

Software Engineering Project

Morgan Ericsson

- ✉ morgan@cse.gu.se
- 🐦 [@morganericsson](https://twitter.com/morganericsson)
- ⌚ [morganericsson](https://www.instagram.com/morganericsson)
- 🌐 [morganericsson](https://www.linkedin.com/in/morganericsson)



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Software Engineering: Report of a conference sponsored by the NATO Science Committee, Garmisch, Germany, 7-11 Oct. 1968

Software Crisis and Engineering

- Established as a reaction to the “Software Crisis”
 - software was **inefficient**
 - software did not meet **requirements**
 - projects ran **over time/budget**
 - projects were **unmanageable** and software **unmaintainable**



“The major cause of the software crisis is that the machines have become several orders of magnitude more powerful! To put it quite bluntly: as long as there were no machines, programming was no problem at all; when we had a few weak computers, programming became a mild problem, and now we have gigantic computers, programming has become an equally gigantic problem.”

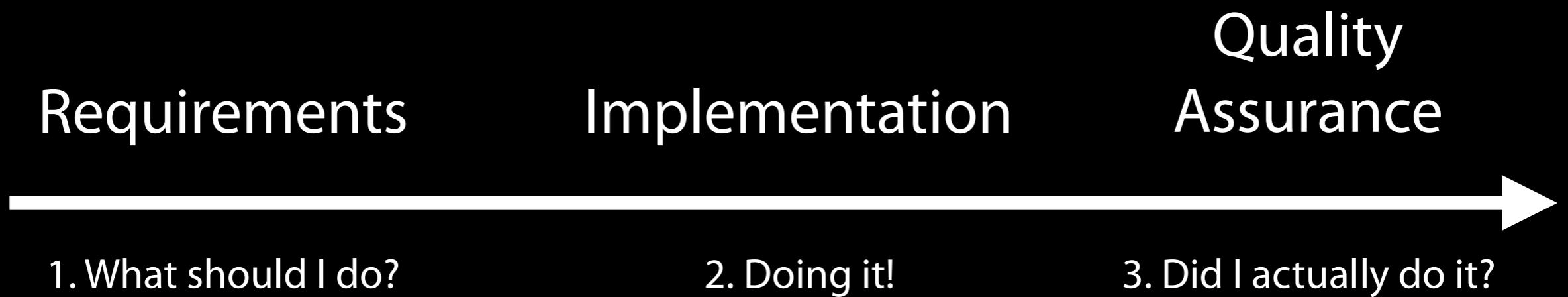
Software Engineering

- The **branch** of computer science that creates **practical, cost-effective solutions** to computing and information processing **problems**
- *“Application of engineering to software”*
 - **systematic, disciplined, quantifiable** approach to the **development, operation, and maintenance** of software
- Assure the **quality** of the process and the **product**

“Engineering Seeks Quality”

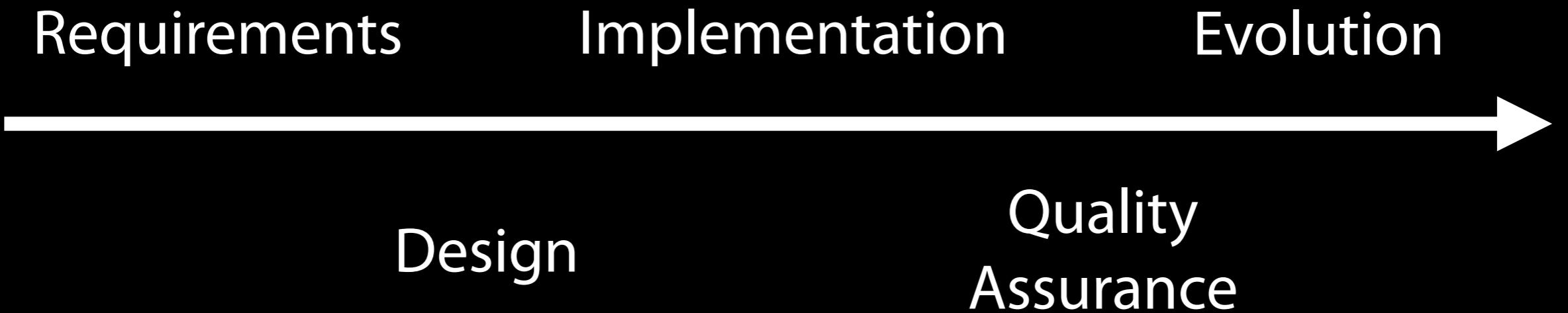
- So, the goal of software engineering is the **production of quality software**
- However, software is **inherently complex**
 - the complexity of software systems often **exceeds the human intellectual capacity**
 - The task of the software development team is to **engineer the illusion of simplicity**

Three Steps Revisited



A **sequential** model of software development

Five Steps



A **sequential** model of software development

The Five Steps/Phases

- Requirements
 - understanding the **problem domain**
 - communication between **stakeholders**
- Design
 - engineer a solution that **addresses the requirements**
 - technology, algorithms, architecture, interfaces...

The Five Steps/Phases

- Implementation
 - **realizing** the design
 - documentation, configuration, standards, tools, ...
- Quality Assurance
 - **ensuring** that the implementation meets quality standards
 - testing, analysis, reviews

The Five Steps/Phases

- Evolution
 - fixing problems
 - adding new functionality/address new requirements
 - while retaining existing functionality and code

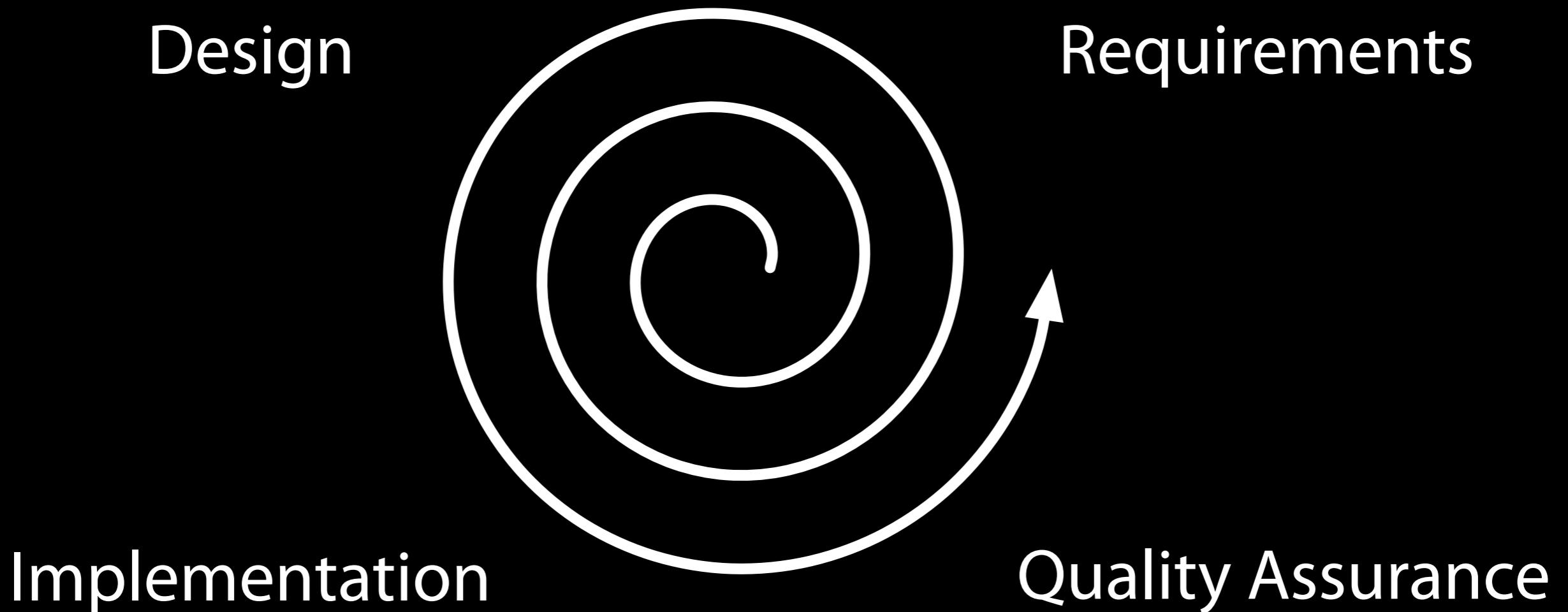
Software Engineering



Change is Ubiquitous

- Manage
 - change
 - uncertainty
 - quality

Change is Ubiquitous



An **iterative** model of software development

Defined Process vs. Empirical Process

- Laying out a process that **repeatedly** will produce **acceptable quality output** is called **defined process control**
- When defined process control **cannot be achieved** because of the **complexity** of the intermediate activities, something called **empirical process control** has to be employed

Production vs. Creation



Defined Process control

- Planning and typically pre-study heavy
- Assumes (more) static environment
- Longer iterations
- Change management intensive
- Assumes good estimations
- Control over actual work (seen as bureaucratic)

Empirical Process control

- Change is reality
- Shorter iterations
- Problem vs. solution space (empowering the developers)
- Just enough (management, documentation, etc.)
- Self organizing teams
- Continuous “customer” interaction
- NOT UNPLANNED, rather adaptive!!!

In reality/practice

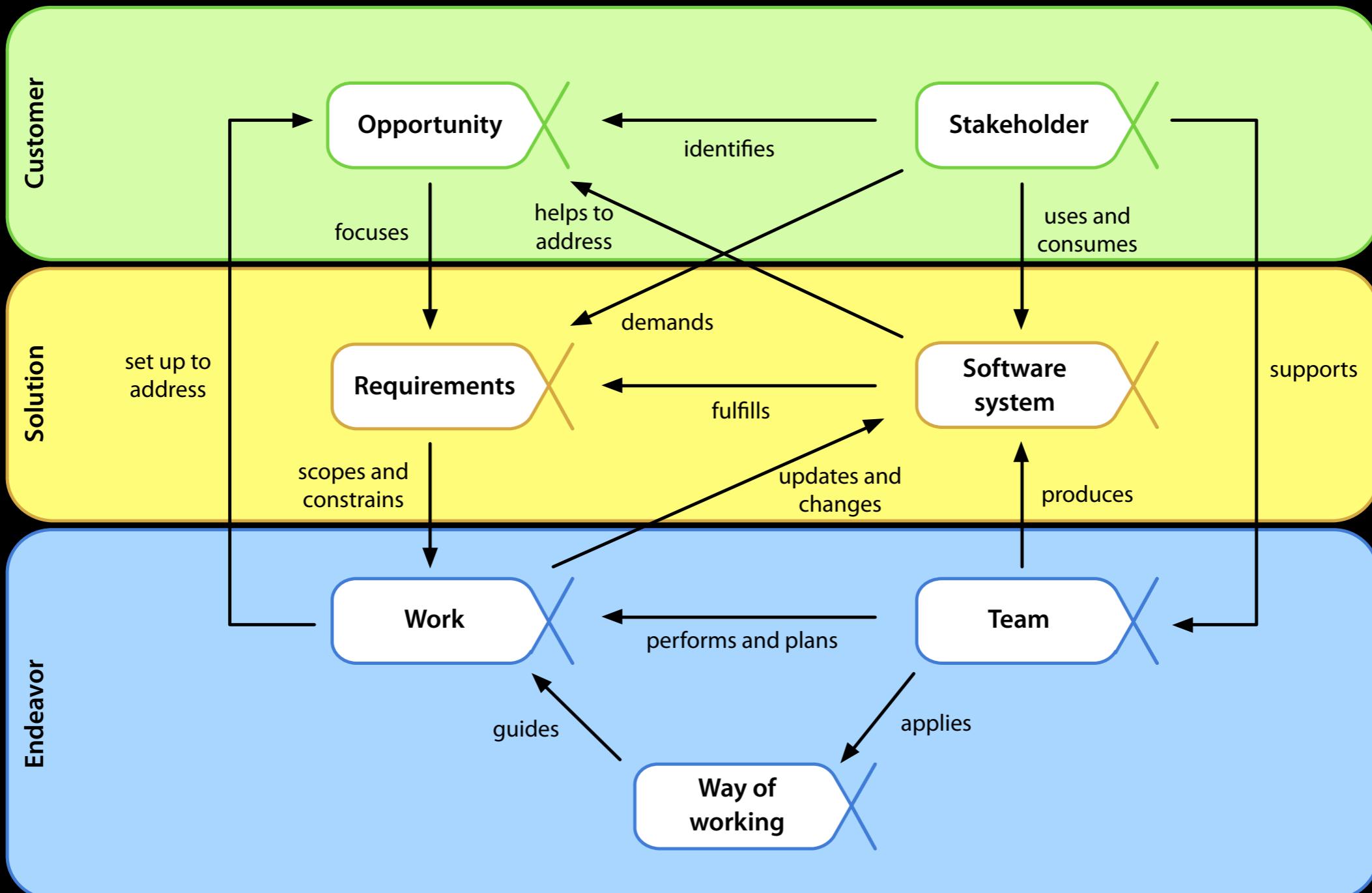
- Many different
 - processes
 - methodologies
 - practices
 - ...

SEMAT

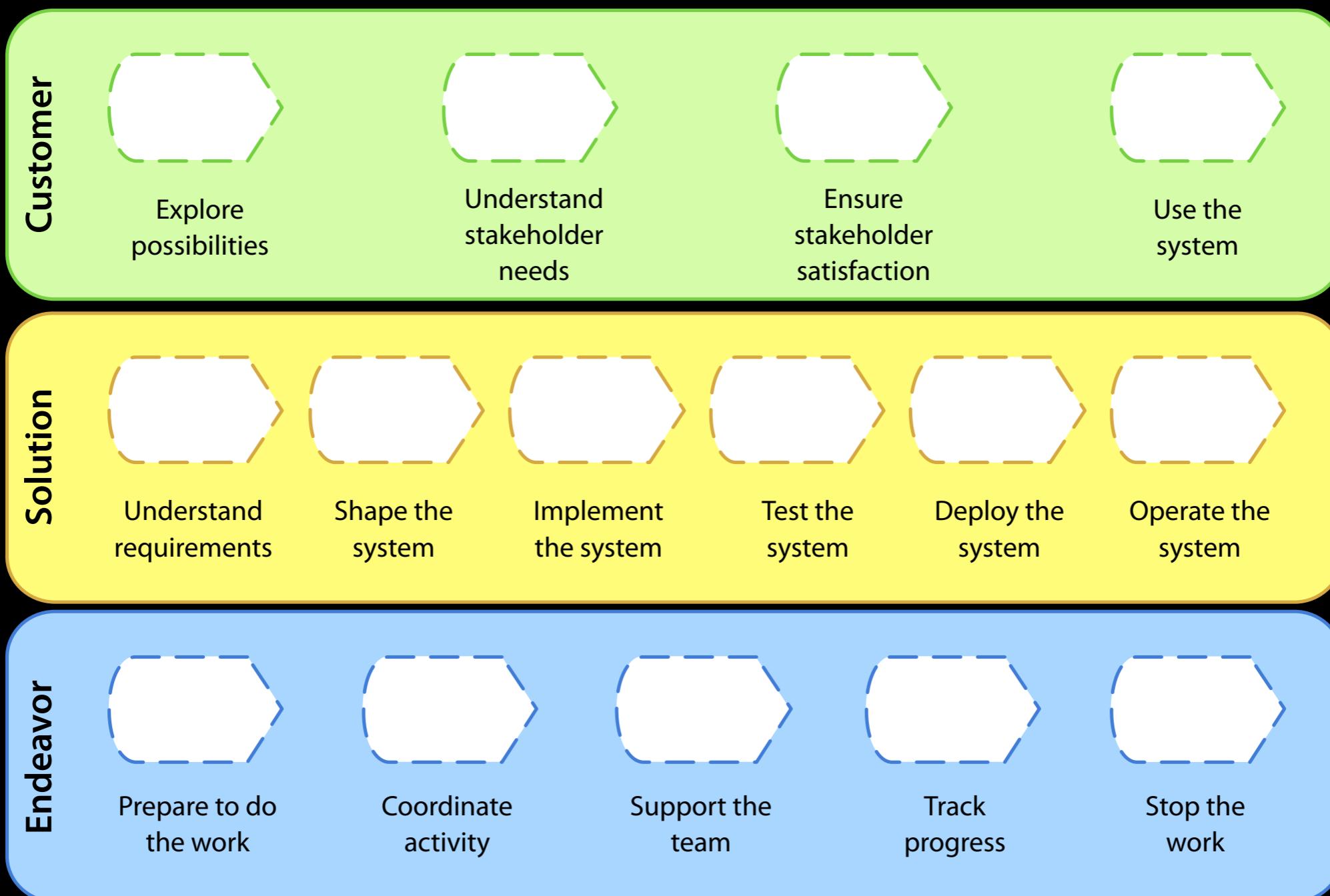
Software Engineering Method And Theory

<http://semat.org>

Things to work with



Things to do



Fred: “*The requirements go in different directions, so our work is not converging on anything that can be released.*”

Eric: “*The proposed software architecture doesn't seem to solve the right problems, but I don't know how to drive it forward.*”

What can we do to help them?

Susan: “*Management is panicking and throwing more developers on the team, but we already have difficulty coordinating the existing team members.*”

Steve: “*I have to spend a lot of time pretending I am following the mandated development process and producing documentation that isn't really useful for anyone.*”

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What can we do to help them?

Getting to the Heart of the Problem

- The system should **meet a business need** or an **opportunity**
 - **what** is that need?
- The system must **provide** some **value**
 - **what** was that value?
- If the value is **not understood**, there is **no point** in **debating** detailed requirements

Getting to the Heart of the Problem (cont'd)

- Were the stakeholders **engaged** and **thinking** about requirements?
- Were the stakeholders in **agreement**?
- Do they have the **required knowledge** of the **system** and its **users**?

Getting to the Heart of the Problem (cont'd)

- Did Fred have a clear **understanding** of
 - scope?
 - requirements?
 - risks?
- Was he focusing on requirements in the **right order**?
- Was he trying to get **too many** requirements nailed down **up front**?

Getting to the Heart of the Problem (cont'd)

- Do stakeholders have a good understanding of the **existing** software system?
 - capabilities
 - limitations
- Is the system (and architecture) **robust** in the face of **change**?

Getting to the Heart of the Problem (cont'd)

- Do the team have the competence to get the job done?
- Is the team working together as a unit?
- Are there conflicts waiting to surface?

Getting to the Heart of the Problem (cont'd)

- Were the problems due to
 - a need to find work for all the team members?
 - the way the work had been planned?
- Was the team working on the wrong things because of a previous planning error?

Getting to the Heart of the Problem (cont'd)

- Were the problems **caused** by the **method**?
 - requirements diverged because it insisted that all **requirements** were detailed **before design** and **implementation**?

Addressing the Challenge

- Explore Possibilities
 - opportunity is the **reason** for a new or changed software system.
 - Understand the **need** for changes or features
 - Make sure that **value is established** is for this opportunity

Addressing the Challenge (cont'd)

- Understand Requirements.
 - get the requirements **bounded**
 - then **find** the **most important requirements** to drive further clarification
- Walk through end-user scenarios

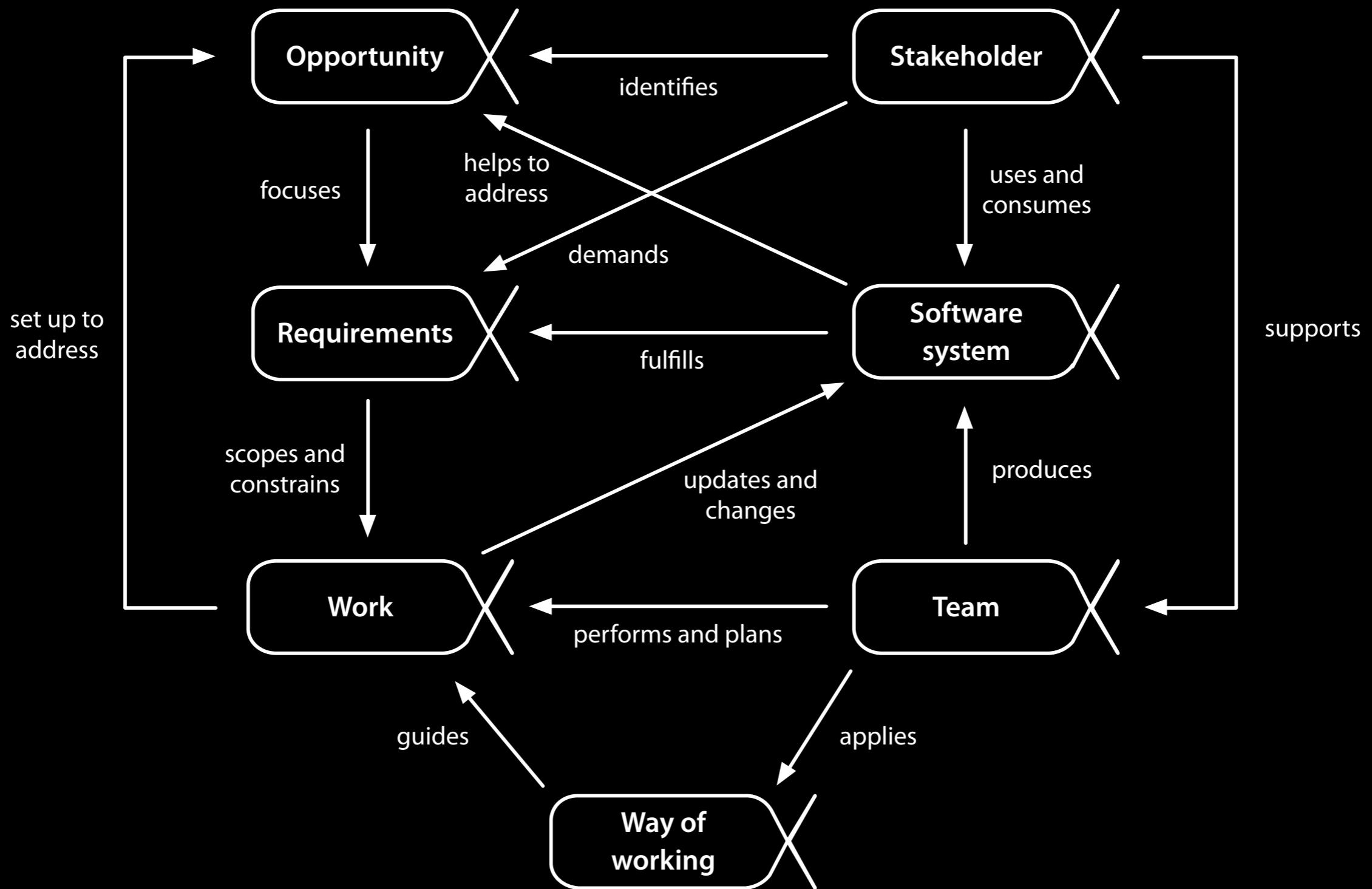
Addressing the Challenge (cont'd)

- Shape the System
 - implement the software system
 - make it demonstrable
- Confirm with stakeholders that the system is on the right track

Introducing the Alphas

- Things whose **evolution** we want to
 - understand
 - monitor
 - direct
 - control
- **Aspiration Led Progress and Health Attribute**

Introducing the alphas



The Requirements alpha

Requirements

Conceived

Bounded

Coherent

Acceptable

Addressed

Fulfilled

Getting to the Heart of the Problem

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Getting to the Heart of the Problem (cont'd)

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Getting to the Heart of the Problem (cont'd)

- Were the problems **caused** by the **method**?
 - requirements diverged because it insisted that all **requirements** were detailed **before design and implementation**?

Getting to the Heart of the Problem

Opportunity

- what was that value?
- If the value is **not understood**, there is **no point** in debating detailed requirements

Getting to the Heart of the Problem (cont'd)

Software system

- **limitations**
- Is the system (and architecture) **robust** in the face of **change**?

Getting to the Heart of the Problem (cont'd)

Stakeholder

- Do they have the **required knowledge** of the **system** and its **users**?

Getting to the Heart of the Problem (cont'd)

Requirements

- Was he focusing on requirements in the **right order**?
- Was he trying to get **too many** requirements nailed down **up front**?

Getting to the Heart of the Problem (cont'd)

Team

- Are there **conflicts** waiting to surface?

Getting to the Heart of the Problem (cont'd)

Work

- Was the team working on the **wrong things** because of a previous **planning error**?

Getting to the Heart of the Problem (cont'd)

Way of working

before design and implementation?

The Kernel

- Essential things to **progress** and **evolve**
 - alphas
- Essential things to **do**
 - activity spaces
- Essential **capabilities** needed
 - competencies

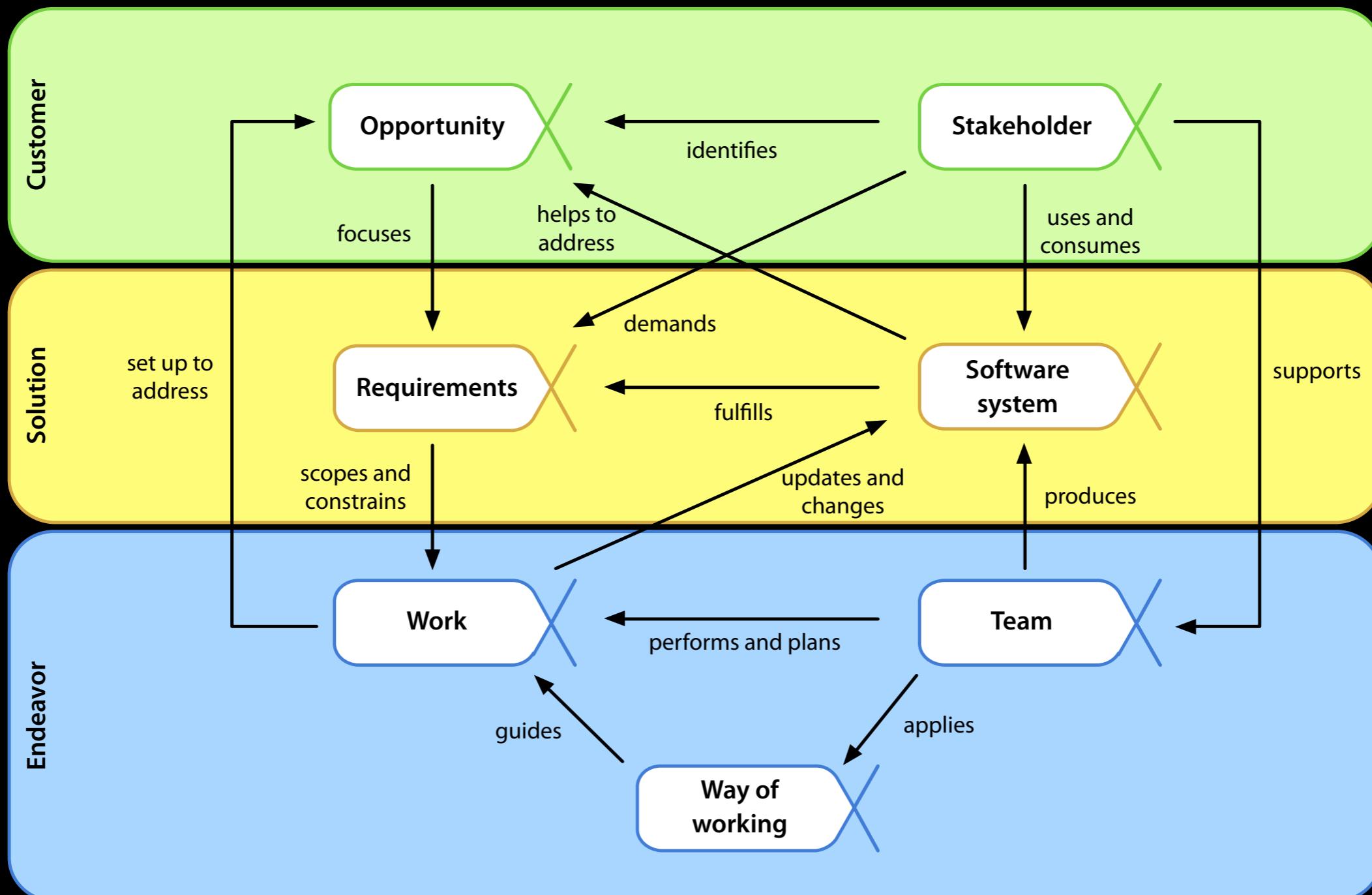
Areas of concern

Customer

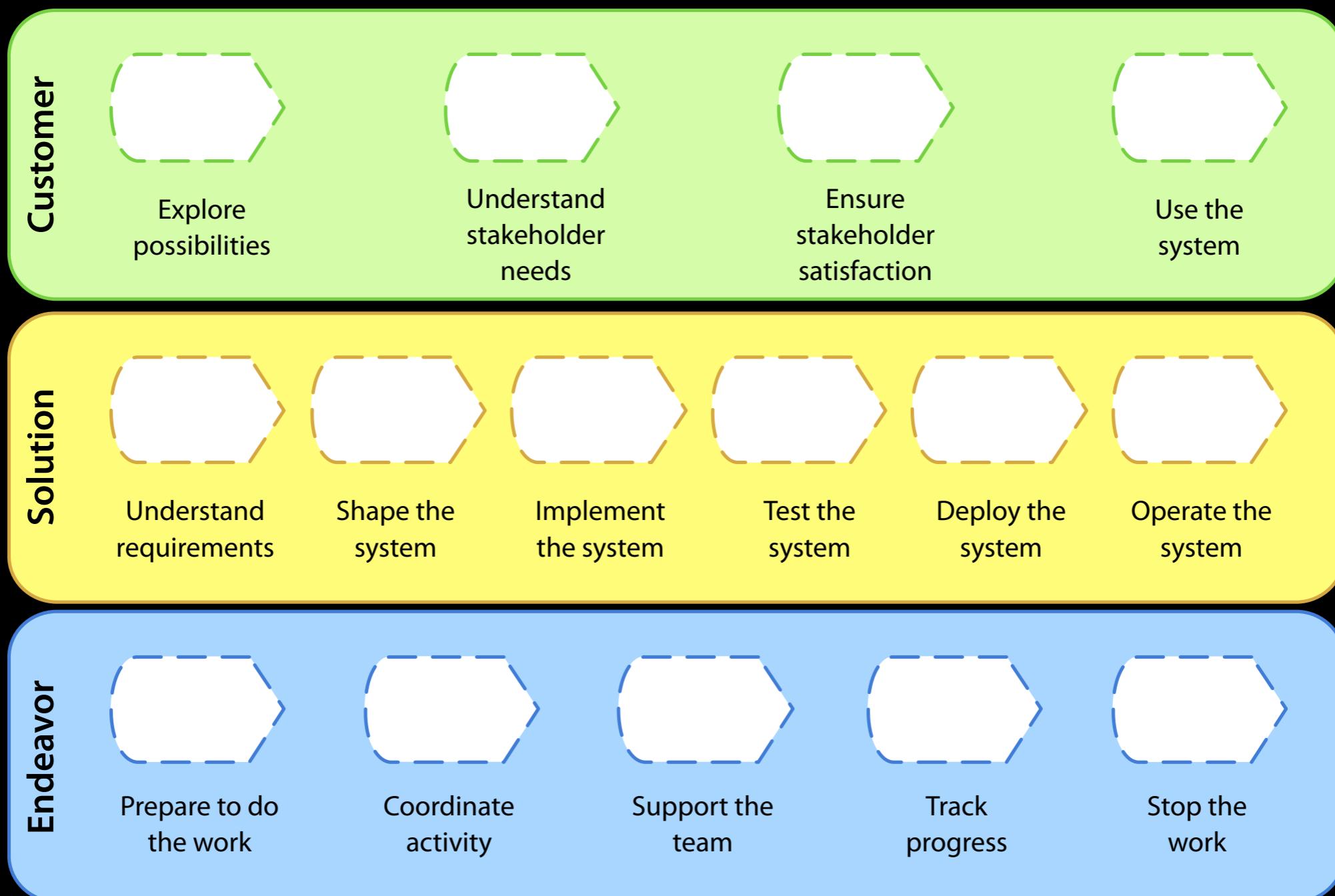
Solution

Endeavor

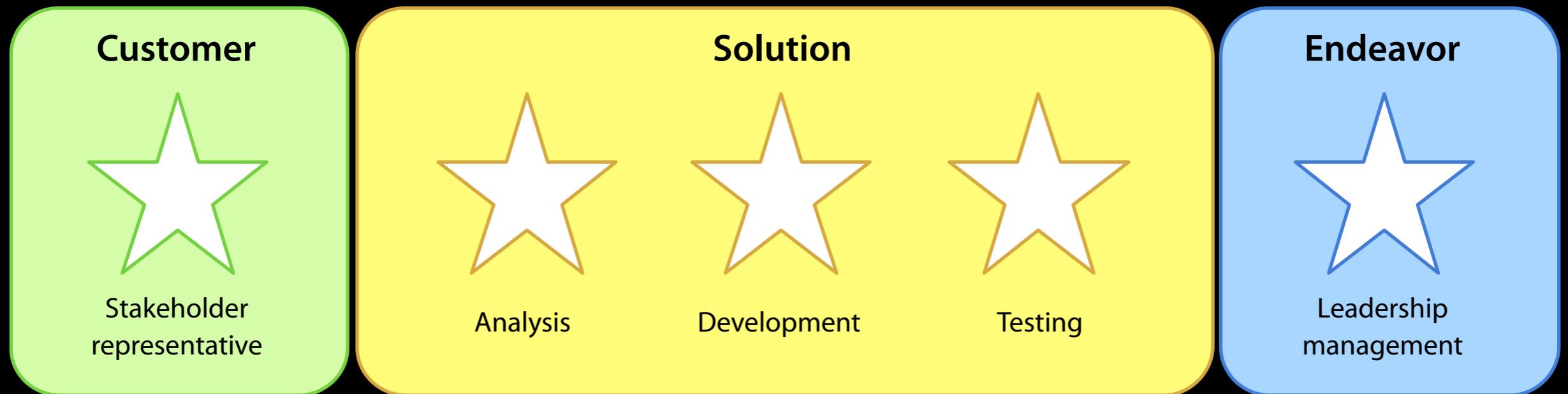
The kernel alphas



The kernel activity space



Competencies



Week 2

- Monday: SEMAT
- Wednesday: SEMAT continued
- Sunday: Submit app vision