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Software Process

DISUSUN OLEH

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E-COMMERCE: DIGITAL MARKETS, DIGITAL GOODS

1. Kemampuan Akhir Yang Diharapkan

The objective of this chapter is to introduce you to the idea of a software process—a coherent set of activities for software production. When you have read this chapter you will:

1. I understand the concepts of software processes and software process models;
2. I have been introduced to three generic software process models and when they might be used;
3. I know about the fundamental process activities of software requirements engineering, software development, testing, and evolution;
4. I understand why processes should be organized to cope with changes in the software requirements and design;
5. I understand how the Rational Unified Process integrates good software engineering practice to create adaptable software processes.

2. Uraian dan Contoh

A software process is a set of related activities that leads to the production of a software product. These activities may involve the development of software from scratch in a standard programming language like Java or C. However, business applications are not necessarily developed in this way. New business software is now often developed by extending and modifying existing systems or by configuring and integrating off-the-shelf software or system components.

There are many different software processes but all must include four activities that are fundamental to software engineering:

1. Software specification The functionality of the software and constraints on its operation must be defined.

2. Software design and implementation The software to meet the specification must be produced.

3. Software validation The software must be validated to ensure that it does what the customer wants.

4. Software evolution The software must evolve to meet changing customer needs.

In some form, these activities are part of all software processes. In practice, of

course, they are complex activities in themselves and include sub-activities such as requirements validation, architectural design, unit testing, etc. There are also supporting process activities such as documentation and software configuration management.

When we describe and discuss processes, we usually talk about the activities in these processes such as specifying a data model, designing a user interface, etc., and the

ordering of these activities. However, as well as activities, process descriptions may also include:

1. Products, which are the outcomes of a process activity. For example, the out-come of the activity of architectural design may be a model of the software architecture.

2. Roles, which reflect the responsibilities of the people involved in the process. Examples of roles are project manager, configuration manager, programmer, etc.

3. Pre- and post-conditions, which are statements that are true before and after a process activity has been enacted or a product produced. For example, before architectural design begins, a pre-condition may be that all requirements have been approved by the customer; after this activity is finished, a post-condition might be that the UML models describing the architecture have been reviewed.

Software processes are complex and, like all intellectual and creative processes, rely on people making decisions and judgments. There is no ideal process and most organizations have developed their own software development processes. Processes have evolved to take advantage of the capabilities of the people in an organization and the specific characteristics of the systems that are being developed. For some systems, such as critical systems, a very structured development process is required. For business systems, with rapidly changing requirements, a less formal, flexible process is likely to be more effective.

Sometimes, software processes are categorized as either plan-driven or agile processes. Plan-driven processes are processes where all of the process activities are planned in advance and progress is measured against this plan. In agile processes, which I discuss in Chapter 3, planning is incremental and it is easier to change the process to reflect changing customer requirements. As Boehm and Turner (2003) discuss, each approach is suitable for different types of software. Generally, you need to find a balance between plan-driven and agile processes.

Although there is no 'ideal' software process, there is scope for improving the software process in many organizations. Processes may include outdated techniques or may not take advantage of the best practice in industrial software engineering. Indeed, many organizations still do not take advantage of software engineering methods in their software development.

Software processes can be improved by process standardization where the diver- sity in software processes across an organization is reduced. This leads to improved communication and a reduction in training time, and makes automated process sup-port more economical. Standardization is also an important first step in introducing new software engineering methods and techniques and good software engineering practice. I discuss software process improvement in more detail in Chapter 14.

2.1. Software process models

As I explained in Chapter 1, a software process model is a simplified representation of a software process. Each process model represents a process from a particular per- spective, and thus provides only partial information about that process. For example, a process activity model shows the activities and their sequence but may not show the roles of the people involved in these activities. In this section, I introduce a num- ber of very general process models (sometimes called 'process paradigms') and present these from an architectural perspective. That is, we see the framework of the process but not the details of specific activities.

These generic models are not definitive descriptions of software processes. Rather, they are abstractions of the process that can be used to explain different approaches to software development. You can think of them as process frameworks that may be extended and adapted to create more specific software engineering processes.

The process models that I cover here are:

1. *The waterfall model* This takes the fundamental process activities of specifica- tion, development, validation, and evolution and represents them as separate process phases such as requirements specification, software design, implemen- tation, testing, and so on.
2. *Incremental development* This approach interleaves the activities of specifica- tion, development, and validation. The system is developed as a series of versions (increments), with each version adding functionality to the previous version.
3. *Reuse-oriented software engineering* This approach is based on the existence of a significant number of reusable components. The system development process focuses on integrating these components into a system rather than developing them from scratch.

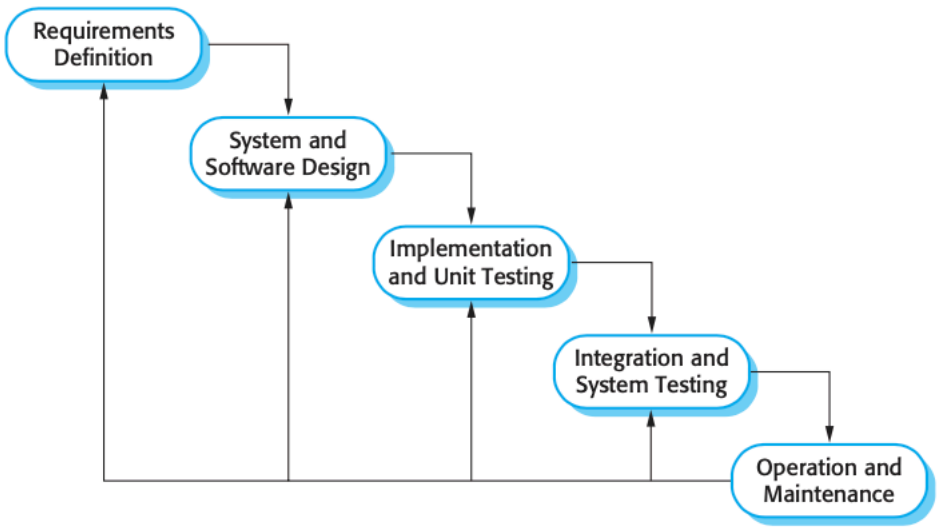
   These models are not mutually exclusive and are often used together, especially for large systems development. For large systems, it makes sense to combine some of the best features of the waterfall and the incremental development models. You need to have information about the essential system requirements to design a soft- ware architecture to support these requirements. You cannot develop this incremen- tally. Sub-systems within a larger system may be developed using different approaches. Parts of the system that are well understood can be specified and devel- oped using a waterfall-based process. Parts of the system which are difficult to specify in advance, such as the user interface, should always be developed using an incremental approach.

2.1.1 The waterfall model

The first published model of the software development process was derived from more general system engineering processes (Royce, 1970). This model is illustrated in Figure 2.1. Because of the cascade from one phase to another, this model is known as the 'waterfall model' or software life cycle. The waterfall model is an example of a plan-driven process—in principle, you must plan and schedule all of the process activities before starting work on them.

The principal stages of the waterfall model directly reflect the fundamental development activities:

1. *Requirements analysis and definition* The system's services, constraints, and goals are established by consultation with system users. They are then defined in detail and serve as a system specification.
2. *System and software design* The systems design process allocates the requirements to either hardware or software systems by establishing an overall system architecture. Software design involves identifying and describing the fundamental software system abstractions and their relationships.
3. *Implementation and unit testing* During this stage, the software design is realized as a set of programs or program units. Unit testing involves verifying that each unit meets its specification.
4. *Integration and system testing* The individual program units or programs are integrated and tested as a complete system to ensure that the software requirements have been met. After testing, the software system is delivered to the customer.
5. *Operation and maintenance* Normally (although not necessarily), this is the longest life cycle phase. The system is installed and put into practical use. Maintenance involves correcting errors which were not discovered in earlier stages of the life cycle, improving the implementation of system units and enhancing the system's services as new requirements are discovered.



In principle, the result of each phase is one or more documents that are approved ('signed off'). The following phase should not start until the previous phase has finished. In practice, these stages overlap and feed information to each other. During design, problems with requirements are identified. During coding, design problems are found and so on. The software process is not a simple linear model but involves feedback from one phase to another. Documents produced in each phase may then have to be modified to reflect the changes made.

Because of the costs of producing and approving documents, iterations can be costly and involve significant rework. Therefore, after a small number of iterations, it is normal to freeze parts of the development, such as the specification, and to con- tinue with the later development stages. Problems are left for later resolution, ignored, or programmed around. This premature freezing of requirements may mean that the system won't do what the user wants. It may also lead to badly structured systems as design problems are circumvented by implementation tricks.

During the final life cycle phase (operation and maintenance) the software is put into use. Errors and omissions in the original software requirements are discovered. Program and design errors emerge and the need for new functionality is identified. The system must therefore evolve to remain useful. Making these changes (software maintenance) may involve repeating previous process stages.

The waterfall model is consistent with other engineering process models and documentation is produced at each phase. This makes the process visible so managers can monitor progress against the development plan. Its major problem is the inflexible par- titioning of the project into distinct stages. Commitments must be made at an early stage in the process, which makes it difficult to respond to changing customer requirements.

In principle, the waterfall model should only be used when the requirements are well understood and unlikely to change radically during system development. However, the waterfall model reflects the type of process used in other engineering projects. As is easier to use a common management model for the whole project, software processes based on the waterfall model are still commonly used.

An important variant of the waterfall model is formal system development, where a mathematical model of a system specification is created. This model is then refined, using mathematical transformations that preserve its consistency, into exe- cutable code. Based on the assumption that your mathematical transformations are correct, you can therefore make a strong argument that a program generated in this way is consistent with its specification.

Formal development processes, such as that based on the B method (Schneider, 2001; Wordsworth, 1996) are particularly suited to the development of systems that have stringent safety, reliability, or security requirements. The formal approach simplifies the production of a safety or security case. This demonstrates to customers or regulators that the system actually meets its safety or security requirements.

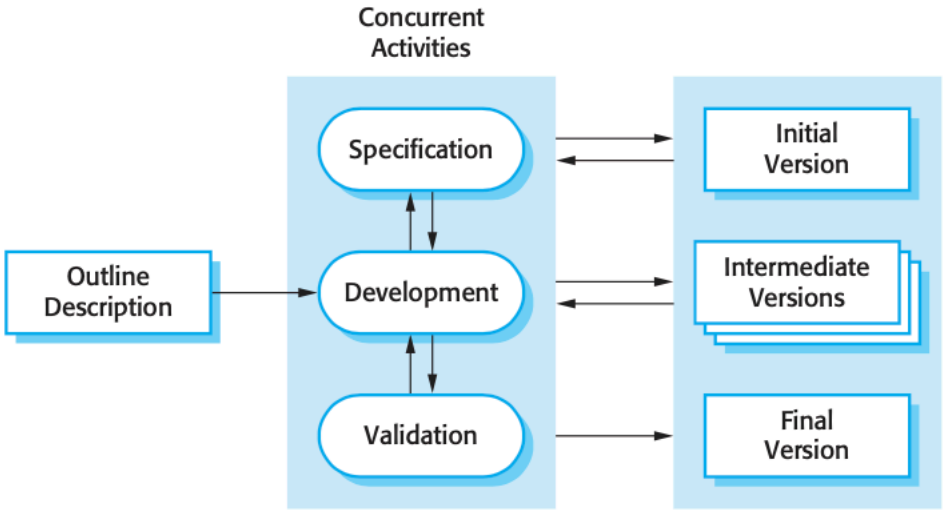
Processes based on formal transformations are generally only used in the development of safety-critical or security-critical systems. They require specialized expertise. For the majority of systems this process does not offer significant cost-benefits over other approaches to system development.

2.1.2 Incremental development

Incremental development is based on the idea of developing an initial implementation, exposing this to user comment and evolving it through several versions until an adequate system has been developed (Figure 2.2). Specification, development, and validation activities are interleaved rather than separate, with rapid feedback across activities.

Incremental software development, which is a fundamental part of agile approaches, is better than a waterfall approach for most business, e-commerce, and personal systems. Incremental development reflects the way that we solve prob- lems. We rarely work out a complete problem solution in advance but move toward a solution in a series of steps, backtracking when we realize that we have made a mistake. By

developing the software incrementally, it is cheaper and easier to make changes in the software as it is being developed.



Each increment or version of the system incorporates some of the functionality that is needed by the customer. Generally, the early increments of the system include the most important or most urgently required functionality. This means that the customer can evaluate the system at a relatively early stage in the development to see if it delivers what is required. If not, then only the current increment has to be changed and, possibly, new functionality defined for later increments.

Incremental development has three important benefits, compared to the waterfall model:

1. The cost of accommodating changing customer requirements is reduced. The amount of analysis and documentation that has to be redone is much less than is required with the waterfall model.
2. It is easier to get customer feedback on the development work that has been done. Customers can comment on demonstrations of the software and see how much has been implemented. Customers find it difficult to judge progress from software design documents.
3. More rapid delivery and deployment of useful software to the customer is possible, even if all of the functionality has not been included. Customers are able to use and gain value from the software earlier than is possible with a waterfall process.

Incremental development in some form is now the most common approach for the development of application systems. This approach can be either plan-driven, agile, or, more usually, a mixture of these approaches. In a plan-driven approach, the system increments are identified in advance; if an agile approach is adopted, the early increments are identified but the development of later increments depends on progress and customer priorities.

From a management perspective, the incremental approach has two problems:

1. The process is not visible. Managers need regular deliverables to measure progress. If systems are developed quickly, it is not cost-effective to produce documents that reflect every version of the system.
2. System structure tends to degrade as new increments are added. Unless time and money is spent on refactoring to improve the software, regular change tends to corrupt its structure. Incorporating further software changes becomes increas- ingly difficult and costly.

The problems of incremental development become particularly acute for large, complex, long-lifetime systems, where different teams develop different parts of the system. Large systems need a stable framework or architecture and the responsibilities of the different teams working on parts of the system need to be clearly defined with respect to that architecture. This has to be planned in advance rather than developed incrementally.

You can develop a system incrementally and expose it to customers for comment, without actually delivering it and deploying it in the customer's environment. Incremental delivery and deployment means that the software is used in real, operational processes. This is not always possible as experimenting with new software can disrupt normal business processes. I discuss the advantages and disadvantages of incre- mental delivery in Section 2.3.2.

2.1.3 Reuse-oriented software engineering

In the majority of software projects, there is some software reuse. This often happens informally when people working on the project know of designs or code that are similar to what is required. They look for these, modify them as needed, and incor- porate them into their system.

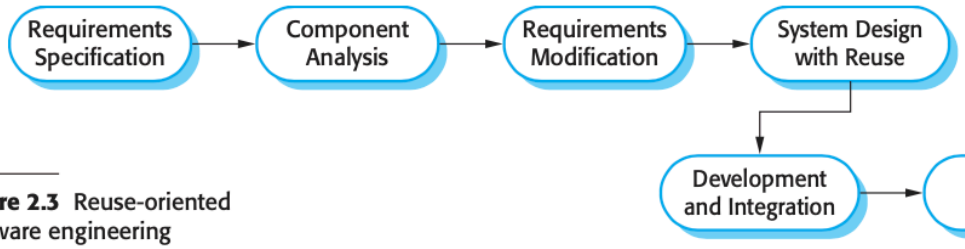


Figure 2.3 Reuse-oriented software engineering

This informal reuse takes place irrespective of the development process that is used. However, in the 21st century, software development processes that focus on the reuse of existing software have become widely used. Reuse-oriented approaches rely on a large base of reusable software components and an integrating framework for the composition of these components. Sometimes, these components are systems in their own right (COTS or commercial off-the-shelf systems) that may provide spe- cific functionality such as word processing or a spreadsheet.

A general process model for reuse-based development is shown in Figure 2.3. Although the initial requirements specification stage and the validation stage are comparable with other software processes, the intermediate stages in a reuse-oriented process are different. These stages are:

1. *Component analysis* Given the requirements specification, a search is made for components to implement that specification. Usually, there is no exact match and the components that may be used only provide some of the functionality required.
2. *Requirements modification* During this stage, the requirements are analyzed using information about the components that have been discovered. They are then mod- ified to reflect the available components. Where modifications are impossible, the component analysis activity may be re-entered to search for alternative solutions.
3. *System design with reuse* During this phase, the framework of the system is designed or an existing framework is reused. The designers take into account the components that are reused and organize the framework to cater for this. Some new software may have to be designed if reusable components are not available.
4. *Development and integration* Software that cannot be externally procured is developed, and the components and COTS systems are integrated to create the new system. System integration, in this model, may be part of the development process rather than a separate activity.

There are three types of software component that may be used in a reuse-oriented process:

1. Web services that are developed according to service standards and which are available for remote invocation.
2. Collections of objects that are developed as a package to be integrated with a component framework such as .NET or J2EE.
3. Stand-alone software systems that are configured for use in a particular environment.

Reuse-oriented software engineering has the obvious advantage of reducing the amount of software to be developed and so reducing cost and risks. It usually also leads to faster delivery of the software. However, requirements compromises are inevitable and this may lead to a system that does not meet the real needs of users. Furthermore, some control over the system evolution is lost as new versions of the reusable components are not under the control of the organization using them.

2.2 Process activities

Real software processes are interleaved sequences of technical, collaborative, and managerial activities with the overall goal of specifying, designing, implementing, and testing a software system. Software developers use a variety of different software tools in their work. Tools are particularly useful for supporting the editing of different types of document and for managing the immense volume of detailed information that is generated in a large software project.

The four basic process activities of specification, development, validation, and evo- lution are organized differently in different development processes. In the waterfall model, they are organized in sequence, whereas in incremental development they are interleaved. How these activities are carried out depends on the type of software,

people, and organizational structures involved. In extreme programming, for example, specifications are written on cards. Tests are executable and developed before the program itself. Evolution may involve substantial system restructuring or refactoring.

2.2.1 Software specification

Software specification or requirements engineering is the process of understanding and defining what services are required from the system and identifying the constraints on the system's operation and development. Requirements engineering is a

particularly critical stage of the software process as errors at this stage inevitably lead to later problems in the system design and implementation.

The requirements engineering process (Figure 2.4) aims to produce an agreed requirements document that specifies a system satisfying stakeholder requirements. Requirements are usually presented at two levels of detail. End-users and customers need a high-level statement of the requirements; system developers need a more detailed system specification.

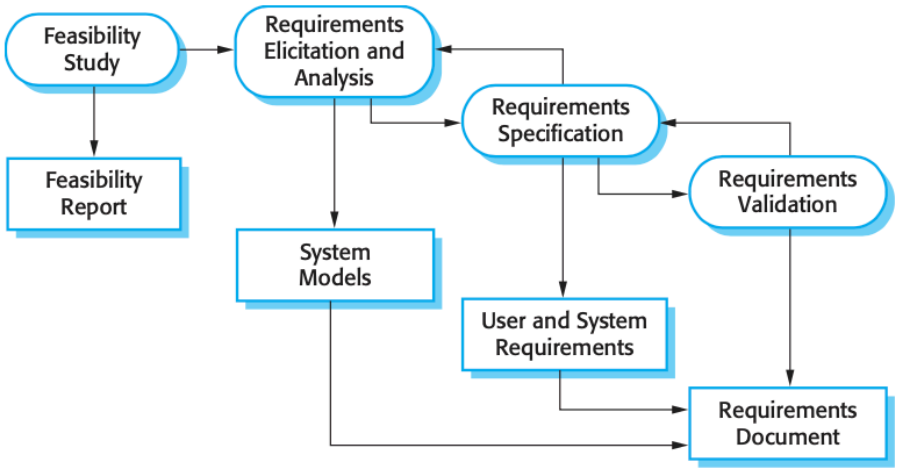


Figure 2.4 The requirements engineering process

There are four main activities in the requirements engineering process:

1. *Feasibility study* An estimate is made of whether the identified user needs may be satisfied using current software and hardware technologies. The study considers whether the proposed system will be cost-effective from a business point of view and if it can be developed within existing budgetary constraints. A feasibility study should be relatively cheap and quick. The result should inform the decision of whether or not to go ahead with a more detailed analysis.
2. *Requirements elicitation and analysis* This is the process of deriving the system requirements through observation of existing systems, discussions with potential users and procurers, task analysis, and so on. This may involve the development of one or more system models and prototypes. These help you understand the system to be specified.
3. *Requirements specification* Requirements specification is the activity of translating the information gathered during the analysis activity into a document that defines a set of requirements. Two types of requirements may be included in this document. User requirements are abstract statements of the system

require- ments for the customer and end-user of the system; system requirements are a more detailed description of the functionality to be provided.

4. *Requirements validation* This activity checks the requirements for realism, consis- tency, and completeness. During this process, errors in the requirements document are inevitably discovered. It must then be modified to correct these problems.

Of course, the activities in the requirements process are not simply carried out in a strict sequence. Requirements analysis continues during definition and specification and new requirements come to light throughout the process. Therefore, the activities of analysis, definition, and specification are interleaved. In agile methods, such as extreme programming, requirements are developed incrementally according to user priorities and the elicitation of requirements comes from users who are part of the development team.

2.2.2 Software design and implementation

The implementation stage of software development is the process of converting a system specification into an executable system. It always involves processes of soft- ware design and programming but, if an incremental approach to development is used, may also involve refinement of the software specification.

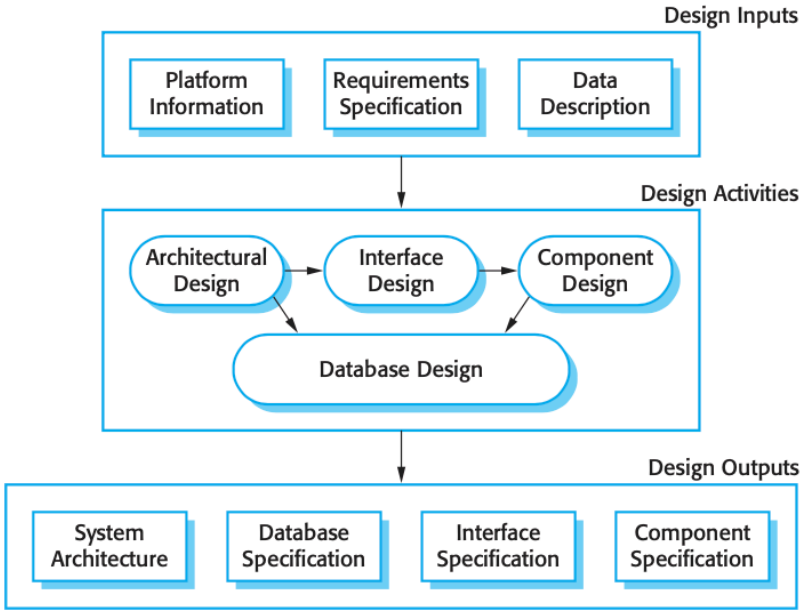


Figure 2.5 A general model of the design process

A software design is a description of the structure of the software to be implemented, the data models and structures used by the system, the interfaces between system com- ponents and, sometimes, the algorithms used. Designers do not arrive at a finished design immediately but develop the design iteratively. They add formality and detail as they develop their design with constant backtracking to correct earlier designs.

Figure 2.5 is an abstract model of this process showing the inputs to the design process, process activities, and the documents produced as outputs from this process.

The diagram suggests that the stages of the design process are sequential. In fact, design process activities are interleaved. Feedback from one stage to another and consequent design rework is inevitable in all design processes.

Most software interfaces with other software systems. These include the operating system, database, middleware, and other application systems. These make up the 'soft- ware platform', the environment in which the software will execute. Information about this platform is an essential input to the design process, as designers must decide how best to integrate it with the software's environment. The requirements specification is a description of the functionality the software must provide and its performance and dependability requirements. If the system is to process existing data, then the description of that data may be included in the platform specification; otherwise, the data description must be an input to the design process so that the system data organization to be defined.

The activities in the design process vary, depending on the type of system being developed. For example, real-time systems require timing design but may not include a database so there is no database design involved. Figure 2.5 shows four activities that may be part of the design process for information systems:

1. *Architectural design,* where you identify the overall structure of the system, the principal components (sometimes called sub-systems or modules), their relationships, and how they are distributed.
2. *Interface design,* where you define the interfaces between system components. This interface specification must be unambiguous. With a precise interface, a component can be used without other components having to know how it is implemented. Once interface specifications are agreed, the components can be designed and developed concurrently.

3. *Component design,* where you take each system component and design how it will operate. This may be a simple statement of the expected functionality to be implemented, with the specific design left to the programmer. Alternatively, it may be a list of changes to be made to a reusable component or a detailed design model. The design model may be used to automatically generate an implementation.
4. *Database design,* where you design the system data structures and how these are to be represented in a database. Again, the work here depends on whether an existing database is to be reused or a new database is to be created.

   These activities lead to a set of design outputs, which are also shown in Figure 2.5.

The detail and representation of these vary considerably. For critical systems, detailed design documents setting out precise and accurate descriptions of the system must be produced. If a model-driven approach is used, these outputs may mostly be diagrams. Where agile methods of development are used, the outputs of the design process may not be separate specification documents but may be represented in the code of the program.

Structured methods for design were developed in the 1970s and 1980s and were the precursor to the UML and object-oriented design (Budgen, 2003). They rely on

producing graphical models of the system and, in many cases, automatically generating code from these models. Model-driven development (MDD) or model-driven engineering (Schmidt, 2006), where models of the software are created at different levels of abstraction, is an evolution of structured methods. In MDD, there is greater emphasis on architectural models with a separation between abstract implementation-independent models and implementation-specific models. The models are developed in sufficient detail so that the executable system can be generated from them. I discuss this approach to development in Chapter 5.

The development of a program to implement the system follows naturally from the system design processes. Although some classes of program, such as safety-critical systems, are usually designed in detail before any implementation begins, it is more common for the later stages of design and program development to be interleaved. Software development tools may be used to generate a skeleton program from a design. This includes code to define and implement interfaces, and, in many cases, the developer need only add details of the operation of each program component.

Programming is a personal activity and there is no general process that is usually followed. Some programmers start with components that they understand, develop these, and then move on to less-understood components. Others take the opposite

approach, leaving familiar components till last because they know how to develop them. Some developers like to define data early in the process then use this to drive the program development; others leave data unspecified for as long as possible.

Normally, programmers carry out some testing of the code they have developed. This often reveals program defects that must be removed from the program. This is called debugging. Defect testing and debugging are different processes. Testing establishes the existence of defects. Debugging is concerned with locating and correcting these defects.

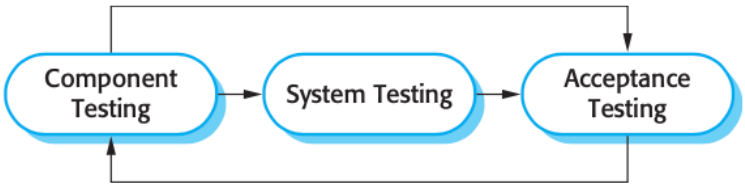


Figure 2.6 Stages of testing

When you are debugging, you have to generate hypotheses about the observable behavior of the program then test these hypotheses in the hope of finding the fault that caused the output anomaly. Testing the hypotheses may involve tracing the program code manually. It may require new test cases to localize the problem. Interactive debugging tools, which show the intermediate values of program variables and a trace of the statements executed, may be used to support the debugging process.

2.2.3 Software validation

Software validation or, more generally, verification and validation (V&V) is intended to show that a system both conforms to its specification and that it meets the expectations of the system customer. Program testing, where the system is exe- cuted using

simulated test data, is the principal validation technique. Validation may also involve checking processes, such as inspections and reviews, at each stage of the software process from user requirements definition to program development. Because of the predominance of testing, the majority of validation costs are incurred during and after implementation.

Except for small programs, systems should not be tested as a single, monolithic unit. Figure 2.6 shows a three-stage testing process in which system components are tested then the integrated system is tested and, finally, the system is tested with the customer's data. Ideally, component defects are discovered early in the process, and interface problems are found when the system is integrated. However, as defects are discovered, the program must be debugged and this may require other stages in the testing process to be repeated. Errors in program components, say, may come to light during system testing. The process is therefore an iterative one with information being fed back from later stages to earlier parts of the process.

The stages in the testing process are:

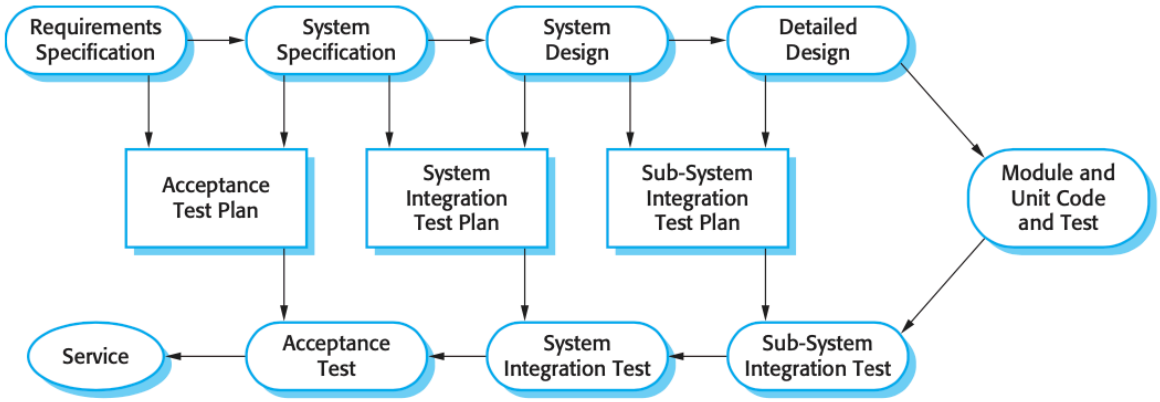
1. *Development testing* The components making up the system are tested by the people developing the system. Each component is tested independently, without other system components. Components may be simple entities such as functions or object classes, or may be coherent groupings of these entities. Test automa- tion tools, such as JUnit (Massol and Husted, 2003), that can re-run component tests when new versions of the component are created, are commonly used.
2. *System testing* System components are integrated to create a complete system. This process is concerned with finding errors that result from unanticipated interactions between components and component interface problems. It is also concerned with showing that the system meets its functional and non-functional requirements, and testing the emergent system properties. For large systems, this may be a multi-stage process where components are integrated to form sub- systems that are individually tested before these sub-systems are themselves integrated to form the final system.
3. *Acceptance testing* This is the final stage in the testing process before the system is accepted for operational use. The system is tested with data supplied by the system customer rather than with simulated test data. Acceptance testing may reveal errors and omissions in the system requirements definition, because the real data exercise the system in different ways from the test data. Acceptance testing may also reveal requirements problems where the system's facilities do not really meet the user's needs or the system performance is unacceptable.

Normally, component development and testing processes are interleaved. Programmers make up their own test data and incrementally test the code as it is developed. This is an economically sensible approach, as the programmer knows the component and is therefore the best person to generate test cases.

If an incremental approach to development is used, each increment should be tested as it is developed, with these tests based on the requirements for that incre- ment. In extreme programming, tests are developed along with the requirements before

development starts. This helps the testers and developers to understand the requirements and ensures that there are no delays as test cases are created.

When a plan-driven software process is used (e.g., for critical systems develop- ment), testing is driven by a set of test plans. An independent team of testers works from these pre-formulated test plans, which have been developed from the system specification and design. Figure 2.7 illustrates how test plans are the link between testing and development activities. This is sometimes called the V-model of develop- ment (turn it on its side to see the V).



Acceptance testing is sometimes called ‘alpha testing’. Custom systems are developed for a single client. The alpha testing process continues until the system developer and the client agree that the delivered system is an acceptable implemen- tation of the requirements.

When a system is to be marketed as a software product, a testing process called ‘beta testing’ is often used. Beta testing involves delivering a system to a number of potential customers who agree to use that system. They report problems to the sys- tem developers. This exposes the product to real use and detects errors that may not have been anticipated by the system builders. After this feedback, the system is mod- ified and released either for further beta testing or for general sale.

The flexibility of software systems is one of the main reasons why more and more software is being incorporated in large, complex systems. Once a decision has been made to manufacture hardware, it is very expensive to make changes to the hardware design. However, changes can be made to software at any time during or after the system development. Even extensive changes are still much cheaper than correspon- ding changes to system hardware.

Historically, there has always been a split between the process of software devel- opment and the process of software evolution (software maintenance). People think of software development as a creative activity in which a software system is devel- oped from an initial concept through to a working system. However, they sometimes think of software maintenance as dull and uninteresting. Although the costs of main- tenance are often several times the initial development costs, maintenance processes are sometimes considered to be less challenging than original software development.

This distinction between development and maintenance is increasingly irrelevant. Hardly any software systems are completely new systems and it makes much more sense to see development and maintenance as a continuum. Rather than two separate processes, it is more realistic to think of software engineering as an evolutionary process (Figure 2.8) where software is continually changed over its lifetime in response to changing requirements and customer needs.

3. Latihan dan Jawaban

1. Software processes are the activities involved in producing a software system. Software process models are abstract representations of these processes.
2. General process models describe the organization of software processes. Examples of these general models include the waterfall model, incremental development, and reuse-oriented development.
3. Requirements engineering is the process of developing a software specification. Specifications are intended to communicate the system needs of the customer to the system developers.
4. Design and implementation processes are concerned with transforming a requirements specification into an executable software system. Systematic design methods may be used as part of this transformation.
5. Software validation is the process of checking that the system conforms to its specification and that it meets the real needs of the users of the system.
6. Software evolution takes place when you change existing software systems to meet new requirements. Changes are continuous and the software must evolve to remain useful.
7. Processes should include activities to cope with change. This may involve a prototyping phase that helps avoid poor decisions on requirements and design. Processes may be structured for iterative development and delivery so that changes may be made without disrupting the system as a whole.
8. The Rational Unified Process is a modern generic process model that is organized into phases (inception, elaboration, construction, and transition) but separates activities (requirements, analysis, and design, etc.) from these phases.

9. Daftar Pustaka

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