

MBSE2022 - ESA TeePee4Space

A practical application of Information Sharing in Extended Enterprise to the space industry



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TeePee Basics

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Information sharing in Extended Enterprise



• Extended Enterprise : An ecosystem constituted of a system integrator and several suppliers, which may also subcontract with other suppliers



• **Problem to be solved :** the companies decision management process needs to be fed by federated SE data coming from their own data warehouse and from their direct and indirect partners

- Challenges :
 - Build a shared vocabulary
 - Specify the collaboration in the extended enterprise
 - Control data exposure
 - Ensure the consistency of the exposed data

TeePee value proposition : to build the **digital continuity** for Systems Engineering artifacts within an **Extended Enterprise** for analysis purposes, by tackling **heterogeneity** of methods and tools, as well as **confidentiality** of data



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Heterogeneity management – viewpoins, pivot metamodel, allocation/satisfaction links

- Pivot meta-models are defined for each viewpoint analyis
- Each company defines a **mapping** between its modelling tool and the pivot meta-model





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TeePee architecture







Power consumption budget analysis

Methodology and use case

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Power consumption viewpoint







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Power consumption viewpoint





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Power consumption viewpoint









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Power consumption viewpoint

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Experimentation – models in their native tools



Product Tree, L	ight_TeePee	4Space ×					
AB - 🚯 - 🖇	K Ab 00	🖗 🔍					
Model: XIPE_Te teration: 4 Option: Light_Te	ePee4Space eePee4Space	Data-Source: Person: Domain Of Expertise:	http://lingequip:500 Romaric Demachy System Engineering	0/ [SYE]	eesa		Т
Name			Valu	e	Owner	Switch	Descrip
⊿ 🔲 XIPE N	lission				SYE		
🗁 🔜 Gr	ound Segme	nt : Ground Segme	nt		SYE		
🗁 🗟 La	unch Segmer	nt : Launch Segmer	it		SYE		
🖌 🗟 Sp	ace Segment	: : Space Segment			SYE		
4- 民	Spacecraft :	Spacecraft			SYE		
-	🔵 dry mas	s		- [kg]	SYE	MANUAL	
-	mass			1000 [kg]	SYE	REFERENCE	
4- 🥥 peak consumed power			SYE				
	— 💓 Uml	bilical to Sun Acqui	sition	25 [W]	SYE	REFERENCE	
	— 💓 Obs	ervation Low Dec	lination	100 [W]	SYE	REFERENCE	
	— 🐹 Mar	noeuvre		150 [W]	SYE	REFERENCE	
	— 🐹 Slov	v Slew		200 [W]	SYE	REFERENCE	

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Experimentation – models in their native tools





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Experimentation – models in their native tools





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Experimentation – Power consumption viewpoint results



Power Consumption by Mode

Namescope: esa

Id: 30e6b522-7d6e-4fd5-a433-318f9c5f0557,685075cb-8eb3-4cde-9df2-d9fbdcfe6167,347df315-cffa-4a78-a-EE_depth: -2



Product Breakdown Structure	Observation High Declination (Target: 350.0W)	Manoeuvre (Target: 300.0W)		
• Spacecraft	372.566W (Observation High Declination)	302.766W (Manoeuvre)		
Service Module	302.57W (roll-up)	302.77W (roll-up)		
AOGNC	154.52W (roll-up)	154.52W (roll-up)		
STR Sodern Hydra Electronics	Unit 1 1.12W (On)	1.12W (On)		
MTQ Zarm MT110-2	2.9W (On)	2.9W (On)		
GYRO Selex Galileo Sireus 1	0.0W (Standby)	0.0W (Standby)		
GYRO Selex Galileo Sireus 2	0.0W (Standby)	0.0W (Standby)		
RW Rockwell Collins RSI 12	90.0W (On)	90.0W (On)		
STR Sodern Hydra Electronics	Unit 2 11.0W (On)	11.0W (On)		

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Conclusion

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Conclusion



Achievements

- Development of a connector for COMET
- Creation of a new viewpoint
- Development of the « closing the loop » capability
- Validation on a use case representative of an Extended Enterprise in the space industry

→The project terminated in February 2022

Perspectives

- Ontology definition (OSMOSE,...), used as pivot meta-models
- Integration of TeePee with EasyMOD (see presentation on Thursday, 2:50pm) for the review of unified aggregated models
- Develop partnerships with tool vendors
- Pursue the research on Extended Enterprise and develop new capabilities for TeePee (continuous integration, trade-offs during bidding phase, use for digital twin) → building of a new IRT project in progress





Thank you for your attention

Contact : systems-engineering@irt-saintexupery.com