



# The ESA Project Office Cost Model

ICEAA - 2014 - Denver CO

H Joumier

15/04/2014

European Space Agency

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## Summary




- Rationale
- Space Segment PO cost model approach;
- Model Concepts and levels:
  - System level activities;
  - Sub-system level engineering;
  - Industrial Set Up and Sub-Contractors;
- Model graphic interface;
- Future development
- Q & A

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## Rationale

Project office is a significant slice of a spacecraft industrial cost  
(Typical > 20%)

Its weight increases further considering actual Cost at Completion  
(schedule delays affect mainly the PO)

↓

Importance of estimating the Project Office cost.  
Models previously used were based on cost-to-cost relations at system  
level  
with complexity correction factors


↓

**Need of a more detailed parametric model to define a reference  
manpower allocation to compare with industrial proposal**

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## PO Cost Model Approach at a glance



**Platform**

- Contractor experience
- Contractor size
- S/S complexity
- S/S responsible


**System Level**

- Contractor experience
- Contractor size
- Contractual scheme
- Quality level

**PO Cost Model  
v. 1.0**

Average team size  
MGMT/PA/Eng

Duration



**Instruments**

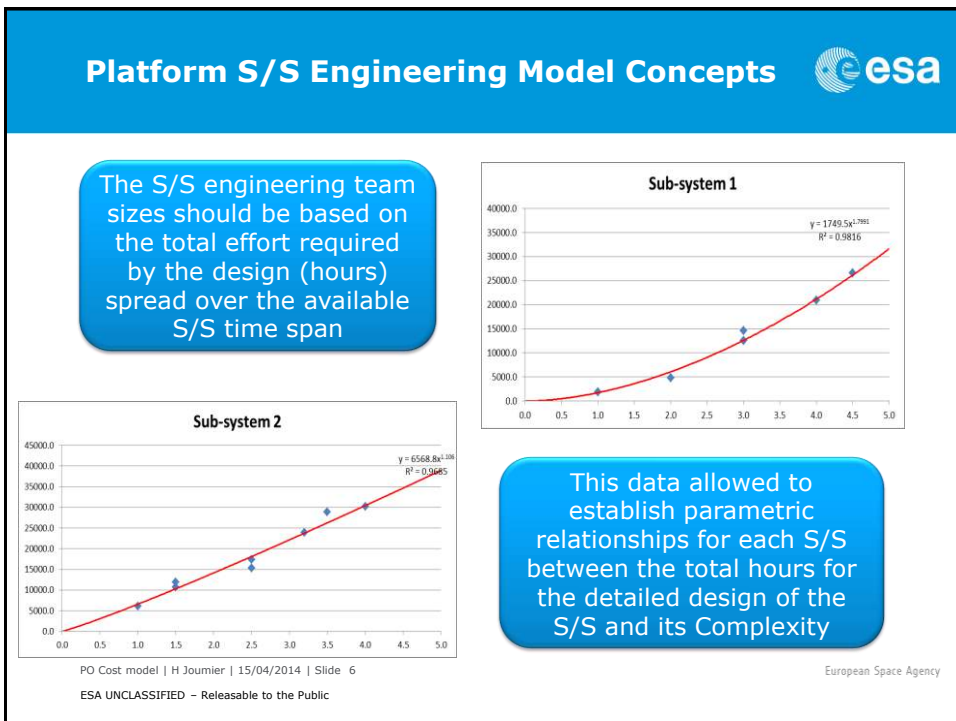
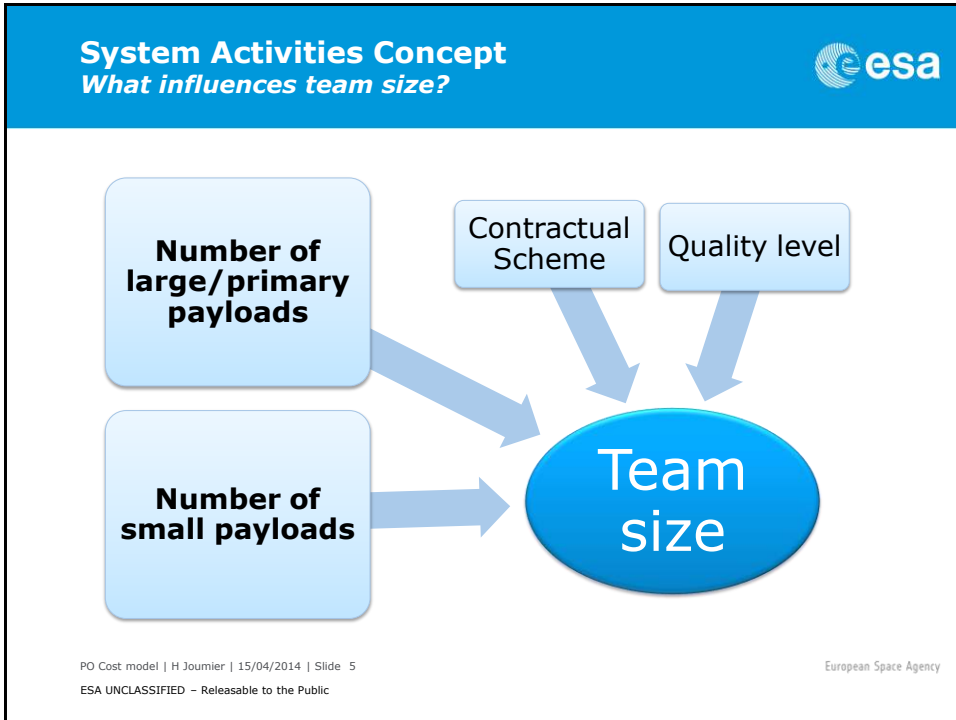
- Contractor experience
- Contractor size
- Consortium complexity
- Quality level

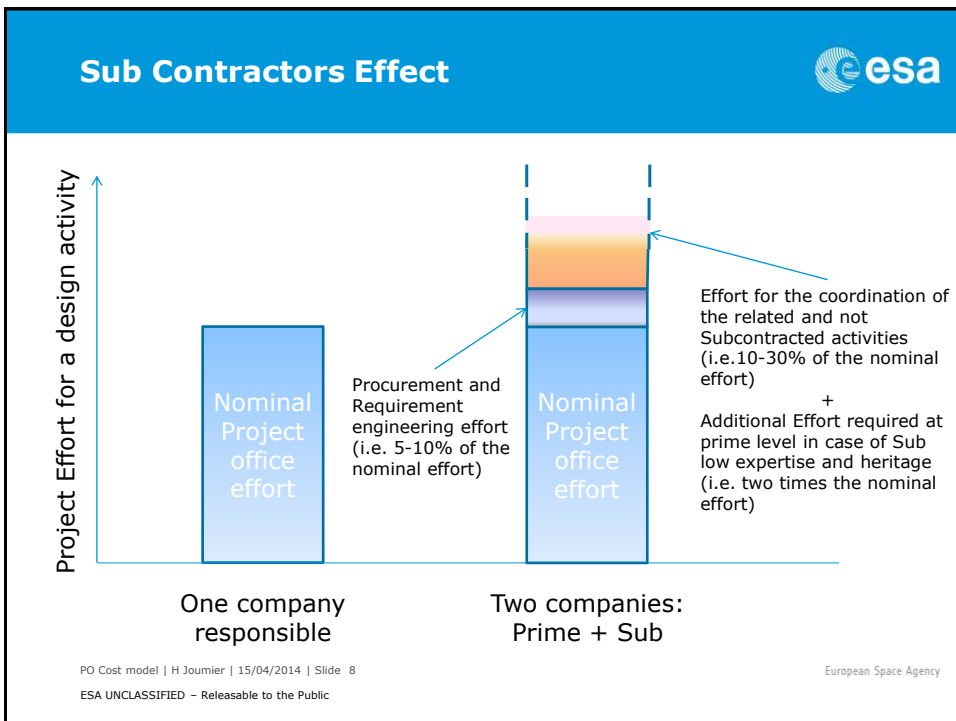
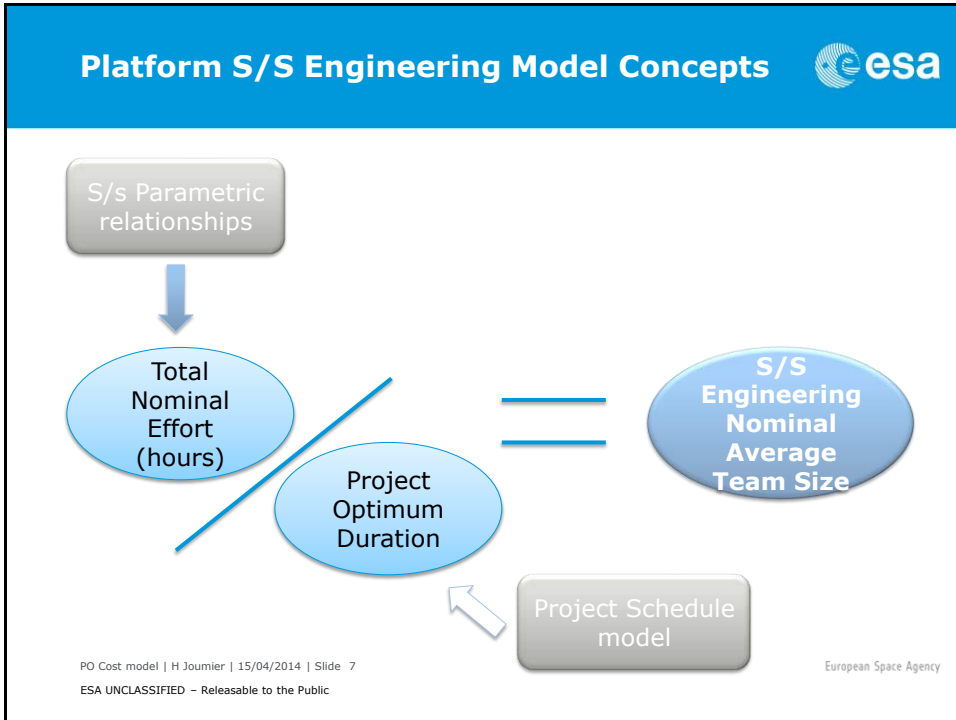
**Small PLs**

- Prime involvement
- Overall complexity

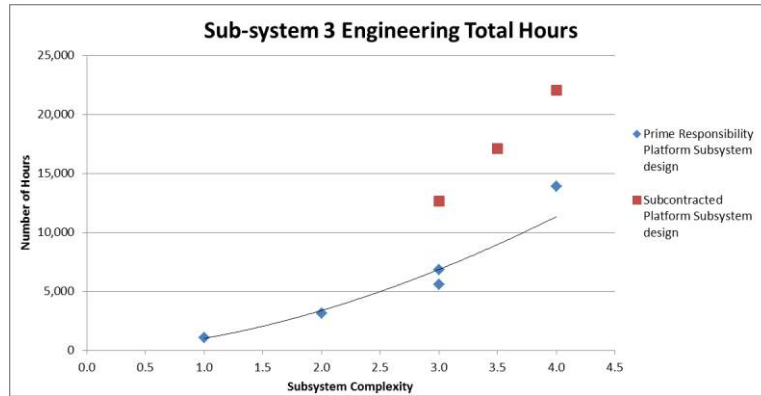
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## Subsystem Subcontracted example



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## Main Menu



**POCaMo (Project Office Cost Model) v 2.0**

Manual input / Calculated

Project: \_\_\_\_\_ Date: \_\_\_\_\_  
 Estimator: \_\_\_\_\_ Issue: \_\_\_\_\_  
 Revision: \_\_\_\_\_

Developed by: G. Olivieri / M. Marini, ESA/ESR/ESR/ESR

Payload instruments total Mass: 500 kg  
 Payload Module Mass excl. Instruments/Optional: \_\_\_\_\_ kg  
 Total Payload Mass: 500 kg  
 In orbit lifetime: \_\_\_\_\_ years

Domain:  Science  Earth Observation  Telecom  Technology demonstration  
 Orbit Type:  GEO  Non-GEO Earth-Orbit  Sun-pointing Sun-orbit  Interplanetary

Payload: Nr. of Large Instruments / Primary payload: 1 Nr. of SMALL Instruments: 0

Prime contractor size:  Large  Medium  Small

Contractual scheme:  TRADITIONAL (Prime responsible for Platform or Instrument, no PO element system level)  
 INTEGRATED (Prime out of system, PO level system level)  
 L300P (Prime responsible for the whole project, but not subcontracted)

Quality Level:  Operational  Standard / Pre-operational  Low cost / Technology demonstration

Prime experience:  High  Medium  Low

Satellite Model:  2 Gen  3rd  4th

Estimated Total Satellite Dry Mass (PF+PI) [kg]:    Override  
 Estimated phase C/D duration [months]:   Override  
 Estimated phase D duration [months]:   Override

- The user is driven through elementary choices covering the Project Office main cost drivers and modifiers such as:
  - Domain, Orbit type
  - Payload mass & characteristics
  - Industrial team structure and experience
  - Quality level and HW matrix
- The model estimates the dry mass of the platform that provides an extensive parameter when needed.
- The model performs an initial parametric estimate of the schedule duration to derive team sizes from man-hours

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## PF Complexity

**Platform complexity**

<b>Platform contractor</b>		Complexity
<input checked="" type="radio"/> Prime-Responsibility <input type="radio"/> Large <input type="radio"/> Medium <input type="radio"/> Small		3
<b>Platform contractor experience</b>		Calculated Manual
<input type="radio"/> High <input checked="" type="radio"/> Medium <input type="radio"/> Low		3
<b>ADCs</b>		
S/S Responsible: <input checked="" type="radio"/> Prime Contractor <input type="radio"/> Dedicated Subcontractor <input type="radio"/> No S/S Subsystem status: <input type="radio"/> Off the Shelf <input checked="" type="radio"/> Newly Modified <input checked="" type="radio"/> Highly Modified <input type="radio"/> Newly Developed Pointing accuracy: <input type="radio"/> Very low (simple systems feasibility) <input type="radio"/> Low >= 1 arcminute <input checked="" type="radio"/> Medium > 2 arcmin < 2 arcmin <input type="radio"/> Precise (High >= 4 arcmin < 0.5 arcmin < 1 arcmin)		2
<b>Propulsion</b>		
S/S Responsible: <input type="radio"/> Prime Contractor <input type="radio"/> Dedicated Subcontractor <input type="radio"/> No S/S Subsystem status: <input type="radio"/> Off the Shelf <input checked="" type="radio"/> Newly Modified <input type="radio"/> Highly Modified <input type="radio"/> Newly Developed Propulsion type: <input type="radio"/> Cold Gas <input checked="" type="radio"/> Mono Prop. Rocket <input type="radio"/> Mono Prop. Pressure <input type="radio"/> Bipropellant <input type="radio"/> Elec. Propulsion <input type="radio"/> Elec. Propulsion incorporating additional Cold Gas Thrusters		2
<b>EPS (Power)</b>		
S/S Responsible: <input checked="" type="radio"/> Prime Contractor <input type="radio"/> Dedicated Subcontractor <input type="radio"/> No S/S Subsystem status: <input type="radio"/> Off the Shelf <input checked="" type="radio"/> Modified <input type="radio"/> Newly Developed Power S/S requirements: <input type="radio"/> Simple feed side amp cans with standard cells <input checked="" type="radio"/> Medium standard feed side amp cans with standard cells <input type="radio"/> Complex feed side amp cans with special materials and cells (for high temperature and/or high radiation environment)		2
<b>Communications</b>		
S/S Responsible: <input type="radio"/> Prime Contractor <input checked="" type="radio"/> Dedicated Subcontractor <input type="radio"/> No S/S Subsystem status: <input type="radio"/> Off the Shelf <input checked="" type="radio"/> Modified <input type="radio"/> Newly Developed Data rate: <input type="radio"/> Low (tens of kbps) <input checked="" type="radio"/> Medium (hundreds of kbps) <input type="radio"/> High (in the order of Mbps) Address type: <input type="radio"/> Low Gain <input checked="" type="radio"/> Low Gain + Medium/High Gain		2

**Subsystems status:** refers to the subsystem as a whole, not to the individual equipment units. A subsystem is only 'Off the Shelf' if the equipment and subsystem design is completely reusable. If all equipment is reusable but the design (as a whole) is new, the subsystem is 'Modified'.

**Complexity** ranges from 1 to 3:  
 1: Noisy, sub-system not included in Simple, off-the-shelf subsystem  
 2: Standard, modified subsystem  
 3: State of the art, all equipment and subsystem design newly developed.

1. Platform contractor is characterized
  - a. Contractor size
  - b. Contractor experience
2. Sub-systems "profiling" determines a complexity factor for each the S/S Project Office sizing (expressed in man-hours)
  - a. Performance parameters
  - b. Development status
3. Make-or-Buy decision is made on each of the sub-systems.
  - a. Contractors of Procured Sub-systems are further qualified (see next page)

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## Sub Contractors

**Platform Subcontractor**

		Complexity
		1
		Manual Adjustment (Prime-Sub Overlay) 20 %
<b>ADCs</b>		
Sub contractor size	<input type="radio"/> Large <input checked="" type="radio"/> Medium <input type="radio"/> Small	
Subcontractor experience	<input type="radio"/> High Expertise <input checked="" type="radio"/> Medium Expertise <input type="radio"/> Low Expertise	
<b>Propulsion</b>		
Sub contractor size	<input type="radio"/> Large <input checked="" type="radio"/> Medium <input type="radio"/> Small	
Subcontractor experience	<input type="radio"/> High Expertise <input checked="" type="radio"/> Medium Expertise <input type="radio"/> Low Expertise	
<b>EPS (Power)</b>		
Sub contractor size	<input type="radio"/> Large <input checked="" type="radio"/> Medium <input type="radio"/> Small	
Subcontractor experience	<input type="radio"/> High Expertise <input checked="" type="radio"/> Medium Expertise <input type="radio"/> Low Expertise	
<b>Communications</b>		
Sub contractor size	<input type="radio"/> Large <input checked="" type="radio"/> Medium <input type="radio"/> Small	
Subcontractor experience	<input type="radio"/> High Expertise <input checked="" type="radio"/> Medium Expertise <input type="radio"/> Low Expertise	
<b>S/S (Data Handling)</b>		
Sub contractor size	<input type="radio"/> Large <input checked="" type="radio"/> Medium <input type="radio"/> Small	
Subcontractor experience	<input type="radio"/> High Expertise <input checked="" type="radio"/> Medium Expertise <input type="radio"/> Low Expertise	
<b>Structure</b>		
Sub contractor size	<input type="radio"/> Large <input checked="" type="radio"/> Medium <input type="radio"/> Small	
Subcontractor experience	<input type="radio"/> High Expertise <input checked="" type="radio"/> Medium Expertise <input type="radio"/> Low Expertise	
<b>Thermal Control</b>		
Sub contractor size	<input type="radio"/> Large <input checked="" type="radio"/> Medium <input type="radio"/> Small	
Subcontractor experience	<input type="radio"/> High Expertise <input checked="" type="radio"/> Medium Expertise <input type="radio"/> Low Expertise	

**Sub-Contractor Experience and Manual adjustment:**  
 The Prime-Sub Overlay percentage represent the additional effort, in terms of hours, required at Prime and Sub for the procurement of a Subsystem design. It is introduced in terms of percentage of the original engineering effort required.  
 The Prime-Sub Overlay percentage represent the additional effort, in terms of hours, required at Prime and Sub for the procurement of a Subsystem design. It is introduced in terms of percentage of the original engineering effort required.  
 The manual adjustment can allow to modify this weighting coefficient. In absence of additional information the user is advised to select 'high expertise' and the companies select in accordance with the expected rates.

1. Greyed sub-system are directly handled by the Platform Prime contractor
2. Highlighted sub-systems are subcontracted with the following specifications:
  - a. Sub-contractor size
  - b. Sub-contractor experience
  - c. Adjustment on the degree of overlap between the Platform prime and the sub contractor

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Major Instruments

**Instrument #1**

Name: Instrument #1			
Type: Optical	N of PPAs: 1		
Mass: 10 (without margin, 10-500 kg)	Design modularity: 0%		
Instrument contractor: <input type="radio"/> Home responsibility, <input checked="" type="radio"/> Large, <input type="radio"/> Medium, <input type="radio"/> Small			
Engineering experience of the contractor: <input type="radio"/> Low (Small and inexperienced contractor that has never faced this technology) <input type="radio"/> Medium (Medium experienced contractor facing a new design / major modifications) <input type="radio"/> High (Experienced team that has already worked on similar relevant projects) <input type="radio"/> Very High (Very experienced team that minority modifies an existing instrument / FSI)			
Instrument core team: Please indicate the n. of members per each category, not including the Prime			
Co-Prime: 0	Responsible for a minor assembly of the instrument		
Major: 0	Responsible for a subassembly or critical HW (e.g. Detectors)		
Minor: 0	Responsible for major engineering support (e.g. Calibration support)		
Support: 0	Responsible for minor studies (i.e. contracts below 500 k€)		
Instrument quality level: <input type="radio"/> Operational, <input checked="" type="radio"/> Standard / Pre-qualified, <input type="radio"/> Low cost / Technology demonstration			
PO Optimization Level: NB This is NOT automatically adapted (checking the contractor size)			
LSI: 0%	SME: 0%	D%: 0%	Commercial/Service: 0%

Estimated phase C/D duration (months): 48

Estimated team size MGMT: 2.0

- Project Administration: 1.1
- Contracts and Subcos Adm: 0.0
- Project Control: 0.9
- Procurement Mgmt: 0.0
- PA: 0.2
- Engineering: 2.9
  - System, mechanical & thermal: 2.9
  - Optical Engineering: 0

1. Project Office related to Main Instruments is also estimated based on:
  - a. Instrument type, size, design repeat and modularity
  - b. Instrument contractor experience and size
  - c. Complexity of the Instrument Core Team
  - d. Instrument Quality level
2. The model estimate the Project Office man-hours
3. The model provides an initial estimate of the schedule duration to determine Team size as a function of the man-hours

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Small instruments

**Small instruments**

Instrument #1	Name	CFI (o%)	CFI (100%)	Overall complexity
Instrument #1		80	80	4
Instrument #2		70	70	2
Instrument #3		0	0	3
Instrument #4		0	0	3
Instrument #5		100	100	3
Instrument #6		100	100	3
Instrument #7		100	100	3

Unused

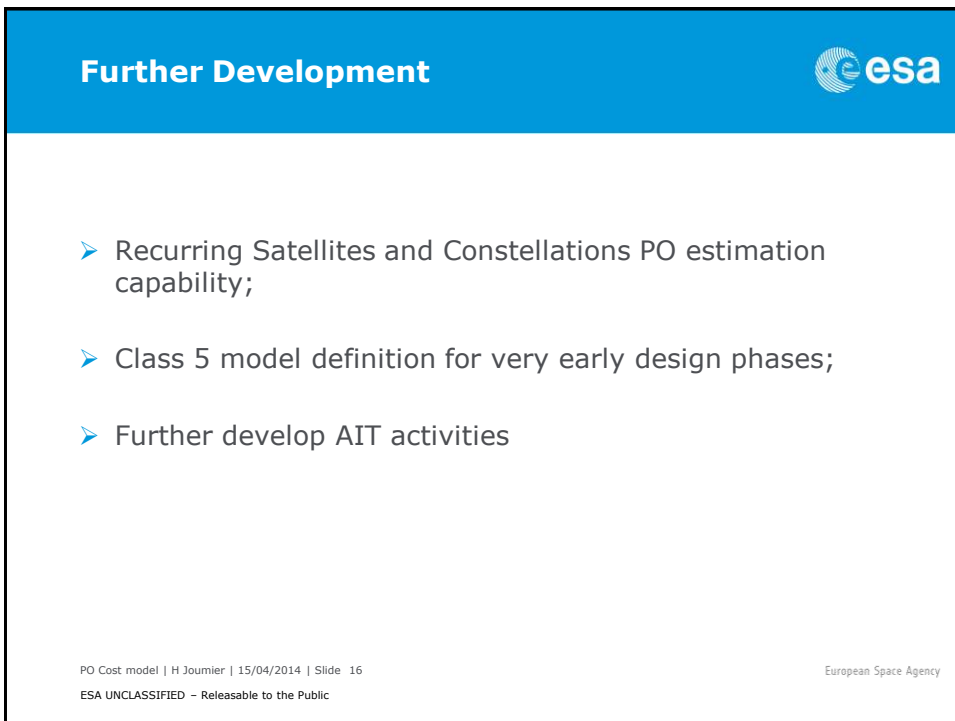
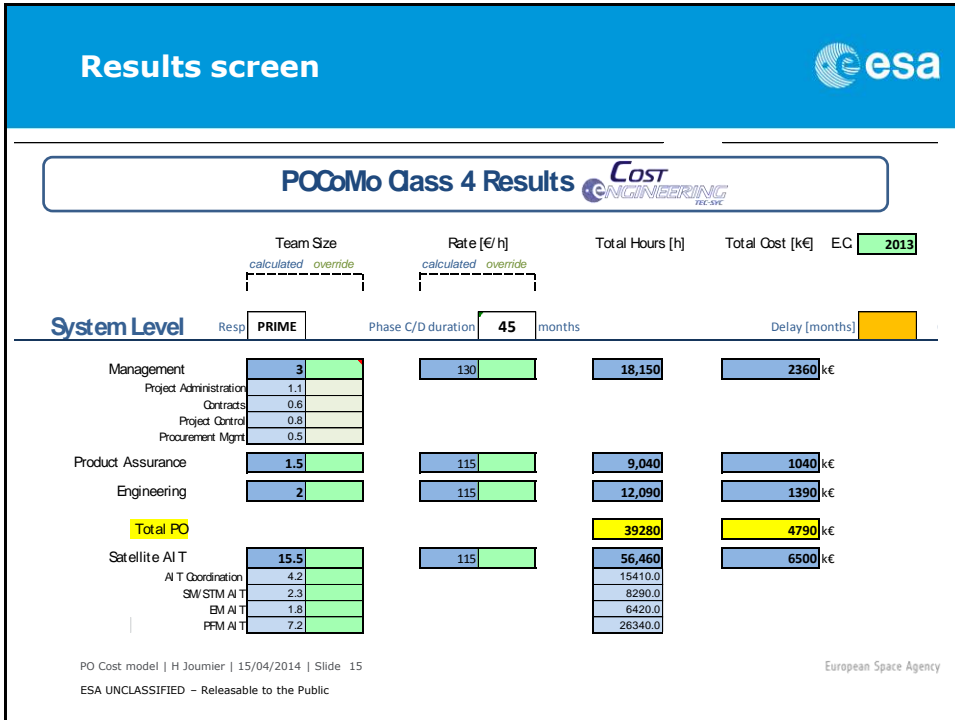
1. The secondary payloads (expected to be small instruments) are also identified and taken into account to adjust the Prime contractor Project Office sizing. The main parameters considered are:
2. The level of Prime Contractor involvement
  - a. CFI : Company Furnished Instrument. The effort is limited to the I/F management and integration onto the Platform
  - b. CPI: Company Procured Instrument. The Prime contractor holds the full responsibility for the development and integration of the Instrument.
3. The complexity of each of the Instruments

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Questions?



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