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Domain Assessment for RSP Adopters

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Introduction

Domain assessment is a technique for evaluating the applicability of software reuse techniques to an organization's product development needs. The Software Productivity Consortium defined a Domain Assessment Model (DAM), as a support to its process for reuse adoption (RA) [2]. RA guides an organization in determining its needs and capabilities for reuse relative to current objectives and practices. It then guides the organization in creating a strategy and corresponding plan for instituting appropriately tailored reuse practices.

This paper reconsiders domain assessment in the context of the Reuse-driven Software Processes (RSP) methodology [1] and proposes a revised model for use by prospective RSP adopters. An RSP-specific model is needed both because the DAM is a generic model, not reflecting significant characteristics of RSP, and because our understanding of reuse adoption issues has advanced based on 4 years of further experience with RSP in industrial use. This work continues development of an RSP-oriented approach to reuse adoption started with a previous report [3] which proposed on a clearer integration of the Reuse Capability Model from SPC and the Software Capability Maturity Model (SW-CMM) from SEI.

Also created at the Software Productivity Consortium, the RSP methodology describes an innovative software lifecycle approach in which reuse is a key driver of process definition. RSP is a software-oriented definition of Domain-specific Engineering (DsE), which is a broadly conceived methodology for producing a family of similar products for customers in a coherent market. In this sense, reuse is a narrow characterization of various techniques for the formalization and leveraging of the knowledge and expertise that give an enterprise its productive competence as a technology-based business. A DsE approach such as RSP enables substantially greater productivity and product quality by introducing a streamlined process that is constrained so that products of a particular type are much easier to produce.

This report establishes a conceptual basis for RSP-oriented domain assessment, focusing on a set of questions that represent the conditions under which an RSP approach is viable for a business. These questions define corresponding assessment criteria that are analyzed in terms of prerequisites and associated positive and negative indicators of success. Domain assessment remains a consensus-based evaluation intended to help an organization's business and technical leadership make an initial decision on whether to institute an RSP domain for a targeted product line business.

Rethinking Domain Assessment

The DAM has been effective in helping organizations focus on questions of whether reuse techniques should be applied to a candidate product line. However, an analysis of the set of assessment factors shows them to be poorly organized, inconsistent, and incomplete. Furthermore, the underlying motivations for the factors are never explicitly defined and, hence, the basis for effectiveness of the DAM is mysterious.

The problems in the DAM arise partly from the lack of a coherent view of how reuse could affect an organization. The SPC RA approach took as its scope all possible ways of approaching reuse. This resulted in generic, lower granularity domain assessment factors than would be necessary for any particular approach to reuse.

In fact, there is a set of underlying assumptions that motivates domain assessment for RSP and that would be clear with a rationalized and better organized presentation of the factors. Taking RSP as a specific context for reuse approach allows more specificity in how factors are organized and expressed.

Preliminary Domain Scoping

Before a domain assessment can occur, there must be a nominal characterization of the candidate domain being considered. The best focus for a domain is an existing type of product that is currently the concern of projects in the organization. Given a product scope, a domain must be targeted to address a particular range of common and diverse customer needs and technology.

To establish a preliminary domain scope, the following questions should be resolved informally and understood by all participants at the start of a domain assessment:

- What products, current and envisioned, will be the focus of the prospective domain?
- Who are the customers for these products and what are their common needs that motivate a domain focus?
- What are the major sources of diversity and change that create a market for multiple or evolvable products?

If the organization initiates an RSP domain effort, these questions will be revisited to create a Domain Master Plan and Domain Definition. At that point, the answers will be made more precise and perhaps narrowed to focus on products, customers, or work products that offer the best cost/benefit results for the business.

Discovering the Motivations for Domain Assessment

The nature of domain assessment in the context of RSP adoption reflects distinctive properties of RSP. Organizations institute an RSP approach for two reasons:

- To be more responsive to diversity and change in customer and market needs.
- To better leverage organizational capabilities for building a set of similar products.

These reasons motivated the design of RSP so that any RSP process adheres to 6 invariant characteristics that distinguish it from a conventional single-product software process:

- **Market Premise.** A market is manifested as a set of customers having similar needs.
- **Family Similarity Premise.** Similar problems are amenable to similar solutions; a set of buildable products corresponding to a set of similar problems and solutions can be represented as a family.
- **Expertise Premise.** An organization that has the expertise to build any of a set of similar products can build a family that represents all such products.

- **Separation of Concerns Premise.** Simultaneously achieving market objectives and satisfying each customer's needs requires managing product line (domain) and product (application) activities as conceptually distinct, interacting processes.
- **Adaptability Premise.** Differences among a set of products are traceable to a set of decisions that correspond to the root causes of diversity and change in customers' needs and enabling technologies.
- **Productivity-Quality Premise.** Limiting problems and solutions to a family enables use of a specialized and streamlined software process, eliminating sources of inconsistency, redundant effort, and error.

These characteristics indicate when an RSP process is to be preferred over a conventional process of single-product crafting. The purpose of domain assessment is to help decision-makers recognize when circumstances make RSP appropriate to their situation and when not. Three predictors of RSP domain viability arise from the above premises:

- A domain investment business case arises from existence of a market of similar needs.
- A capability for building products is prerequisite to a capability to build a domain.
- An organization leverages the skills of individuals by focusing their energies on a common goal.

These three predictors lead to three questions of domain assessment for RSP domain viability. The DAM is pervaded by concerns not relevant to these predictors. In particular, many DAM attributes raise questions concerning technical issues of domain scope or engineering approach, usually from a perspective of past practices. These do not need to be considered in an RSP domain assessment but rather are more properly addressed as part of the RSP process that is initiated as the result of a positive assessment outcome. If a product line business is judged, according to the three questions, to be viable as an RSP domain, it becomes the responsibility of the domain leadership to resolve these issues consistent with their business objectives.

The Three Questions of Domain Assessment

Based on the preceding analysis, the decision to adopt an RSP approach for a product line business hinges on satisfying three enabling criteria:

- **Market Opportunity:** There are customers for a line of similar products of the envisioned type.
- **Technical Competence:** The organization has the expertise and technical resources to build the products needed.
- **Business Commitment:** Management is committed to focusing on products of the envisioned type.

These can also be understood by considering the corresponding negative criteria that would lead to a decision against instituting an RSP domain. Any one of these is sufficient to preclude a domain effort:

- For the envisioned type of products, prospective customers' needs are too similar or too diverse to justify a domain effort.
- The organization lacks the expertise or resources needed to build products of the type and variety envisioned.
- The organization has conflicting priorities, inadequate justification, or external constraints, mitigating against a concerted effort on this product line.

Following is a table for each of these criteria defining them in terms of prerequisite conditions and associated positive and negative indicators. A criterion is satisfied if its prerequisite conditions are met and associated indicators are judged predominately positive. This judgment is subjective and by consensus of an organization's business and technical leaders to the satisfaction of the organization's management. Additional indicators, whether generally applicable or specific to an organization, are likely to be identified and added as part of any particular assessment.

Focus: Market Opportunity

Question: Is there a market for a line of similar products of the type envisioned?

Prerequisites:

1. There is a consensus on the type of products to be produced.
2. There are customers who need products of the type envisioned.
3. A single product is not adequate to meet the needs of all customers.
4. Customers' needs are sufficiently similar that they are likely to be satisfied with similar products.

Positive Indicators:

1. There are currently successful vendors of products similar to the envisioned type.
2. There are customers who recognize they have needs that would be met by a product of the envisioned type.
3. Customers will add or replace such products in the future because of changing needs.
4. Customers will need revised or enhanced products because of future changes in technology.
5. Customers need customized products because of differences in functionality, operational environment, user work procedures, or operational constraints such as performance, reliability, or safety.
6. Customers will acquire products that meet their needs more closely, given equivalent cost and quality, and would realize associated productive or competitive advantages due to a product's better fit to their business practices.

Negative Indicators:

1. Competitors have knowledge, resources, or expertise that give them an advantage in providing customers with products of the envisioned type.
2. Current or proposed standards limit opportunities for innovation or change in products, limiting the potential demand for customization.
3. Customers have previously adapted their business practices in order to use a generalized product and would disregard or not benefit from customized products.
4. Customers' needs are both too dissimilar and individually too stable to provide an adequate market for a product line capability.

Focus: Technical Competence

Question: Does the organization have the expertise and technical resources to build the products needed?

Prerequisites:

1. Assignable technical staff are familiar with the nature of customer needs to be addressed.
2. Assignable technical staff are familiar with technology required to produce and verify appropriate solution products.
3. Assignable program and project managers are familiar with organizing, planning, and leading product development efforts of the type needed.

Positive Indicators:

1. Projects have previously built and delivered products of the envisioned type.
2. Assignable staff have participated in projects to develop and maintain such products.
3. Expertise is available to minimize risks associated with achieving needed innovative features of products.
4. Assignable staff understand the factors that motivate changes in customer needs and technology.
5. Assignable staff understand why solution products differ as a result of different customer needs.
6. Previously built products are available as examples and sources of raw material for developing a product family.
7. Enabling tools and technology are stable, reflecting conducive standards, or are responsively changed by supportive vendors.

Negative Indicators:

1. There is insufficient knowledge or experience in key portions of customer needs or required product technology.
2. There have been unacceptable cost/schedule overruns or failures in delivering such products in the past.
3. Key product capabilities are dependent on external sources (vendors or consultants) that are unstable, unreliable, or unresponsive to special or changing needs.
4. Direct needs of current/future projects in producing individual products will limit availability of key staff needed for an effective domain effort.
5. Arbitrary customer preferences, particularly involving unjustified constraints on solution details, limit benefits of a domain capability.
6. Emerging standards (formal or de facto) or prospective vendor changes in enabling technology will force domain changes, increase costs, or reduce competitive advantages.

Focus: Business Commitment

Question: Are there resources and a business case to justify a product line investment strategy?

Prerequisites:

1. All levels of responsible management agree that these products will be important to the business and will monitor market positioning and acceptance.
2. Sources for domain investment exist, given a sound business case.
3. There is an organizational authority who has the scope to initiate a domain effort and delegate appropriate staff and funding to it.
4. A successful domain effort would provide benefits that are important to executive and program-level decision-makers.
5. Relevant support organizations have identified internal and external constraints, implications, and feasible options to enable instituting RSP domains.

Positive Indicators:

1. The organization is already a vendor of this type of products.
2. Management, marketing/sales, and engineering/production/distribution/service resources are currently dedicated to this business.
3. Existing products/projects are part of a coherent product line business effort.
4. Customers will accept product pricing that includes prorated domain investment (effort and infrastructure) costs, given net cost/benefit improvements.
5. Ownership or resale rights to previously developed assets are retained, providing a foundation for future products.
6. Customers base product acquisition/acceptance on responsiveness to needs, as well as cost, and will negotiate adjustments in over-specified requirements.
7. Current products of this type contribute positively to the organization's valuation by its owners.
8. More consistent or improved productivity or product quality would provide a competitive advantage over marketplace rivals.

Negative Indicators:

1. Standard business practice is opportunistic contracting of services, emphasizing responses to requests for proposal based on general technical capabilities.
2. Customers restrict how acquired products are built, require delivery of development tools, and control reuse and resale rights.
3. Application projects, being accustomed to autonomy, independent management, and exclusive control over allocated resources, are adverse to dependence on cross-project cooperation, coordination, or support.
4. Needed changes in practices and procedures conflict substantively with views of internal support organizations (legal, finance and accounting, human resources, standards), particularly related to externally originating regulations, agreements, or constraints.
5. Proposed domain scoping would create an unacceptable conflict with the product or market alignments of other associated business organizations.

RSP Process Adoption and Improvement

A prior report related to RA [3] outlined steps for RSP-specific process adoption and improvement. The following refines those steps slightly to reflect insights from thinking about RSP-specific domain assessment.

The intent of RSP-specific process adoption and improvement is to provide a more precise framework for defining and improving an RSP process to fit the needs and capabilities of an adopting organization. This framework assumes a process improvement effort comprising two stages. The assumed starting point is an organization that has an established software development capability based on a conventional single-product process. The purpose of stage 1 is to assess the organization's current process capability and objectives in order to identify improvement priorities and institute an RSP process based on those priorities. Process assessment consists of process capability (CMM), reuse capability, and domain assessments. The purpose of stage 2 is to apply process capability and reuse capability assessments jointly to guide improvements in the established RSP capability.

Stage 1 steps are performed only in preparation for instituting a domain and the associated transition to an RSP process. The steps of stage 1 are:

- Perform organizational CMM assessment and establish a process improvement action plan.
- Identify any appropriate product line business areas as candidates for RSP adoption and obtain preliminary management commitment for a domain effort.
- For a business area candidate, perform a domain assessment, based on a preliminary domain scope, to determine whether an RSP approach is viable for that business area.
- For an RSP-viable business area, perform a reuse capability assessment for the business area organization and develop an adoption strategy, determining a targeted level of RSP capability.
- Develop an RSP adoption action plan which includes setting business objectives for the domain, establishing a responsible organization with associated resources, and creating a tailored definition of the RSP process to be followed.

Instituting use of an RSP process initiates stage 2 for continuous improvement of the process. Stage 2 steps, which should be revisited annually for each domain, are:

- Perform combined process capability and reuse capability assessments for the domain business to identify weaknesses and improvement opportunities.
- Develop an action plan to exploit improvement opportunities in pursuing the domain business.
- Periodically reevaluate the cost-risk/benefit of moving to a different level of RSP capability or changing domain scope or objectives; create a corresponding RSP adoption action plan and seek necessary organizational concurrence if a change is found to be justified.

Summary

This report has defined a new model for RSP-specific domain assessment. Based loosely on the DAM and the distinguishing characteristics shared by all RSP processes, this new model identifies the key questions that motivate whether an RSP domain approach is viable for a particular product line business area. These questions are elaborated in the form of a set of prerequisites and associated positive and negative indicators. This informal characterization of RSP domain viability is an element in the development of a comprehensive RSP-oriented approach to process adoption and improvement.

References

1. Software Productivity Consortium. *Reuse-driven Software Processes Guidebook*, SPC-92019-CMC, version 2.0, 1993.
2. Software Productivity Consortium. *Reuse Adoption Guidebook*, SPC-92051-CMC, Version 2.0, 1993.
3. Grady H. Campbell, Jr. *A Unified Approach to the CMM and RCM for RSP Adopters*, Prosperity Heights Software, 1997.

Abbreviations

CMM	SEI Software Capability Maturity Model
DAM	SPC Domain Assessment Model, defined in [2]
DsE	PHS Domain-specific Engineering methodology
PHS	Prosperity Heights Software
RA	SPC Reuse Adoption approach, defined in [2]
RCM	SPC Reuse Capability Model, defined in [2]
RSP	SPC Reuse-driven Software Processes methodology, defined in [1], a software-specific precursor and variant of DsE
SEI	Software Engineering Institute
SPC	Software Productivity Consortium