

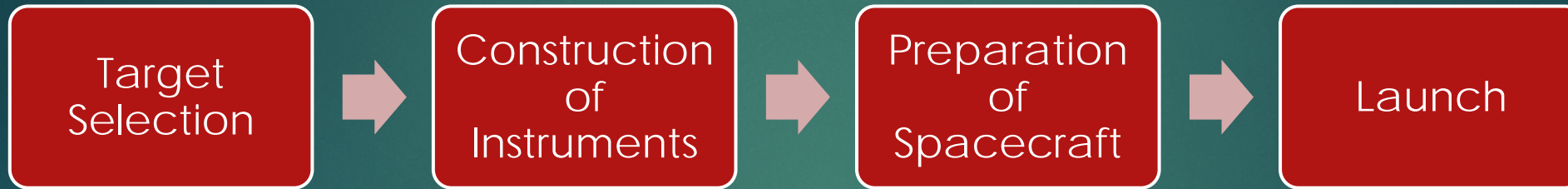
# Pre-NEA Discovery Asteroid Mission Assessment

FEASIBILITY FROM SCIENTIFIC AND POLICY PERSPECTIVES

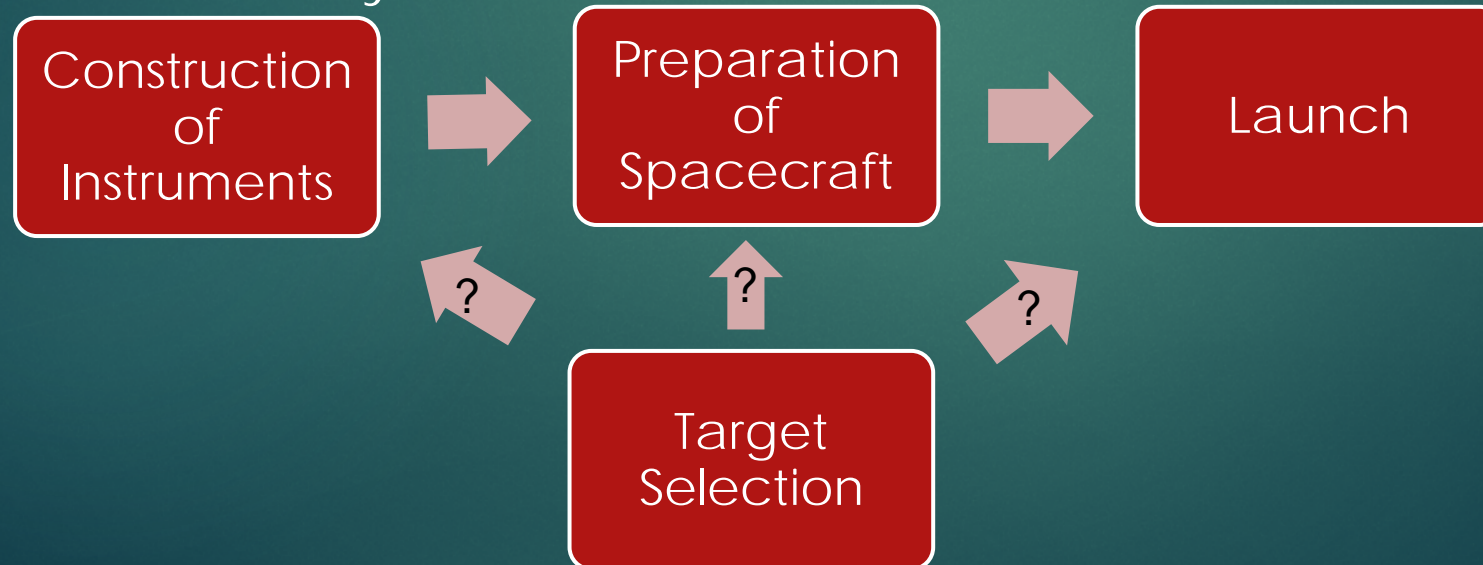
# Definition and Motivation

# What is a pre-discovery mission?

## ▶ Traditional mission:

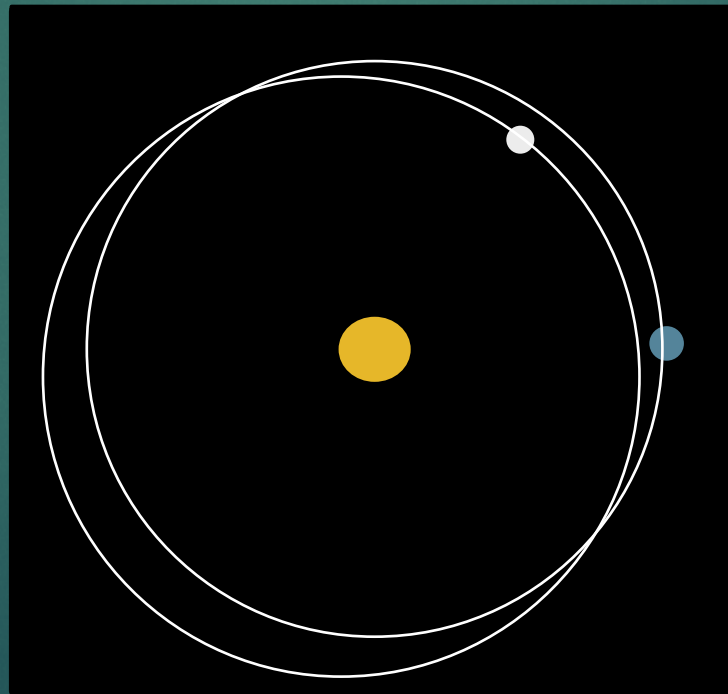


## ▶ Pre-discovery Mission



# Why plan a mission without a target?

- ▶ Promising NEAs often have long synodic periods relative to Earth



# NEA Target Population


# NEA population of interest

- ▶ Easy to reach
- ▶ Long synodic period relative to Earth
- ▶ Not yet discovered


# How to estimate? – Easy to Reach:

Define “Easy to Reach” from literature

- ▶ Typically requires a close distance( $<0.1\text{AU}$ ) and low relative speed( $<2\text{Km s}^{-1}$ )
- ▶ Adjust with definition of target from other unmanned NEO missions



# How to estimate? – Long Synodic Period:



- ▶ Requires estimates of orbital knowledge
- ▶ Minor constraint since orbital knowledge is necessary for mission
- ▶ Necessary to prevent overestimating use of pre-discovery missions



# How to estimate? – Future discoveries of NEAs

Debiased population estimates

Provides upper bound on NEA target estimate

Minor Planet Center NEA database

- Check if number of NEA targets represent a consistent percentage of total NEAs found
- Check if the number of NEA targets within each NEA category is consistent
- Check if certain telescopes tend to discover NEA targets

Future discovery estimates

Use estimates from the literature to evaluate how many NEAs are likely to be found

# Mission Types



# Type 1 – Prepared instruments



- ▶ Build and maintain spacecraft instruments in a state of readiness
- ▶ Smallest/cheapest “ask”
- ▶ Requires large window or opportunity
- ▶ Evaluate cost/benefit via shelf-life of instruments

# Type 2 – Completed Spacecraft

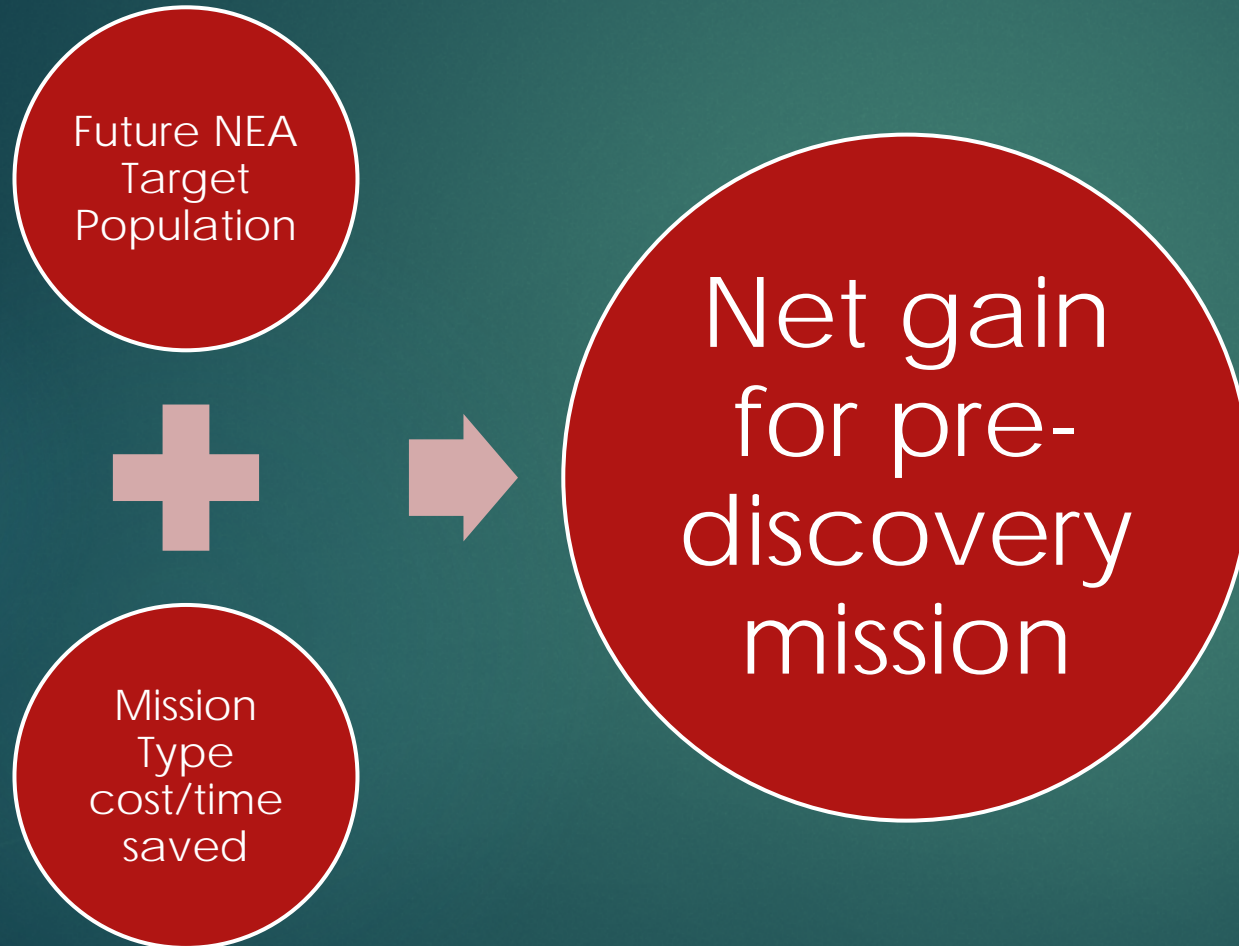
- ▶ Build and maintain a spacecraft in a state of launch readiness
- ▶ Middle of the road in terms of initial investment and window of opportunity
- ▶ Comparable to other cases with long term launch delays

# Type 3 – Orbital Spacecraft

- ▶ Launch a spacecraft and have it orbit until a target is found
- ▶ Requires largest initial investment and smallest target window
- ▶ Must be launched with method of propulsion once target NEA is selected
- ▶ Maintenance in orbit may be comparable to satellite or ISS

# Generating Findings

# Mission type comparison



- ▶ Compare mission types to determine most efficient mission type
- ▶ Compare with extant unmanned missions to evaluate overall worth

# Policy of similar mission types

- ▶ Has NASA completed other missions where equipment was constructed prior to target selection?
- ▶ Has other government-funded research followed a similar pattern?
- ▶ If so, how were those funded/promoted? How would that apply in this case?



# Final Thoughts

## Impact Scenario

- ▶ Pre-prepared craft could be repurposed
- ▶ Experience in preparing craft for an unknown target could be crucial in an impact scenario

## Non-NASA Mission

- ▶ Pre-discovery mission might serve as proof of concept for private ISRU company
- ▶ Could be demonstration of technical prowess of other organizations with interplanetary ambitions

Questions/Comments?

