Research Projects

T-701-REM4

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Spring 2023

Overview of Today

- Starting a research project
- Basics of project management
- In-class exercise

Getting Started

How research projects begin:

- Interesting questions
- Interest in a topic became a specific investigation
- Forced to identify a problem to work on

Getting Started on a Research Project

- **Finding a question**
- **Working with an advisor**
- **Planning the research**

Steps of a Research Project

What kinds of stages and events does a researcher have to manage in order to produce an interesting, valid piece of work?

- Formation of a precise *question*, the answer to which will satisfy the aim of the research.
- Development of a detailed *understanding*, through reading and critical analysis of scientific literature and other resources.
- Gathering of *evidence* that relates to the question, through experiment, analysis, or theory. Use these to find out if the hypothesis underlying the question is supported.
- Linking of the question and evidence with an *argument*, a chain of reasoning.
- Description of the work in a publication.

The Special Thing About Research

- **Doing research involves a range of skills:**
  - Skills first learned under supervision
- **Research sometimes pursued as if it's something else:**
  - Experimentation as software development
  - Research write-ups as manuals or documentation
- **Research is a process that leads to papers and theses**

Beginnings

- **Student shopping around for ideas is typical**
- **First step is exploration:**
  - Guesses at what might be possible
- **Informal and formal conversation**
- **Writing and thinking**

Shaping a Research Project

- **Two main questions:**
  - What is the broad problem to be investigated?
  - What are the specific initial activities to undertake and outcomes to pursue?
- **From topic to research question:**
  - Explore what makes the topic interesting
- **Productive research is often driven by strong motivations**
- **Purely hypotheticals are difficult to evaluate**

Finding a Topic

- **Often students focus on the question:**
  - Is this the most interesting topic on offer?
- **Other important questions:**
  - Is this advisor right for me?
  - Am I drawn to this topic only because it’s fashionable?
  - Is this project at the right kind of technical level?

Many Topics Found in One Area

Examples of strengths and topics in the area of Web search:

- *Statistical* - Identify properties of Web pages that are useful in determining whether they are good answers to queries
- *Mathematical* - Prove that the efficiency of index construction has reached a lower bound in terms of asymptotic cost
- *Analytical* - Quantify bottlenecks in query processing and relate them to properties of computers and networks
- *Algorithmic* - Develop and demonstrate the benefit of a new index structure
- *Representational* - Propose and evaluate a formal language for capturing properties of image, video, or audio to be used in search.
- *Behavioural* - Quantify the effect on searchers of varying the interface.
- *Social* - Link changes in search technology to changes in queries and user demographics

Shaping a Research Project

- **Most projects that are intellectually challenging are interesting:**
  - You might not find *the* project
- **Consider is the barrier to entry:**
  - Knowledge, infrastructure, or resources required to work in some field
- **The project scale issue:**
  - Major breakthroughs are rare
- **Most research is to some extent incremental**
- **Pursue the smallest question that is interesting**

Planning

- **A typical research project has just one deadline:** Completion
- **Leave time for the write-up:**
  - Often the write-up is the only part of the work that survives or is assessed
- **Defining a project and setting milestones:**
  - Explicitly consider what is needed at the end, then reason backwards
- **Identify milestones and decompose into smaller activities as necessary**

Planning

- **Traditional research strategy:**
  - Read the literature, design, analyze or implement, test or evaluate, write
- **Alternative strategy:**
  - Overlap these stages more
  - Begin the implementation, analysis, and write-up, *if reasonable*
- **Be flexible:**
  - Break the work down
  - A schedule of long-term timelines that may be daunting

Research Proposal Structure

- **Introduction:**
  - Statement of objectives and focused research question
- **Literature review:**
  - Summary of the main findings of selected work in the relevant field
- **Methodology:**
  - Type of study and data collection proposed
- **Results:**
  - Potential outcomes and possible implications
- **Timeline for work**
- **References**

Students and Advisors

- **Each student-advisor *relationship* is unique**
- **Research programs provide students with training**
- **Student show skills to undertake research from conception to write-up:**
  - Working independently, producing novel and critical insights
- **Tasks advisors may ask of students:**
  - Verify a proof in a published paper
  - Attempt to confirm someone else's results
  - Define your boundaries
- **Apprenticeship model:**
  - Starting students on activities expected to lead to a research publication

Student-Advisor Relationship Progression

- **Early stages, tasks are more explicit:**
  - Run a certain experiment
  - Identify a suitable source of data
  - Search the literature to resolve a particular question
  - Writing one small section of a proposed paper
- **With time, relationship becomes guidance rather than management:**
  - Students take on more responsibility

Students-Advisor Relationship

- **Question of authorship of the student's work**
- **Degree of independence**
- **Advisor may think:**
  - Students are either demanding or overconfident
- **Student may feel:**
  - Confined by excessive control
  - Paralyzed by more responsibility and independence
- **Solution:**
  - Communication
  - Defining boundaries

Advice for Students

- **Advisor expert in scoping the project:**
  - Allow for freedom, yet make sure it can succeed
- **Prepare for your meetings**
- **Be honest**
- **Advisor also benefits from student working on research**

Successful Research Students

1. Show willingness to read widely, explore the field beyond their specific topic, to try things out, and take part in the academic community
2. Have enthusiasm to develop interest in some area and ask for advice on how that can be turned into a thesis project
3. Have ability and persistence to undertake a detailed investigation of a specific facet of a larger topic.
4. Take initiative in terms of what needs to be done and how to present it, gradually assuming responsibility for all aspects of the research
5. Systematic and organized, understand the need for rigor, discipline, stringency, quality, and high standards.
6. Actively reflect on habits and working practices, seek to improve themselves and overcome their limitations and knowledge gaps
7. Work has the form and feel of high-quality published papers
8. Have strength to keep working despite significant failed or unsuccessful activity

Getting Started Checklist

- Is your proposed topic clearly a research activity? Is it consistent with the aims and purposes of research?
- How is your project different from, say, software development, essay writing, or data analysis?
- In the context of your project, what are the area, topic, and research question? (How are these concepts distinct from each other?)
- Is the project of appropriate scale, with challenges that are a match to your skills and interests? Is the question narrow enough to give you confidence that the project is achievable?
- Is the project distinct from other active projects in your research group? Is it clear that the anticipated outcomes are interesting enough to justify the work?
- Is it clear what skills and contributions you bring to the project, and what will be contributed by your advisor? What skills do you need to develop?
- What resources are required and how will you obtain them?
- What are the likely obstacles to completion, or the greatest difficulties? Do you know how these will be addressed?
- Can you write down a road map, with milestones, that provides a clear path to the anticipated research outcomes?
- Do you and your advisor have an agreed method for working together, with a defined schedule of meetings?

Basics of Project Management

Project Management

- You have all done project management to some extent

Basic definitions:

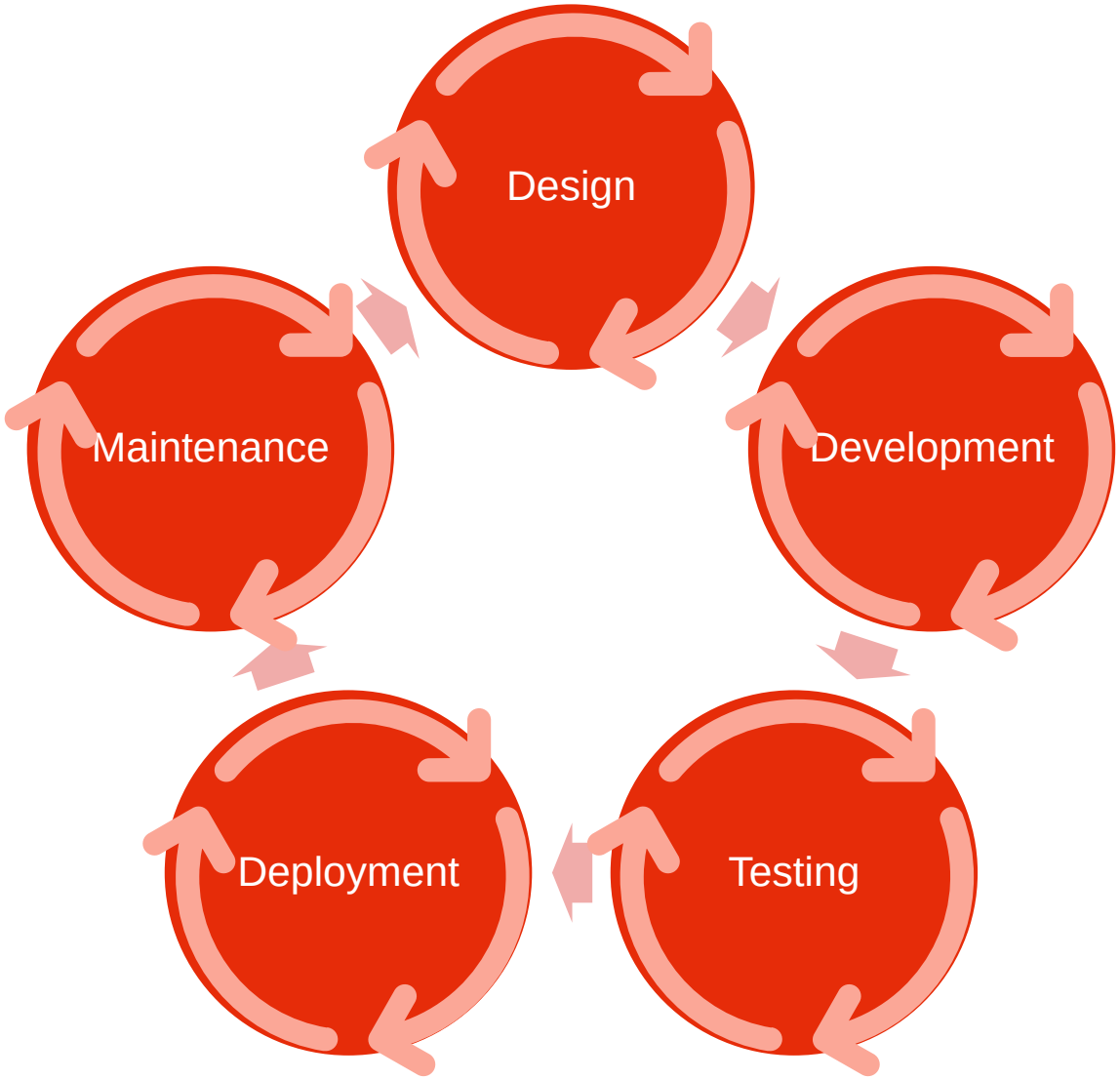
- PM: Planning and organizing a project and its resources
- Project: Temporary endeavor to create a unique solution

https://www.pmi.org

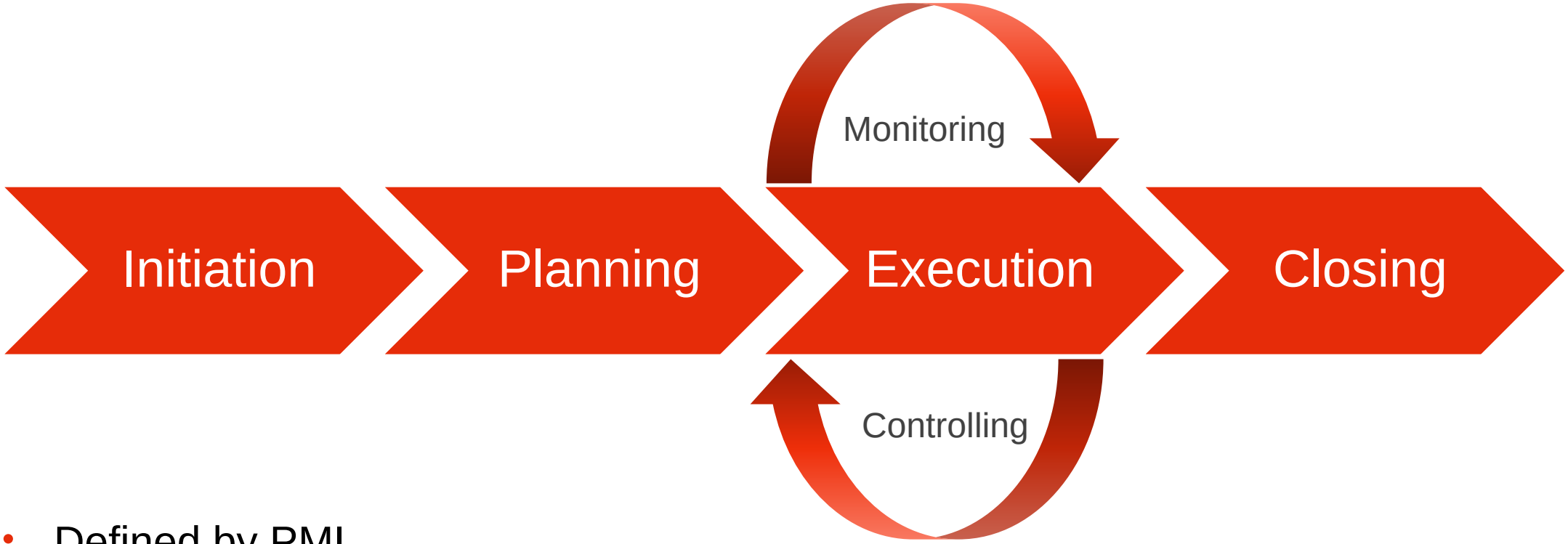
Deniz Sasal
PwC Consulting

Project Life Cycle

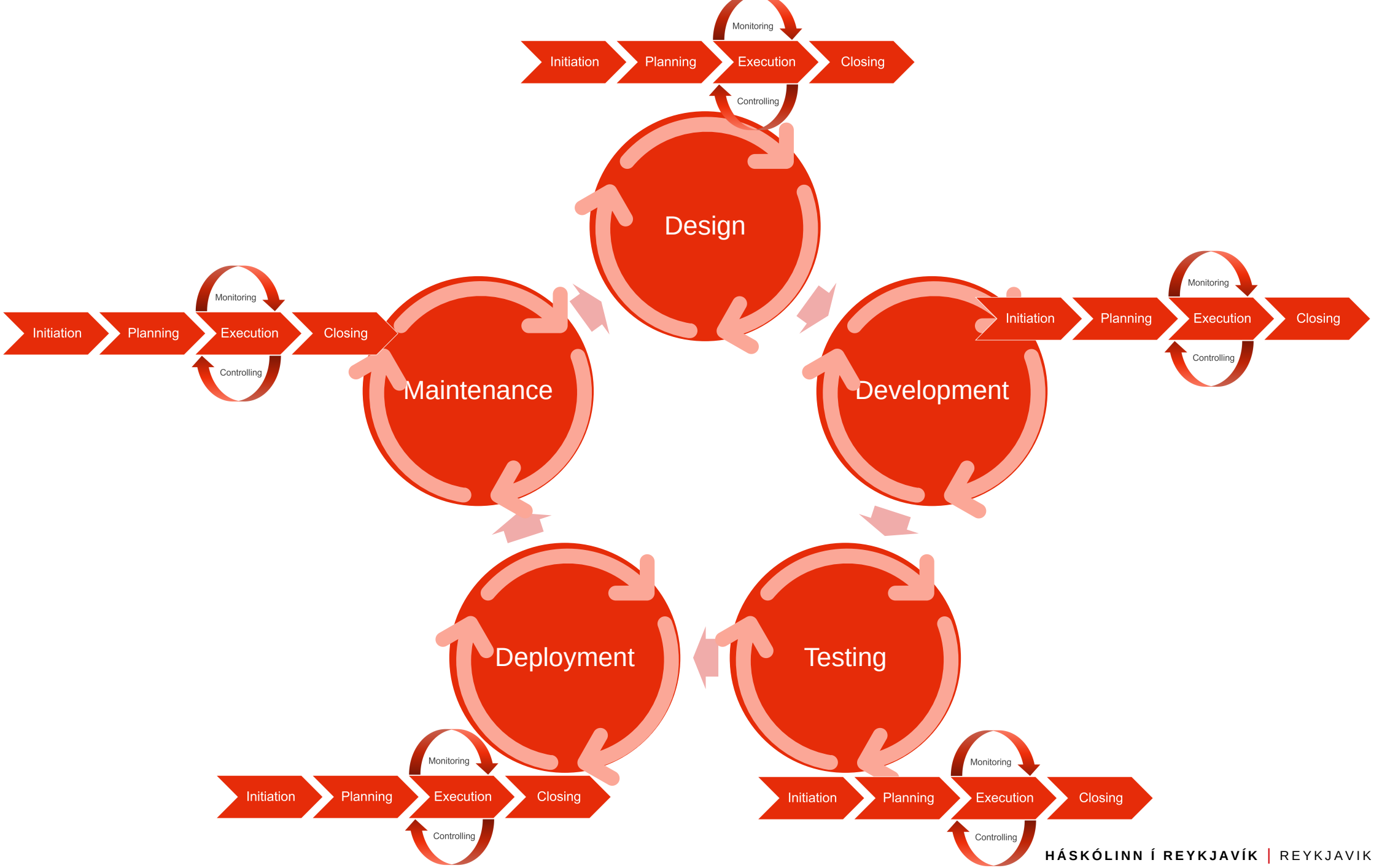
- **Example:** App development cycle with five phases
- PLC will be specific to your project
- Should meet your your needs



Project Management Process Groups



- Defined by PMI
- Should not change (much)


Monitoring
Initiation
Planning
Execution
Closing
Controlling
Design
Monitoring
Initiation
Planning
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Maintenance
Development
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Closing
Controlling
Deployment
Testing
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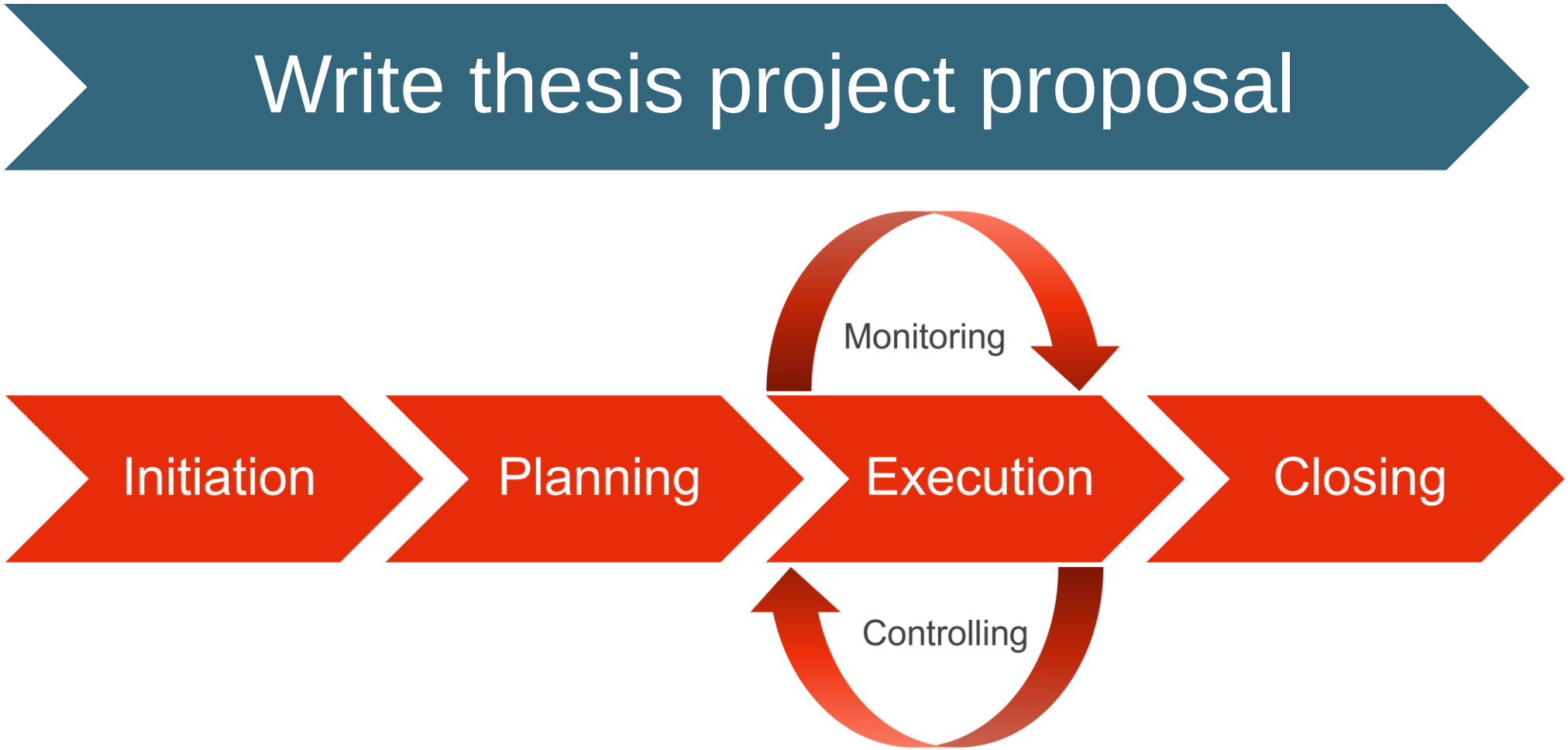
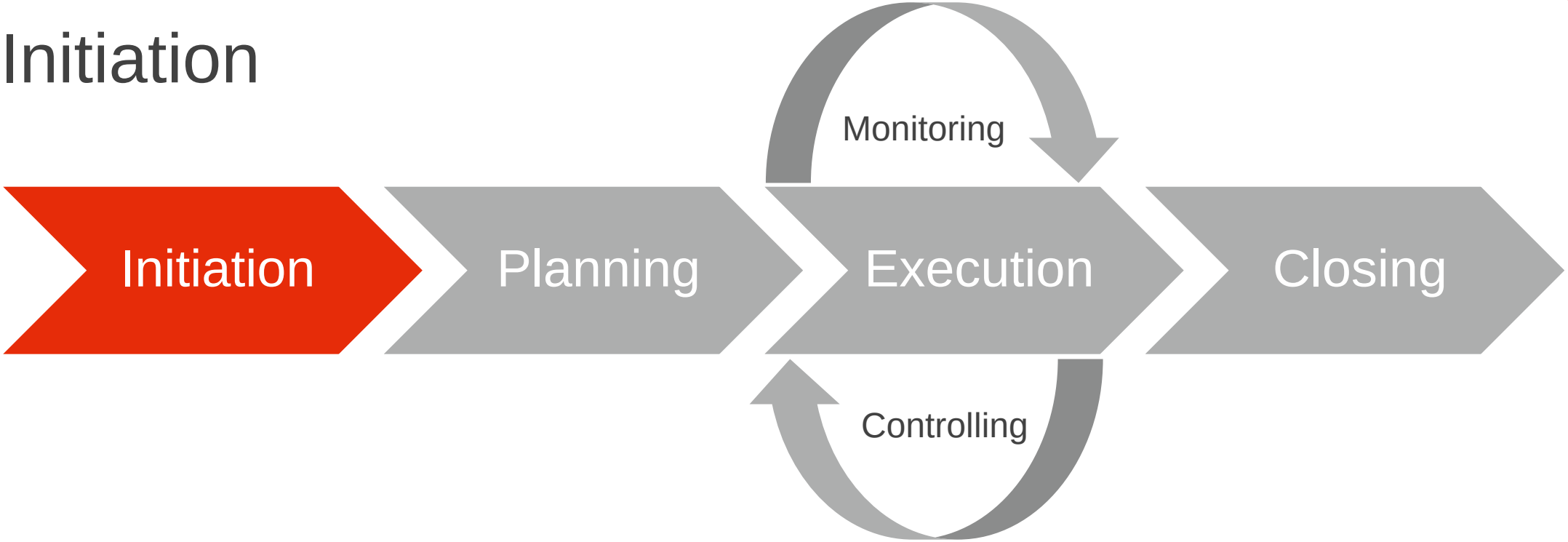
Closing
Controlling

Smaller Projects – One Phase Life Cycle

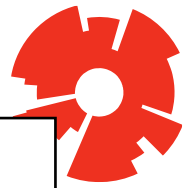


Initiation



- Project charter
- Identify stakeholders

Project Charter



1 Business Case

- To further my career
- Advancing science

2 Project Objectives

- Complete MSc in CS
- Produce paper for publication

3 Major Deliverables

- Project proposal
- Project management documents
- MSc thesis
- Research paper

4 Roles & Responsibilities

- Project manager: successful project execution and completion
- Advisor: guaranteeing support

5 Stakeholders

- Myself
- Advisor
- Family

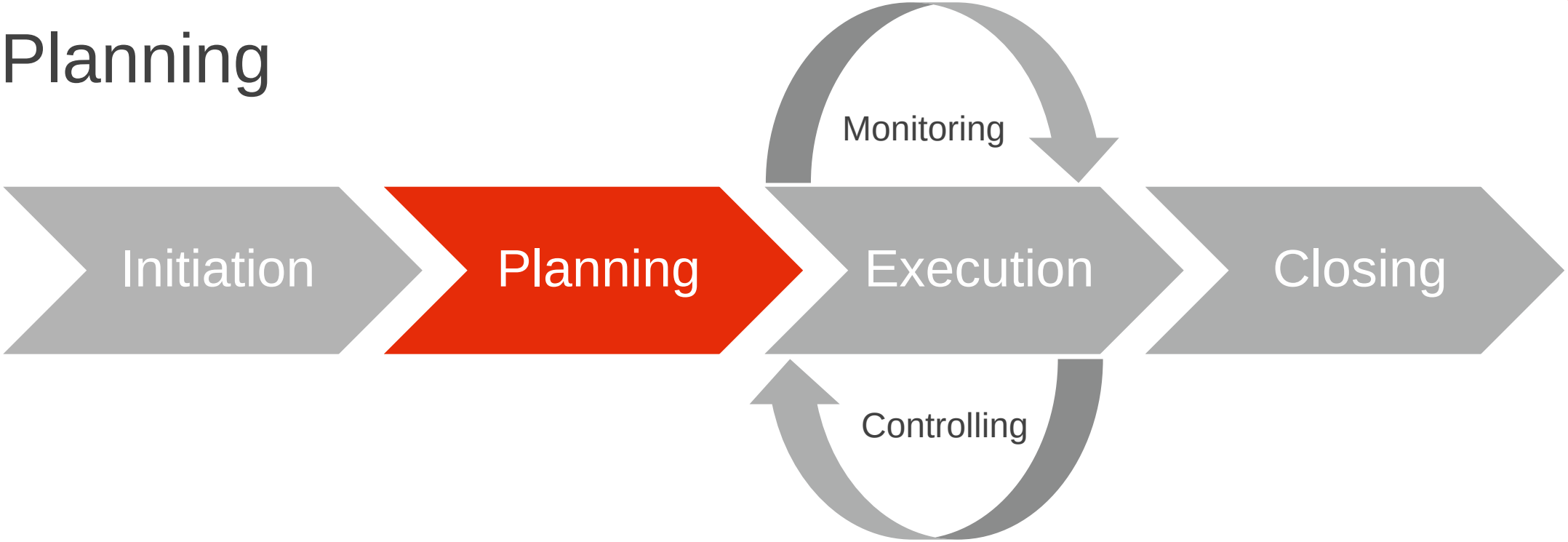
6 Assumptions

- Access to resources

Identify Stakeholders

- **Who is the project sponsor?**
  - The one giving the go-ahead
- **Who is the manager?**
  - You?
- **Who is on the project team?**
  - Others involved

Planning



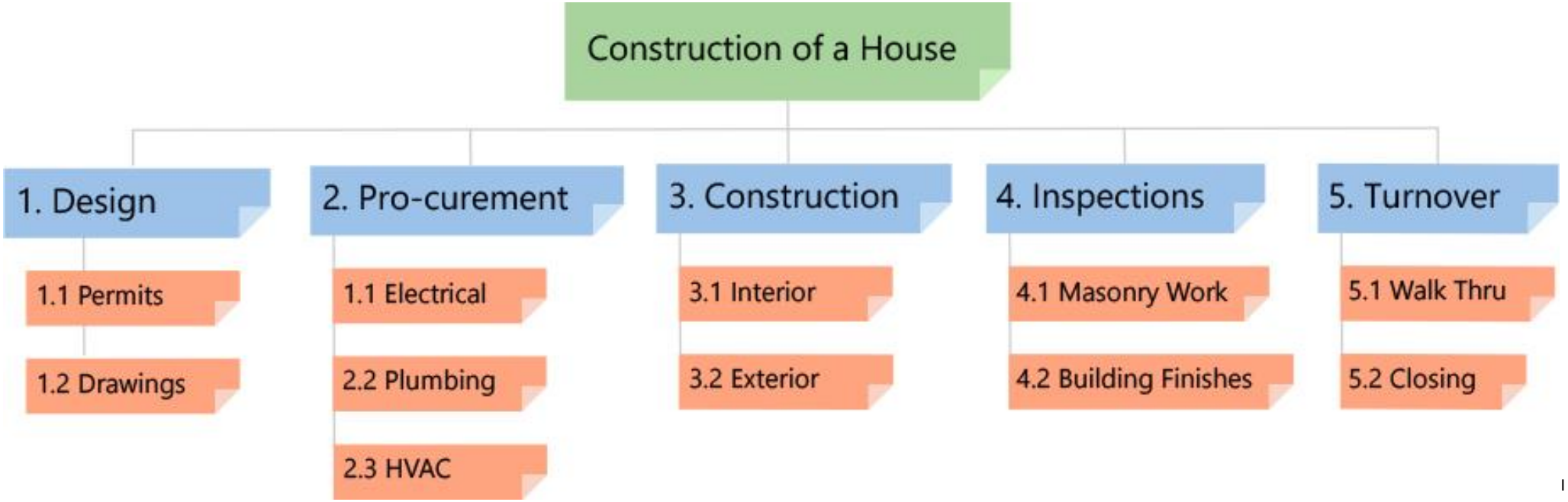
- What are we going to do?
- How are we going to do it?
- How do we know when the project is done?

Components of Planning

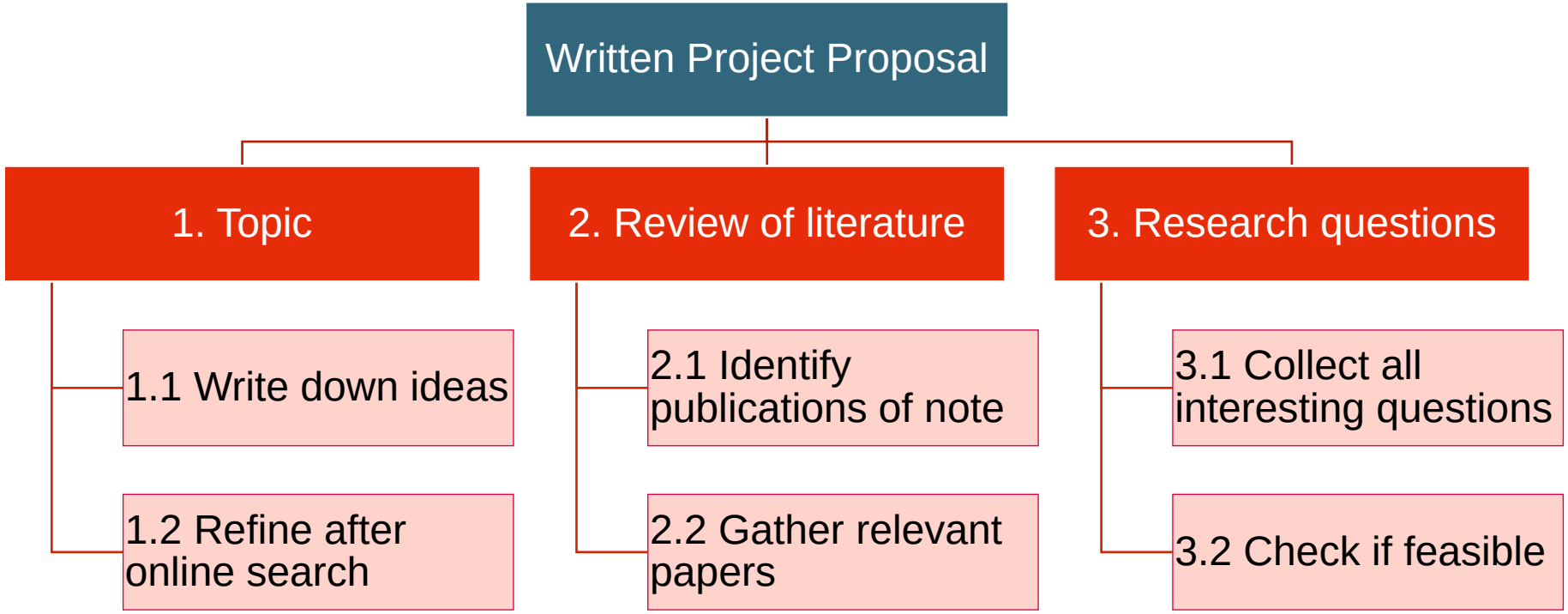
- **Project requirements:**
  - Gathered from stakeholders
- **Project scope:**
  - Justification, scope statement, deliverables, project success criteria
- **Work breakdown structure**
- **Schedule**
- **Budget**
- **Based on project need:**
  - Risk, Quality, HR, Communications

Work Breakdown Structure – WBS

- **Decomposing into deliverables:**
  - Manageable pieces - work packages
  - Can you confidently estimate the cost and time requirements of that work package?



Work Breakdown Structure – WBS



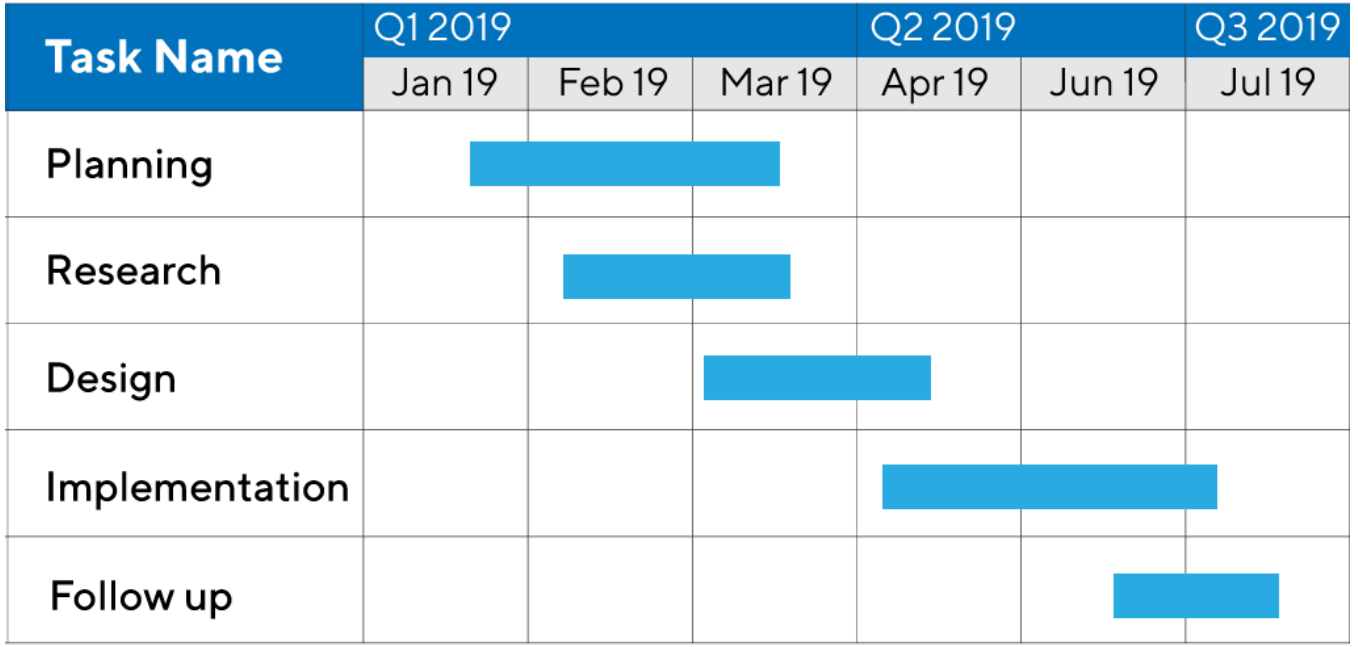
WBS Dictionary

- How to avoid scope creep
- Putting boundaries around work packages

WBS *Level*	WBS *Code*	WBS *Name*	WBS *Description*
1	1	Pre Project Implementation	Looking at the market conditions, what products are needed by the market
2	1.1	Initial Product Concept	Survey product prices and target ages
3	1.1.1	Market Analysis	Determine major themes for projects and book content, product details (doll products, pop ups, eva books, tool boxes, etc.), and advanced technology that can be included in the product so that the user gets a different experience
3	1.1.2	Survey	Make a product concept
3	1.1.3	Determination of Themes and Product Details	Make concept revisions
3	1.1.4	Make a product concept	Perform ACC concept
3	1.1.5	Concept revision	Survey product prices and target ages
3	1.1.6	ACC concept	Determine major themes for projects and book content, product details (doll products, pop ups, eva books, tool boxes, etc.), and advanced technology that can be included in the product so that the user gets a different experience
. . . . .	. . . . .	. . . . .	. . . . .
1	2	Project Implementation	
2	2.1	Book Concept	

Scheduling

- Allocate time for each work package
- Can’t do it? Then break the WP down further
- Common tool: Gantt chart
- Google Sheets Gantt Template



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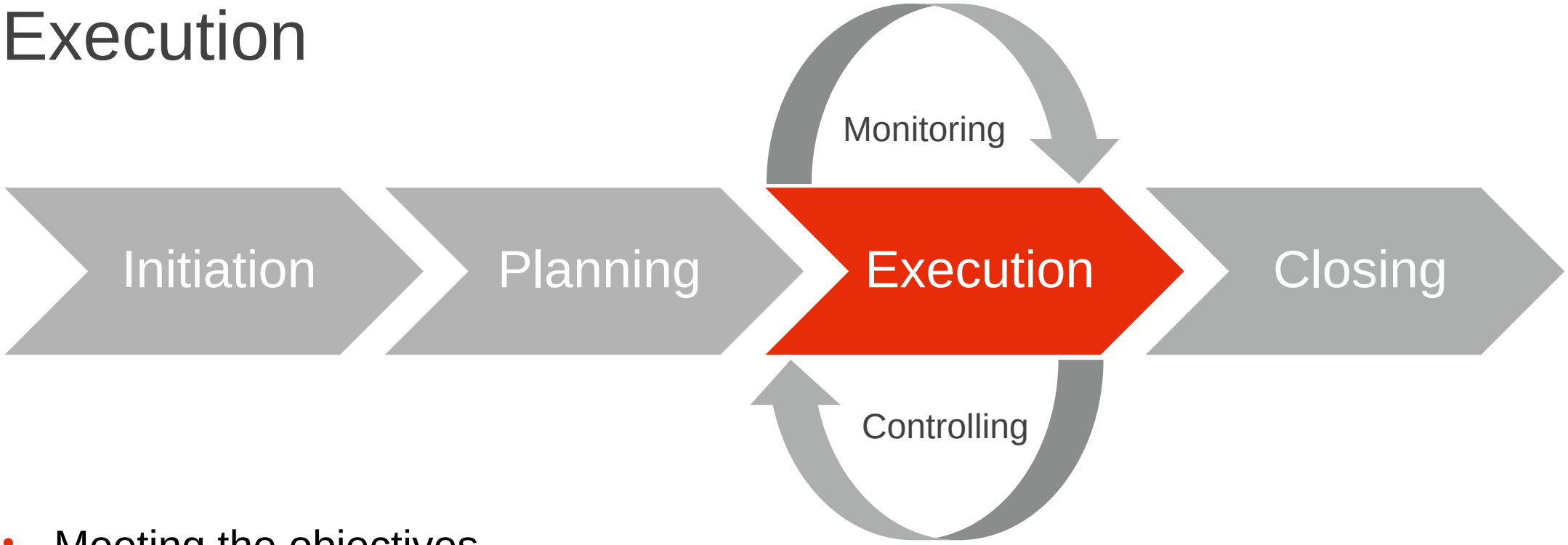
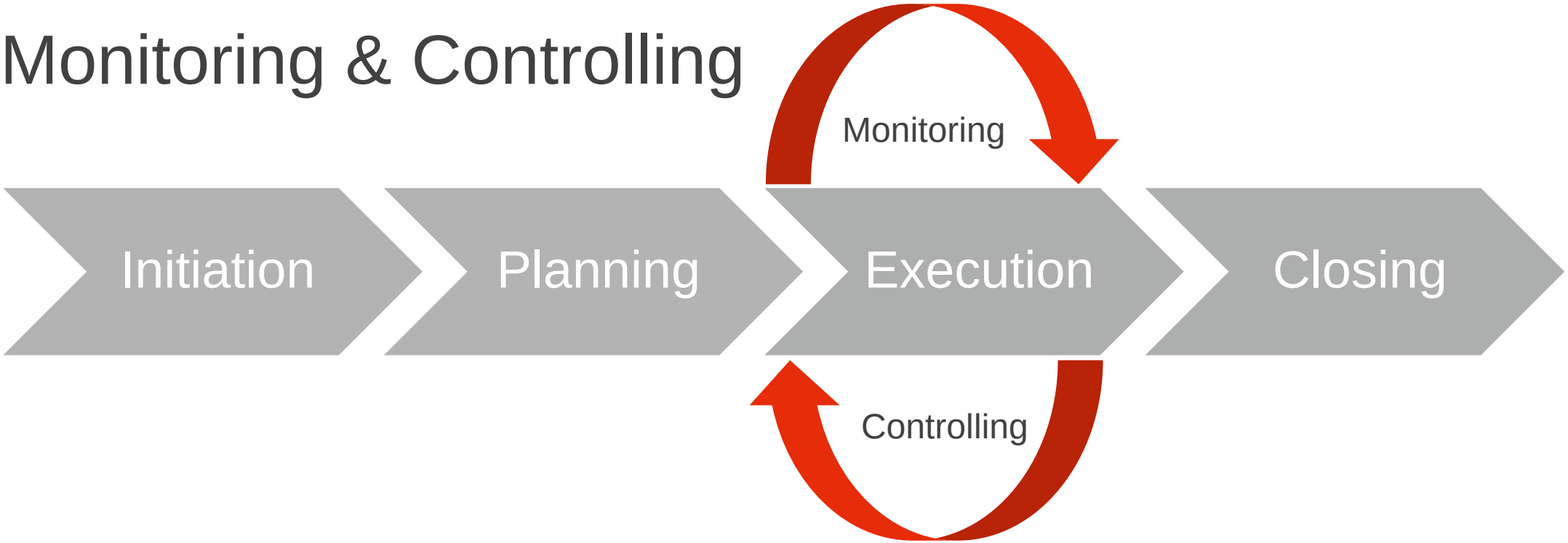
Execution



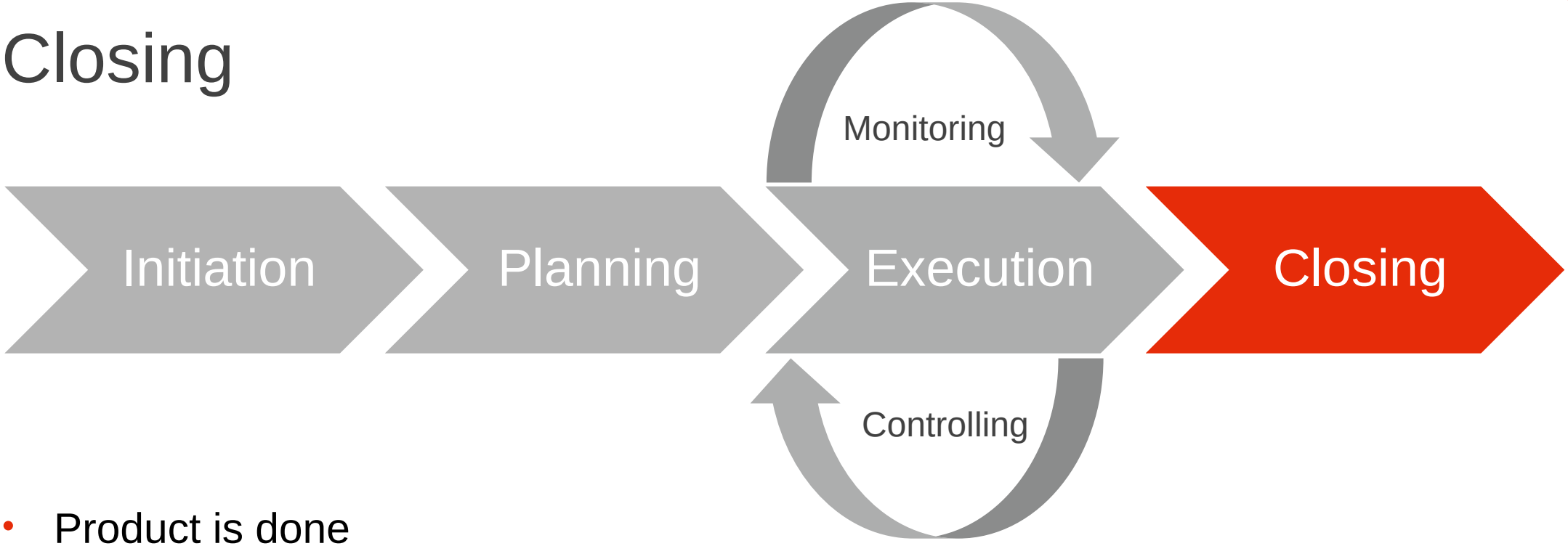
- Meeting the objectives
- Follow processes
- Depends on good planning
- Prevent scope creep

Monitoring & Controlling



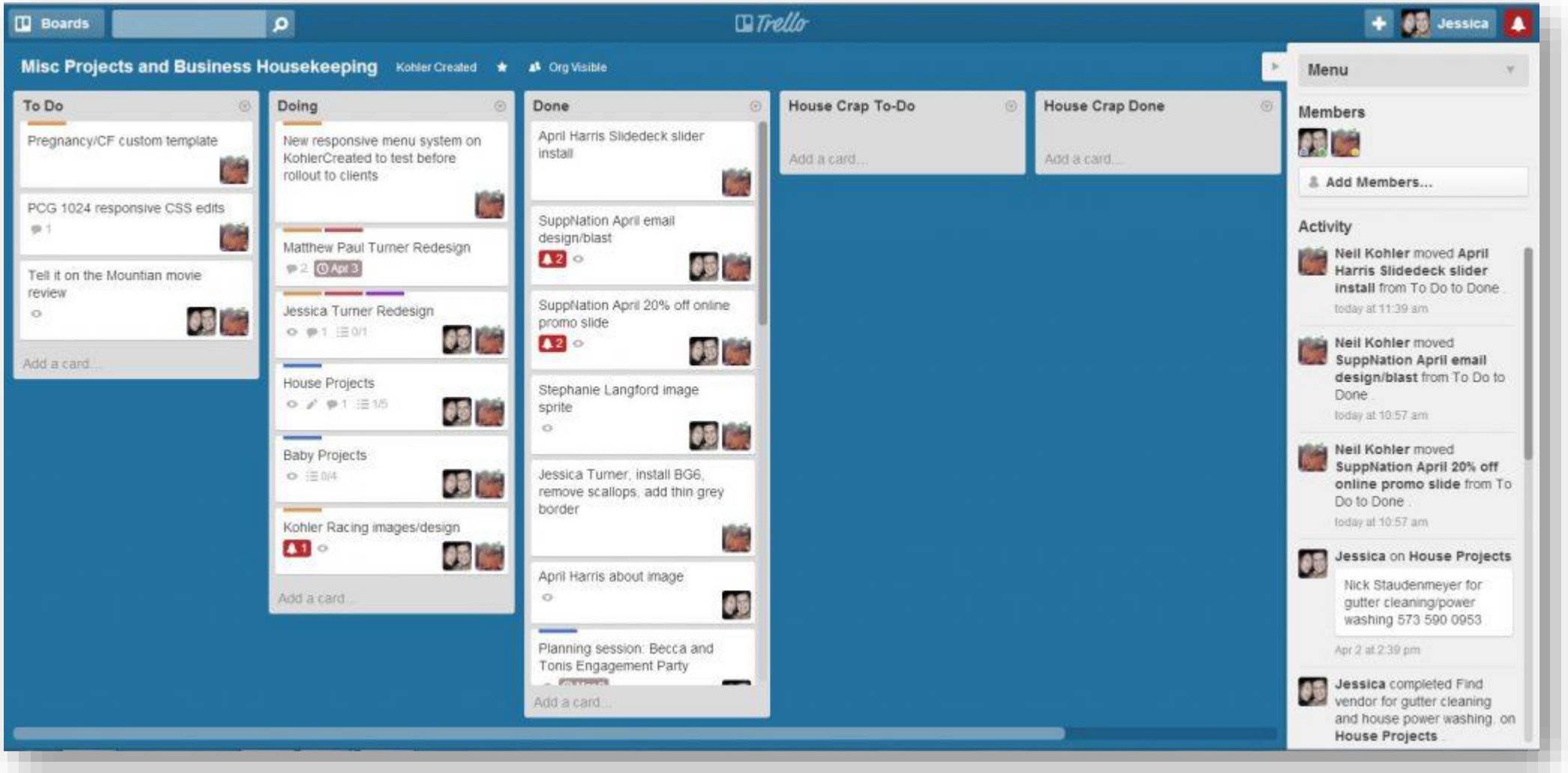
- Measuring performance of project against the plan
- Manage change requests
- Monitor scope and schedule per work package
- Document activities

Closing



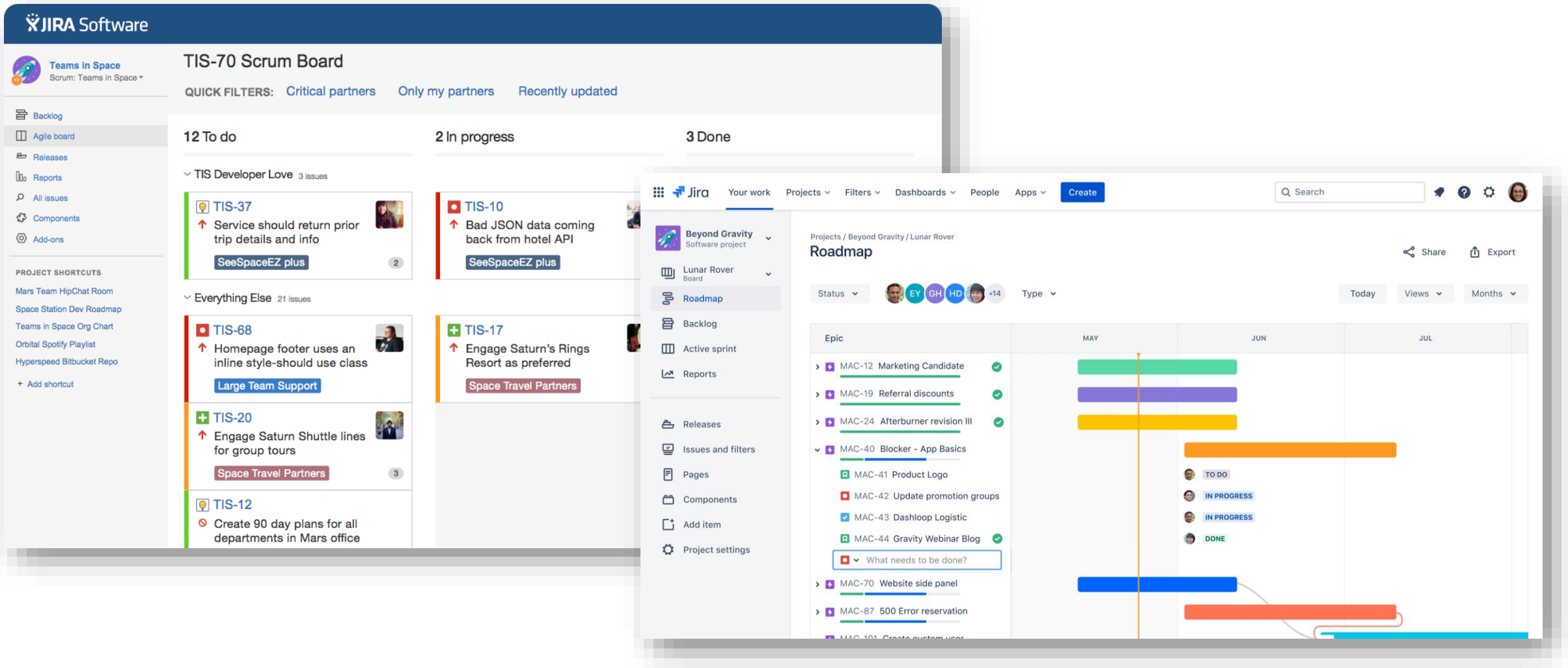
- Product is done
- Hand over the end product: Sign-off
- Complete payments and cost records
- Gather lessons learned
- Release resources

Popular Tools for Projects
Trello



Popular Tools for Projects

Jira



Exercise

1. Define for the project:
   - Scope, objectives, resources, and schedule
2. Consider what approach or tools are most appropriate for managing this project