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## ACQUISITION VERIFICATION

An Acquisition Process Area at Maturity Level 3

### Purpose

The purpose of Acquisition Verification (AVER) is to ensure that selected work products meet their specified requirements.

### Introductory Notes

Acquisition verification addresses whether acquirer work products properly reflect specified requirements.

The Acquisition Verification process area involves the following activities:

- Preparing for verification
- Performing verification
- Identifying corrective action

Verification is inherently an incremental process because it occurs throughout the acquisition of the product or service, beginning with verification of requirements and plans, progressing through the verification of evolving work products such as design and test results, and culminating in the verification of the completed product.

The specific practices of this process area build on each other in the following way:

- The Select Work Products for Verification specific practice enables the identification of work products to be verified, methods to be used to perform the verification, and documented requirements to be satisfied by each selected work product.
- The Establish the Verification Environment specific practice enables the selection or creation of the environment to be used to carry out the verification.
- The Establish Verification Procedures and Criteria specific practice enables the development of verification procedures and criteria that are aligned with selected work products, requirements, methods, and characteristics of the verification environment.
- The Prepare for Peer Reviews, Conduct Peer Reviews, and Analyze Peer Review Data specific practices enable the performance of peer reviews, an important type of verification that is a proven mechanism for effective defect removal.
- The Perform Verification specific practice enables the conduct of verification according to available methods, procedures, and criteria.

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Verification of work products substantially increases the likelihood that the product will meet the customer, product, and product component requirements.¶

The Verification and Validation process areas are similar, but they address different issues. Validation demonstrates that the product, as provided (or as it will be provided), will fulfill its intended use, whereas verification addresses whether the work product properly reflects the specified requirements. In other words, verification ensures that "you built it right"; whereas, validation ... [1]

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- The Analyze Verification Results specific practice enables analysis of verification results against established criteria.

Related Process Areas

Refer to the Acquisition Validation process area for more information about confirming that a product or product component fulfills its intended use when placed in its intended environment.

Refer to the Acquisition Requirements Development process area for more information about generating and developing customer and contractual requirements.

Refer to the Acquisition Technical Management process area for more information about evaluating supplier work products.

Refer to the Requirements Management process area for more information about managing requirements.

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Specific Goal and Practice Summary

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SG 1 Prepare for Verification

- SP 1.1 Select Work Products for Verification
- SP 1.2 Establish the Verification Environment
- SP 1.3 Establish Verification Procedures and Criteria

SG 2 Perform Peer Reviews

- SP 2.1 Prepare for Peer Reviews
- SP 2.2 Conduct Peer Reviews
- SP 2.3 Analyze Peer Review Data

SG 3 Verify Selected Work Products

- SP 3.1 Perform Verification
- SP 3.2 Analyze Verification Results

Specific Practices by Goal

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SG 1 Prepare for Verification

**Preparation for verification is conducted.**

Up-front preparation is necessary to ensure that verification provisions are embedded in contractual requirements, constraints, plans, and schedules. Verification includes the selection, inspection, testing, analysis, and demonstration of acquirer work products.

Verification methods include, but are not limited to, inspections, peer reviews, audits, walkthroughs, analyses, simulations, testing, and demonstrations. Practices related to peer reviews as a verification method are included in specific goal 2.

Preparation for verification includes the definition of support tools, test equipment and software, simulations, prototypes, and facilities.

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SP 1.1 Select Work Products for Verification

**Select work products to be verified and verification methods to be used.**

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Acquisition Verification (A)VER)

Acquirer work products are selected based on their contribution to meeting project objectives and requirements, and to addressing project risks.

Typical verification activities include the review of the solicitation package, supplier agreements and plans, requirements documents, design constraints developed by the acquirer, and other acquirer-developed work products.

Selection of verification methods typically begins with the definition of requirements to ensure that the requirements are verifiable. Re-verification should be addressed by verification methods to ensure that rework performed on work products does not cause unintended defects. Suppliers should be involved in this selection to ensure that the project's methods are appropriate for the supplier's environment.

**Typical Work Products**

1. Lists of work products selected for verification
2. Verification methods for each selected work product

**Subpractices**

1. Identify acquirer work products for verification.
2. Identify requirements to be satisfied by each selected work product.

A traceability matrix is a useful tool for identifying requirements for each selected work product, as it typically includes information that relates requirements to work products. When identifying requirements for each selected work product, consult the traceability matrix maintained as part of managing requirements for the project.

*Refer to the Maintain Bidirectional Traceability of Requirements specific practice in the Requirements Management process area for more information about tracing requirements to work products.*

3. Identify verification methods available for use.
4. Define verification methods to be used for each selected work product.
5. Identify verification activities and methods to be used in the project plan.

*Refer to the Project Planning process area for more information about coordinating with project planning.*

**SP 1.2 Establish the Verification Environment**

***Establish and maintain the environment needed to support verification.***

An environment must be established to enable verification to take place. The type of environment required depends on the work products selected for verification and the verification methods used. A peer

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For Software Engineering

Examples of verification methods include the following:

<#>Path coverage testing

<#>Load, stress, and performance testing

<#>Decision-table-based testing

<#>Functional decomposition-based testing

<#>Test-case reuse

<#>Acceptance tests

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review may require little more than a package of materials, reviewers, and a room. A product test may require simulators, emulators, scenario generators, data reduction tools, environmental controls, and interfaces with other systems.

The verification environment may be acquired, developed, reused, modified, or a combination of these, depending on the needs of the project.

**Typical Work Products**

1. Verification environment

**Subpractices**

1. Identify verification environment requirements.
2. Identify verification resources that are available for reuse or modification.
3. Identify verification equipment and tools.
4. Acquire verification support equipment and an environment (e.g., test equipment and software).

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**SP 1.3 Establish Verification Procedures and Criteria**

***Establish and maintain verification procedures and criteria for the selected work products.***

Verification criteria are defined to ensure that work products meet their requirements.

Examples of sources for verification criteria include the following:

- Standards
- Organizational policies
- Types of work products
- Proposals and agreements

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**IPPD Addition¶**

The verification procedures and criteria should be developed concurrently and iteratively with the product and product component designs.¶

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<#>Test parameters¶  
<#>Parameters for tradeoff between quality and cost of testing¶  
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**Typical Work Products**

1. Verification procedures
2. Verification criteria

**Subpractices**

1. Generate a set of comprehensive, integrated verification procedures for work products and commercial off-the-shelf products, as necessary.
2. Develop and refine verification criteria as necessary.
3. Identify the expected results, tolerances allowed, and other criteria for satisfying the requirements.
4. Identify equipment and environmental components needed to support verification.

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SG 2 Perform Peer Reviews

Peer reviews are performed on selected work products.

Peer reviews are an important part of verification and are a proven mechanism for effective defect removal. An important corollary is to develop an understanding of work products and the processes that produced them to help prevent defects and identify opportunities.

Peer reviews are applied to acquirer-developed work products. These reviews involve a methodical examination of work products by the acquirer's peers to identify defects for removal and to recommend other changes that are needed. Example work products to be peer reviewed include the solicitation package and the supplier agreement.

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Deleted: The peer review is an important and effective verification method implemented via inspections, structured walkthroughs, or a number of other collegial review methods. Peer reviews are primarily applied to work products developed by the projects, but they can also be applied to other work products such as documentation and training work products that are typically developed by support groups.

SP 2.1 Prepare for Peer Reviews

Prepare for peer reviews of selected work products.

Preparation activities for peer reviews typically include identifying the staff to be invited to participate in the peer review of each work product; identifying key reviewers who must participate in the peer review; preparing and updating materials to be used during peer reviews, such as checklists and review criteria; and scheduling peer reviews.

Typical Work Products

- 1. Peer review schedule
- 2. Selected work products to be reviewed

Subpractices

- 1. Determine the type of peer review to be conducted.
- 2. Establish and maintain checklists to ensure that work products are reviewed consistently.
- 3. Distribute the work product to be reviewed and related information to participants early enough to enable them to adequately prepare for the peer review.
- 4. Assign roles for the peer review, as appropriate.

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- Deleted: Peer review checklist
- 3. Entry and exit criteria for work products
- 4. Criteria for requiring another peer review
- 5. Peer review training material
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- <#>Inspections
- <#>Structured walkthroughs
- <#>Active reviews

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SP 2.2 Conduct Peer Reviews

Conduct peer reviews of selected work products and identify issues resulting from these reviews.

One of the purposes of conducting a peer review is to find and remove defects early. Peer reviews are performed incrementally as work products are being developed. These reviews are structured and are not management reviews.

Typical Work Products

- 1. Peer review results
- 2. Peer review issues
- 3. Peer review data

**Subpractices**

1. Perform the assigned roles in the peer review.
2. Identify and document defects and other issues in the work product.
3. Record results of the peer review, including action items.
4. Collect peer review data.

*Refer to the Measurement and Analysis process area for more information about data collection.*

5. Identify action items and communicate issues to relevant stakeholders.
6. Conduct an additional peer review if needed.

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7. Ensure that the exit criteria for the peer review are satisfied

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Deleted: Typical data are product name, product size, composition of the peer review team, type of peer review, preparation time per reviewer, length of the review meeting, number of defects found, type and origin of defect, and so on. Additional information on the work product being peer reviewed may be collected, such as size, development stage, operating modes examined, and requirements being evaluated.

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3. Protect the data to ensure that peer review data are not used inappropriately.

Examples of inappropriate use of peer review data include using data to evaluate the performance of people and using data for attribution.

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<#>Phase defect was injected

<#>Preparation time or rate versus expected time or rate

<#>Number of defects versus number expected

<#>Types of defects detected

<#>Causes of defects

<#>Defect resolution impact

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**SP 2.3 Analyze Peer Review Data**

**Analyze data about the preparation, conduct, and results of the peer reviews.**

*Refer to the Measurement and Analysis process area for more information about obtaining and analyzing data.*

**Typical Work Products**

1. Peer review data
2. Peer review action items

**Subpractices**

1. Record data related to the preparation, conduct, and results of peer reviews.
2. Analyze the peer review data.

**SG 3 Verify Selected Work Products**

**Selected work products are verified against their specified requirements.**

Verification methods, procedures, criteria and the environment are used to verify selected work products and associated maintenance, training, and support services. Verification activities should be performed throughout the project lifecycle. Practices related to peer reviews as a verification method are included in specific goal 2.

**SP 3.1 Perform Verification**

**Perform verification on selected work products.**

Verifying work products incrementally promotes early detection of problems and can result in the early removal of defects. The results of verification save the considerable cost of fault isolation and rework associated with troubleshooting problems.

**Typical Work Products**

1. Verification results
2. Verification reports

**Acquisition Verification (AVER)**

- 3. Demonstrations
- 4. As-run procedures log

**Subpractices**

- 1. Perform the verification of selected work products against their requirements.
- 2. Record the results of verification activities.
- 3. Identify action items resulting from the verification of work products.
- 4. Document the “as-run” verification method and deviations from available methods and procedures discovered during its performance.

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**SP 3.2 Analyze Verification Results**

**Analyze results of all verification activities.**

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Actual results must be compared to established verification criteria to determine acceptability.

The results of the analysis of verification results are recorded as evidence that verification was conducted. The acquirer might consult supplier work product verification results and reports to conduct verification activities of acquirer work products.

Refer to the Acquisition Technical Management process area for more information about evaluating supplier work products and reviewing verification results.

For each work product, all available verification results are incrementally analyzed and corrective actions are initiated to ensure that documented requirements have been met. Corrective actions are typically integrated into project monitoring activities. Since a peer review is one of several verification methods, peer review data should be included in this analysis activity to ensure that verification results are analyzed sufficiently.

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Analysis reports or “as-run” method documentation may also indicate that bad verification results are due to method problems, criteria problems, or a verification environment problem.

Refer to the Project Monitoring and Control process area for more information about corrective actions.

**Typical Work Products**

- 1. Analysis report (e.g., statistics on performance, causal analysis of nonconformances, comparison of the behavior between the real product and models, and trends)
- 2. Trouble reports
- 3. Change requests for verification methods, criteria, and the environment

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**Typical Supplier Deliverables**

1. Verification results

2. Verification reports

**Subpractices**

1. Compare actual results to expected results.
2. Based on the established verification criteria, identify products that do not meet their requirements or identify problems with methods, procedures, criteria, and the verification environment.
3. Analyze the defect data.
4. Record all results of the analysis in a report.
5. Provide information on how defects can be resolved (including verification methods, criteria, and verification environment) and formalize it in a plan.

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*Refer to the corrective action practices of Project Monitoring and Control process area for more information about implementing corrective action.*¶  
Generic Practices by Goal¶

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This plan for performing the verification process can be included in (or referenced by) the project plan, which is described in the Project Planning process area.¶

**GP 2.3 Provide Resources¶**

**Provide adequate resources for performing the verification process, developing the work products, and providing the services of the process.**¶

Elaboration:¶  
Special facilities may be required for verifying selected work products. When necessary, the facilities required for the activities in the Verification process area are developed or purchased.¶

¶  
Certain verification methods may require special tools, equipment, facilities, and training (e.g., peer reviews may require meeting rooms and trained moderators; and certain verification tests may require special test equipment and people skilled in the use of the equipment).¶

¶  
Examples of other resources provided include the following tools:¶

<#>Test management tools¶

<#>Test-case generators¶

<#>Test-coverage analyzers¶

<#>Simulators¶

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**GP 2.4 Assign Responsibility¶**

**Assign responsibility and authority for performing the process.** [15]



The Perform Verification specific practice conducts the verification according to the available methods, procedures, and criteria.

Verification of work products substantially increases the likelihood that the product will meet the customer, product, and product component requirements.

The Verification and Validation process areas are similar, but they address different issues. Validation demonstrates that the product, as provided (or as it will be provided), will fulfill its intended use, whereas verification addresses whether the work product properly reflects the specified requirements. In other words, verification ensures that “you built it right”; whereas, validation ensures that “you built the right thing.”

An important corollary is to develop a better understanding of the work products and the processes that produced them so that defects can be prevented and process improvement opportunities can be identified.

Peer reviews involve a methodical examination of work products by the producers' peers to identify defects and other changes that are needed.

Examples of peer review methods include the following:

- Inspections
- Structured walkthroughs

approach to work product verification and the specific approaches that will be used to verify that specific work products meet their requirements.

#### *For Software Engineering*

*Examples of verification methods include the following:*

- Path coverage testing*
- Load, stress, and performance testing*
- Decision-table-based testing*
- Functional decomposition-based testing*
- Test-case reuse*
- Acceptance tests*

*For Systems Engineering*

Verification for systems engineering typically includes prototyping, modeling, and simulation to verify adequacy of system

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(and allocation).

*For Hardware Engineering*

Verification for hardware engineering typically requires a parametric approach that considers various environmental conditions (e.g., pressure, temperature, vibration, and humidity), various input ranges (e.g., input power could be rated at 20V to 32V for a planned nominal of 28V), variations induced from part to part tolerance issues, and many

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variables. Hardware verification normally tests most variables separately except when problematic interactions are suspected

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**IPPD Addition**

The verification methods should be developed concurrently and iteratively with the product and product component designs.

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Submit for integration with the project plan the identification of work products to be verified, the requirements to be satisfied, and the methods to be used

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verification environment can be acquired, developed, reused, modified, or a combination of these, depending on the needs of the project.

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Define requirements for collecting data during the peer review.

*Refer to the Measurement and Analysis process area for information about identifying and collecting data.*

3. Establish and maintain entry and exit criteria for the peer review.
4. Establish and maintain criteria for requiring another peer review.
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Examples of items addressed by the checklists include the following:

- Rules of construction
- Design guidelines
- Completeness
- Correctness
- Maintainability
- Common defect types

The checklists are modified as necessary to address the specific type of work product and peer review. The peers of the checklist developers and potential users review the checklists.

6. Develop a detailed peer review schedule, including the dates for peer review training and for when materials for peer reviews will be available.
7. Ensure that the work product satisfies the peer review entry criteria prior to distribution.
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Examples of roles include the following:

- Leader
- Reader
- Recorder
- Author

10. Prepare for the peer review by reviewing the work product prior to conducting the peer review.

Peer reviews may be performed on key work products of specification, design, test, and implementation activities and specific planning work products.

The focus of the peer review should be on the work product in review, not on the person who produced it.

When issues arise during the peer review, they should be communicated to the primary developer of the work product for correction.

*Refer to the Project Monitoring and Control process area for information about tracking issues that arise during a peer review.*

Peer reviews should address the following guidelines: there must be sufficient preparation, the conduct must be managed and controlled, consistent and sufficient data must be recorded (an example is conducting a formal inspection), and action items must be recorded.

initiate corrective action.

*Refer to the corrective action practices of Project Monitoring and Control process area for more information about implementing corrective action.*

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**GG 1      Achieve Specific Goals**

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*The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.*

**GP 1.1      Perform Specific Practices**

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*Perform the specific practices of the verification process to develop work products and provide services to achieve the specific goals of the process area.*

**GG 2      Institutionalize a Managed Process**

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*The process is institutionalized as a managed process.*

**Staged Only**

**GG 3      Institutionalize a Defined Process**

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*The process is institutionalized as a defined process.*

This generic goal's appearance here reflects its location in the staged representation.

**GP 2.1      Establish an Organizational Policy**

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*Establish and maintain an organizational policy for planning and performing the verification process.*

Elaboration:

This policy establishes organizational expectations for establishing and maintaining verification methods, procedures, criteria, and the verification environment, as well as for performing peer reviews and verifying selected work products.

**GP 2.2      Plan the Process**

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Establish and maintain the

Elaboration:

This plan for performing the verification process can be included in (or referenced by) the project plan, which is described in the Project Planning process area.

### **GP 2.3 Provide Resources**

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***Provide adequate resources for performing the verification process, developing the work products, and providing the services of the process.***

Elaboration:

Special facilities may be required for verifying selected work products. When necessary, the facilities required for the activities in the Verification process area are developed or purchased.

Certain verification methods may require special tools, equipment, facilities, and training (e.g., peer reviews may require meeting rooms and trained moderators; and certain verification tests may require special test equipment and people skilled in the use of the equipment).

Examples of other resources provided include the following tools:

- Test management tools
- Test-case generators
- Test-coverage analyzers
- Simulators

### **GP 2.4 Assign Responsibility**

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***Assign responsibility and authority for performing the process, developing the work products, and providing the services of the verification process.***

### **GP 2.5 Train People**

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***Train the people performing or supporting the verification process as needed.***

Elaboration:

Examples of training topics include the following:

- Application or service domain
- Verification principles, standards, and methods (e.g., analysis, demonstration, inspection, and test)
- Verification tools and facilities
- Peer review preparation and procedures
- Meeting facilitation

## **GP 2.6      Manage Configurations**

***Place designated work products of the verification process under appropriate levels of control.***

Elaboration:

Examples of work products placed under control include the following:

- Verification procedures and criteria
- Peer review training material
- Peer review data
- Verification reports

## **GP 2.7      Identify and Involve Relevant Stakeholders**

***Identify and involve the relevant stakeholders of the verification process as planned.***

Elaboration:

Select relevant stakeholders from customers, end users, developers, producers, testers, suppliers, marketers, maintainers, disposal personnel, and others who may be affected by, or may affect, the product as well as the process.

Examples of activities for stakeholder involvement include the following:

- Selecting work products and methods for verification
- Establishing verification procedures and criteria
- Conducting peer reviews
- Assessing verification results and identifying corrective action

## **GP 2.8      Monitor and Control the Process**

***Monitor and control the verification process against the plan for performing the process and take appropriate corrective action.***

Elaboration:

Examples of measures and work products used in monitoring and controlling include the following:

- Verification profile (e.g., the number of verifications planned and performed, and the defects found; or perhaps categorized by verification method or type)
- Number of defects detected by defect category
- Verification problem report trends (e.g., number written and number closed)
- Verification problem report status (i.e., how long each problem report has been open)
- Schedule for a specific verification activity

**GP 2.9 Objectively Evaluate Adherence**

***Objectively evaluate adherence of the verification process against its process description, standards, and procedures, and address noncompliance.***

Elaboration:

Examples of activities reviewed include the following:

- Selecting work products for verification
- Establishing and maintaining verification procedures and criteria
- Performing peer reviews
- Verifying selected work products

Examples of work products reviewed include the following:

- Verification procedures and criteria
- Peer review checklists
- Verification reports

**GP 2.10 Review Status with Higher Level Management**

***Review the activities, status, and results of the verification process with higher level management and resolve issues.***

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**GG 3 Institutionalize a Defined Process**

***The process is institutionalized as a defined process.***

This generic goal's appearance here reflects its location in the continuous representation.

**GP 3.1 Establish a Defined Process**

***Establish and maintain the description of a defined verification process.***

**GP 3.2 Collect Improvement Information**

***Collect work products, measures, measurement results, and improvement information derived from planning and performing the verification process to support the future use and improvement of the organization's processes and process assets.***

Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

- Peer review records that include conduct time and average preparation time
- Number of product defects found through verification per development phase
- Verification and analysis report

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**GG 4 Institutionalize a Quantitatively Managed Process**

***The process is institutionalized as a quantitatively managed process.***

**GP 4.1 Establish Quantitative Objectives for the Process**

***Establish and maintain quantitative objectives for the verification process, which address quality and process performance, based on customer needs and business objectives.***

**GP 4.2 Stabilize Subprocess Performance**

***Stabilize the performance of one or more subprocesses to determine the ability of the verification process to achieve the established quantitative quality and process-performance objectives.***

**GG 5 Institutionalize an Optimizing Process**

***The process is institutionalized as an optimizing process.***

**GP 5.1 Ensure Continuous Process Improvement**

***Ensure continuous improvement of the verification process in fulfilling the relevant business objectives of the organization.***

**GP 5.2 Correct Root Causes of Problems**

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***Identify and correct the root causes of defects and other problems in the verification process.***

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