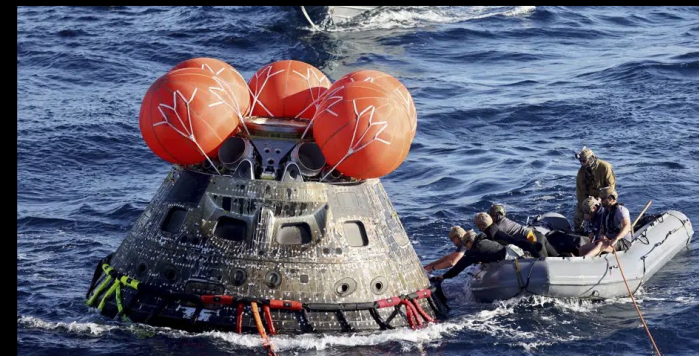


# LET'S CREATE THE FUTURE

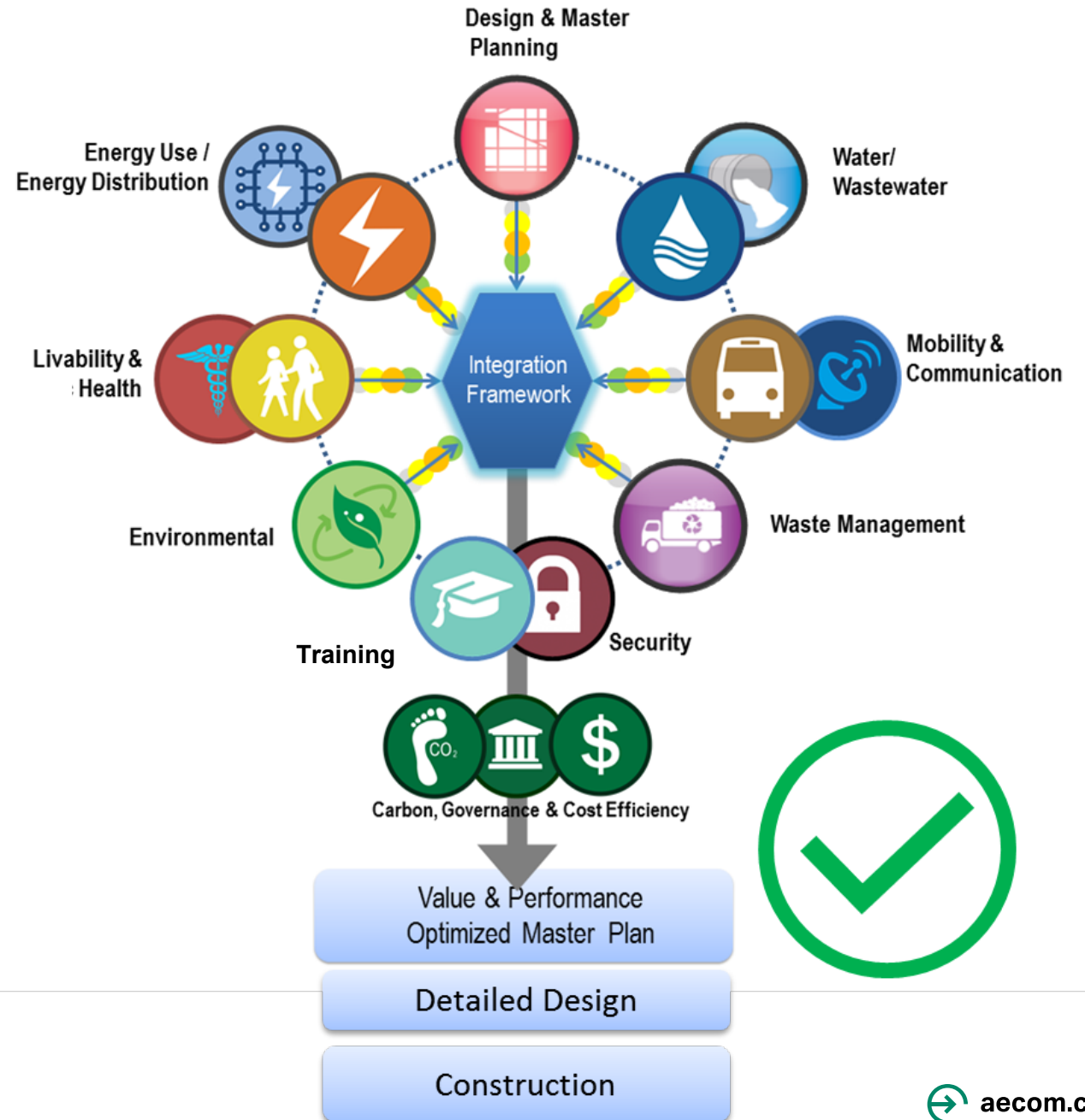
Lunarscape Master Planning: AN INTEGRATED APPROACH

Dec 14, 2022



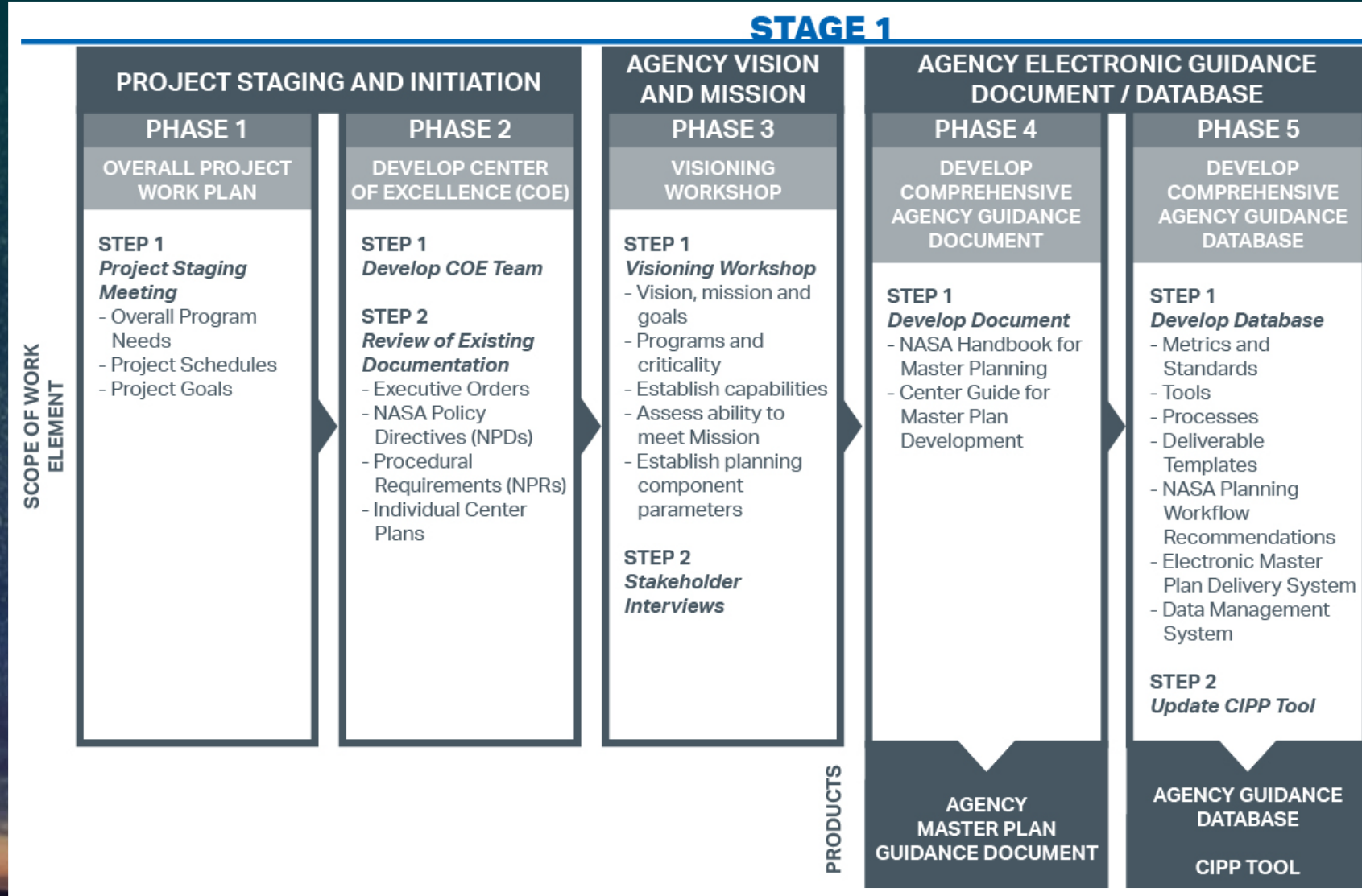
# AECOM's Integrated Approach To Master Planning Combines:

- Requirements/risk analysis,
- Facilities conditions identification,
- Architecture, Planning,
- Sound economic and environmental strategies
- Utilize decades of Master Planning experience.



# Planning Methodology And Approach – Stage 1

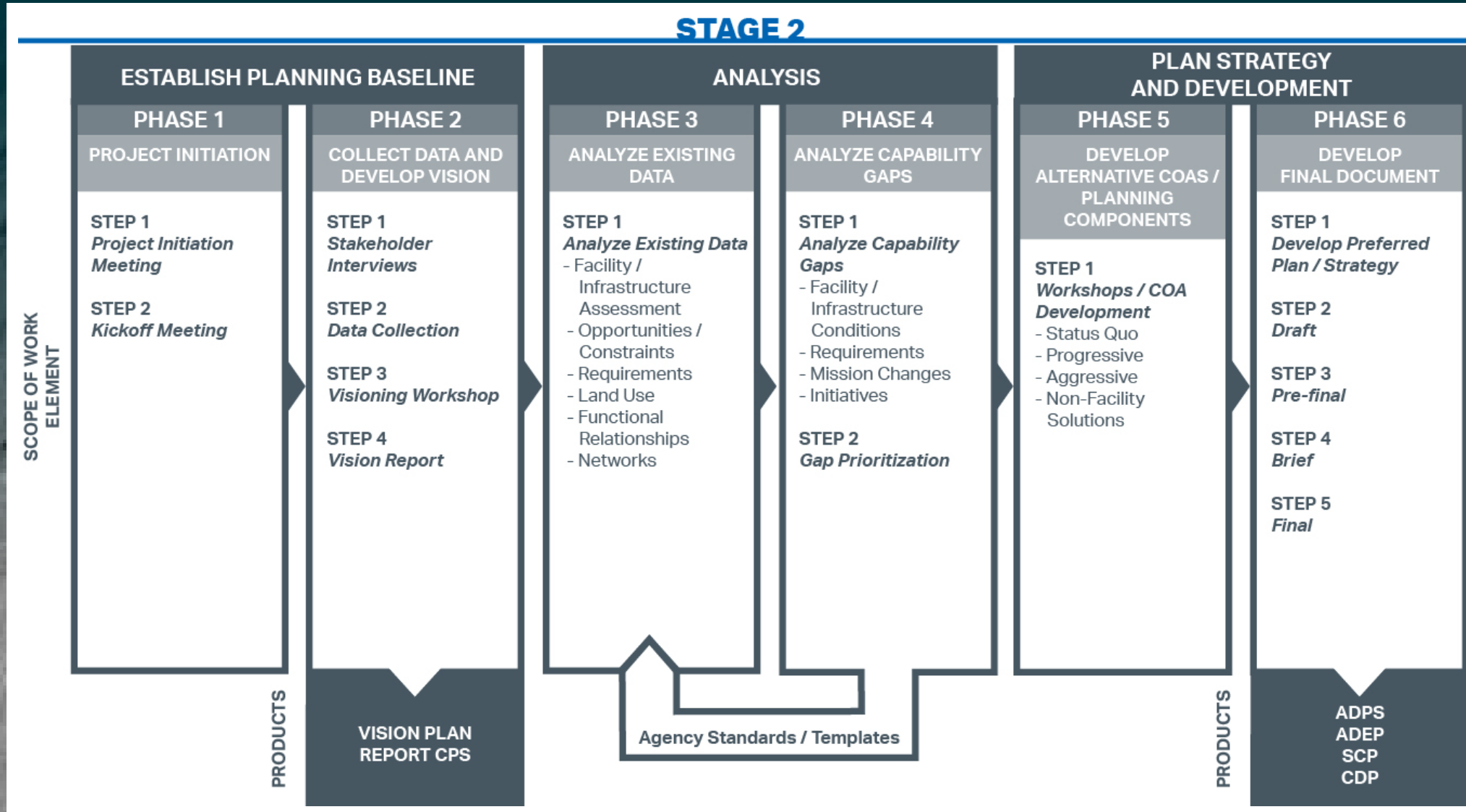
## Aligning with NASA Goals



Master Planning efforts will align with the **NASA 2022 Strategic Plan**, and specifically Strategic Objective 2.1.

# Planning Methodology and Approach – Stage 2

## Master Planning Framework



# Integrated Planning Process



# Off-World Conditions

	Earth	Space	Moon	Mars
Diameter (km)	12756	-	3475	6792
Period of revolution (year)	365 Earth days	N/A	28 Earth days	792 Earth days (26 months)
Period of rotation (day)	24 h	N/A	672 h; 28 Earth days	24.66 h (24h 38min)
Gravity	9.81 m/s <sup>2</sup>	Microgravity	1.62 m/s <sup>2</sup> (0.17g)	3.69 m/s <sup>2</sup> (0.38g)
Mean surface temperature	15 °C Max. +60 °C Min. -89 °C	- Max. +200 °C Min. -270 °C	-20 °C (much colder at the poles in deep craters) Max. +123 °C (possibly up to 140 °C in some locations near the equator) Min. -233 °C (surface)	-65 °C Max. +20 °C Min. -120 °C
Atmospheric pressure	1 bar = 100.000 Pa (78% N <sub>2</sub> , 21% O <sub>2</sub> )	0 bar (vacuum)	0 bar (almost a perfect vacuum)	0.01 bar = 600 Pa (95% CO <sub>2</sub> , 3% N <sub>2</sub> )
Radiation shielding	Natural protection by the Earth's atmosphere equivalent to about 1000 g/cm <sup>2</sup> and the Von Allen Belt	Exposure to Solar Particle Events (SPE) and Galactic Cosmic Rays (GCR)	Exposure to Solar Particle Events (SPE) and Galactic Cosmic Rays (GCR); mass of the surface gives "half protection" but the surface also generates secondary thermal neutrons from bombardment	Atmosphere gives about 30 g/cm <sup>2</sup> equivalent protection. Mass of the planet gives about "half shielding"
Radiation dose	0.000004 Sieverts/hour or 0.035 Sieverts/year	0.000083 Sieverts/hour or 0.72 Sieverts/year	0.000075 Sieverts/hour or 0.65 Sieverts/year	0.000030 Sieverts/hour or 0.26 Sieverts/year
Light and Solar irradiation	1371 W/m <sup>2</sup>	N/A (depends on distance from sun) Extreme bright light and glare	1368 W/m <sup>2</sup> Extreme bright light and glare	590 W/m <sup>2</sup> (44% of Earth)

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Resilience is the ability to **anticipate, prepare for, and respond** to hazardous events, trends, or disturbances <sup>[1]</sup>.

**Energy resilience** is the ability of energy systems to prepare for and **adapt to changing** conditions and withstand and recover rapidly from disruptions<sup>[2]</sup>.

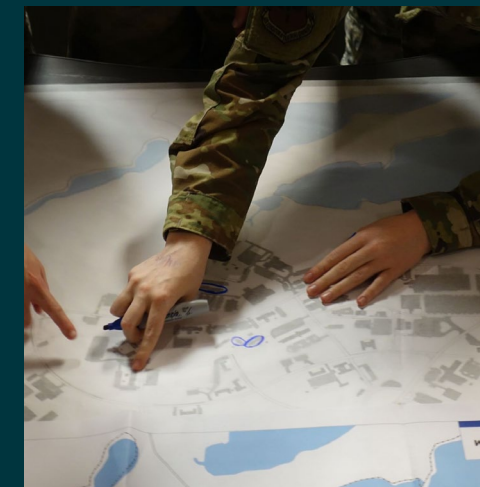
[1] Center for Climate and Energy Solution

[2] Presidential Policy Directive -- Critical Infrastructure Security and Resilience

# Integrated Master Planning

## Tyndall Air Force Base Hurricane Recovery Plan

- A \$3-billion effort to rebuild and transform Tyndall AFB into an “Installation of the Future” with agile, flexible and resilient facilities and infrastructure.
- An installation master plan to rebuild the AFB devastated by the natural disaster.
- The recovery plan supported and updated the 2015 Tyndall AFB Installation Development Plan in compliance with AFI 32-1017 Comprehensive Planning and DoD UFC 2-100-01, Installation Master Planning.
- 3 large-scale comprehensive and integrated planning charrettes over a four-day period.
- The largest and most complex of the three study areas was the Flightline District, which involved 92 stakeholders.
- Prepared conceptual plans, presented to HQ USAF and the US Congress.





# Organizational Response Strategy

Team operations for extreme circumstances



Communications Operations – Underground C2 Operations



Extreme Cold Facilities



Extreme Cold Facilities



Assessment and Testing, Space, Bio-Hazard

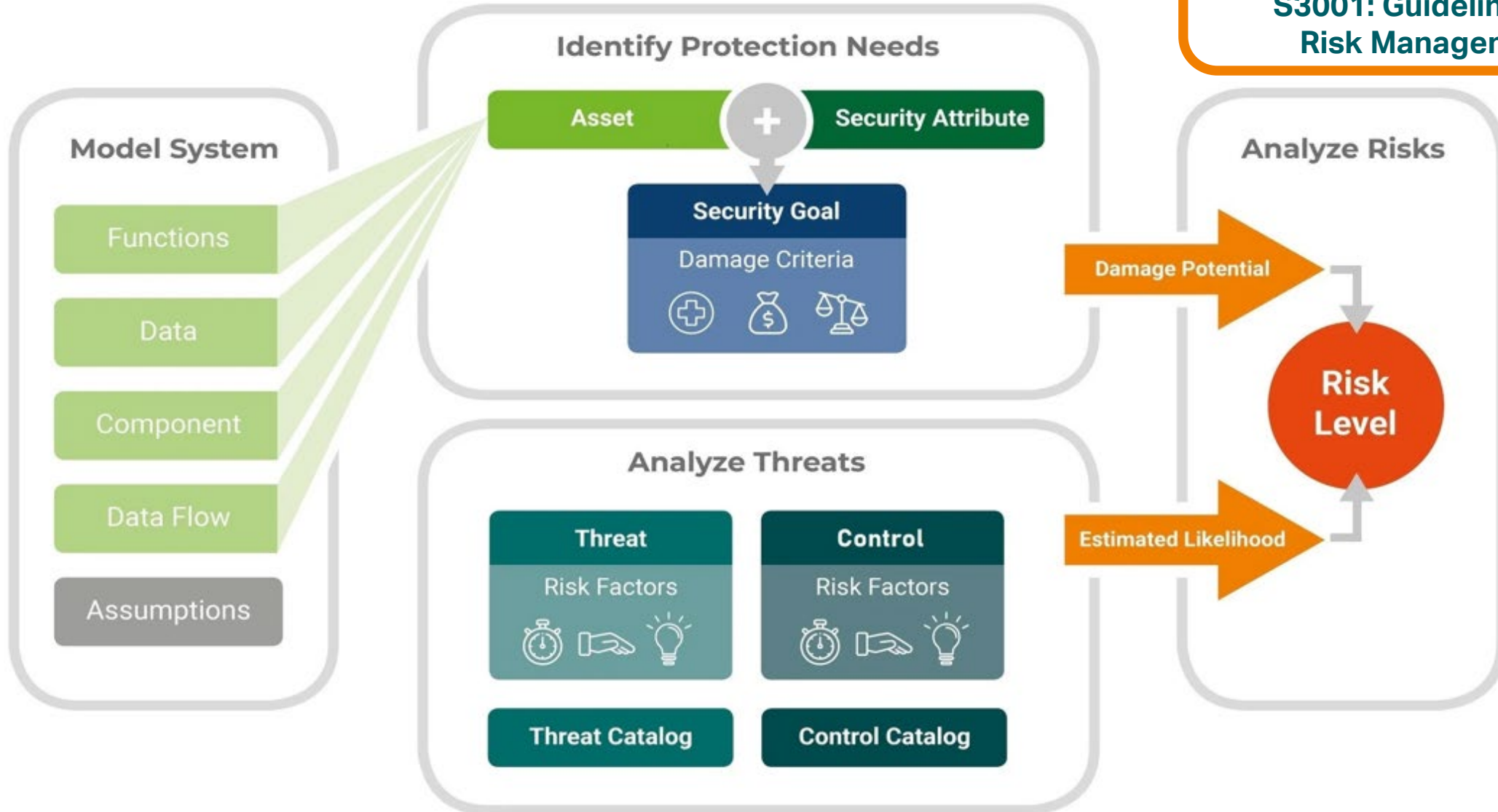


Lunarscape Master Planning

# Managing Risk And Uncertainty

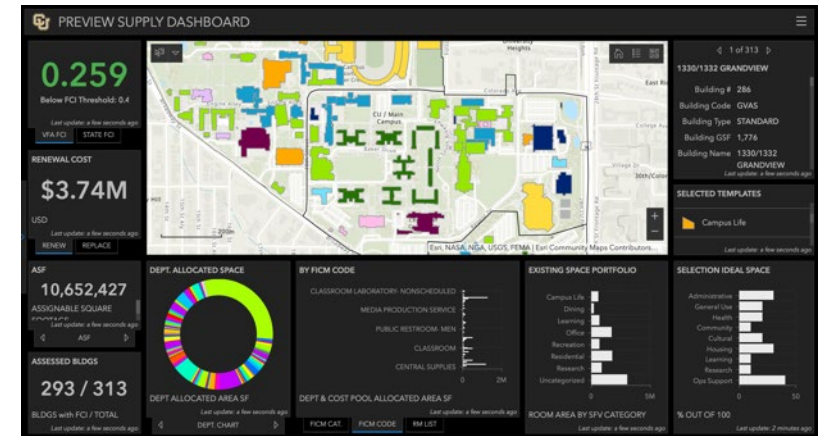
Team operations for extreme circumstances

AECOM's Program Risk Management Approach is robust and aligned with NASA's **S3001: Guidelines for Risk Management**



# Digital Adaptation

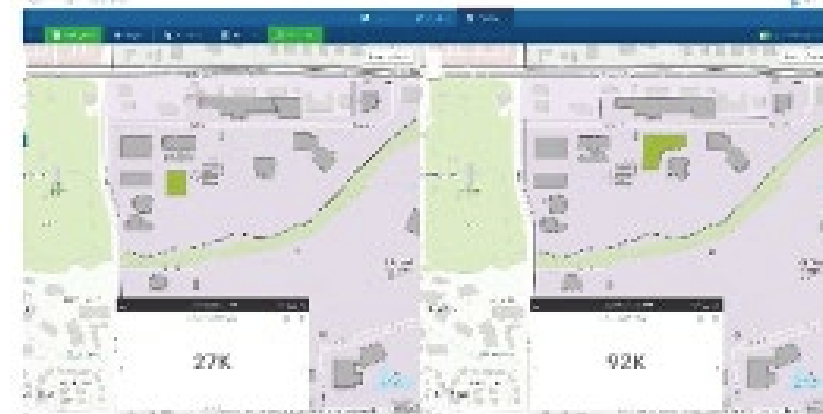
Understand the condition, capabilities and performance of your site



Forecast site needs based on growth, risk and change scenarios



Anticipate and respond to a variety of investment/technology requests



# THERE FOR ALL THE GIANT LEAPS

#APOLLO50TH

**Komal Dewan**  
[Komal.Dewan@aecom.com](mailto:Komal.Dewan@aecom.com)

**Roberto de Moraes**  
[roberto.demoraes@aecom.com](mailto:roberto.demoraes@aecom.com)

**Bobby Harward**  
[bobby.harward@aecom.com](mailto:bobby.harward@aecom.com)

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AECOM Space

