ENGESIS PLM

A Transdisciplinary Process Oriented Framework to Support Generic PLM Implementation for Use by Small and Medium Enterprises

CURSO DE INVERNO
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SUMMARY

- Warm Up Session
- Fundamentals of the T-ProST Methodology
- The T-ProST Approach
- Mission Definition (Problem Statement)
- The Reference and SE Models (TPMN)
- Specialized Model Building and Analysis
  - PM Modelling (PERT)
  - BPM Modelling (BPMN)
  - Simulation Modelling (Simprocess)
- Global Assessment
- Holistic Review and Conclusions

TARGETS OF THE TALK

What is a Model?

What is Transdisciplinary Process Science and Technology (T - ProST)?

How can it be used to Support Generic PLM Implementation for Use by SME?

WHAT IS A MODEL?

- A picture is worth a thousand words
- A model is worth a thousand pictures put together as a solved puzzle
- A model is the representation of a logical content (of structural or dynamical nature)
- The logical content may range from a bit of data to a complete knowledge database

HOW TO CREATE A MODEL?

- **Abstract**
  - Make equivalences
  - Use different representations
- **Generalize**
  - Use hierarchy
  - Decompose and/or group concepts (use top-down / bottom-up approaches)
- **Simplify**
  - Seek concision
  - Organize the results

RESULT = K (KNOWLEDGE) = THE LOGICAL CONTENT HAS BEEN CREATED

- **T-ProST is a transdisciplinary science that aims at the integration and unification of several autonomous disciplines dealing with complex discrete event processes, with their different views, for application in Systems Concurrent Engineering, defined as the integrated study of product engineering and organisation management process life cycles.**

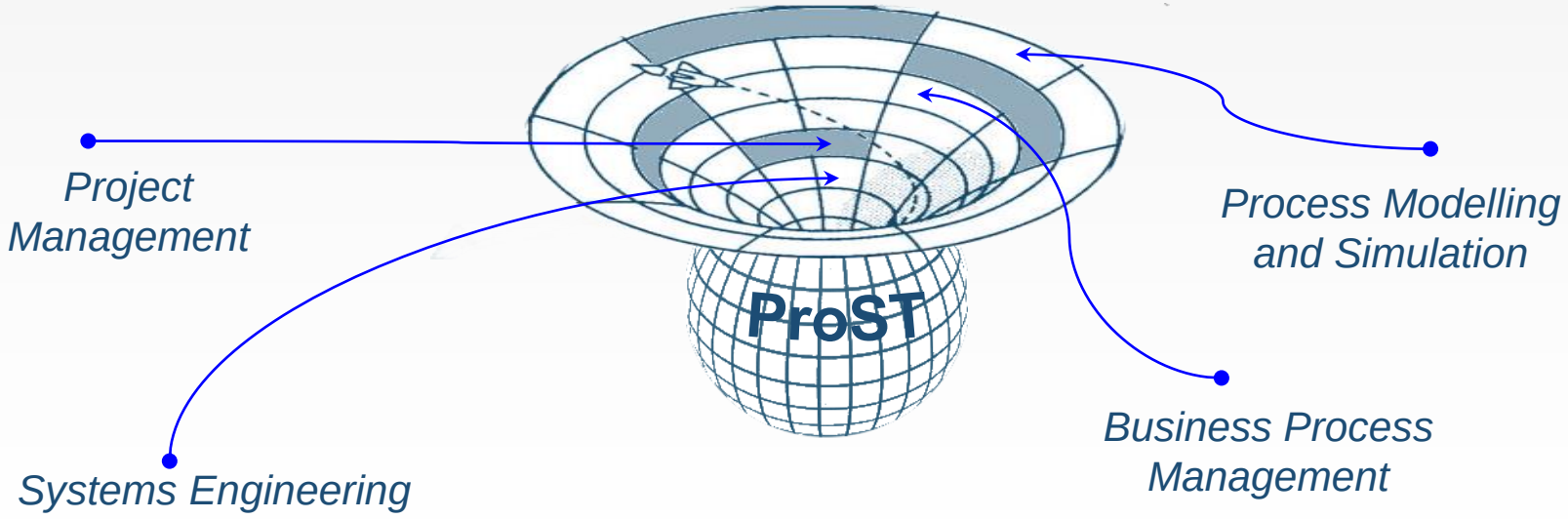


Figure 1: Transdisciplinary Process Science and Technology

Warm Up Session

- THE TREND: Organizations and the Academy are seeking to deal with business processes making use of a unified and systematic approach.

Methods – Techniques - Tools

Which are used for analysis and solution of problems involving a broad knowledge about complex discrete event processes. They have started to be treated as part of a unified science that might be denominated

Design and Process Science

OR

Systems Concurrent Engineering

OR

System of Systems Engineering

OR

Process Science and Technology

Warm Up Session

- DEFINITION: Process Science and Technology is a transdisciplinary science, which addresses the integration and unification of concepts and techniques originated in several autonomous scientific areas involving a broad knowledge about processes, namely:

Systems Engineering

Project Management

Business Process Management

Simulation Modelling

- Aiming at:

Automation and Continuous Improvement of Integrated Product Engineering and Organization Management Processes, by means of

Creating a Unified Methodology and Building its Supporting Environment.

Fundamentals of T – ProST Methodology

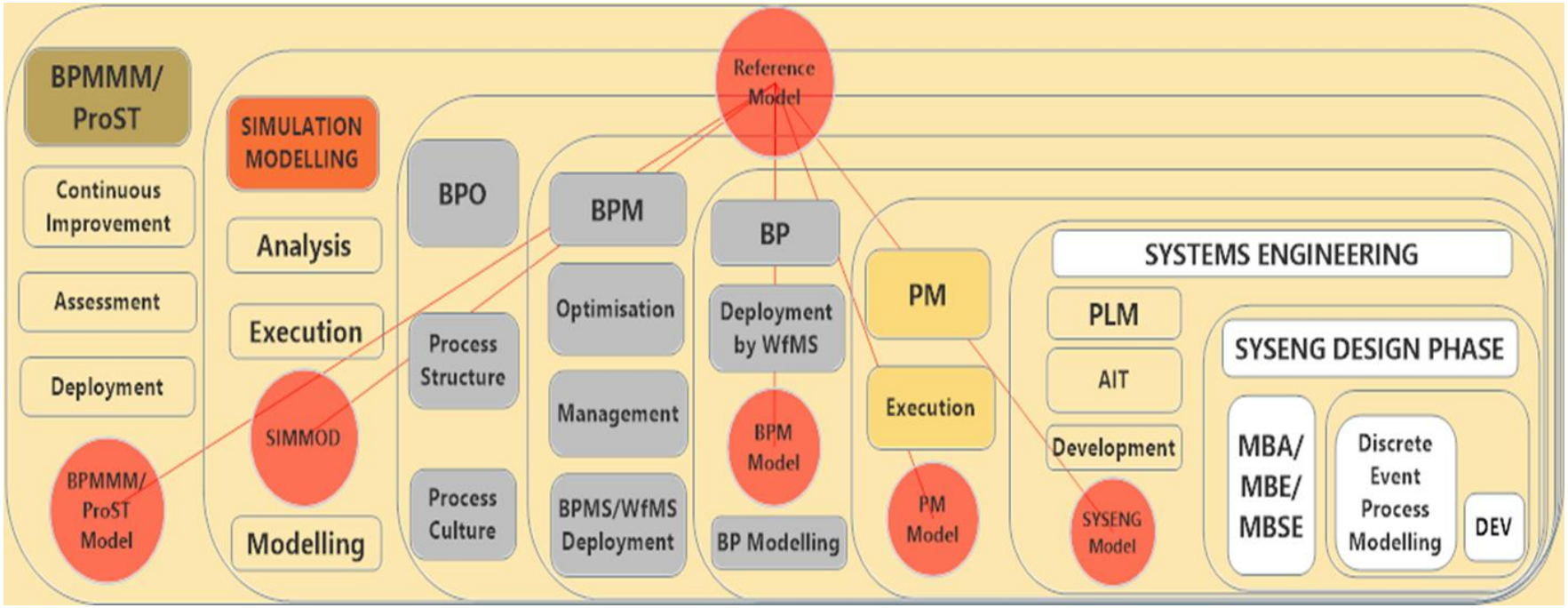
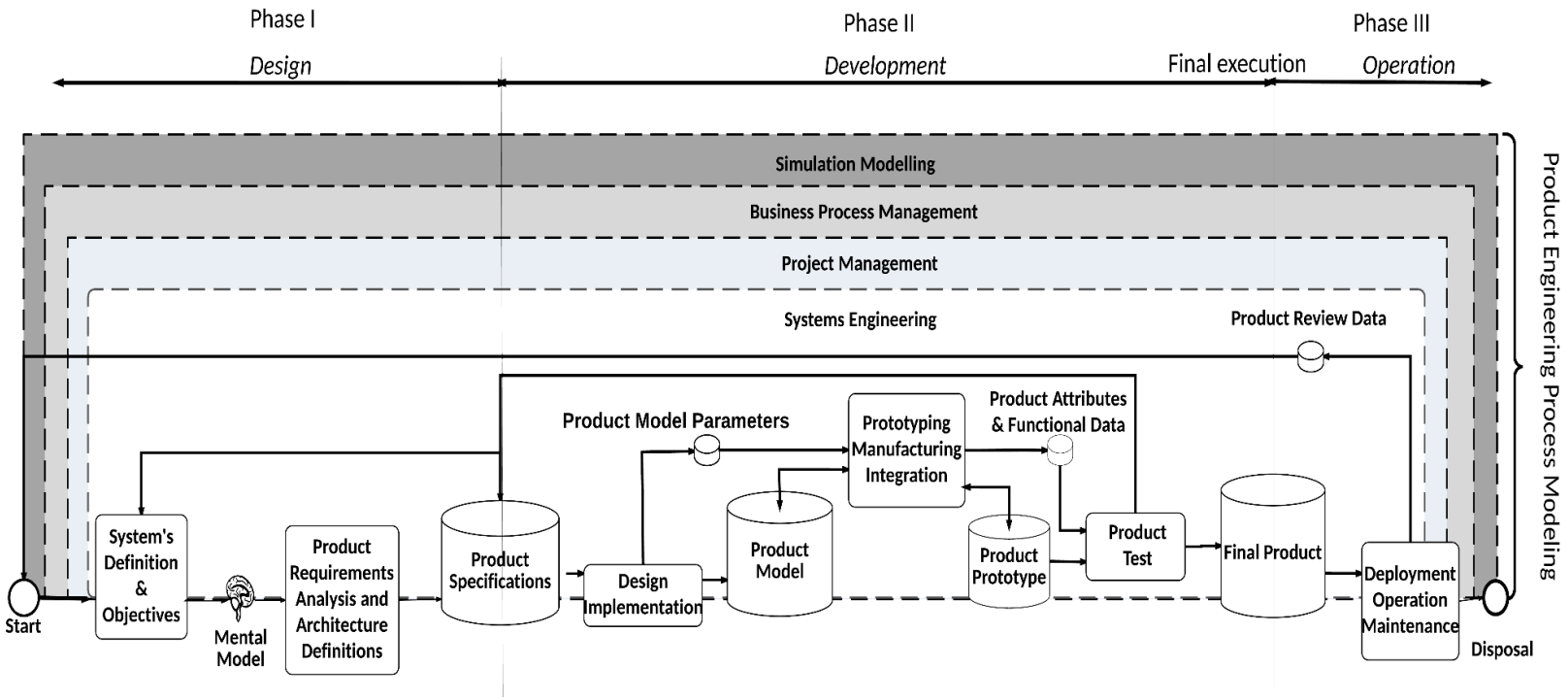


Figure 2 – The Knowledge Architecture – Descriptive View

Fundamentals of T – ProST Methodology



Product Engineering Process Lifecycle

Figure 3 – The Knowledge Architecture – Process View

Fundamentals of T – ProST Methodology

The Traditional Process Modelling Approach

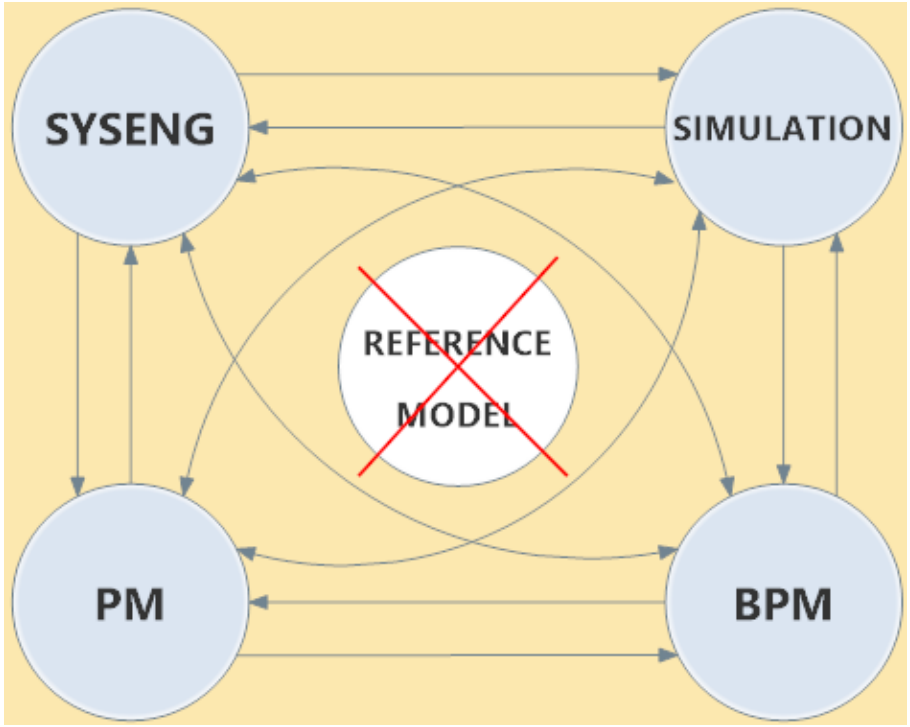


Figure 4 – The Mesh Point-to-Point Approach

Fundamentals of T – ProST Methodology

The Transdisciplinary Process Modelling Approach

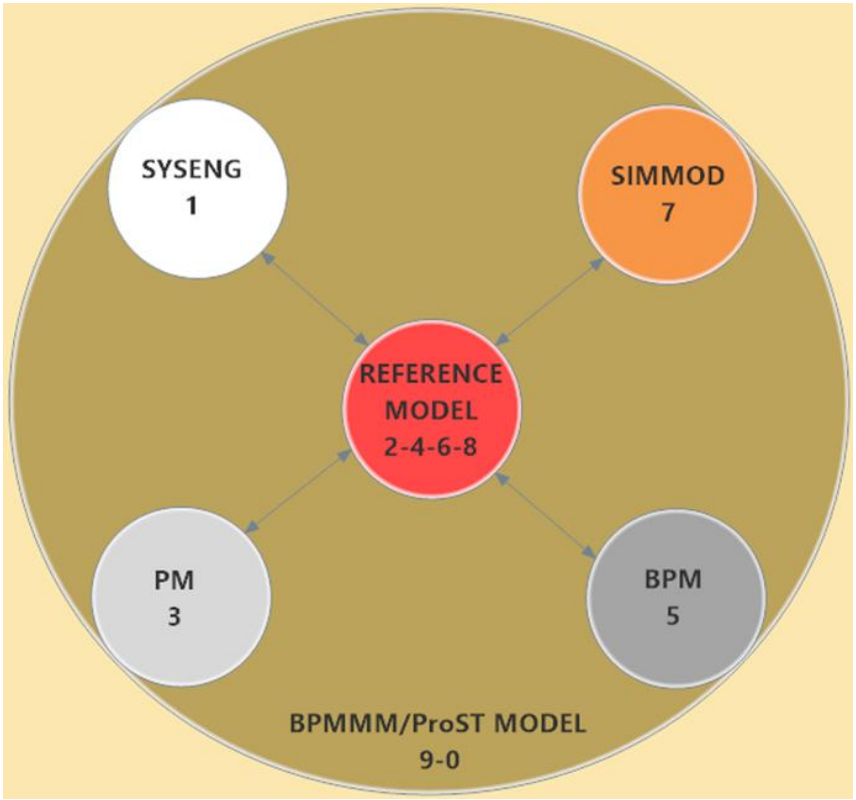
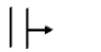
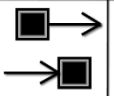
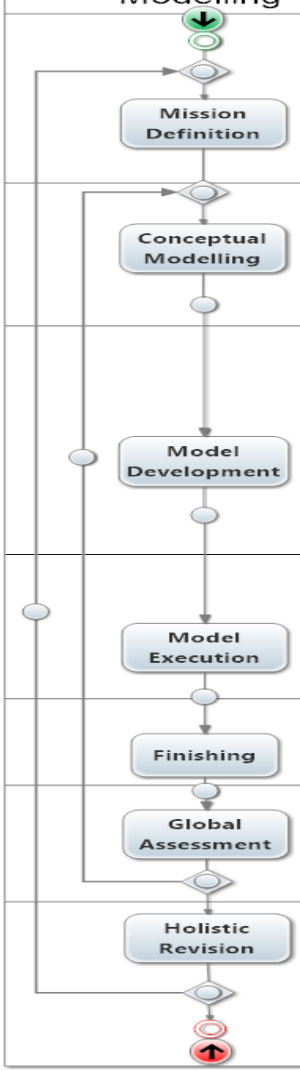


Figure 5 – The T-ProST Modelling Approach

Fundamentals of T – ProST Methodology - TPMN

Designation		Description
UCMD / ULMD	TPMN	
		Starting point of the entity's lifecycle process
		Finishing point of the entity's lifecycle process
		Repositories of entities or resources
N/A		Crossovers of entities or resources between two processes displayed in separate swimming lanes or frames
		Macroprocess
		Simple process / activity
		Link showing the control flow path carrying any type and number of entities and resources being transferred
N/A		The crossing over the borders of the flow of control path carrying any type or number of entities and resources. The borders separate swimming lines or frames and the symbols depict respectively the send and receive mechanisms
		Link showing the control flow path carrying a specific artifact, message or triggering mechanism that needs to be distinguished
N/A		The crossing over the borders of the flow of control path carrying a specific artifact or message being transferred, which needs to be distinguished. The borders separate swimming lines or frames and the symbols depict respectively the send and receive mechanisms
N/A		Link used for process synchronization
N/A		Connector used to direct the flow of control among processes to express routing at junctions (or exclusive, split and join)
N/A		Pads indicate the splitting or joining of paths associated with any type or numbers of entities, resources, artifacts or messages
	N/A	Queue of entities/resources waiting to enter an activity
	N/A	Queue of artifact/messages waiting to enter an activity

The T-ProST Approach

TRANSDISCIPLINARY PROCESS SCIENCE AND TECHNOLOGY (T-ProST)			
Unified Lifecycle Modelling	Phases	Activities	Tasks
	Mission Definition	Mission Definition **(A0)**	Elicitation, Problem Definition and Strategic Planning
	Conceptual Modelling	Analysis **(A)**	IDEF0 Model Creation, Reference Meta-Model Creation
	Model Development	Specialized Model Building **(B)** Specialized Model Construction/ Implementation **(C)**	B1, B2, B3, B4 C1, C2, C3, C4
	Model Execution	Design of Experiments **(D)** Experimentation **(E)**	D1, D2, D3, D4 E1, E2, E3, E4
	Finishing	Finishing **(F)**	F1, F2, F3, F4
	Global Assessment	General Assessment **(G)**	General Assessment
	Holistic Revision	Holistic Revision **(H)**	Holistic Revision

The T-ProST Approach

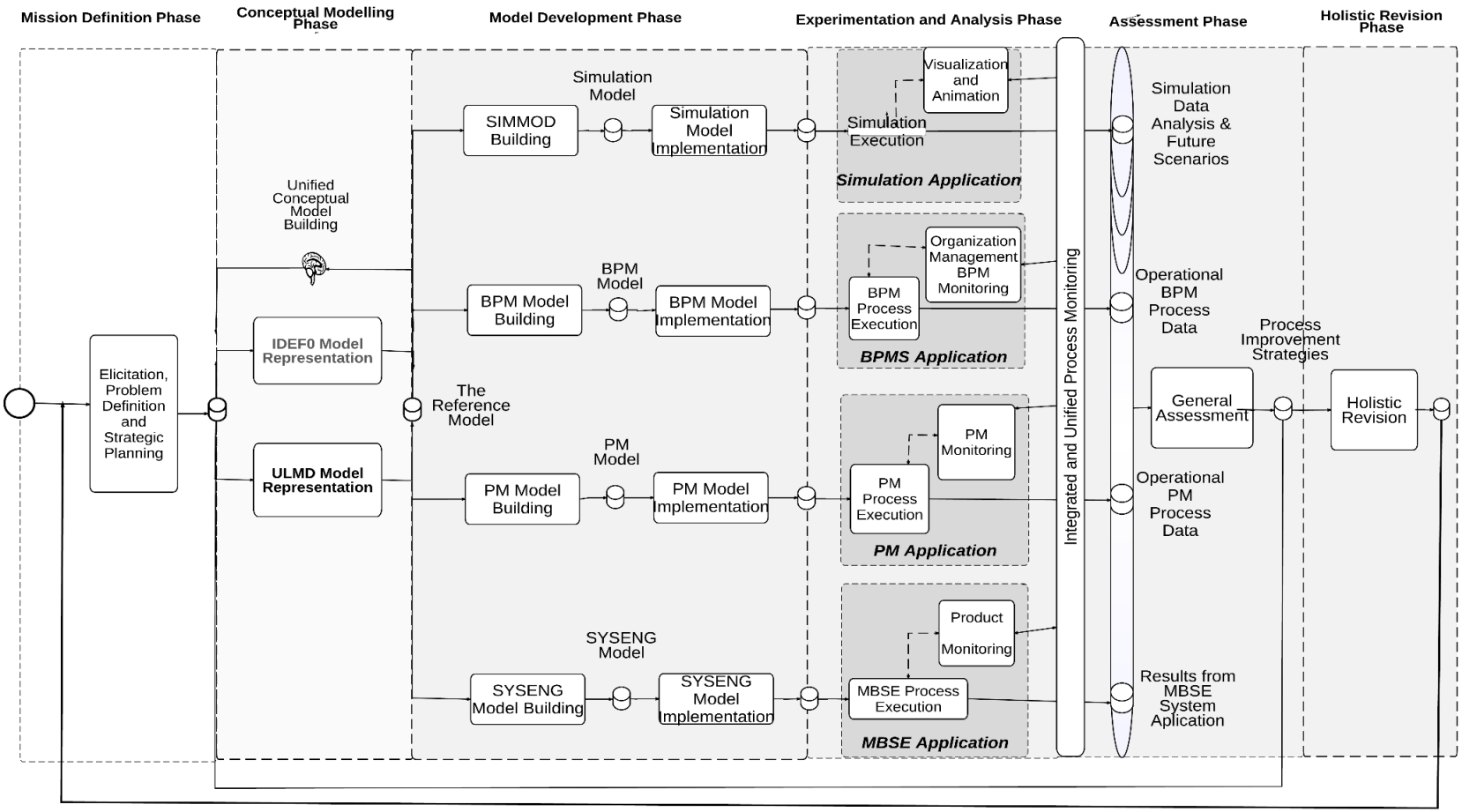


Figure 6 – The Unified Process Modelling Methodology

The T-ProST Approach

The Complete Process Model Lifecycle:

I. Define and build the process models using Unified Conceptual Process Modelling:
   1. Start by building the Reference Model (RM) using TPMN -> TPD
   2. Create the Systems Engineering Model (TPD with complete RM)
   3. Create the PM, BPM and Simulation Models based on RM + SE
   4. Modify and/or extend the individual process models created in each *modelling view* whenever necessary, as part of process (re)design
   5. Changes that impact the Reference Model need to be incorporated in it and in all other types of model

II. Implement the process models in each of the techniques for analysis using the different views and techniques.

III. Perform data collection, comparative analysis and recycling for process assessment and continuous improvement

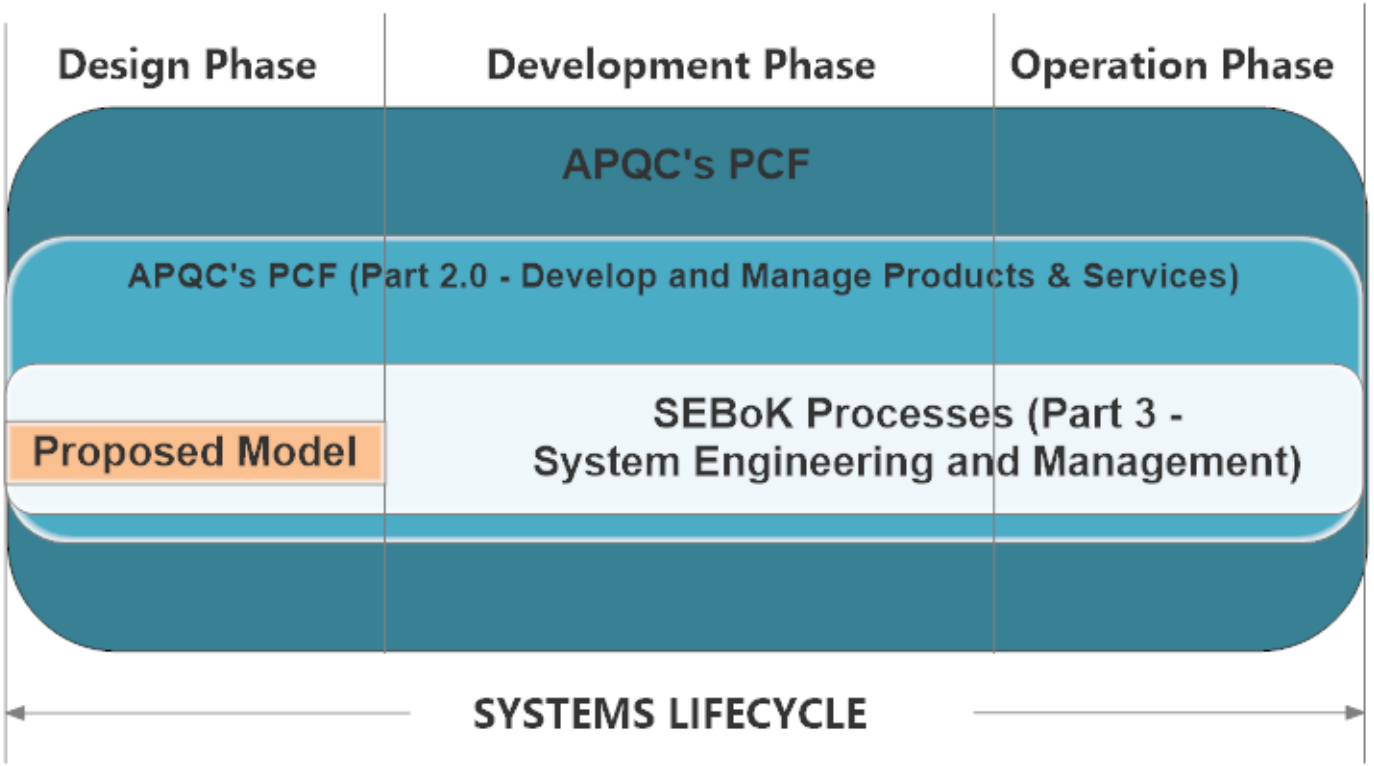


Figure 7 - APQC´s PCF and SEBoK SE´s Design Phase Reference Models

The Reference Model - Macroprocess View

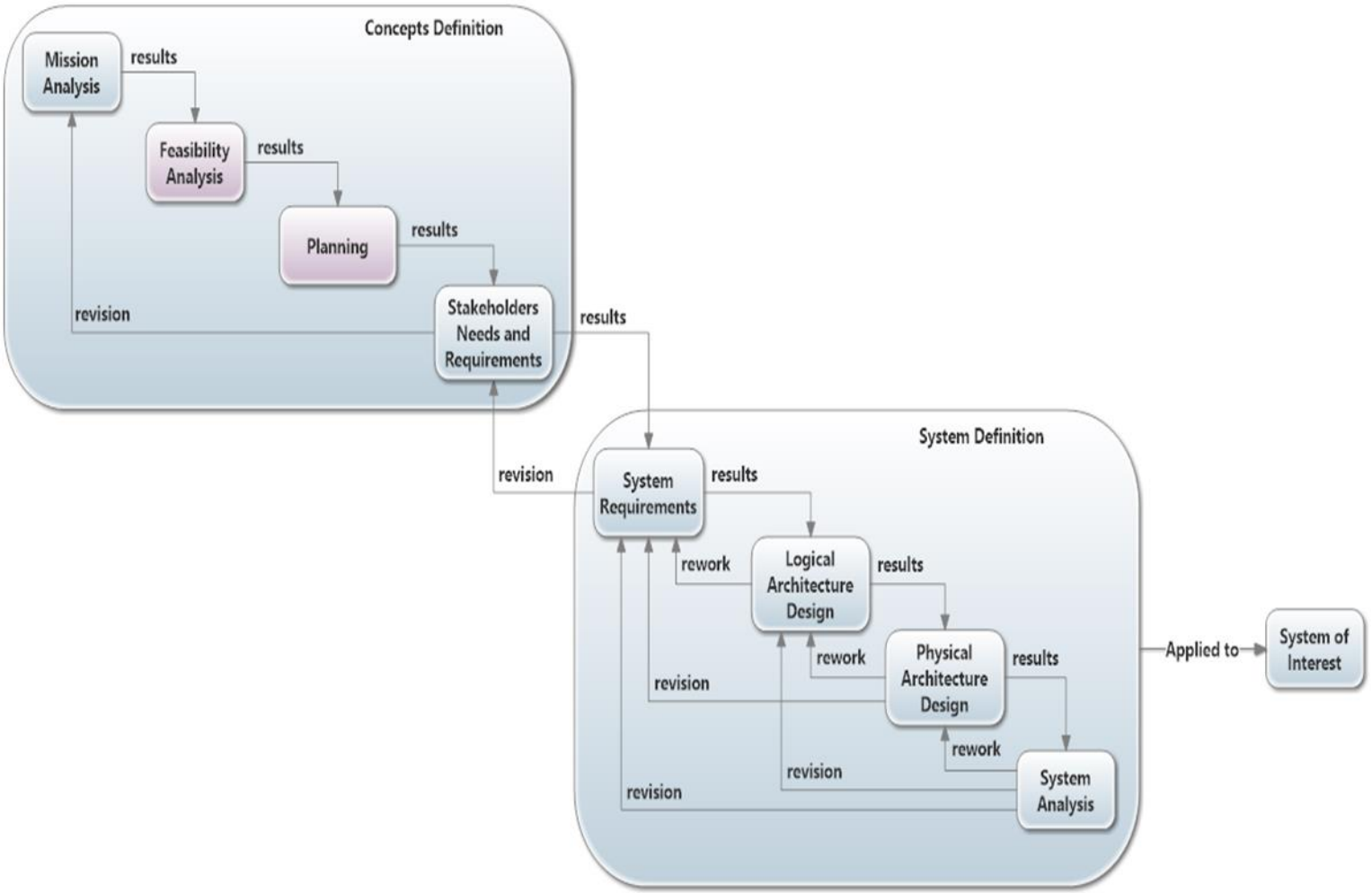


Figure 8 - SEBoK SE´s Design Phase Macroprocesses (modified by authors)

The Reference Model – IDEF0

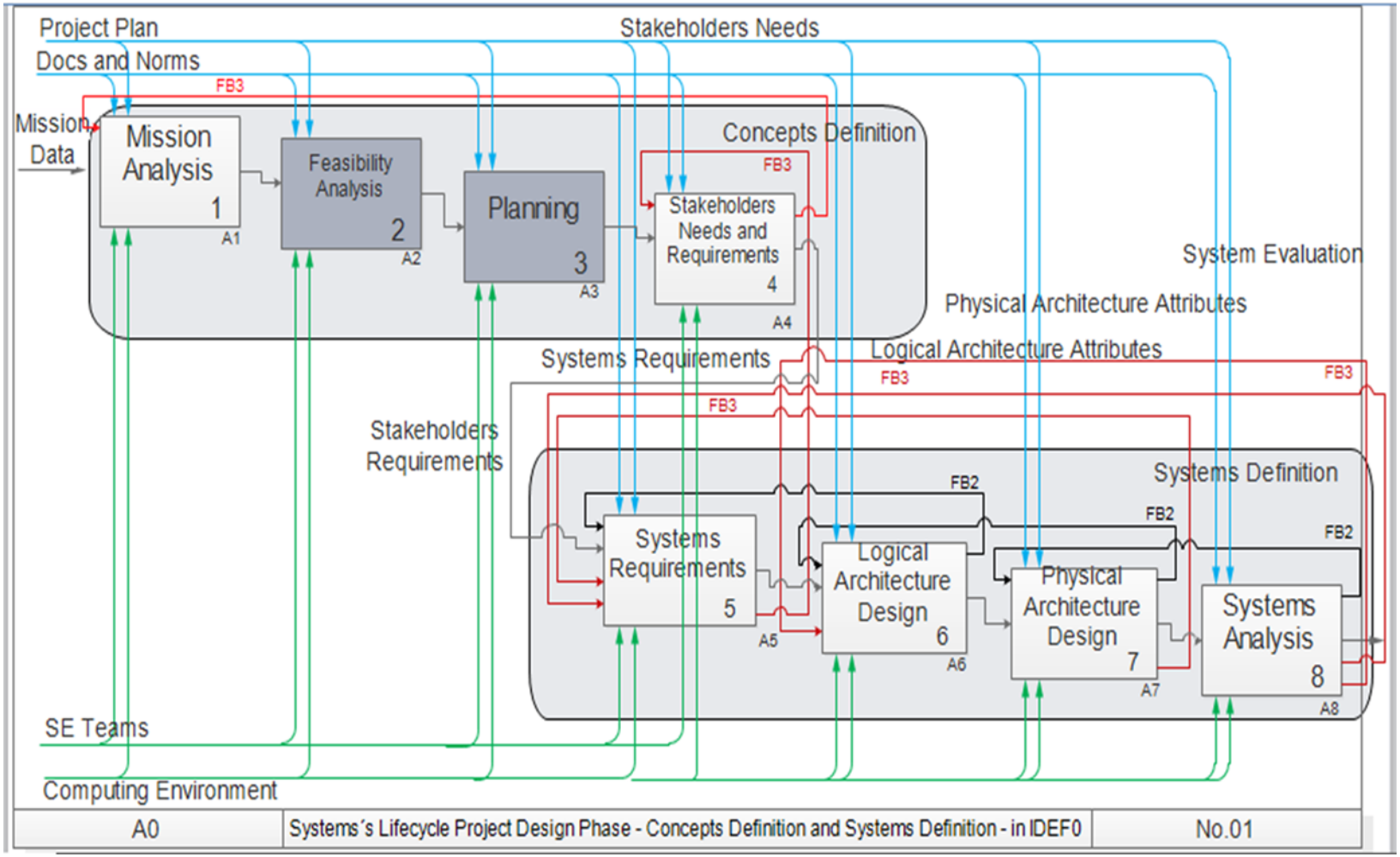


Figure 9 - SE´s Design Phase – in IDEF0

TPD - Reference Model in TPMN (SmartDraw)

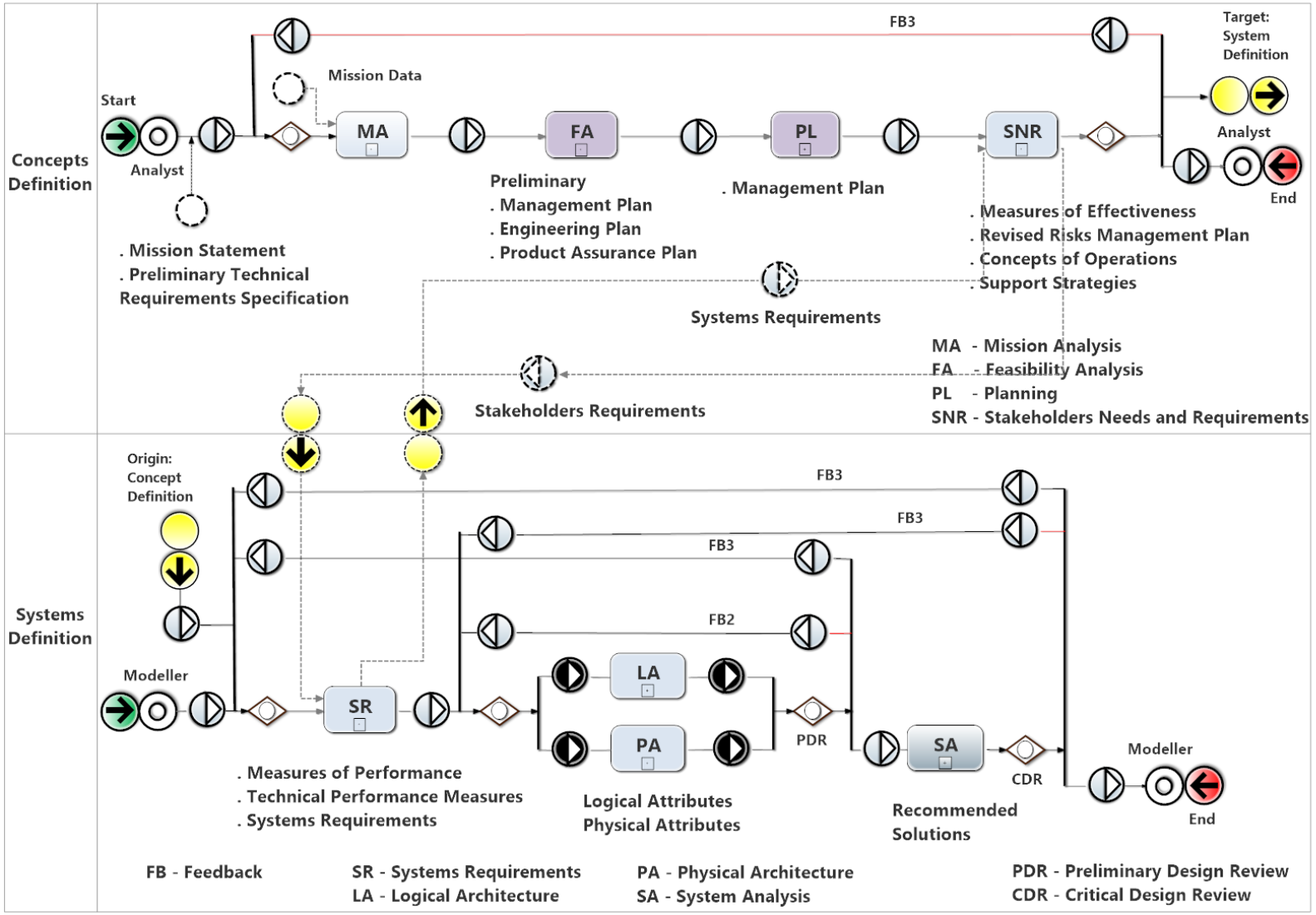


Figure 10 – SE´s Design Phase in TPMN (Smartdraw)

TPD - Systems Engineering Model in TPMN (SmartDraw)

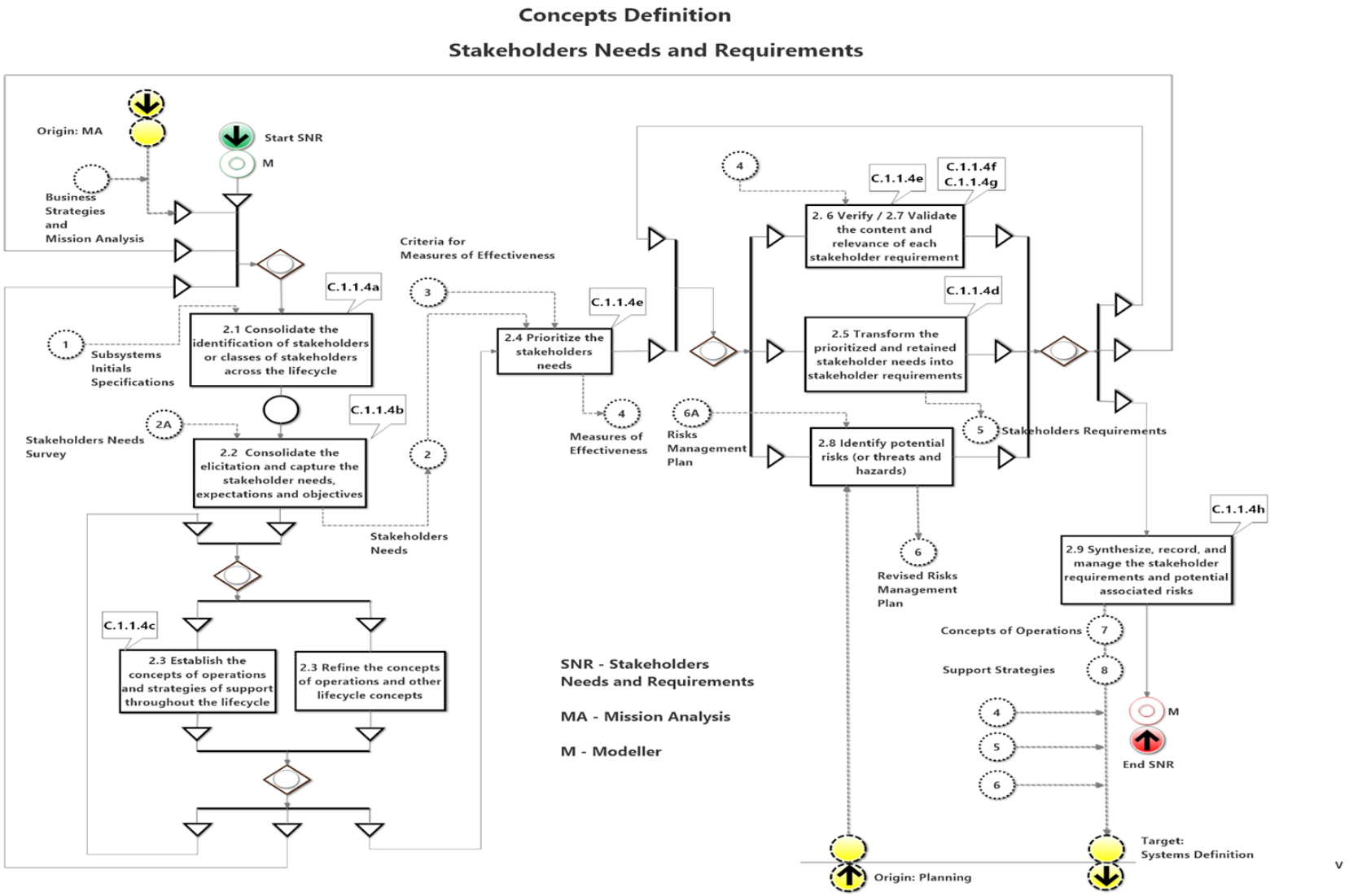


Figure 11 – Stakeholders Needs and Requirements in TPMN

Testing the Reference Hierarchical Model (Simprocess)

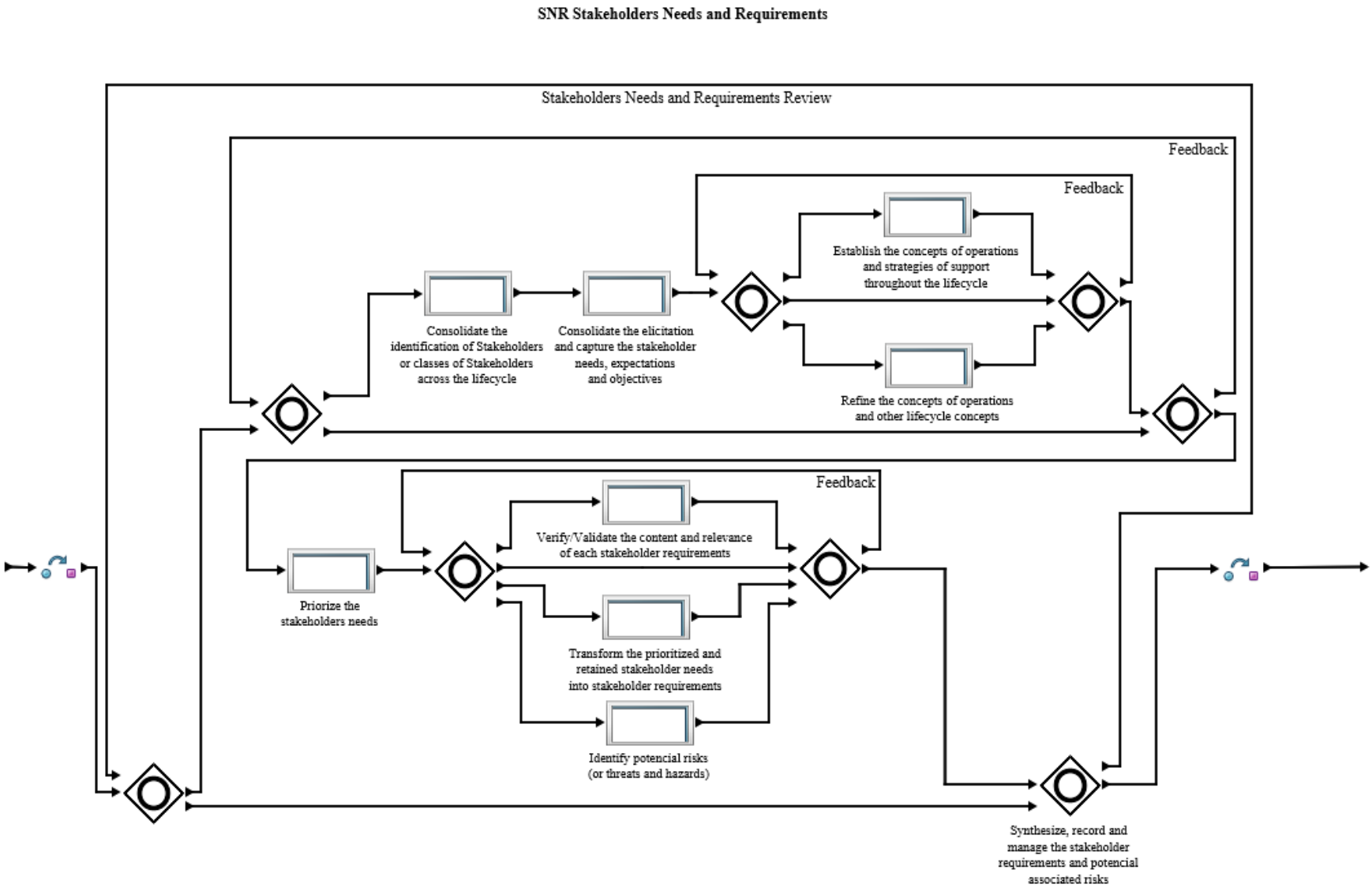


Figure 16 - The Stakeholder´s Needs and Requirements (Simprocess GUI)

The Specialized Project Management Model

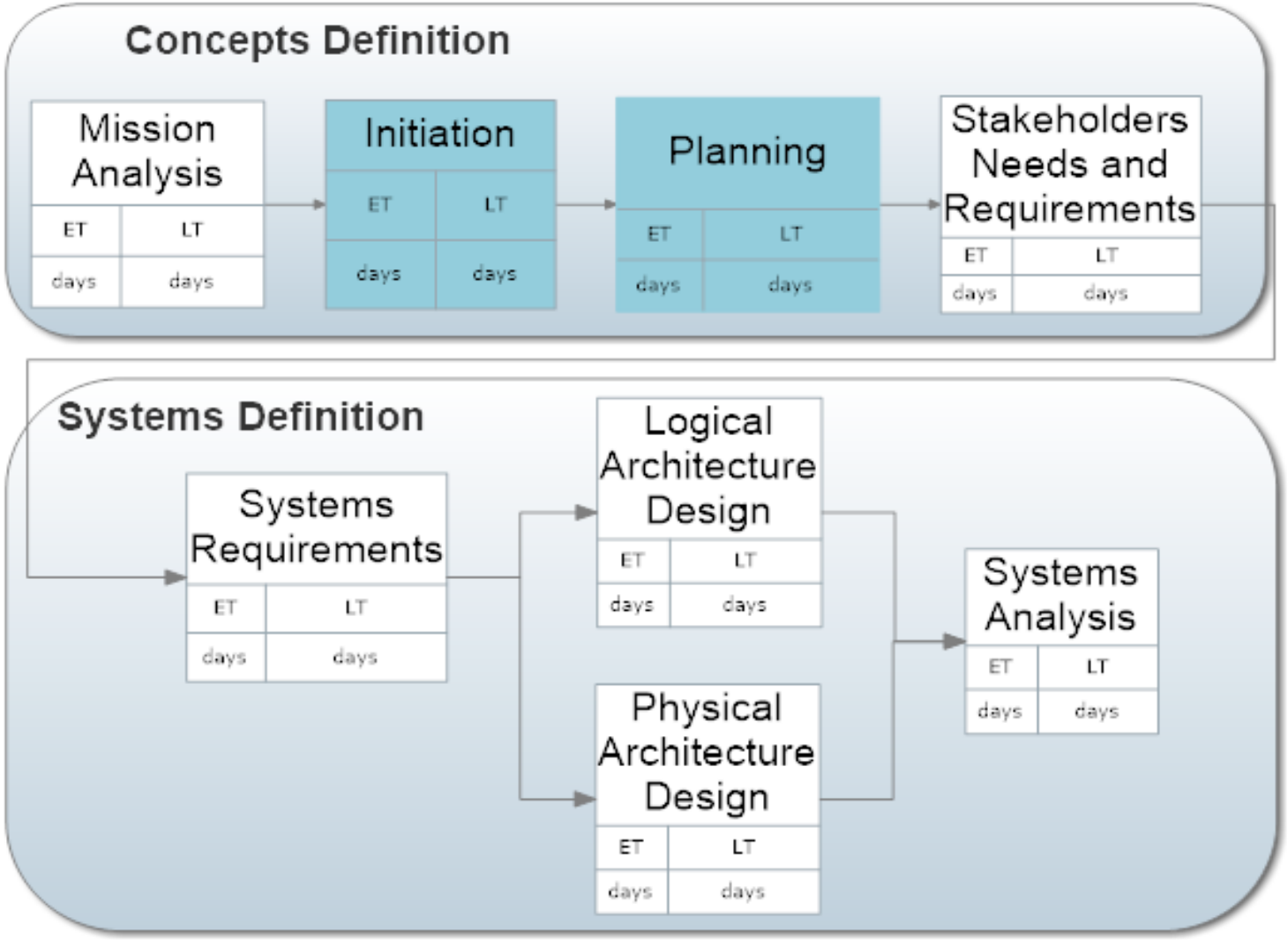
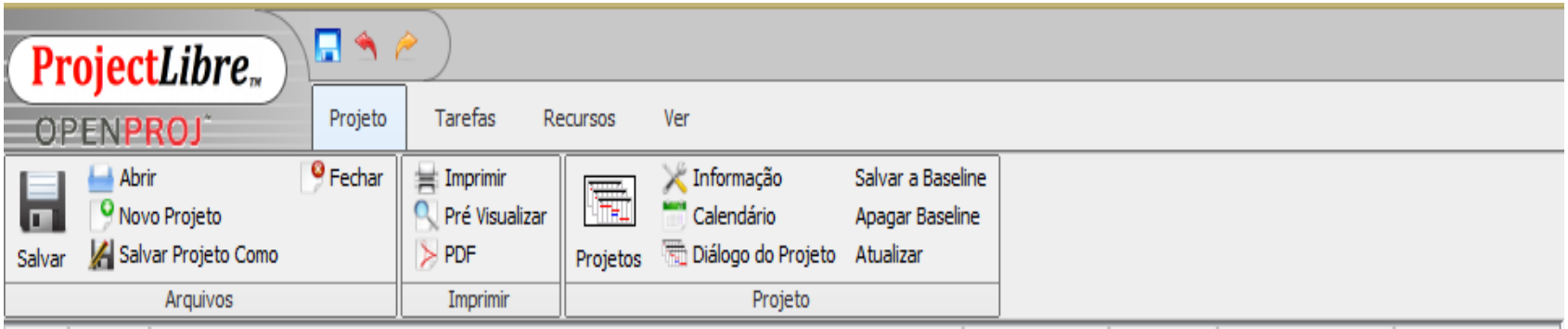


Figure 13 - Concepts Definition Process – PERT model

The Specialized PM Model – ProjectLibre



		Nome	Trabalho	Duração	Início	Fim
1		Fase de Design do Satélite	4.544,8 horas	130 dias	04/01/16 09:00	01/07/16 18:00
2		Definição de Conceitos	2.755,2 horas	85 dias	04/01/16 09:00	29/04/16 18:00
3		Análise de Missão	568,8 horas	14 dias	04/01/16 09:00	21/01/16 18:00
14		Análise de Viabilidade	770,4 horas	14 dias	22/01/16 09:00	10/02/16 18:00
28		Planejamento	896 horas	30 dias	11/02/16 09:00	23/03/16 18:00
57		Necessidades e Requisitos de Stakeholders	520 horas	27 dias	24/03/16 09:00	29/04/16 18:00
68		Definição de Sistemas	1.789,6 horas	45 dias	02/05/16 09:00	01/07/16 18:00
69		Requisitos de Sistemas	808 horas	16 dias	02/05/16 09:00	23/05/16 18:00
85		Concepção da Arquitetura Lógica	324 horas	14 dias	24/05/16 09:00	10/06/16 18:00
92		Concepção da Arquitetura Física	337,6 horas	15 dias	24/05/16 09:00	13/06/16 18:00
102		Análise de Sistemas	320 horas	14 dias	14/06/16 09:00	01/07/16 18:00

ProjectLibre <= XML

Figure 14 – SE´s Design Phase Process – PM Data Model

The Specialized Business Process Model

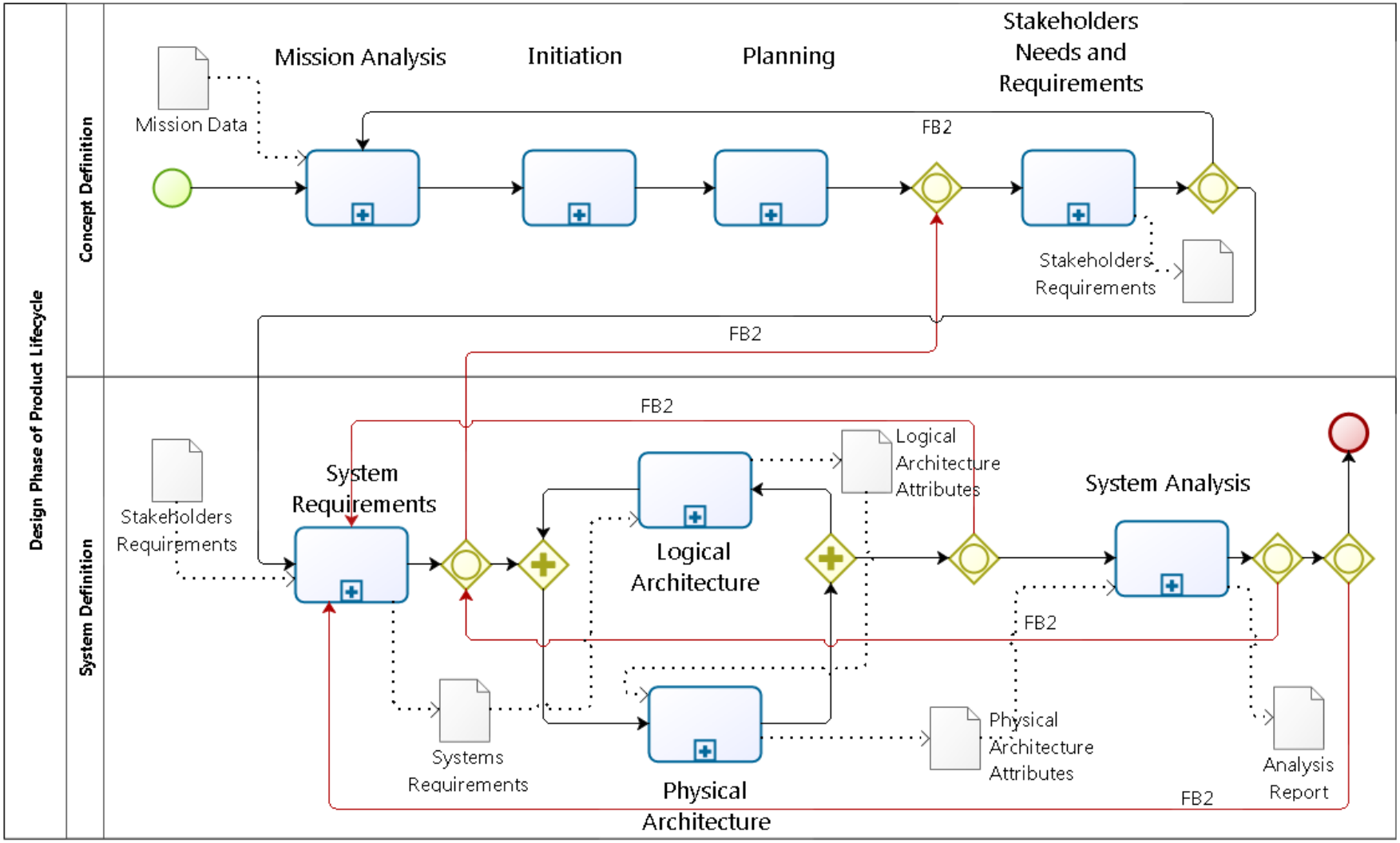


Figure 15 - SE´s design phase - BPMN Model in Bizagi Modeler

The Complete (Extended) Simulation Model (Simprocess)

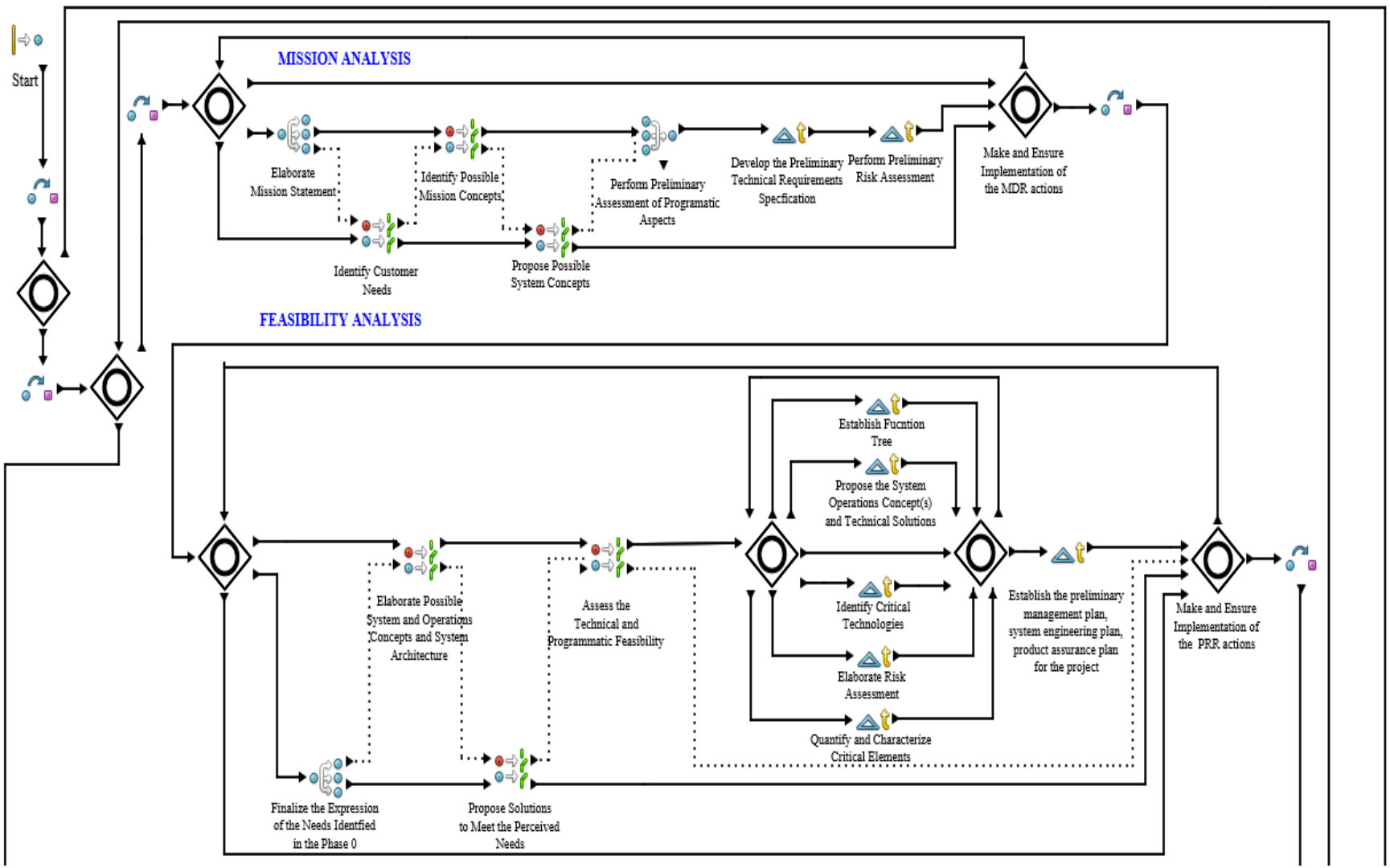


Figure 12 - Concepts Definition Phase – Simprocess Extended Model

Benefits of T-ProST

- The T-ProST holistic view addresses both the restructuring of the knowledge content (descriptive view) and the creation of a general systematic modeling procedure (unified process view), thereby achieving benefits from the combined use of the diverse modeling techniques based on multifaceted models.

- The proposed methodology can be applied to a large problem class, with special interest focused on applications in systems engineering product lifecycle and in multi-projects of an identical single project nature, whose execution share common resources and occur in parallel.

Drawbacks of T-ProST

- There is an expected overhead in the attempt to apply a transdisciplinary approach based on existing autonomous tools, represented by the expensive procedure in regard to maintaining model consistency and compatibility across the whole model development life cycle.
- The full development and application of the methodology will require the use of existing tools to perform several case studies, as well as the creation of a new hybrid environment, which on its turn will require quite a lot of software application and development time.

Global Assessment

THE SYSTEMS ENGINEERING DESIGN PHASE PROCESS:

The modelling in Bizagi of the Systems Engineering Design Phase:
Shows the Product Engineering and the Organisation´s Business Management Processes

APQC CLASSIFICATION FRAMEWORK:

Shows an example of how the processes of the life cycle of a generic organisation can be described and organised

THE HANDBOOK ON PROCESS SCIENCE AND TECHNOLOGY:

A Handbook with a collection of papers documenting the research on ProST and some case studies

CONCLUSION

Understanding the meaning of T - ProST

- **What is Transdisciplinary Process Science and Technology (T - ProST)?**

T - ProST = Model Based Systems Engineering +
Project Management +
Business Process Management +
Simulation Modelling

Applied to Enterprise´s Systems Engineering and Management Process Lifecycles

ENGESIS PLM ARCHITECTURE

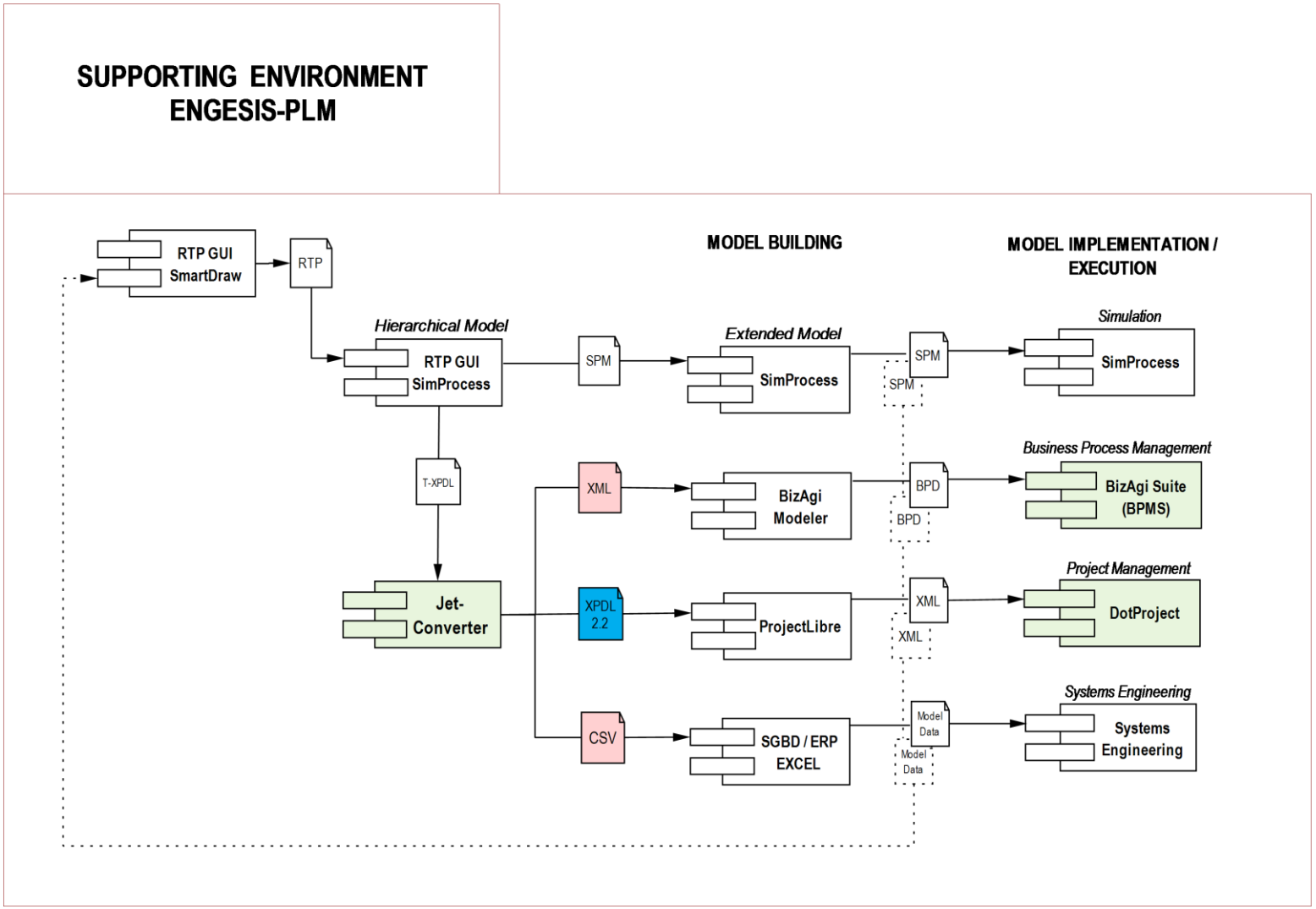


Figure 17 – ENGESIS PLM ARCHITECTURE

Ongoing / Future Researches

THE SYSTEMS ENGINEERING DESIGN PHASE PROCESS:

- T-ProST´s Application to the Design Phase in Systems Engineering has been the subject of two terms (three months each) course in the postgraduation program in Systems Engineering and Management at the Space Research Institute, focusing on the design of small satellites (pico, nano and micro). It helps both the Product Engineering and the Organisation´s Business Management Processes

CREATION/INTEGRATION OF TOOLS:

- Creation/integration of tools to build a unified environment

THE HANDBOOK ON PROCESS SCIENCE AND TECHNOLOGY:

- A Handbook with a collection of papers documenting the research on ProST and some case studies

Conference Papers

Using Simulation Modeling to Create Transdisciplinary Process Models and to Build Basic PLM Tools to Support the Systems Engineering Lifecycle

- SIMUL 2015 - Seventh International Conference on Advances in System Simulation. November 15 to 20, 2015 - Barcelona, Spain.

T-PROST: A Transdisciplinary Process Modelling Methodology and its Application to the Systems Engineering Lifecycle in Space Missions

- II IAA Latin American CubeSat Workshop. February 28 to March 2, 2016 - Florianópolis, Brasil.

An Environment to Support PLM in Small Satellites Project Development (co-participante)

- II IAA Latin American CubeSat Workshop. February 28 to March 2, 2016 - Florianópolis, Brasil.

T-PROST: A Transdisciplinary Process Oriented Framework to Support the Product Design Phase in Systems Concurrent Engineering

- International Conference on Transdisciplinary Engineering. October 4 to 6, 2016 - Curitiba, Brasil.

A Transdisciplinary Process Oriented Framework to Support Generic PLM Implementation for use by Small and Medium Enterprises

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THE END

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Thank you!

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