

3.2 DsE Program Management

Program management is (as described broadly in section 2.1) a designated governing authority over a set of related projects. A program is chartered by executive management through the allocation of business objectives, market scope, personnel, physical assets, and core funding.

As a candidate for a DsE approach, program management verifies the business potential for a targeted coherent market and evaluates program technical capabilities and resources as viable for addressing that market's needs. For a viable market and preliminary DsE technical approach, program management initiates and allocates resources to domain engineering and initial product manufacturing projects to be coordinated and evaluated against program market-based objectives.

A DsE-based program encompasses all the normal responsibilities of program management but will impose a greater level of conformity on its product manufacturing projects based on their sharing similar purpose, objectives, and resources. A unified marketing function is chartered to coordinate this market-perspective across all elements of program management, in cooperation with the domain engineering effort and supporting product manufacturing efforts as needed.

Each product manufacturing project focuses on the needs of a single customer (or simple market) within the program-targeted market. A domain engineering effort focuses on the needs of the market as a whole and the needs of associated product manufacturing projects in building products. Each product manufacturing project uses domain capabilities to build and sustain a product that meets the needs of its designated customer.

DsE program management has three elements¹: program governance, program direction, and program performance. Program governance addresses domain viability, process capability, and organizational structure. Program direction builds on these to specify a DsE domain strategy and process maturity criteria for continuous process

¹ Adapted from *A Framework for Product Line Adoption* and a tutorial on *Reuse-driven Process Improvement*, both Prosperity Heights Software, 2002.

improvement. Program performance specifies expected and actual results in performing the domain strategy to inform improvements.

A DsE domain strategy model defines the business strategy for a viable DsE-based program, supported by models [Figure 3.2-1] for domain viability and the capability-maturity-performance characterizations of a defined process. These models support iterative improvement in the efficiency and effectiveness of the domain strategy. The elements of this model are iteratively reviewed for revision as long as the program's market focus remains viable. Reviews by enterprise management of programs and their market alignments may lead to revisions in a program's scope and charter.

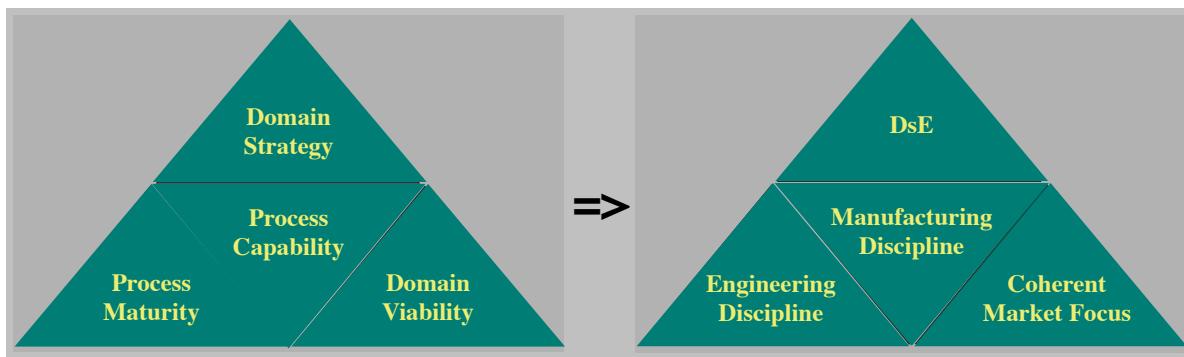


Figure 3.2-1. Program Management Models and Corresponding Objectives

Program Governance

The program governance element specifies the criteria by which the program has determined the initial and continuing feasibility of a DsE approach and the form that approach will take. A DsE-conforming program is conceived based on a perceived coherent market for a family of similar products and an existing (or intention to develop) organizational competence for building products of the type that family represents.

A program is typically created based on one or more existing successful projects having developed similar products for that market. Alternatively, it may originate in recognition of a previously unrecognized market opportunity, such as may arise due to emerging technology, that the organization believes it can support.

As with traditional program management, program governance specifies the focus, scope, and objectives for the program as directed by executive management. With a DsE approach, program governance elaborates scope to define the coherent market that the program will address as a domain and evaluates that domain as a viable business objective.

Domain Viability

The domain viability element specifies whether the circumstances of the program's charter justify pursuing a DsE approach:

- Market opportunity – Are there potential customers with sufficiently similar or changing needs to warrant creating a capability for building a set of similar products?
- Technical competence – Are sufficient resources, including developer competence and initial funding, available to the program to support building the type of products that customers need?
- Business commitment – Is there sufficient enterprise commitment and realistic expectations concerning long-term market acceptance to justify the necessary investment in creating a suitable product manufacturing capability?

With confirmed domain viability, program governance identifies the factors that determine the targeted capability of an envisioned DsE process and establishes an appropriate organization to pursue program objectives. The program governance element is periodically reviewed and revised to reflect progress and changing circumstances of the business and its market.

The conclusion can be augmented and substantiated with an experience-based financial model (e.g., as described in section 3.1) and used to compare the potential results among various levels of commitment to a DsE approach by the program. This model relies on the organization's past and projected costs and benefits of building similar products.

Process Capability

The process capability element specifies the level of capability that a defined process needs to provide to be a suitable fit to a program's business and technical objectives. The capability of a process is the range of productivity, for a given level of product quality, that it supports in its performance. DsE accommodates alternative definitions of the DsE process that will provide different levels of potential productivity, based on the division of effort between the domain versus among projects due to changes to the developmental culture that are acceptable for a corresponding increase in productivity potential of the program as a whole.

The capability of a DsE process is determined by four factors that provide leverage across product manufacturing projects:

- Management integration – the degree to which projects' plans are coordinated
- Needs orientation – the degree that domain efforts are able to focus on market needs over individual project or customer needs
- Product integration – the level and degree to which products can be viewed as a cohesive whole versus as a loose collection of parts
- Organizational stability versus operational optimization – the degree to which the organizational culture can be rethought to support an improved operational process

There are five recognized DsE levels of increasing process capability, with variations possible at each level, based on these four factors. A program can initially target any of these levels of capability but may transition over time to higher levels:

1. Customer-exclusive projects [singular] – Projects operate independently based on enterprise conventions and technical guidance with program review of plans and progress (a DsE-extended variant of basic software product engineering, particularly suited to a program that has not previously developed products for the targeted market, to establish initial domain competence and assets)

2. Enhanced project-level reuse [opportunistic] – Projects are supported with domain capabilities in cross-project sharing of methods, tools, and previously developed assets
3. Integration of products and management [integrated] – Domain engineering guides projects in collaborating on establishing shared solutions to similar problems
4. Standardization of products and process [leveraged] – Domain engineering, in coordination with projects, establishes a standardized capability for product manufacture
5. Domain-market coevolution [anticipating] – Domain capabilities are built to align and leverage program/market coevolution for synergy among projects in building similar products

Actions can be taken to increase process capability:

- Reconsider the four factors that determine process capability so as to initiate actions for transition to a higher level process
- Streamline the process to eliminate activities for reduced effort
- Invest in instituting process capabilities that will streamline product manufacturing efforts
- Increase automation of the process to eliminate practitioner effort

Organizational Structure

The organizational structure element allocates responsibilities for performance of technical efforts within the program. Three particular considerations shape the structure of a DsE program:

- The role of domain engineering as the technical agent for the overall program, providing shared technical capabilities, practices, and assets with which manufacturing projects are able to efficiently build products of consistent quality.

- The role of marketing, as surrogate for the market as a whole to domain engineering, framing and articulating current and future needs, and as an agent for the program in identifying and engaging with potential customers to initiate manufacturing projects to work with qualified candidates.
- The role of product manufacturing projects in establishing consensus with domain engineering on program technical priorities and resolution of domain-product tradeoffs for consistency and collaboration across projects.

A program can organize its technical efforts, based on its targeted process capability objective, into one of three structures:

- Domain engineering is a service that anticipates and responds to requests from projects for needed technical capabilities and resources;
- Domain engineering leads a collaborative panel that identifies and prioritizes needed technical capabilities and resources based on negotiation among projects;
- Domain engineering prescribes technical guidance with a market-based perspective that determines the capabilities and resources that all projects must use.

The appropriate structure is determined according to which is the best match for a program's priorities and degree of technical uniformity. All permit the flexible tasking of personnel with appropriate technical or market competence to particular domain or manufacturing efforts as needed.

Program Direction

The program direction element specifies a DsE domain strategy for the disciplined engineering and manufacture of products appropriate to the program's market focus and technical competence. This includes defining a DsE process targeted to the process capability factors specified in the program governance element. This is supported by the monitoring (with a DsE metrics strategy as described in section 3.1) and improvement of the maturity with which the process is performed (adjusted over time as the process is modified to improve its capability).

Domain Strategy

The domain strategy element specifies the business strategy for a DsE-based program in accordance with the program governance element. Domain engineering, as designated program technical agent, amplifies and iteratively revises the technical aspects of the domain strategy to reflect realized progress and evolution of the market and technology. This strategy has six elements:

- Market focus – An elaboration of program scope and objectives as a characterization of the market and products targeted by the program, reflective of domain viability factors;
- Business model – How program business is to be conducted (i.e., relations with the enterprise, other programs, customers, and suppliers) as constrained by enterprise and market culture and conventions (e.g., legal, financial, and regulatory) and business objectives;
- Organizational structure – An elaboration of the organizational structure needed to allocate responsibilities for performance of the DsE process;
- DsE process – How the development process is constituted, based on its targeted capability and expected maturity of process performance, elaborated with preferred management and engineering practices;
- Support environment – Tools, infrastructure, and legacy assets that will support program performance;
- Transition roadmap – How the program's market and product technology, process capability, and technical capabilities are expected to evolve over its envisioned life (itself to be periodically revised).

The DsE process element specifies the process by which program management and domain engineering concurrently operate. Domain engineering is delegated responsibility by program management to detail its process and provide a domain capability that enables coordination and integration in performance of product manufacturing projects.

Definition of the product manufacturing process and associated quality criteria is delegated to the process engineering element of domain engineering. The provided domain capability and the definition of that process, to which associated manufacturing projects are expected to conform, are improved over the life of the program in collaboration with those projects.

Process Maturity

The process maturity element specifies the degree to which practitioners, in performing a defined process, are able to achieve potential productivity and product quality. To be performed effectively, a process has to be well-defined and uniformly understood by its practitioners. The objective for a sound process is that its practitioners will consistently produce timely results with envisioned quality. The process maturity model is the medium for improving a defined process so as to increase future productivity and product quality.

Process maturity is a measure of the degree to which its definition and use satisfy several factors:

- Management and engineering practices are sufficiently defined and understood to support consistent and predictable performance across the program
- The process is suited to the competence of its practitioners, accounting for differing roles and responsibilities
- The process is consistent with enterprise and program guidance, program objectives, and external constraints
- The process addresses proper management of external relationships with customers and suppliers, including collaboration as warranted
- The process provides flexibility for accommodating essential differences in differing and changing project and customer circumstances
- Productivity and process quality goals are adequately defined and measured to expose performance deficiencies as a basis for improvement

Some additional concerns are specific to a DsE approach:

- Effective coordination between engineering and manufacturing projects as well as among manufacturing projects
- Relevant aspects of the program's DsE approach are appropriately accommodated in enterprise governance (administrative, legal, contractual, financial, acquisition, and technical)
- Capital investment for managed development, acquisition, retention, and use of developmental assets and program-level allocation of integrated funding to engineering and manufacturing efforts
- Managed adherence to budget and schedule constraints at all levels (program, domain, and projects) for predictable and timely delivery of acceptable products
- Information needed to produce correct results accessible to developers (e.g., not unduly impeded by provider or customer competitive or security constraints, inability to access needed personnel or resources, or imposed use of inferior technology or conventions)

Three actions can be undertaken to improve process maturity; in all cases, future results are monitored to verify attainment and retention of expected improvements in performance:

- Train and mentor practitioners for a proper shared understanding and conformance to the process
- Revise process guidance to improve clarity and completeness relative to program circumstances and to better align with practitioner needs and abilities
- Increase automated support of routine process activities, both to increase productivity and to improve predictability and quality of results

Program Performance

The program performance element specifies reviews of the coordinated performance by chartered domain engineering and product manufacturing projects in accordance with the domain strategy. Domain engineering is evaluated in terms of the efficiency and

utility of the capabilities it provides to product manufacturing projects considering overall market needs. Each manufacturing project is evaluated in terms of its effective use of domain capabilities in the timely development and sustainment of a product suited to its customer's operational needs.

Program management, in consultation with domain engineering, determines when to initiate a product manufacturing project for a marketing-targeted customer or to terminate or redirect support for an existing project. Marketing periodically evaluates the fit of each candidate or existing customer's needs to domain capabilities, in consultation with domain engineering on domain plans and the domain definition. Such evaluations may result in marketing recommendations to domain engineering regarding current and future market needs to influence domain capability priorities and evolution.