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# Requirements Management

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*a key process area for Level 2: Repeatable*

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The purpose of Requirements Management is to establish a common understanding between the customer and the software project of the customer's requirements that will be addressed by the software project.

Requirements Management involves establishing and maintaining an agreement with the customer on the requirements for the software project. This agreement is referred to as the "system requirements allocated to the software." The "customer" may be interpreted as the system engineering group, the marketing group, another internal organization, or an external customer. The agreement covers both the technical and nontechnical (e.g., delivery dates) requirements. The agreement forms the basis for estimating, planning, performing, and tracking the software project's activities throughout the software life cycle.

The allocation of the system requirements to software, hardware, and other system components (e.g., humans) may be performed by a group external to the software engineering group (e.g., the system engineering group), and the software engineering group may have no direct control of this allocation. Within the constraints of the project, the software engineering group takes appropriate steps to ensure that the system requirements allocated to software, which they are responsible for addressing, are documented and controlled.

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# Requirements Management

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To achieve this control, the software engineering group reviews the initial and revised system requirements allocated to software to resolve issues before they are incorporated into the software project. Whenever the system requirements allocated to software are changed, the affected software plans, work products, and activities are adjusted to remain consistent with the updated requirements.

## Goals

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- Goal 1**      **System requirements allocated to software are controlled to establish a baseline for software engineering and management use.**
- Goal 2**      **Software plans, products, and activities are kept consistent with the system requirements allocated to software.**

## Commitment to perform

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- Commitment 1**   **The project follows a written organizational policy for managing the system requirements allocated to software.**

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The system requirements allocated to the software are referred to as "allocated requirements" in these practices.

The allocated requirements are the subset of the system requirements that are to be implemented in the software components of the system. The allocated requirements are a primary input to the software development plan. Software requirements analysis elaborates and refines the allocated requirements and results in software requirements which are documented.

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**(Commitment 1)** This policy typically specifies that:

1. The allocated requirements are documented.
2. The allocated requirements are reviewed by:
  - q the software managers, and
  - q other affected groups.

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Examples of affected groups include:

- system test,
- software engineering (including all subgroups, such as software design),
- system engineering,
- software quality assurance,
- software configuration management, and
- documentation support.

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3. The software plans, work products, and activities are changed to be consistent with changes to the allocated requirements.

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# Requirements Management

Level 2: Repeatable

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## Ability to perform

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**Ability 1**      **For each project, responsibility is established for analyzing the system requirements and allocating them to hardware, software, and other system components.**

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Analysis and allocation of the system requirements is not the responsibility of the software engineering group, but is a prerequisite for their work.  
XBOLERI( )

**(Ability 1)**      This responsibility covers:

1. Managing and documenting the system requirements and their allocation throughout the project's life.
2. Effecting changes to the system requirements and their allocation.

**Ability 2**      **The allocated requirements are documented.**

The allocated requirements include:

1. The nontechnical requirements (i.e., the agreements, conditions, and/or contractual terms) that affect and determine the activities of the software project.

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Examples of agreements, conditions, and contractual terms include:  
- products to be delivered,  
- delivery dates, and  
- milestones.  
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2. The technical requirements for the software.

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Examples of technical requirements include:

- end user, operator, support, or integration functions;
- performance requirements;
- design constraints;
- programming language; and
- interface requirements.

XBOLERI( )

3. The acceptance criteria that will be used to validate that the software products satisfy the allocated requirements.

**Ability 3**

**Adequate resources and funding are provided for managing the allocated requirements.**

1. Individuals who have experience and expertise in the application domain and in software engineering are assigned to manage the allocated requirements.
2. Tools to support the activities for managing requirements are made available.

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Examples of support tools include:

- spreadsheet programs,
- tools for configuration management,
- tools for traceability, and
- tools for test management.

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**Ability 4**

**Members of the software engineering group and other software-related groups are trained to perform their requirements management activities.**

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# Requirements Management

*Level 2: Repeatable*

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Examples of training include:

- the methods, standards, and procedures used by the project, and
- the application domain.

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## Activities performed

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### Activity 1

**The software engineering group reviews the allocated requirements before they are incorporated into the software project.**

1. Incomplete and missing allocated requirements are identified.

### (Activity 1)

2. The allocated requirements are reviewed to determine whether they are:

- q feasible and appropriate to implement in software,
- q clearly and properly stated,
- q consistent with each other, and
- q testable.

3. Any allocated requirements identified as having potential problems are reviewed with the group responsible for analyzing and allocating system requirements, and necessary changes are made.

4. Commitments resulting from the allocated requirements are negotiated with the affected groups.

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Examples of affected groups include:

- software engineering (including all subgroups, such as software design),
- software estimating,
- system engineering,
- system test,
- software quality assurance,
- software configuration management,
- contract management, and
- documentation support.

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Refer to Activity 6 of the Software Project Planning key process area for practices covering negotiating commitments.

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## Activity 2

**The software engineering group uses the allocated requirements as the basis for software plans, work products, and activities.**

(Activity 2)

The allocated requirements:

1. Are managed and controlled.

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"Managed and controlled" implies that the version of the work product in use at a given time (past or present) is known (i.e., version control), and changes are incorporated in a controlled manner (i.e., change control).

If a greater degree of formality than is implied by "managed and controlled" is desired, the work product can be placed under the full discipline of configuration management, as is described in the Software Configuration Management key process area.

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2. Are the basis for the software development plan.

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## Requirements Management

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3. Are the basis for developing the software requirements.

### Activity 3

#### **Changes to the allocated requirements are reviewed and incorporated into the software project.**

1. The impact to existing commitments is assessed, and changes are negotiated as appropriate.
  - q Changes to commitments made to individuals and groups external to the organization are reviewed with senior management.

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Refer to Activity 4 of the Software Project Planning key process area and Activity 3 of the Software Project Tracking and Oversight key process area for practices covering commitments made external to the organization.

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- q Changes to commitments within the organization are negotiated with the affected groups.

### (Activity 3)

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Refer to Activities 5, 6, 7, and 8 of the Software Project Tracking and Oversight key process area for practices covering negotiating changes to commitments.

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2. Changes that need to be made to the software plans, work products, and activities resulting from changes to the allocated requirements are:
  - q identified,
  - q evaluated,
  - q assessed for risk,
  - q documented,
  - q planned,
  - q communicated to the affected groups and individuals, and
  - q tracked to completion.



## Measurement and analysis

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**Measurement 1** Measurements are made and used to determine the status of the activities for managing the allocated requirements.

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Examples of measurements include:

- status of each of the allocated requirements;
- change activity for the allocated requirements; and
- cumulative number of changes to the allocated requirements, including total number of changes proposed, open, approved, and incorporated into the system baseline.

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## Verifying implementation

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Verification 1 The activities for managing the allocated requirements are reviewed with senior management on a periodic basis. XTOLERI( )

The primary purpose of periodic reviews by senior management is to provide awareness of and insight into software process activities at an appropriate level of abstraction and in a timely manner. The time between reviews should meet the needs of the organization and may be lengthy, as long as adequate mechanisms for exception reporting are available.

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Refer to Verification 1 of the Software Project Tracking and Oversight key process area for practices covering the typical content of senior management oversight reviews.

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**Verification 2** The activities for managing the allocated requirements are reviewed with the project manager on both a periodic and event-driven basis.

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# Requirements Management

*Level 2: Repeatable*

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Refer to Verification 2 of the Software Project Tracking and Oversight key process area for practices covering the typical content of project management oversight reviews.

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**Verification 3**    **The software quality assurance group reviews and/or audits the activities and work products for managing the allocated requirements and reports the results.**

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Refer to the Software Quality Assurance key process area.

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**(Verification 3)** At a minimum, these reviews and/or audits verify that:

1. The allocated requirements are reviewed, and problems are resolved before the software engineering group commits to them.
2. The software plans, work products, and activities are appropriately revised when the allocated requirements change.
3. Changes to commitments resulting from changes to the allocated requirements are negotiated with the affected groups.

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# Software Project Planning

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*a key process area for Level 2: Repeatable*

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The purpose of Software Project Planning is to establish reasonable plans for performing the software engineering and for managing the software project.

Software Project Planning involves developing estimates for the work to be performed, establishing the necessary commitments, and defining the plan to perform the work.

The software planning begins with a statement of the work to be performed and other constraints and goals that define and bound the software project (those established by the practices of the Requirements Management key process area). The software planning process includes steps to estimate the size of the software work products and the resources needed, produce a schedule, identify and assess software risks, and negotiate commitments. Iterating through these steps may be necessary to establish the plan for the software project (i.e., the software development plan).

This plan provides the basis for performing and managing the software project's activities and addresses the commitments to the software project's customer according to the resources, constraints, and capabilities of the software project.

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# Software Project Planning

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*a key process area for Level 2: Repeatable*

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## Goals

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- Goal 1**      **Software estimates are documented for use in planning and tracking the software project.**
- Goal 2**      **Software project activities and commitments are planned and documented.**
- Goal 3**      **Affected groups and individuals agree to their commitments related to the software project.**

## Commitment to perform

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- Commitment 1** **A project software manager is designated to be responsible for negotiating commitments and developing the project's software development plan.**
- Commitment 2** **The project follows a written organizational policy for planning a software project.**

This policy typically specifies that:

1. The system requirements allocated to software are used as the basis for planning the software project.

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Refer to Activity 2 of the Requirements Management key process area.

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2. The software project's commitments are negotiated between:

- q the project manager,
  - q the project software manager, and
- (Commitment 2)** q the other software managers.
3. Involvement of other engineering groups in the software activities is negotiated with these groups and is documented.

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Examples of other engineering groups include:

- system engineering,
- hardware engineering, and
- system test.

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4. Affected groups review the software project's:
- q software size estimates,
  - q effort and cost estimates,
  - q schedules, and
  - q other commitments.

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Examples of affected groups include:

- software engineering (including all subgroups, such as software design),
- software estimating,
- system engineering,
- system test,
- software quality assurance,
- software configuration management,
- contract management, and
- documentation support.

XBOLERI( )

5. Senior management reviews all software project commitments made to individuals and groups external to the organization.

6. The project's software development plan is managed and controlled.

**(Commitment 2)**XTOLERI( )

The term "software development plan" is used throughout these practices to refer to the overall plan for managing the software project. The use of "development" terminology is not intended to exclude software maintenance or support projects and should be appropriately interpreted in the context of the individual project.

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"Managed and controlled" implies that the version of the work product in use at a given time (past or present) is known (i.e., version control), and changes are incorporated in a controlled manner (i.e., change control).

If a greater degree of control than is implied by "managed and controlled" is desired, the work product can be placed under the full discipline of configuration management, as is described in the Software Configuration Management key process area.

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## **Ability to perform**

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**Ability 1**

**A documented and approved statement of work exists for the software project.**

1. The statement of work covers:
  - q scope of the work,
  - q technical goals and objectives,
  - q identification of customers and end users,

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The end users referred to in these practices are the customer designated end users or representatives of the end users.

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**(Ability 1)**

- q imposed standards,
- q assigned responsibilities,
- q cost and schedule constraints and goals,
- q dependencies between the software project and other organizations,

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Examples of other organizations include:

- the customer,
- subcontractors, and
- joint venture partners.

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- q resource constraints and goals, and
  - q other constraints and goals for development and/or maintenance.
2. The statement of work is reviewed by:
    - q the project manager,
    - q the project software manager,
    - q the other software managers, and
    - q other affected groups.
  3. The statement of work is managed and controlled.

**Ability 2**

**Responsibilities for developing the software development plan are assigned.**

1. The project software manager, directly or by delegation, coordinates the project's software planning.

2. Responsibilities for the software work products and activities are partitioned and assigned to software managers in a traceable, accountable manner.

**(Ability 2)**XTOLERI( )

Examples of software work products include:

- work products for delivery to the external customer or end users, as appropriate;
- work products for use by other engineering groups; and
- major work products for internal use by the software engineering group.

XBOLERI( )**Ability 3****Adequate resources and funding are provided for planning the software project.**

1. Where feasible, experienced individuals, who have expertise in the application domain of the software project being planned, are available to develop the software development plan.
2. Tools to support the software project planning activities are made available.

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Examples of support tools include:

- spreadsheet programs,
- estimating models, and
- project planning and scheduling programs.

XBOLERI( )**Ability 4****The software managers, software engineers, and other individuals involved in the software project planning are trained in the software estimating and planning procedures applicable to their areas of responsibility.**



## **Activities performed**

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**Activity 1**      **The software engineering group participates on the project proposal team.**

(Activity 1)

1. The software engineering group is involved in:
  - q proposal preparation and submission,
  - q clarification discussions and submissions, and
  - q negotiations of changes to commitments that affect the software project.
2. The software engineering group reviews the project's proposed commitments.

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Examples of project commitments include:

- the project's technical goals and objectives;
- the system and software technical solution;
- the software budget, schedule, and resources; and
- the software standards and procedures.

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**Activity 2**      **Software project planning is initiated in the early stages of, and in parallel with, the overall project planning.**

**Activity 3**      **The software engineering group participates with other affected groups in the overall project planning throughout the project's life.**

1. The software engineering group reviews the project-level plans.

**Activity 4**      **Software project commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.**

**Activity 5**      **A software life cycle with predefined stages of manageable size is identified or defined.**

(Activity 5)

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Examples of software life cycles include:

- waterfall,
- overlapping waterfall,
- spiral,
- serial build, and
- single prototype/overlapping waterfall.

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**Activity 6**      **The project's software development plan is developed according to a documented procedure.**

This procedure typically specifies that:

1. The software development plan is based on and conforms to:
  - q the customer's standards, as appropriate;
  - q the project's standards;
  - q the approved statement of work; and
  - q the allocated requirements.
2. Plans for software-related groups and other engineering groups involved in the activities of the software engineering group are negotiated with those groups, the support efforts are budgeted, and the agreements are documented.

XTOLERI( )  
Examples of software-related groups include:  
- software quality assurance,  
- software configuration management, and  
- documentation support.  
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**(Activity 6)**

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Examples of other engineering groups include:  
- system engineering,  
- hardware engineering, and  
- system test.  
XBOLERI( )

3. Plans for involvement of the software engineering group in the activities of other software-related groups and other engineering groups are negotiated with those groups, the support efforts are budgeted, and the agreements are documented.

4. The software development plan is reviewed by:

- q the project manager,
- q the project software manager,
- q the other software managers, and
- q other affected groups.

**5. The software development plan is managed and controlled. Activity 7 The plan for the software project is documented.**

XTOLERI( )  
In the key practices, this plan or collection of plans is referred to as the software development plan.

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Refer to Activity 1 of the Software Project Tracking and Oversight key process area for practices concerning the project's use of the software development plan.

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The software development plan covers:

1. The software project's purpose, scope, goals, and objectives.
2. Selection of a software life cycle.
3. Identification of the selected procedures, methods, and standards for developing and/or maintaining the software.

**(Activity 7)**

XTOLERI( )

Examples of software standards and procedures include:

- software development planning,
- software configuration management,
- software quality assurance,
- software design,
- problem tracking and resolution, and
- software measurement.

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4. Identification of software work products to be developed.
5. Size estimates of the software work products and any changes to the software work products.
6. Estimates of the software project's effort and costs.
7. Estimated use of critical computer resources.
8. The software project's schedules, including identification of milestones and reviews.
9. Identification and assessment of the project's software risks.
10. Plans for the project's software engineering facilities and support tools.

**Activity 8**      **Software work products that are needed to establish and maintain control of the software project are identified.**

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Refer to Activity 4 of the Software Configuration Management key process area.  
XBOLERI(      )

**Activity 9**      **Estimates for the size of the software work products (or changes to the size of software work products) are derived according to a documented procedure.**

This procedure typically specifies that:

1. Size estimates are made for all major software work products and activities.

XTOLERI(      )  
Examples of software size measurements include:  
- function points,  
- feature points,  
- lines of code,  
- number of requirements, and  
- number of pages.  
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XTOLERI(      )  
Examples of types of work products and activities for which size estimates are made include:  
- operational software and support software,  
- deliverable and nondeliverable work products,  
- software and nonsoftware work products (e.g., documents), and  
- activities for developing, verifying, and validating work products.  
XBOLERI(      )

2. Software work products are decomposed to the granularity needed to meet the estimating objectives.

3. Historical data are used where available.
4. Size estimating assumptions are documented.
5. Size estimates are documented, reviewed, and agreed to.

**(Activity 9)**XTOLERI( )

Examples of groups and individuals who review and agree to size estimates include:

- the project manager,
- the project software manager, and
- the other software managers.

XBOLERI( )**Activity 10****Estimates for the software project's effort and costs are derived according to a documented procedure.**

This procedure typically specifies that:

1. Estimates for the software project's effort and costs are related to the size estimates of the software work products (or the size of the changes).
2. Productivity data (historical and/or current) are used for the estimates when available; sources and rationale for these data are documented.
  - q The productivity and cost data are from the organization's projects when possible.
  - q The productivity and cost data take into account the effort and significant costs that go into making the software work products.

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Examples of significant costs that go into making the software work products include:

- direct labor expenses,
- overhead expenses,
- travel expenses, and
- computer use costs.

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3. Effort, staffing, and cost estimates are based on past experience.
  - q Similar projects should be used when possible.
  - q Time phasing of activities is derived.
  - q Distributions of the effort, staffing, and cost estimates over the software life cycle are prepared.
4. Estimates and the assumptions made in deriving the estimates are documented, reviewed, and agreed to.

**(Activity 10)**

**Activity 11**

**Estimates for the project's critical computer resources are derived according to a documented procedure.**

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Critical computer resources may be in the host environment, in the integration and testing environment, in the target environment, or in any combination of these.

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This procedure typically specifies that:

1. Critical computer resources for the project are identified.

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Examples of critical computer resources include:

- computer memory capacity,
- computer processor use, and
- communications channel capacity.

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2. Estimates for the critical computer resources are related to the estimates of:
  - q the size of the software work products,
  - q the operational processing load, and
  - q the communications traffic.
3. Estimates of the critical computer resources are documented, reviewed, and agreed to.

**Activity 12      The project's software schedule is derived according to a documented procedure.**

(Activity 12)      This procedure typically specifies that:

1. The software schedule is related to:
  - q the size estimate of the software work products (or the size of changes), and
  - q the software effort and costs.
2. The software schedule is based on past experience.
  - q Similar projects are used when possible.
3. The software schedule accommodates the imposed milestone dates, critical dependency dates, and other constraints.
4. The software schedule activities are of appropriate duration and the milestones are of appropriate time separation to support accuracy in progress measurement.
5. Assumptions made in deriving the schedule are documented.
6. The software schedule is documented, reviewed, and agreed to.



**Activity 13      The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented.**

1. The risks are analyzed and prioritized based on their potential impact to the project.
2. Contingencies for the risks are identified.

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Examples of contingencies include:

- schedule buffers,
- alternate staffing plans, and
- alternate plans for additional computing equipment.

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**Activity 14      Plans for the project's software engineering facilities and support tools are prepared.**

1. Estimates of capacity requirements for these facilities and support tools are based on the size estimates of the software work products and other characteristics.

XTOLERI(

Examples of software development facilities and support tools include:

- host computers and peripherals for software development,
- software test computers and peripherals,
- target computer environment software, and
- other support software.

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2. Responsibilities are assigned and commitments are negotiated to procure or develop these facilities and support tools.
3. The plans are reviewed by all affected groups.

**Activity 15      Software planning data are recorded.**

1. Information recorded includes the estimates and the associated information needed to reconstruct the estimates and assess their reasonableness.
2. The software planning data are managed and controlled.

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## **Measurement and analysis**

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**Measurement 1      Measurements are made and used to determine the status of the software planning activities.**

(Measurement 1)

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Examples of measurements include:

- completions of milestones for the software project planning activities compared to the plan; and
- work completed, effort expended, and funds expended in the software project planning activities compared to the plan.

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## **Verifying implementation**

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**Verification 1      The activities for software project planning are reviewed with senior management on a periodic basis.**

XTOLERI( )

The primary purpose of periodic reviews by senior management is to provide awareness of, and insight into, software process activities at an appropriate level of abstraction and in a timely manner. The time between reviews should meet the needs of the organization and may be lengthy, as long as adequate mechanisms for exception reporting are available.

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1. The technical, cost, staffing, and schedule performance is reviewed.
2. Conflicts and issues not resolvable at lower levels are addressed.
3. Software project risks are addressed.
4. Action items are assigned, reviewed, and tracked to closure.
5. A summary report from each meeting is prepared and distributed to the affected groups and individuals.

**Verification 2    The activities for software project planning are reviewed with the project manager on both a periodic and event-driven basis.**

- (Verification 2)
1. Affected groups are represented.
  2. Status and current results of the software project planning activities are reviewed against the software project's statement of work and allocated requirements.
  3. Dependencies between groups are addressed.
  4. Conflicts and issues not resolvable at lower levels are addressed.

5. Software project risks are reviewed.
6. Action items are assigned, reviewed, and tracked to closure.
7. A summary report from each meeting is prepared and distributed to the affected groups and individuals.

**Verification 3    The software quality assurance group reviews and/or audits the activities and work products for software project planning and reports the results.**

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Refer to the Software Quality Assurance key process area.  
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At a minimum, the reviews and/or audits verify:

1. The activities for software estimating and planning.
2. The activities for reviewing and making project commitments.
3. The activities for preparing the software development plan.
4. The standards used for preparing the software development plan.
5. The content of the software development plan.



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# Software Project Tracking and Oversight

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*a key process area for Level 2: Repeatable*

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The purpose of Software Project Tracking and Oversight is to provide adequate visibility into actual progress so that management can take effective actions when the software project's performance deviates significantly from the software plans.

Software Project Tracking and Oversight involves tracking and reviewing the software accomplishments and results against documented estimates, commitments, and plans, and adjusting these plans based on the actual accomplishments and results.

A documented plan for the software project (i.e., the software development plan, as described in the Software Project Planning key process area) is used as the basis for tracking the software activities, communicating status, and revising plans. Software activities are monitored by the management. Progress is primarily determined by comparing the actual software size, effort, cost, and schedule to the plan when selected software work products are completed and at selected milestones. When it is determined that the software project's plans are not being met, corrective actions are taken. These actions may include revising the software development plan to reflect the actual accomplishments and replanning the remaining work or taking actions to improve the performance.

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# Software Project Tracking and Oversight

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*a key process area for Level 2: Repeatable*

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## Goals

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- Goal 1**      **Actual results and performances are tracked against the software plans.**
- Goal 2**      **Corrective actions are taken and managed to closure when actual results and performance deviate significantly from the software plans.**
- Goal 3**      **Changes to software commitments are agreed to by the affected groups and individuals.**

## Commitment to perform

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- Commitment 1** **A project software manager is designated to be responsible for the project's software activities and results.**
- Commitment 2** **The project follows a written organizational policy for managing the software project.**

This policy typically specifies that:

1. A documented software development plan is used and maintained as the basis for tracking the software project.
2. The project manager is kept informed of the software project's status and issues.

3. Corrective actions are taken when the software plan is not being achieved, either by adjusting performance or by adjusting the plans.
4. Changes to the software commitments are made with the involvement and agreement of the affected groups.

**(Commitment 2)**

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Examples of affected groups include:

- software engineering (including all subgroups, such as software design),
- software estimating,
- system engineering,
- system test,
- software quality assurance,
- software configuration management,
- contract management, and
- documentation support.

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5. Senior management reviews all commitment changes and new software project commitments made to individuals and groups external to the organization.

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## **Ability to perform**

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**Ability 1**

**A software development plan for the software project is documented and approved.**

XTOLERI( )

Refer to Activities 6 and 7 of the Software Project Planning key process area for practices covering the software development plan.

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**Ability 2            The project software manager explicitly assigns responsibility for software work products and activities.**

The assigned responsibilities cover:

1. The software work products to be developed or services to be provided.
2. The effort and cost for these software activities.
3. The schedule for these software activities.
4. The budget for these software activities.

**(Ability 2)**

**Ability 3            Adequate resources and funding are provided for tracking the software project.**

1. The software managers and the software task leaders are assigned specific responsibilities for tracking the software project.
2. Tools to support software tracking are made available.

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Examples of support tools include:

- spreadsheet programs, and
- project planning/scheduling programs.

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**Ability 4            The software managers are trained in managing the technical and personnel aspects of the software project.**

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Examples of training include:

- managing technical projects;
- tracking and oversight of software size, effort, cost, and schedule; and
- managing people.

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## Ability 5

**First-line software managers receive orientation in the technical aspects of the software project.**

(Ability 5)

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Examples of orientation include:

- the project's software engineering standards and procedures, and
- the project's application domain.

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## Activities performed

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### Activity 1

**A documented software development plan is used for tracking the software activities and communicating status.**

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Refer to Activity 7 of the Software Project Planning key process area for practices covering the content of the software development plan.

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This software development plan is:

1. Updated as the work progresses to reflect accomplishments, particularly when milestones are completed.
2. Readily available to:

- q the software engineering group (including all subgroups, such as software design),
- q the software managers,
- q the project manager,
- q senior management, and
- q other affected groups.

**Activity 2****The project's software development plan is revised according to a documented procedure.**

(Activity 2)

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Refer to Activity 6 of the Software Project Planning key process area for practices covering the activities for producing the software development plan.

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This procedure typically specifies that:

1. The software development plan is revised, as appropriate, to incorporate plan refinements and incorporate plan changes, particularly when plans change significantly.

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Interdependencies between the system requirements allocated to software, design constraints, resources, costs, and schedule need to be reflected in all changes to the plan.

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2. The software development plan is updated to incorporate all new software project commitments and changes to commitments.
3. The software development plan is reviewed at each revision.
4. The software development plan is managed and controlled.

XTOLERI( )

"Managed and controlled" implies that the version of the work product in use at a given time (past or present) is known (i.e., version control), and changes are incorporated in a controlled manner (i.e., change control).

If a greater degree of control than is implied by "managed and controlled" is desired, the work product can be placed under the full discipline of configuration management, as is described in the Software Configuration Management key process area.

XBOLERI( )

**Activity 3**

**Software project commitments and changes to commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.**

**Activity 4**

**Approved changes to commitments that affect the software project are communicated to the members of the software engineering group and other software-related groups.**

XTOLERI( )

Examples of other software-related groups include:

- software quality assurance,
- software configuration management, and
- documentation support.

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**Activity 5**

**The size of the software work products (or size of the changes to the software work products) are tracked, and corrective actions are taken as necessary.**

XTOLERI( )

Refer to Activity 9 of the Software Project Planning key process area for practices covering derivation of size estimates.

XBOLERI( )

1. Sizes for all major software work products (or the size of the changes) are tracked.

2. Actual size of code (generated, fully tested, and delivered) is compared to the estimates documented in the software development plan.
3. Actual units of delivered documentation are compared to the estimates documented in the software development plan.
4. Overall projected size of the software work products (estimates combined with actuals) is refined, monitored, and adjusted on a regular basis.

**(Activity 5)**

5. Changes in size estimates of the software work products that affect software commitments are negotiated with the affected groups and are documented.

**Activity 6****The project's software effort and costs are tracked, and corrective actions are taken as necessary.**XTOLER( )

Refer to Activity 10 of the Software Project Planning key process area for practices covering the derivation of cost estimates.

XBOLER( )

1. Actual expenditures of effort and costs over time and against work completed are compared to the estimates documented in the software development plan to identify potential overruns and underruns.
2. Software costs are tracked and compared to the estimates documented in the software development plan.
3. Effort and staffing are compared to the estimates documented in the software development plan.
4. Changes in staffing and other software costs that affect software commitments are negotiated with the affected groups and are documented.

**Activity 7**

**The project's critical computer resources are tracked, and corrective actions are taken as necessary.**

XTOLERI( )

Refer to Activity 11 of the Software Project Planning key process area for practices covering the derivation of computer resource estimates.

XBOLERI( )

1. The actual and projected use of the project's critical computer resources are tracked and compared to the estimates for each major software component as documented in the software development plan.
2. Changes in estimates of critical computer resources that affect software commitments are negotiated with the affected groups and are documented.

**(Activity 7)**

**Activity 8**

**The project's software schedule is tracked, and corrective actions are taken as necessary.**

XTOLERI( )

Refer to Activity 12 of the Software Project Planning key process area for practices covering derivation of the schedule.

XBOLERI( )

1. Actual completion of software activities, milestones, and other commitments is compared against the software development plan.
2. Effects of late and early completion of software activities, milestones, and other commitments are evaluated for impacts on future activities and milestones.
3. Software schedule revisions that affect software commitments are negotiated with the affected groups and are documented.

**Activity 9**

**Software engineering technical activities are tracked, and corrective actions are taken as necessary.**

1. Members of the software engineering group report their technical status to their first-line manager on a regular basis.
2. Software release contents for successive builds are compared to the plans documented in the software development plan.
3. Problems identified in any of the software work products are reported and documented.
4. Problem reports are tracked to closure.

Activity 10

The software risks associated with cost, resource, schedule, and technical aspects of the project are tracked. **(Activity 10)** XTOLERI( )

Refer to Activity 13 of the Software Project Planning key process area for practices covering identification of risks.

XBOLERI( )

1. The priorities of the risks and the contingencies for the risks are adjusted as additional information becomes available.
2. High-risk areas are reviewed with the project manager on a regular basis.

**Activity 11**

**Actual measurement data and replanning data for the software project are recorded.**

XTOLERI( )

Refer to Activity 15 of the Software Project Planning key process area for practices covering recording of project data.

XBOLERI( )

1. Information recorded includes the estimates and associated information needed to reconstruct the estimates and verify their reasonableness.

2. The software replanning data are managed and controlled. 3. The software planning data, replanning data, and the actual measurement data are archived for use by ongoing and future projects.

**Activity 12**

**The software engineering group conducts periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan.**

These reviews are conducted between:

1. The first-line software managers and their software task leaders.
2. The project software manager, first-line software managers, and other software managers, as appropriate.

**Activity 13**

**Formal reviews to address the accomplishments and results of the software project are conducted at selected project milestones according to a documented procedure.**

These reviews:

1. Are planned to occur at meaningful points in the software project's schedule, such as the beginning or completion of selected stages.
2. Are conducted with the customer, end user, and affected groups within the organization, as appropriate.

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The end users referred to in these practices are the customer designated end users or representatives of the end users.

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3. Use materials that are reviewed and approved by the responsible software managers.
4. Address the commitments, plans, and status of the software activities.
5. Result in the identification and documentation of significant issues, action items, and decisions.
6. Address the software project risks.
7. Result in the refinement of the software development plan, as necessary.

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## Measurement and analysis

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**Measurement 1** Measurements are made and used to determine the status of the software tracking and oversight activities.

(Measurement 1)

XTOLERI( )

Examples of measurements include:

- effort and other resources expended in performing the tracking and oversight activities; and
- change activity for the software development plan, which includes changes to size estimates of the software work products, software cost estimates, critical computer resource estimates, and schedule.

XBOLER( )

## **Verifying implementation**

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Verification 1      The activities for software project tracking and oversight are reviewed with senior management on a periodic basis. XTOLER(I

The primary purpose of periodic reviews by senior management is to provide awareness of, and insight into, software process activities at an appropriate level of abstraction and in a timely manner. The time between reviews should meet the needs of the organization and may be lengthy, as long as adequate mechanisms for exception reporting are available.

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1. The technical, cost, staffing, and schedule performance are reviewed.
2. Conflicts and issues not resolvable at lower levels are addressed.
3. Software project risks are addressed.
4. Action items are assigned, reviewed, and tracked to closure.
5. A summary status report from each meeting is prepared and distributed to the affected groups.

### **Verification 2      The activities for software project tracking and oversight are reviewed with the project manager on both a periodic and event-driven basis.**

1. Affected groups are represented.
2. The technical, cost, staffing, and schedule performance is reviewed against the software development plan.
3. Use of critical computer resources is reviewed; current estimates and actual use of these critical computer resources are reported against the original estimates.

4. Dependencies between groups are addressed.
5. Conflicts and issues not resolvable at lower levels are addressed.
6. Software project risks are addressed.
7. Action items are assigned, reviewed, and tracked to closure.
8. A summary report from each meeting is prepared and distributed to the affected groups.

**Verification 3    The software quality assurance group reviews and/or audits the activities and work products for software project tracking and oversight and reports the results.**

XTOLERI( )

Refer to the Software Quality Assurance key process area.

XBOLERI( )

At a minimum, the reviews and/or audits verify:

1. The activities for reviewing and revising commitments.
2. The activities for revising the software development plan.
- (Verification 3)** 3. The content of the revised software development plan.
4. The activities for tracking the software project's cost, schedule, risks, technical and design constraints, and functionality and performance.
5. The activities for conducting the planned technical and management reviews.

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# Software Subcontract Management

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*a key process area for Level 2: Repeatable*

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The purpose of Software Subcontract Management is to select qualified software subcontractors and manage them effectively.

Software Subcontract Management involves selecting a software subcontractor, establishing commitments with the subcontractor, and tracking and reviewing the subcontractor's performance and results. These practices cover the management of a software (only) subcontract, as well as the management of the software component of a subcontract that includes software, hardware, and possibly other system components.

The subcontractor is selected based on its ability to perform the work. Many factors contribute to the decision to subcontract a portion of the prime contractor's work. Subcontractors may be selected based on strategic business alliances, as well as technical considerations. The practices of this key process area address the traditional acquisition process associated with subcontracting a defined portion of the work to another organization.

When subcontracting, a documented agreement covering the technical and nontechnical (e.g., delivery dates) requirements is established and is used as the basis for managing the

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# Software Subcontract Management

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*a key process area for Level 2: Repeatable*

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subcontract. The work to be done by the subcontractor and the plans for the work are documented. The standards that are to be followed by the subcontractor are compatible with the prime contractor's standards.

The software planning, tracking, and oversight activities for the subcontracted work are performed by the subcontractor. The prime contractor ensures that these planning, tracking, and oversight activities are performed appropriately and that the software products delivered by the subcontractor satisfy their acceptance criteria. The prime contractor works with the subcontractor to manage their product and process interfaces.

## Goals

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- Goal 1**      **The prime contractor selects qualified software subcontractors.**
  
- Goal 2**      **The prime contractor and the software subcontractor agree to their commitments to each other.**
  
- Goal 3**      **The prime contractor and the software subcontractor maintain ongoing communications.**

**Goal 4**            **The prime contractor tracks the software subcontractor's actual results and performance against its commitments.**

## **Commitment to perform**

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**Commitment 1**   **The project follows a written organizational policy for managing the software subcontract.**

(Commitment 1)   This policy typically specifies that:

1. Documented standards and procedures are used in selecting software subcontractors and managing the software subcontracts.
2. The contractual agreements form the basis for managing the subcontract.
3. Changes to the subcontract are made with the involvement and agreement of both the prime contractor and the subcontractor.

**Commitment 2**   **A subcontract manager is designated to be responsible for establishing and managing the software subcontract.**

1. The subcontract manager is knowledgeable and experienced in software engineering or has individuals assigned who have that knowledge and experience.
2. The subcontract manager is responsible for coordinating the technical scope of work to be subcontracted and the terms and conditions of the subcontract with the affected parties.

XTOLERI( )

The project's system engineering group and software engineering group define the technical scope of the work to be subcontracted.

The appropriate business function groups, such as purchasing, finance, and legal, establish and monitor the terms and conditions of the subcontract.

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3. The subcontract manager is responsible for:
  - q selecting the software subcontractor,
  - q managing the software subcontract, and
  - q arranging for the post-subcontract support of the subcontracted products.

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## **Ability to perform**

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### **Ability 1**

**Adequate resources and funding are provided for selecting the software subcontractor and managing the subcontract.**

1. Software managers and other individuals are assigned specific responsibilities for managing the subcontract.
2. Tools to support managing the subcontract are made available.

XTOLERI( )

Examples of support tools include:

- estimating models,
- spreadsheet programs, and
- project management and scheduling programs.

XBOLER( )

**Ability 2**

**Software managers and other individuals who are involved in establishing and managing the software subcontract are trained to perform these activities.**

XTOLERI( )

Examples of training include:

- preparing and planning for software subcontracting,
- evaluating a subcontract bidder's software process capability,
- evaluating a subcontract bidder's software estimates and plans,
- selecting a subcontractor, and
- managing a subcontract.

XBOLERI( )

**Ability 3**

**Software managers and other individuals who are involved in managing the software subcontract receive orientation in the technical aspects of the subcontract.**

(Ability 3)

XTOLERI( )

Examples of orientation include:

- application domain,
- software technologies being applied,
- software tools being used,
- methodologies being used,
- standards being used, and
- procedures being used.

XBOLERI( )

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## **Activities performed**

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**Activity 1**

**The work to be subcontracted is defined and planned according to a documented procedure.**



This procedure typically specifies that:

1. The software products and activities to be subcontracted are selected based on a balanced assessment of both technical and nontechnical characteristics of the project.
  - q The functions or subsystems to be subcontracted are selected to match the skills and capabilities of potential subcontractors.
  - q The specification of the software products and activities to be subcontracted is determined based on a systematic analysis and appropriate partitioning of the system and software requirements.
2. The specification of the work to be subcontracted and the standards and procedures to be followed are derived from the project's:
  - q statement of work,
  - q system requirements allocated to software,
  - q software requirements,
  - q software development plan, and
  - q software standards and procedures.
3. A subcontract statement of work is:
  - q prepared,
  - q reviewed,
  - q agreed to,

**(Activity 1)**

XTOLERI( )

Examples of individuals who review and agree to the subcontract statement of work include:

- the project manager,
- the project software manager,
- the responsible software managers,
- the software configuration management manager,
- the software quality assurance manager, and
- the subcontract manager.

XBOLER( )

- q revised when necessary, and
- q managed and controlled.

XTOLERI( )

"Managed and controlled" implies that the version of the work product in use at a given time (past or present) is known (i.e., version control), and changes are incorporated in a controlled manner (i.e., change control).

If a greater degree of control than is implied by "managed and controlled" is desired, the work product can be placed under the full discipline of configuration management, as is described in the Software Configuration Management key process area.

XBOLERI( )

XTOLERI( )

Refer to Ability 1 of the Software Project Planning key process area for practices covering typical contents of the statement of work.

XBOLERI( )

- 4. A plan for selecting a subcontractor is prepared concurrent with the subcontract statement of work and is reviewed, as appropriate.

## Activity 2

**The software subcontractor is selected, based on an evaluation of the subcontract bidders' ability to perform the work, according to a documented procedure.**

This procedure covers the evaluation of:

1. Proposals submitted for the planned subcontract.
2. Prior performance records on similar work, if available.
3. The geographic locations of the subcontract bidders' organizations relative to the prime contractor.

XTOLERI( )

Effective management of some subcontracts may require frequent face-to-face interactions.

XBOLERI( )

4. Software engineering and software management capabilities.

XTOLERI( )

An example of a method to evaluate subcontractors' capabilities is the SEI Software Capability Evaluation method.

XBOLERI( )

5. Staff available to perform the work.
6. Prior experience in similar applications, including software expertise on the subcontractor's software management team.
7. Available resources.

XTOLERI( )

Examples of resources include:

- facilities,
- hardware,
- software, and
- training.

XBOLERI( )

### Activity 3

**The contractual agreement between the prime contractor and the software subcontractor is used as the basis for managing the subcontract.**

The contractual agreement documents:

1. The terms and conditions.
2. The statement of work.

XTOLERI( )

Refer to Ability 1 of the Software Project Planning key process area for practices covering the typical contents of a statement of work.

XBOLERI( )

3. The requirements for the products to be developed.
4. The list of dependencies between the subcontractor and the prime contractor.
5. The subcontracted products to be delivered to the prime contractor.

XTOLERI( )

Examples of products include:

- source code,
- software development plan,
- simulation environment,
- design documentation, and
- acceptance test plan.

XBOLERI( )

6. The conditions under which revisions to products are to be submitted.
7. The acceptance procedures and acceptance criteria to be used in evaluating the subcontracted products before they are accepted by the prime contractor.

**(Activity 3)**

8. The procedures and evaluation criteria to be used by the prime contractor to monitor and evaluate the subcontractor's performance.

**Activity 4**

**A documented subcontractor's software development plan is reviewed and approved by the prime contractor.**

1. This software development plan covers (directly or by reference) the appropriate items from the prime contractor's software development plan.

XTOLERI( )

In some cases, the prime contractor's software development plan, may include the software development plan for the subcontractor, and no separate subcontractor's software development plan is needed.

XBOLERI( )

XTOLERI( )

Refer to Activity 7 of the Software Project Planning key process area for practices covering content of the project's software development plan.

XBOLERI( )

**Activity 5**

**A documented and approved subcontractor's software development plan is used for tracking the software activities and communicating status.**

**Activity 6**

**Changes to the software subcontractor's statement of work, subcontract terms and conditions, and other commitments are resolved according to a documented procedure.**

1. This procedure typically specifies that all affected groups of both the prime contractor and the subcontractor are involved.

**Activity 7**

**The prime contractor's management conducts periodic status/coordination reviews with the software subcontractor's management.**

(Activity 7)

1. The subcontractor is provided with visibility of the needs and desires of the product's customers and end users, as appropriate.

XTOLERI( )

The end users referred to in these practices are the customer designated end users or representatives of the end users.

XBOLERI( )

2. The subcontractor's technical, cost, staffing, and schedule performance is reviewed against the subcontractor's software development plan.
3. Computer resources designated as critical for the project are reviewed; the subcontractor's contribution to the current estimates are tracked and compared to the estimates for each software component as documented in the subcontractor's software development plan.
4. Critical dependencies and commitments between the subcontractor's software engineering group and other subcontractor groups are addressed.
5. Critical dependencies and commitments between the prime contractor and the subcontractor are addressed.
  - q Subcontractor commitments to the prime contractor and prime contractor commitments to the subcontractor are both reviewed.
6. Nonconformance to the subcontract is addressed.
7. Project risks involving the subcontractor's work are addressed.
8. Conflicts and issues not resolvable internally by the subcontractor are addressed.
9. Action items are assigned, reviewed, and tracked to closure.

**Activity 8**

**Periodic technical reviews and interchanges are held with the software subcontractor.**

(Activity 8)

These reviews:

1. Provide the subcontractor with visibility of the customer's and end users' needs and desires, as appropriate.
2. Monitor the subcontractor's technical activities.
3. Verify that the subcontractor's interpretation and implementation of the technical requirements conform to the prime contractor's requirements.
4. Verify that commitments are being met.
5. Verify that technical issues are resolved in a timely manner.

**Activity 9**

**Formal reviews to address the subcontractor's software engineering accomplishments and results are conducted at selected milestones according to a documented procedure.**

This procedure typically specifies that:

1. Reviews are preplanned and documented in the statement of work.
2. Reviews address the subcontractor's commitments for, plans for, and status of the software activities.
3. Significant issues, action items, and decisions are identified and documented.
4. Software risks are addressed.
5. The subcontractor's software development plan is refined, as appropriate.

**Activity 10**      **The prime contractor's software quality assurance group monitors the subcontractor's software quality assurance activities according to a documented procedure.**

(Activity 10)      This procedure typically specifies that:

1. The subcontractor's plans, resources, procedures, and standards for software quality assurance are periodically reviewed to ensure they are adequate to monitor the subcontractor's performance.
2. Regular reviews of the subcontractor are conducted to ensure the approved procedures and standards are being followed.
  - q The prime contractor's software quality assurance group spot checks the subcontractor's software engineering activities and products.
  - q The prime contractor's software quality assurance group audits the subcontractor's software quality assurance records, as appropriate
3. The subcontractor's records of its software quality assurance activities are periodically audited to assess how well the software quality assurance plans, standards, and procedures are being followed.

**Activity 11**      **The prime contractor's software configuration management group monitors the subcontractor's activities for software configuration management according to a documented procedure.**

This procedure typically specifies that:

1. The subcontractor's plans, resources, procedures, and standards for software configuration management are reviewed to ensure they are adequate.



2. The prime contractor and the subcontractor coordinate their activities on matters relating to software configuration management to ensure that the subcontractor's products can be readily integrated or incorporated into the project environment of the prime contractor.
3. The subcontractor's software baseline library is periodically audited to assess how well the standards and procedures for software configuration management are being followed and how effective they are in managing the software baseline.

**Activity 12      The prime contractor conducts acceptance testing as part of the delivery of the subcontractor's software products according to a documented procedure.**

This procedure typically specifies that:

1. The acceptance procedures and acceptance criteria for each product are defined, reviewed, and approved by both the prime contractor and the subcontractor prior to the test.
2. The results of the acceptance tests are documented.
3. An action plan is established for any software product that does not pass its acceptance test.

**Activity 13      The software subcontractor's performance is evaluated on a periodic basis, and the evaluation is reviewed with the subcontractor.**

XTOLERI( )

Evaluation of the subcontractor's performance provides an opportunity for the subcontractor to obtain feedback on whether or not it is satisfying its customer's (i.e., the prime contractor's) needs. A mechanism such as performance award fee reviews provides this type of feedback, as opposed to the periodic coordination and technical reviews which occur throughout the project. Documentation of these evaluations also acts as input for future subcontractor selection activities.

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## Measurement and analysis

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**Measurement 1** Measurements are made and used to determine the status of the activities for managing the software subcontract.

(Measurement 1)

XTOLERI( )

Examples of measurements include:

- costs of the activities for managing the subcontract compared to the plan,
- actual delivery dates for subcontracted products compared to the plan, and
- actual dates of prime contractor deliveries to the subcontractor compared to the plan.

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## Verifying implementation

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Verification 1 The activities for managing the software subcontract are reviewed with senior management on a periodic basis. XTOLERI( )

The primary purpose of periodic reviews by senior management is to provide awareness of and insight into software process activities at an appropriate level of abstraction and in a timely manner. The time between reviews should meet the needs of the organization and may be lengthy, as long as adequate mechanisms for exception reporting are available.

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XTOLERI( )

Refer to Verification 1 of the Software Project Tracking and Oversight key process area for practices covering the typical content of senior management oversight reviews.

XBOLERI( )

**Verification 2    The activities for managing the software subcontract are reviewed with the project manager on both a periodic and event-driven basis.**

(Verification 2)

XTOLERI( )

Refer to Verification 2 of the Software Project Tracking and Oversight key process area for practices covering the typical content of project management oversight reviews.

XBOLERI( )

**Verification 3    The software quality assurance group reviews and/or audits the activities and work products for managing the software subcontract and reports the results.**

XTOLERI( )

Refer to the Software Quality Assurance key process area.

XBOLERI( )

At a minimum, the reviews and/or audits verify:

1. The activities for selecting the subcontractor.
2. The activities for managing the software subcontract.
3. The activities for coordinating configuration management activities of the prime contractor and subcontractor.
4. The conduct of planned reviews with the subcontractor.
5. The conduct of reviews that establish completion of key project milestones or stages for the subcontract.
6. The acceptance process for the subcontractor's software products.





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# Software Quality Assurance

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*a key process area for Level 2: Repeatable*

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The purpose of Software Quality Assurance is to provide management with appropriate visibility into the process being used by the software project and of the products being built.

Software Quality Assurance involves reviewing and auditing the software products and activities to verify that they comply with the applicable procedures and standards and providing the software project and other appropriate managers with the results of these reviews and audits.

The software quality assurance group works with the software project during its early stages to establish plans, standards, and procedures that will add value to the software project and satisfy the constraints of the project and the organization's policies. By participating in establishing the plans, standards, and procedures, the software quality assurance group helps ensure they fit the project's needs and verifies that they will be usable for performing reviews and audits throughout the software life cycle. The software quality assurance group reviews project activities and audits software work products throughout the life cycle and provides management with visibility as to whether the software project is adhering to its established plans, standards, and procedures.

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# Software Quality Assurance

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*a key process area for Level 2: Repeatable*

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Compliance issues are first addressed within the software project and resolved there if possible. For issues not resolvable within the software project, the software quality assurance group escalates the issue to an appropriate level of management for resolution.

This key process area covers the practices for the group performing the software quality assurance function. The practices identifying the specific activities and work products that the software quality assurance group reviews and/or audits are generally contained in the Verifying Implementation common feature of the other key process areas.

## Goals

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- |               |   |
|---------------|---|
| <b>Goal 1</b> | <b>Software quality assurance activities are planned.</b>   |
| <b>Goal 2</b> | <b>Adherence of software products and activities to the applicable standards, procedures, and requirements is verified objectively.</b> |
| <b>Goal 3</b> | <b>Affected groups and individuals are informed of software quality assurance activities and results.</b>                               |
| <b>Goal 4</b> | <b>Noncompliance issues that cannot be resolved within the software project are addressed by senior management.</b>                     |

## Commitment to perform

### **Commitment 1 The project follows a written organizational policy for implementing software quality assurance (SQA).**

This policy typically specifies that:

1. The SQA function is in place on all software projects.

#### **(Commitment 1)** 2. The SQA group has a reporting channel to senior management that is independent of:

- q the project manager,
- q the project's software engineering group, and
- q the other software-related groups.

XTOLERI( )

Examples of other software-related groups include:

- software configuration management, and
- documentation support.

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XTOLERI( )

Organizations must determine the organizational structure that will support activities that require independence, such as SQA, in the context of their strategic business goals and business environment.

Independence should:

- provide the individuals performing the SQA role with the organizational freedom to be the "eyes and ears" of senior management on the software project;
- protect the individuals performing the SQA role from performance appraisal by the management of the software project they are reviewing; and
- provide senior management with confidence that objective information on the process and products of the software project is being reported.

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# Software Quality Assurance

Level 2: Repeatable

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3. Senior management periodically reviews the SQA activities and results.

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## Ability to perform

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### Ability 1

**A group that is responsible for coordinating and implementing SQA for the project (i.e., the SQA group) exists.**

(Ability 1)

XTOLERI( )

A group is the collection of departments, managers, and individuals who have responsibility for a set of tasks or activities. A group could vary from a single individual assigned part time, to several part-time individuals assigned from different departments, to several individuals dedicated full time. Considerations when implementing a group include assigned tasks or activities, the size of the project, the organizational structure, and the organizational culture. Some groups, such as the software quality assurance group, are focused on project activities, and others, such as the software engineering process group, are focused on organization-wide activities.

XBOLERI( )

### Ability 2

**Adequate resources and funding are provided for performing the SQA activities.**

1. A manager is assigned specific responsibilities for the project's SQA activities.
2. A senior manager, who is knowledgeable in the SQA role and has the authority to take appropriate oversight actions, is designated to receive and act on software noncompliance items.
  - q All managers in the SQA reporting chain to the senior manager are knowledgeable in the SQA role, responsibilities, and authority.

3. Tools to support the SQA activities are made available.

XTOLERI( )

Examples of support tools include:

- workstations,
- database programs,
- spreadsheet programs, and
- auditing tools.

XBOLERI( )

### **Ability 3**

**Members of the SQA group are trained to perform their SQA activities.**

(Ability 3)

XTOLERI( )

Examples of training include:

- software engineering skills and practices;
- roles and responsibilities of the software engineering group and other software-related groups;
- standards, procedures, and methods for the software project;
- application domain of the software project;
- SQA objectives, procedures, and methods;
- involvement of the SQA group in the software activities;
- effective use of SQA methods and tools; and
- interpersonal communications.

XBOLERI( )

### **Ability 4**

**The members of the software project receive orientation on the role, responsibilities, authority, and value of the SQA group.**

## **Activities performed**

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### **Activity 1**

**A SQA plan is prepared for the software project according to a documented procedure.**

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# Software Quality Assurance

Level 2: Repeatable

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This procedure typically specifies that:

1. The SQA plan is developed in the early stages of, and in parallel with, the overall project planning.
2. The SQA plan is reviewed by the affected groups and individuals.

## (Activity 1)

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Examples of affected groups and individuals include:

- the project software manager;
- other software managers;
- the project manager;
- customer SQA representative;
- the senior manager to whom the SQA group reports noncompliance issues; and
- the software engineering group (including all subgroups, such as software design as well as the software task leaders).

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3. The SQA plan is managed and controlled.XTOLERI( )

"Managed and controlled" implies that the version of the work product in use at a given time (past or present) is known (i.e., version control), and changes are incorporated in a controlled manner (i.e., change control).

If a greater degree of control than is implied by "managed and controlled" is desired, the work product can be placed under the full discipline of configuration management, as is described in the Software Configuration Management key process area.

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## Activity 2

**The SQA group's activities are performed in accordance with the SQA plan.**

The plan covers:

1. Responsibilities and authority of the SQA group.

2. Resource requirements for the SQA group (including staff, tools, and facilities).
3. Schedule and funding of the project's SQA group activities.
- (Activity 2)** 4. The SQA group's participation in establishing the software development plan, standards, and procedures for the project.
5. Evaluations to be performed by the SQA group.

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Examples of products and activities to be evaluated include:

- operational software and support software,
- deliverable and nondeliverable products,
- software and nonsoftware products (e.g., documents),
- product development and product verification activities (e.g., executing test cases), and
- the activities followed in creating the product.

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6. Audits and reviews to be conducted by the SQA group.
7. Project standards and procedures to be used as the basis for the SQA group's reviews and audits.
8. Procedures for documenting and tracking noncompliance issues to closure.

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These procedures may be included as part of the plan or may be included via reference to other documents where they are contained.

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9. Documentation that the SQA group is required to produce.

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## Software Quality Assurance

*Level 2: Repeatable*

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10. Method and frequency of providing feedback to the software engineering group and other software-related groups on SQA activities.

### **Activity 3      The SQA group participates in the preparation and review of the project's software development plan, standards, and procedures.**

(Activity 3)

1. The SQA group provides consultation and review of the plans, standards, and procedures with regard to:
  - q compliance to organizational policy,
  - q compliance to externally imposed standards and requirements (e.g., standards required by the statement of work),
  - q standards that are appropriate for use by the project,
  - q topics that should be addressed in the software development plan, and
  - q other areas as assigned by the project.
2. The SQA group verifies that plans, standards, and procedures are in place and can be used to review and audit the software project.

### **Activity 4      The SQA group reviews the software engineering activities to verify compliance.**

1. The activities are evaluated against the software development plan and the designated software standards and procedures.

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Refer to the Verifying Implementation common feature in the other key process areas for practices covering the specific reviews and audits performed by the SQA group.

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2. Deviations are identified, documented, and tracked to closure.

3. Corrections are verified.

**Activity 5      The SQA group audits designated software work products to verify compliance.**

1. The deliverable software products are evaluated before they are delivered to the customer.
2. The software work products are evaluated against the designated software standards, procedures, and contractual requirements.

**(Activity 5)      3. Deviations are identified, documented, and tracked to closure.**

4. Corrections are verified.

**Activity 6      The SQA group periodically reports the results of its activities to the software engineering group.**

**Activity 7      Deviations identified in the software activities and software work products are documented and handled according to a documented procedure.**

This procedure typically specifies that:

- 1 Deviations from the software development plan and the designated project standards and procedures are documented and resolved with the appropriate software task leaders, software managers, or project manager, where possible.

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## Software Quality Assurance

*Level 2: Repeatable*

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2. Deviations from the software development plan and the designated project standards and procedures not resolvable with the software task leaders, software managers, or project manager are documented and presented to the senior manager designated to receive noncompliance items.
3. Noncompliance items presented to the senior manager are periodically reviewed until they are resolved.
4. The documentation of noncompliance items is managed and controlled.

### Activity 8

**The SQA group conducts periodic reviews of its activities and findings with the customer's SQA personnel, as appropriate.**

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## Measurement and analysis

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**Measurement 1 Measurements are made and used to determine the cost and schedule status of the SQA activities.**

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Examples of measurements include:

- completions of milestones for the SQA activities compared to the plan;
- work completed, effort expended, and funds expended in the SQA activities compared to the plan; and
- numbers of product audits and activity reviews compared to the plan.

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## Verifying implementation

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Verification 1      The SQA activities are reviewed with senior management on a periodic basis. XTOLER( )

The primary purpose of periodic reviews by senior management is to provide awareness of and insight into software process activities at an appropriate level of abstraction and in a timely manner. The time between reviews should meet the needs of the organization and may be lengthy, as long as adequate mechanisms for exception reporting are available.

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XTOLER( )

Refer to Verification 1 of the Software Project Tracking and Oversight key process area for practices covering the typical content of senior management oversight reviews.

XBOLER( )

### **Verification 2      The SQA activities are reviewed with the project manager on both a periodic and event-driven basis.**

XTOLER( )

Refer to Verification 2 of the Software Project Tracking and Oversight key process area for practices covering the typical content of project management oversight reviews.

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### **Verification 3      Experts independent of the SQA group periodically review the activities and software work products of the project's SQA group.**



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# Software Quality Assurance

*Level 2: Repeatable*

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# Software Configuration Management

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*a key process area for Level 2: Repeatable*

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The purpose of Software Configuration Management is to establish and maintain the integrity of the products of the software project throughout the project's software life cycle.

Software Configuration Management involves identifying the configuration of the software (i.e., selected software work products and their descriptions) at given points in time, systematically controlling changes to the configuration, and maintaining the integrity and traceability of the configuration throughout the software life cycle. The work products placed under software configuration management include the software products that are delivered to the customer (e.g., the software requirements document and the code) and the items that are identified with or required to create these software products (e.g., the compiler).

A software baseline library is established containing the software baselines as they are developed. Changes to baselines and the release of software products built from the software baseline library are systematically controlled via the change control and configuration auditing functions of software configuration management.

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# Software Configuration Management

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*a key process area for Level 2: Repeatable*

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This key process area covers the practices for performing the software configuration management function. The practices identifying specific configuration items/units are contained in the key process areas that describe the development and maintenance of each configuration item/unit.

## Goals

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- Goal 1**      **Software configuration management activities are planned.**
  
- Goal 2**      **Selected software work products are identified, controlled, and available.**
  
- Goal 3**      **Changes to identified software work products are controlled.**
  
- Goal 4**      **Affected groups and individuals are informed of the status and content of software baselines.**

## Commitment to perform

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- Commitment 1**   **The project follows a written organizational policy for implementing software configuration management (SCM).**

This policy typically specifies that:

1. Responsibility for SCM for each project is explicitly assigned.
2. SCM is implemented throughout the project's life cycle.
3. SCM is implemented for externally deliverable software products, designated internal software work products, and designated support tools used inside the project (e.g., compilers).
4. The projects establish or have access to a repository for storing configuration items/units and the associated SCM records.

**(Commitment 1)**

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The contents of this repository are referred to as the "software baseline library" in these practices.

The tools and procedures for accessing this repository are referred to as the "configuration management library system" in these practices.

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Work products that are placed under configuration management and treated as a single entity are referred to as configuration items.

Configuration items are typically decomposed into configuration components, and configuration components are typically decomposed into units. In a hardware/software system, all of the software may be considered as a single configuration item, or the software may be decomposed into multiple configuration items. In these practices the term "configuration items/units" is used to refer to the elements under configuration management.

XBOLERI( )

5. The software baselines and SCM activities are audited on a periodic basis.

## **Ability to perform**

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### **Ability 1**

**A board having the authority for managing the project's software baselines (i.e., a software configuration control board - SCCB) exists or is established.**

The SCCB:

1. Authorizes the establishment of software baselines and the identification of configuration items/units.
2. Represents the interests of the project manager and all groups who may be affected by changes to the software baselines.

### **(Ability 1)**

XTOLERI( )

Examples of affected groups include:

- hardware quality assurance,
- hardware configuration management,
- hardware engineering,
- manufacturing engineering,
- software engineering (including all subgroups, such as software design),
- system engineering,
- system test,
- software quality assurance,
- software configuration management,
- contract management, and
- documentation support.

XBOLER( )

3. Reviews and authorizes changes to the software baselines.
4. Authorizes the creation of products from the software baseline library.

**Ability 2**

**A group that is responsible for coordinating and implementing SCM for the project (i.e., the SCM group) exists.**

XTOLERI( )

A group is the collection of departments, managers, and individuals who have responsibility for a set of tasks or activities. A group could vary from a single individual assigned part time, to several part-time individuals assigned from different departments, to several individuals dedicated full time. Considerations when implementing a group include assigned tasks or activities, the size of the project, the organizational structure, and the organizational culture. Some groups, such as the software quality assurance group, are focused on project activities, and others, such as the software engineering process group, are focused on organization-wide activities.

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**(Ability 2)**

The SCM group coordinates or implements:

1. Creation and management of the project's software baseline library.
2. Development, maintenance, and distribution of the SCM plans, standards, and procedures.
3. The identification of the set of work products to be placed under SCM.

XTOLERI( )

A work product is any artifact from defining, maintaining, or using a software process.

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4. Management of the access to the software baseline library.
5. Updates of the software baselines.
6. Creation of products from the software baseline library.

7. Recording of SCM actions.
8. Production and distribution of SCM reports.

**Ability 3****Adequate resources and funding are provided for performing the SCM activities.**

1. A manager is assigned specific responsibilities for SCM.
2. Tools to support the SCM activities are made available.

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Examples of support tools include:

- workstations,
- database programs, and
- configuration management tools.

XBOLERI(**Ability 4****Members of the SCM group are trained in the objectives, procedures, and methods for performing their SCM activities.**XTOLERI(

Examples of training include:

- SCM standards, procedures, and methods; and
- SCM tools.

XBOLERI(**Ability 5****Members of the software engineering group and other software-related groups are trained to perform their SCM activities.**XTOLERI(

Examples of other software-related groups include:

- software quality assurance, and
- documentation support.

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XTOLERI( )

Examples of training include:

- the standards, procedures, and methods to be followed for SCM activities performed inside the software engineering group and other software-related groups; and
- the role, responsibilities, and authority of the SCM group.

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## Activities performed

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**Activity 1**      **A SCM plan is prepared for each software project according to a documented procedure.**

This procedure typically specifies that:

1. The SCM plan is developed in the early stages of, and in parallel with, the overall project planning.
- (Activity 1 ) 2. The SCM plan is reviewed by the affected groups.

3.      The SCM plan is managed and controlled.XTOLERI( )

"Managed and controlled" implies that the version of the work product in use at a given time (past or present) is be known (i.e., version control), and changes are incorporated in a controlled manner (i.e., change control).

If a greater degree of control than is implied by "managed and controlled" is desired, the work product can be placed under the full discipline of configuration management, as is described in this key process area.

XBOLER( )

**Activity 2**      **A documented and approved SCM plan is used as the basis for performing the SCM activities.**

The plan covers:



1. The SCM activities to be performed, the schedule of activities, the assigned responsibilities, and the resources required (including staff, tools, and computer facilities).
2. The SCM requirements and activities to be performed by the software engineering group and other software-related groups.

**Activity 3****A configuration management library system is established as a repository for the software baselines**

This library system:

1. Supports multiple control levels of SCM.

**(Activity 3)**

XTOLERI( )

Examples of situations leading to multiple levels of control include:

- differences in the levels of control needed at different times in the life cycle (e.g., tighter control as product matures),
- differences in the levels of control needed for software-only systems vs. systems which include both hardware and software.

XBOLERI( )

2. Provides for the storage and retrieval of configuration items/units.
3. Provides for the sharing and transfer of configuration items/units between the affected groups and between control levels within the library.
4. Helps in the use of product standards for configuration items/units.
5. Provides for the storage and recovery of archive versions of configuration items/units.

6. Helps to ensure correct creation of products from the software baseline library.
7. Provides for the storage, update, and retrieval of SCM records.
8. Supports production of SCM reports.
9. Provides for the maintenance of the library structure and contents.

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Examples of library maintenance functions include:

- backup/restoring of library files, and
- recovery from library errors.

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#### **Activity 4**

#### **The software work products to be placed under configuration management are identified.**

(Activity 4)

1. The configuration items/units are selected based on documented criteria.

XTOLERI( )

Examples of software work products that may be identified as configuration items/units include:

- process-related documentation (e.g., plans, standards, or procedures)
- software requirements,
- software design,
- software code units,
- software test procedures,
- software system build for the software test activity,
- software system build for delivery to the customer or end users,
- compilers, and
- other support tools.

XBOLERI( )

2. The configuration items/units are assigned unique identifiers.
3. The characteristics of each configuration item/unit are specified.
4. The software baselines to which each configuration item/unit belongs are specified.
5. The point in its development that each configuration item/unit is placed under configuration management is specified.
6. The person responsible for each configuration item/unit (i.e., the owner, from a configuration management point of view) is identified.

**Activity 5**      **Change requests and problem reports for all configuration items/units are initiated, recorded, reviewed, approved, and tracked according to a documented procedure.**

**Activity 6**      **Changes to baselines are controlled according to a documented procedure.**

This procedure typically specifies that:

1. Reviews and/or regression tests are performed to ensure that changes have not caused unintended effects on the baseline.
2. Only configuration items/units that are approved by the SCCB are entered into the software baseline library.

3. Configuration items/units are checked in and out in a manner that maintains the correctness and integrity of the software baseline library.

XTOLERI( )

Examples of check-in/out steps include:

- verifying that the revisions are authorized,
- creating a change log,
- maintaining a copy of the changes,
- updating the software baseline library, and
- archiving the replaced software baseline.

XBOLERI( )

**Activity 7**

**Products from the software baseline library are created and their release is controlled according to a documented procedure.**

This procedure typically specifies that:

1. The SCCB authorizes the creation of products from the software baseline library.
2. Products from the software baseline library, for both internal and external use, are built only from configuration items/units in the software baseline library.

**Activity 8**

**The status of configuration items/units is recorded according to a documented procedure.**

(Activity 8)

This procedure typically specifies that:

1. The configuration management actions are recorded in sufficient detail so that the content and status of each configuration item/unit are known and previous versions can be recovered.

2. The current status and history (i.e., changes and other actions) of each configuration item/unit are maintained.

**Activity 9**

**Standard reports documenting the SCM activities and the contents of the software baseline are developed and made available to affected groups and individuals.**

XTOLERI(

Examples of reports include:

- SCCB meeting minutes,
- change request summary and status,
- trouble report summary and status (including fixes),
- summary of changes made to the software baselines,
- revision history of configuration items/units,
- software baseline status, and
- results of software baseline audits.

XBOLERI(**Activity 10**

**Software baseline audits are conducted according to a documented procedure.**

This procedure typically specifies that:

1. There is adequate preparation for the audit.
2. The integrity of software baselines is assessed.
3. The structure and facilities of the configuration management library system are reviewed.
4. The completeness and correctness of the software baseline library contents are verified.

**(Activity 10)**

5. Compliance with applicable SCM standards and procedures is verified.

6. The results of the audit are reported to the project software manager.
7. Action items from the audit are tracked to closure.

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## Measurement and analysis

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### **Measurement 1 Measurements are made and used to determine the status of the SCM activities.**

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Examples of measurements include:

- number of change requests processed per unit time;
- completions of milestones for the SCM activities compared to the plan; and
- work completed, effort expended, and funds expended in the SCM activities.

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## Verifying implementation

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Verification 1 The SCM activities are reviewed with senior management on a periodic basis. XTOLER( )

The primary purpose of periodic reviews by senior management is to provide awareness of and insight into software process activities at an appropriate level of abstraction and in a timely manner. The time between reviews should meet the needs of the organization and may be lengthy, as long as adequate mechanisms for exception reporting are available.

XBOLER( )

### **(Verification 1)**

XTOLER( )

Refer to Verification 1 of the Software Project Tracking and Oversight key process area for practices covering the typical content of senior management oversight reviews.

XBOLER( )

**Verification 2    The SCM activities are reviewed with the project manager on both a periodic and event-driven basis.**

XTOLERI( )

Refer to Verification 2 of the Software Project Tracking and Oversight key process area for practices covering the typical content of project management oversight reviews.

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**Verification 3    The SCM group periodically audits software baselines to verify that they conform to the documentation that defines them.**

**Verification 4    The software quality assurance group reviews and/or audits the activities and work products for SCM and reports the results.**

XTOLERI( )

Refer to the Software Quality Assurance key process area.

XBOLERI( )

At a minimum, the reviews and/or audits verify:

1. Compliance with the SCM standards and procedures by:
  - q the SCM group,
  - q the SCCB,
  - q the software engineering group, and
  - q other software-related groups.
2. Occurrence of periodic software baseline audits.





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# Level 2 Index

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