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EINSTEIN
TELESCOPE

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Horizon Europe: Coordination
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ETO Project Office – Risk Assessment – Flexibility – TRL Assessment

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Rationale

- **Define Baseline Configurations**

Review existing proposed configurations and layouts.
(Establish a baseline cost estimate for each configuration)

- **Identify Key Technologies**

Example : Optical Layout: Compare cavity designs, alternative arm lengths, and mirror coatings…
Cryogenics ; Seismic Isolation ; Quantum Noise Reduction: squeezing ..
(Identify key technologies that can be incrementally integrated over time)

- **Apply a Design Structure Matrix (DSM)**

Use a DSM to map dependencies between subsystems (based on functionality).
(Identify low risk areas where future upgrades can be implemented with minimal disruption , and High risk areas where the design is rigid)
Example: Opting for a technology that supports incremental upgrades instead of radical upgrades / trade-offs.
Benchmark Against Existing Detectors : technological advancements of other detectors;

(Define an Upgrade Pathway if needed : Propose an upgrade strategy over 5; 10; 15 years..)

What does DSM Do

- **Captures Component Interdependencies**
- **Modularization & Reusability** :By clustering related components, DSM aids in understanding which configurations allow for maximum component reuse and which require major modifications.
- **Complexity & Cost Trade-offs**
- **Change Propagation Analysis**
- **Optimization**

Output: / Input:	Design Inputs	Outbound Trajectory	Inbound Trajectory	DeltaV Budget	Launch Vehicle	Power & Mass Margin	Propellant Margin	Margined Outbound Trajectory	Margined Inbound Trajectory	Margined DeltaV Budget	Margined Launch Vehicle	Residual Propellant	Solar Array Power	CDHS	ADCS	Telecom	Power	Propulsion	Thermal	Mechanical	MEL	Timeline
Design Inputs		3	2	2		4	1			1				1	1	5	3	2	1	3	2	1
Outbound Trajectory				3	2			2					1					1				
Inbound Trajectory				2									1									
DeltaV Budget		1	1									3										
Launch Vehicle																					2	
Power & Mass Margin								1	1	1	2											
Propellant Margin										1	1											
Margined Outbound Trajectory										2	2		1									3
Margined Inbound Trajectory										2			1									3
Margined DeltaV Budget					1	1	1	1	1		1	3						3		1	2	
Margined Launch Vehicle																						
Residual Propellant				1								1										
Solar Array Power		1	1					1	1								1					
CDHS																				1	1	
ADCS																				1	1	
Telecom																				1	1	
Power																				2	1	
Propulsion				4						3										1	1	
Thermal																				1	1	
Mechanical																					2	
MEL				1	2	1													2	2		
Timeline																						

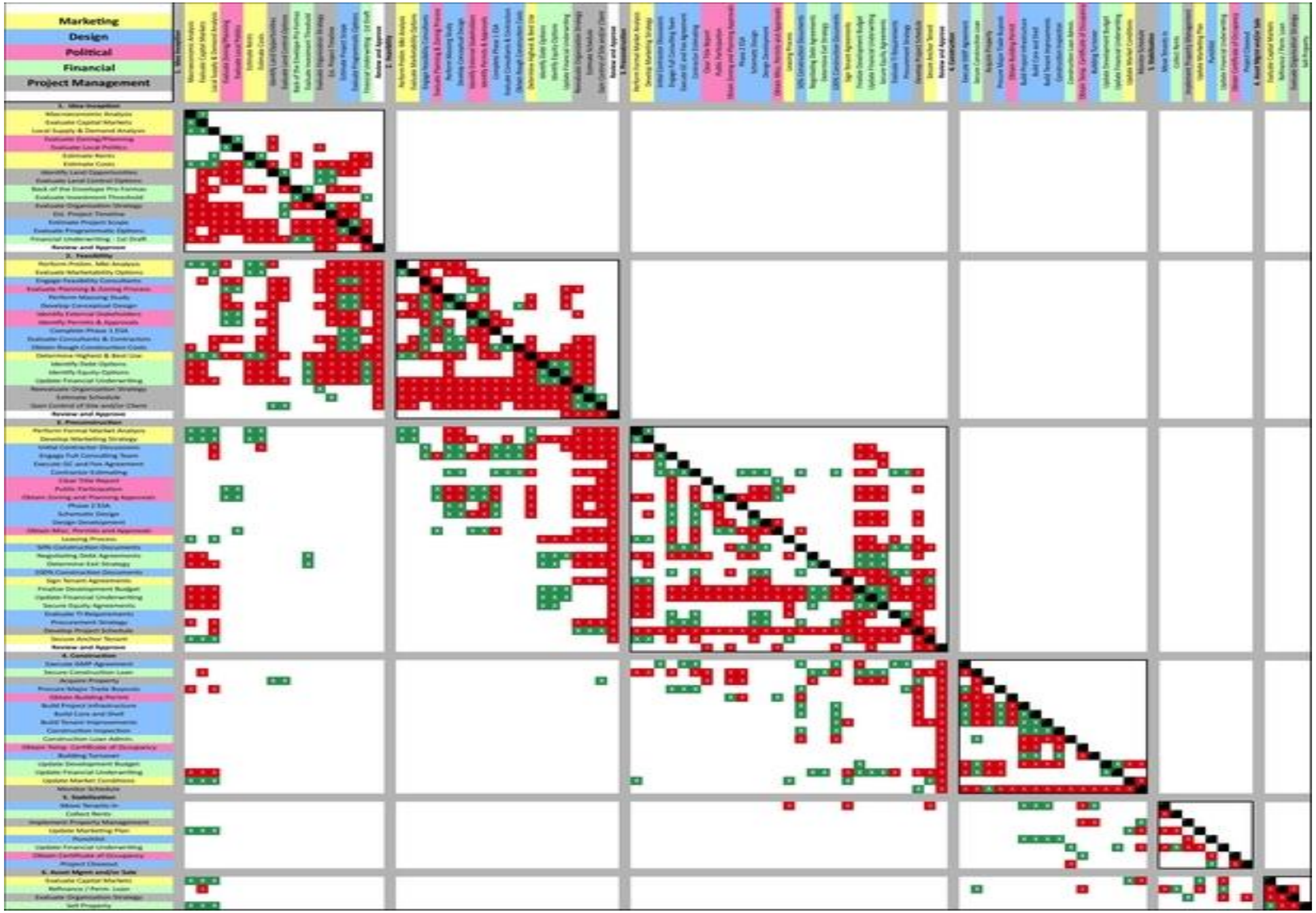
Round-trip Solar Electric Propulsion (SEP) Missions for Mars Sample Return (MSR)

- Each **row and column** represents a different **domain-specific sub-model** used in the SEP mission design.
- The **cells** indicate **dependencies and interactions** between models.
- The **numbers in the cells** represent the number of data connections between models.

- The **red section** represents **mission design models** (trajectories, launch vehicle models).
- The **blue section** represents **margin calculations** (mass, power, and propellant).
- The **green section** represents **spacecraft subsystem sizing** (power, ADCS, thermal, …).

Ref :

Round-trip Solar Electric Propulsion Missions for Mars Sample Return, Zachary James Bailey et al
January 2014, Advances in the Astronautical Sciences 152
Conference: AAS/AIAA Space Flight Mechanics Meeting At: Santa Fe, NM


Marketing
Design
Political
Financial
Project Management

Thank you!

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Keep in mind

- The Design should remain Modular, Allowing Phased Improvements :

A **modular design** means that different parts of the system can be **upgraded separately** instead of replacing everything at once.
A **non-modular** design would mean any upgrade requires **replacing major components**, which is expensive and inefficient.

- Technological Choices should allow **Incremental** (be able to be introduced **gradually,** rather than requiring a complete redesign) Rather Than **Radical** Upgrades.

Penalty of Change (PoC) : Understanding Decision Consequences

PoC=(Cost Impact)+Time Delay×500)

Cost Impact (How expensive is the change?)

- Direct cost of redesigning or modifying a component (changing the vacuum system…)
- Includes labor, material costs, infrastructure modifications.
- Can be estimated from historical costs or engineering evaluations.

Time Delay (How much time does the change add?

- The time required for the modification (measured in months or weeks).
- Includes engineering design time, construction time, testing phases.

Multiply time delay by 500 to convert it into an equivalent cost impact, 500 (euros) is the estimated cost of the delay per months or weeks