Opening Remarks

67th Virtual UNISEC-Global Meeting

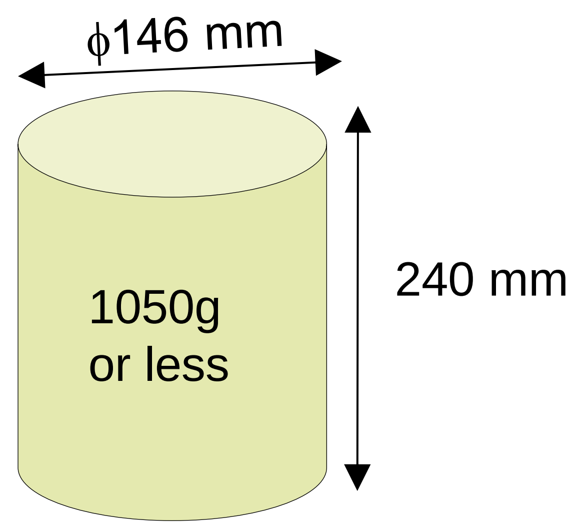
Hiraku Sakamoto, Ph.D.
hiraku.sakamoto@unisec.jp

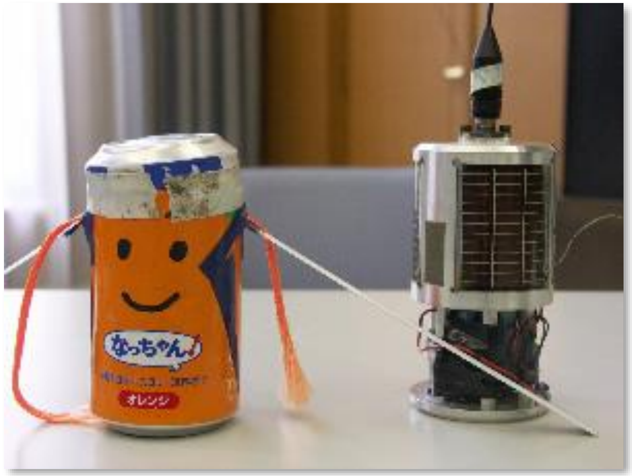
Chairperson, UNISEC-Japan

Professor, Dept. of Mechanical Engineering,
Institute of Science Tokyo (formerly Tokyo Institute of Technology)

CanSat development

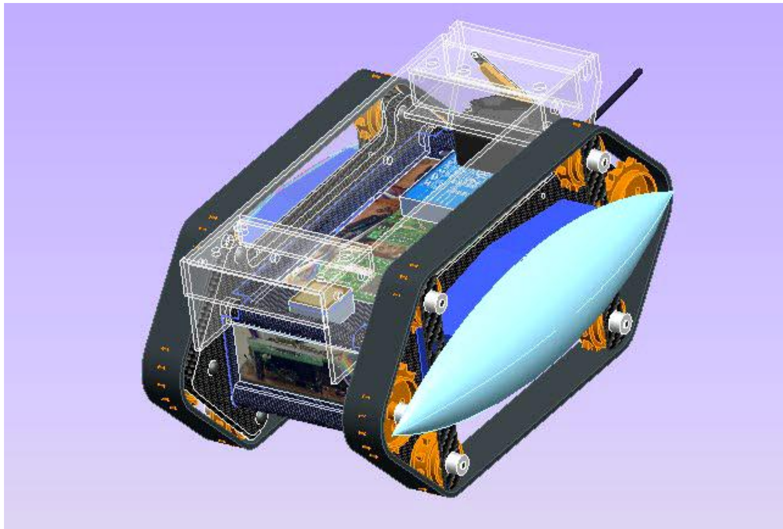
- Simulated-satellite
- Launched up to 4km altitude by amateur rockets
  - Desert in Nevada, USA
- Started in 1999 by Prof. Twiggs (Stanford Univ) and Prof. Nakasuka (Univ. of Tokyo)





ARLISS
(A Rocket Launch for International Student Satellites)

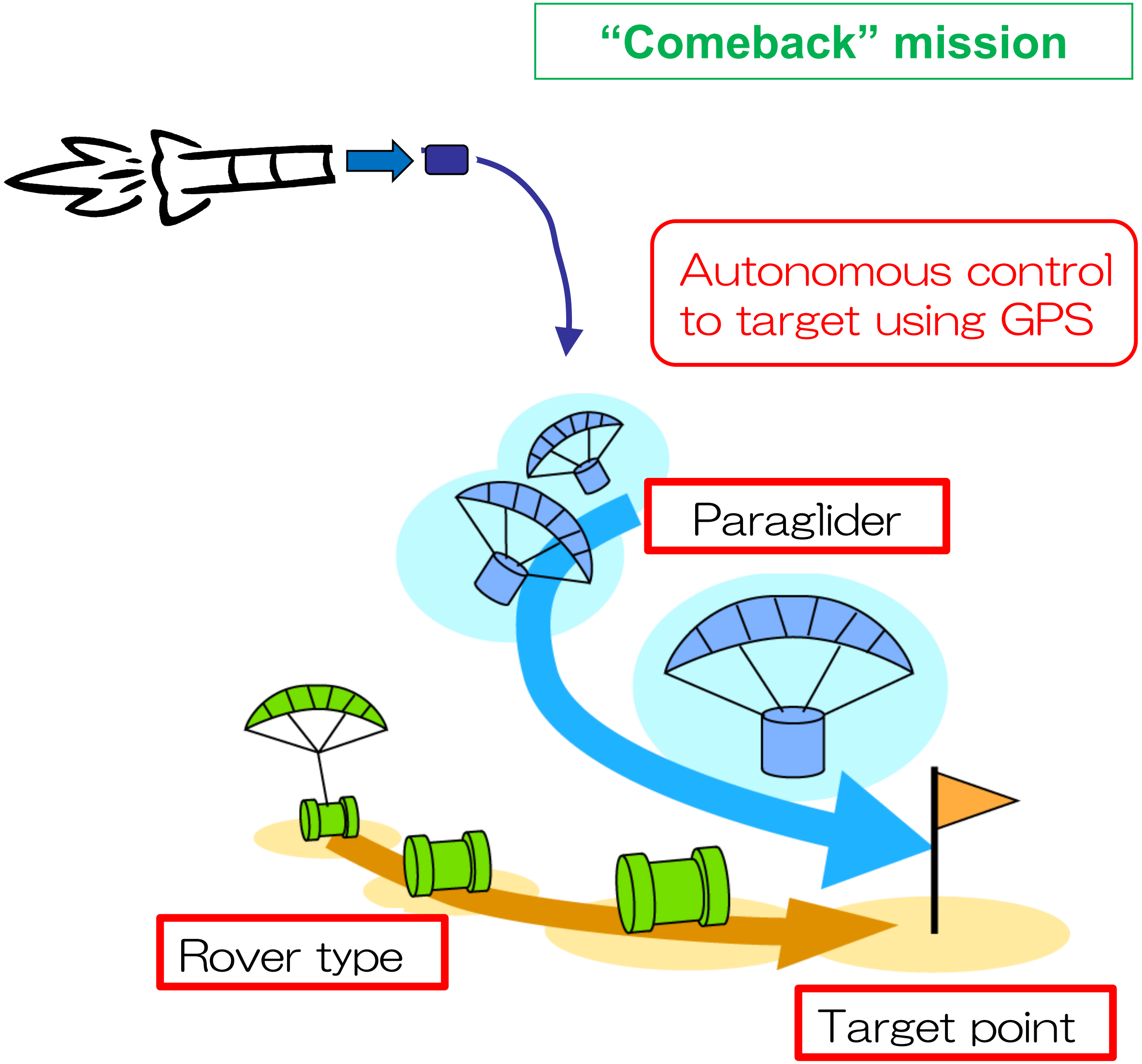
CanSat Examples



Hybrid type CanSat with “crawler” (2009)

Mission definition

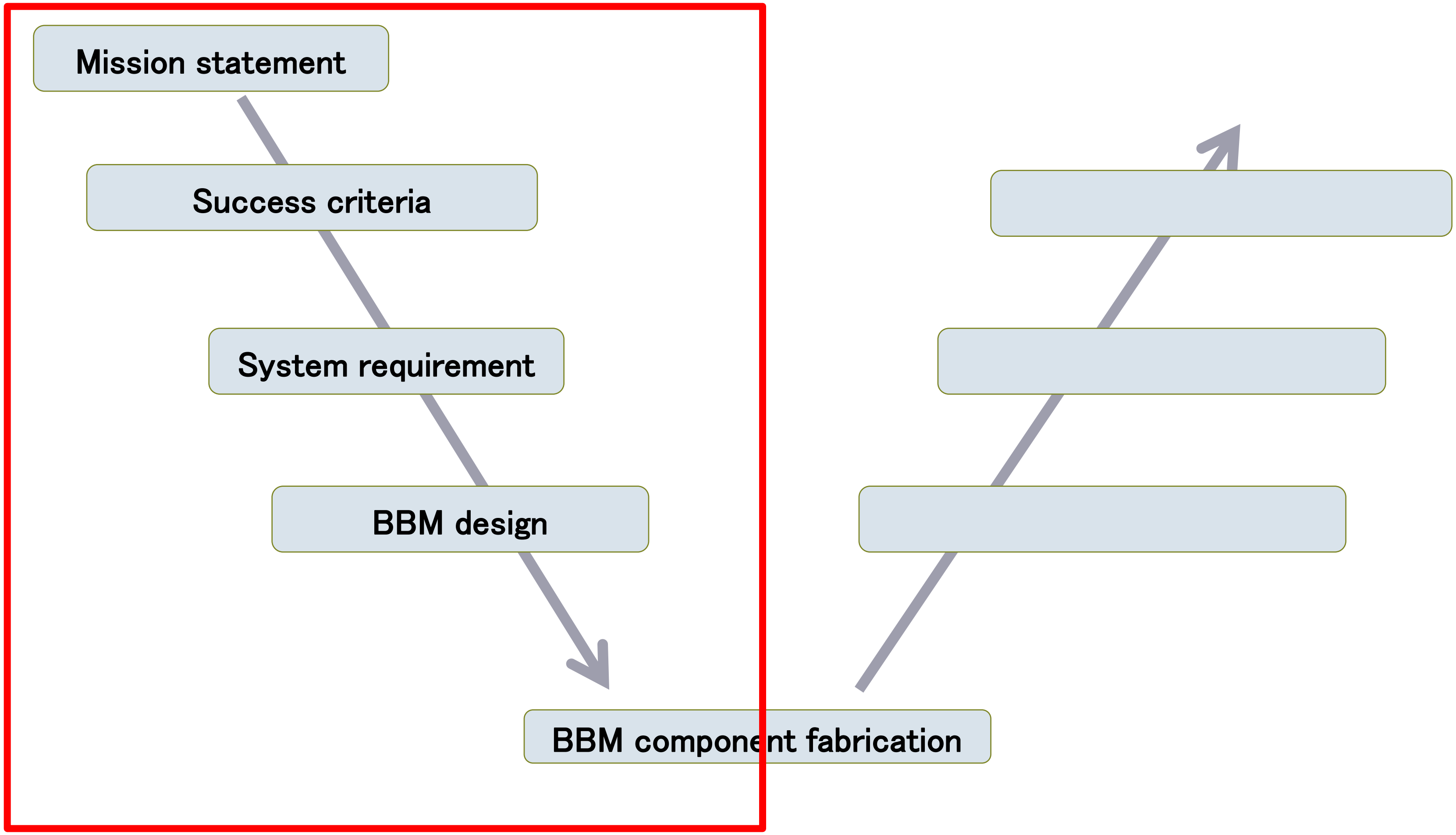
- April-May



Amateur rocket

Concept design

Bread Board Model (BBM)



Mission definition

Mission statement

Success criteria

System requirement

BBM design

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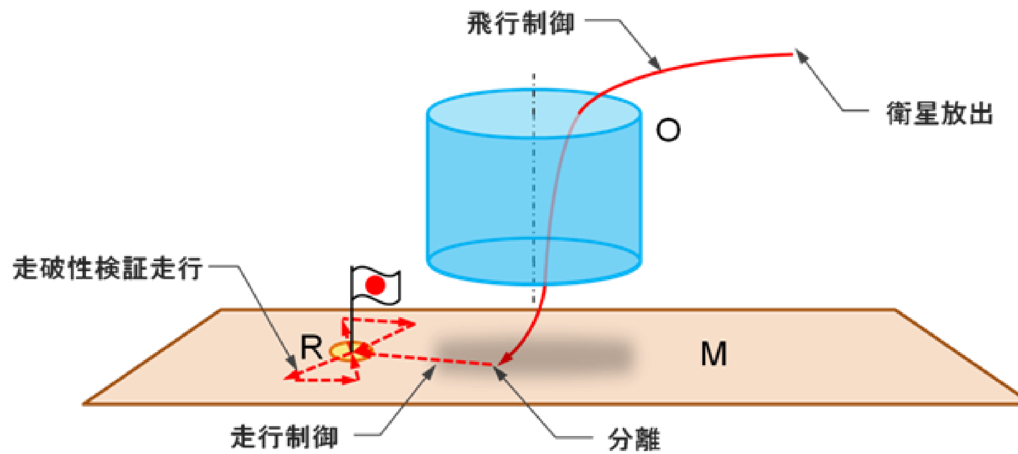


Point 1: Mission statement & mission sequence visualization

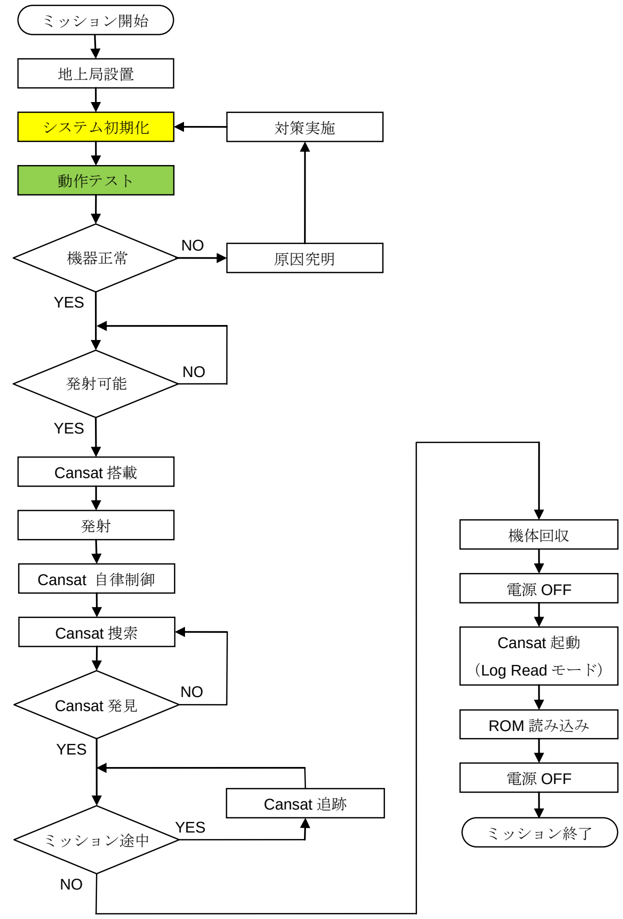
Mission definition

Mission statement

Success criteria

System requirement

BBM design



Point 2: Mission sequence flowchart

Mission definition

Minimum Success • Control input record shall be stored in ROM (verified after Recovery) • CanSat shall run away from cover (verified by visual observation)
Full Success • Entry into the aerial target area O while flight control inputs are applied shall be confirmed from ROM data. • Entry into the ground target area R while driving control inputs are applied shall be confirmed from ROM data.
Advance Success • After reaching area R, a figure-eight trajectory in the driving history shall be confirmed from ROM GPS data.

Point 3: Defining **Objective** in success criteria

System design

CanSat Development Requirements
(Based on ARLISS Regulations)

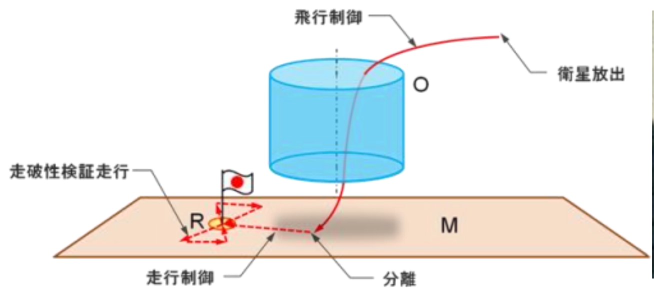
Size	Diameter: ≤ 146 mm, Height: ≤ 240 mm
Weight	Total mass: ≤ 1050 g
Position Acquisition	Latitude, longitude, altitude
Wireless Communication	Communication range: 4 km
ROM	Logging duration: 5 hours
Descent Velocity Control & Redundancy	Free-fall prevention
Structural Strength	Must withstand 10 G acceleration and landing shock
Impact Resistance	25 G

Flight System	
Straight Flight & Turning Performance	TBD
Glide Ratio	TBD
Payload Capacity	400 g
Deployment Trigger	Kill S/W
Flight Duration	Maximum 30 minutes

Mobility (Ground) System	
Straight Motion & Turning Performance	TBD
Obstacle Traversal (Hard Terrain)	Must overcome obstacles of 5 cm height
Traversability (Soft Terrain)	TBD
Capture, Recovery	TBD
Obstacle Avoidance	≤ 600 g
Vehicle Weight	At least 90 minutes
Travel Distance	Maximum 4 km

State Transition System	
Ground Detection	Measure distance to ground up to 2 m
Mode Switching	Must reliably transition to driving mode
Impact Resistance	Must withstand impact from a 50 cm drop

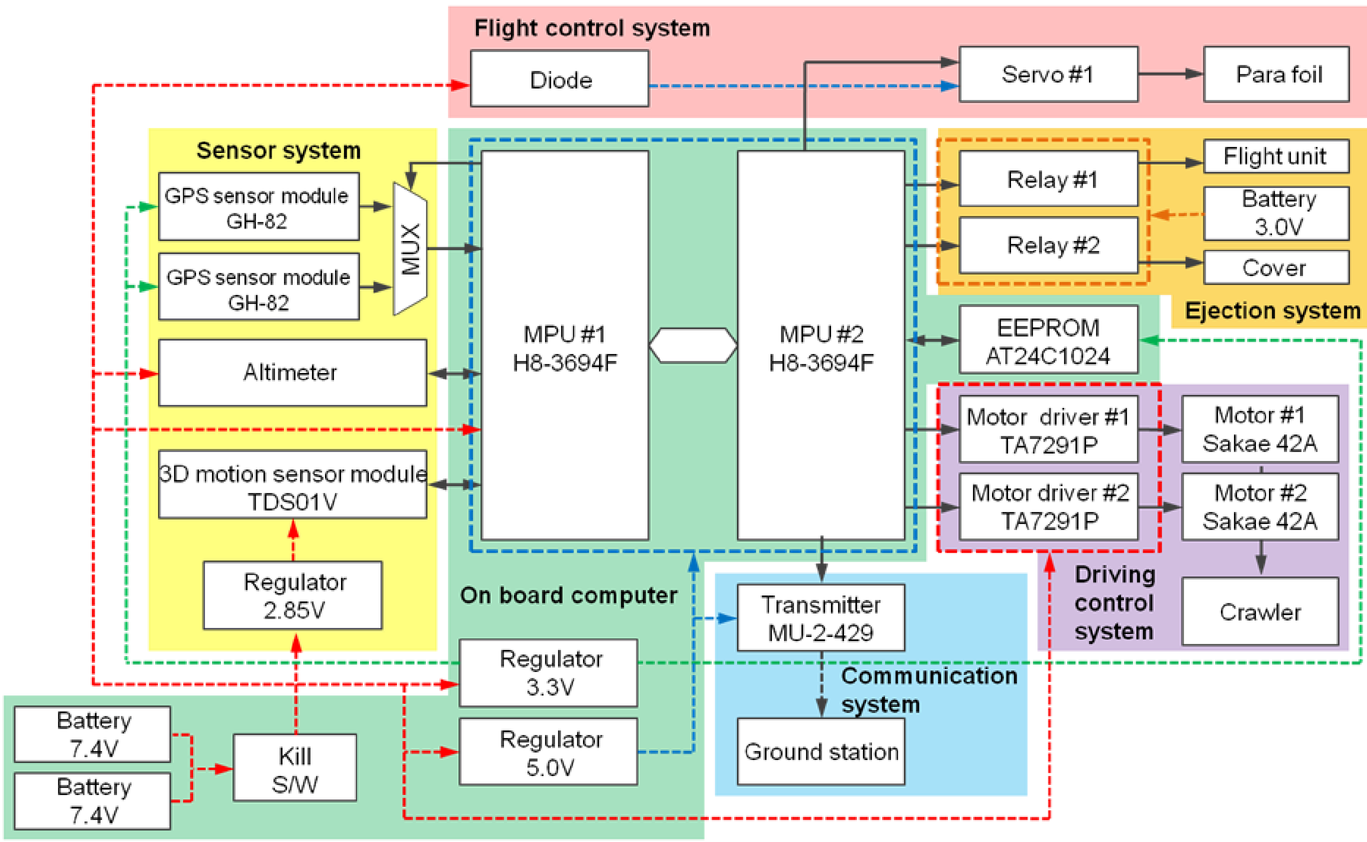
Thermal Design	
Thermal Design	Must withstand operation for 2 hours



Examples of requirements:
(R1) Weight must be 1050g or less.
(R2) CanSat must resist 10G static load.
(R3) Paraglider must resist parachute deployment shock load
(R4) The relative position between the target location and the current location, as well as the heading direction, shall be obtained at 2-second intervals.
(R5) The system shall be capable of turning TBD degrees within TBD seconds under no-wind conditions. . . .

Point 4: Clarify system requirements

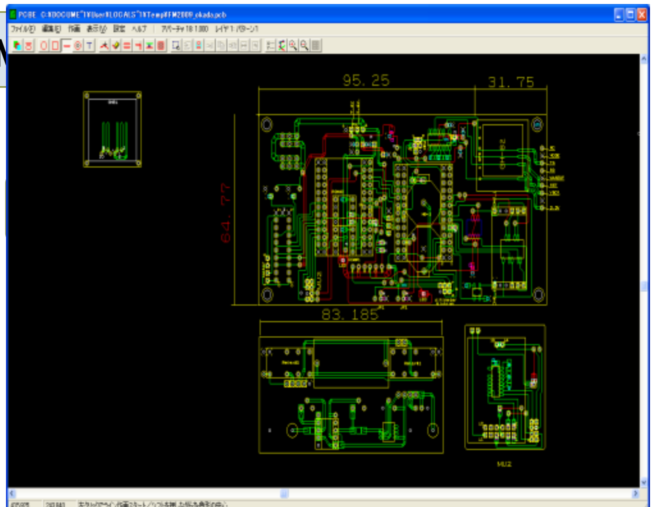
System design

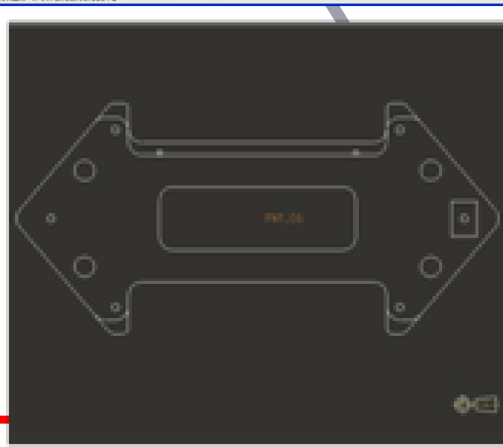


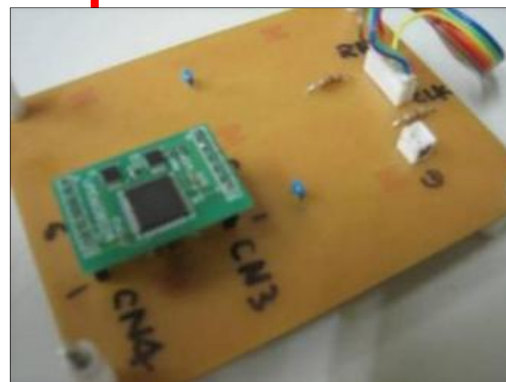
Point 5: Design a system with functions, which will satisfy requirements + divide system into some subsystems

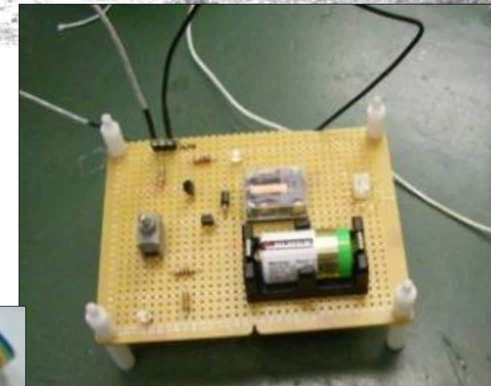
BBM component fabrication

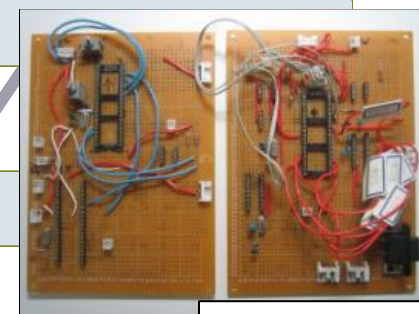
BBM: Bread Board Model











OBC BBM:
Verifying codes

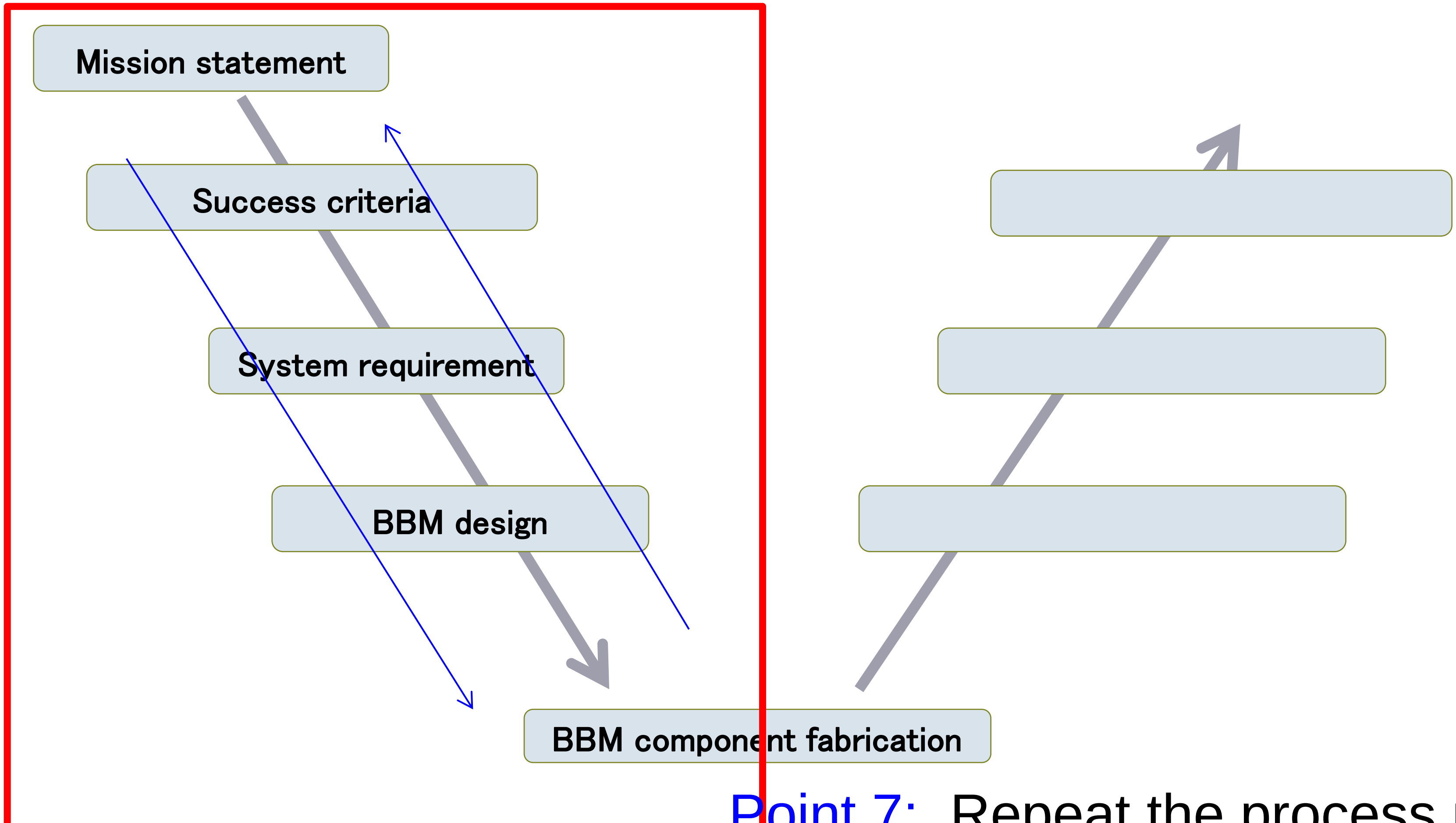
component fabricati

Structure prototype

Point 6: BBM development

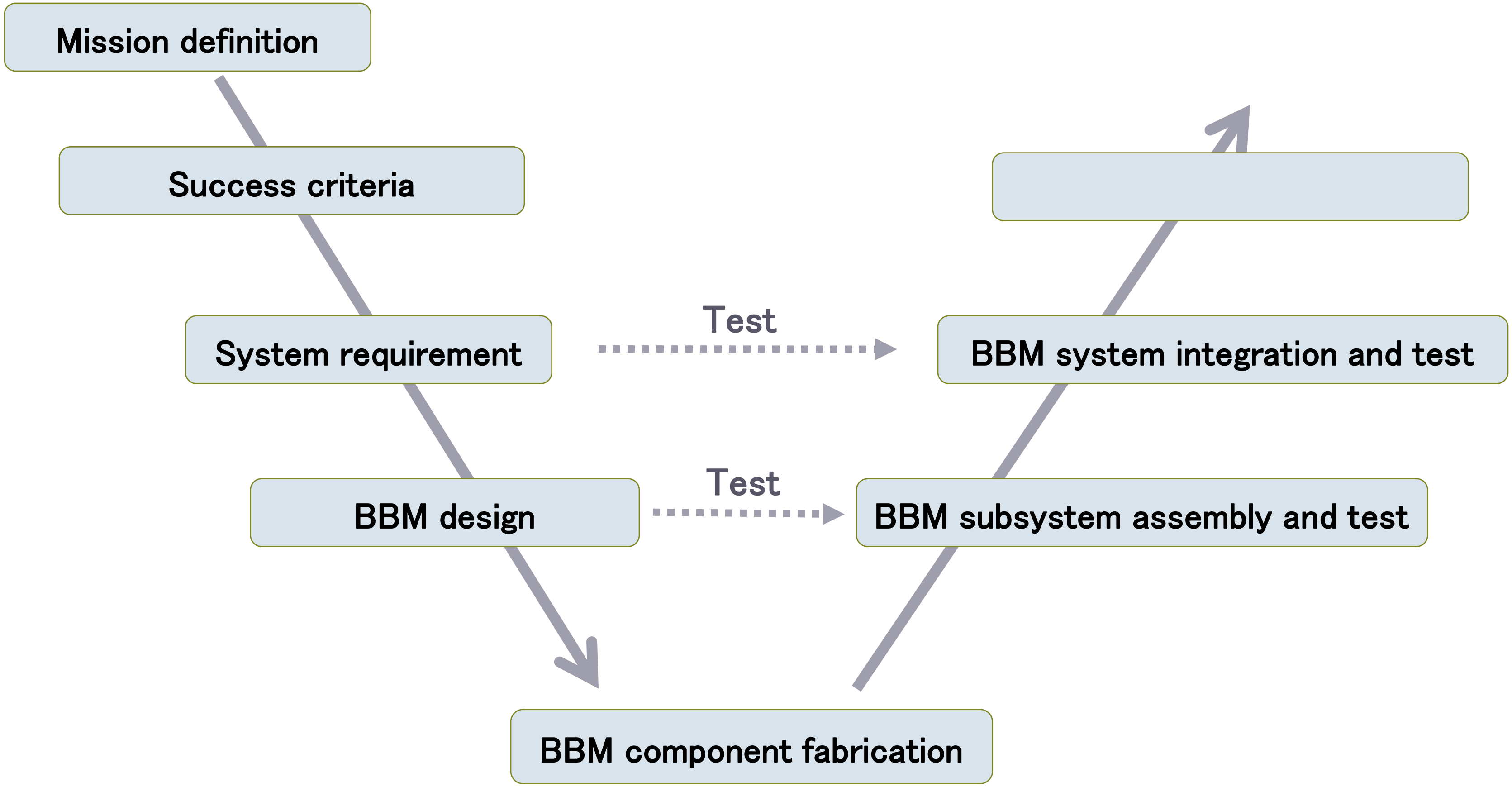
System design

Bread Board Model (BBM) design



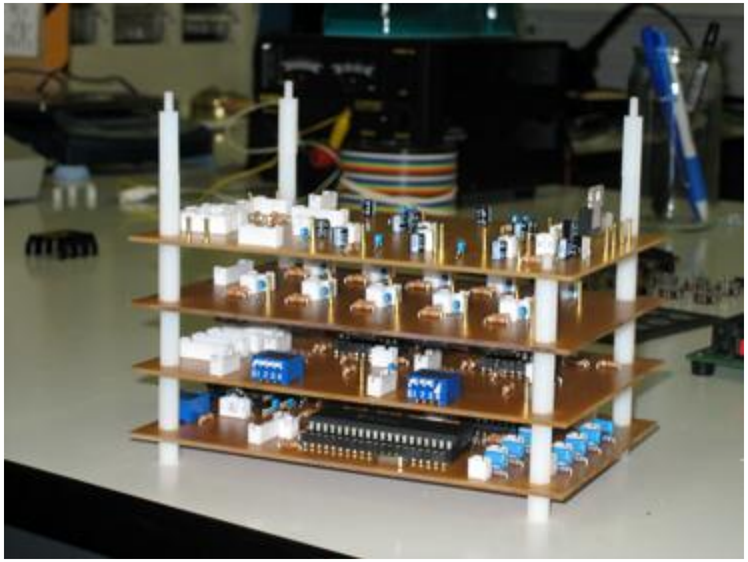
Point 7: Repeat the process until you find a feasible system design

Subsystem assembly and test

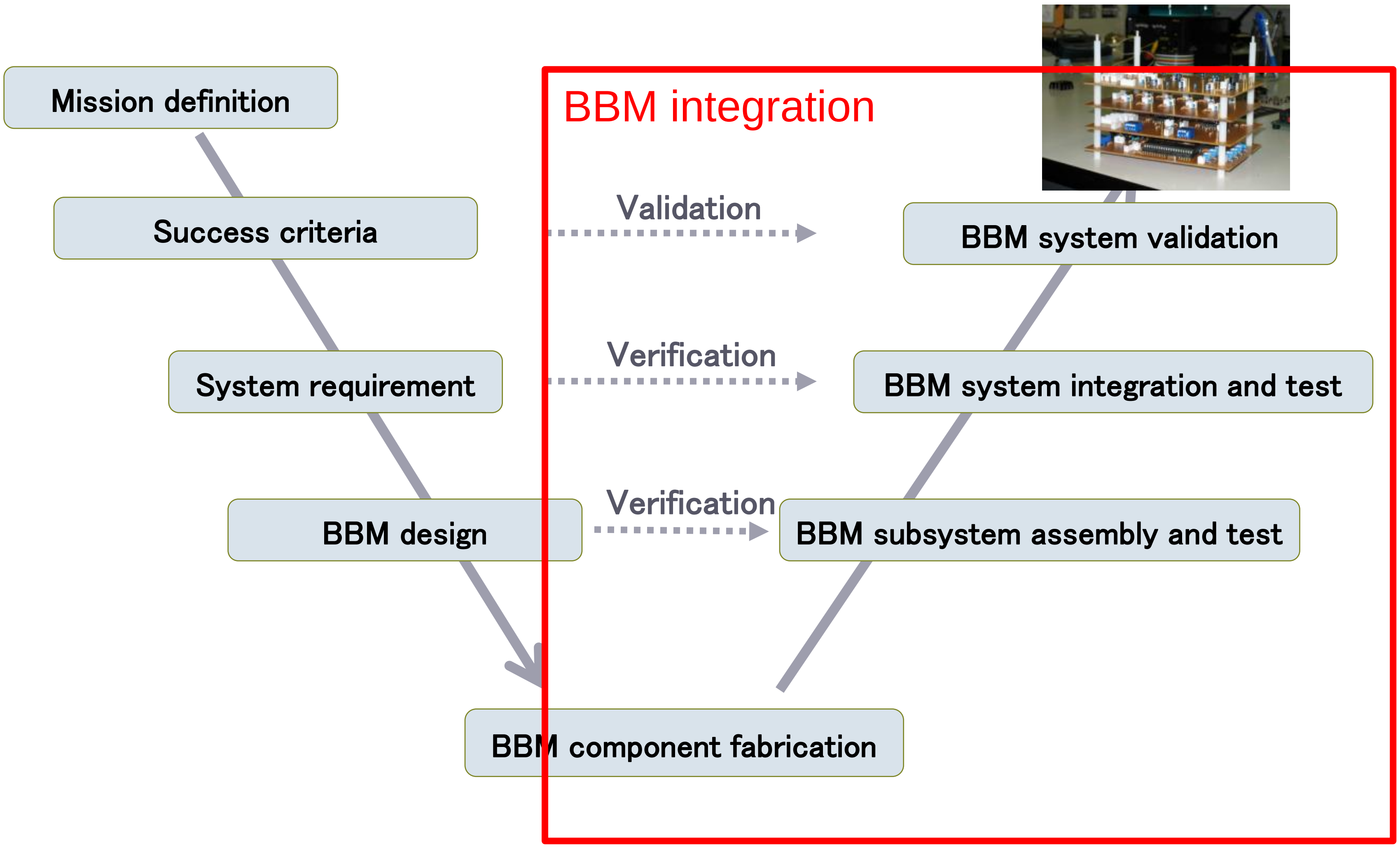


BBM system verification

- June: BBM integration test
  - "End-to-end test" (verify the following functions in mission sequence)
    - GPS reception
    - Data storage
    - OBC computation
    - Control mechanisms
    - Power management
    - Communication
    - Mass and volume

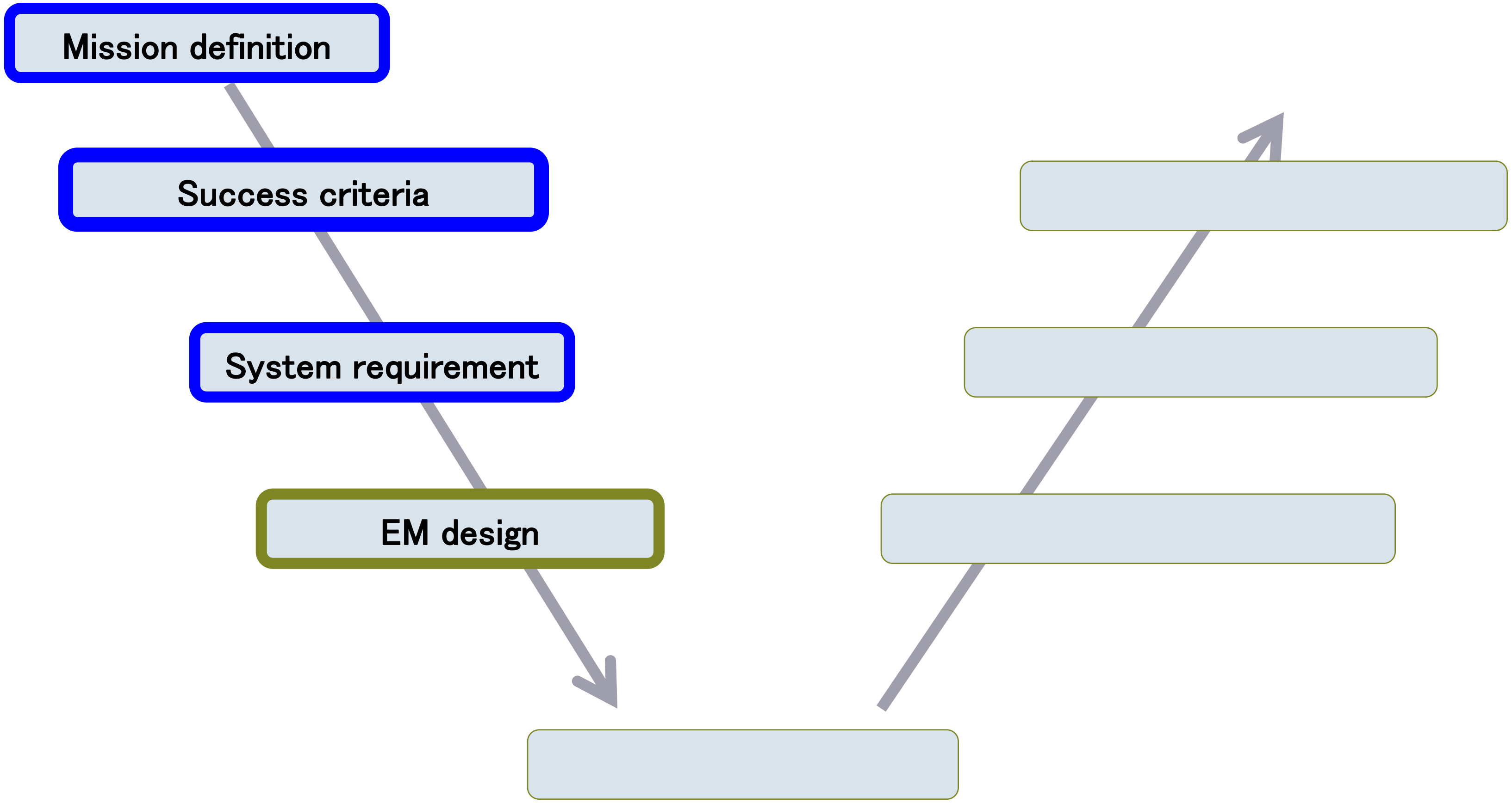


System validation

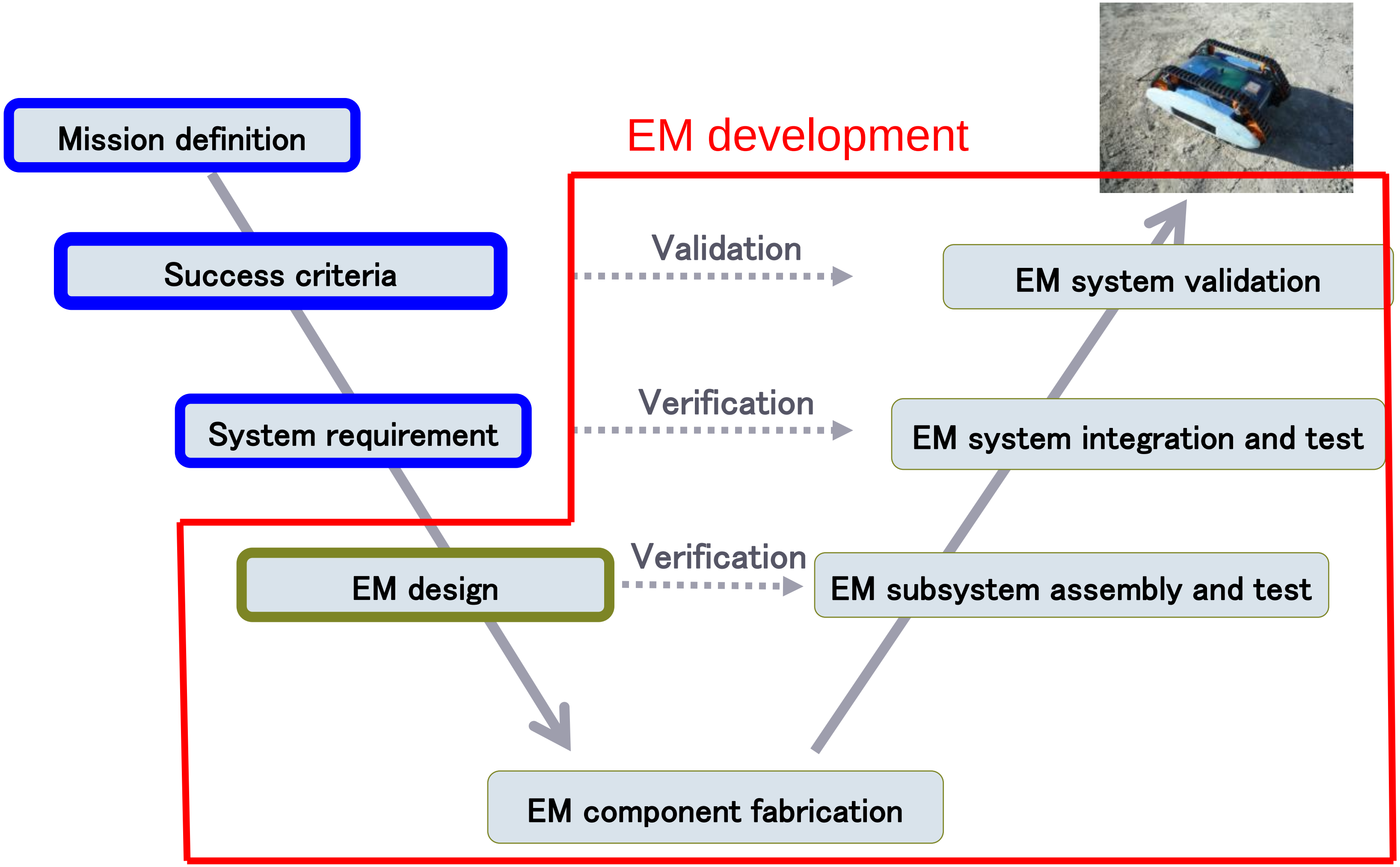


Engineering model (EM)

July: EM development



EM development



EM test

- August: Test, design upgrading, operation practice

Flight mode test

Rover mode test

```
*DR=04,190
*DR=0A,34,44,0,0
*DR=0B,135,21,0,0
*DR=02,0
*DR=02,0
*DR=02,0
*DR=0D,78,172,65368
*DR=05,3036
*DR=0B,26,8,65452
*DR=09,47,65386
*DR=06,10194
*DR=06,65280
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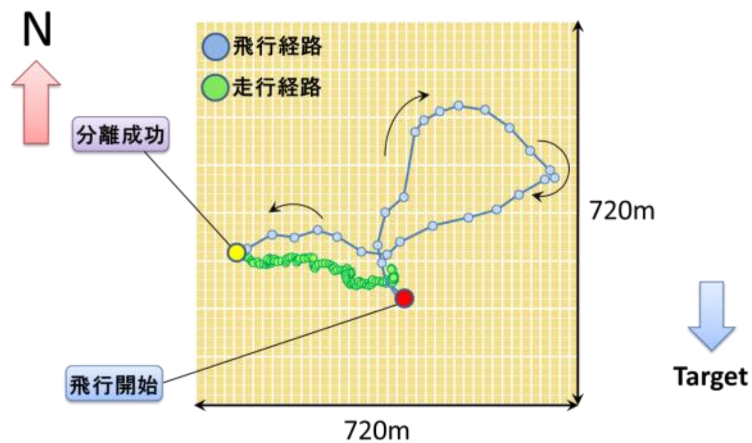
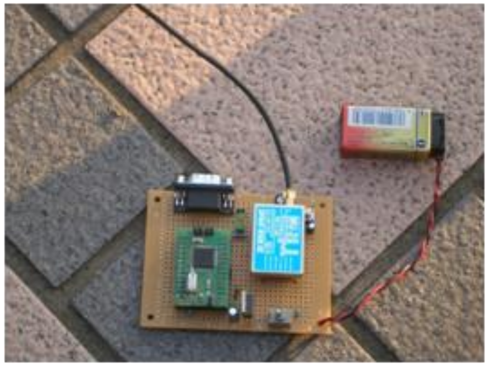


EM test

- August: Test, design upgrading, operation practice

Vibration test

Communication test



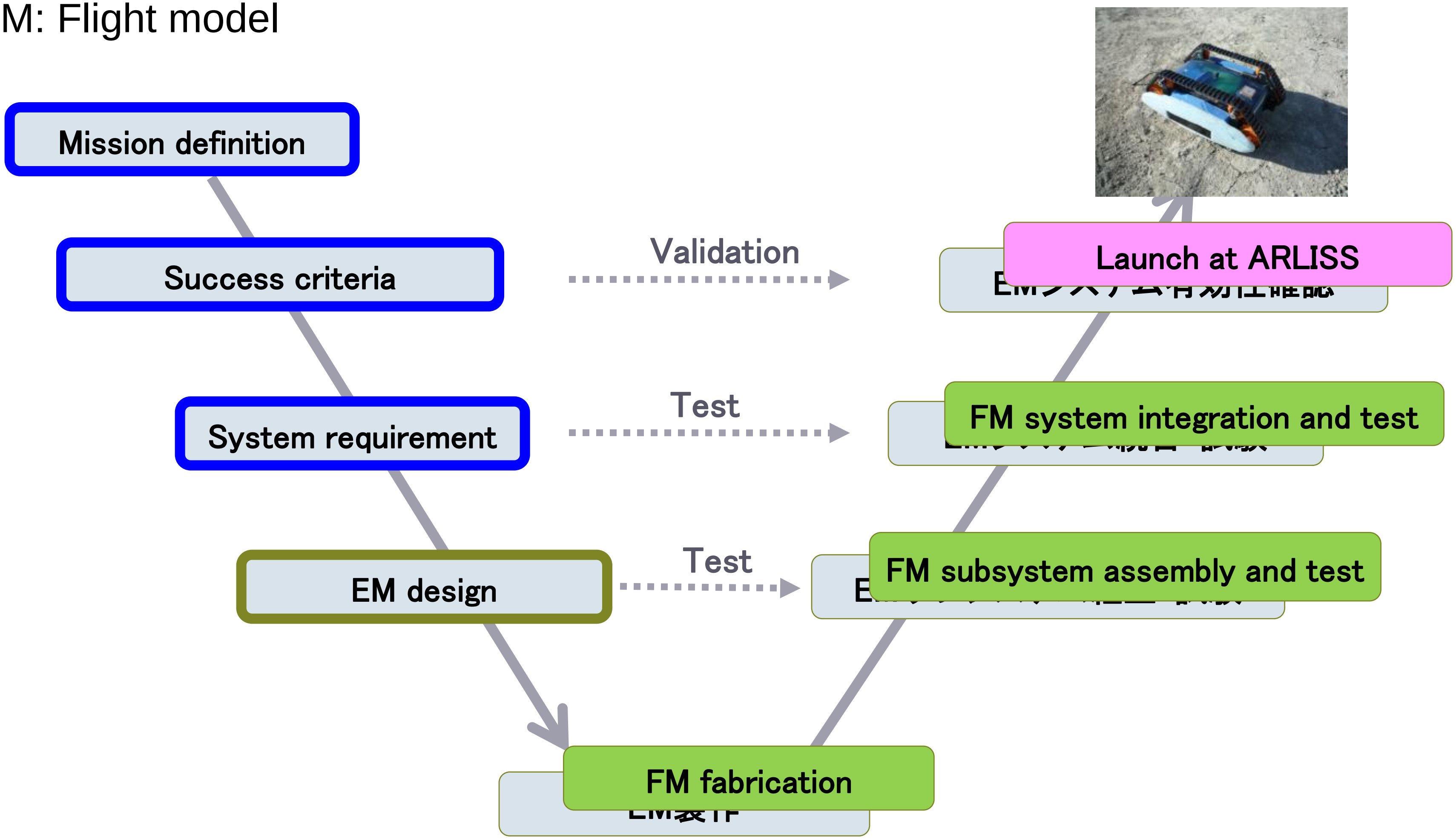
EM test

- August: Test, design upgrading, operation practice

End-to-end test using balloon

After EM development

FM: Flight model



UNISEC Guest Lecture:
Decision-focused Engineering in an AI-Accelerated World

- Artificial intelligence is now part of everyday engineering work.
- Across the space and aerospace sector, teams are already using AI to:
  - generate concepts and architectures
  - accelerate trade studies and analysis
  - draft requirements and documentation
  - support proposal development
  - explore design alternatives
- The pace of engineering work is increasing.
- The number of options available to teams is increasing.
- But the fundamental responsibility for program outcomes has not changed.
  - There's no escaping the "systems engineering universe" that must balance cost, schedule, performance and risk

Dr. Jerry Jon Sellers

Teaching Science & Technology Inc.

Implications for Systems Engineers, Chief Engineers, and Program Teams

Saturday, 18 April 2026