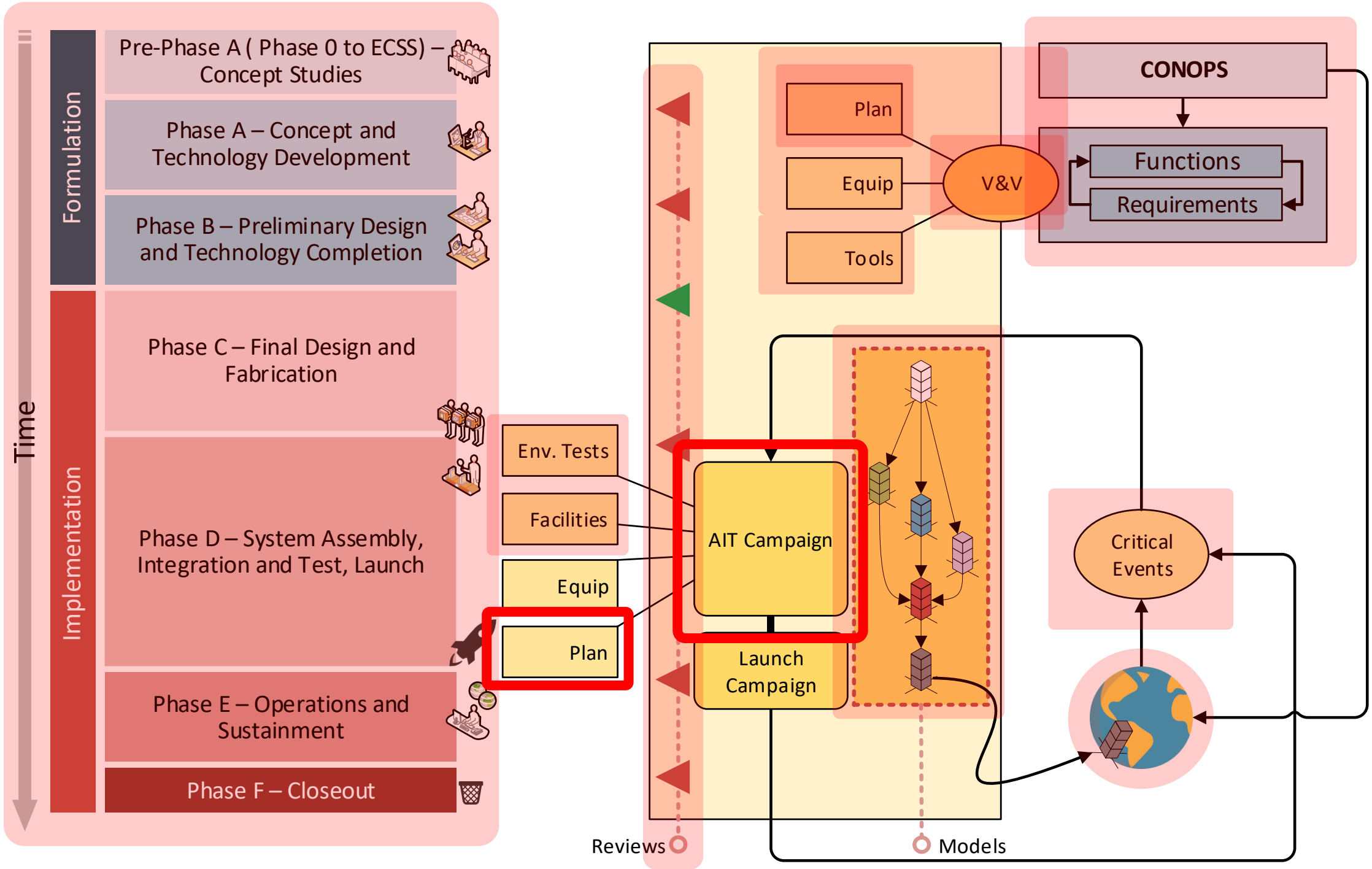
AIT PLanning

[SIS-08][LEC-011]


Time
Formulation
Implementation
Pre-Phase A (Phase 0 to ECSS) – Concept Studies
Phase A – Concept and Technology Development
Phase B – Preliminary Design and Technology Completion
Phase C – Final Design and Fabrication
Phase D – System Assembly, Integration and Test, Launch
Phase E – Operations and Sustainment
Phase F – Closeout
Env. Tests
Facilities
Equip
Plan
AIT Campaign
Launch Campaign
Plan
Equip
Tools
V&V
CONOPS
Functions
Requirements
Critical Events
Reviews
Models

Date	SES	In Class	Deliverables
Aug, 1	01	[LEC-000] Course Introduction [LEC-001] SE Review	-
Aug, 8	02	[LEC-002] Global Verification Process	[PRD-001] [redacted]
Aug, 15	03	[LEC-003] Tool and Processes to Verification	[PRD-002] [redacted] Product Tree
Aug, 22	04	[LEC-004] Life Cycle, Reviews & Baselines	[PRD-003] Revised Requirements
Aug, 29	05	[LEC-005] Model Philosophy	[PRD-004] Verifications per Requirement through the Life Cycle
Sep, 5	06	[LEC-006] Preparing to test Campaigns	[PRD-005] Models
Sep, 12	07	[LEC-007] Planning V&V	[PRD-006] Test Articles, Procedures & VCD
Sep, 19	08	[TST-001] V&V Conceptual Questions [PRD-007] DRAFT V&V Plan Presentation	[PRD-007] DRAFT V&V Plan (DVM)
Sep, 26	Week off		
Oct, 03	09	[LEC-008] AIT Process	[PRD-008] End to End Test Articles
Oct, 10	10	[LEC-009] Critical Events & Environmental Tests	[PRD-009] AIT Activities through the Life Cycle
Oct, 17	11	[LEC-010] Testing Facilities	[PRD-010] Vehicle and On-Orbit Testing
Oct, 24	12	[LEC-011] Planning AIT	[PRD-011] Facilities
Oct, 31	13	[LEC-012] GSEs [LEC-013] SCOE/OCOE	[PRD-012] AIT Flows & Activity Log
Nov, 07	14	[LEC-014] Launching Campaign	[PRD-013] GSEs
Nov, 14	15	[LEC-015] Trends / MBSE / Industry 4.0	[PRD-014] AIT Task Sheets [PRD-015] Vehicle Integration & Launching Plan
Nov, 21	16	[TST-002] AIT Conceptual Questions [PRD-016] V&V & AIT Plans Presentation	[PRD-016] V&V & AIT Plans
Nov, 28 Dez, 05	EXAM: Design of an AIT Facility to ITA's SmallSat Projects		

CONOPS

Oct, 17th – 10 – Events + Facilities

Oct, 31th – 11 – Planning

Nov, 07th – 12 – Equips

Nov, 08th – 13 – Launching

Nov, 14th – 14 – Ending

Nov, XX?th – 15 – TST-002

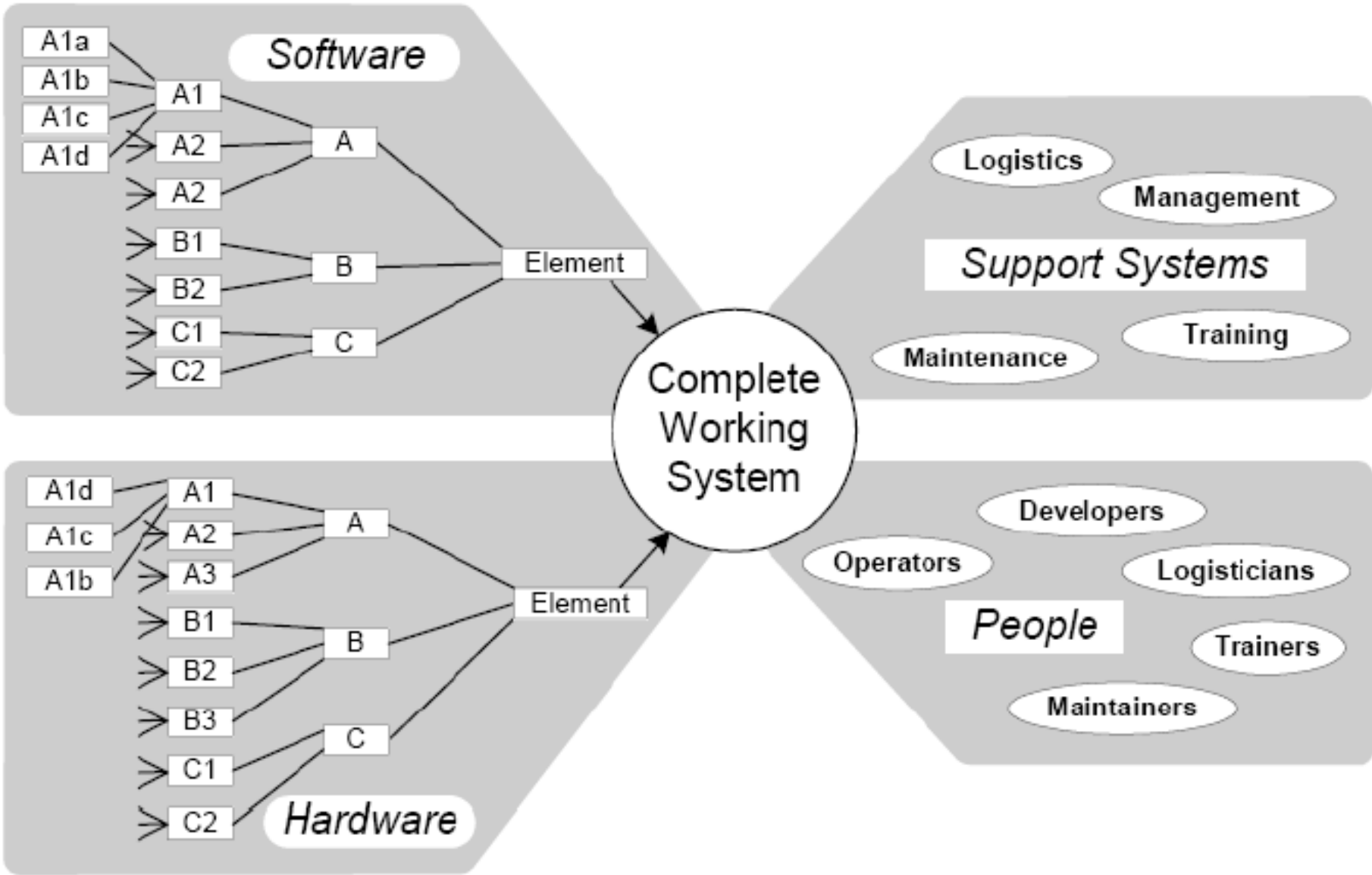
Nov, 21th – 16 – CEI-AIT

GOAL OF INTEGRATION

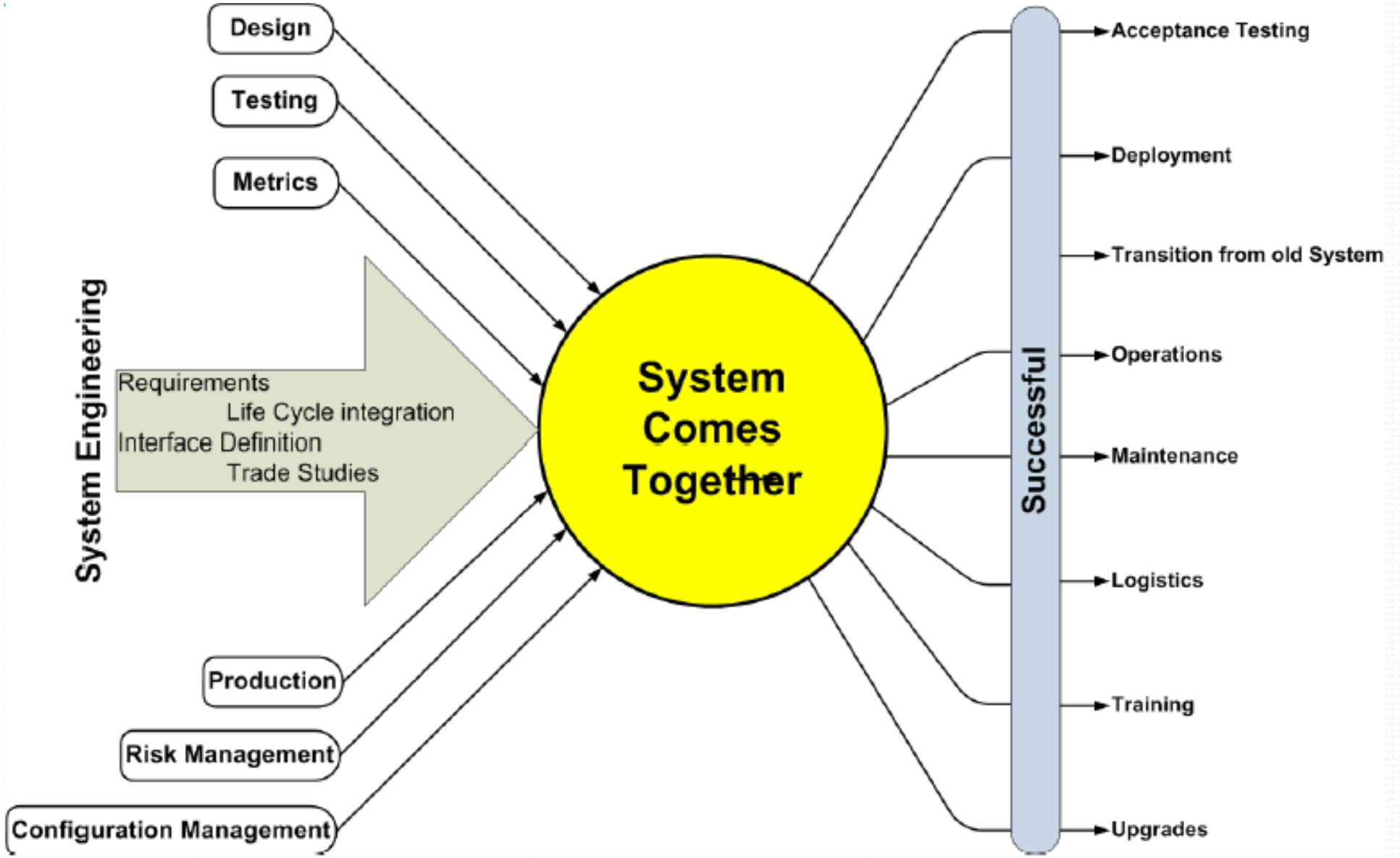
- The goal of integration **is to reduce the project risk of being late or the risk of creating an ill performing system**.
- During integration, the project team tries to find unforeseen problems as early as possible, in order to solve these problems in time. **Integration plays a major role in risk reduction.**
- **Problems can be unforeseen**
  - because the knowledge of the creation team is limited.
  - due to invalid assumptions. For instance many assumptions are being made early in the design to cope with many uncertainties.
  - problems is interference between functions or components of system.

Gerrit Muller, 2007

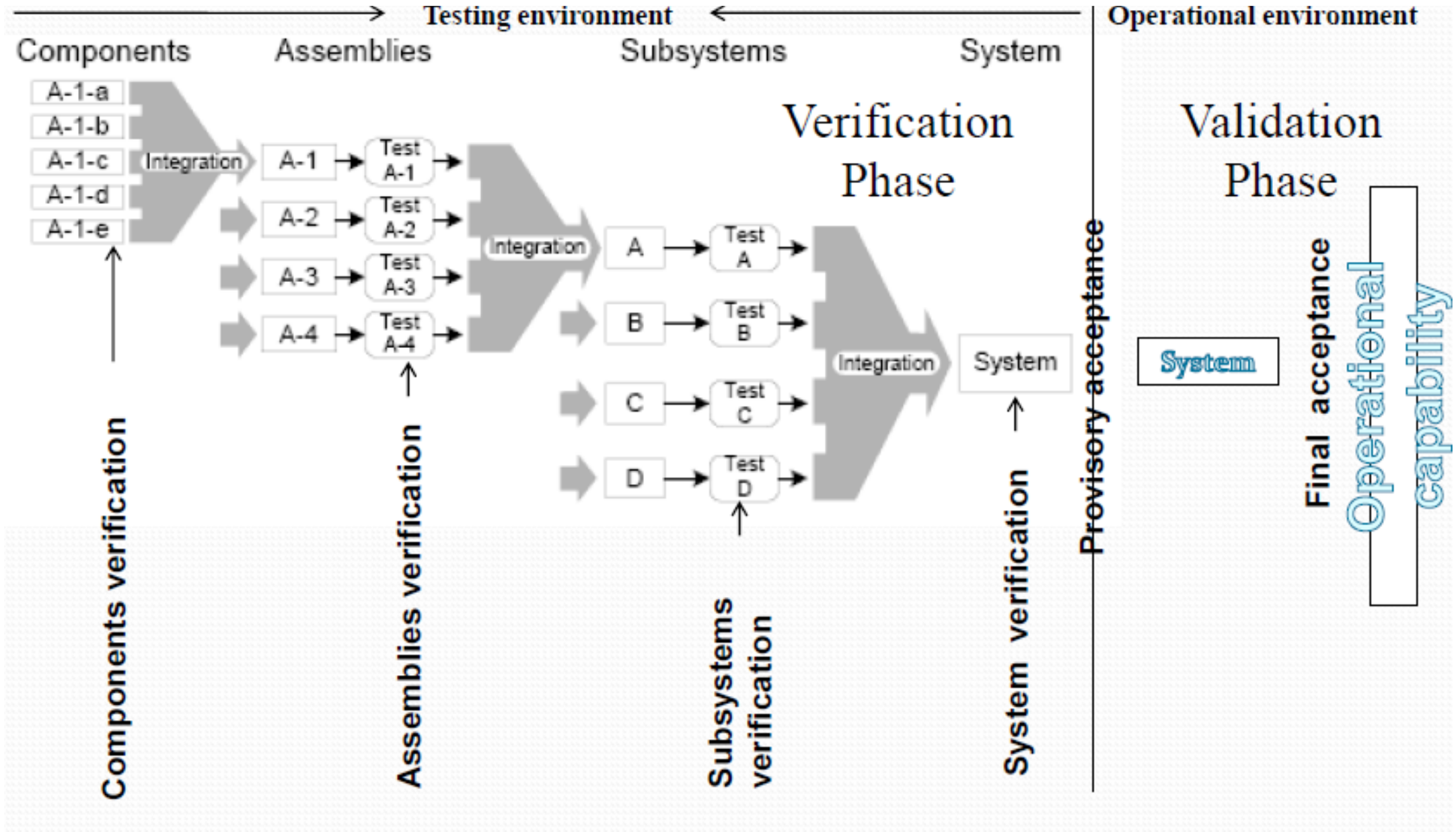
SYTEM INTEGRATION - IMPLEMENTATION

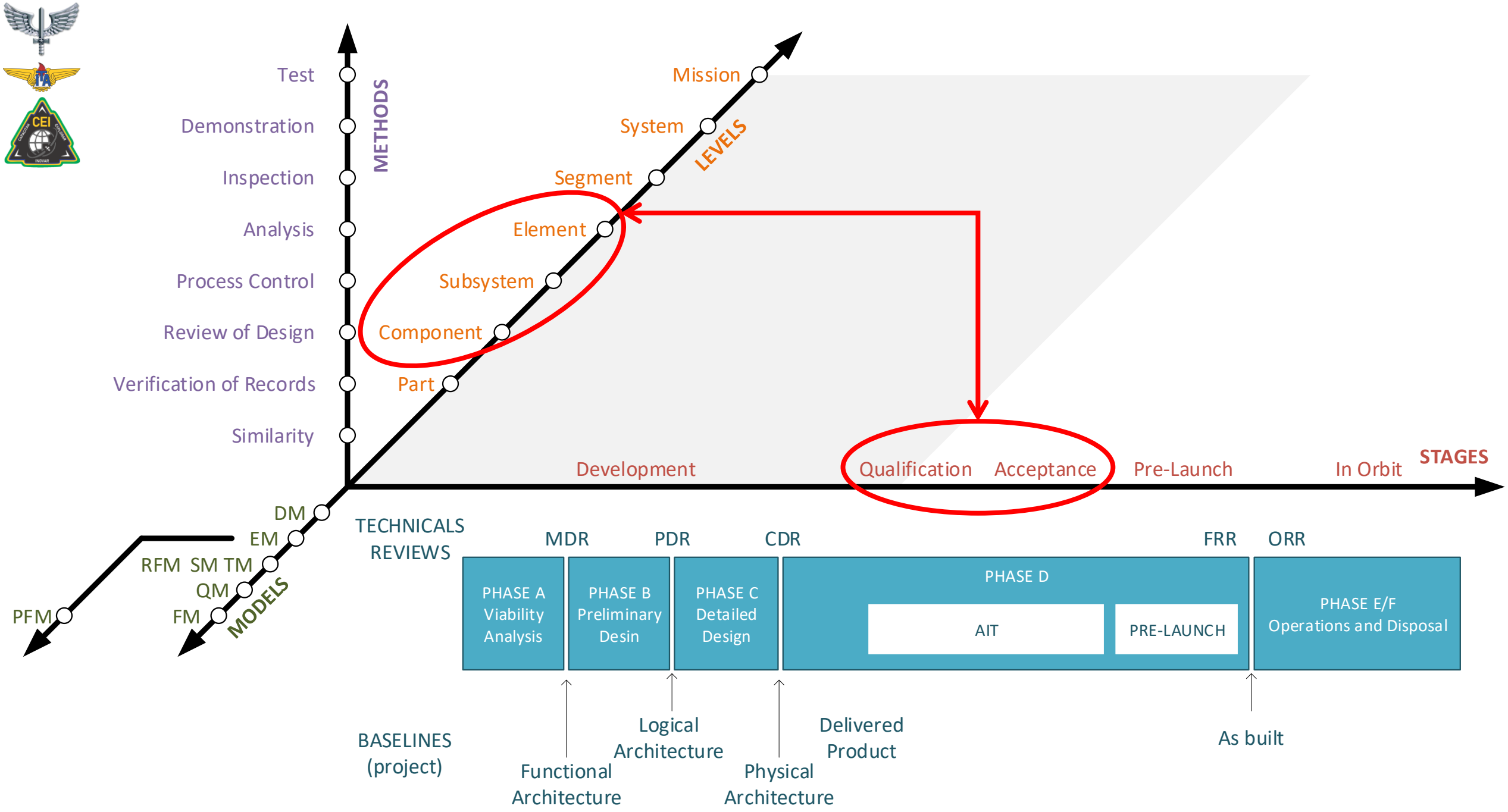


SYSTEM INTEGRATION - IMPLEMENTATION



SYSTEM INTEGRATION – VERIFICATION LEVELS




METHODS
Test
Demonstration
Inspection
Analysis
Process Control
Review of Design
Verification of Records
Similarity
LEVELS
Mission
System
Segment
Element
Subsystem
Component
Part
STAGES
Development
Qualification
Acceptance
Pre-Launch
In Orbit
MODELS
DM
EM
RFM
SM TM
QM
FM
PFM
TECHNICALS REVIEWS
MDR
PDR
CDR
FRR
ORR
PHASE A Viability Analysis
PHASE B Preliminary Desin
PHASE C Detailed Design
PHASE D
AIT
PRE-LAUNCH
PHASE E/F Operations and Disposal
BASELINES (project)
Functional Architecture
Logical Architecture
Physical Architecture
Delivered Product
As built

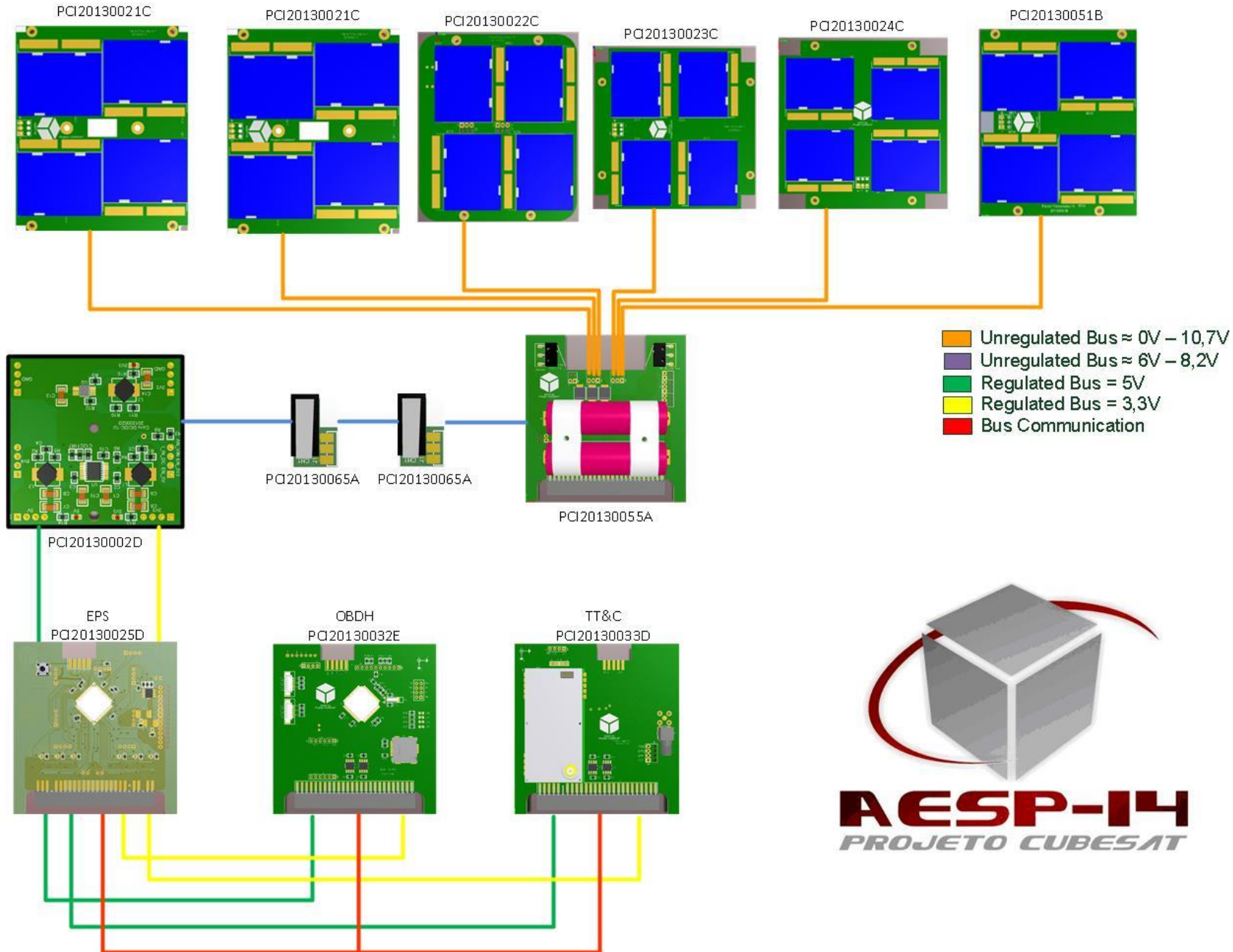
AESP-14 Example CASE

PROPOSTA DE MÉTODO PARA AIT DE PICO E NANOSSATÉLITES

Eduardo Escobar Bürger

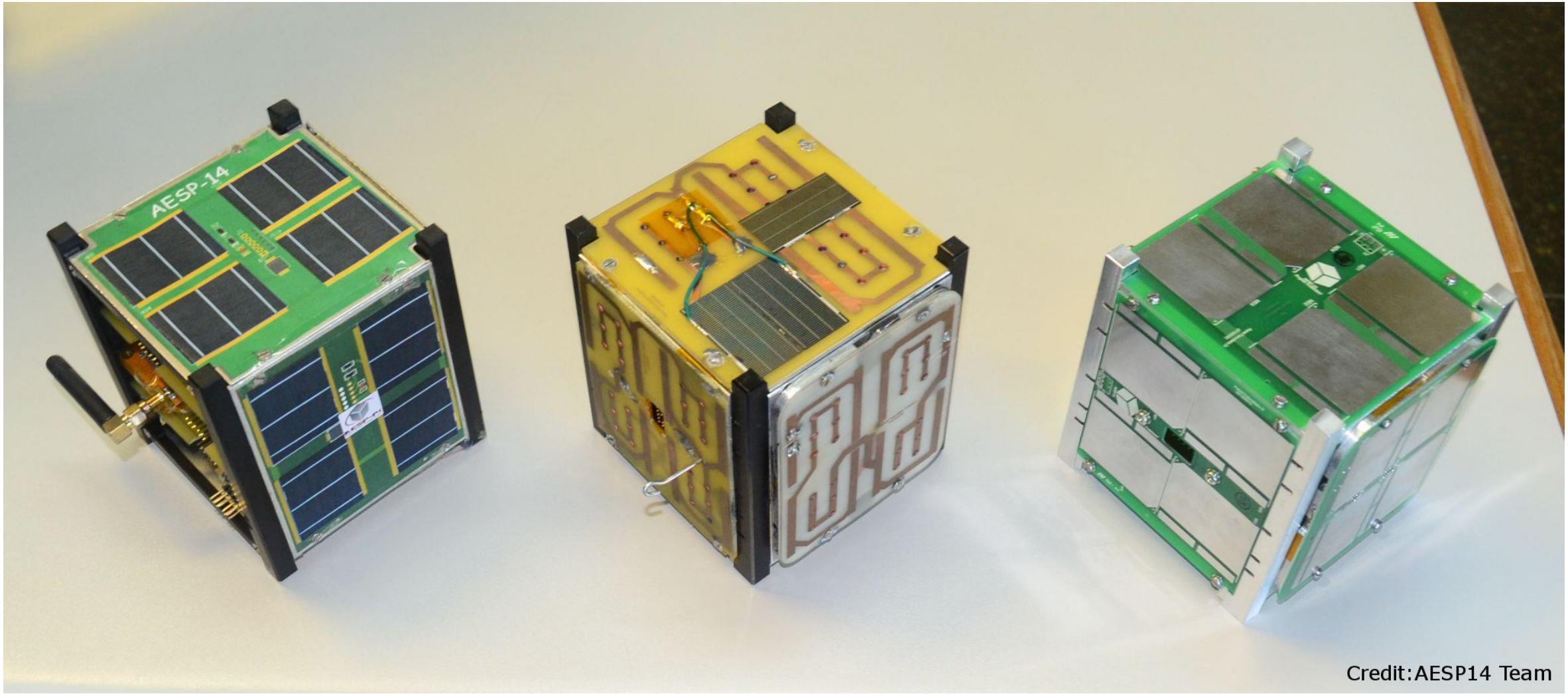
Dissertação de Mestrado do Curso de Pós-Graduação em Engenharia e Tecnologia Espaciais/Gerenciamento de Sistemas Espaciais, orientada pelo Dr. Geilson Loureiro, aprovada em 24 de Fevereiro de 2014.

Satellite AESP-14 Architecture Diagram

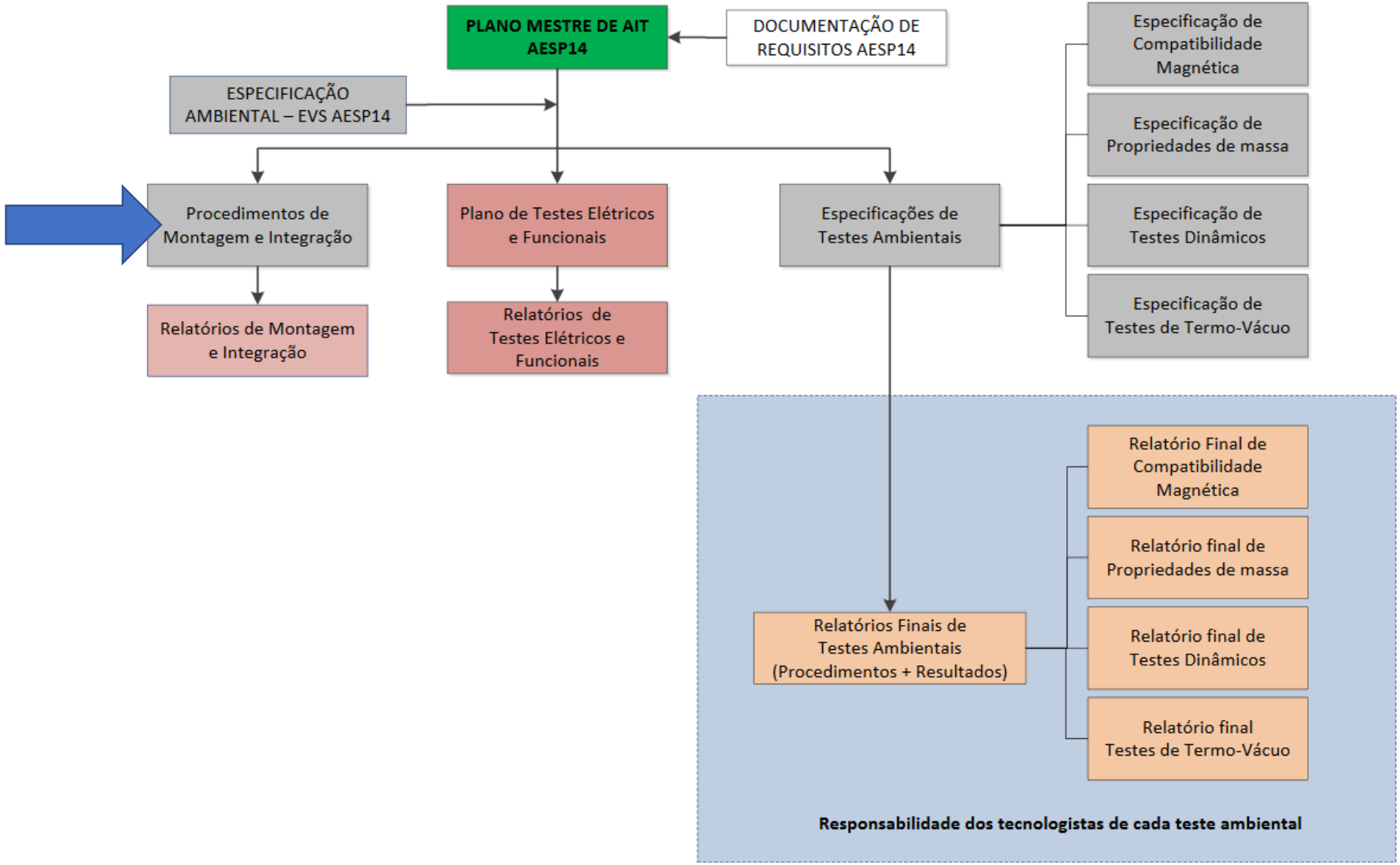


AESP-14
PROJETO CUBESAT

MODELOS



Estrutura geral da documentação de AIT do AESP14

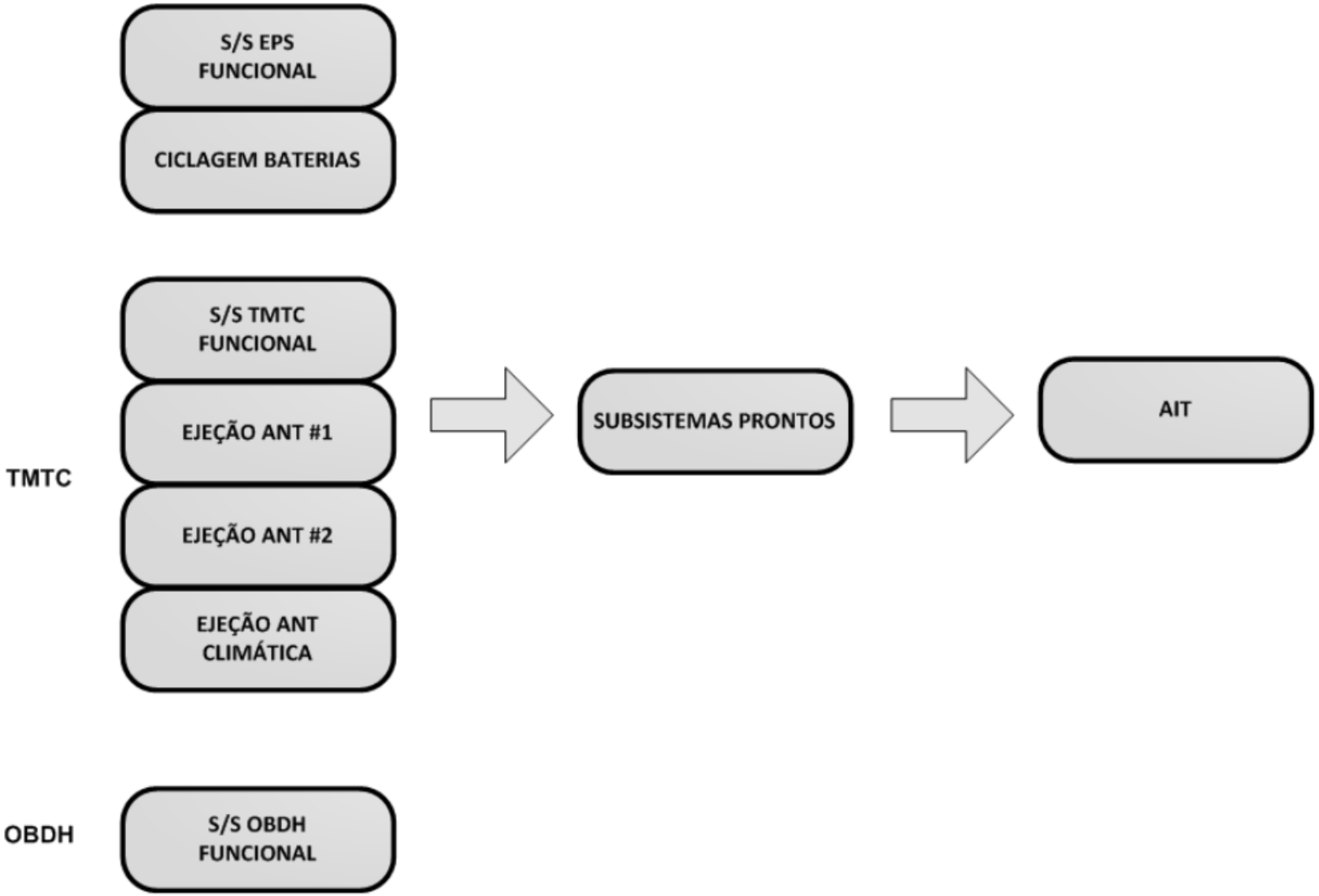


Macro Sequência de testes do Projeto AESP14

Testes x Modelos

Testes Sistêmicos	QM	FM
Check Funcional	X	X
Teste Funcional Baseline/Final	X	X
Teste EMC	X	
Propriedades de Massa	X	X
Assinatura	X	X
Teste de Choque	X	
Teste Randômico	X	X
Teste Senoidal	X	X
Teste Quase estático	X	X
Teste de Ciclagem Térmica no Vácuo	X	X
Bake-out	X	X

Testes de subsistema -QM

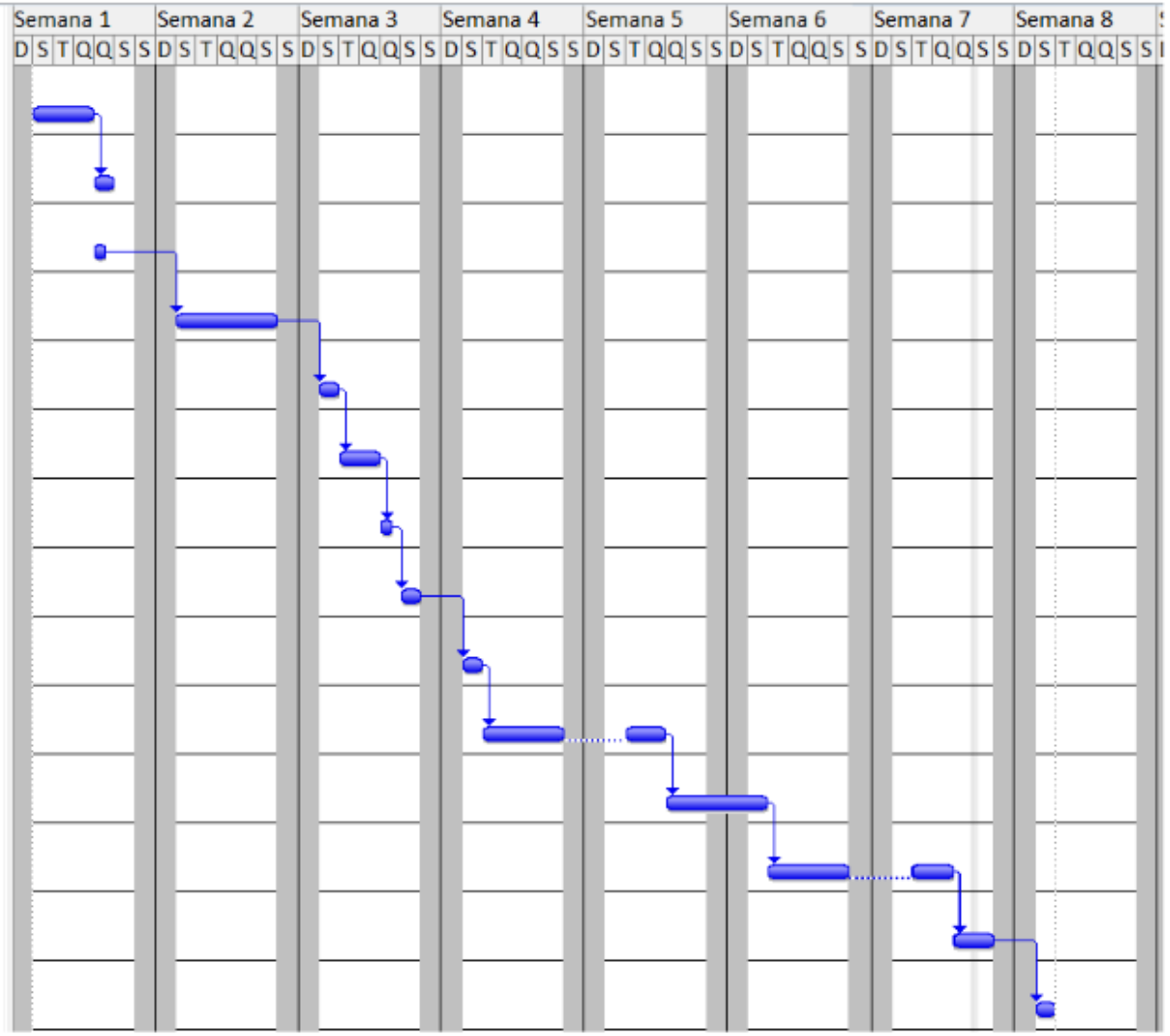


Matriz de requisitos de AIT.

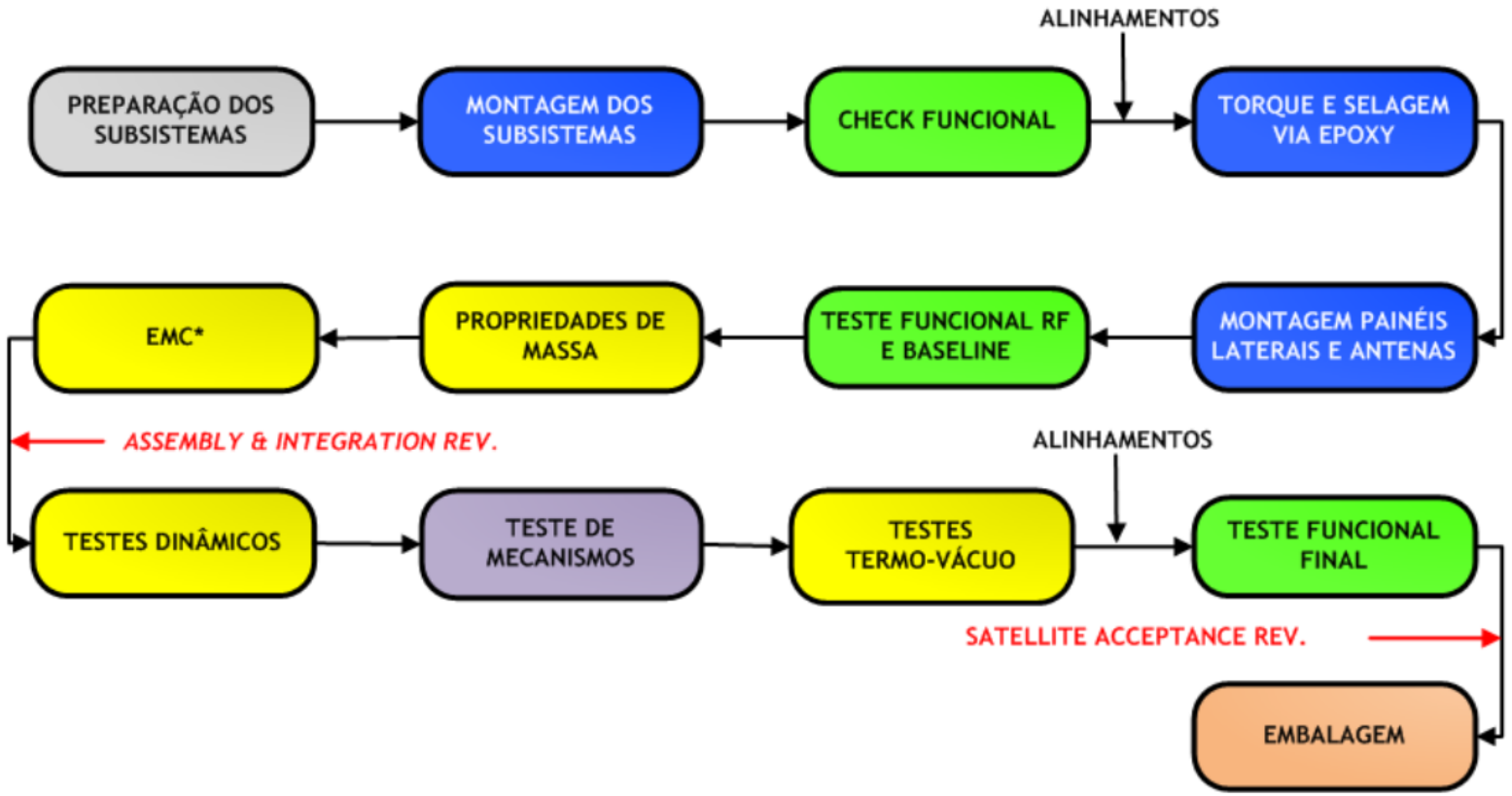
ID	REQUISITOS DE TESTE	ESTÁGIO DE VERIFICAÇÃO		MÉTODO DE VERIFICAÇÃO	CRITÉRIO DE VERIFICAÇÃO
		Q	A		
	REQUISITOS DE TESTES DINÂMICOS				
2-03-001-01	O AESP14 deve ser capaz de manter sua integridade mecânica e funcional perante os testes dinâmicos nos três eixos ortogonais com níveis especificados no EVS-AESP14.	X	X	Testes dinâmicos / Testes funcionais /Teste de Mecanismos	O AESP14 deve manter sua integridade mecânica e funcional.
2-03-001-01-01	O AESP14 deve ser capaz de manter sua integridade mecânica e funcional perante o teste de choque de qualificação nos três eixos ortogonais, com	X		Teste de Choque	O AESP14 deve manter sua integridade mecânica e funcional

Gráfico de Gannt das atividades de AIT

	Nome da tarefa	Duração
1	**Preparação dos Subsistemas**	3 dias
2	**Montagem dos Subsistemas**	1 dia
3	**Check Funcional**	0,5 dias
4	**Torque e Selagem via Epoxy**	5 dias
5	**Montagem Painéis Laterais e Antenas**	1 dia
6	**Teste Funcional RF e Testes Funcional Baseline**	2 dias
7	**Propriedades de Massa**	0,5 dias
8	**EMC**	1 dia
9	**Assembly & Integration Review (AIR)**	1 dia
10	**Testes Dinâmicos**	6 dias
11	**Teste de Mecanismos**	3 dias
12	**Testes de Termo-Vácuo**	6 dias
13	**Teste Funcional Final**	2 dias
14	**Embalagem**	1 dia



SEQUÊNCIA GERAL DE AIT–QM E FM



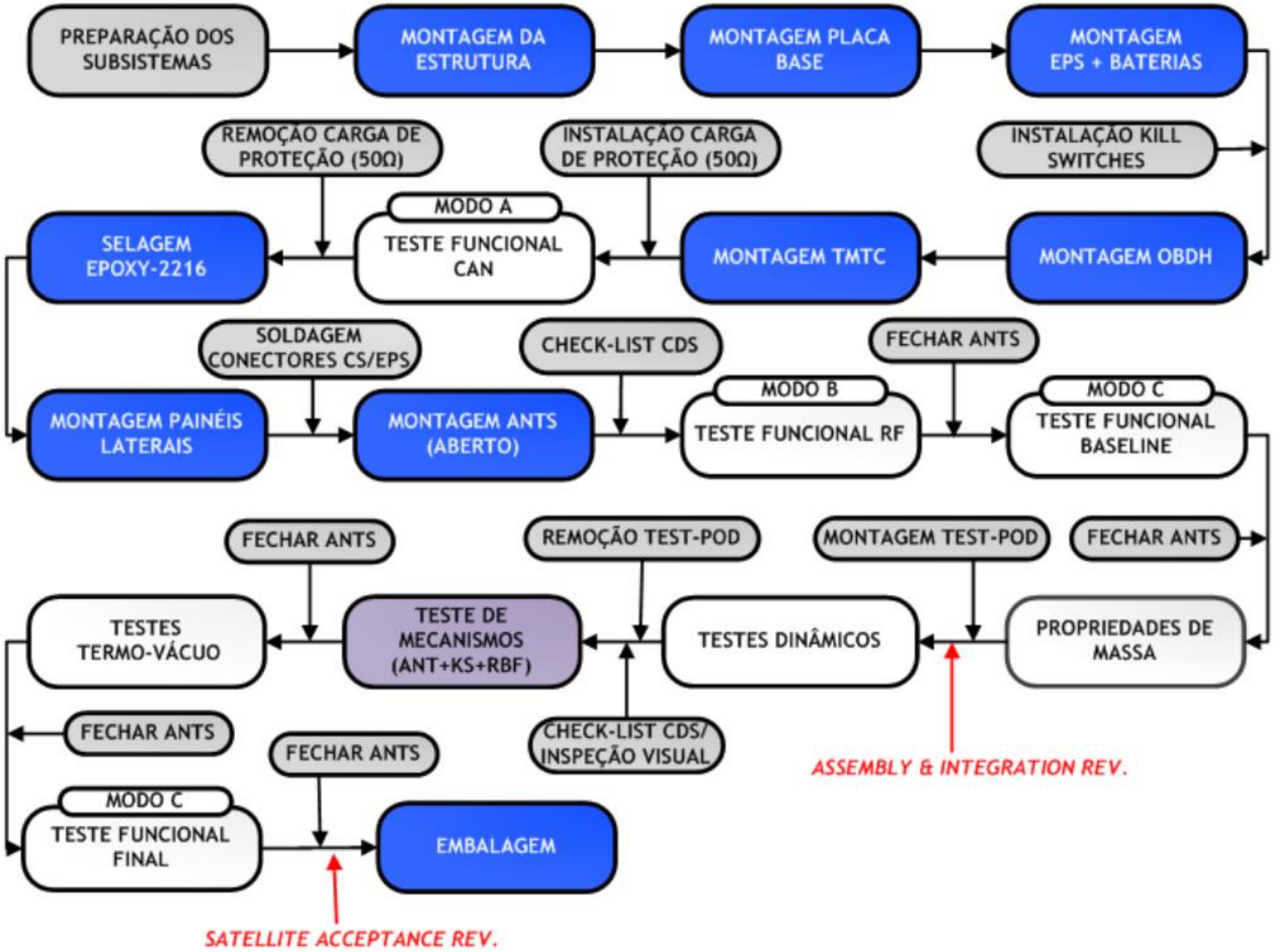
*Realizado apenas no QM.

Modos

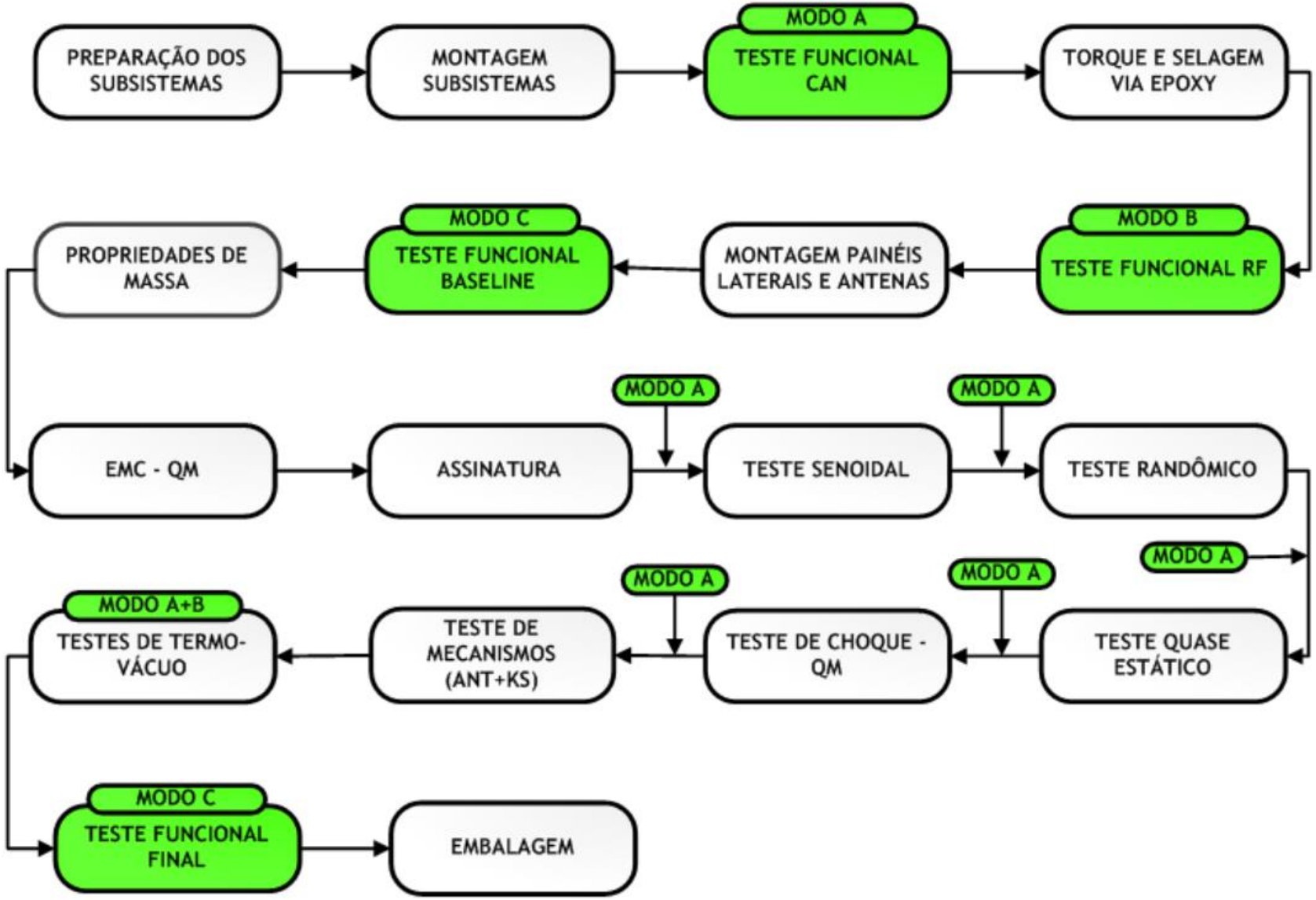
- Modo A –Verificação da comunicação básica via protocolo CAN;
- Modo B –Verificação das funções de comunicação via RF;
- Modo C –Teste de simulação de voo com todas as funções, desempenho e interação entre S/S via RF

			MODOS		
			A	B	C
Configuração do CubeSat	Subsistemas		X		
	Subsistemas + Painéis laterais + Antenas			X	X
Monitoramento e Controle	Cabos	Umbilical – S/C	X	X	X
		Coaxial		X	
	Antenas				X
Fonte de Alimentação	Baterias		X	X	X
	Fonte		X	X	
EGSE	EGSE CubeSat		X	X	X
	EGSE COTS do módulo RF			X	

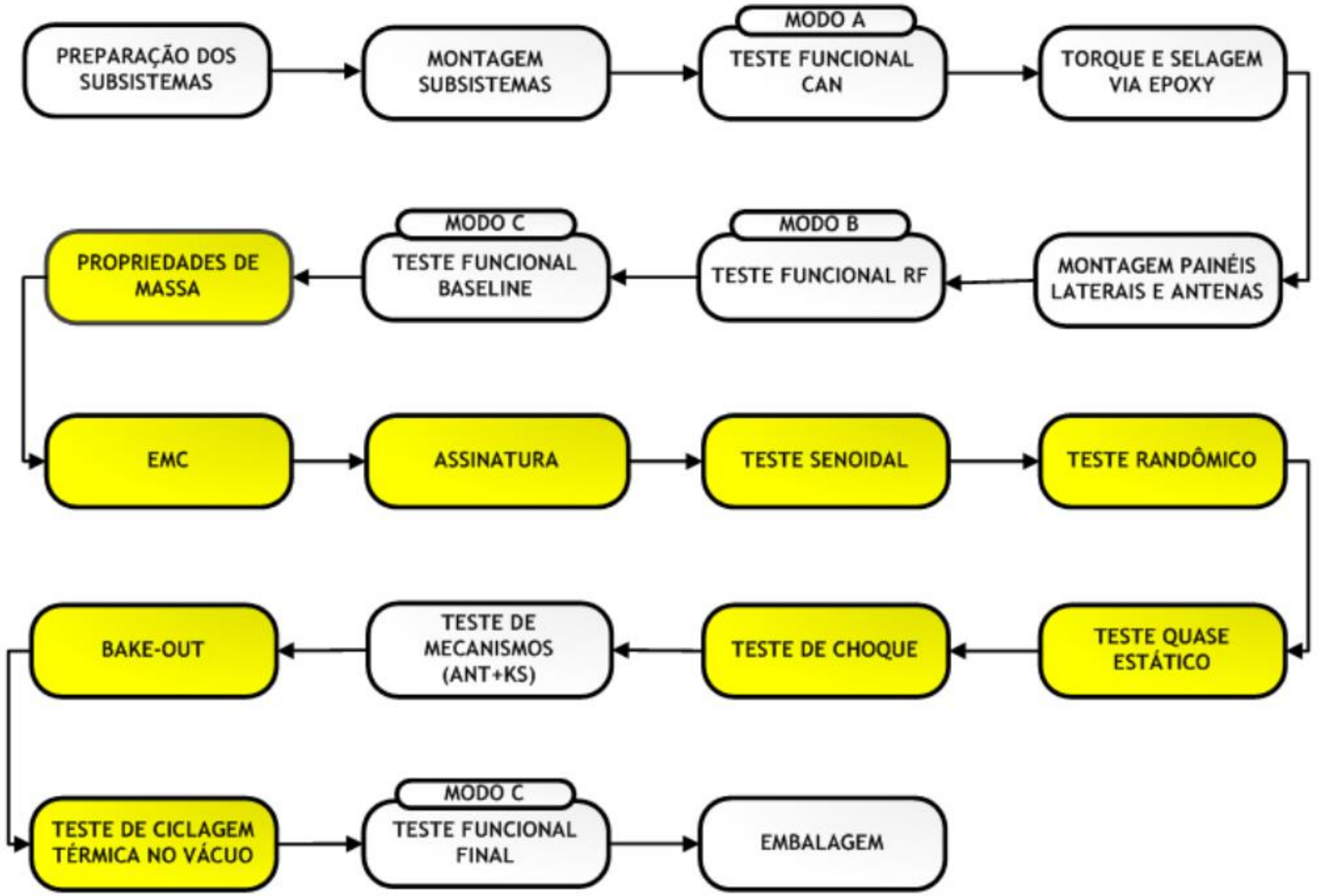
SEQUÊNCIA DE MONTAGEM E INTEGRAÇÃO – QM E FM



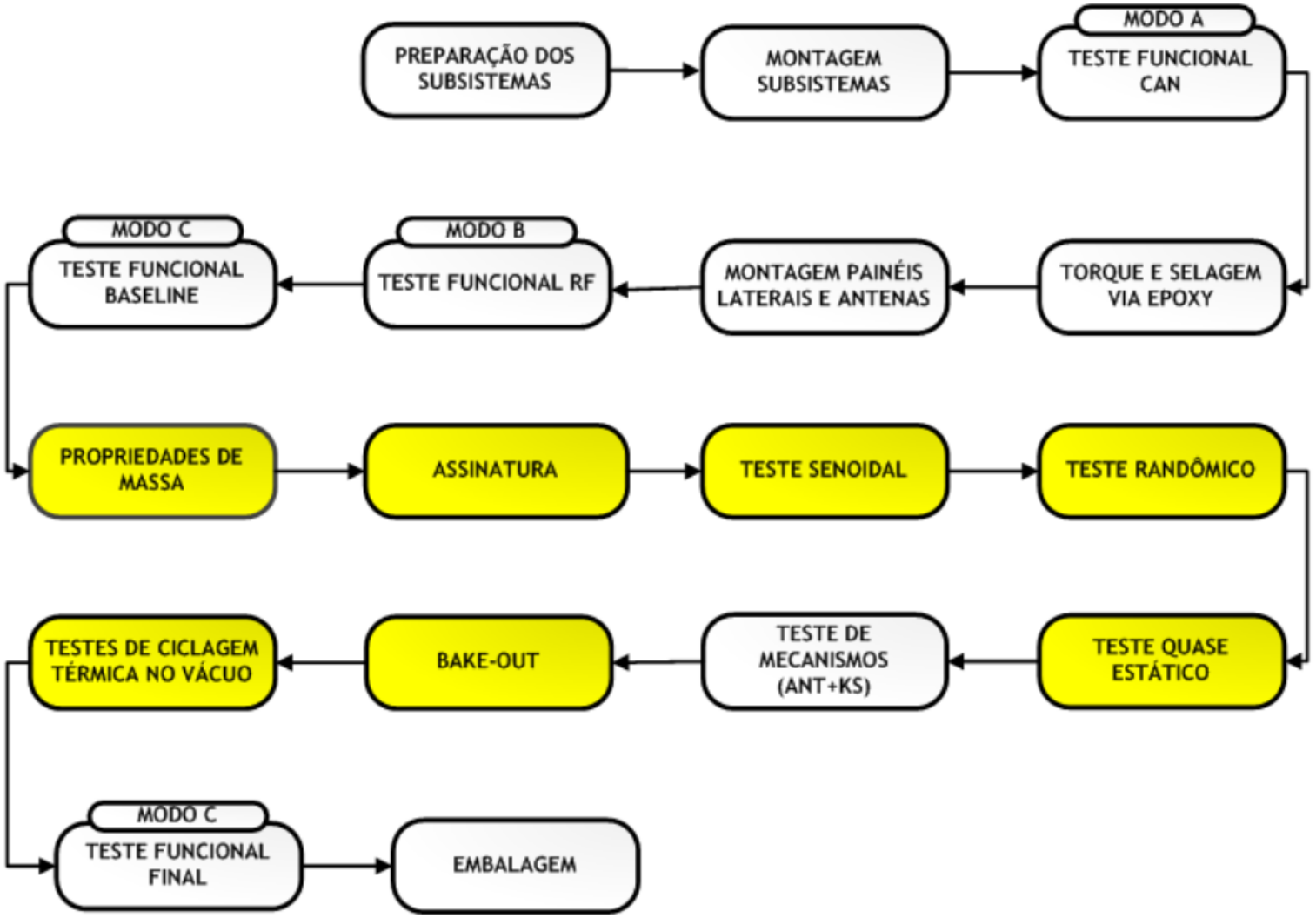
SEQUÊNCIA GERAL DE TESTES ELÉTRICOS E FUNCIONAIS –QM E FM



SEQUÊNCIA GERAL DE TESTES AMBIENTAIS -QM

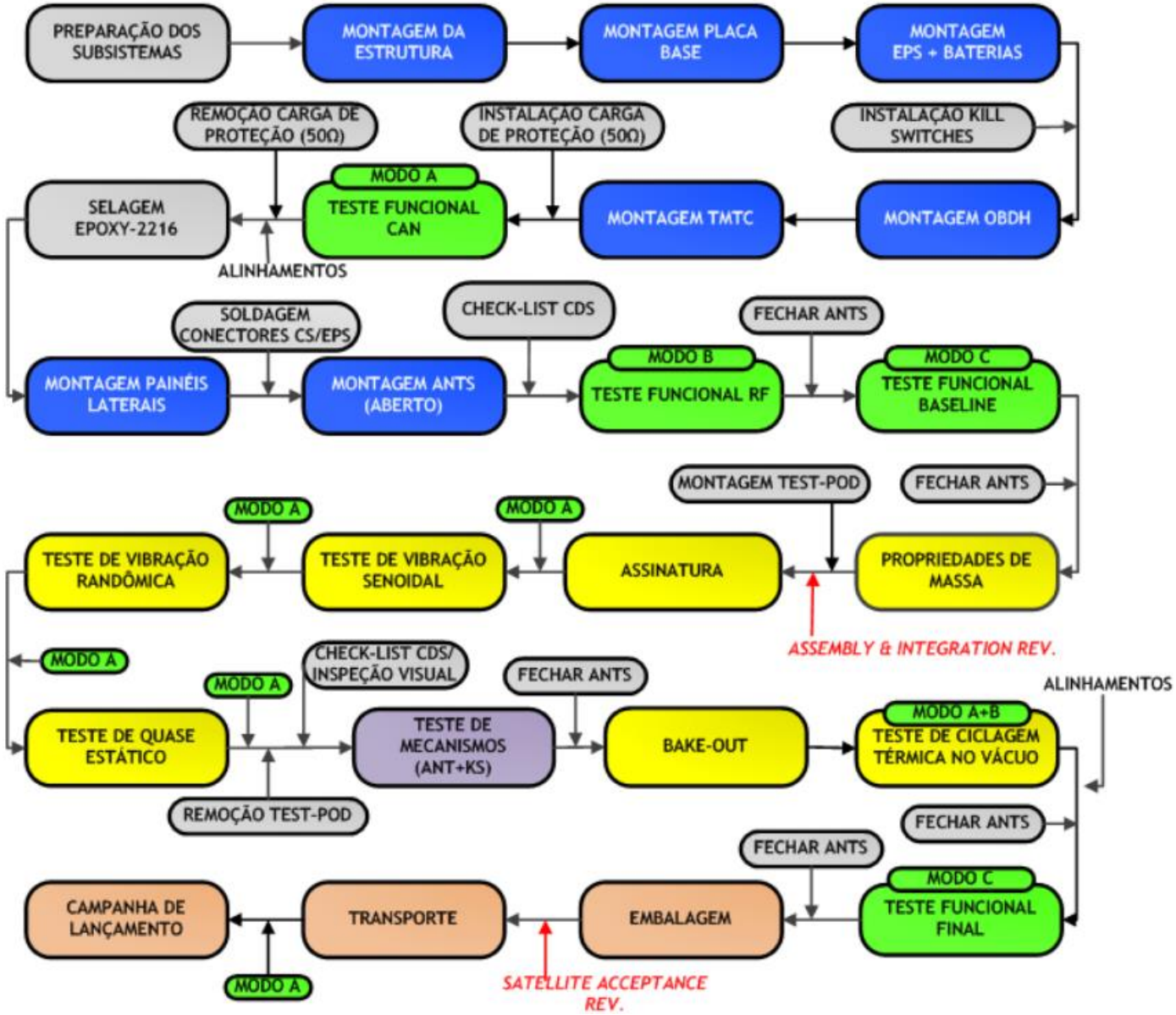


SEQUÊNCIA GERAL DE TESTES AMBIENTAIS -FM



SEQUÊNCIA DETALHADA DE AIT –QM

SEQUÊNCIA DETALHADA DE AIT –FM



Class Ending

HOMEWORK

- Create a detailed AIT Sequence for the PFM of our example satellite.
  - Create a macro sequence
  - Detailed per activity: assembly, functional testing, environmental.
  - Describe each step: facility & resources involved
    - Use the dissertation of the AESP-14 as reference.
- **This must be presented in next class: Nov, 07th ~50min**
  - **Each subsystem representative will describe the tests related to its subsystem**