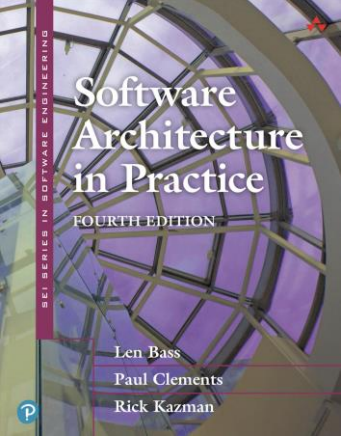
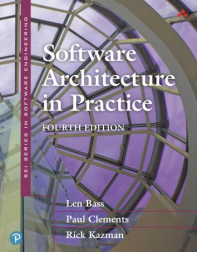


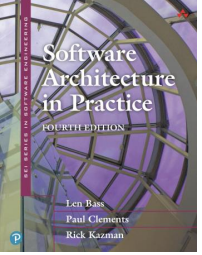
Chapter 20: Designing an Architecture

A designer knows he has achieved perfection not when there is nothing left to add, but when there is nothing left to take away.
—Antoine de Saint-Exupéry



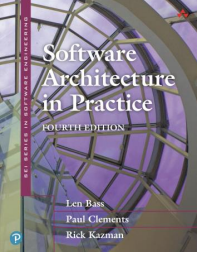
Chapter Outline

- Attribute-Driven Design
- The Steps of ADD
- Choosing Design Concepts
- Producing Structures
- Creating Preliminary Documentation
- Performing Analysis
- Summary



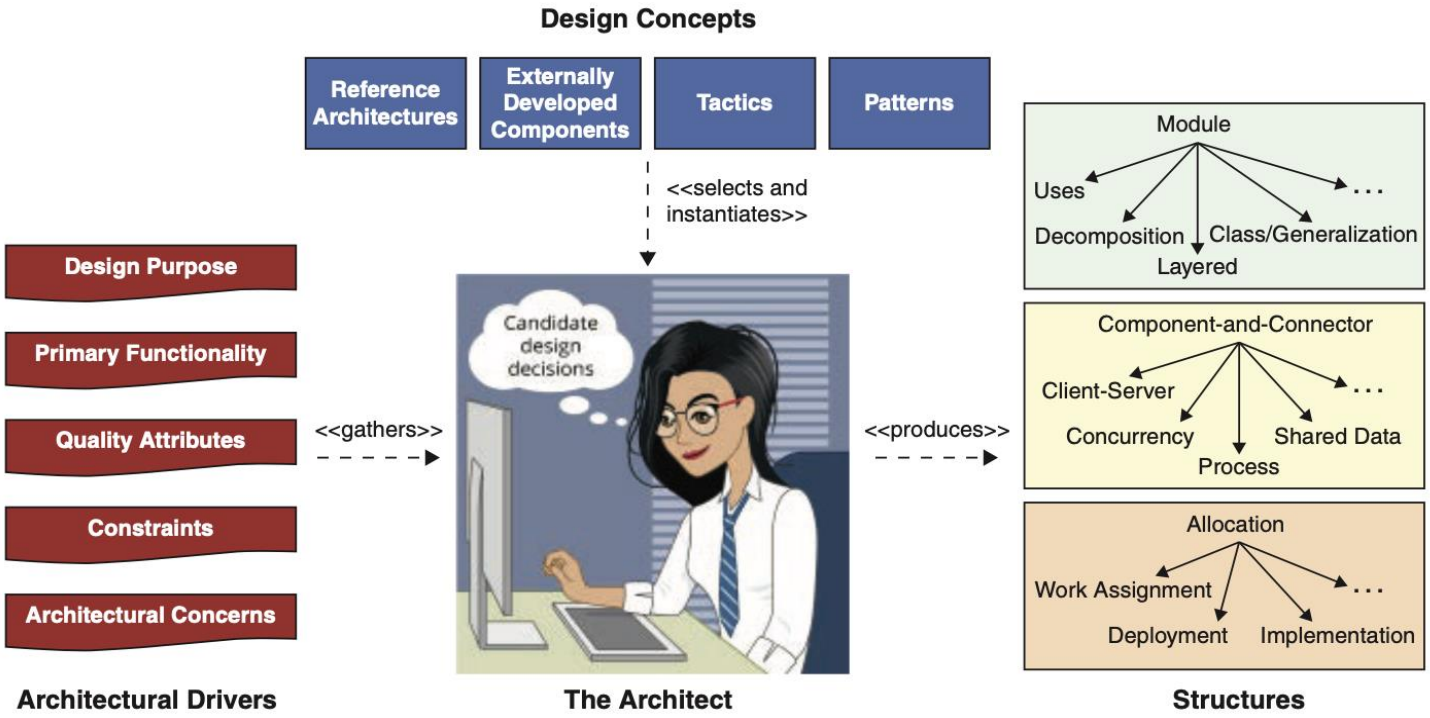
Attribute-Driven Design

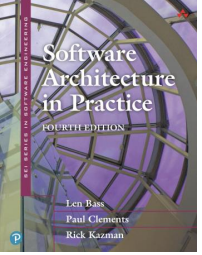
- Architecture design is notoriously difficult to master
  - Design can (and should) be performed in a systematic way.
  - Design decisions should be justified.
- The architect is accountable for design decisions
- A systematic method provides guidance in performing this complex activity so that it can be learned and capably performed by mere mortals.



Attribute-Driven Design

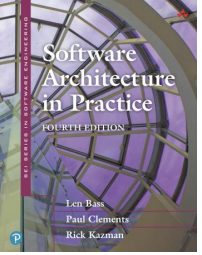
- Architectural design involves making decisions, and working with the available materials and skills, to satisfy requirements and constraints.
- In architectural design, we turn drivers into structures.





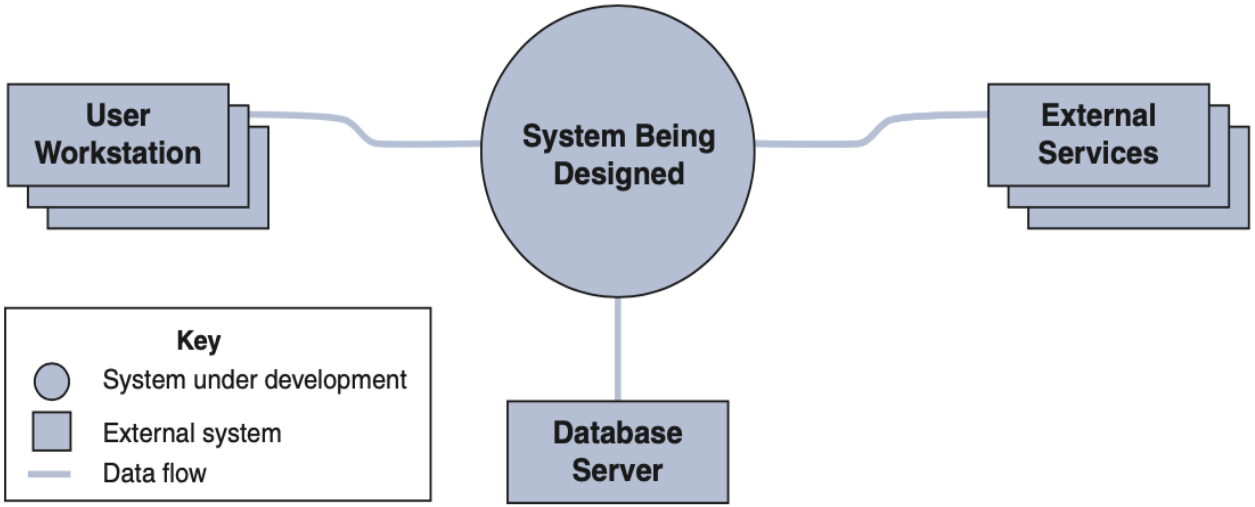
Attribute-Driven Design

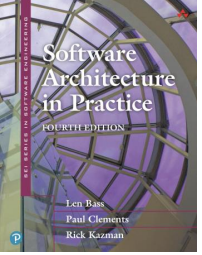
- Architectural drivers comprise architecturally significant requirements (ASRs—the topic of Chapter 19), but also include functionality, constraints, architectural concerns, and design purpose.
- The resulting structures guide analysis, implementation, and much more (remember Chapter 2?).



Attribute-Driven Design

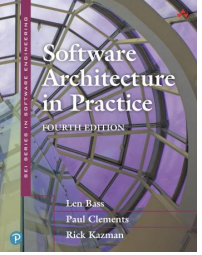
- Prior to starting design, you need to determine the scope of the system— what is in and what is out, and which external entities your system will interact with.
- This can be represented as a context diagram.



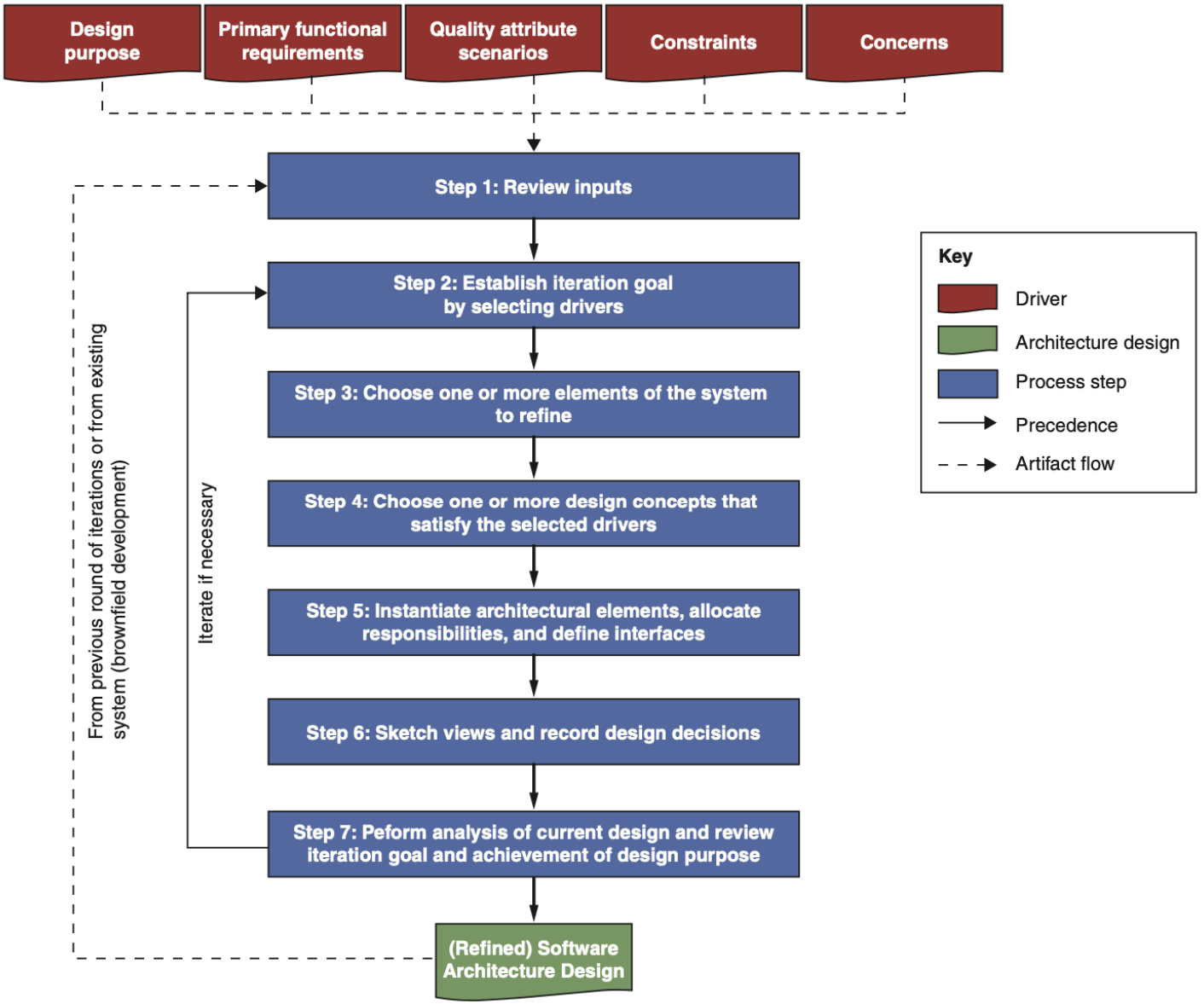


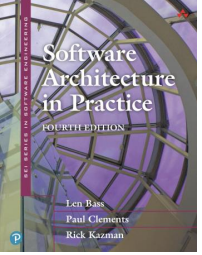
The Steps of ADD

- In ADD, architecture design is performed in iterations.
- Within each iteration, a series of design steps is performed.



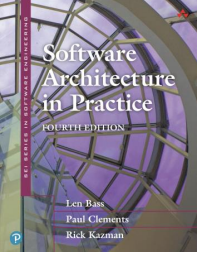
The Steps of ADD





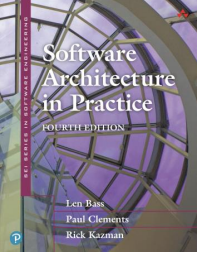
Step 1: Review Inputs

- Before starting a design round, you need to ensure that the architectural drivers (the inputs to the design process) are available and correct. These include:
  - The purpose of the design round
  - The primary functional requirements
  - The primary quality attribute (QA) scenarios
  - Any constraints
  - Any concerns



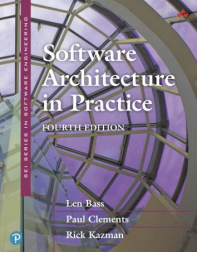
Step 2: Establish Iteration Goal by Selecting Drivers

- Each design iteration focuses on achieving a particular goal--to satisfy a subset of the drivers.
- When doing design, you need to establish a goal *before* you start an iteration.



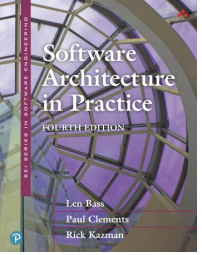
Step 3: Choose One or More Elements of the System to Refine

- Every design decision is manifested as a set of elements, relationship, and properties of architectural structures.
- For existing systems (or later design iterations in greenfield systems) you refine elements that were identified in prior iterations.
- When designing a greenfield system you may select a particular element and the associated drivers that you want to address.



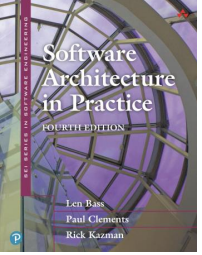
Step 4: Choose One or More Design Concepts That Satisfy the Selected Drivers

- Choosing the design concept(s) is probably the most difficult decision in design.
- Many different types of design concepts are available—tactics, patterns, reference architectures, and externally developed components—and for each type there are many options.



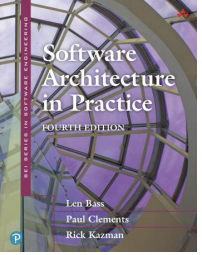
Step 5: Instantiate Architectural Elements, Allocate Responsibilities, Define Interfaces

- Once you have selected one or more design concepts, you must make another type of design decision: how to *instantiate* elements out of the design concepts that you just selected.
- After instantiating the elements, you then need to allocate responsibilities to each of them.



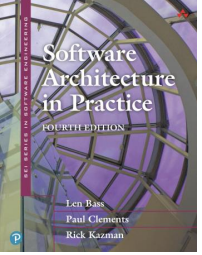
Step 6: Sketch Views and Record Design Decisions

- At this point, you have finished performing the *design* activities for the iteration.
- Now you should ensure that the views—the representations of the structures you created—are preserved.
- You should also record any significant decisions made in the design iteration, as well as the rationale, to facilitate later analysis and understanding of the decisions



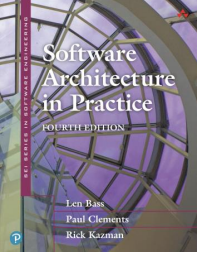
Step 7: Perform Analysis of Design, Review Iteration Goal, and Design Purpose

- By now, you have created a partial design that addresses the goals established for the iteration.
- Making sure that this is actually the case is a good idea, to avoid unhappy stakeholders and later rework.
- Once the design performed in the iteration has been analyzed, you should review the state of your architecture in terms of your established design purpose.



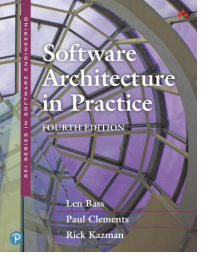
Iterate If Necessary

- You should perform additional iterations and repeat steps 2–7 for every driver that was considered.
- More often than not this kind of repetition will not be possible because of time or resource constraints.
- What are the criteria for evaluating if more design iterations are necessary? Let *risk* be your guide.



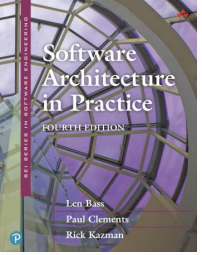
Choosing Design Concepts

- Most of the time you, as an architect, don't need to, and should not, reinvent the wheel.
- Your major design activity is to identify and select design concepts to address drivers.
- This is the hardest part of design.



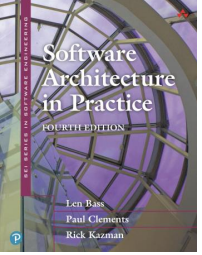
Identifying Design Concepts

- So how to choose a design concept?
- The identification of design concepts might appear daunting, because of the vast number of options available, scattered across many blogs, and websites, and in books.
- So … what to do?
  - *Leverage existing best practices*.
  - *Leverage your own knowledge and experience*
  - *Leverage the knowledge and experience of others*



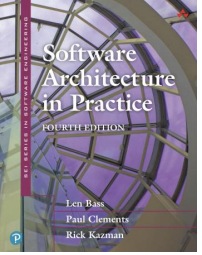
Selecting Design Concepts

- Once you have identified a list of alternative design concepts, you need to select.
- You might create a table that lists the pros and cons of each alternative. This table could contain cost information.
- Methods such as SWOT (strengths, weaknesses, opportunities, threats) analysis can help you here.
- Decisions that you made in previous iterations may restrict the concepts you can now select.



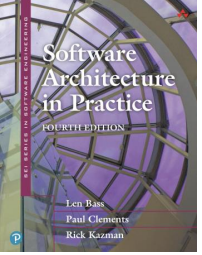
Creation of Prototypes

- Often you will need to create prototypes to determine the properties of technologies.
- When thinking about whether you should create a prototype, ask these questions:
  - Does the project incorporate emerging technologies?
  - Is the technology new in the company?
  - Are there certain drivers, particularly QAs, whose satisfaction using the selected technology presents risks?
  - Is there a lack of trusted information that would provide some certainty that the selected technology will be useful to satisfy the project drivers?
  - Are there configuration options associated with the technology that need to be tested or understood?
  - Is it unclear whether the selected technology can be easily integrated with other technologies that are used in the project?



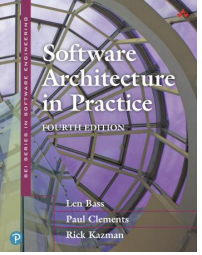
Producing Structures

- Design concepts won't help you unless you produce *structures*.
- This is the "instantiation" phase for architectural elements in ADD: creating elements and relationships, and associating responsibilities with them.
- When you instantiate a design concept, you may actually affect more than one structure.



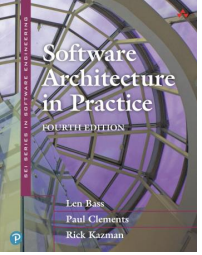
Associating Responsibilities and Identifying Properties

- When you are creating elements (instantiating design concepts) you need to consider the responsibilities allocated to them.
- Elements should have high cohesion (internally), a narrow set of responsibilities, and low (external) coupling.
- And you need to consider the *properties* of the elements.



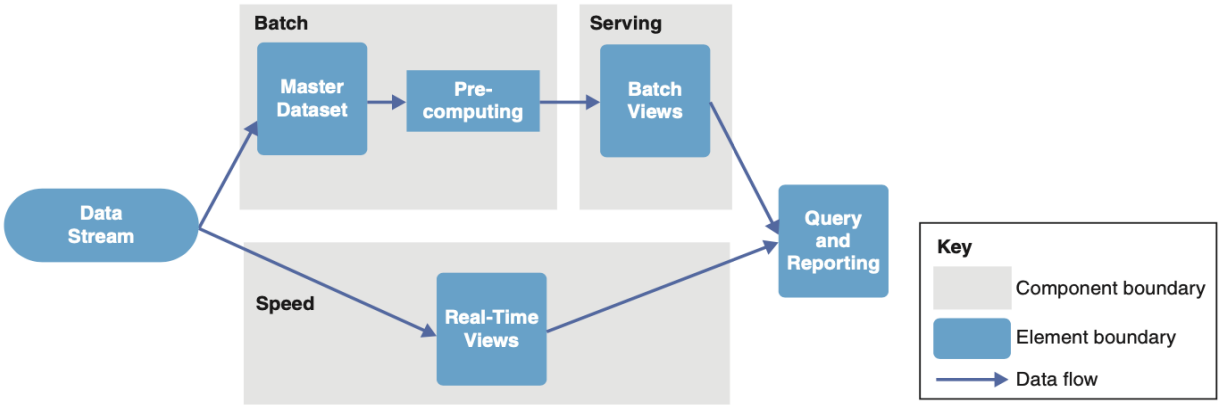
Defining Relationships and Interfaces

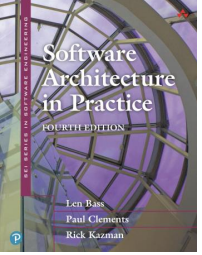
- The creation of structures also requires making decisions with respect to the relationships that exist between the elements and their properties.
- Interfaces establish a contractual specification that allows elements to collaborate and exchange information.



Creating Preliminary Documentation

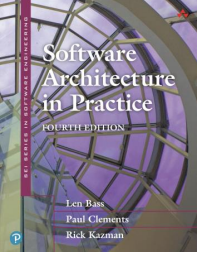
- The formal documentation of views is not part of ADD.
- Structures, however, are naturally produced as part of design.
- Capture them, even if they are represented informally (as sketches).
- This requires some discipline.
- The benefits are worth it, as you will be able to more easily produce detailed architecture documentation later.





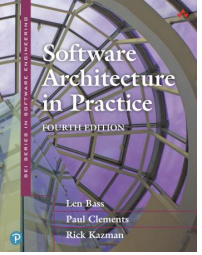
Recording Design Decisions

- When you see an architectural diagram, you see the end product but can't always understand the decisions made to achieve this result.
- Recording design decisions *beyond* the elements, relationships, and properties is fundamental to clarify how you arrived at the result—your *design rationale*.



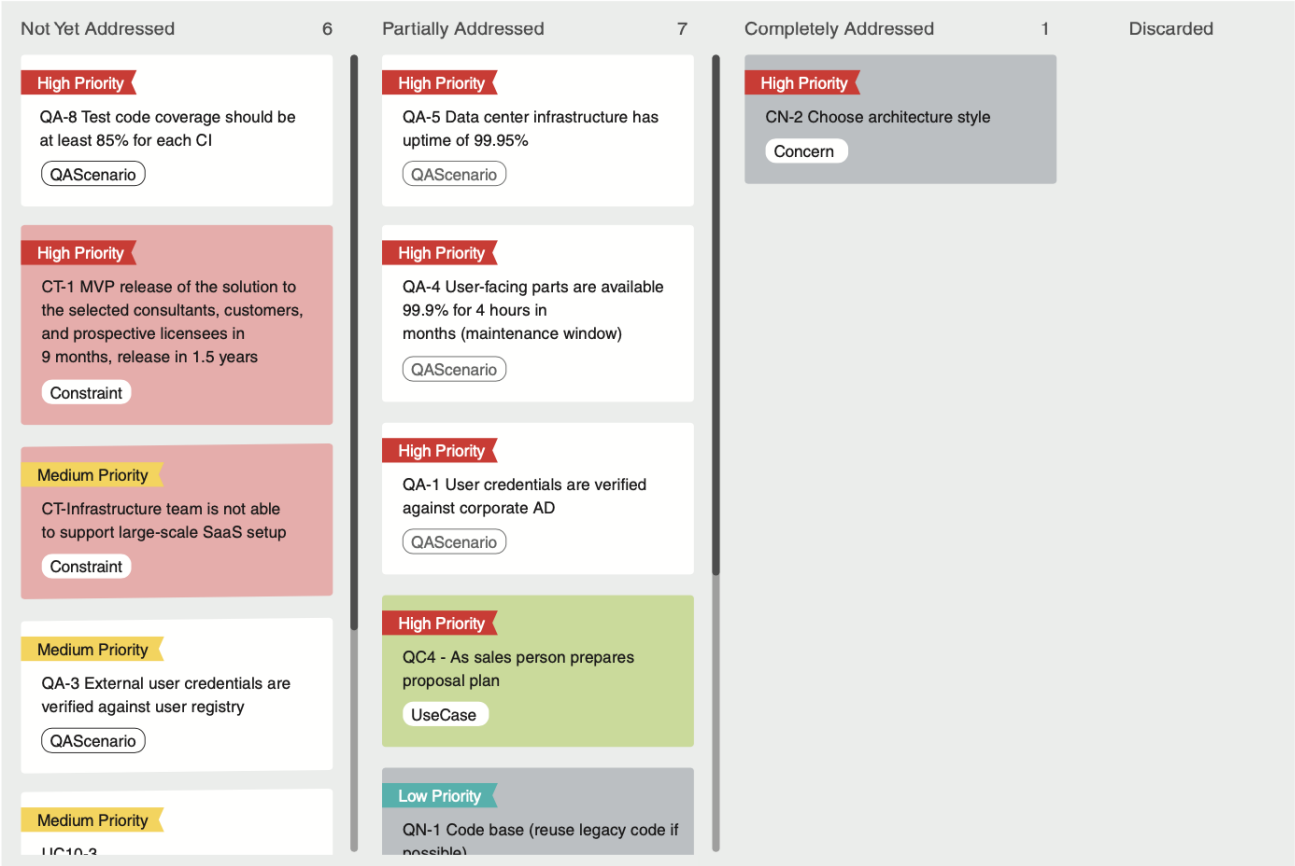
Perform Analysis of the Design, Review the Iteration Goals

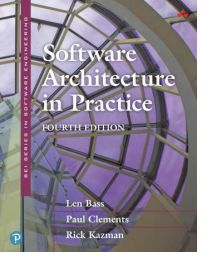
- At the end of an iteration, it is prudent to do some analysis to reflect on the decisions you just made.
- One kind of analysis that you need to perform at this point is to assess whether you have done enough design work. In particular:
  - How much design do you need to do?
  - How much design have you done so far?
  - Are you finished?



Perform Analysis of the Design, Review the Iteration Goals

- Practices such as the use of backlogs and Kanban boards can help you track the design progress and answer these questions.





Summary

- Design is hard.
- Methods are needed to make it more tractable (and repeatable).
- The ADD method allows an architecture to be designed in a systematic and cost-effective way.