

(1st Rebuild on Excel) → Iterate → Push (submit) → publish → pull (synchronise)



Name	Value	Owner	Switch	Description	Model Code	Row Type	Category
Space Mission		SYS			MIS	Element Definition	[ED]-Systems
Launcher : Launcher		SYS			MIS.LAUNCHER	Element Usage	[ED]-Systems
Reykjavík : Reykjavík		AOC			MIS.RKK	Element Usage	
Satellite : Satellite		SYS			MIS.sat	Element Usage	
mass	- [kg]	SYS	MANUAL		sat.m	Parameter	
Electrical Power Subsys...		SYS			sat.eps	Element Usage	[ED]-Subsystem
Reaction wheel : Reacti...		SYS			sat.RW	Element Usage	
mass	- [kg]	AOC	MANUAL		RW.m	Parameter	
mass moment of in...	- [kg·m ²]	AOC	MANUAL		RW.J	Parameter	
solar panel : solar panel		SYS			cat.e panel	Element Usage	
solar panel : solar panel		SYS			anel	Element Usage	
solar panel : solar panel		AOC			anel	Element Usage	
solar panel : solar panel		AOC			anel	Element Usage	



Blue & Bold =
modified parameters

Only visible once the
values are pushed!

A note on Publications

Publish!

The screenshot shows the CDP4-COMET IME - Community Edition software interface. The top menu bar includes Home, View, Directory, Reference Data, Requirements, Model (selected), and Scripting. The toolbar below has icons for Element Definitions, Product Tree, Options States, Publications, Parameter to State Mapper, Relationships, Relationship Matrix, and Relationships. The Publications tab is highlighted with a red arrow. The main window shows a 'Publications, iteration_1' view with a table of published elements. A red arrow points to the 'mass' entry in the table. To the right, a 'Element Definitions' view shows a tree structure of a 'Space Mission' domain, with a red arrow pointing to the 'mass' entry under the 'Satellite' node. The bottom of the interface shows a 'Created On' dropdown and 'Domain' and 'Model Code' fields.

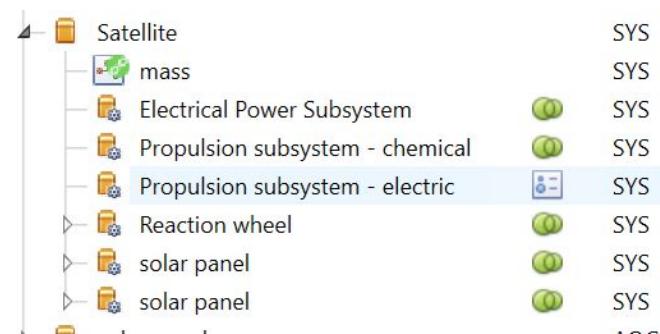
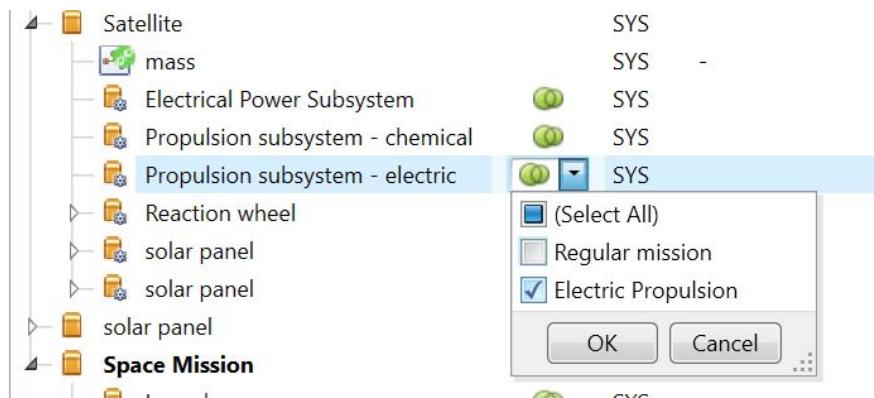
Name	Value	Owner	Switch
Space Mission		SYS	
Launcher : Launcher		SYS	
Reykjavík : Reykjavík		AOC	
Satellite : Satellite		SYS	
mass	- [kg]	SYS	MANUAL
Electrical Power Subsys...		SYS	
Reaction wheel : Reacti...		SYS	
mass	- [kg]	AOC	MANUAL
mass moment of in...	- [kg·m ²]	AOC	MANUAL
solar panel : solar panel		SYS	
solar panel : solar panel		SYS	
solar panel : solar panel		SYS	
solar panel : solar panel		AOC	

Select the ones
which should be
published

Model Options

At the start of your design, you may have several architecture options.

COMET allows you to model this.



A note on Parameters

Typically, you should have all the parameters you need.

If you need more, choose the good type of parameter

- First check if there isn't any good parameter to use.
- If the parameter is derived from SI units, use a Derived Quantity Kind.
 - Need to build the derived unit (with exponents of each unit)
- If the parameter is a renamed SI unit (e.g. Delta V which is a unit renamed from velocity ← Note: Delta V already exists): use a Specialised Quantity Kind
- If you want an array, use the Array Parameter Kind

	Create an Array Parameter Type
	Create a Boolean Parameter Type
	Create a Compound Parameter Type
	Create a Date Parameter Type
	Create a Date Time Parameter Type
	Create a Derived Quantity Kind
	Create an Enumeration Parameter Type
	Create a Sampled Function Parameter Type
	Create a Simple Quantity Kind
	Create a Specialized Quantity Kind
	Create a Text Parameter Type
	Create a Time of Day Parameter Type

See Sect. 6.2.1 of the COMET CDP4 User Manual for details on ParameterType