



Technology Insertion– A Project Perspective

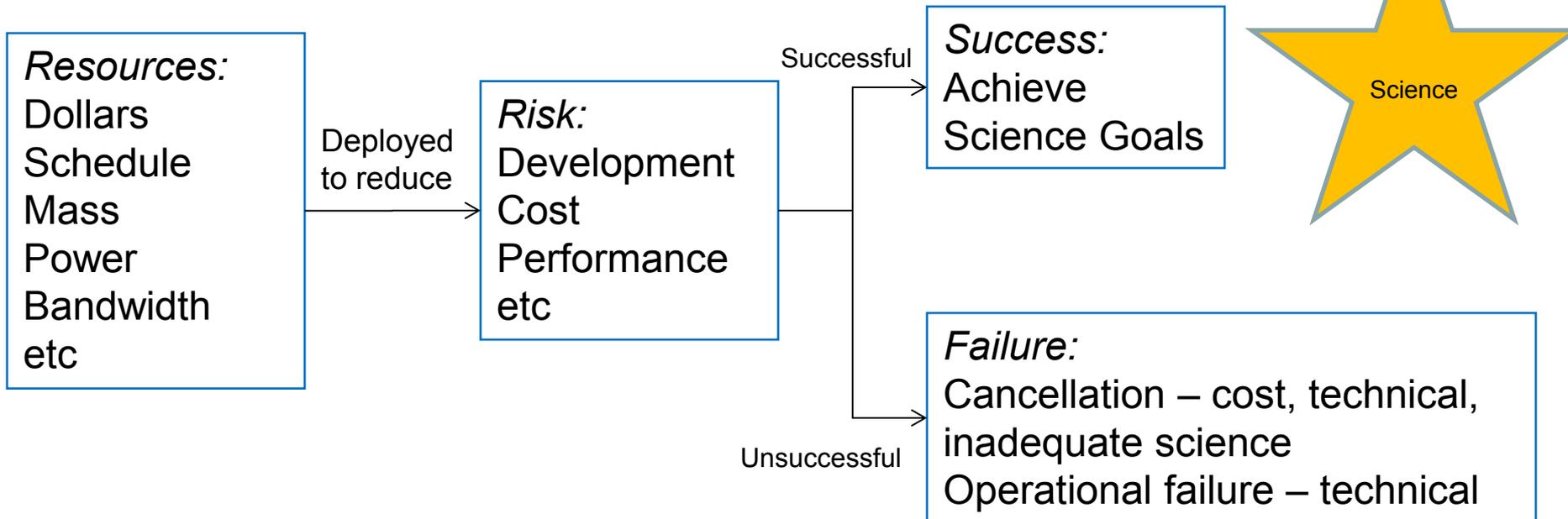
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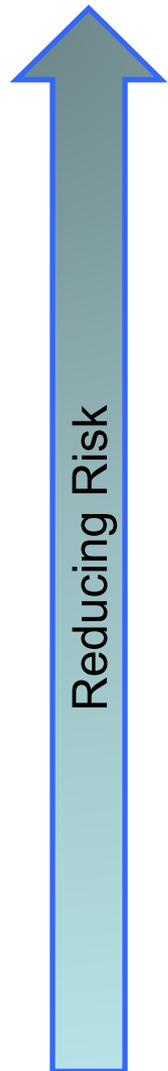
Project Management

- Managing the balance between mission goal, resources and risk
- Project Managers deploy resources to reduce risk and achieve mission goal





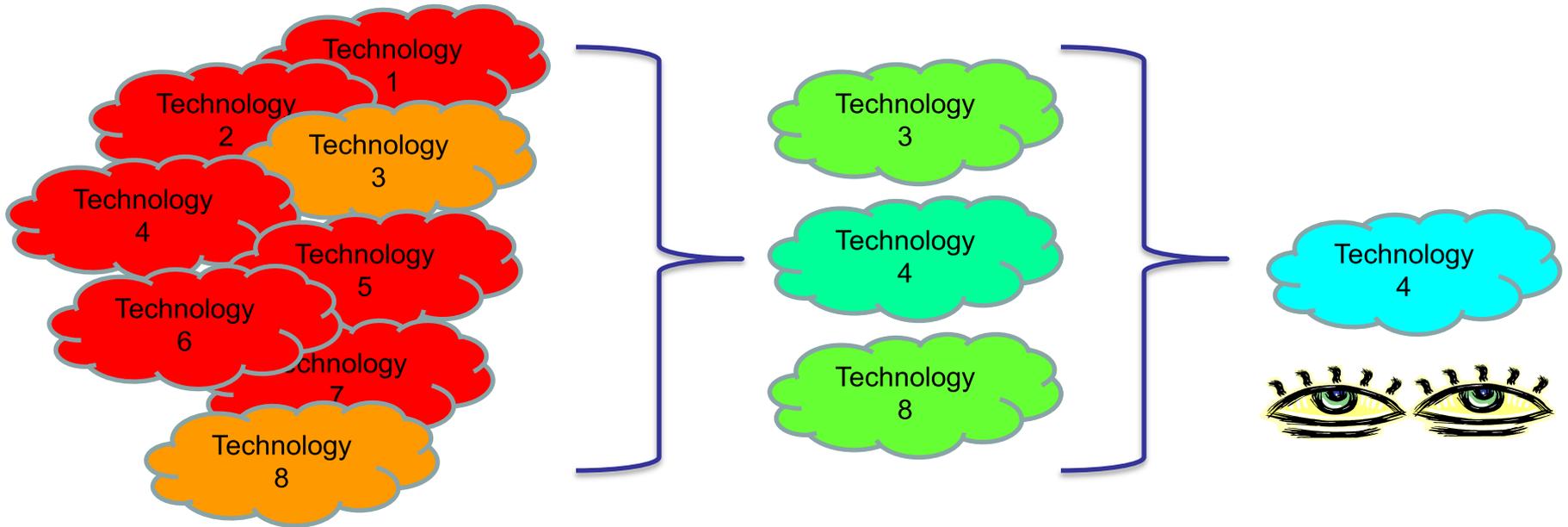
Technology Readiness Levels



System Test and Launch Ops	TRL 9	Actual system "flight proven" through successful mission operations
System/Subsystem Development	TRL 8	Actual system completed and "flight qualified"
	TRL 7	System prototype demonstration in a space environment
Technology Demonstration	TRL 6	System/subsystem model or prototype demo in a relevant environment (Ground or Space)
	TRL 5	Component and/or breadboard validation in relevant environment
Technology Development	TRL 4	Component and/or breadboard validation in laboratory environment
	TRL 3	Analytical and experimental critical function and/or characteristic proof-of-concept
Research to Prove Feasibility	TRL 2	Technology concept and/or application formulated
Basic Technology Research	TRL 1	Basic principles observed and reported



Technology



Lots of creative ideas
“marketing” promises
Few defined requirements

Proof-of-concept ideas
More realistic promises
Still few defined requirements
Start looking for end-users

Intensely
looking for end
Users

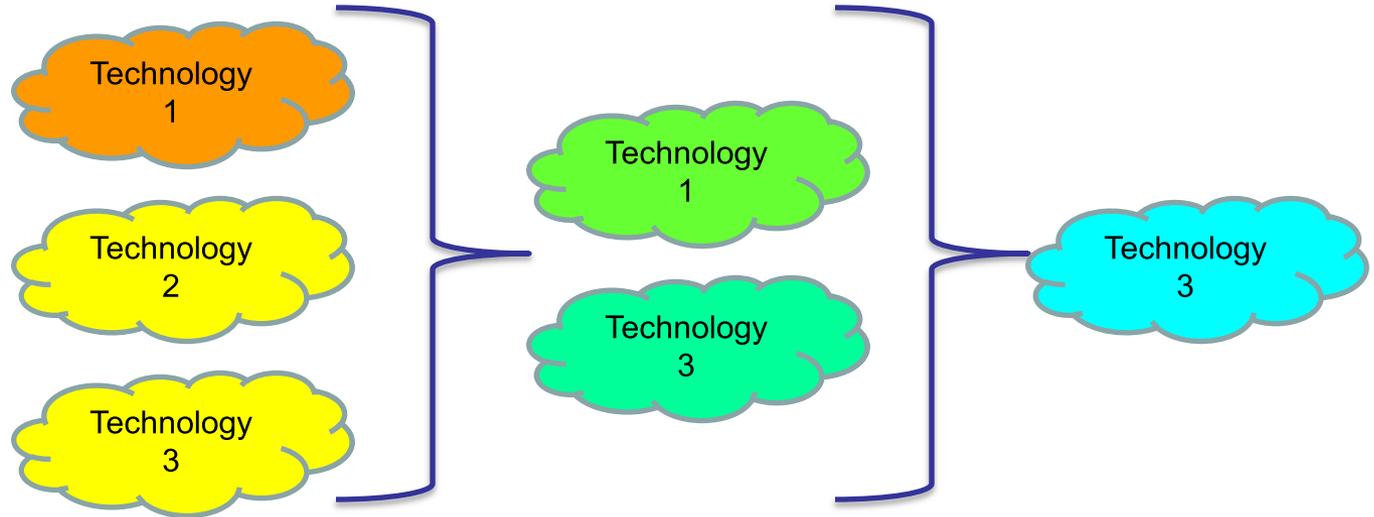
- No clear driving schedule
- Can be very long time between concept and flight - 20-30 years
- Many technology developments do not reach flight status



Technology



Venus Surface Explorer



Defined requirements

Promising technologies evaluated by project

Promising technologies developed by project

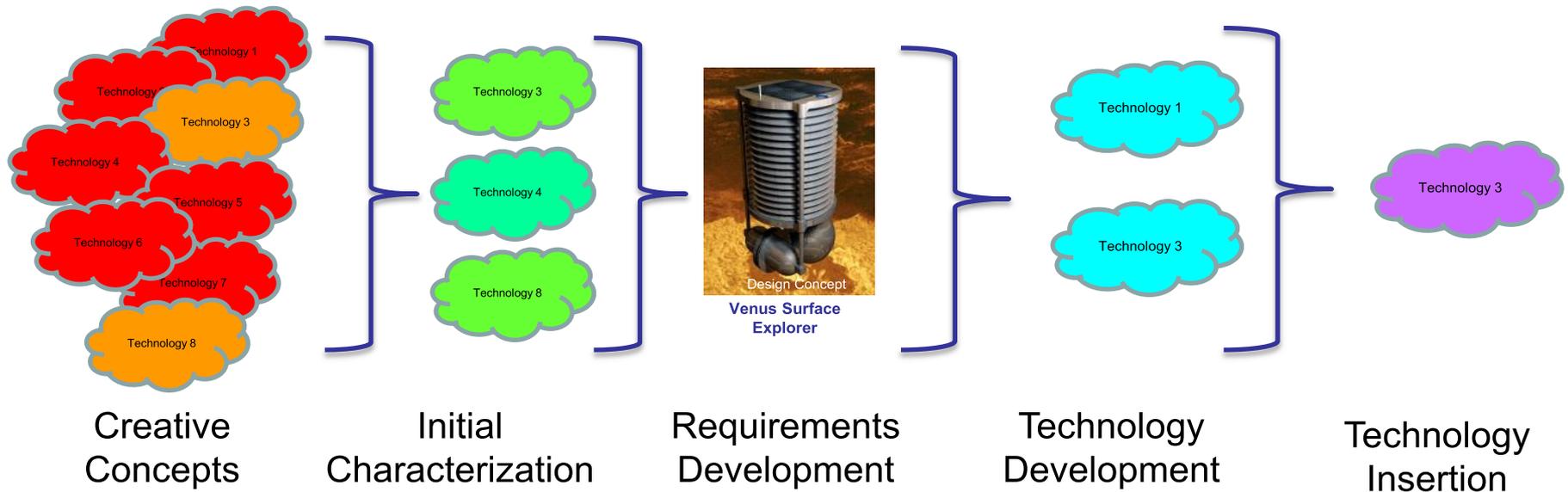
Often picked up by project for implementation

- Has clearly defined schedule and down-selection criteria
- Project may help guide or pay for some development after initial investment
- Project likely has backup approach to technology



Nominal Approach

- Likely process is “Push” for creative concept development and “Pull” for concept maturation



- Point in process where technology is picked up by project is function of: project resources, technology risk and benefit, and project risk posture



Project Technology Insertion Approaches

- Project will only consider baselining new technology if:
 - Technical benefit vs impact is clearly defined
 - Cost is understood and controlled
 - Project can reasonably plan for cost and cost growth
 - Risk is “reasonable”
 - Risks identified
 - Mitigation plan is in place
- If possible, project will have fallback approach in case technology fails to develop as planned
- Projects may elect to identify “on-ramps” for technologies to displace baseline approach IF key development milestones are reached
- Risk posture of project greatly influences approach and required decision criteria

Technology insertion is a risk/benefit decision, treat it as such



Lessons Learned – Requirements for Successful Insertion

- Fundamental understanding of the technology and its challenges
 - Strong benefit vs impact assessment
- Strong mission pull with well defined technical and programmatic requirements
- Comprehensive development and insertion plan including identified risk and risk reduction plan
 - Clear technical approach with clearly identified technology gates
- Effective and early co-operation between mission, manufacturing and technology development teams
- Adequate resources and margins
- Long-term investment strategy
- Strong management team
 - Management advocacy and commitment
 - Technically and programmatically enlightened sponsor

None of this matters if you cannot communicate it to the Project and Sponsor