Chapter-4

Introduction to requirement engineering

Requirements engineering provides the appropriate mechanism for understanding what the customer wants, analyzing need, assessing easibility, negotiating a reasonable solution, specifying the solution unambiguously, validating the specification.

Requirement engineering consists of seven different tasks as follow:

1. Inception

Inception is a task where the requirement engineering asks a set of questions to establish a software process. In this task, it understands the problem and evaluates with the proper solution. It collaborates with the relationship between the customer and the developer. The developer and customer decide the overall scope and the nature of the question.

2. Elicitation

Elicitation means to find the requirements from anybody. The requirements are difficult because the **following problems occur in elicitation**.

Problem of scope: The customer give the unnecessary technical detail rather than clarity of the overall system objective.
Problem of understanding: Poor understanding between the customer and the developer regarding various aspect of the project like capability, limitation of the computing environment.
Problem of volatility: In this problem, the requirements change from time to time and it is difficult while developing the project.

3. Elaboration

In this task, the information taken from user during inception and elaboration and are expanded and refined in elaboration. Its main task is developing pure model of software using functions, feature and constraints of a software.

4. Negotiation

In negotiation task, a software engineer decides the how will the project be achieved with limited business resources.To create rough guesses of development and access the impact of the requirement on the project cost and delivery time.

5. Specification

In this task, the requirement engineer constructs a final work product. The work product is in the form of software requirement specification. In this task, formalize the requirement of the proposed software such as informative, functional and behavioral. The requirement are formalize in both graphical and textual formats.

6. Validation

The work product is built as an output of the requirement engineering and that is accessed for the quality through a validation step. The formal technical reviews from the software engineer, customer and other stakeholders helps for the primary requirements validation mechanism.

7. Requirement management

It is a set of activities that help the project team to identify, control and track the requirements and changes can be made to the requirements at any time of the ongoing project.

These tasks start with the identification and assign a unique identifier to each of the requirement. After finalizing the requirement traceability table is developed.

REQUIREMENT ANALYSIS

Requirements analysis results in the specification of software's operational characteristics, indicates software's interface with other system elements, and establishes constraints that software must meet. Requirements analysis allows you to elaborate on basic requirements established during the inception, elicitation, and negotiation tasks that are part of requirements engineering.

The requirements modeling action results in one or more of the following types of models:

- Scenario-based models of requirements from the point of view of various system "actors"

- Data models that depict the information domain for the problem

- Class-oriented models that represent object-oriented classes (attributes and operations) and the manner in which classes collaborate to achieve system requirements

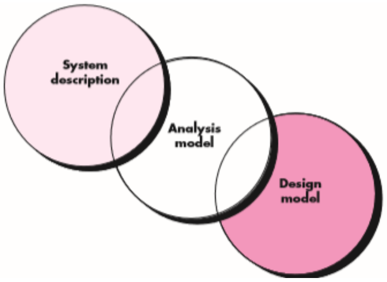
- Flow-oriented models that represent the functional elements of the system and how they transform data as it moves through the system

- Behavioral models that depict how the software behaves as a consequence of external "events"

These models provide a software designer with information that can be translated to architectural, interface, and component-level designs.

FIGURE 6.1

The requirements model as a bridge between the system description and the design model



In this chapter, I focus on scenario-based modeling—a technique that is growing increasingly popular throughout the software engineering community;

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data modeling—a more specialized technique that is particularly appropriate when an application must create or manipulate a complex information space;

class modeling—a representation of the object-oriented classes and the resultant collaborations that allow a system to function.

DESIGN WITHIN CONTEXT OF SOFTWARE ENGINEERING

Software design begins once software requirements have been analyzed and modeled, software design is the last software engineering action within the modeling activity and sets the stage for construction (code generation and testing).

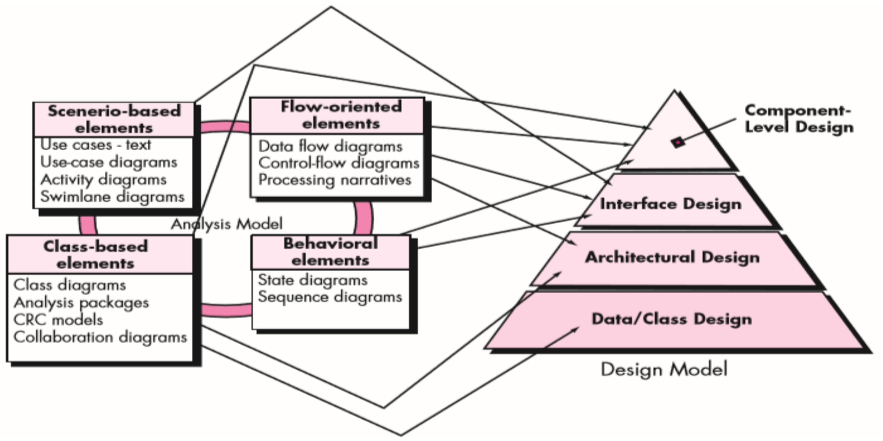


FIGURE 8.1 Translating the requirements model into the design model

Each of the elements of the requirements model provides information that is necessary to create the four design models required for a complete specification of design. The flow of information during software design is illustrated in Figure 8.1.
The requirements model, manifested by scenario-based, class-based, flow-oriented, and behavioral elements, feed the design task.

The data/class design transforms class models data structures required to implement the software. The objects and relationships defined in the CRC diagram and the detailed data content depicted by class attribute.

The architectural design defines the relationship between major structural elements of the software, the architectural styles and design patterns that can be used to achieve the requirements defined for the system, and the constraints that affect the way in which architecture can be implemented.

The interface design describes how the software communicates with systems that interoperate with it, and with humans who use it. An interface implies a flow of information and a specific type of behavior.

The component-level design transforms structural elements of the software architecture into a procedural description of software components.

THE DESIGN PROCESS

Software design is an iterative process through which requirements are translated into a "blueprint" for constructing the software.The design is represented a high level of abstraction— a level that can be directly traced to the specific system objective and more detailed data, functional, and behavioral requirements.

Software Quality Guidelines and Attributes

Throughout the design process, the quality of the evolving design is assessed. Three characteristics that serve as a guide for the evaluation of a good design: Each of these characteristics is actually a goal of the design process.

- The design must implement all of the explicit requirements.
- The design must be a readable, understandable guide for those who generate code and for those who test.
- The design should provide a complete picture of the software, addressing the data, function and behavior.

Quality Guidelines

- A design should exhibit an architecture that has been created using recognizable architectural styles or patterns.
- A design should be modular.
- A design should contain distinct representations of data, architecture, interfaces, and component.
- A design should lead to components that exhibit independent functional characteristics.
- A design should lead to interfaces that reduce the complexity of connections between components and with the external environment.
- A design should be represented using a notation that effectively communicates its meaning.
- A design should be derived using a repeatable method that is driven by information obtained during software requirements analysis.

Quality Attributes

Quality attributes represent a target for all software design:

- Functionality - It is assessed by evaluating the feature set and capabilities of the program.
- Usability – It is assessed by considering human factors
- Reliability - It is evaluated by measuring the frequency and severity of failure, the accuracy of output results, the mean-time-to-failure (MTTF), the ability to recover from failure, and the predictability of the program.
- Performance - It is measured by considering processing speed, response time, resource consumption, throughput, and efficiency.
- Supportability – It combines the ability to extend the program.

THE DESIGN MODEL

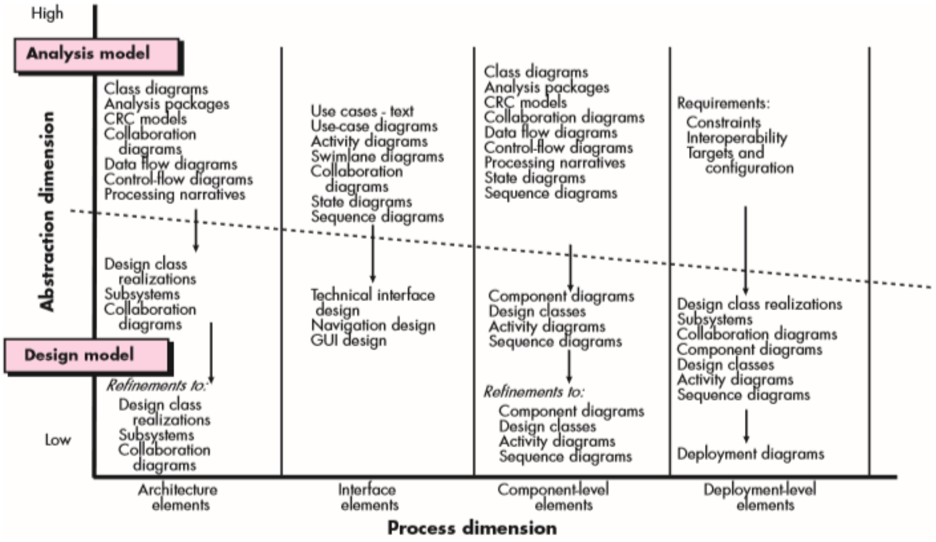
The design model can be viewed in two different dimensions as illustrated in Figure 8.4.

The process dimension indicates the evolution of the design model as design tasks are executed as part of the software process. The abstraction dimension represents the level of detail as each element of the analysis model is transformed into a design equivalent and then refined iteratively.

Referring to Figure 8.4, the dashed line indicates the boundary between the analysis and design models. In some cases, a clear distinction between the analysis and design models is possible.

The elements of the design model use many of the same UML diagrams that were used in the analysis model. The difference is that these diagrams are refined and elaborated as part of design; more implementation-specific detail is provided, and architectural structure and style, components that reside within the architecture, and interfaces between the components and with the outside world are all emphasized.

FIGURE 8.4 Dimensions of the design model



You should note, however, that model elements indicated along the horizontal axis are not always developed in a sequential fashion. The deployment model is usually delayed until the design has been fully developed.

You can apply design patterns at any point during design. These patterns enable you to apply design knowledge to domain-specific problems that have been encountered and solved by others.

SOFTWARE ARCHITECTURE

The software architecture of a program is the structure, which comprise software components, the externally visible properties of those components, and the relationships among them.

The architecture is not the operational software. Rather, it is a representation that enables you to

(1) analyze the effectiveness of the design in meeting its stated requirements,

(2) consider architectural alternatives at a stage when making design changes is still relatively easy, and

(3) reduce the risks associated with the construction of the software.

This definition emphasizes the role of "software components" in any architectural representation. In the context of architectural design, the properties of components are those characteristics that are necessary for an understanding of how the components interact with other components. At the architectural level, internal properties (e.g., details of an algorithm) are not specified. The relationships between components can be as simple as a procedure call from one module to another or as complex as a database access protocol.

Software architecture considers two levels of the design pyramid (Figure 8.1)—data design and architectural design.

Data design enables you to represent the data component of the architecture in conventional systems and class definitions in object-oriented systems.

Architectural design focuses on the representation of the structure of software components, their properties, and interactions.

ELEMENTS OF SOFTWARE QUALITY ASSURANCE

Software Quality Assurance(SQA) encompasses a broad range of concerns(elements) and activities that focus on the management of software quality.

Standards - The IEEE, ISO, and other standards organizations have produced a broad array of software engineering standards and related documents. The job of SQA is to ensure that standards that have been adopted are followed and that all work products conform to them.

Reviews and audits - Technical reviews are a quality control activity performed by software engineers, Their intent is to uncover errors. Audits are a type of review performed by SQA with the intent of ensuring that quality guidelines are being followed for software engineering work.

Testing - Software testing primary goal is to find errors. The job of SQA is to ensure that testing is properly planned and efficiently conducted.

Error/defect collection and analysis - SQA collects and analyzes error and defect data to better understand how errors are introduced and what software engineering activities are best suited to eliminating them.

Change management - change is not properly managed, change can lead to confusion, and confusion almost always leads to poor quality. SQA ensures that adequate change management have been instituted.

Education - Every software organization wants to improve its software engineering practices. A key contributor to improvement is education of software engineers, their managers, and other stakeholders. The SQA organization takes the lead in software process improvement and is a key proponent and sponsor of educational programs.

Security management - SQA ensures that appropriate process and technology are used to achieve software security.

Safety - SQA may be responsible for assessing the impact of software failure and for initiating those steps required to reduce risk

Risk management - SQA organization ensures that risk management activities are properly conducted and that risk-related contingency plans have been established.

Vendor management - The job of the SQA organization is to ensure that high-quality software results by suggesting specific quality practices that the vendor should follow, and incorporating quality mandates as part of any contract with an external vendor.

SOFTWARE TESTING FUNDAMENTALS

The goal of testing is to find errors, and a good test is one that has a high probability of finding an error.

Testability - "Software testability is simply how easily can be tested." The following characteristics lead to testable software.

Operability - "The better it works, the more efficiently it can be tested." If a system is designed and implemented with quality in mind, relatively few bugs will block the execution of tests, allowing testing to progress without fits and starts.

Observability - "What you see is what you test." Inputs provided as part of testing produce distinct outputs. System states and variables are visible or queriable during execution. Incorrect output is easily identified. Internal errors are automatically detected and reported. Source code is accessible.

Controllability - "The better we can control the software, the more the testing can be automated and optimized."

Decomposability - "By controlling the scope of testing, we can more quickly isolate problems and perform smarter retesting." The software system is built from independent modules that can be tested independently.

Simplicity - "The less there is to test, the more quickly we can test it." The program should exhibit functional simplicity, structural simplicity and code simplicity .

Stability - "The fewer the changes, the fewer the disruptions to testing." Changes to the software are infrequent, controlled when they do occur, and do not invalidate existing tests. The software recovers well from failures.

Understandability - "The more information we have, the smarter we will test." The architectural design and the dependencies between internal, external, and shared components are well understood. Technical documentation is instantly accessible, well organized, specific and detailed, and accurate. Changes to the design are communicated to tester.

Test Characteristics

- A good test has a high probability of finding an error.
- A good test is not redundant.
- A good test should be "best of breed".
- A good test should be neither too simple nor too complex.