

## CAUSAL ANALYSIS AND RESOLUTION

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A Support Process Area at Maturity Level 5

### Purpose

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The purpose of Causal Analysis and Resolution (CAR) is to identify causes of defects and ~~other~~ problems and take action to prevent them from occurring in the future.

### Introductory Notes

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The Causal Analysis and Resolution process area involves the following activities:

- Identifying and analyzing causes of defects and ~~other~~ problems
- Taking ~~specific~~ actions to remove ~~the~~ causes and prevent the occurrence of those types of defects and problems in the future

Causal analysis and resolution improves quality and productivity by preventing the introduction of defects ~~into a product and occurrence of problems~~. Reliance on detecting defects and problems after they have been introduced is not cost effective. It is more effective to prevent defects ~~from being introduced and problems~~ by integrating causal analysis and resolution activities into each phase of the project.

Since similar defects and problems may have been previously encountered on other projects or in earlier phases or tasks of the current project, causal analysis and resolution activities are a mechanism for communicating lessons learned among projects.

~~The types~~ Types of defects and ~~other~~ problems encountered are analyzed to identify ~~any~~ trends. Based on an understanding of the defined process and how it is implemented, ~~the~~ root causes of ~~the~~ defects and ~~the problems and~~ future implications of ~~the defects~~ them are determined.

Causal analysis may ~~also~~ be performed on problems unrelated to defects. For example, causal analysis may be used to improve quality attributes such as coordination and cycle time. ~~Improvement proposals, simulations, dynamic systems models, engineering analyses, new business directives, with one supplier or other items may initiate such analysis~~ multiple suppliers.

When it is impractical to perform causal analysis on all defects, ~~defect and problems~~, targets are selected by tradeoffs on estimated investments and estimated returns of quality, productivity, and cycle time.

A measurement process should already be in place. ~~The~~Already defined measures can be used, though in some instances new measures may be needed to analyze the effects of the process change.

*Refer to the Measurement and Analysis process area for more information about ~~establishing objectives for~~aligning measurement and analysis, ~~specifying the measures and analyses to be performed, obtaining and analyzing measures, and reporting activities and providing measurement~~ results.*

Causal Analysis and Resolution activities provide a mechanism for projects to evaluate their processes at the local level and look for improvements that can be implemented.

When improvements are judged to be effective, the information is extended to the organizational level.

*Refer to the Organizational Innovation and Deployment process area for more information about ~~improving organizational level processes through proposed~~selecting and deploying incremental and innovative improvements ~~and action proposals~~that measurably improve the ~~organization's processes and technologies~~.*

The informative material in this process area is written ~~with the~~ ~~assumption~~assuming that the specific practices are applied to a quantitatively managed process. The specific practices of this process area may be applicable, but with reduced value, if this assumption is not met.

See the definitions of “stable process” and “common cause of process variation” in the glossary.

## Related Process Areas

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*~~Refer to the Quantitative Project Management process area for more information about the analysis of process performance and the creation of process capability measures for selected project processes.~~*

*~~Refer to the Organizational Innovation and Deployment process area for more information about the selection and deployment of improvements to organizational processes and technologies.~~*

*Refer to the Measurement and Analysis process area for more information about ~~establishing objectives for~~aligning measurement and analysis, ~~specifying the measures and analyses to be performed, obtaining and analyzing measures, and reporting activities and providing measurement~~ results.*

*Refer to the Organizational Innovation and Deployment process area for more information about selecting and deploying incremental and innovative improvements that measurably improve the organization's processes and technologies.*

*Refer to the Quantitative Project Management process area for more information about applying statistical methods to understand variation and monitoring performance of the selected subprocesses.*

### Specific Goal and Practice Summary

- SG 1 Determine Causes of Defects and Problems
- SP 1.1 Select ~~Defect Data for Analysis~~ Defects and Problems
  - SP 1.2 Analyze Causes
- SG 2 Address Causes of Defects and Problems
- SP 2.1 Implement ~~the~~ Action Proposals
  - SP 2.2 Evaluate the Effect of Changes
  - SP 2.3 Record Data

### Specific Practices by Goal

#### SG 1 Determine Causes of Defects and Problems

***Root causes of defects and ~~other~~ problems are systematically determined.***

A root cause is a source of a defect or problem such that, if it is removed, the defect or problem is decreased or removed.

#### SP 1.1 Select ~~Defect Data for Analysis~~ Defects and Problems

***Select ~~the~~ defects and ~~other~~ problems for analysis.***

##### Typical Work Products

1. Defect and problem data selected for further analysis

##### Subpractices

1. Gather relevant defect ~~or~~ and problem data.

Examples of relevant defect data ~~may~~ include the following:

- Defects reported by the customer
- Defects reported by ~~end users~~ service teams
- Defects found in ~~peer reviews~~ service verification
- ~~Defects found in testing~~

Examples of relevant problem data ~~may~~ include the following:

- Project management problem reports requiring corrective action
- Process capability problems
- Process duration measurements
- ~~Earned value measurements by process (e.g., cost performance index)~~
- Resource throughput, utilization, or response time measurements

~~Refer to the Verification process area for more information about work product verification.~~

- ~~Help desk calls, by time and incident category~~
- ~~Inadequate availability of the service system~~

*Refer to the Quantitative Project Management process area for more information about statistical management.*

2. Determine ~~which the~~ defects and ~~other~~ problems ~~will to~~ be analyzed further.

When determining which defects ~~and problems~~ to analyze further, consider ~~the~~ ~~their~~ impact ~~of the defects~~, their frequency of occurrence, the ~~similarity between~~ ~~defects similarities among them~~, the cost of analysis, the time and resources needed, ~~the~~ safety considerations, etc.

Examples of methods for selecting defects and ~~other~~ problems include the following:

- Pareto analysis
- Histograms
- ~~Process capability analysis~~
- ~~Cause and effects analysis (e.g., design failure mode and effects analysis for the service system being developed, process failure mode and effects analysis for service system development or service delivery)~~

## SP 1.2 Analyze Causes

***Perform causal analysis of selected defects and ~~other~~ problems and propose actions to address them.***

The purpose of this analysis is to develop solutions to ~~the~~ identified ~~defects and~~ problems by analyzing ~~the~~ relevant data and producing action proposals for implementation.

### Typical Work Products

1. Action proposal
2. Root cause analysis results

### Subpractices

1. Conduct causal analysis with ~~the people who are those~~ responsible for performing the task.

Causal analysis is performed, typically in meetings, with those ~~people who have an understanding of who understand~~ the selected defect or problem under study. ~~The people Those~~ who have the best understanding of the selected defect ~~or~~ problem are typically those responsible for performing the task.

Examples of when to perform causal analysis include the following:

- When a stable subprocess does not meet its specified quality and process-performance objectives
- During the task, if and when problems warrant a causal analysis meeting
- When a work product exhibits an unexpected deviation from its requirements

*Refer to the Quantitative Project Management process area for more information about achieving the project's quality and process-monitoring performance objectives of selected subprocesses.*

2. Analyze selected defects and other problems to determine their root causes.

Depending on the type and number of defects and problems, it may make sense to first group the defects them before identifying their root causes.

Examples of methods to determine root causes include the following:

- Cause-and-effect (fishbone) diagrams
- Check sheets

3. Group the selected defects and other problems based on their root causes.

Examples of cause groups, or categories, include the following:

- Inadequate training
- Breakdown of communications
- Not accounting for all details of a task
- Making mistakes in manual procedures (e.g., typing)
- Process deficiency

4. Propose and document actions that need to be taken to prevent the future occurrence of similar defects or other and problems.

Examples of proposed actions include changes to the following:

- The process in question
- Training
- Tools
- Methods
- Communications
- Work products

Examples of specific actions include the following:

- Providing training in common problems and techniques for preventing them
- Changing a process so that error-prone steps do not occur
- Automating all or part of a process
- Reordering process activities
- Adding process steps to prevent defects and problems, such as task kickoff meetings to review common defects and problems as well as actions to prevent them

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An action proposal usually documents the following:

- Originator of the action proposal
- ~~Description of the problem~~
- Description of the defect ~~cause~~ or problem
- Description of the cause of the defect or problem
- Defect or problem cause category
- Phase when ~~the~~ the defect or problem was introduced
- Phase when the defect or problem was identified
- Description of the action proposal
- Action proposal category

## SG 2 **Address Causes of Defects and Problems**

***Root causes of defects and other problems are systematically addressed to prevent their future occurrence.***

Projects operating according to a well-defined process ~~will~~ systematically analyze where in the operation ~~where~~ problems still occur and implement process changes to eliminate root causes of selected problems.

### SP 2.1 **Implement ~~the~~ Action Proposals**

***Implement ~~the~~ selected action proposals ~~that were~~ developed in causal analysis.***

Action proposals describe ~~the~~ tasks necessary to remove ~~the~~ root causes of ~~the~~ analyzed defects ~~or~~ and problems and avoid their reoccurrence.

Only changes that prove to be of value should be considered for broad implementation.

#### **Typical Work Products**

1. Action proposals selected for implementation
2. Improvement proposals

#### **Subpractices**

1. Analyze ~~the~~ action proposals and determine their priorities.

Criteria for prioritizing action proposals include the following:

- Implications of not addressing the ~~defects~~ defect or problem
- Cost to implement process improvements to prevent the ~~defects~~ defect or problem
- Expected impact on quality

2. Select ~~the~~ action proposals ~~that will~~ to be implemented.
3. Create action items for implementing the action proposals.

Examples of information provided in an action item include the following:

- Person responsible for implementing it
- Description of the areas affected by it
- People who are to be kept informed of its status
- Next date that status will be reviewed
- Rationale for key decisions
- Description of implementation actions
- Time and cost ~~for identifying~~ required to identify the defect or problem and ~~correcting to correct~~ it
- Estimated cost of not fixing the problem

To implement ~~the~~ action proposals, the following tasks must be ~~done~~ performed:

- Make assignments
- Coordinate the ~~persons~~ people doing the work
- Review the results
- Track ~~the~~ action items to closure

Experiments may be conducted for particularly complex changes.

Examples of experiments include the following:

- Using a temporarily modified process
- Using a new tool

Action items may be assigned to members of the causal analysis team, members of the project team, or other members of the organization.

4. Identify and remove similar defects and problems that may exist in other processes and work products.
5. Identify and document improvement proposals for the organization's set of standard processes.

*Refer to the Organizational Innovation and Deployment process area for more information about ~~the selection~~ collecting and ~~deployment of~~ analyzing improvement proposals ~~for the organization's set of standard processes~~.*

## SP 2.2 Evaluate the Effect of Changes

### ***Evaluate the effect of changes on process performance.***

*Refer to the Quantitative Project Management process area for more information about ~~analyzing process performance and creating process capability~~ selecting measures ~~for selected processes and~~ analytic techniques.*

Once the changed process is deployed across the project, the effect of ~~the~~ changes must be ~~checked~~ evaluated to gather evidence that the process change ~~has~~ corrected the problem and improved performance.

### Typical Work Products

1. Measures of performance and performance change

### Subpractices

1. Measure the change in ~~the~~ performance of the ~~project's~~project's defined process or of subprocesses as appropriate.

This subpractice determines whether the selected change has positively influenced ~~the~~ process performance and by how much.

An example of a change in the performance of ~~the project's defined design process~~a service would be the change in the ~~defect density~~cost of delivering the service after a change in the ~~design documentation, as statistically measured~~subprocess for integrating revised service system components. This ~~change in performance would be determined~~ through ~~peer reviews~~monitoring the delivered service before and after the improvement has been made ~~and comparing these differences statistically (e.g., through a hypothesis test)~~. On a statistical process control chart, this change in performance would be represented by a change in the mean.

2. Measure the capability of the ~~project's defined process~~project's defined process or of subprocesses as appropriate.

This subpractice determines whether the selected change has positively influenced the ability of the process to meet its quality and process-performance objectives, as determined by relevant stakeholders.

An example of a change in the capability of ~~the project's defined design process~~a service would be a change in the ability ~~of the process to stay~~deliver the service so that the resulting service stays within its ~~process specification~~cost boundaries. ~~This~~This change can be statistically measured by calculating the range ~~of in the cost of delivering the defect density of design documentation, as collected in peer reviews~~service through monitoring before and after the improvement has been made. On a statistical process control chart, this change in cost would be represented by ~~lowered~~narrowed control limits.

### SP 2.3 Record Data

***Record causal analysis and resolution data for use across the project and organization.***

Data are recorded so that other projects and organizations can make appropriate process changes and achieve similar results.

Record the following:

- Data on defects and ~~other~~ problems that were analyzed
- Rationale for decisions
- Action proposals from causal analysis meetings
- Action items resulting from action proposals
- Cost of ~~the~~ analysis and resolution activities
- Measures of changes to the performance of the defined process resulting from resolutions

**Typical Work Products**

1. Causal analysis and resolution records

**Generic Practices by Goal**

**Continuous-Only**

**GG 1 — Achieve Specific Goals**

*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**

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

**GG 2 — Institutionalize a Managed Process**

*The process is institutionalized as a managed process.*

**Staged-Only**

**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 staged representation.

### **GP 2.1 — Establish an Organizational Policy**

***Establish and maintain an organizational policy for planning and performing the causal analysis and resolution process.***

**Elaboration:**

This policy establishes organizational expectations for identifying and systematically addressing root causes of defects and other problems.

### **GP 2.2 — Plan the Process**

***Establish and maintain the plan for performing the causal analysis and resolution process.***

**Elaboration:**

This plan for performing the causal analysis and resolution process can be included in (or referenced by) the project plan, which is described in the Project Planning process area. This plan differs from the action proposals and associated action items described in several specific practices in this process area. The plan called for in this generic practice would address the project's overall causal analysis and resolution process (perhaps tailored from a standard process maintained by the organization). In contrast, the process action proposals and associated action items address the activities needed to remove a specific root cause under study.

### **GP 2.3 — Provide Resources**

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

**Elaboration:**

Examples of resources provided include the following tools:

- Database systems
- Process modeling tools
- Statistical analysis packages
- Tools, methods, and analysis techniques (e.g., Ishikawa or fishbone diagram, Pareto analysis, histograms, process capability studies, or control charts)

### **GP 2.4 — Assign Responsibility**

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

#### **GP 2.5 — Train People**

***Train the people performing or supporting the causal analysis and resolution process as needed.***

Elaboration:

Examples of training topics include the following:

- Quality management methods (e.g., root cause analysis)

#### **GP 2.6 — Manage Configurations**

***Place designated work products of the causal analysis and resolution process under appropriate levels of control.***

Elaboration:

Examples of work products placed under control include the following:

- Action proposals
- Action proposals selected for implementation
- Causal analysis and resolution records

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

***Identify and involve the relevant stakeholders of the causal analysis and resolution process as planned.***

Elaboration:

Examples of activities for stakeholder involvement include the following:

- Conducting causal analysis
- Assessing the action proposals

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

***Monitor and control the causal analysis and resolution 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:

- Number of root causes removed
- Change in quality or process performance per instance of the causal analysis and resolution process
- Schedule of activities for implementing a selected action proposal

**GP 2.9 — Objectively Evaluate Adherence**

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

Elaboration:

Examples of activities reviewed include the following:

- Determining causes of defects
- Addressing causes of defects

Examples of work products reviewed include the following:

- Action proposals selected for implementation
- Causal analysis and resolution records

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

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

**Continuous-Only**

**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 causal analysis and resolution process.*

**GP 3.2 — Collect Improvement Information**

*Collect work products, measures, measurement results, and improvement information derived from planning and performing the causal analysis and resolution 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:

- Action proposals
- Number of action proposals that are open and for how long
- Action proposal status reports

**Continuous-Only**

**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 causal analysis and resolution 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 causal analysis and resolution 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 causal analysis and resolution process in fulfilling the relevant business objectives of the organization.*

**GP 5.2 Correct Root Causes of Problems**

*Identify and correct the root causes of defects and other problems in the causal analysis and resolution process.*

readlines