



# Development of New Instruments at the W.M. Keck Observatory

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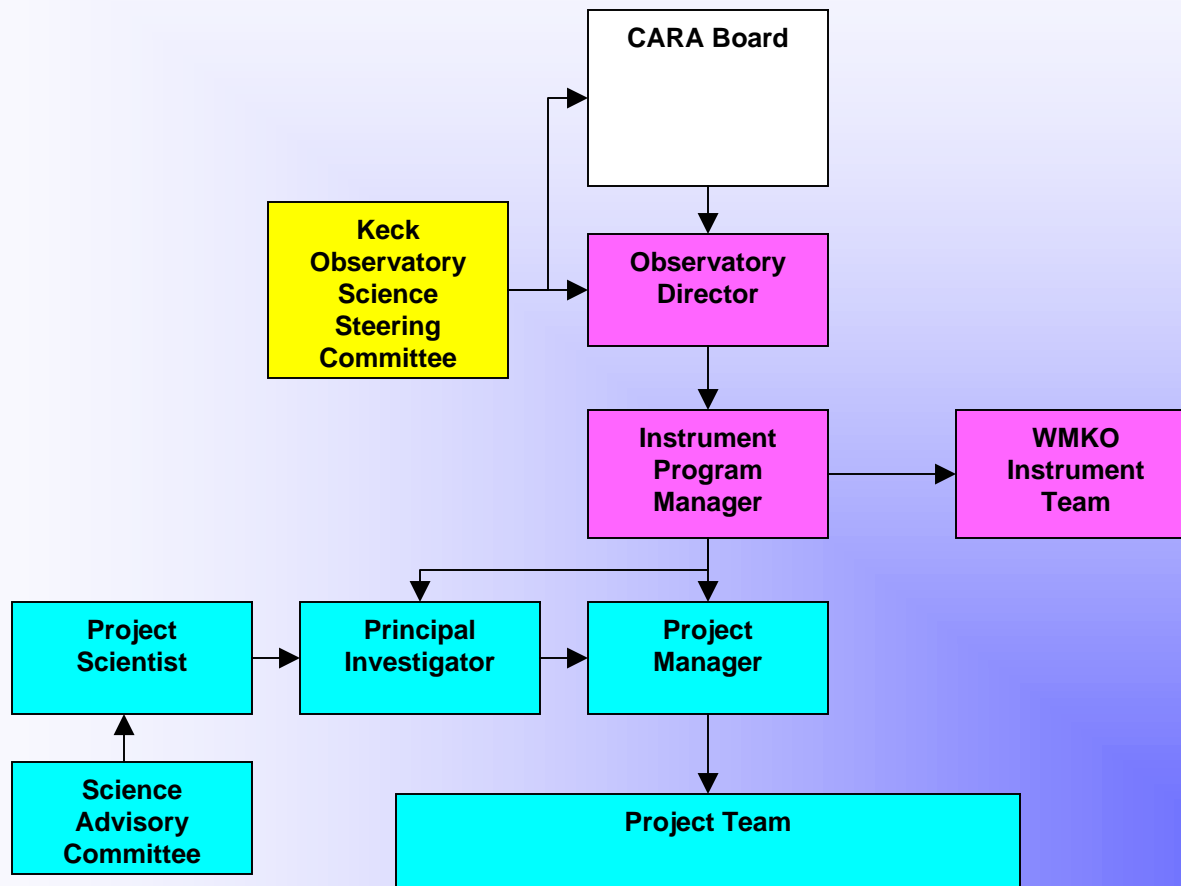


California Association for Research in Astronomy  
Instrument Program Management

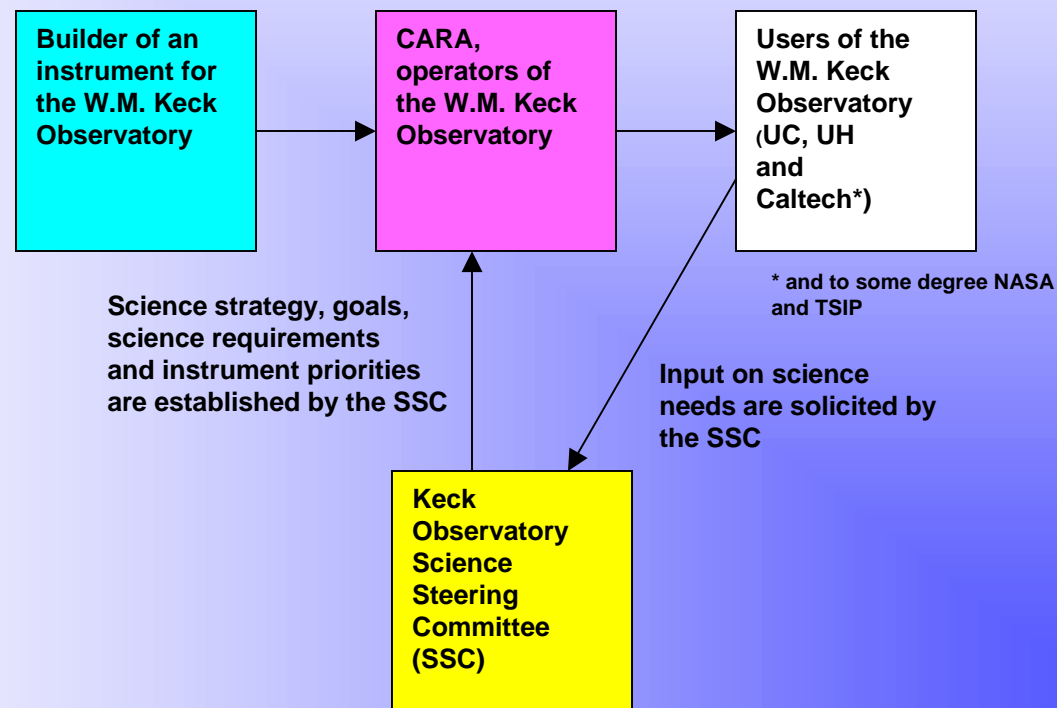
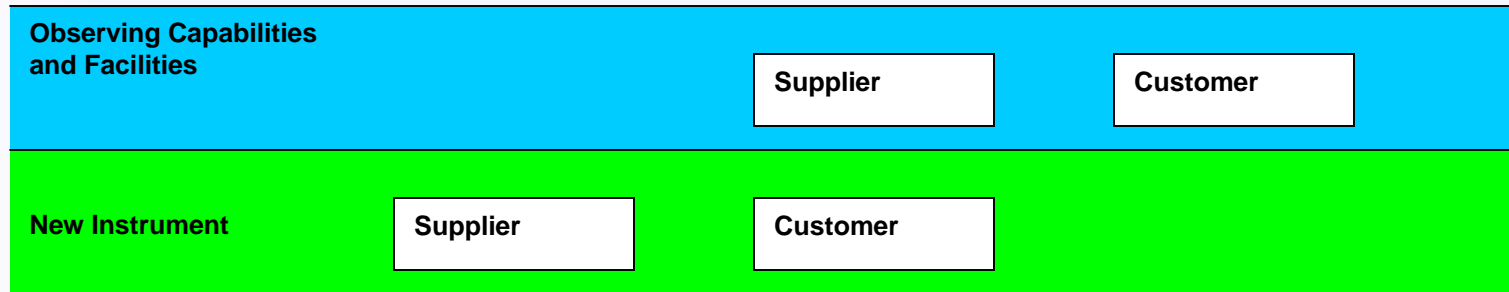
# What is it?

- A framework for development based on a well defined process, consistent with current best practices
- Considers the full life cycle – “cradle to grave”
- For each process step, establishes:
  - Organization
  - Accountability
  - Documentation
  - Success criteria
  - Decision points

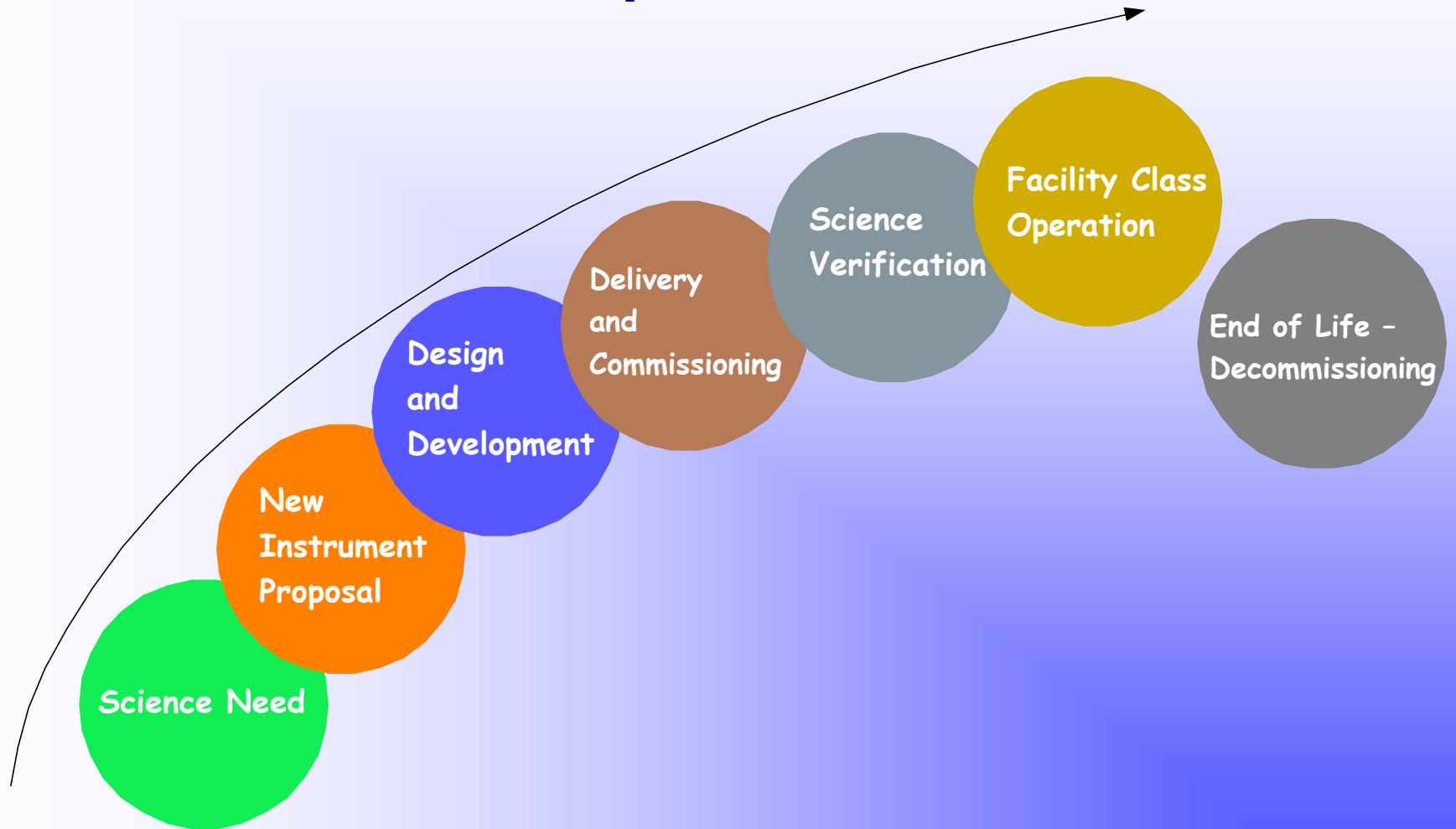
# Who Does It?



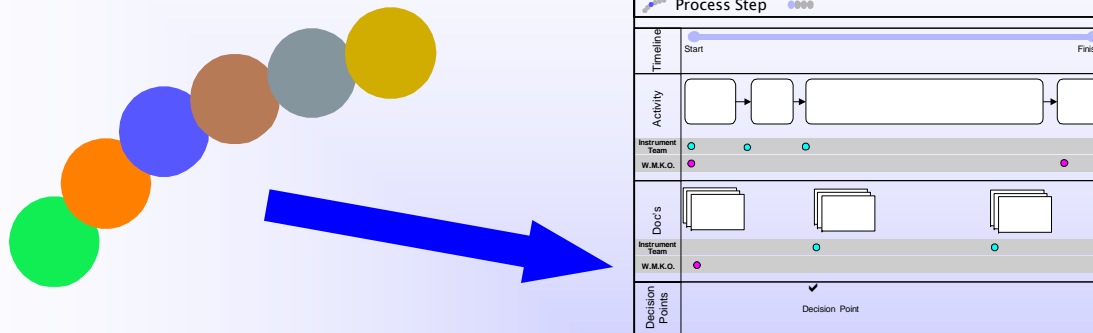
# Who is the Customer?



# The Development Process



# What Follows:



Each program step is shown in a process diagram

- What the step is and how it fits into the overall program
- What the work activities are
- Which group is accountable for getting the work done (but other groups may participate)
- What the documentation products are
- Which group is accountable for getting the documentation done
- Where the program decision points are and what they are

Where this step is the overall program

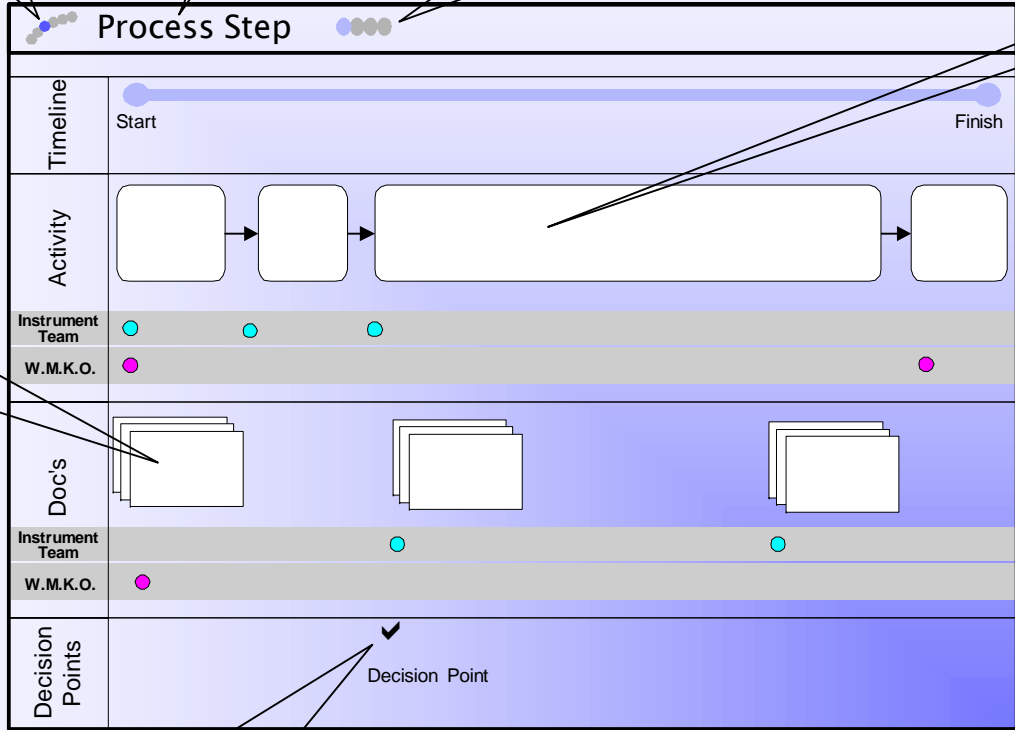
Step name

Where this step is in the design & development process

Activity flow chart

Group accountable for getting development work done

The documentation products



Indicates when decisions to proceed are made

Group accountable for getting documentation done





# Science Need

- How are new instrument requirements identified?
- Through various forms of consultation and discussion by the SSC, WMKO and the CARA board
- SSC is the primary group responsible for this
  - Observatory strategic plan – astronomy domain
  - Community input
  - Advisory groups formed by the SSC
  - Should follow a process of regular review



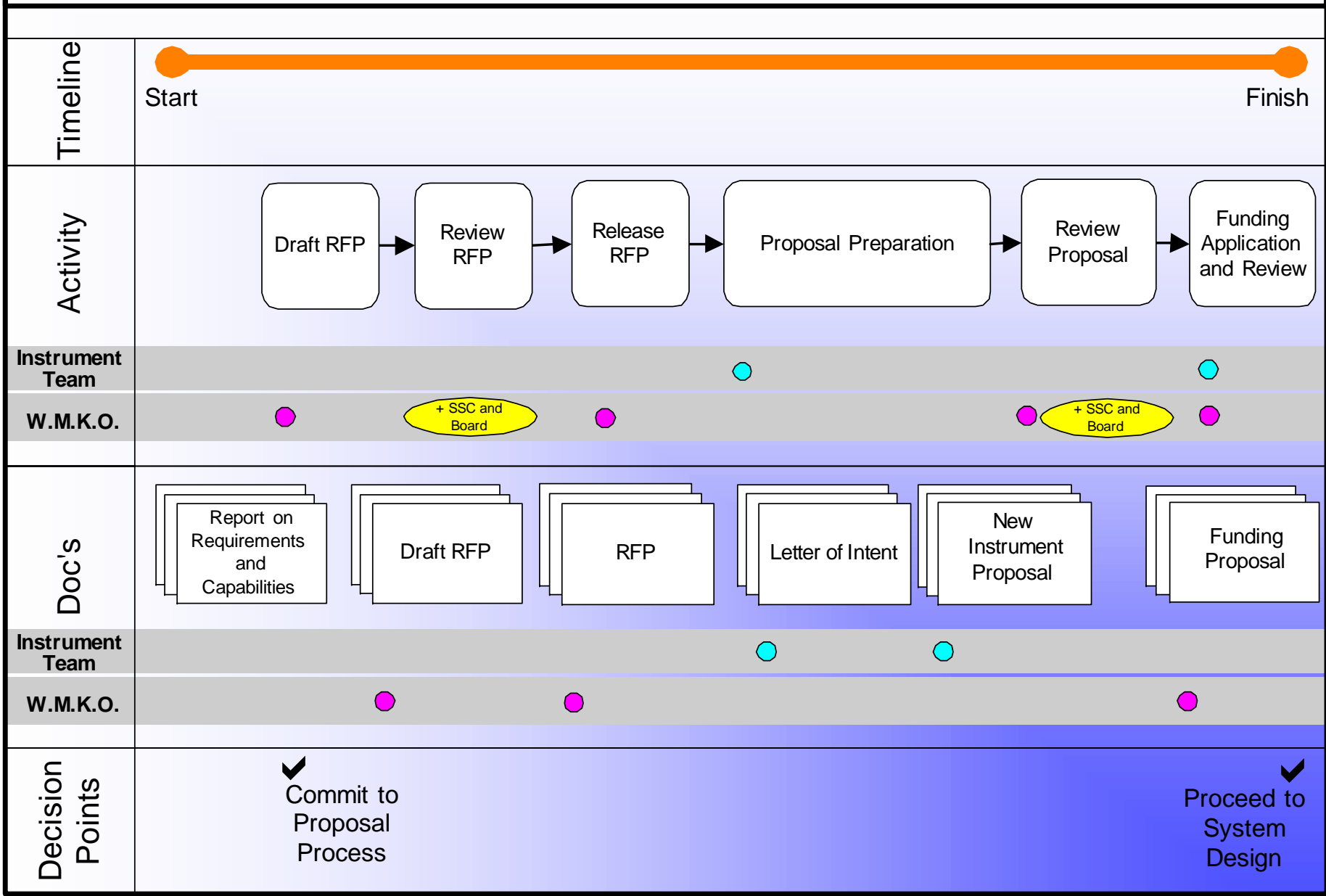


# New Instrument Proposal

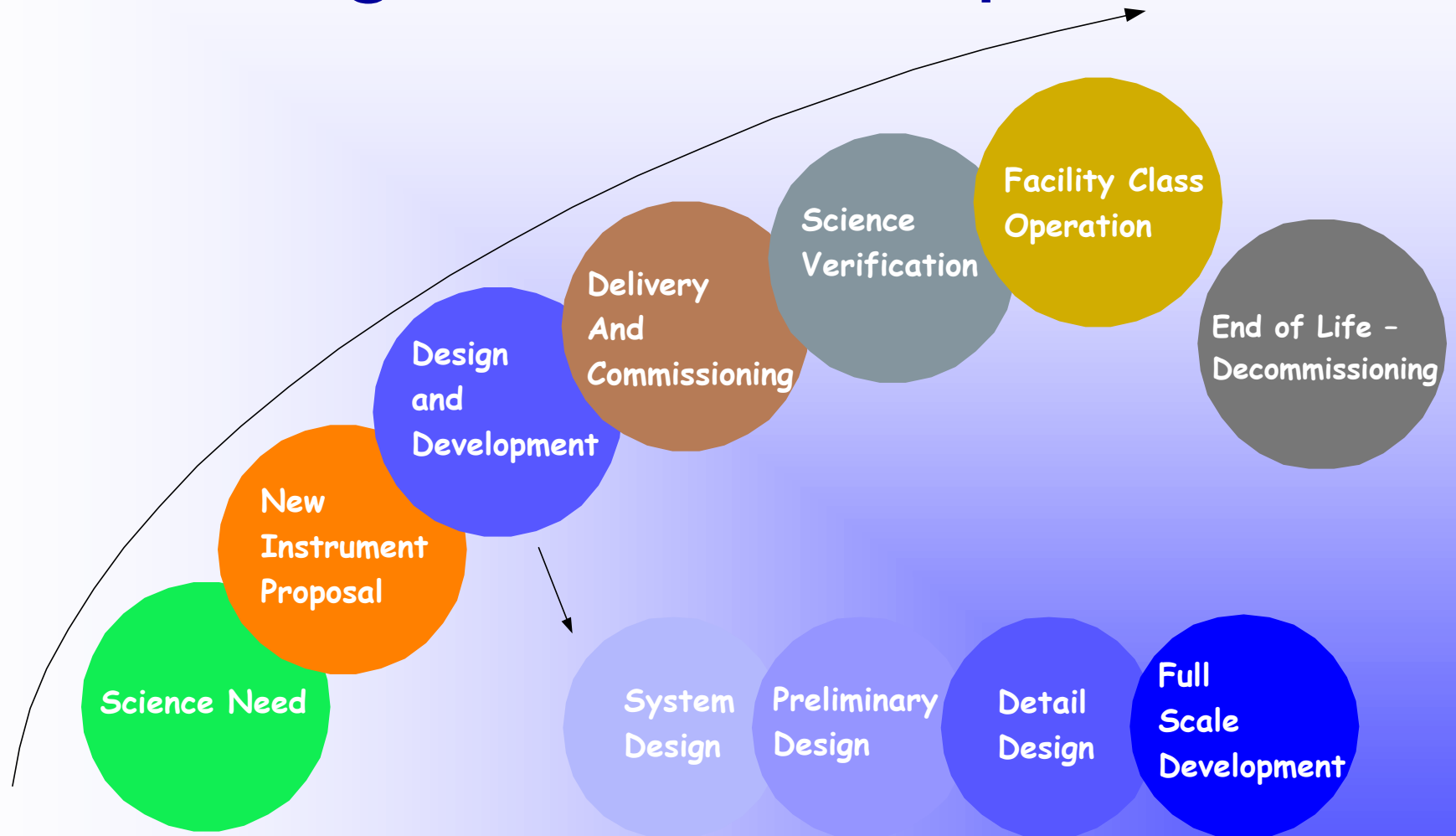
- Based on the science requirements and priorities recommended by the SCC, WMKO drafts a Request for Proposal (RFP)
- RFP
  - References science requirements
  - Defines management requirements
  - Defines proposal content and form
  - Sets the stage for the funding process
- Instrument Proposal
- Funding Proposal



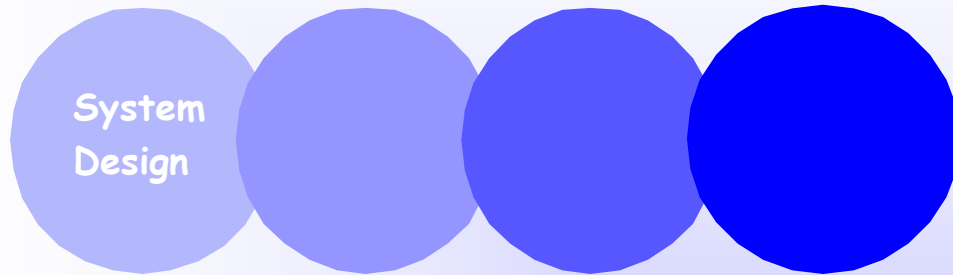
# New Instrument Proposal



# Design and Development



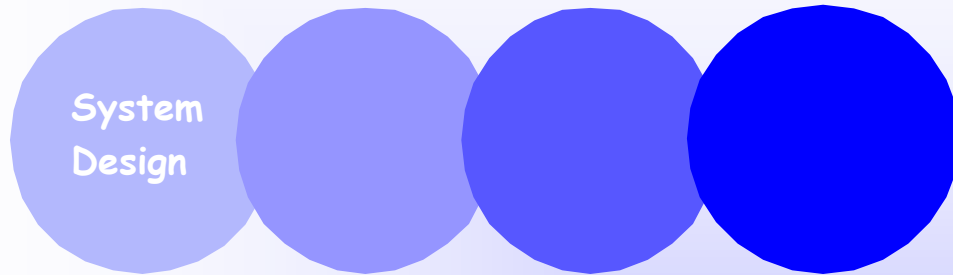
# System Design



## Start with a System Requirements Document

- System requirements “flow” from the science case
- Based on the science, establish system functions and required performance
- Establish user needs and features
- Complete lifecycle considered – development and operations

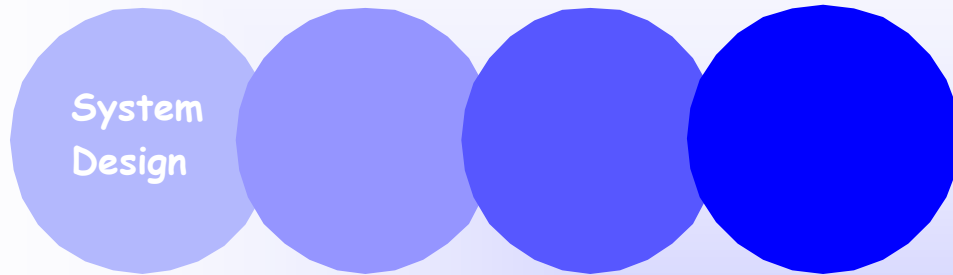
# System Design



## What happened to Conceptual Design?

- It is too nebulous and it is under funded
- We need more systems design thinking
- A system design discipline is a key to design to cost
- The system design discipline is key to making user requirements paramount (users are the observers and the observatory)

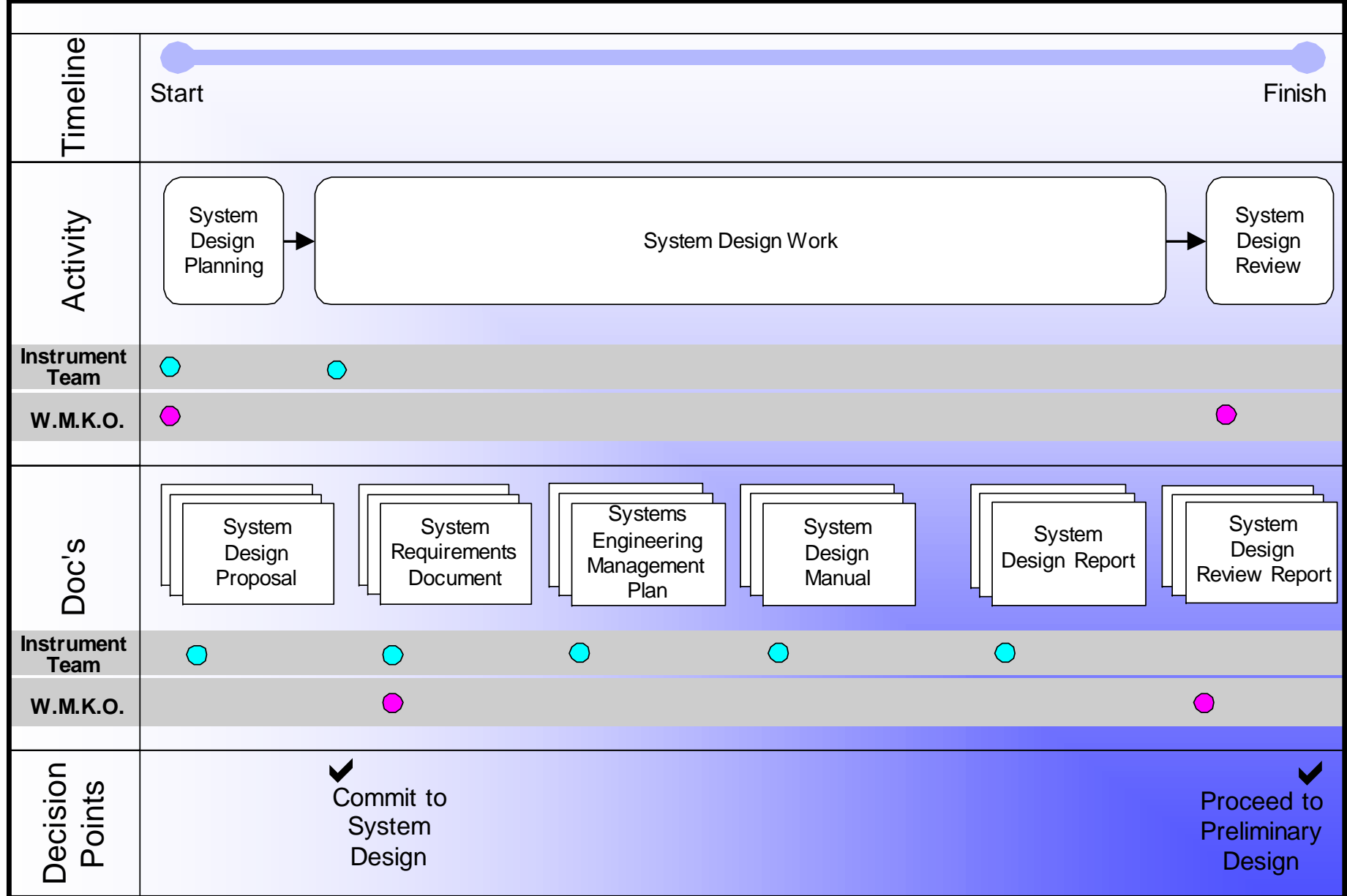
# System Design



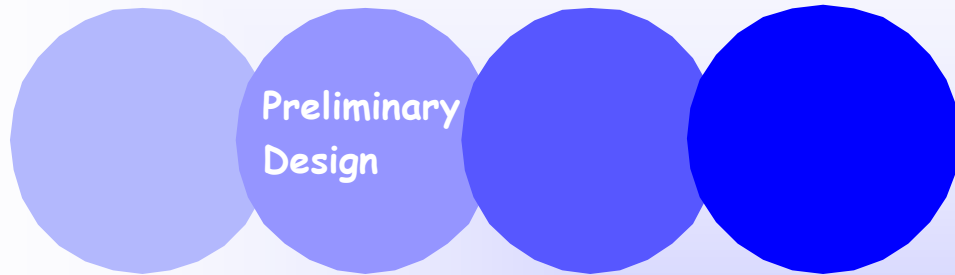
**Objective:** establish a discipline integrated engineering plan for the proposed design, understand the technical risks, explore trade-offs, and determine estimates for performance and cost to completion.



# System Design



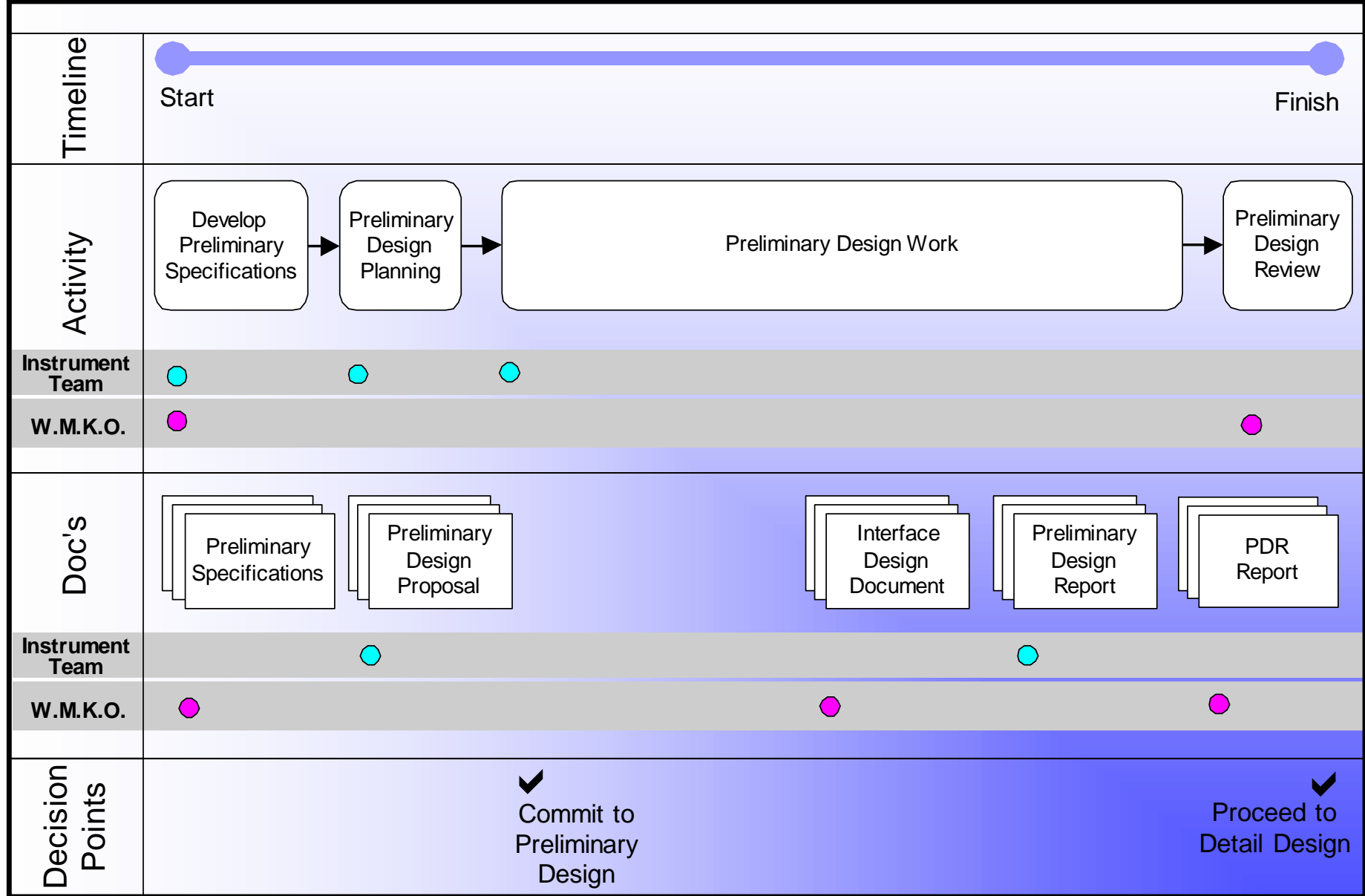
# Preliminary Design



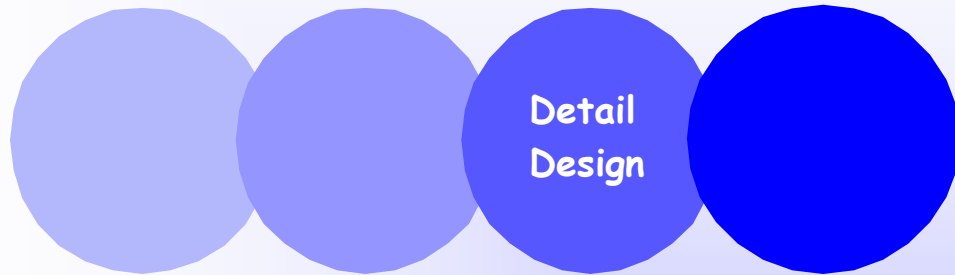
**Objective:** establish the feasibility of the proposed design through research, design, simulation and prototyping. Confirm the estimated performance and cost to completion.



# Preliminary Design

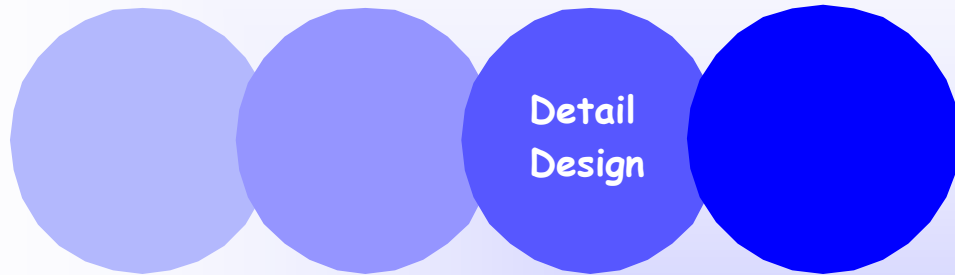


# Detail Design



**Objective:** complete the design, fabrication and assembly documentation for the system and all components and show that the final design demonstrates compliance with all specifications and applicable standards.

# Detail Design

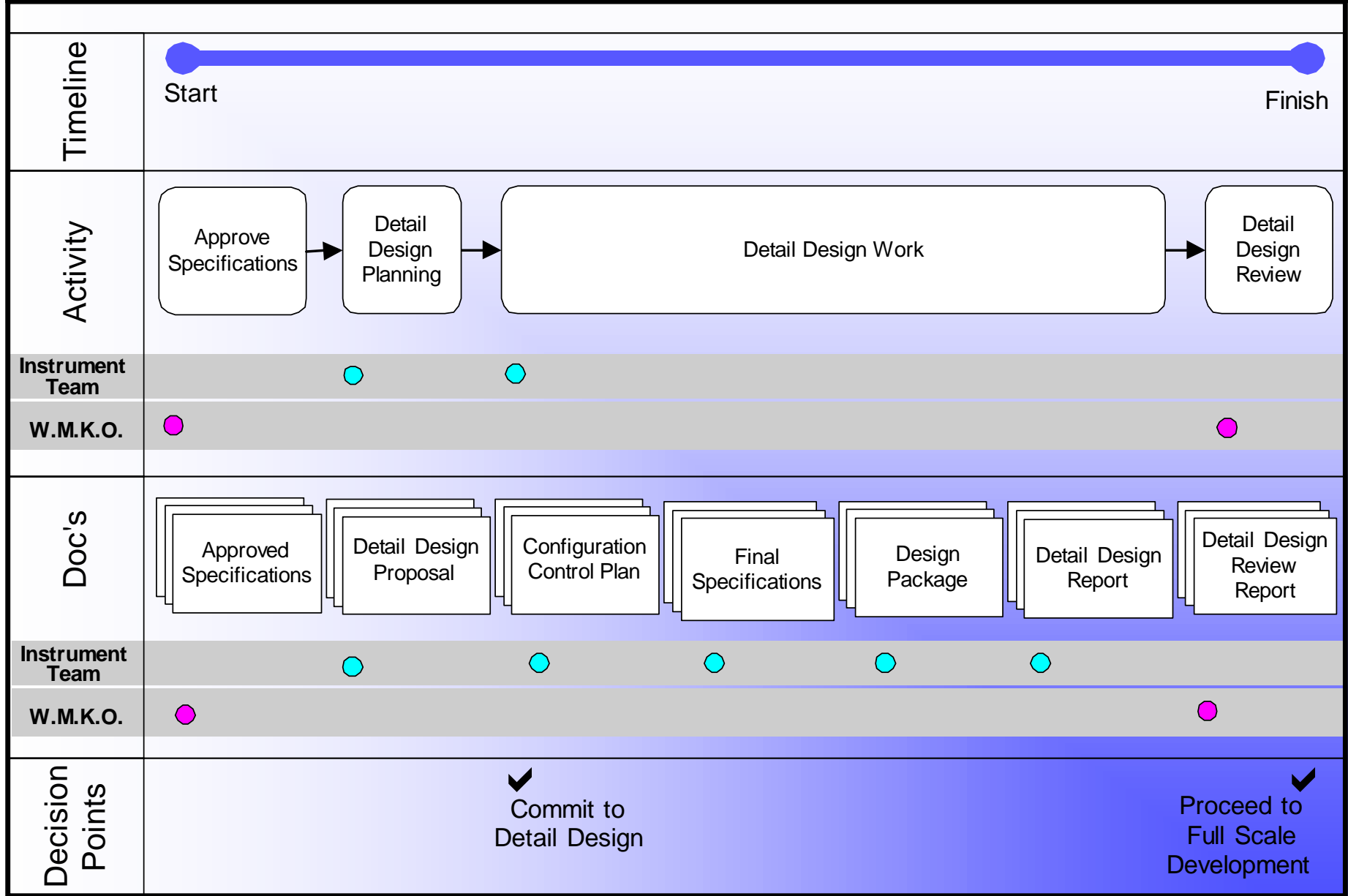


## What happened to Critical Design?

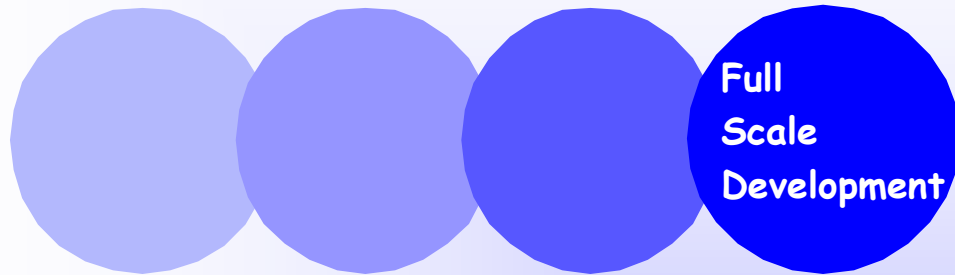
- The name just doesn't make sense
- We need finished designs ready to build in full scale development – not incomplete designs or concepts with detail design occurring during full scale development



# Detail Design



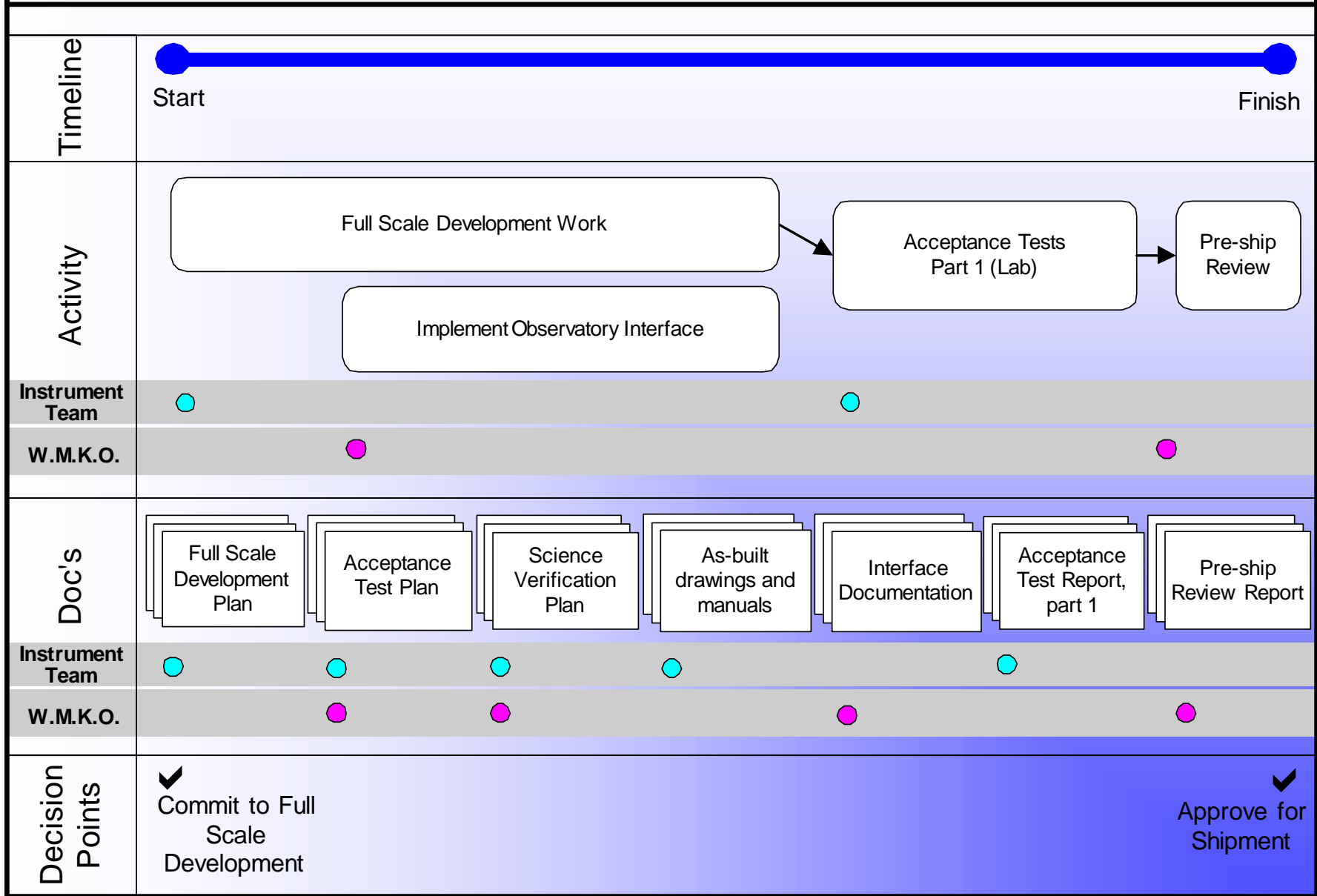
# Full Scale Development



**Objective:** produce a working system that meets the specifications and is ready for delivery and commissioning.



# Full Scale Development

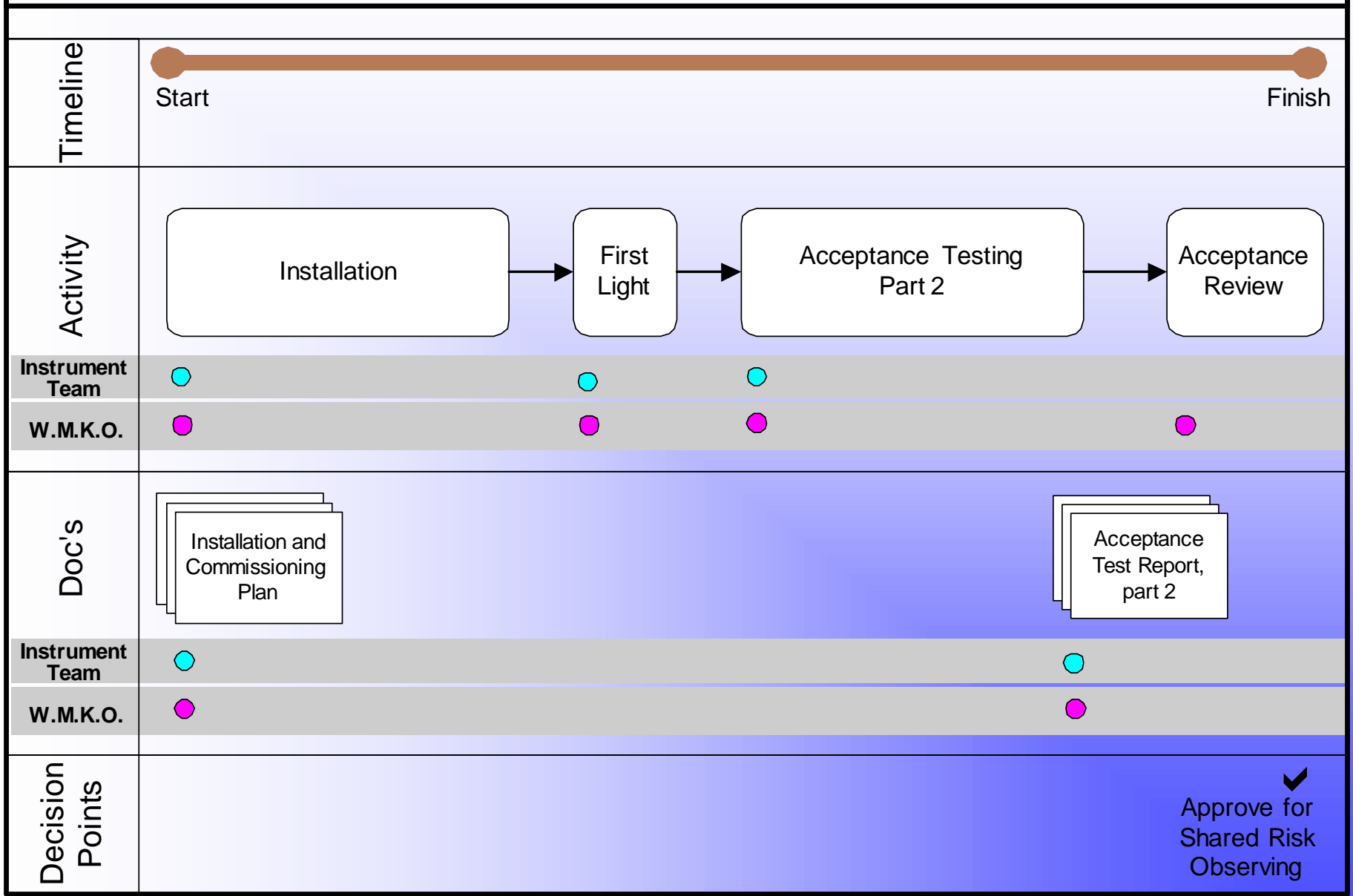


# Delivery and Commissioning



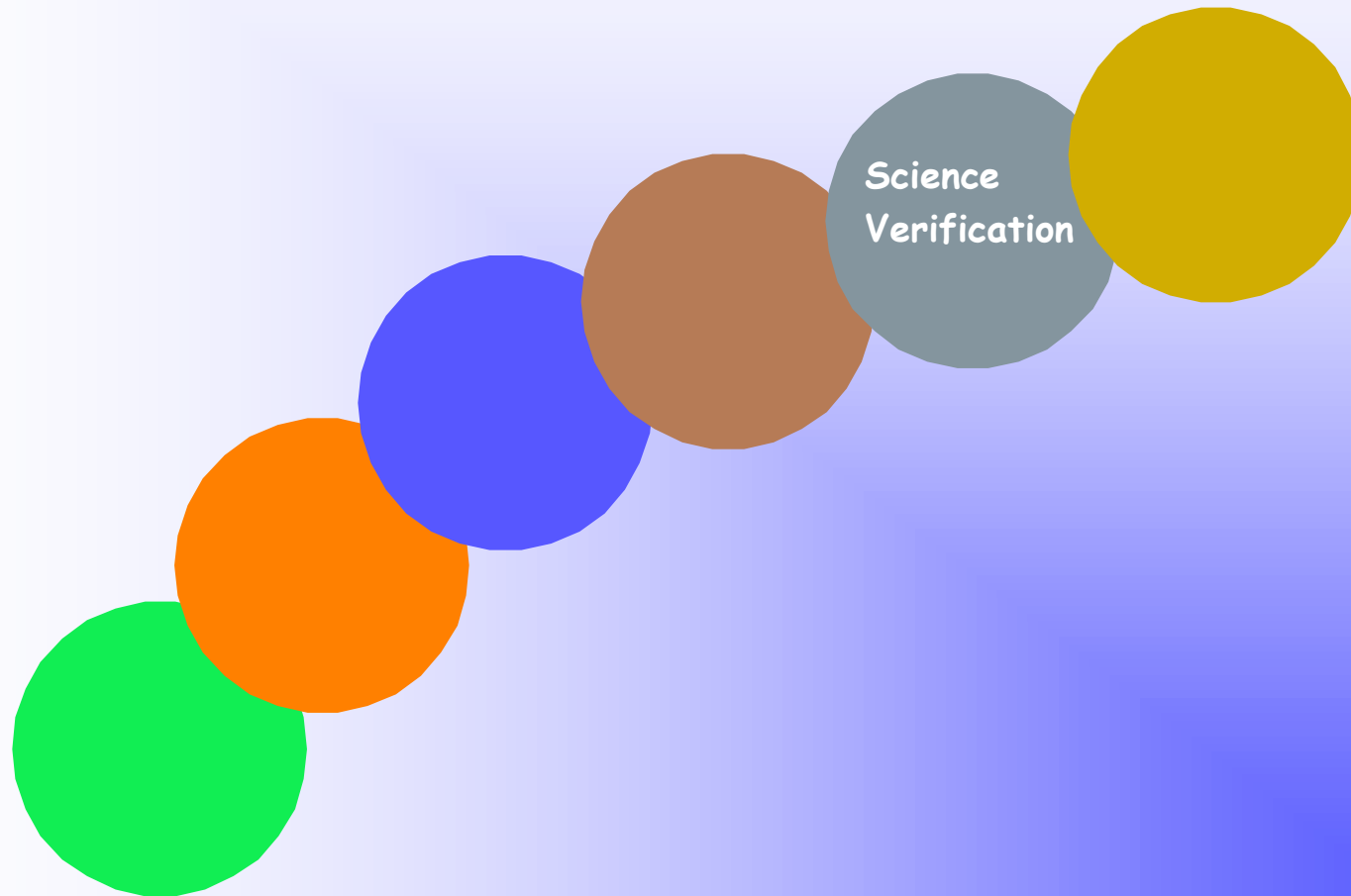


# Delivery and Commissioning



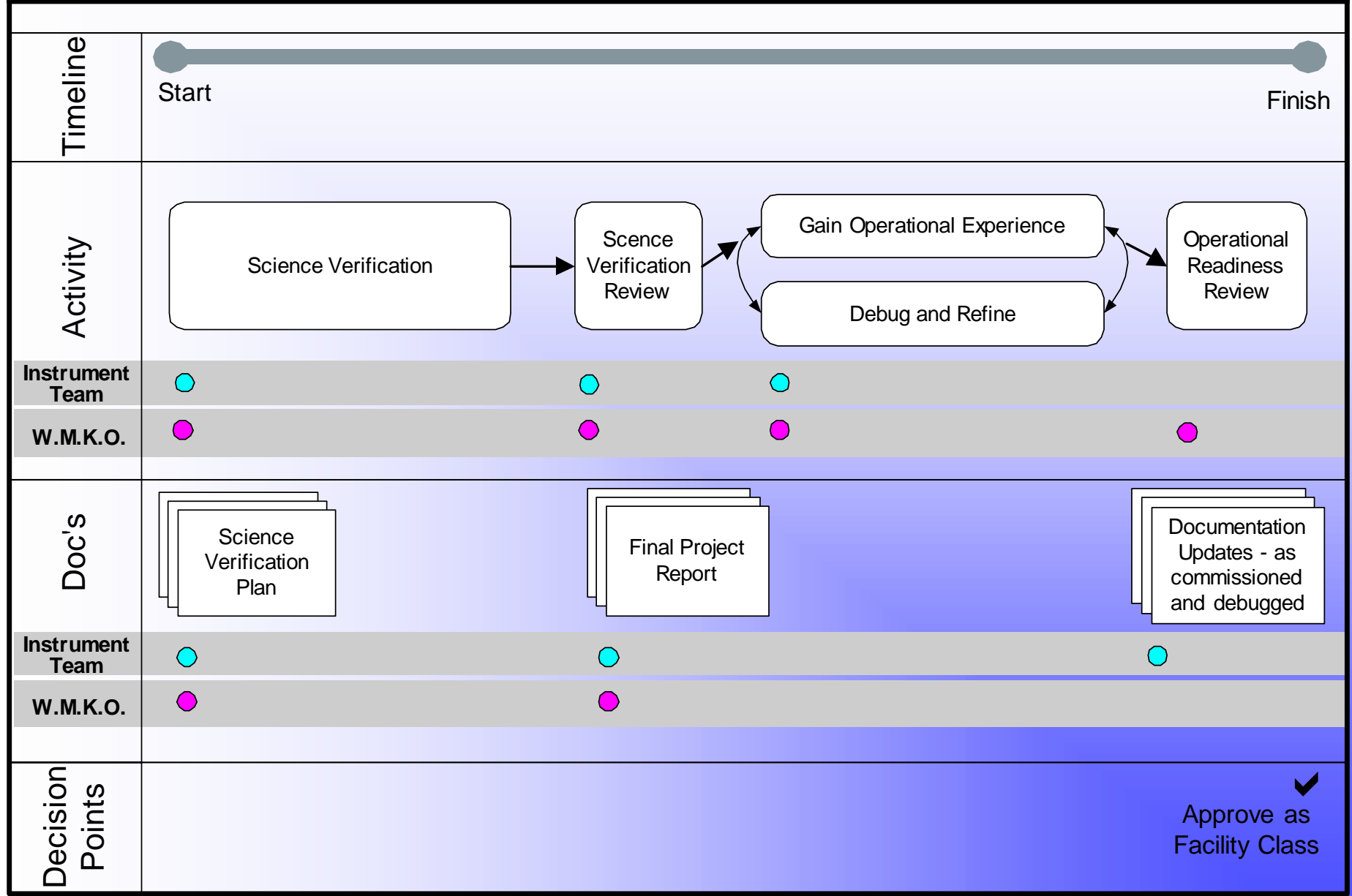


# Science Verification





# Science Verification and Shared Risk Observing



# Operational Instrument

Facility Class  
Operation

## When is it “Operational”?

- When the specifications are met?
- When the science time is  $\geq 75\%$ ?

## Realities of being operational:

1. One of a kind – the prototype is the product
2. Reliability and maintenance experience must be gained through actual use
3. Being there first counts for a lot





# Summary

- A good process is important to the outcome
- Discipline and coordination can sometimes be painful, but the benefits are worth it
- No, it is not too much documentation!
- As we use the process we will learn from it and make changes