

performance, monitoring actions taken and results achieved, addressing problems encountered, and sharing information with people interested in the project. If a substantial deviation occurs between the planned work and the actual work, the project manager needs to reallocate resources, change the schedule, or renegotiate the outcome.

- *Terminating.* This activity is concerned with finishing the project. It involves delivering the system to the client according to the acceptance criteria defined in the project agreement, installing the accepted system at the customer site, reviewing the project history to extract lessons learned from the project, and modifying of project templates for the next iteration of the project or for a new project.

From a dynamic point of view, a project can be in one of several phases, which we have already mentioned in Chapter 3. We refine this model by adding another state, Conception (see Figure 14-1).

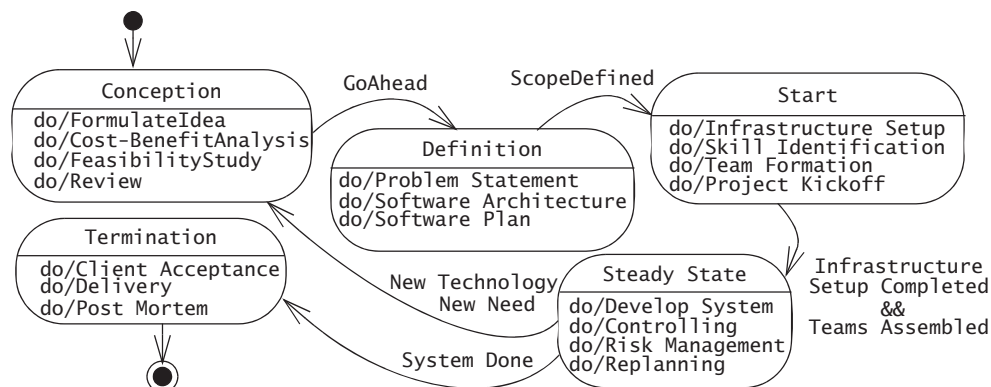


Figure 14-1 Phases of a Software Project (UML state machine diagram).

Project conception. During this phase, also called *concept phase*, the idea for the project is born. In a software project this is usually a new requirement triggered by the need of an existing market or a new technology. The concept phase is handled in many different ways. For a small project it may consist of an informal discussion between interested people and a go-ahead decision based on a verbal agreement.

In a larger project, the idea is investigated thoroughly, usually with a cost–benefit analysis and a technical feasibility study. The cost–benefit analysis is a comparative assessment of all costs that will be incurred to perform the project and of all benefits anticipated from the project’s outcome. Some benefits can be reduced operating costs or increased revenue. Other benefits might include improved morale, reduced turnover, increased productivity, or fewer absences.

The technical feasibility study investigates if the outcome is technically feasible. A typical issue to be addressed is whether the required innovation can be made available in time during the duration of the project. Proceeding to the next phase usually requires a formal review and a formal go-ahead decision.

Project definition. During this phase, the project manager, a client, and the software architect are involved. The project manager can be one of the interested people from the concept phase or, as it is quite common, brought in from the outside at the beginning of this phase. The project definition phase includes the following activities:

- **Problem definition.** During this activity, the client and the project manager define the scope of the system in terms of functionality, constraints, and deliverables. The client and the project manager also agree on acceptance criteria and target dates. The resulting document, called the **problem statement**, serves as the starting point of the Requirements Analysis Document (RAD), which is developed during the steady state phase.
- **Initial Software Project Management Plan (SPMP).** During this activity, the project manager provides an overview of the project, a description of the results to be produced, a work breakdown structure, roles and responsibilities, a project schedule, budgets for required resources, and a description of how risks will be identified and managed.
- **Initial software architecture.** This activity is performed in parallel to the development of the SPMP. The focus is on the software architecture, in particular on the decomposition of the system into subsystems. The software architecture is crucial for managing the project, because it also serves as the basis for the initial team organization. It therefore requires a close interaction between the software architect and the project manager. The software architect revises the subsystem decomposition during the steady state phase. The initial software architecture document will expand into the System Design Document (SDD).
- **Project Agreement definition.** The client and the project manager formally agree on the scope of the system and the delivery date as baselined in the *Project Agreement* document.

Project start. During this phase, the project manager sets up the project infrastructure, hires participants, organizes them in teams, and kicks off the project. Project start includes the following activities:

- **Infrastructure set-up.** In project-based organizations, it cannot be assumed that the infrastructure exists. The project manager must therefore define the requirements for the infrastructure of the project. These requirements address the communication channels for project participants like bulletin boards, web sites, and meeting

management procedures, tools for configuration management, building and testing environments and workflows for the authoring and reviews of documents. The project manager can then give this infrastructure specification to an infrastructure team, which will set up this infrastructure and maintain it throughout the project.¹

- **Skill identification.** During this activity, the project manager identifies the skills and interests of the developers and records them in a skills matrix.
- **Team assembly.** The project manager uses the skill matrix to assign the participants to teams for each subsystem defined in the initial software architecture document, defines cross-functional teams, and selects team leaders. The project manager and the team leaders together then assign roles and responsibilities to participants. When skills and roles do not match, the project manager identifies additional training needs and tutorials for the team members during this phase. Finally, the project manager assigns work packages to the teams.
- **Project kick-off.** The project manager, the team leaders, and the client officially start the project in a kick-off meeting with all developers being present. The purpose of the kick-off meeting is to share with all the project participants the scope of the project, the communication infrastructure, and the responsibilities of each team. After project kick-off, the project enters steady state.

Project steady state. During project definition and project start, most decisions are made by the project manager. During the steady state, team leaders are taking over some management functions. In particular, they are responsible for tracking the status of their team and identifying problems in team meetings. Team leaders report the status of their team to the project manager, who then evaluates the status of the complete project. Team leaders respond to deviations from the plan by reallocating tasks to developers or obtaining additional resources from the project manager. The project manager is responsible for the interaction with the client, obtaining formal agreements and renegotiating resources and deadlines. Steady state project management includes the following activities:

- **Project scope definition.** Once the analysis model is stable, the client and the project manager formally agree on the functional and nonfunctional requirements of the system, which might lead to an update in the *Project Agreement* document.
- **Controlling.** Throughout the remaining project phases, team leaders and the project manager monitor status in a weekly meeting and compare it with the planned schedule from the SPMP. The team leaders are responsible for collecting status information through meetings, reviews, problem reports, and work product completion. They are also responsible to report status to the project manager.

1. Depending on the size and complexity of the project, financial and personal management systems are set up as well. These systems are not covered in this book.

- **Risk management.** During this activity, project participants identify additional potential problems that could cause delays in the schedule and budget overruns. The project manager and the team leaders identify, analyze, and prioritize risks, and prepare contingency plans.
- **Project replanning.** Whenever the project deviates from the schedule or when a contingency plan is activated, the project manager needs to revise the schedule and reallocates resources to meet the delivery deadline. The project manager can hire new staff, create new teams, or merge existing teams. Project replanning can also be triggered when the client changes the requirements.

Project termination. During this phase, the project outcome is delivered to the customer and the project history is collected. Most of the developers' involvement with the project ends just before this phase when they clean up models and code and complete the documentation. A handful of key developers, the technical writers, and the team leaders are involved with wrapping up the system for installation and acceptance and collecting the project history for future use.

- **Delivery.** This activity consists of two subactivities, the client acceptance test and installation, usually in that order.
 - **Client acceptance test.** The software system is evaluated with the client according to the acceptance criteria set forth in the Project Agreement. Functional and nonfunctional requirements are demonstrated and tested using scenarios defined in the Project Agreement. The client formally accepts the product at this stage.
 - **Installation.** The system is deployed in the target environment and documents are delivered. The installation may include user training and a roll-out phase, during which data is migrated from the previous system to the new system.
- **Postmortem.** The project manager and the team leaders collect the history of the project to allow the organization to learn from it. By capturing the history of major and minor failures and by analyzing their causes, an organization can avoid repeating mistakes and improve its practice.

Each of the states allows significant parallelism of the project management activities. This is modeled in the activity diagram in Figure 14-2. In the following we describe these activities in more detail. In the next section we describe project management models used for the various project phases, in particular for the work to be performed, schedules, and team-based organizations. We also describe how to document these models in a software project management plan.

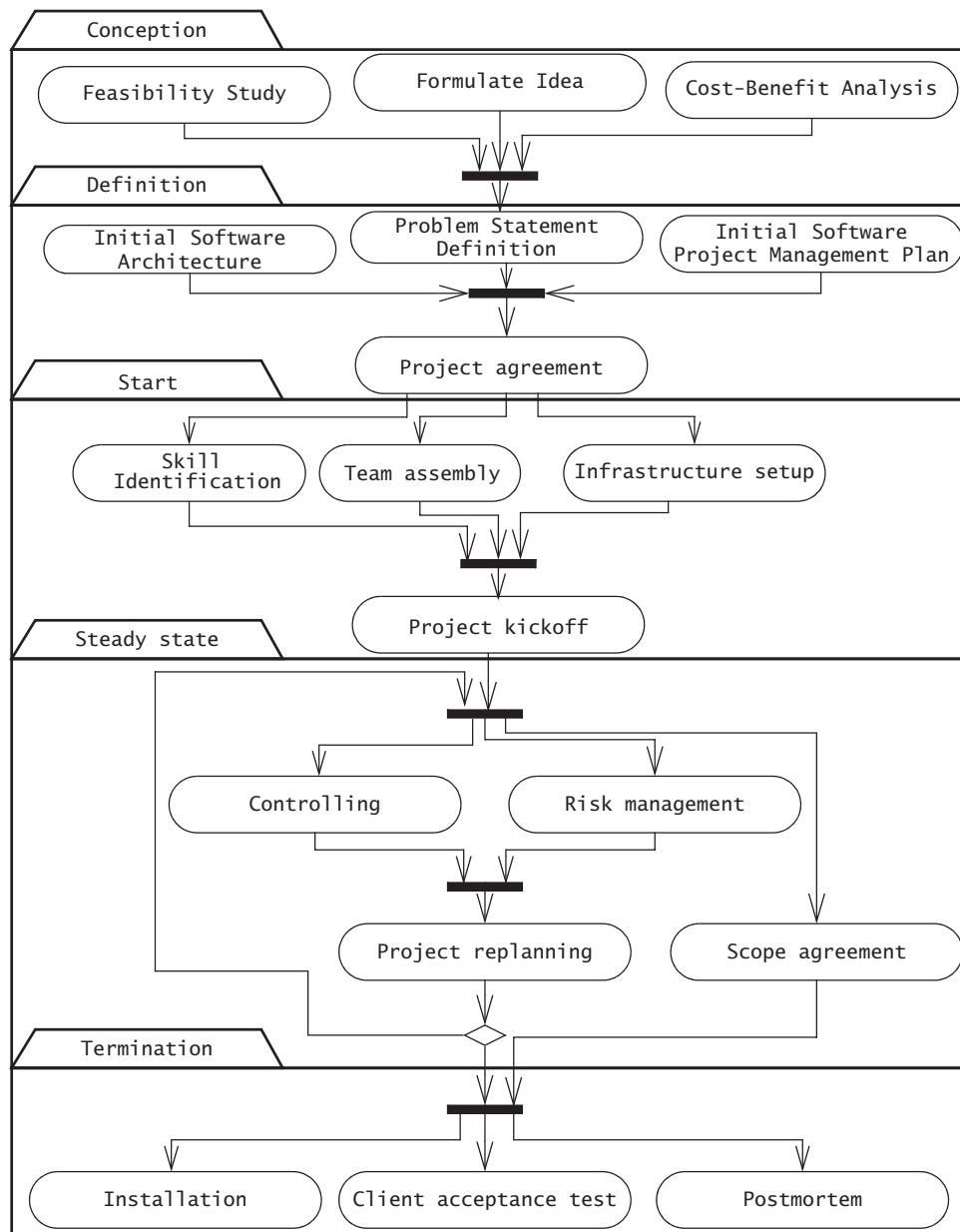


Figure 14-2 Management activities in a software project (UML activity diagram).