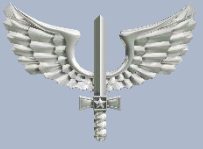# AGILE METHODOLOGY APPLIED TO SYSTEM ENGINEERING IN THE DOMAIN OF COST ANALYSIS OF A 6U CUBESAT

Ana Carolina Di Iorio Jeronymo
Lidia Hissae Shibuya Sato
Luís Eduardo V. Loures da Costa
Jonas Bianchini Fulindi
Victoria de Souza Rodrigues

Instituto Tecnológico de Aeronáutica
ITA Space Center

Agenda

- Agile, CubeSats and System Engineering Processes

- Agile in the domain of a CubeSat System Engineering

- Cost management and procurement guidance

- Scintillation Prediction Observations Research Task (SPORT) Mission

- Example of application on SPORT Project

- Phase 0 – Sprint 1: Cost Analysis

- Next Sprints

- Conclusions

Agile, CubeSats and System Engineering Processes
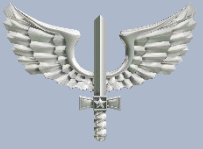
- "Agile *method is a set of values and practices that support the active evolution of a system's design and architecture*" [The Agile manifesto]

- Agile model emphasizes the need for each project to be treated differently, based on the individual needs of the project, the schedule and the team available.

https://www.cognodata.com/

- The project is divided into **small and regular portions**, where a sprint is one these timeboxed iteration of a continuous development cycle.
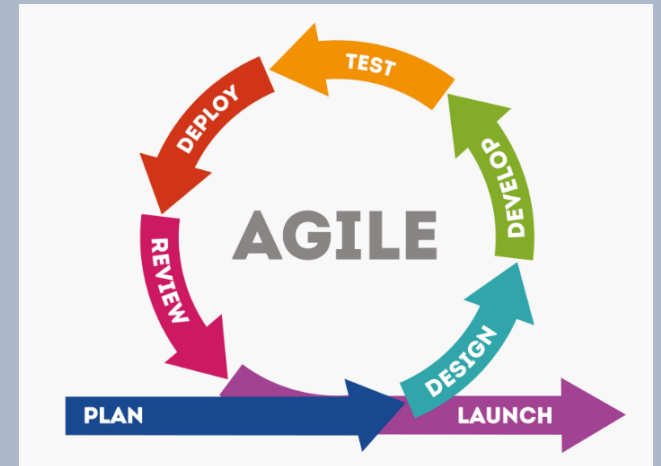
- CubeSats projects can be characterized as **agile architectures** [LaBarge 2014]

Agile, CubeSats and System Engineering Processes

- The life cycle is divided into **phases** where within this phase a **rapid** change may occur.

- In a sprint, the scope can be broken down into a set of requirements and **deliverables** and the work is done to prioritize these requirements

- Being flexible for changes doesn't means that good practices or stablish processes are not used in a CubeSat project.

- Agile requires customized methods and processes to provide **incremental** resources

- To provide the required capacity aligned with the stakeholder needs, the program must conduct **continuous interdisciplinary systems engineering reviews**.
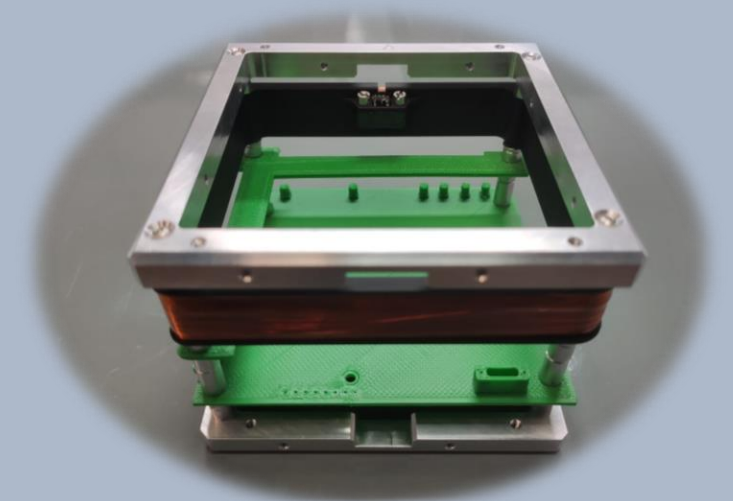
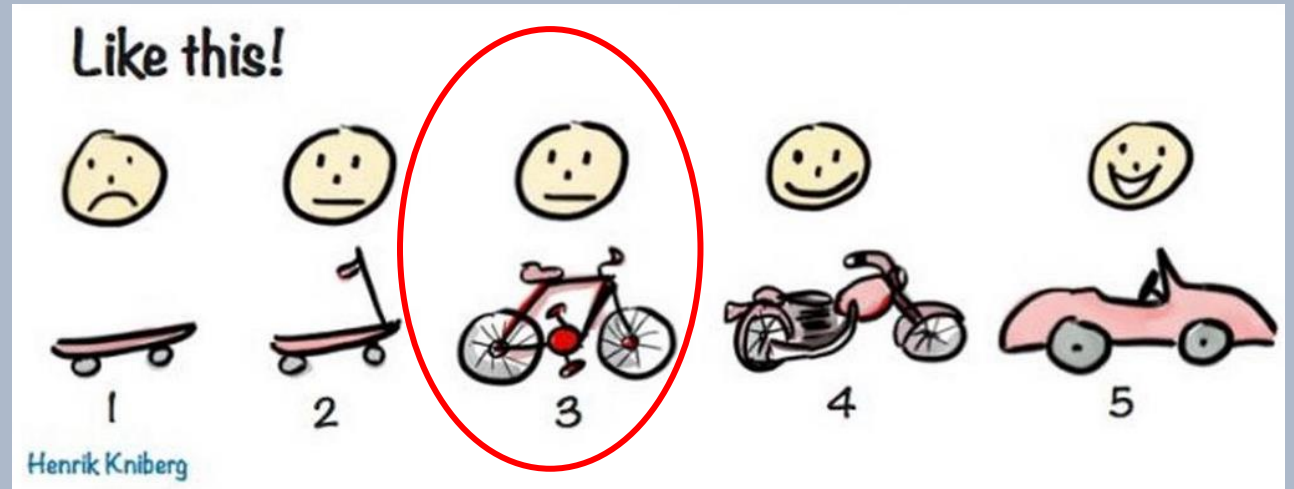# Agile in the domain of a CubeSat System Engineering

How to systematize the use of agile methods, such as Scrum, for a space project?

STEP 1
Defining the capabilities to be presented at mission level.

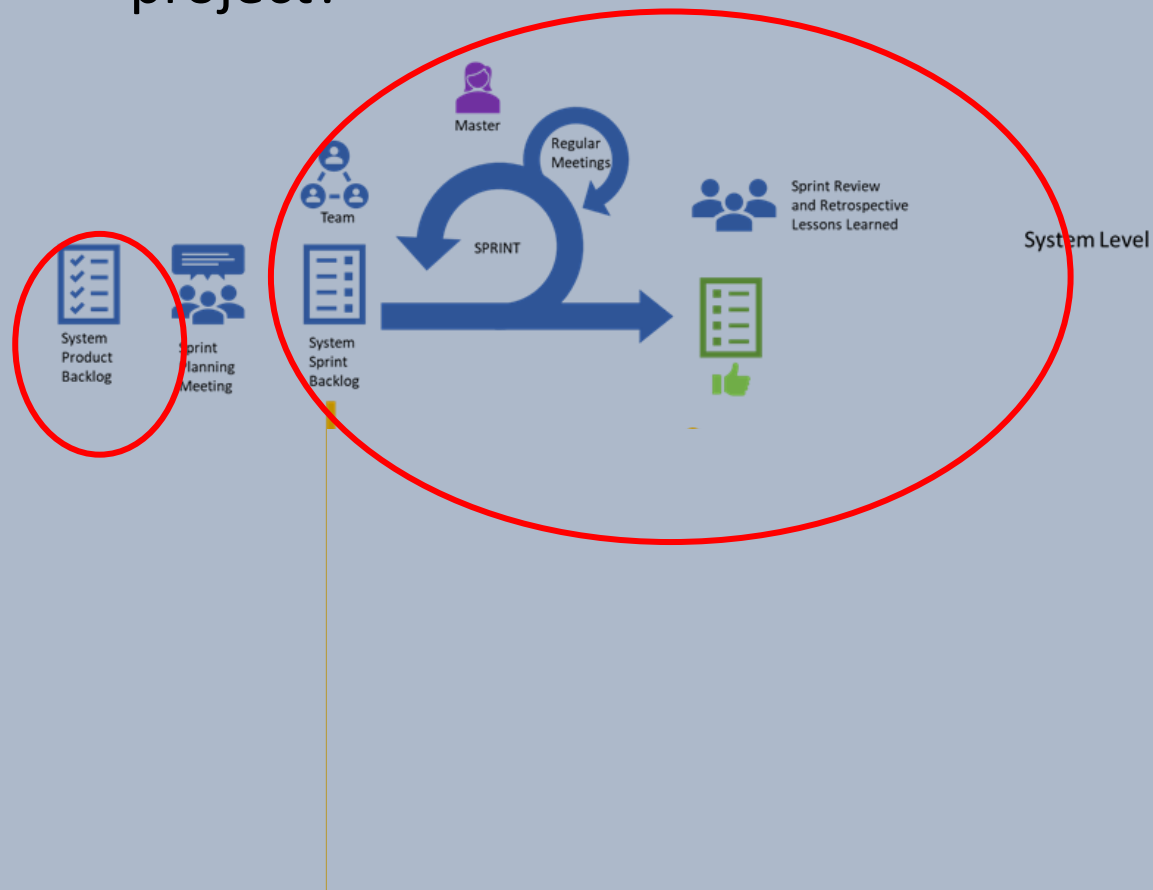In analogy, at this point, it is defined the product backlog for the mission.

Like this!

1   2   3   4   5

Henrik Kniberg

Agile in the domain of a CubeSat System Engineering

How to systematize the use of agile methods, such as Scrum, for a space project?

STEP 2
Deriving system requirements from the mission requirements to be partially or fully tested.

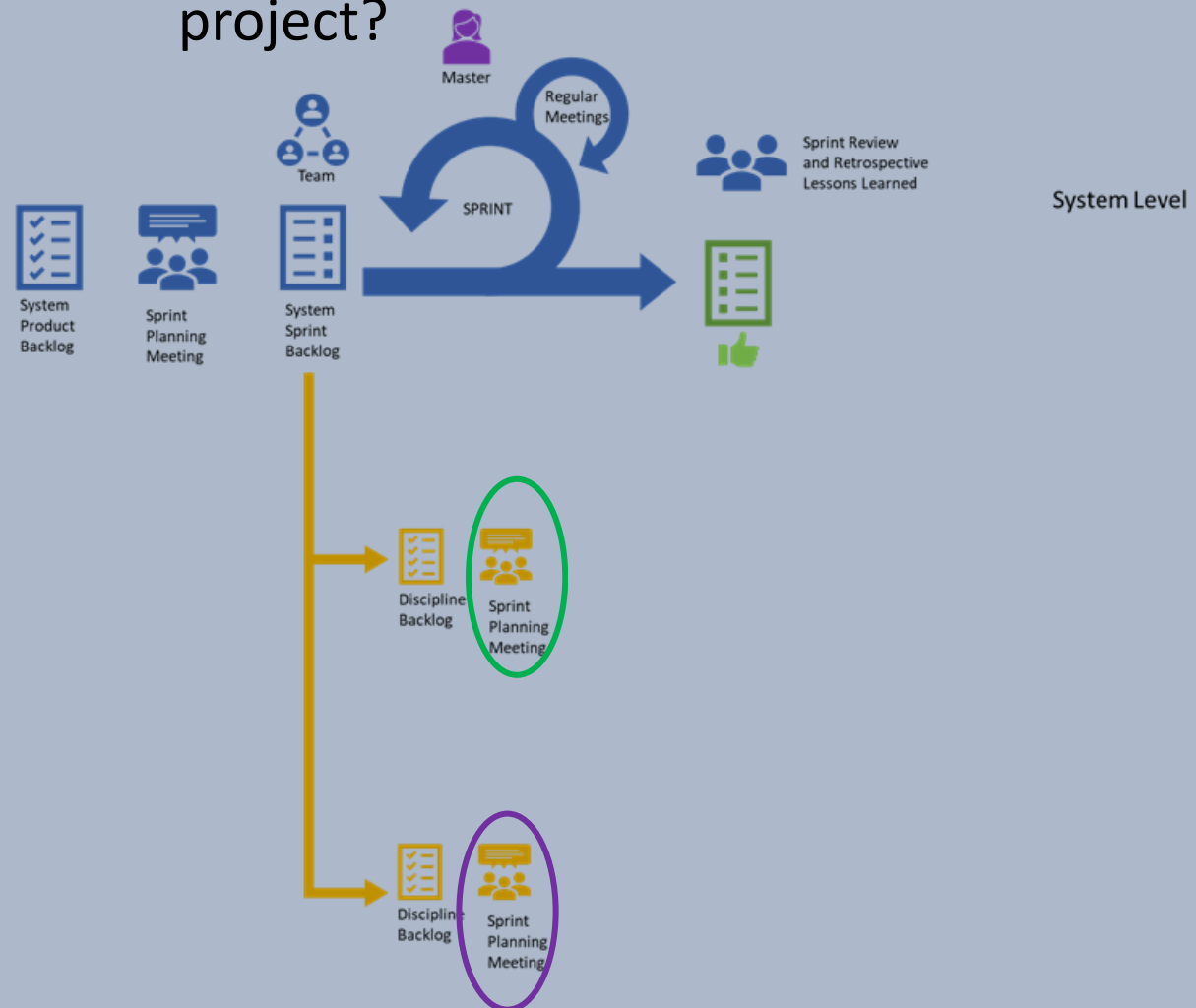In analogy, at this point, it is defined the system Product backlog and System Sprint Backlog

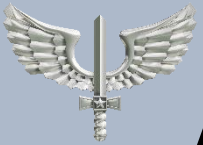# Agile in the domain of a CubeSat System Engineering

How to systematize the use of agile methods, such as Scrum, for a space project?

STEP 3
Deriving subsystem requirements from the system requirements and defining components specification (i.e. the implementation).

In analogy, at this point, it is defined the disciplines Product backlog.
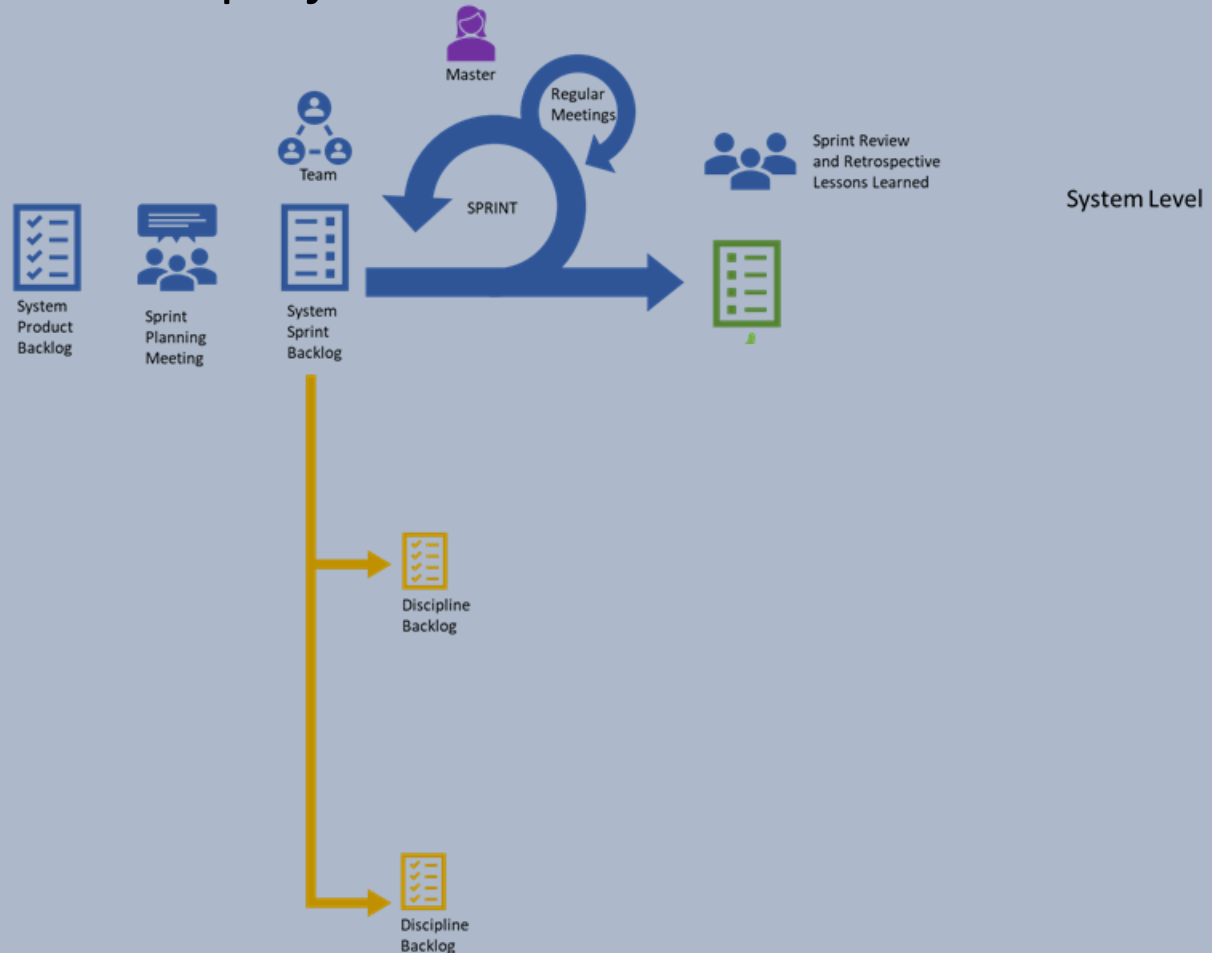
Agile in the domain of a CubeSat System Engineering

How to systematize the use of agile methods, such as Scrum, for a space project?

STEP 4
Each discipline defines how many sprints will be worked out to accomplish their tasks and how much effort will be applied in each sprint.

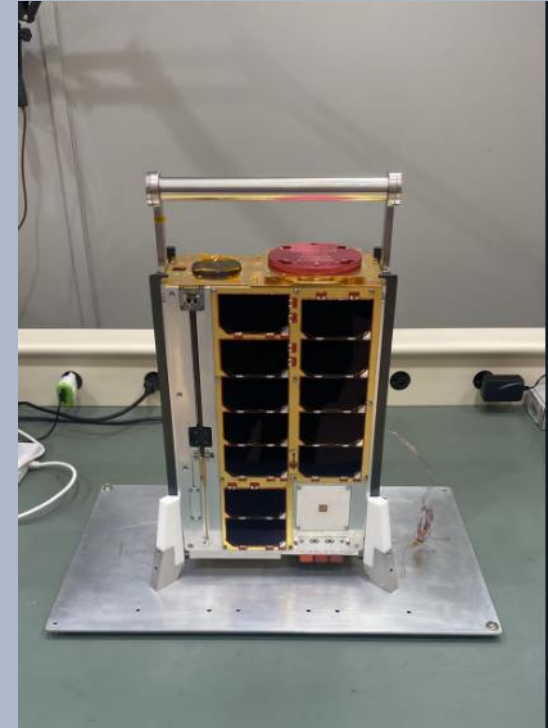# The use of agile methodologies in system engineering, and the cost management and procurement guidance

•Agile methodologies are based on **iterative and incremental approaches** to project management, which emphasize flexibility and adaptability to changes.

•The book offers guidance on how to use agile techniques to manage costs and procurements, including how to break down work into **smaller tasks**, prioritize tasks, and estimate their costs.

•Some of the techniques presented in the book include story points, planning poker, and velocity-based planning, which can help teams estimate the effort and resources required to complete tasks and track progress.

•By using these techniques, agile teams can better **manage costs, reduce waste, and deliver value to stakeholders** in a more efficient and effective manner.
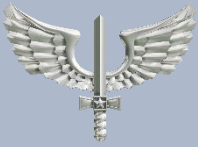
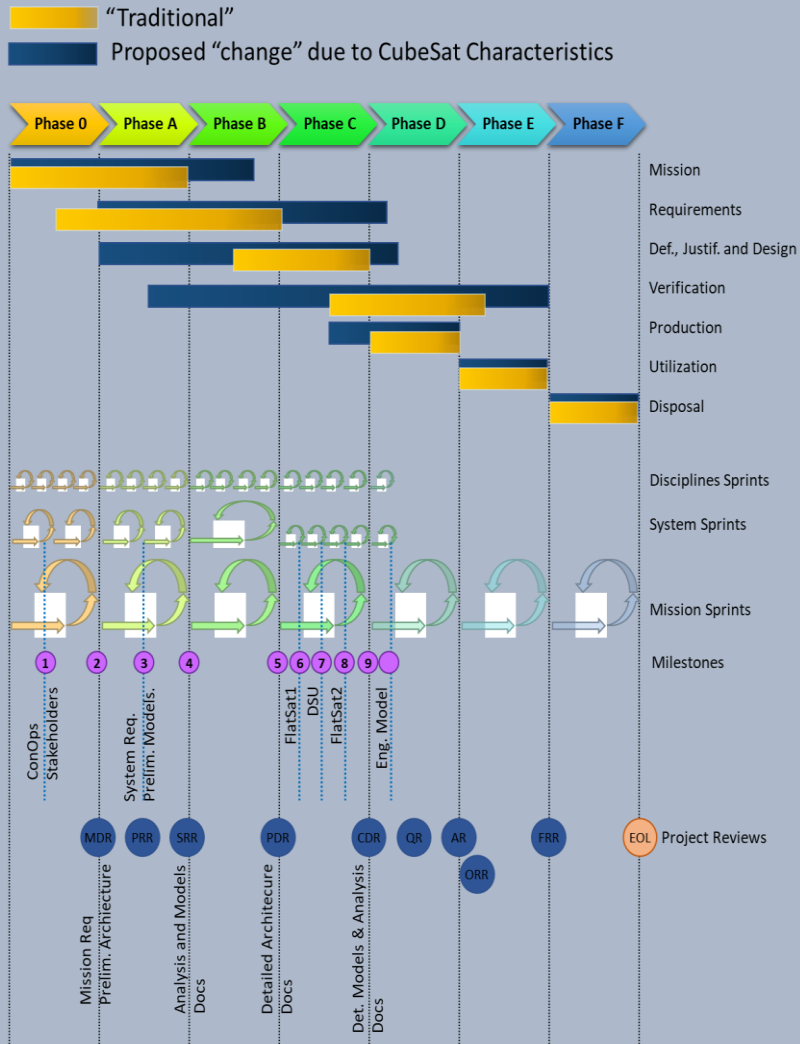# Scintillation Prediction Observations Research Task (SPORT) Mission

- Scintillation Prediction Observations Research Task (SPORT) is a 6U CubeSat mission

- Mission aims to understand preconditions leading to equatorial plasma bubbles

- Scientific literature describes preconditions in plasma drifts and density profiles related to bubble formations that occur several hours later in the evening

- SPORT will provide a systematic study of the state of the pre-bubble conditions at all longitude sectors

- Aims to enhance understanding between geography and magnetic geometry

- SPORT is an international partnership between NASA, the Brazilian National Institute for Space Research (INPE), and the Technical Aeronautics Institute under the Brazilian Air Force Command Department (DCTA/ITA)

- Project is encouraged by U.S. Southern Command

Example of application on SPORT Project
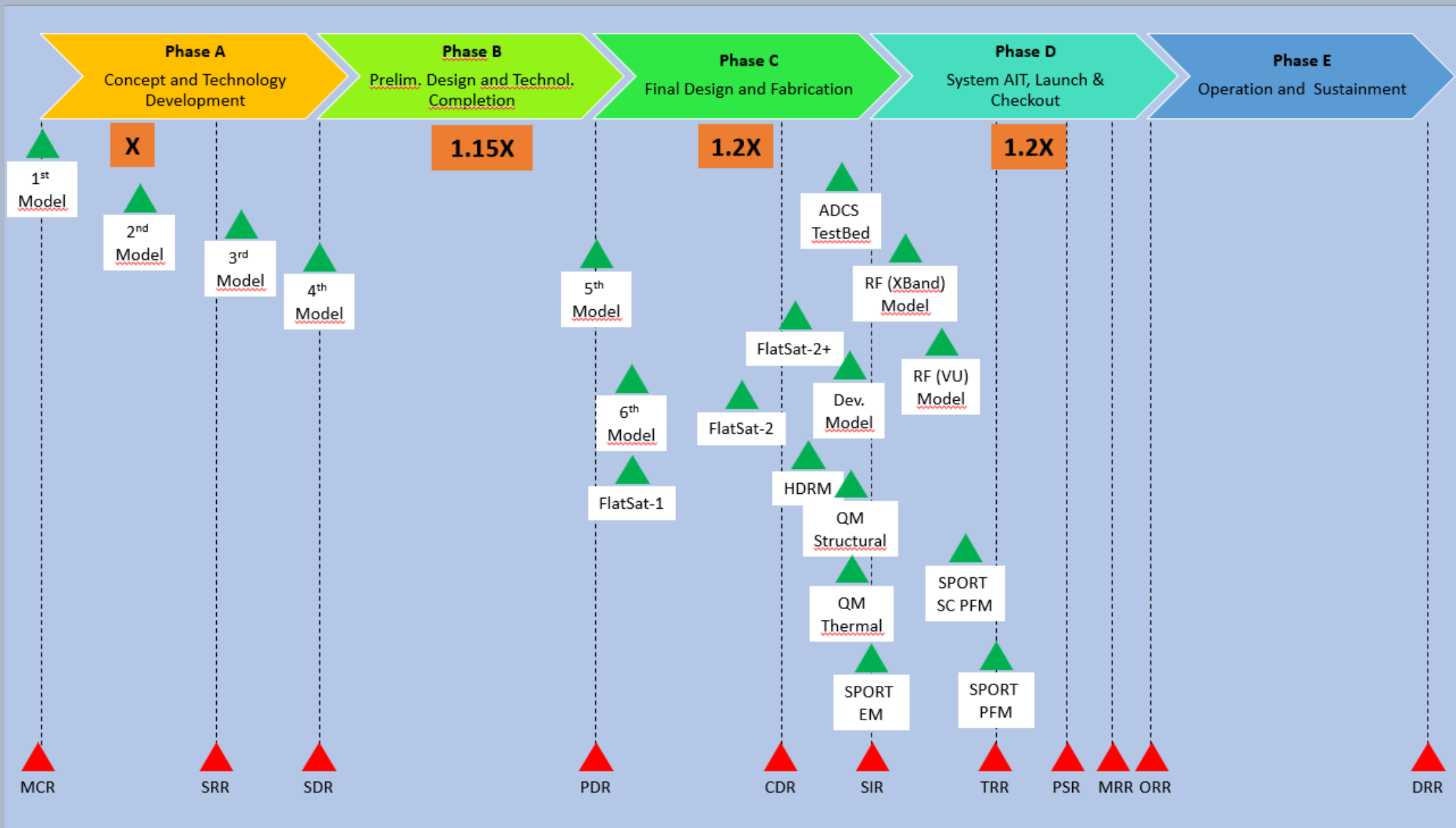
Phase 0 – Sprint 1
Cost Analysis

- The first sprint was based on previous mission developed by ITA Space Center: ITASAT;

- ITASAT is a 6U CubeSat LEO mission;

- There are some commonalities between ITASAT and SPORT Plataform Subsystems, such as two on-board computers;

- Not common: ADCS and Solar Panel;

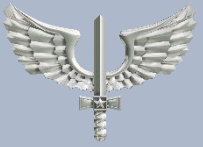- Estimated platform budget: **X**.

Next Sprints

Conclusions

• Agile approach is **effective** in managing CubeSat-based space missions;

• Breaking down system engineering process and cost analysis into **smaller sprints** helps to ensure the project stays on track, meets stakeholder expectations, and stays within budget;

• SPORT CubeSat mission is an example of how the agile approach can be applied to a complex scientific mission to improve cost management and procurement guidance;

• As CubeSat missions become more complex and important**, the agile approach is likely to become an increasingly valuable tool for mission planners and project managers.**

Figure 1: ITASAT-2 Conceptual Design (Artistic Representation)
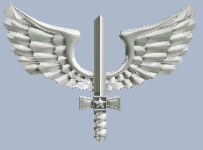
Questions?

Thank You!

aiorio@ita.br