

## 2.2 Project Management

The project management model describes the effort undertaken to realize a product over its useful life that will satisfy the changing needs of a designated customer / simple market. This model is both a record of past and ongoing effort and a projection of potential future effort.

The essential responsibility of project management is to determine how best to use available resources so that a product suited to the customer's needs is provided in a predictable and timely fashion. Program management, in consultation with projects and considering enterprise-provided infrastructure, establishes uniform policies and conventions, a development process and shared assets, physical and computing facilities, and developmental quality criteria by which productivity (efficiency and effectiveness) of projects is evaluated and improved.

The project management model has three elements: project direction, product planning, and increment performance. Project direction concerns how the project operates to build and evolve a product in keeping with business goals, productivity objectives, and contextual constraints. Product planning concerns how a product is developed over its useful life, in keeping with an incrementally realized master plan and consistent with customer needs. Increment performance concerns the project's efforts to iteratively build a product increment as specified in the product master plan.

### Project Direction

The project direction element specifies the relationship of a project with the program and with any related projects. In initiating a project, program management specifies its product focus, its targeted customer, and resources for project performance. Project direction builds on adherence to program-prescribed practices and services in operation of the project, the monitoring and periodic reporting to program management on project plans, risks, and progress, and coordination with related projects to leverage common interests and achieve best use of shared resources.

The project direction specification has three elements: project performance, process definition, and developmental quality.

### *Project Performance*

The project performance specification has three elements: concept, resources, and productivity.

The concept element specifies the project's focus on a product suited to specific needs of a targeted customer. Focus limits the scope and capabilities of an envisioned product, in coordination with program marketing, to align with the program's market objectives and technical competence.

Over time, program objectives, market, and capabilities will evolve in keeping with changing market circumstances, program staffing, and technology. Similarly, the experiences of a project may influence changes in program scope and competence to accommodate a given customer's changing needs or circumstances. These changes, in turn, may result in changes in project concept or practices.

The resources element specifies the efforts taken to identify and obtain funding, staffing, and physical and computing facilities needed by the project over its life. The nature and level of resources obtained influence the goals and pace that product planning can expect development to achieve.

Project funding may come from the program as a capital investment, as payments from the project's customer, or from retained proceeds of prior product deliveries. Staffing may include personnel having expertise shared across projects, as transfers from other projects, as new hires, or as assignees from a customer organization. Physical and computing facilities may be shared program resources or may be obtained using project funds. The program may also allow a project to develop, use, and share assets (components or tools) of collaboratively maintained (program- or community- based) open source libraries when appropriate for project-determined needs.

The productivity element profiles the degree to which the project is meeting project-specified developmental guidance. Productivity is determined via increment-level reviews for evidence of conformance to project objectives, methodology guidance, developmental quality criteria, and progress against plan. Measurements of developmental quality factors are collected and analyzed for potential improvements in

methodology guidance (i.e., process, methods, tools, and practices) or the effectiveness of developers in applying that methodology. Quality measures come from reviews by competent developers of each task's performance (e.g., based on goal-question-metric practices appropriate to each process-specified activity). Determinations of any deficiencies may result in additional methodology guidance to the project or adjustments in product scope, project plan, or resources. Program management uses project performance information to maintain realism in program-level planning, direction, and coordination across projects.

### ***Process Definition***

The process definition element specifies the process to be performed by the project and evaluations of its adequacy. A process, as a framework for defining the activities that comprise the work of a project, is conceived to achieve some specific result. For a product development process, that result is a product fit for a specified purpose and of acceptable quality. The process itself is judged from a perspective of productivity, that the effort to realize a product over its useful life is both effective and efficient. (This chapter assumes use of the concurrent development process, based on the specified project model, described in section 2.0.)

Program management may establish guidance regarding the process a project is to follow and criteria for its evaluation. Project management may be allowed to tailor this guidance as needed to suit the specific circumstances of the project, such as differing customer-prescribed standards or constraints related to future product sustainment.

An adjunct to the process definition is material specific to each product model element for review and substantiation of its content. These materials include productivity and product quality reviews, analyses of alternatives considered, rationale for results, potential future changes, and evaluations of consistency with related product model elements.

### ***Developmental Quality***

The developmental quality element specifies the criteria and mechanism for evaluating the productivity (efficiency and effectiveness) of a project. Evaluations based on this

criteria as part of increment performance inform project management toward improvements in prescribed practices to better fit project circumstances.

Productivity is expressed as an elaboration of the four categories defined in the framework for developmental quality (presented in section 2.0):

- (*feasibility*) The envisioned product can reasonably be actualized with expected observable behavior given the organization's competence, capabilities, and available resources;
- (*sustainability*) The product can be built so as to accommodate potentially beneficial modifications over its useful life;
- (*conformability*) The product can be built as a rational formulation of needed capabilities with appropriate similarity to other of the program's past, present, or future products;
- (*verifiability*) The means exist to evaluate the degree to which the product satisfies specified behavioral qualities<sup>1</sup>.

As aspects of productivity, these four categories together accommodate all concerns that must be addressed to ensure the efficient building of an effective product. The program elaborates each of these quality factors with more specific factors, each having associated success criteria and metrics for evaluating the degree to which the project satisfies each of them. An effective project will give all factors due consideration.

## Product Planning

The product planning element defines the relationship between the project and the customer as realized by the product. This entails coordination with the customer to keep expectations aligned with plans. Product planning has two elements: a customer relationship specification and a product master plan specification.

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<sup>1</sup> Product quality (i.e., behavioral qualities) is specified separately, as an element of the product requirements model.

### *Customer Relationship*

The customer relationship element specifies the relationship between the project and its targeted customer. If the relationship is based on a formal commitment (either contractual or by agreement) made between the project and customer, this specification is the medium by which conformance to that commitment is established and tracked. To this end, this specification tracks interactions between project and customer representatives that may arise due to this commitment.

This element specifies the project and customer commitments and responsibilities that characterize their relationship in business and technical terms. This specification establishes criteria that development cannot modify unilaterally but only with customer concurrence. Business terms concern constraints, costs, and schedule for product delivery. Technical terms, concerning behavior (capabilities and quality) that the customer envisions needing a product to support, are specified in the customer needs element of the product delivery model.

If issues arise concerning the cost, schedule, or feasibility of product delivery, this specification is the vehicle by which changes in project planning and customer needs are negotiated with the customer (or program marketing as their proxy). This includes identification, negotiation between project and customer as needed, and resolution of any issues related to customer needs and responsibilities as specified in the project's product delivery element. Such issues can arise due to changes in the substance or understanding of customer's needs or circumstances or due to advances or impediments of product development.

Project management evaluates the status of the product model as a whole in accordance with the current product model master plan and, in consultation with the customer, determines when the product is acceptable for deployment. This will typically entail, as the product model is being developed, a negotiation of changes in acceptance criteria, cost, and schedule according to project and customer priorities and tradeoffs.

By convention, the product delivered to customers includes only the operationally-useful elements of the product model. The program retains the complete product model

—both developmentally- and operationally-useful elements—for developer use in the continued development of this and possibly other products. In the case of a product being developed for the sole use of a single customer, program management may agree to deliver (at increased cost) the entirety of the product model to allow the customer to independently maintain and improve the product. In such a case, the customer may specify use of specific development tools and practices, which may preclude use or require reformulation of previously developed assets.

### ***Product Master Plan***

The product master plan element specifies the project's development of a product over its expected useful life. This plan is a roadmap for envisioned product releases, overlaid with a series of increments that evolve the product over time as needs and technology change. Each increment is characterized in terms of its contribution either to improved capabilities or behavior that the product will gain or to improved productivity in performing subsequent increments.

The product master plan specifies a timeline for a series of envisioned product releases, each defined by an objective, scope of expected improvements, and staffing / resources. Development is organized into increments, each tasked and resourced to contribute to, to finalize, or to revise one or more designated product model baselines.

Improvements in the product could include adding customer-directed capabilities, improving product behavior, or correcting discovered deficiencies. Significant improvements may be planned and developed within a single or over multiple increments. A release may be developed over multiple increments to permit interim points for evaluating progress. Each increment toward a release is evaluated against release criteria so as to revise the plan to account for actual versus projected progress and any changes in program, market, or customer needs and circumstances.

Typically, an increment will span enough time (e.g., three to six months) to do significant work but not too long to spend before circumstances can cause needs to change. The product for any baselined version of the project model can be released for evaluation and deployment into use by the customer. A baselined project model may be

modified only to correct localized defects for an interim update to a released product; changes that would modify product capabilities or entail changes that span model element instances require a new product model baseline.

*{show transition view (initial as-is/increment/to-be -> new as-is) for a master plan}*

Planning the lifecycle of a product requires giving thought based on knowledge of the purpose of the product in a customer enterprise to envision how needs and enabling technology for it are likely to change over the product's envisioned useful life. The ability to evolve a product as needs and technology change can be less costly if the product is built with an awareness as to what sorts of changes are most likely over time. An objective of product planning is to provide the project with a coherent concept of how the product is likely to change over its useful life. Attempting to anticipate likely changes does not eliminate the need to accommodate unforeseen changes but is meant to limit their occurrence with well-considered foresight—unexpected changes can undermine the conceptual and structural integrity of a product, imposing untenable costs and risks on a project. If change becomes unduly difficult or disruptive to a product, a new effort will then have to be undertaken to revamp or replace the product.

## **Increment Performance**

The increment performance element specifies an increment of development to build an interim or baselined version of the product model. An increment entails a set of tasks, each defined to revise appropriate elements of the product model. Tasks are defined in accordance with the project process and the increment's objective for advancing the product toward envisioned releases as specified in the product master plan. Planned tasking is adjusted based on the availability of staff with needed competence.

Increment tasks are organized into a series of iterations, each planned for a fixed-time duration, ideally no more than two to four weeks, to allow for timely review to evaluate progress and make needed changes in increment tasking. An increment should be managed to complete within the span of time allocated to it in the master plan. An increment is complete when the result is a consistent version of the product model that

satisfies the goals specified in the increment plan, adjusted as needed to account for actual progress.

Increment performance has three elements: an increment plan, version control, and task performance for each plan-specified task.

### *Increment Plan*

The product master plan element, revised as needed based on the results of prior product increments, defines the objectives for each increment. The increment plan defines and coordinates the tasks required to achieve goals for meeting its specified objective, given availability of needed resources. The purpose of an increment is to create a product model baseline version based on an existing baseline version. Each task is an allocation of time, staff, and scope to iteratively revise designated elements of the product model within the time allotted to the increment in the master plan.

Increment management initiates a task as specified in the increment plan by assigning resources to develop content associated with one or a related set of activities. A task is the assignment of developers having the needed competence to perform specified work and availability within a given span of time.

The work to be done is specified in terms of the elements of the product model to be modified and the corresponding subject matter scope to be addressed. For example, a task may entail modifying the customer needs specification of the product delivery model but might also include revising related aspects of the product requirements model. Or, a task to create scenarios to verify satisfaction of customer needs might include developing test materials for use in evaluating those scenarios. Conversely, this work might be split into different tasks if that would result in more effective use of developer efforts. For a task addressing multiple related activities, the order in which these activities are performed is not prescribed but is left to the developer's judgment (e.g., requirements model content may be defined before or after corresponding customer needs content, as long as the end results are mutually consistent).

Ordering of tasks is influenced by information dependencies among model elements. Work can proceed concurrently on various elements of the product model. Work on a



given model element is typically initiated when the content of a model element on which it depends has been modified or when work on a dependent element identifies uncertainties or issues with the subject element's existing content. When the content of a model element has been evaluated as satisfying task criteria, including consistency with specified versions of related model elements, the content is baselined as a version accredited for reference by other tasks.

The increment plan captures progress on assigned tasks to recognize when adjustments in the plan are needed. The plan is augmented with increment- and task-level reviews that profile the degree to which the product model is consistent with the terms of the customer relationship element and the degree to which tasks are being performed in accordance with the specified process definition and developmental quality elements.

The increment plan can and should be revised in-progress if unforeseen opportunities or impediments arise. An opportunity might involve unexpected technical progress that will result in improved product capabilities or early completion of a task. For impediments, there are three dimensions in which the plan could be adjusted, considering the effect of each on the master plan. The preferred change is to reduce the capability to be completed as part of the increment, deferring work to a later increment. An alternative option is to extend the increment, possibly delaying a product release, in order to complete envisioned capabilities or improve quality. The most detrimental option, in that it can impact the long term viability of the product, is to accept reduced product quality (but only with a clear near-term plan for addressing deficiencies).

### *Version Control*

The version control element specifies the derivation and descendency of each baselined (and therefore immutable) version of the product model and its elements. Each version traces the developmental lineage of each of its baselined element parts and instances. Any baselined version of a consistent product model may be a candidate for release into customer operational use if designated as such by the product master plan.

An increment creates a new product model version as a derivation from one or more designated prior baselined versions. A baselined product model instance consists of

baselined versions of each included element instance. A product model version initially includes all element parts/instances of a prior model version. A new version is created by adding, modifying, or removing element parts/instances. Each element part/instance has associated metadata, including its author, date of completion/revision, and its relation to other element parts/instances of the current version (or prior model version in that an element part/instance version may remain unchanged over multiple increments, spanning multiple product model versions without change).

Each version of a product model element instance may exist in a series of *revisions*. Once an instance is baselined, it cannot be modified (excepting for changes allowed only to correct localized defects). A product model version is considered incomplete until all elements have been baselined and confirmed in aggregate as satisfying (possibly revised) increment objectives.

### ***Task Performance***

The task performance element captures the experience of performing each of the tasks for an increment as specified in the increment plan. This experience for each task consists of the results of the iterative development of assigned product model elements. Results are augmented with (1) rationale based on analyses of alternatives and tradeoffs considered, (2) the nature of potential future changes, how these can be accommodated, and any implications, and (3) results of responsible developer-initiated directed reviews of task-associated product model elements.

Task rationale documents decisions and alternatives encountered in performing a task and the associated risks, tradeoffs, and rationale for their subsequent resolution.

Tradeoffs considered inform the consistency and completeness of task results relative to related elements of the product model. Tradeoffs may arise in the degree to which developmental versus behavioral quality can be achieved (e.g., spending more time to achieve higher product quality versus delivering an adequate product sooner).

Potential for future change often presents itself while considering alternatives of current results. Awareness of new capabilities and emerging technology that may be addressed in the future may suggest potential changes. Such potential for change should be

anticipated in performing a task so as to make such changes easier. At the least, changes that are anticipated as likely should be described in terms of how they would change relevant product element instances. Past projections of potential change may be reconsidered at this point in light of past progress and current prospects for future change.

Completion of a task is conditioned on acceptance of the task's reviews by the increment plan developer. Peer practitioners with task-relevant competence review conformance to process quality criteria and associated activity guidance to identify any variances to be corrected or any revisions to guidance that could improve productivity. Relevant peer developers and subject matter experts review task results, focused on developer-identified areas of complexity or uncertainty, emphasizing completeness and soundness of associated aspects of rationale and potential change and consistency in specification-realization dependencies with related product model elements.

The substantive content of a task's results are defined in the process definition. Each task addresses relevant elements of the product model and subject matter scope assigned by the increment plan to the task. The process definition element of project direction specifies the practices to be used and how results are to be represented. The performance of each task is evaluated with respect to criteria specified in the process quality element. Evaluation of a task's results should reference the results of product quality reviews and related empirical or theory-based verifications. Product quality reviewers include peer developers of related product model elements and program-designated experts who are cognizant in subject matter relevant to the content of work being evaluated.

A task may entail creating multiple versions of product model elements in order to comparatively explore uncertainties, alternatives, and tradeoffs as needed to determine which version will best meet customer needs. When a task identifies an uncertainty, issue, or flaw in reference to related elements of the product model, the responsible developers may need to confer to determine a proper resolution of the concern. Depending on the nature of a concern and pending a mutual resolution, a task can be adjusted in one of three ways:

- Work related to the concern is deferred until the developer of the related element can provide clarification or correction.
- Work proceeds based on an assumption conveyed to the related element developer as to the nature and suggested resolution of the resulting inconsistency between the elements.
- Work proceeds with the assumption that the related element is valid as it is but the concern is referred for review and clarification.