

Chapter 6

■ Principles that Guide Practice

Slide Set to accompany

Software Engineering: A Practitioner's Approach

by Roger S. Pressman and Bruce R. Maxim

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Software Engineering Knowledge

- You often hear people say that software development knowledge has a 3-year half-life: half of what you need to know today will be obsolete within 3 years. In the domain of technology-related knowledge, that's probably about right.
- But there is another kind of software development knowledge—a kind that I think of as "**software engineering principles**"—that does not have a three-year half-life. These software engineering principles are likely to serve a professional programmer throughout his or her career.

Steve McConnell

Principles that Guide Process - I

- **Principle #1. Be agile.** Whether the process model you choose is prescriptive or agile, the basic tenets of agile development should govern your approach.
- **Principle #2. Focus on quality at every step.** The exit condition for every process activity, action, and task should focus on the **quality** of the work product that has been produced.
- **Principle #3. Be ready to adapt.** Process is not a religious experience and dogma has no place in it. When necessary, adapt your approach to constraints imposed by the problem, the people, and the project itself.
- **Principle #4. Build an effective team.** Software engineering process and practice are important, but **the bottom line is people**. Build a self-organizing team that has mutual trust and respect.

Principles that Guide Process - II

- **Principle #5.** *Establish mechanisms for communication and coordination.* Projects fail because important information falls into the cracks and/or stakeholders fail to coordinate their efforts to create a successful end product.
- **Principle #6.** *Manage change.* The approach may be either formal or informal, but **mechanisms** must be established to manage the way changes are requested, assessed, approved and implemented.
- **Principle #7.** *Assess risk.* Lots of things can go wrong as software is being developed. It's essential that you establish contingency plans.
- **Principle #8.** *Create work products that provide value for others.* Create only those work products that provide value for other process activities, actions or tasks.

Principles that Guide Practice

- **Principle #1. *Divide and conquer.*** Stated in a more technical manner, analysis and design should always emphasize *separation of concerns* (SoC).
- **Principle #2. *Understand the use of abstraction.*** An abstraction is a simplification of some complex element of a system used to communicate meaning in a single phrase.
- **Principle #3. *Strive for consistency.*** A familiar context makes software easier to use.
- **Principle #4. *Focus on the transfer of information.*** Pay special attention to the analysis, design, construction, and testing of **interfaces**.

Principles that Guide Practice

- **Principle #5.** *Build software that exhibits effective modularity.* Separation of concerns (Principle #1) establishes a philosophy for software. *Modularity* provides a mechanism for realizing the philosophy.
- **Principle #6.** *Look for patterns.* Brad Appleton [App00] suggests that: “The goal of patterns within the software community is to create a body of literature to help software developers resolve recurring problems encountered throughout all of software development.
- **Principle #7.** *When possible, represent the problem and its solution from a number of different perspectives.*
- **Principle #8.** *Remember that someone will maintain the software.*

Communication Principles

- **Principle #1. *Listen.*** Try to focus on the speaker's words, rather than formulating your response to those words.
- **Principle # 2. *Prepare before you communicate.*** Spend the time to understand the problem before you meet with others.
- **Principle # 3. *Someone should facilitate the activity.*** Every communication meeting should have a leader (a facilitator) to keep the conversation moving in a productive direction; (2) to mediate any conflict that does occur, and (3) to ensure than other principles are followed.
- **Principle #4. *Face-to-face communication is best.*** But it usually works better when some other representation of the relevant information is present.

Communication Principles

- **Principle # 5.** *Take notes and document decisions.* Someone participating in the communication should serve as a “recorder” and write down all important points and decisions.
- **Principle # 6.** *Strive for collaboration.* Collaboration and consensus occur when the collective knowledge of members of the team is combined ...
- **Principle # 7.** *Stay focused, modularize your discussion.* The more people involved in any communication, the more likely that discussion will bounce from one topic to the next.
- **Principle # 8.** *If something is unclear, draw a picture.*
- **Principle # 9.** *(a) Once you agree to something, move on; (b) If you can't agree to something, move on; (c) If a feature or function is unclear and cannot be clarified at the moment, move on.*
- **Principle # 10.** *Negotiation is not a contest or a game. It works best when both parties win.*

Planning Principles

- **Principle #1.** *Understand the scope of the project.* It's impossible to use a roadmap if you don't know where you're going. Scope provides the software team with a destination.
- **Principle #2.** *Involve the customer in the planning activity.* The customer defines priorities and establishes project constraints.
- **Principle #3.** *Recognize that planning is iterative.* A project plan is never engraved in stone. As work begins, it very likely that things will change.
- **Principle #4.** *Estimate based on what you know.* The intent of estimation is to provide an indication of effort, cost, and task duration, based on the team's current understanding of the work to be done.

Planning Principles

- **Principle #5.** *Consider risk as you define the plan.* If you have identified risks that have high impact and high probability, contingency planning is necessary.
- **Principle #6.** *Be realistic.* People don't work 100 percent of every day.
- **Principle #7.** *Adjust granularity as you define the plan.* Granularity refers to the level of detail that is introduced as a project plan is developed.
- **Principle #8.** *Define how you intend to ensure quality.* The plan should identify how the software team intends to ensure quality.
- **Principle #9.** *Describe how you intend to accommodate change.* Even the best planning can be obviated by uncontrolled change.
- **Principle #10.** *Track the plan frequently and make adjustments as required.* Software projects fall behind schedule one day at a time.

Modeling Principles

- In SE work, two classes of models can be created:
 - *Requirements models* (also called *analysis models*) represent the customer requirements by depicting the software in three different domains:
 - the information domain
 - the functional domain
 - the behavioral domain.
 - *Design models* represent characteristics of the software that help practitioners to construct it effectively:
 - the architecture
 - the user interface
 - component-level detail.

Agile Modeling Principles

- Principle #1. *The primary goal of the software team is to build software not create models.*
- Principle #2. *Travel light – don't create more models than you need.*
- Principle #3. *Strive to produce the simplest model that will describe the problem or the software.*
- Principle #4. *Build models in a way that makes them amenable to change.*
- Principle #5. *Be able to state an explicit purpose for each model that is created.*

Agile Modeling Principles

- Principle #6. Adapt the models you create to the system at hand.
- Principle #7. Try to build useful models, forget about building perfect models.
- Principle #8. Don't become dogmatic about model syntax. Successful communication is key.
- Principle #9. If your instincts tell you a paper model isn't right, you may have a reason to be concerned.
- Principle #10. Get feedback as soon as you can.

Requirements Modeling Principles

- Principle #1. *The information domain of a problem must be represented and understood.*
- Principle #2. *The functions that the software performs must be defined.*
- Principle #3. *The behavior of the software (as a consequence of external events) must be represented.*
- Principle #4. *The models that depict information, function, and behavior must be partitioned in a manner that uncovers detail in a layered (or hierarchical) fashion.*
- Principle #5. *The analysis task should move from essential information toward implementation detail.*

Design Modeling Principles

- Principle #1. Design should be traceable to the requirements model.
- Principle #2. Always consider the architecture of the system to be built.
- Principle #3. Design of data is as important as design of processing functions.
- Principle #4. Interfaces (both internal and external) must be designed with care.
- Principle #5. User interface design should be tuned to the needs of the end-user. Stress ease of use.

Design Modeling Principles

- Principle #6. Component-level design should be functionally independent.
- Principle #7. Components should be loosely coupled to each other than the environment.
- Principle #8. Design representations (models) should be easily understandable.
- Principle #9. The design should be developed iteratively.
- Principle #10. Creation of a design model does not preclude using an agile approach.

Construction Principles

- The construction activity encompasses a set of coding and testing tasks that lead to operational software that is ready for delivery to the customer or end-user.
- **Coding principles and concepts** are closely aligned programming style, programming languages, and programming methods.
- **Testing principles and concepts** lead to the design of tests that systematically uncover different classes of errors and to do so with a minimum amount of time and effort.

Preparation Principles

■ *Before you write one line of code, be sure you:*

- Understand the problem you're trying to solve.
- Understand basic design principles and concepts.
- Pick a programming language that meets the needs of the software to be built and the environment in which it will operate.
- Select a programming environment that provides tools that will make your work easier.
- Create a set of unit tests that will be applied once the component your code is completed.

Coding Principles

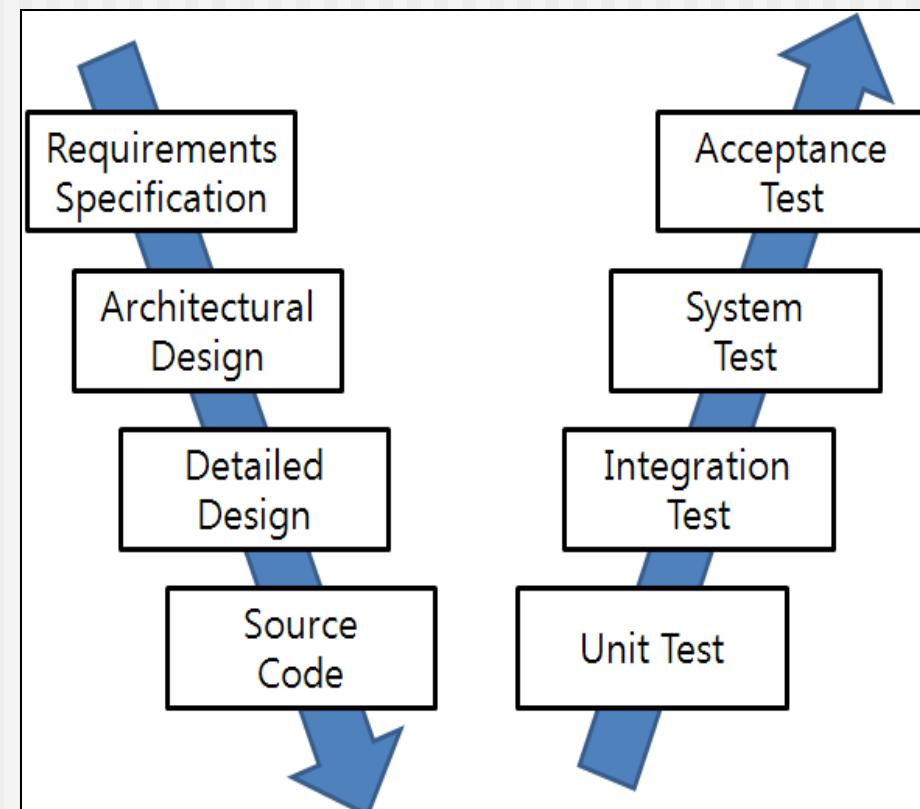
- *As you begin writing code, be sure you:*
 - Constrain your algorithms by following structured programming [Boh00] practice.
 - Consider the use of pair programming
 - Select data structures that will meet the needs of the design.
 - Understand the software architecture and create interfaces that are consistent with it.
 - Keep conditional logic as simple as possible.
 - Create nested loops in a way that makes them easily testable.
 - Select meaningful variable names and follow other local coding standards.
 - Write code that is self-documenting.
 - Create a visual layout (e.g., indentation and blank lines) that aids understanding.

Validation Principles

- *After you've completed your first coding pass, be sure you:*
 - Conduct a code walkthrough when appropriate.
 - Perform unit tests and correct errors you've uncovered.
 - Refactor the code.

Testing Principles

- Al Davis [Dav95] suggests the following:
 - **Principle #1.** *All tests should be traceable to customer requirements.*
 - **Principle #2.** *Tests should be planned long before testing begins.*
 - **Principle #3.** *The Pareto principle applies to software testing.*
 - **Principle #4.** *Testing should begin “in the small” and progress toward testing “in the large.”*



V model of SW development²²

Testing Principles

- Principle #5. *Exhaustive testing is not possible.*
- Principle #6. *Testing effort for each system module commensurate to expected fault density.*
- Principle #7. *Static testing (i.e. document review) can yield high results.*
- Principle #8. *Track defects and look for patterns in defects uncovered by testing.*
- Principle #9. *Include test cases that demonstrate software is behaving correctly.*

Deployment Principles

- Principle #1. *Customer expectations for the software must be managed.*
- Principle #2. *A complete delivery package should be assembled and tested.*
- Principle #3. *A support regime must be established before the software is delivered.*
- Principle #4. *Appropriate instructional materials must be provided to end-users.*
- Principle #5. *Buggy software should be fixed first, delivered later.*

Communication Mistakes (pg 90)

■ The scene:

- SE team workspace

■ The players:

- Jamie Lazar, software team member;
- Vinod Raman, software team member;
- Ed Robbins, software team member;

The conversation:

Ed: What have you heard about this SafeHome project?

Vinod: The kick-off meeting is scheduled for next week.

Jamie: I've alreadyd done a little bit of investigation, but it didn't go well.

Ed: What do you mean?

Jamie: Well, I gave Lisa Perez a call. She's the marketing honcho on this thing

Vinod: And ...?

Jamie: I wanted her to tell me about SafeHome features and functions... that sort of thing. Instead, she began asking me questions about security systems, surveillance systems... I'm not an expert

Vinod: What does that tell you?

(Jami shrugs)

Vinod: That marking will need us to act as consultants and that we'd better do some homework on this product are before our kick-off meeting. Doug said that he wanted us to "collaborate" with our customer, so we'd better lean how to do that

Ed: Probably would have been netter to stop by her office. Phone calls just don't work as well for this sort of thing.

Jamie: You're both right. We've got to get our act together or our early communications will be a struggle.

Vinod: I saw Doug reading a book on "requirements engineering". I'll bet that lists some principles of good communication. I'm going to borrow it from him

Jami; Good idea... then you can teach us

Vinod (smiling): Yeah, right.

- **Facilitator:** Does that also add some constraints?
- **Jamie:** It does, both technical and legal.
- **Production rep:** Meaning?
- **Jamie:** We better make sure an outsider can't hack into the system, disarm it, and rob the place or worse. Heavy liability on our part.
- **Doug:** Very true.
- **Marketing:** But we still need Internet connectivity. Just be sure to stop an outsider from getting in.
- **Ed:** That's easier said than done and....
- **Facilitator (interrupting):** I don't want to debate this issue now. Let's note it as an action item and proceed. (Doug, serving as the recorder for the meeting, makes an appropriate note.)
- **Facilitator:** I have a feeling there's still more to consider here.
- (The group spends the next 45 minutes refining and expanding the details of the home security function.)