

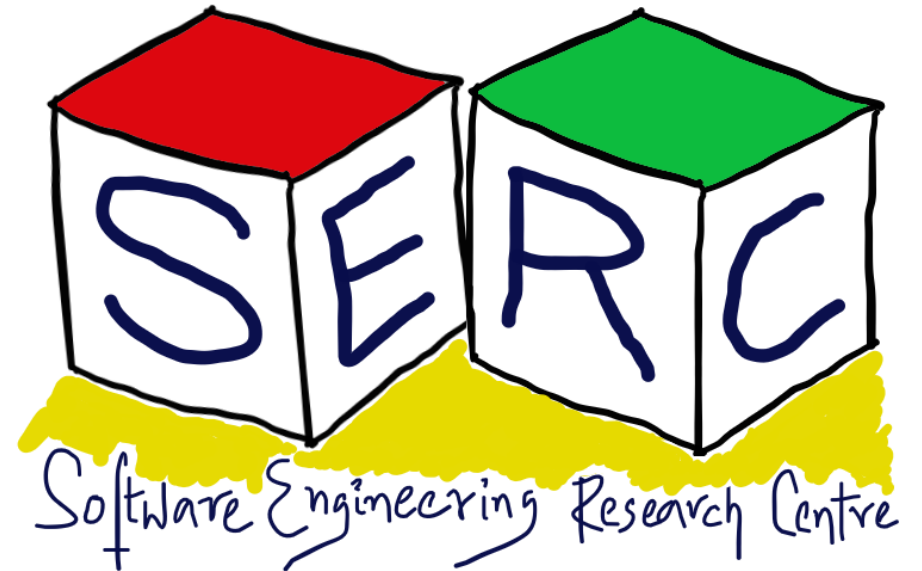
Introduction to Software Architecture

CS6.401 Software Engineering

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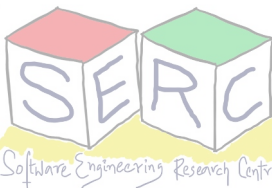


Acknowledgements

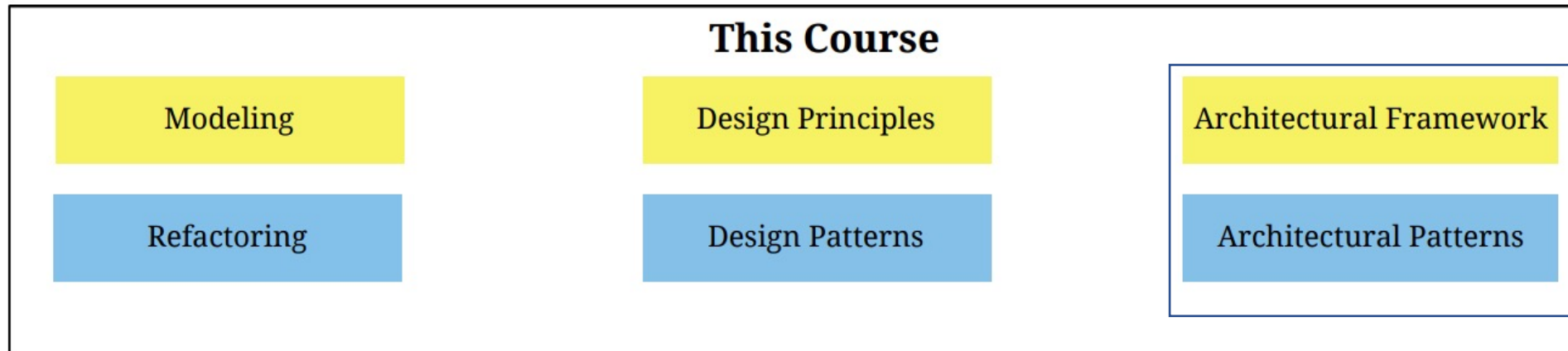
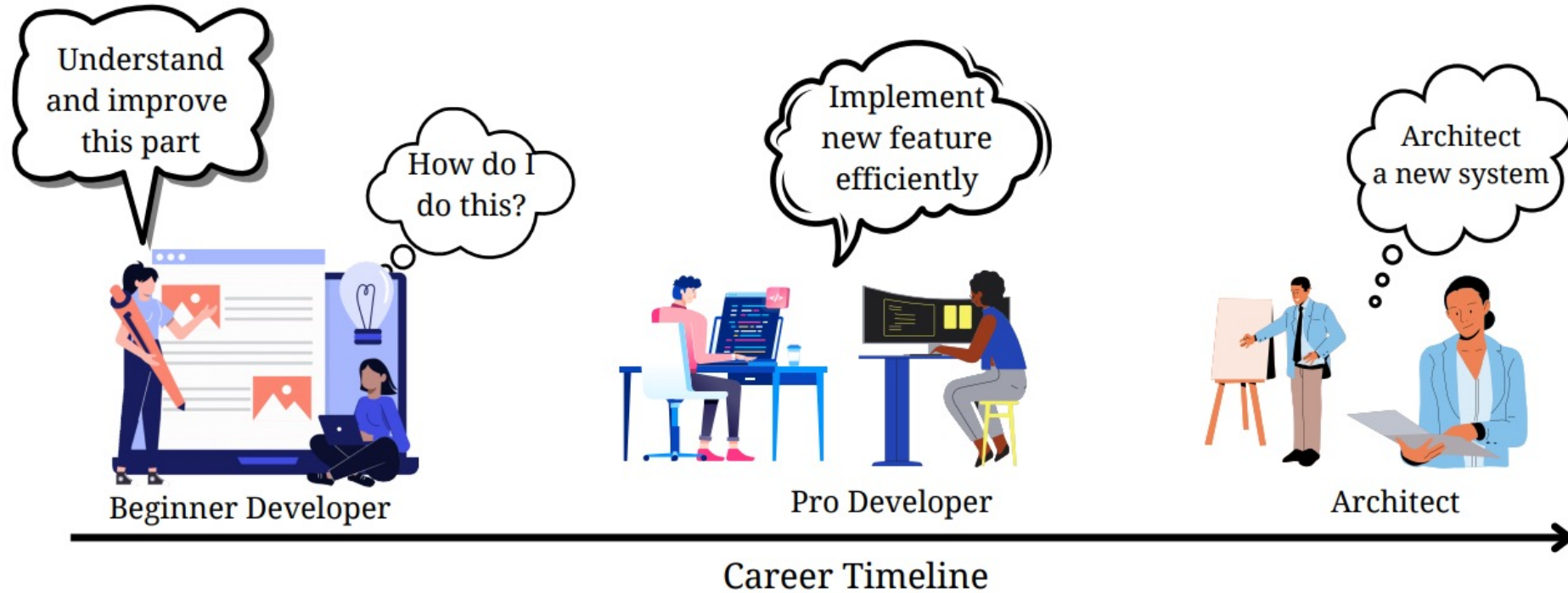
The materials used in this presentation have been gathered/adapted/generate from various sources as well as based on my own experiences and knowledge -- Karthik Vaidhyanathan

Sources:

1. Introduction to Software Architecture, Henry Muccini, University of L'Aquila
2. What is Software Architecture, Raghu Reddy, IIIT Hyderabad
3. Software Architecture in Practice, Len Bass, 3rd edition
4. Software Architecture (SE Course), Alessio Gambi, Saarland University, Germany
5. Software Architecture Design Reasoning Workshop, Antony Tang, ISAPS 2018



The Journey





In your opinion what is
Software Architecture?

What will you do if you want to build a house?

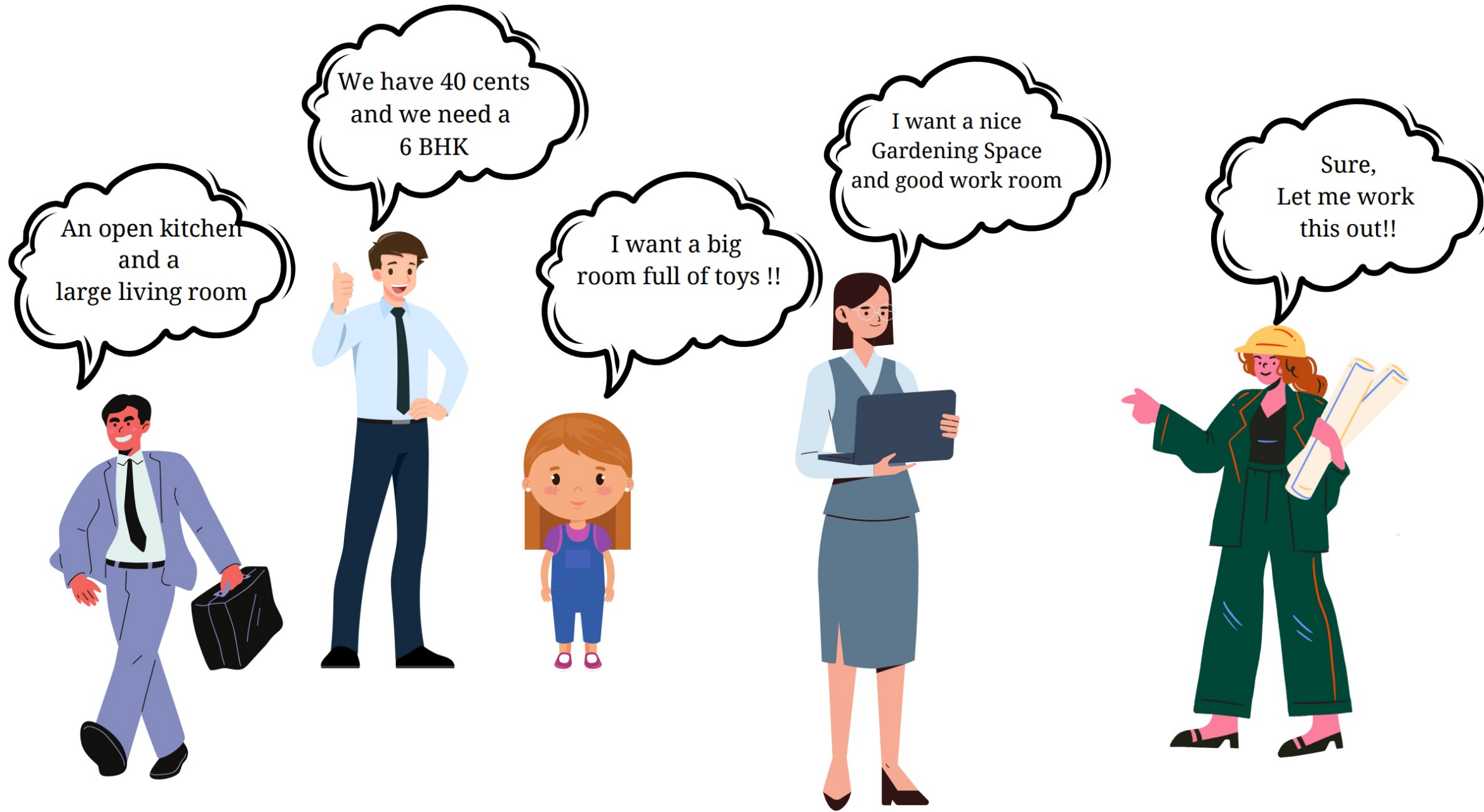
- Family of 6
- Independent house
- Land of 40 cents
- Accommodate 6 + 2
-



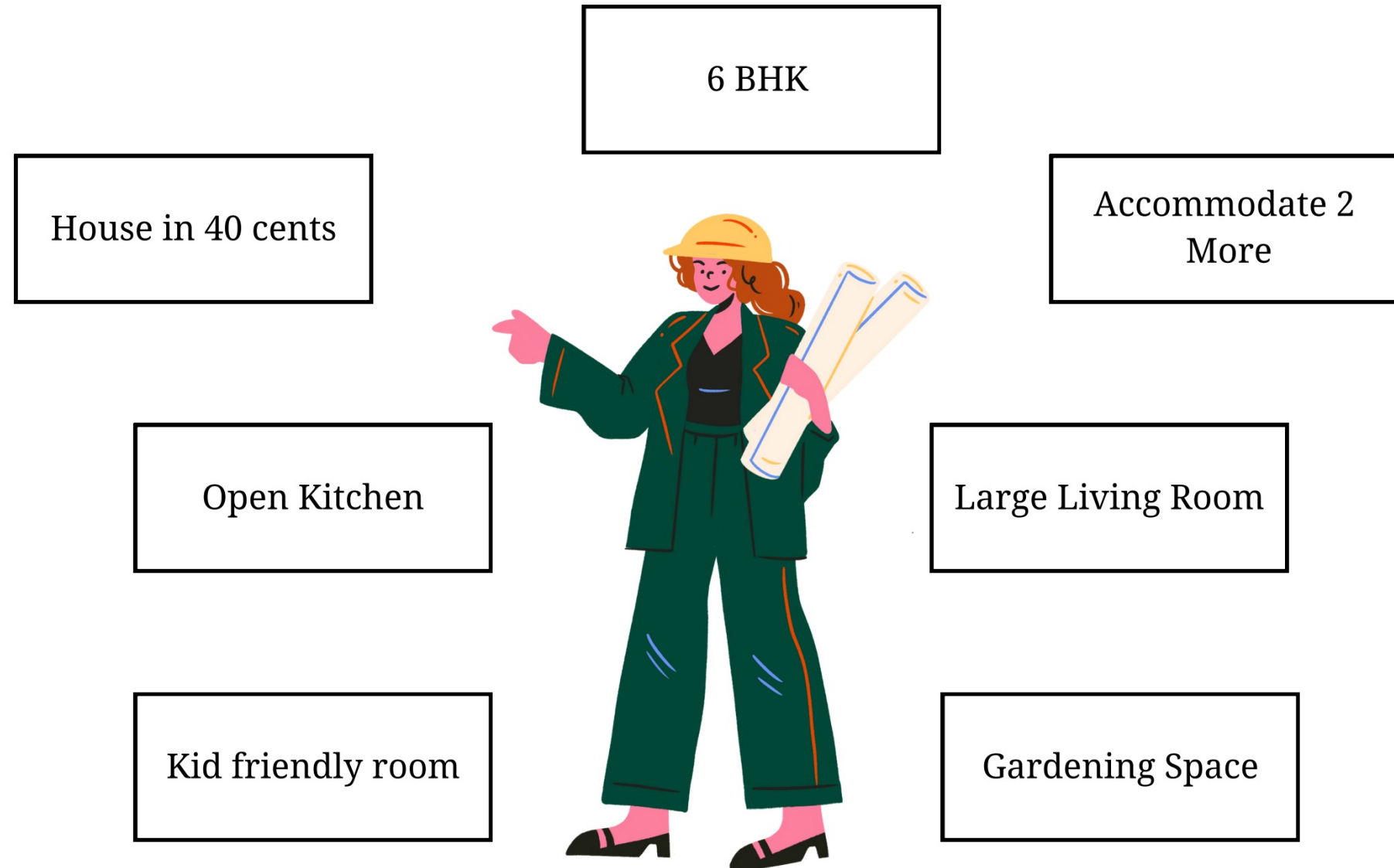
Give the requirements!!



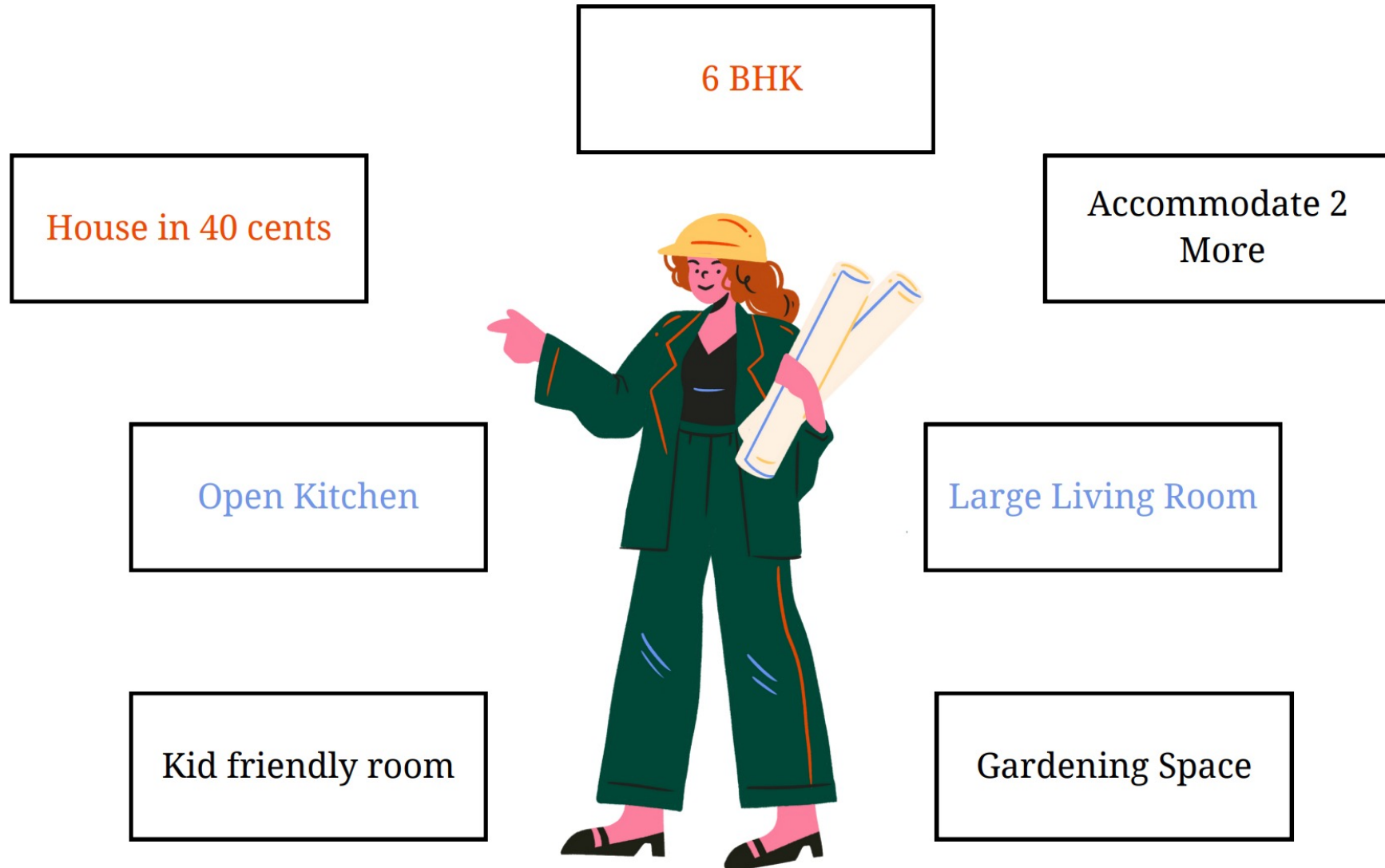
Here you go!!! – There are always multiple Stakeholders



Let me list all the requirements



Let me see Constraints and Significant Requirements



Time for Some Decisions


What material to be used?

- Budget
- Weather Condition
- ...

How to balance size?

- Living room size
- Kitchen Size
- ...

Design Decisions!!



Some Decisions
Needs to be
made

What about window type?

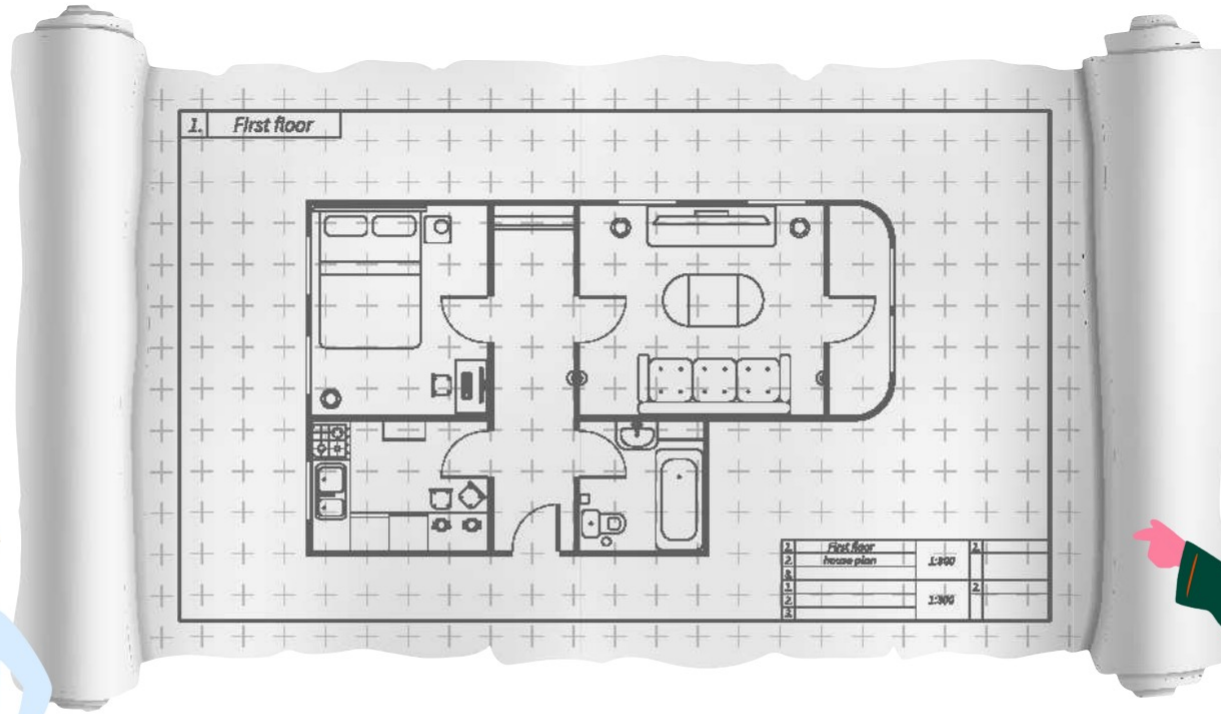
- French Window
- Normal window
- Consider window location
- ...

What about stair elevation?

- Roof length
- Type of people
- ...

High level Plan Ready

This is good
but can you provide
3D view for
others?



How's this?

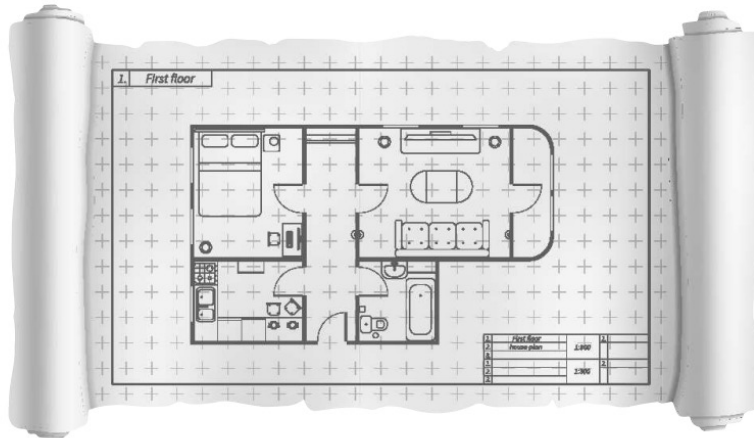


Floor Plan, each room, stairs,
doors, size, how they connect,
etc....

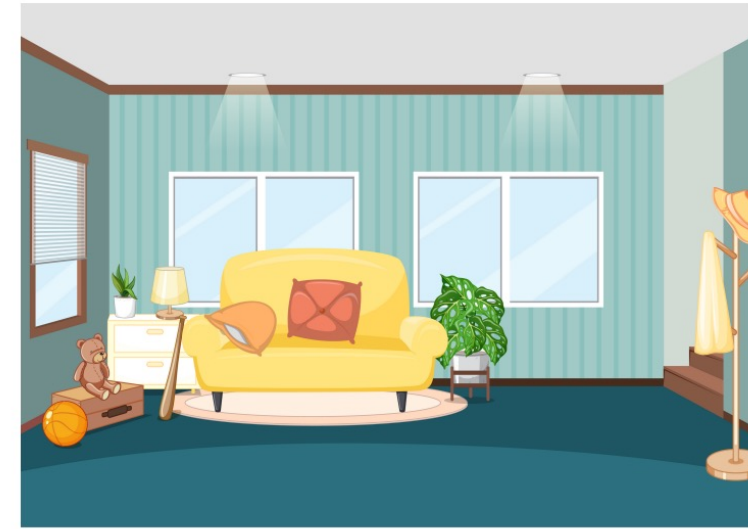
Multiple Views for different set of people



3D View



2D View



Interior View

Views and Viewpoints

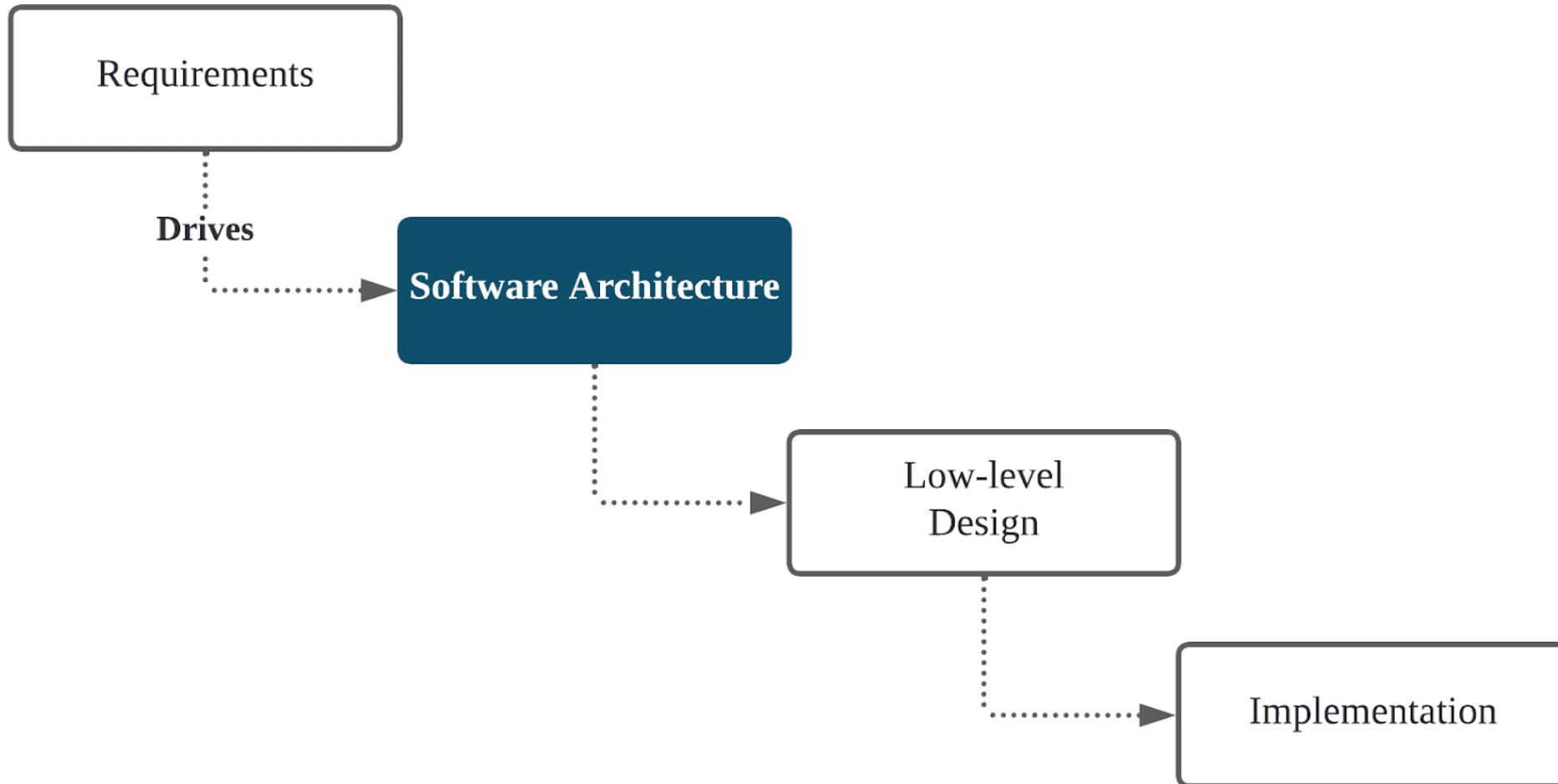
Construction happens and the house is ready!





Let's take this to Software

Where does Software Architecture come into Picture?



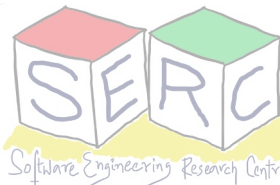
Software Architecture: Is that it?

*“Software is **not limited by physics**, like buildings are. It is **limited by imagination**, by design, by organization. In short, it is limited by properties of people, not by properties of the world. We have **met the enemy, and he is us**”*



Martin Fowler, ***Who needs an Architect?*** IEEE Software, 2003

Ralph Johnson





What is Software Architecture?

Software Architecture Definitions

Many different definitions exist for software architecture!

Check: <https://sei.cmu.edu/architecture/definitions.html>

Software Architecture Definitions

- Garlan and Shaw, '93:

Architecture for a specific system may be captured as “**a collection of** computational **components** - or simply components - together with a description of the interactions between these components - the **connectors**”

- Bass et al.:

"The software architecture of a program or computing system is the **structure or structures** of the system, which comprise **software elements**, the **externally visible properties** of those elements, and the **relationships** between them."

Software Architecture

ACM SIGSOFT

SOFTWARE ENGINEERING NOTES vol 17 no 4

Oct 1992 Page 40

Foundations for the Study of Software Architecture

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Software Architecture = {Elements, Form, Rationale}

Elements, Form and Rationale

Elements (Components and Connectors)

1. Three types: data, processing and connecting elements
2. They form the foundational pieces of a software architecture

Form (Architectural Patterns/Styles)

1. Weighted properties and relationships
2. Properties indicate the properties of the elements and weight indicates relevance/preference
3. Relationships constrain the placements of elements (how they interact, how they are organized, etc.)

Rationale (Design Decisions)

1. Captures the motivation for choice of architectural style, elements and form

Software Architecture

The Software Architecture is the **earliest model** of the **whole software system** created along the software lifecycle

- A set of **components and connectors** communicating through interface
- A set of **architecture design decisions**
- Focus on set of **views and viewpoints**
- Developed according to **architectural styles**



Why Software Architecture?

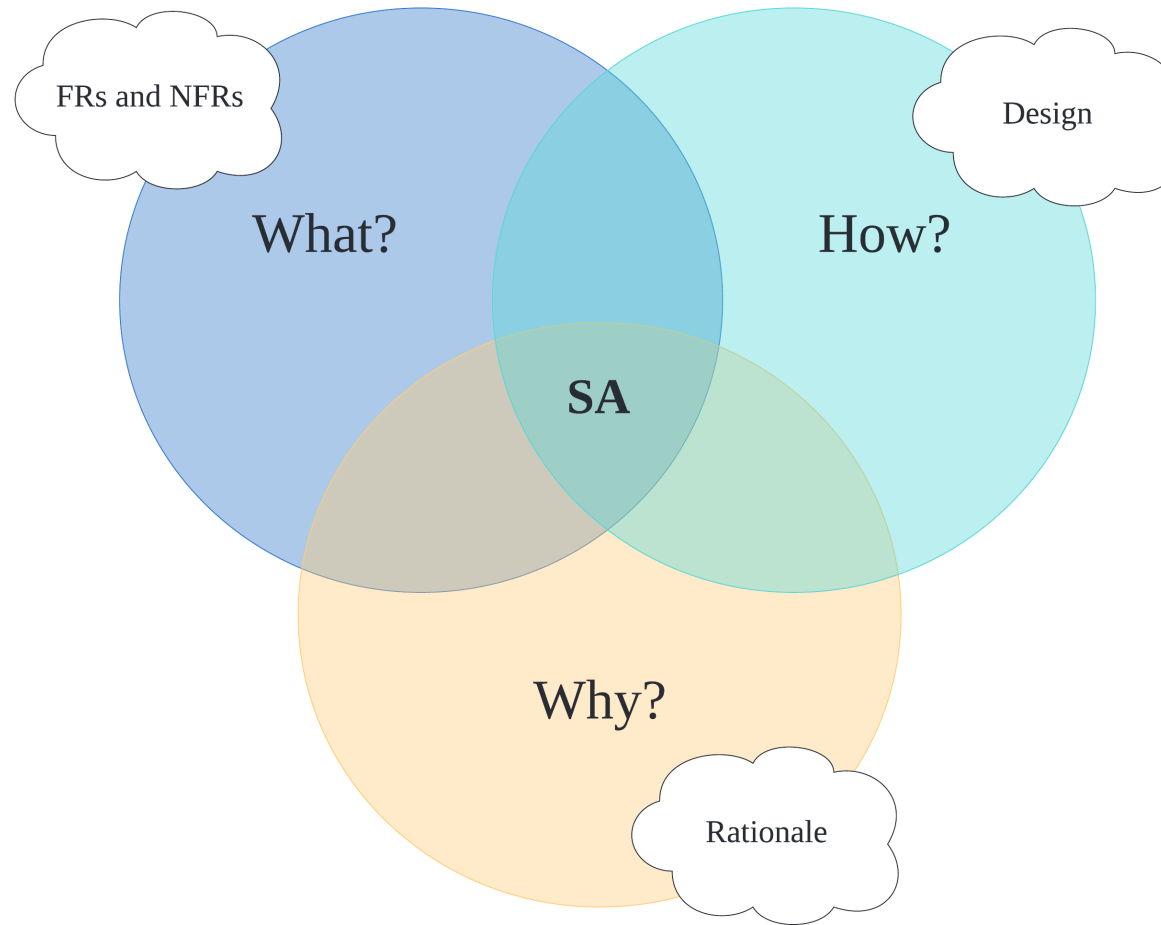
Interesting Rather Relevant Definitions

“The shared understanding that the expert developers have of the system design”

“The decisions you wish you could get right early in a project”

*“Software Architecture is about **all the important stuff**, whatever that is”*

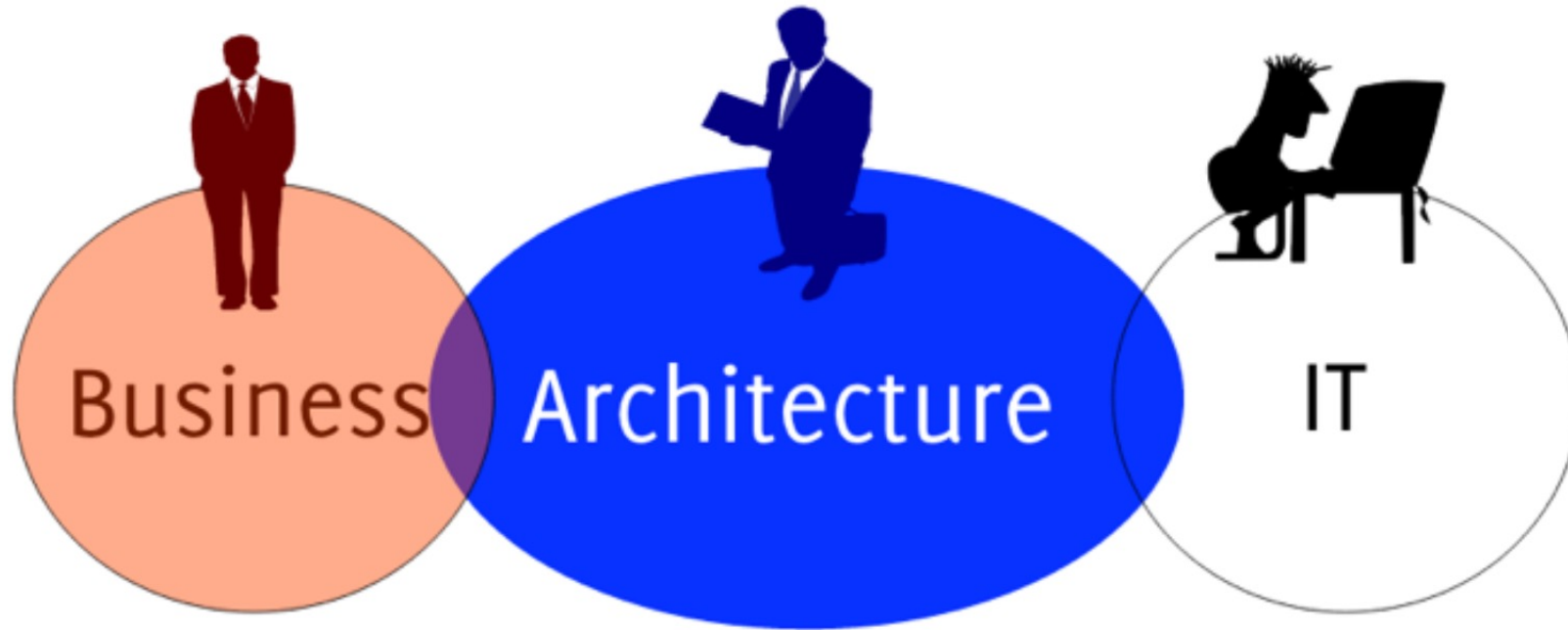
Abstraction



Manage complexity in the design (Transferable abstraction, promotes reuse)

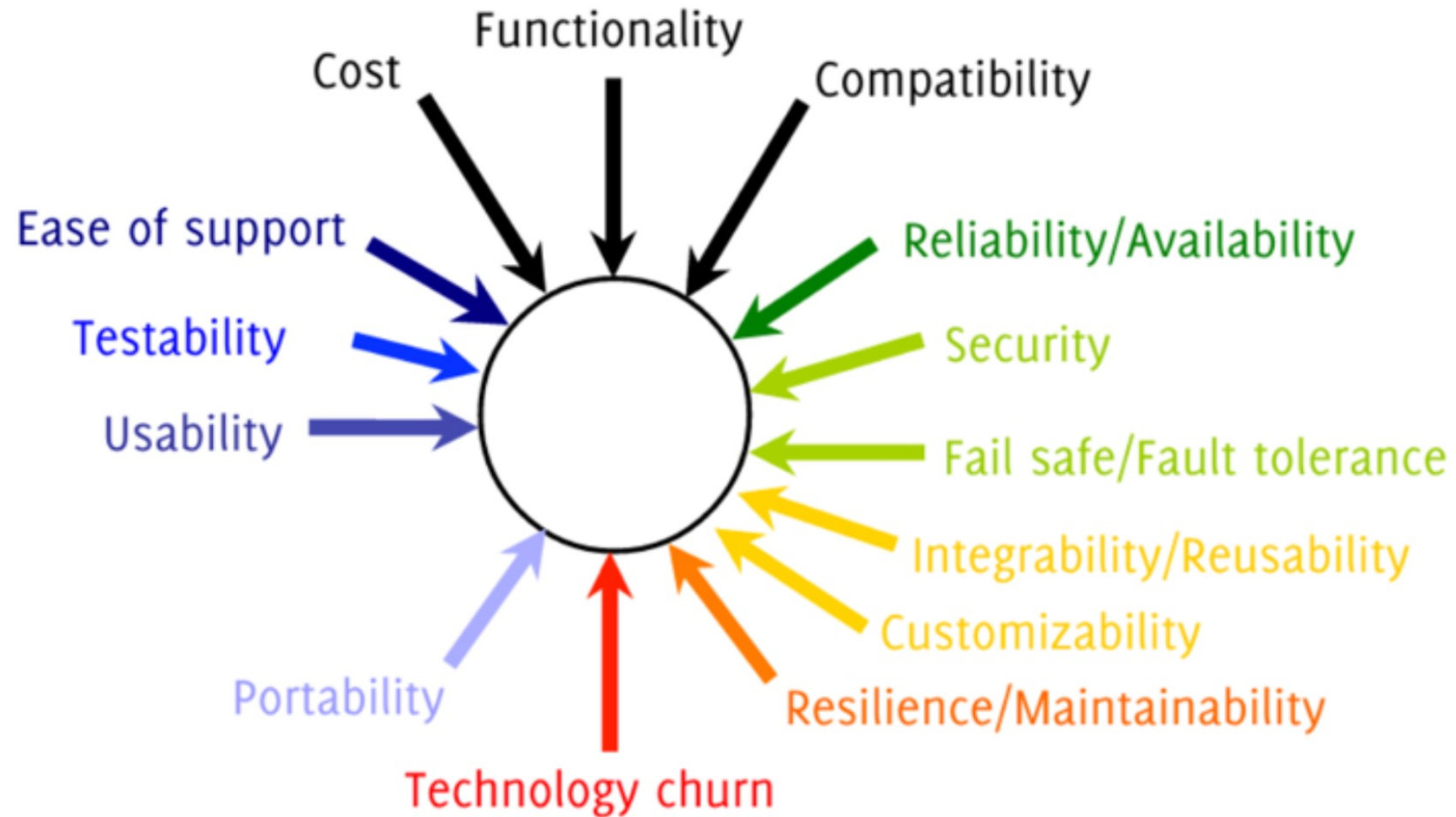
Communication

“Good architects are grown not born”



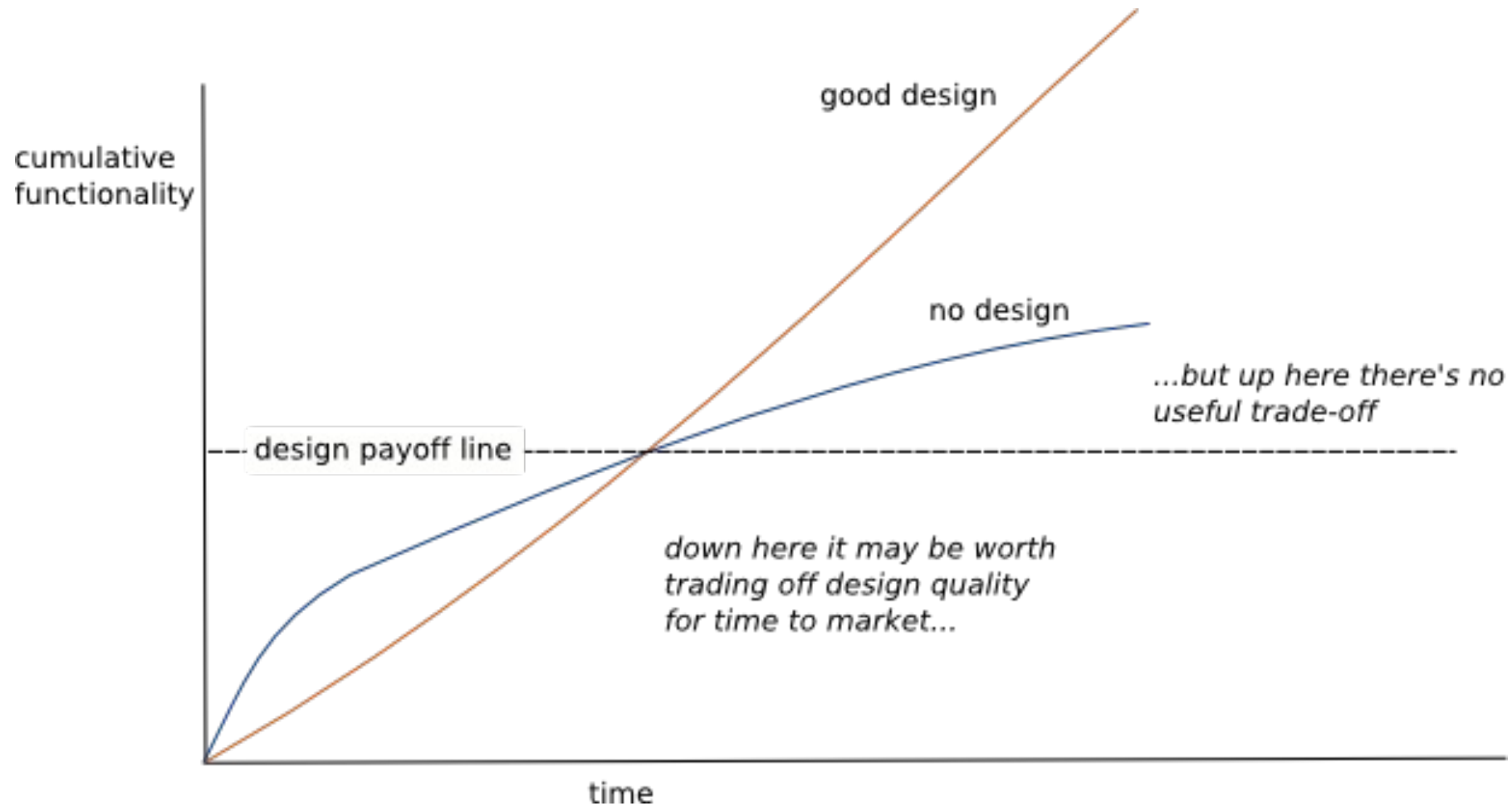
1. Document, remember and communicate among stakeholders
2. Manifest early design decisions

Quality Analysis



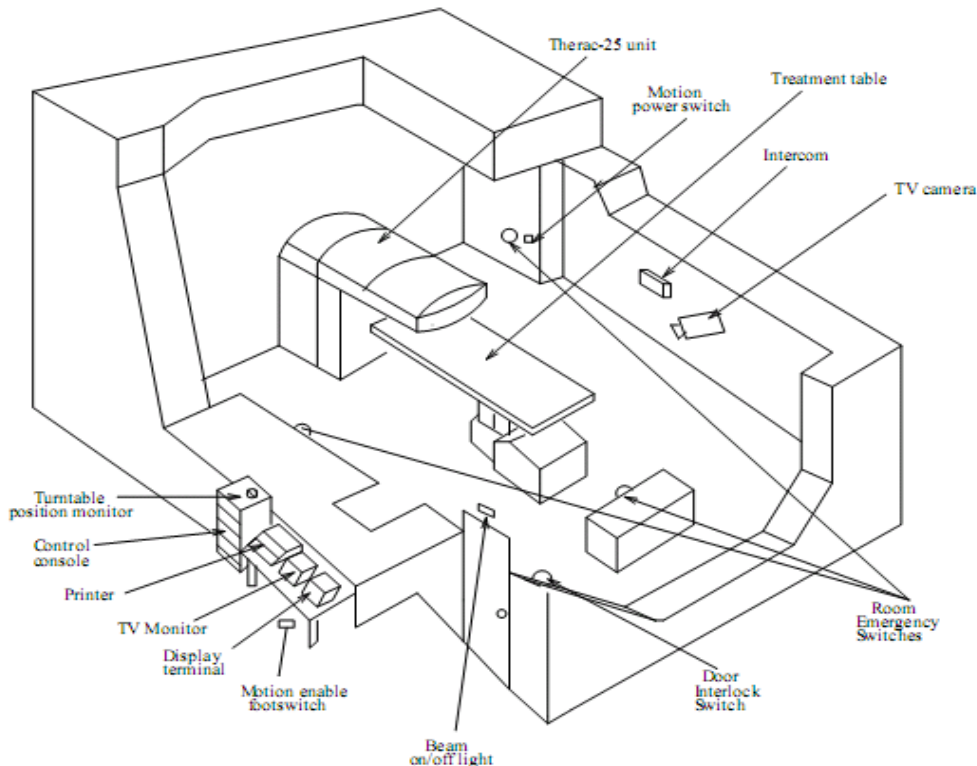
Understand, Predict and Control

Design Stamina Hypothesis



Why to Care? - The Case of Therac 25

- approximately 100 times the intended dose of radiation
- 3 people died, and 6 got injured



1. **Overconfidence in software!!**
2. In adequate software engineering practices
3. Design failure – No defensive approach (0 error handling or verification)

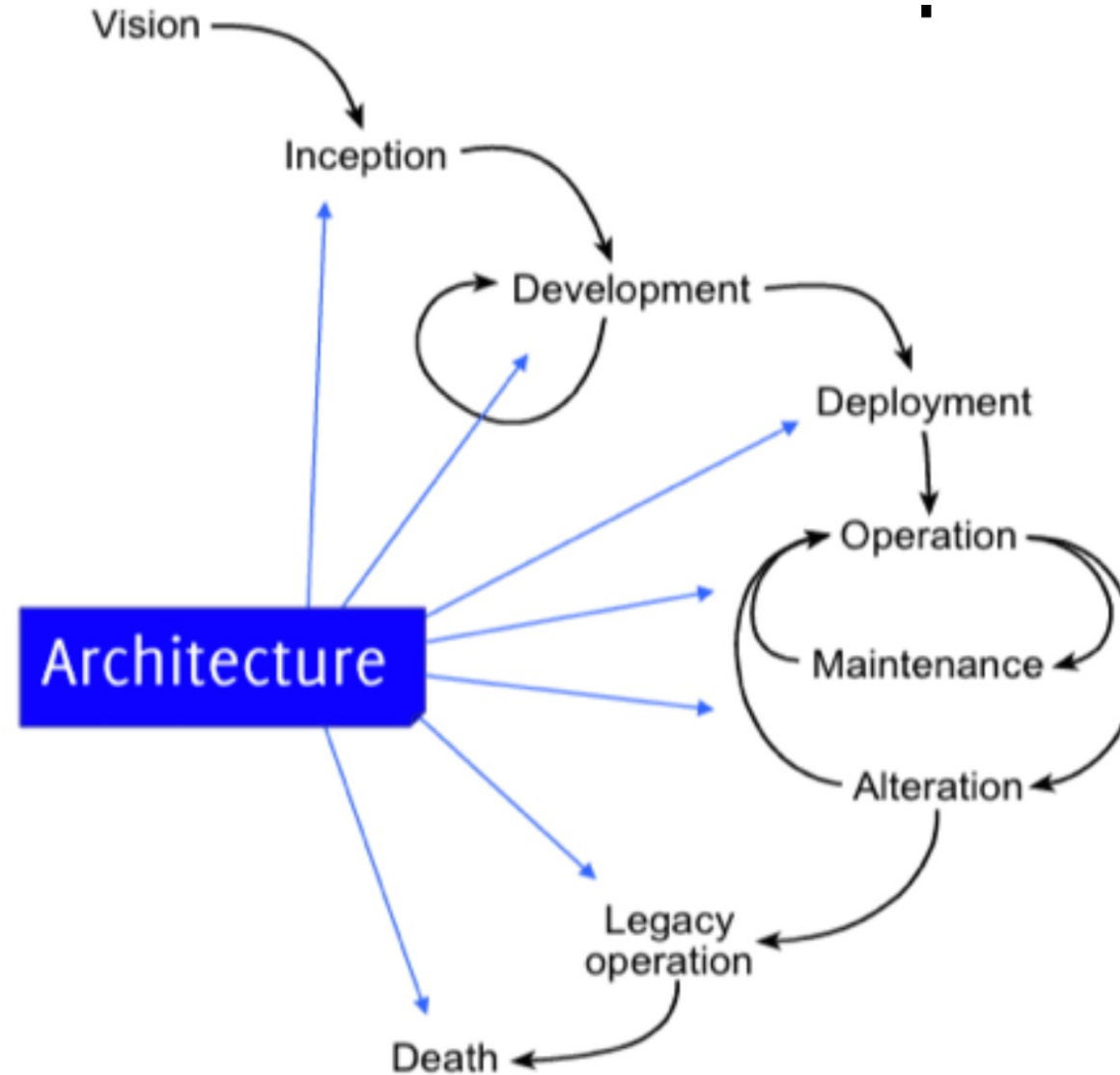
For more info: <http://sunnyday.mit.edu/papers/therac.pdf>

<https://www.computer.org/csdl/magazine/co/2017/11/mco2017110008/13rRUxAStVR>

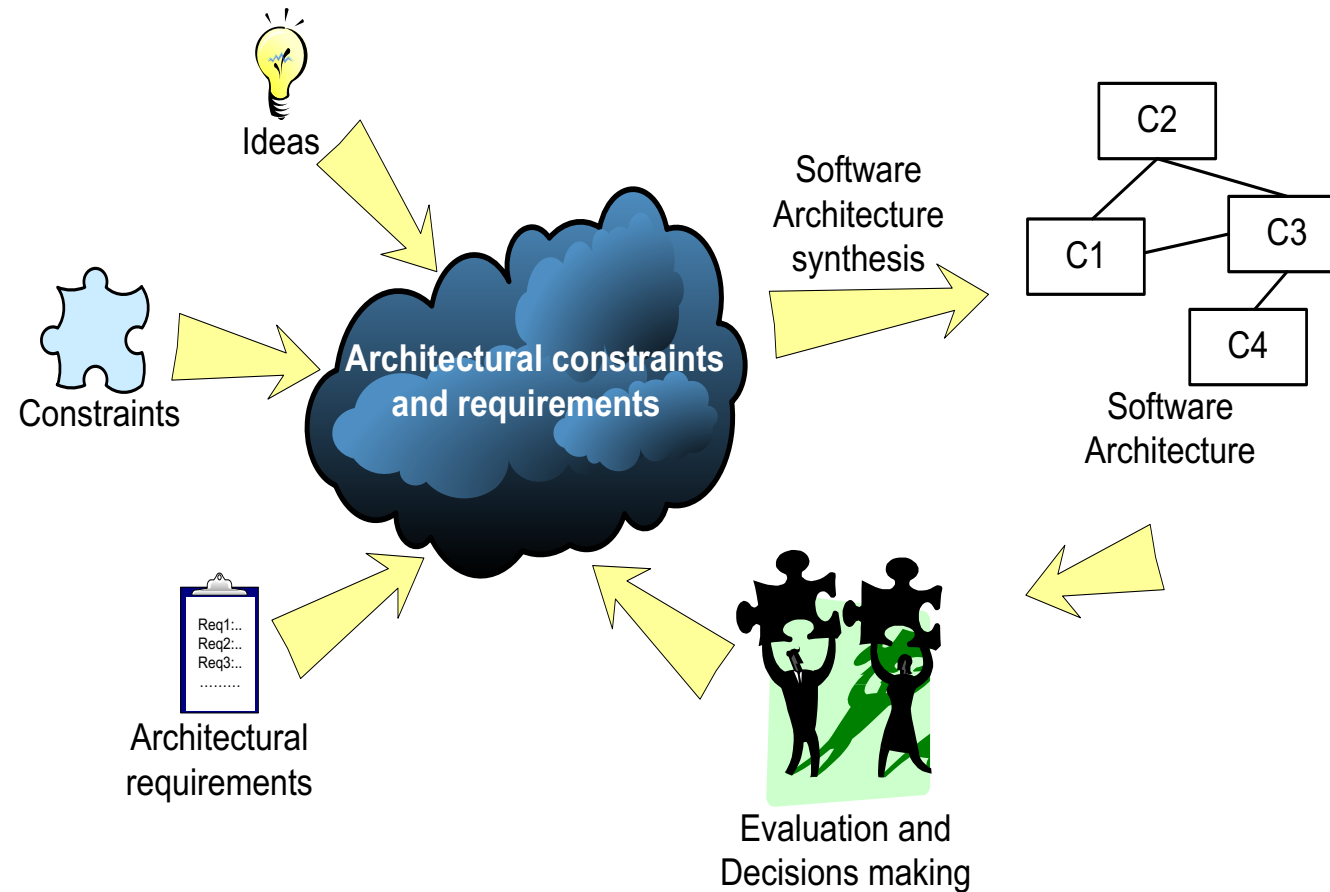
Why to Care?

- All the software systems have an architecture
 - All the **critical/complex** systems must have it carefully and explicitly specified
- Architecture-level decisions impact the **scalability, performance, testability, functioning** of the produced system
- Even if the code is perfectly written, a wrong architecture produces a wrong system

When does SA end?

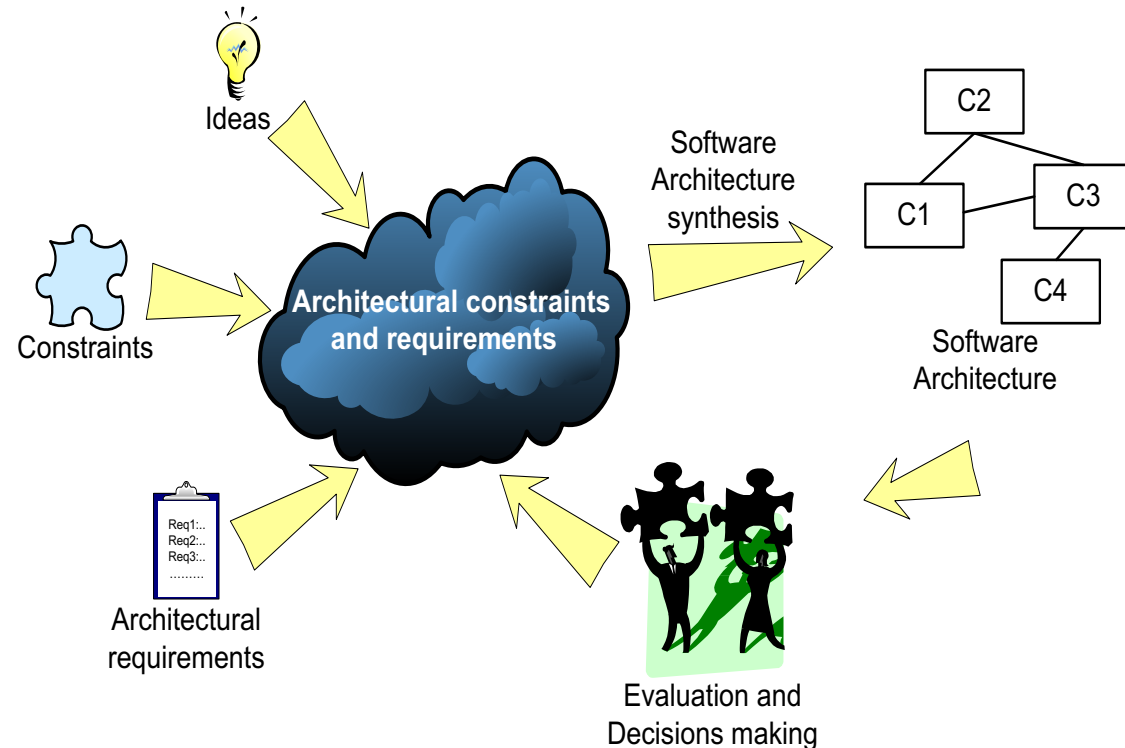


The Overall Architecting Process



So which is the right architecture?

- There is not one that is the best – tradeoff's
- The one that satisfies at best the requirements and constraints
- The "less" risky one



Thank You



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