



مدیریت پروژه بر اساس PMBOK به همراه الحاقیه ساخت (ویرایش هفتم)

بخش چهارم:

بررسی تفصیلی راهنمای پیکره دانش مدیریت پروژه PMBOK + الحاقیه ساخت

ارائه دهندگان:

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دانشگاه Illinois Tech آمریکا

What we will learn?

- ❑ Introduction
- ❑ A Guide To the Project Management Body of Knowledge
 - ❖ 7th Edition – Project Performance Domains
 - ❖ Domain 1 (7th edition + PMBOK Construction Extension)
 - ❖ Domain 2 (7th edition + PMBOK Construction Extension)
 - ❖ Domain 3 (7th edition + PMBOK Construction Extension)
 - ❖ Domain 4 (7th edition + PMBOK Construction Extension)
 - ❖ Domain 5 (7th edition + PMBOK Construction Extension)
 - ❖ Domain 6 (7th edition + PMBOK Construction Extension)
 - ❖ Domain 7 (7th edition + PMBOK Construction Extension)
 - ❖ Domain 8 (7th edition + PMBOK Construction Extension)

Project procurement management executing

Using the statements of work as a foundation, conducting procurements is focused on soliciting and acquiring the various sellers to provide construction services for the project. This process may be a well-defined and regulated government mandate or an entirely private undertaking, such as searching the internet for contractors, briefly describing the project needs, and signing an agreement for services. Executing procurement in public or government sectors can be a lengthy and heavily regulated process. Regardless of the procurement methodology, documents will be produced that prescribe the scope of work and form the contract agreements.

1. Procurement solicitation
2. Contract statement of work
3. Procurement documents
4. Prequalification of service providers
5. Nongovernment organizations (NGO) solicitation of seller responses
6. Public and government solicitations
7. Evaluation and selection of sellers
8. Single-source procurement

Project procurement management executing – Procurement solicitation

The procurement solicitation method is either based on a request for quotation (RFQ) or request for proposal (RFP). The RFQ process is a direct evaluation that is focused on the apparent low bidder, provided that the seller's submission satisfies the procurement and contract requirements. An RFQ is considered a more rigid process that provides an exact monetary amount for a prescribed set of deliverables. An RFP is a bit more flexible in that it provides a base price for the scope of work to be performed, but allows for additional adjustments for scope and cost and may be set to an hourly or task-oriented basis as the job becomes more defined.

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Project procurement management executing – Contract statement of work

The contract statement of work (SOW) describes the facilities to be constructed in sufficient detail to allow potential bidders to determine if they are capable of providing the required construction services. It is important to note that a performance specification states requirements in terms of the required results with criteria for verifying compliance, but without stating the methods for achieving the required results. On the other hand, a detail specification specifies design requirements, such as materials to be used, how a requirement is to be achieved, or how an item is to be fabricated or constructed. Contract SOWs can contain both performance and detail requirements yet still be considered a detail specification.

**Remember the SOW I gave you in Planning and Scheduling course?
I will provide many forms and documents in **Contract Management Course!****

Who should develop?

Project procurement management executing – Contract statement of work

Typically, the A/E engaged in project design develops the SOW. In cases where a turnkey or design-build contract type is chosen, the owner will provide the functional and aesthetic requirements of the facilities they envision in a statement of requirements (SOR). In addition, the SOW may solicit potential bidder input to propose solutions for certain problems. The SOW and associated tender documents should be clear and concise, and specify all contract requirements.

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Project procurement management executing – Procurement documents

❑ In addition to the procurement documents, the review of the contractor evaluation and selection criteria is also important that includes the following:

- **Standard forms.** Construction trade organizations, professional societies, and large owner organizations generate standard forms for use in contract development. These standard forms help reduce the time and expense for each contract and tender solicitation. These also help standardize processes from project to project and help ensure the quality of the final agreement.
- **Procurement documents.** These documents should describe the tendering procedures and seller evaluation process and criteria, and convey the information to be submitted by the seller. These documents should specify the following:
 - The items the buyer is expecting with the seller's response to satisfy the deliverables and requirements, which can range from price data only to a larger list of information such as drawings, product data, and preliminary bill of materials (BOM); company brochures/contract history; and qualifications of key personnel.
 - The process the buyer will use to evaluate the seller's response. The buyer outlines a brief narrative on how the bid information in the seller's response will be evaluated to determine the contract award. For RFQs, the price and bid information of the apparent low bid response is evaluated. For RFPs, the bid information for all seller responses is evaluated. Evaluation criteria are usually listed in order of importance with the highest-weighted criteria listed first.

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Project procurement management executing – NGO solicitation of seller responses

❑ The criteria for assessing bidder eligibility for the qualified seller lists may include:

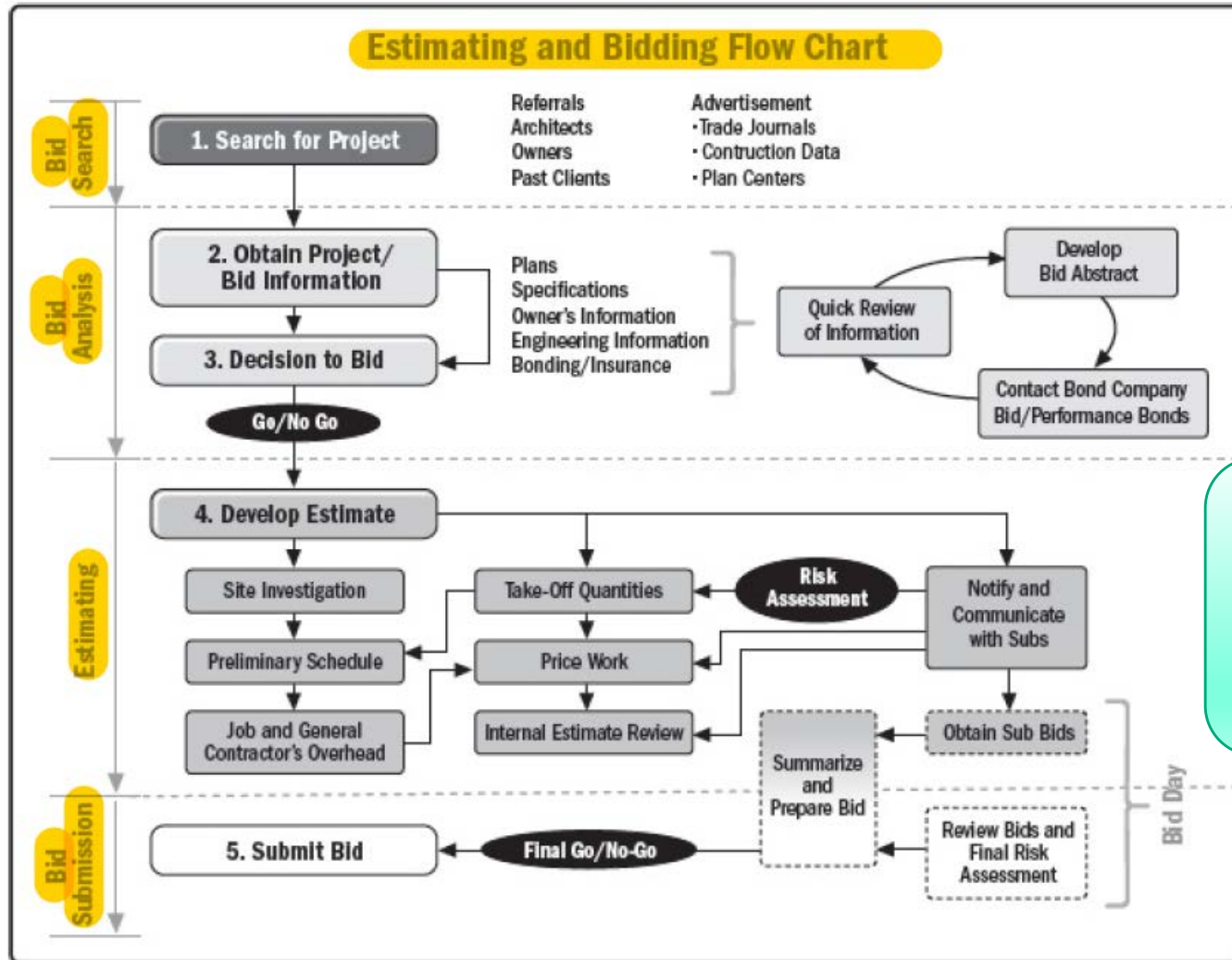
- Relevant construction experience;
- Identification of key members, including résumés with descriptions of relevant work experience and upper-level team members, such as project managers;
- Project health, safety, security, and environmental (HSSE/(HSE) and sustainability programs that indicate the contractor's approach and experience with these project components. In some instances, a verification of the bidder (seller) experience rate from its workers' compensation insurance carrier can validate a contractor's safety record;
- Description and availability of the proposed project resource elements, such as manpower, equipment, machinery, and materials;
- Description of and experience with quality programs, including quality planning, quality assurance, and quality control;
- Surety bonding that demonstrates the ability to secure construction surety bonds for the appropriate amount and coverage;
- Insurance certificates that meet the requirements set forth in the contract documents;
- Previous contract disputes that describe any claims of the material breach of contract that have led to arbitration, litigation, or some other form of dispute resolution proceedings; and
- Regulatory requirements that demonstrate the ability to comply with any special regulations for the project.

Project procurement management executing

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Project procurement management executing – Evaluation and selection of sellers



Do you remember the difference between this process and the one provided in Financial Management Course?

Figure 12-4. Contractor Estimating and Bidding Process



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Project procurement management monitoring and controlling

In monitoring and controlling, procurement contract administration is a two-way process to ensure the buyer and seller adhere to contract requirements. Both the buyer and seller administer procurement contracts for similar purposes, involving items such as directing and managing project work, controlling quality, controlling risks, performing integrated change control, and controlling the financial management components.

1. Contract management and contract administration
2. Work performance reporting
3. Approved change request
4. Buyer-conducted performance review
5. Inspections and audits
6. Progress payment system
7. Claims administration
8. Records management system
9. Project and contract documentation
10. Project management plan updates

Project procurement management monitoring and controlling – Project management plan updates

Updating the project management plan usually requires updating the procurement management plan, and any contract administration documents generated through the procurement and contract administration process. Any approved change orders to the contract documents, including revised drawings and specifications, require the responsible project management team to make the appropriate updates, revisions, and amendments to all affected subsidiary plans.

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Project procurement management closing

Most contracts are closed at the end of the project; however, certain contracts may be closed upon completion of the contracted work regardless of the time frame in relation to the completion of the project. Project contract closure is initiated by a written communication, such as a notice letter or specified form submitted by the contractor (seller) advising the designer and owner (buyer) that the seller has achieved substantial completion.

What architect or engineer does?

Project procurement management closing

The architect or engineer of record should certify that substantial completion has been reached, or advise the seller as to why it has not. Closure documentation prepared and submitted by the contractor may include all terms and conditions of the contract and the procurement management plan, including:

- Material warranties and workmanship guarantees,
- Equipment manufacturer warranties,
- Final inspection approvals from buyer (owner or government authorities),
- Equipment manufacturer operation and maintenance manuals,
- As-built drawings,
- Sign-off sheets for training of owner personnel, and
- Subcontractors and material/equipment supplier payment certifications.

1. Punch list

2. Administrative closeout

Project procurement management closing – Administrative closeout

Administrative closeout of all procurements can be an extensive undertaking once the construction work has been accepted. This administrative closure includes items such as the release of any retained funds or progress payments, insurance policy closures, activation of any warranties, and the issuance of certificates of works completed or certificates of proper equipment or machinery installations. The presence of any outstanding claims may postpone final payments and possibly the start of warranty periods. The construction project management professional should be intimately aware of all contractual obligations and requirements until all aspects of the administrative duty are complete.

How to audit?

Project procurement management closing – Administrative closeout

Audits and procurement negotiations to settle all final contract adjustments, issues, and claims are usually an essential part of procurement closure. The records management system should incorporate all final settlements and records of the procurements and lessons learned for archival purposes. The management of potential contract disputes is ultimately required to close procurements.

How about early terminations?

Project procurement management closing – Administrative closeout

Early terminations in construction are not infrequent and can occur at any time during the project when circumstances merit. Reasons for early termination can be between the primary buyer and seller due to nonperformance, or between the general contractor and a subcontractor for the same reason. The rights and responsibilities of the parties in this event are outlined in the termination clause of the procurement contract.

Remember claim management course?

Supplementary Documents

Read Files #1 to #3

A Guide To the Project Management Body of Knowledge

(Domain 6: Delivery Performance Domain)

Project performance domains



Delivery performance domain

DELIVERY PERFORMANCE DOMAIN

The Delivery Performance Domain addresses activities and functions associated with delivering the scope and quality that the project was undertaken to achieve.

Effective execution of this performance domain results in the following desired outcomes:

- ▶ Projects contribute to business objectives and advancement of strategy.
- ▶ Projects realize the outcomes they were initiated to deliver.
- ▶ Project benefits are realized in the time frame in which they were planned.
- ▶ The project team has a clear understanding of requirements.
- ▶ Stakeholders accept and are satisfied with project deliverables.

Delivery performance domain

The following definitions are relevant to the Delivery Performance Domain:

Requirement. A condition or capability that is necessary to be present in a product, service, or result to satisfy a business need.

Work Breakdown Structure (WBS). A hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables.

Definition of Done (DoD). A checklist of all the criteria required to be met so that a deliverable can be considered ready for customer use.

Quality. The degree to which a set of inherent characteristics fulfills requirements.

Cost of Quality (COQ). All costs incurred over the life of the product by investment in preventing nonconformance to requirements, appraisal of the product or service for conformance to requirements, and failure to meet requirements.

Delivery performance domain

□ We will talk about the following in this section:

1. **Delivery of value**
2. **Deliverables**
3. **Quality**
4. **Suboptimal outcomes**
5. **Interactions with other performance domains**
6. **Checking results**

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Delivery performance domain

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Delivery performance domain – Delivery of value

Projects that use a development approach that supports releasing deliverables throughout the project life cycle can start delivering value to the business, customer, or other stakeholders during the project. Projects that deliver the bulk of their deliverable at the end of the project life cycle generate value after the initial deployment.

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Delivery performance domain – Delivery of value

Business value often continues to be captured long after the initial project has ended.

Frequently, longer product and program life cycles are used to measure the benefits and value contributed by earlier projects.

Project-authorizing documents attempt to quantify the project's desired outcomes to allow for periodic measurement. These documents may range from detailed, baselined plans or high-level roadmaps that provide an overview of the project life cycle, major releases, key deliverables, reviews, and other top-level information.

Project Authorization Form (PAR)

Date : December 31, 2004
PAR # [1501]

[Your Name]
[Address]
[City, ST ZIP Code]
[Phone]
[E-mail address]

To: PMO
Attn:
[Street Address]
[City, ST ZIP Code]
[email:]

Project Info	Response (Required)	Approver	Approved (Y/N)
Portfolio or Program	Strategic Planning Program (pid: 1499)		
Project Name	Strategic Planning Process Project		
Intention	Create process (es) to align new project requests with Strategic Organizational objectives; Map the Strategic Planning Process, Project Request and Project Approval Processes		
Description	Insert detailed Project Description		
Scope/Boundaries	Processes for assembly of Strategic Plans. The actual Strategic Plan creation is not within scope for this project.		
Target beneficiary	All Departments		
Planned start date	January 1, 2015		
Planned completion date	April 1, 2015		
Budget	\$10,000		
Strategic Objective alignment	Aligns with the Strategic Plan 2013–2014 Objective that all core processes impacting organizational effectiveness be mapped with the goal process optimization.		
Required support	Project sponsor will ensure resource support will be provided from one Project Manager (PM) leading a team of 4 Green Belts.		
Additional consideration	This initiative will have a beneficial ongoing impact on the organization's ability to achieve its strategic objectives.		

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Delivery performance domain – Deliverables

In this context, *deliverable* refers to the interim or final product, service, or results from a project. The deliverables enable the outcomes that the project was undertaken to create. Deliverables reflect the stakeholder requirements, scope, and quality, along with the long-term impacts to profit, people, and the planet.

1. Requirements
2. Scope definition
3. Moving targets of completion

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Delivery performance domain – Deliverables: Requirements

- ▶ **Requirements elicitation.** To elicit means to draw out, bring forth, or evoke. There is more to collecting requirements than interviewing or conducting focus groups. Sometimes requirements are drawn out by analyzing data, observing processes, reviewing defect logs, or other methods.

Part of eliciting requirements is documenting them and gaining stakeholder agreement. Well-documented requirements meet the following criteria:

- ▷ **Clear.** There is only one way to interpret the requirement.
- ▷ **Concise.** The requirement is stated in as few words as possible.
- ▷ **Verifiable.** There is a way to verify that the requirement has been met.
- ▷ **Consistent.** There are no contradictory requirements.
- ▷ **Complete.** The set of requirements represents the entirety of the current project or product needs.
- ▷ **Traceable.** Each requirement can be recognized by a unique identifier.

Delivery performance domain – Deliverables: Requirements

- ▶ **Evolving and discovering requirements.** On projects that do not have clearly defined requirements up front, prototypes, demonstrations, storyboards, and mock-ups can be used to evolve the requirements. In these situations, stakeholders are more likely to take an “I’ll know it when I see it” approach to developing requirements. Evolving requirements are common in projects using iterative, incremental, or adaptive development approaches. In some cases, new opportunities arise that change requirements.

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Delivery performance domain – Deliverables: Requirements

- ▶ **Managing requirements.** Regardless of whether requirements are documented up front, evolved along the way, or discovered, there is a need to manage them. Ineffective requirements management can lead to rework, scope creep, customer dissatisfaction, budget overruns, schedule delay, and overall project failure. Therefore, many projects have one accountable person for requirements management. This person may serve as business analyst, product owner, value engineer, or other title. Those individuals managing requirements may use specialized software, backlogs, index cards, traceability matrices, or some other method to ensure there is an appropriate level of requirement flexibility versus stability, and that new and changing requirements are agreed to by all relevant stakeholders.

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Delivery performance domain – Deliverables: Scope definition

As requirements are identified, the scope that will meet them is defined. Scope is the sum of the products, services, and results to be provided as a project. As scope is defined, it creates the need for more requirements identification. Therefore, like requirements, scope can be well defined up front, it can evolve over time, or it can be discovered.

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Delivery performance domain – Deliverables: Scope definition

- **Scope decomposition.** Scope can be elaborated using a **scope statement** to identify the **major deliverables** associated with the **project** and the **acceptance criteria** for **each deliverable**. Scope can also be elaborated by **decomposing** it into lower levels of detail using a work breakdown structure (**WBS**). A WBS is a hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables. **Each level down** in the hierarchy represents a **greater level of detail** of the deliverable and work required to produce it.

Another way to elaborate scope is by identifying the themes of the project in an agile charter, roadmap, or as part of the product hierarchy.

Delivery performance domain – Deliverables: Scope definition

- ▶ **Completion of deliverables.** Depending on the approach used, there are different ways to describe component or project completion:
 - ▷ **Acceptance or completion criteria.** The criteria required to be met before the customer accepts the deliverable or before the project is considered complete are often documented in a scope statement.
 - ▷ **Technical performance measures.** The technical specifications for a product may be documented in a separate specifications document, or they may be documented as an extension to the WBS. This extension, known as a WBS dictionary, elaborates the information for each deliverable (work package) in the WBS.
 - ▷ **Definition of done.** The definition of done is used with adaptive approaches, particularly in software development projects. It is a checklist of all the criteria required to be met so that a deliverable can be considered ready for customer use.

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Delivery performance domain – Deliverables: Moving targets of completion

Projects that operate in uncertain and rapidly changing environments face the situation that a “good enough for release” or “done” goal may be subject to change. In markets where competitors are releasing new products frequently, the features planned for a new release may be updated. Likewise, new technology trends, such as mobile devices or wearable devices, might trigger a change in direction or introduce new requirements.

In these environments, the definition of the project goal being delivered or “done” is constantly moving. Project teams track the planned rate of project goal achievement relative to the rate of progress toward completion. The longer the project takes to complete, the further the project goal of “done” is likely to move. This is sometimes referred to as “done drift.”

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Delivery performance domain – Deliverables: Moving targets of completion

Figure 2-21 shows a scenario for developing a new smart watch. The initial schedule shows 12 months to develop the watch with the initial set of capabilities and features. As competitors launch similar products, the initial set of capabilities and features increases to stay relevant with the market. This pushes the launch date to Month 14. At 13 months, another competitor launches a product with even more capabilities. Adding these capabilities would delay the launch to Month 16. At some point, a decision will be made whether to release the product as is, even though it doesn't have the latest features, or continue to update the features prior to launch.

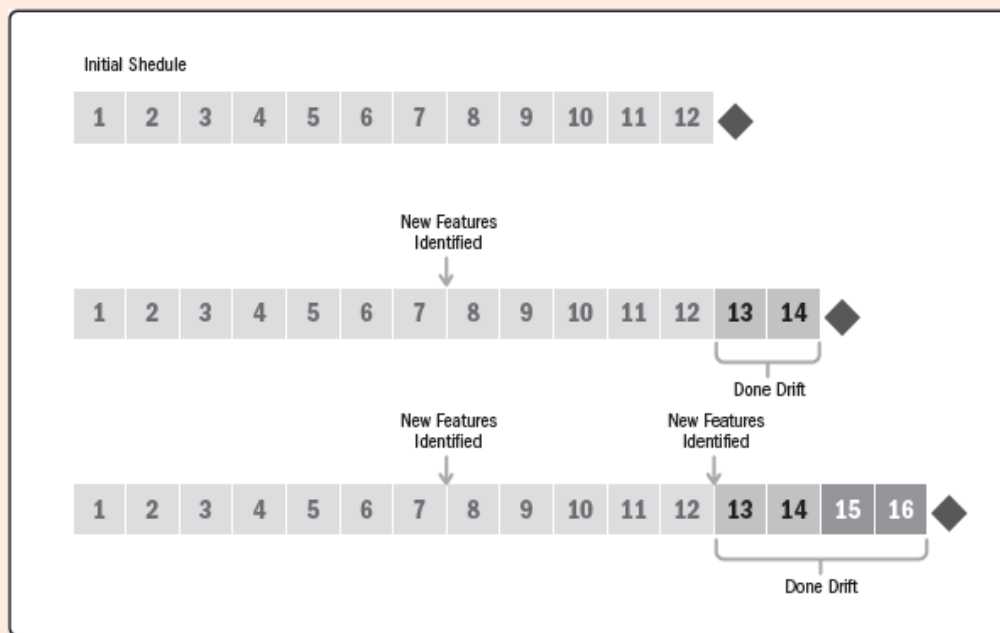


Figure 2-21. Scenario for Developing a Smart Watch

Delivery performance domain – Deliverables

Projects that operate in a more stable environment often face “scope creep.” This is when additional scope or requirements are accepted without adjusting the corresponding schedule, budget, or resource needs. To combat scope creep, project teams use a change control system where all changes are evaluated for the potential value they bring to the project and the potential resources, time, and budget needed to realize the potential value. The project team then presents the changes to the project governance body, product owner, or executive sponsor for formal approval.

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Delivery performance domain – Quality

Delivery is more than just scope and requirements. Scope and requirements focus on what needs to be delivered. Quality focuses on the performance levels that are required to be met. Quality requirements may be reflected in the completion criteria, definition of done, statement of work, or requirements documentation.

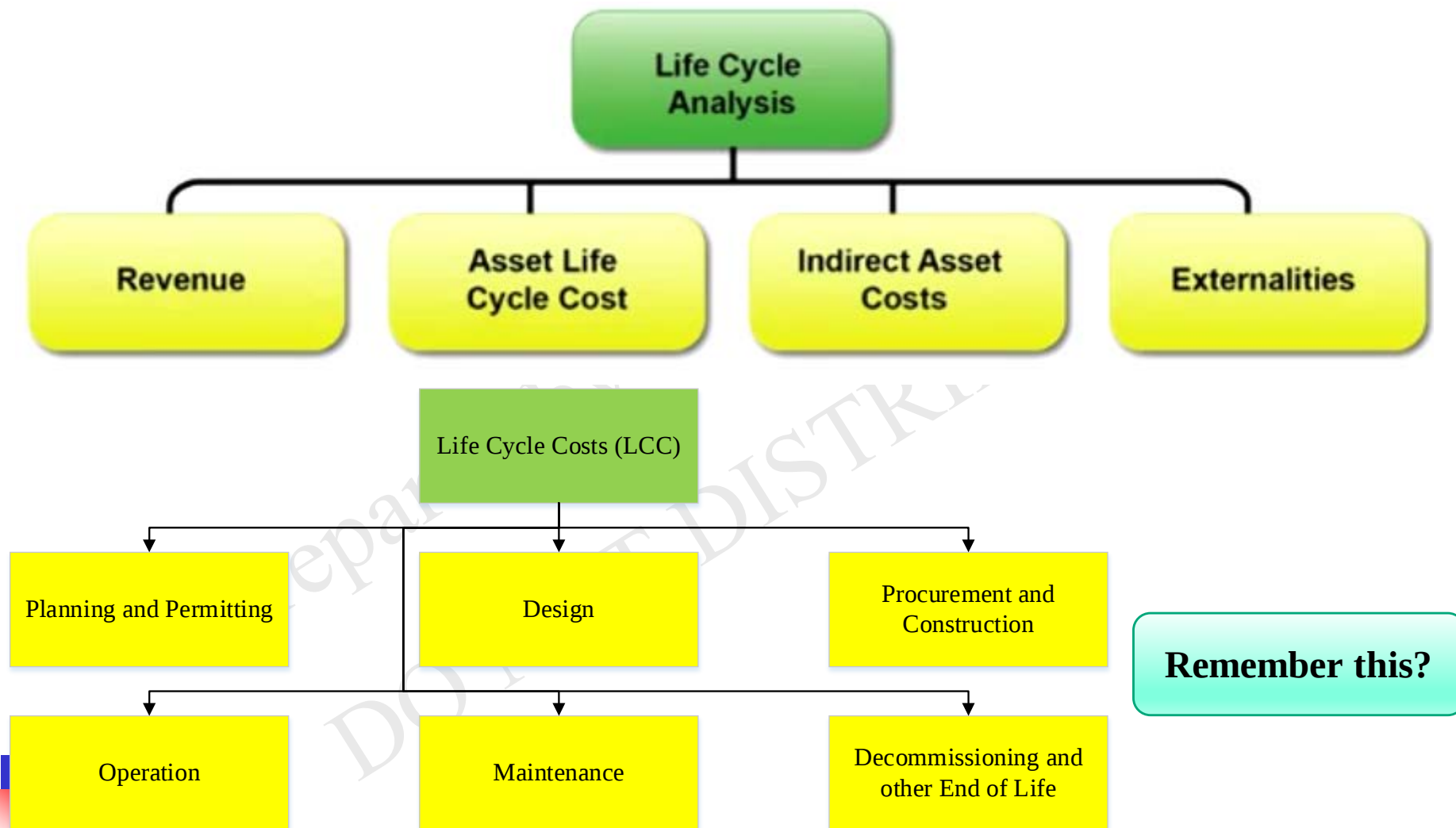
Much of the costs associated with quality are born by the sponsoring organization and are reflected in policies, procedures, and work processes. For example, organizational policies that govern how work is performed and procedures that prescribe work processes are often part of the organization's quality policy. The cost of overhead, training, and process audit are born by the organization, though they are employed by the project. Inherent in projects is balancing the quality needs of the processes and products with the costs associated with meeting those needs.

Let's talk about:

1. Cost of quality
2. Cost of change

DO NOT FORGET WE HAVE LIFE CYCLE COSTING IN CONSTRUCTION

Delivery performance domain – Quality

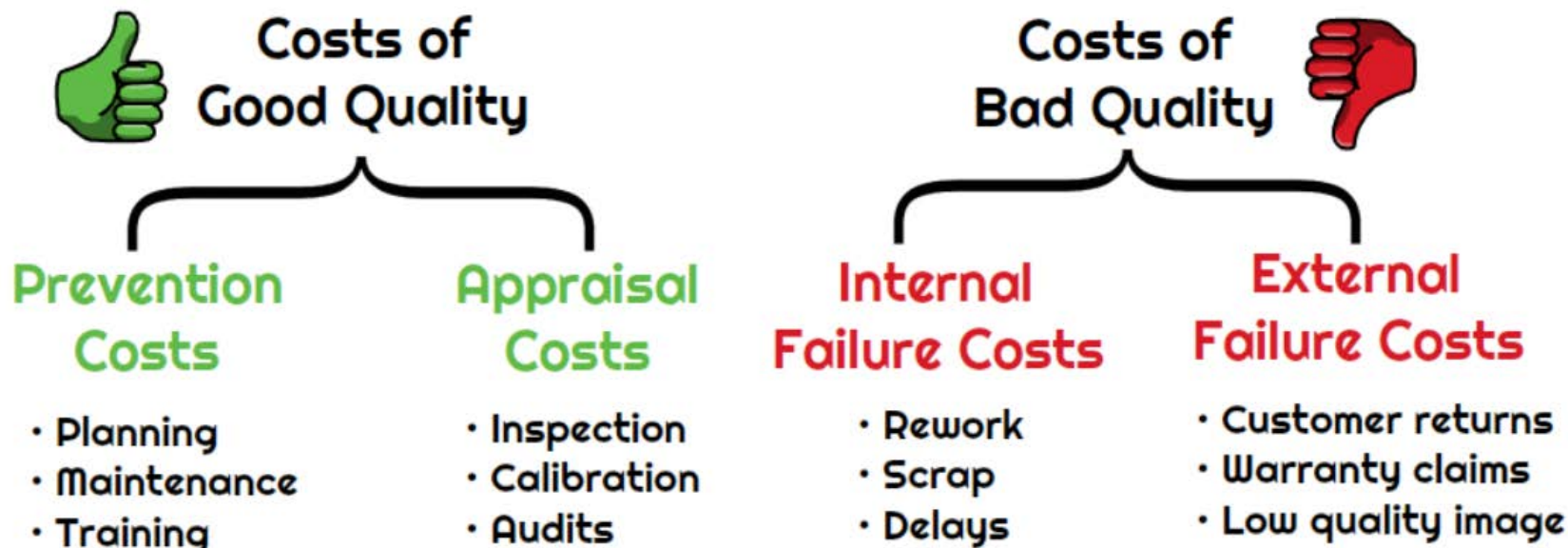


Remember this?

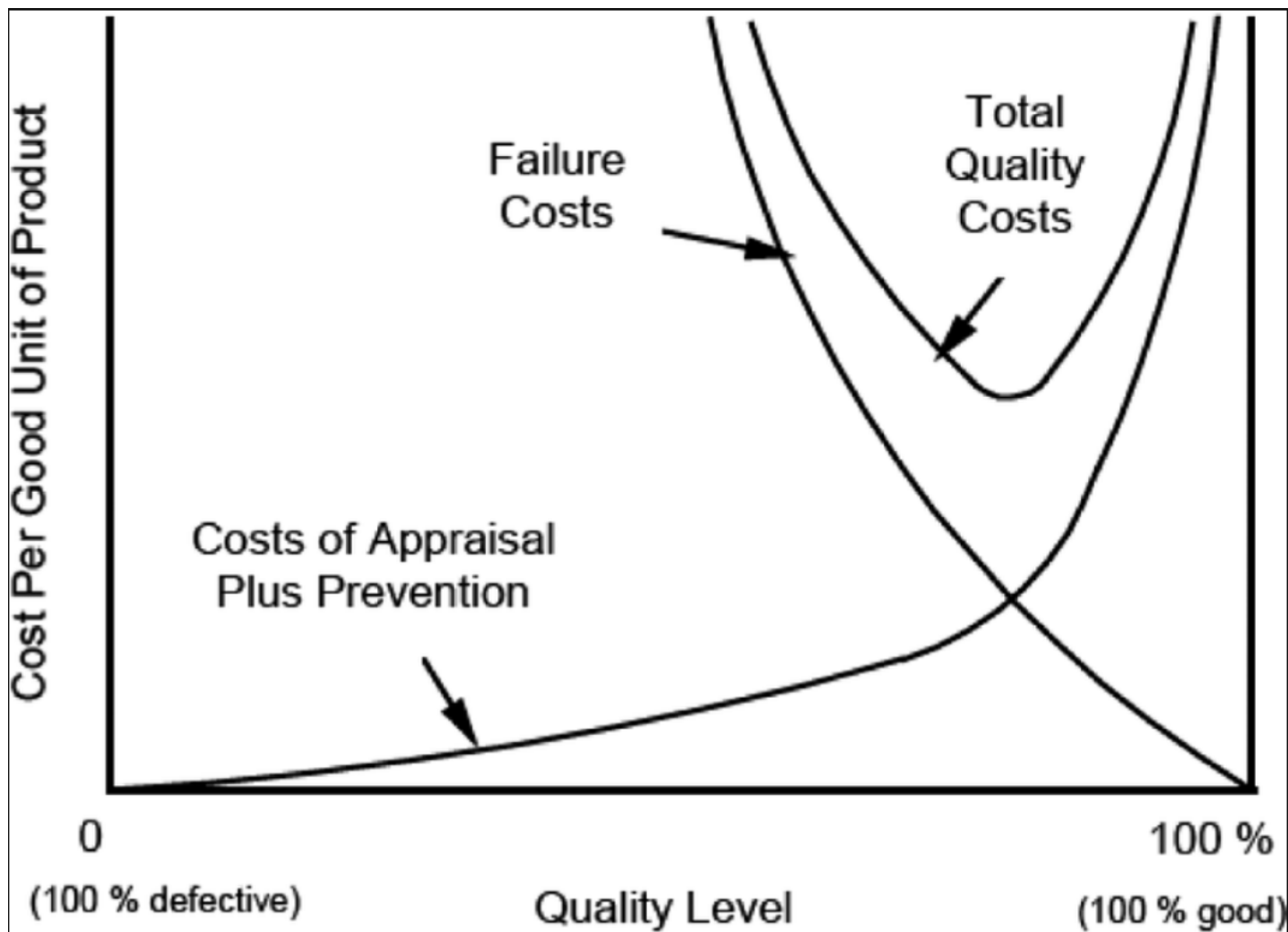
Delivery performance domain – Quality: Cost of quality

The **cost of quality (COQ) methodology** is used to find the **appropriate balance** for investing in **quality prevention** and **appraisal to avoid** defect or product failures. This model identifies **four categories** of costs associated with quality: **prevention**, **appraisal**, **internal failure**, and **external failure**. Prevention and appraisal costs are associated with the **cost of compliance** to quality requirements. Internal and external failure costs are associated with the **cost of noncompliance**.

Cost of Quality Types



Delivery performance domain – Quality: Cost of quality



Delivery performance domain – Quality: Cost of quality

- ▶ **Prevention.** Prevention costs are incurred to keep defects and failures out of a product. Prevention costs avoid quality problems. They are associated with the design, implementation, and maintenance of the quality management system. They are planned and incurred before actual operation. Examples include:
 - ▷ *Product or service requirements*, such as the establishment of specifications for incoming materials, processes, finished products, and services;
 - ▷ *Quality planning*, such as the creation of plans for quality, reliability, operations, production, and inspection;
 - ▷ *Quality assurance*, such as the creation and maintenance of the quality system; and
 - ▷ *Training*, such as the development, preparation, and maintenance of programs.

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Delivery performance domain – Quality: Cost of quality

- **Appraisal.** Appraisal costs are incurred to determine the degree of conformance to quality requirements. Appraisal costs are associated with measuring and monitoring activities related to quality. These costs may be associated with evaluation of purchased materials, processes, products, and services to ensure that they conform to specifications. They could include:
- ▷ **Verification,** such as checking incoming material, process setup, and products against agreed specifications;
 - ▷ **Quality audits,** such as confirmation that the quality system is functioning correctly; and
 - ▷ **Supplier rating,** such as assessment and approval of suppliers of products and services.

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Delivery performance domain – Quality: Cost of quality

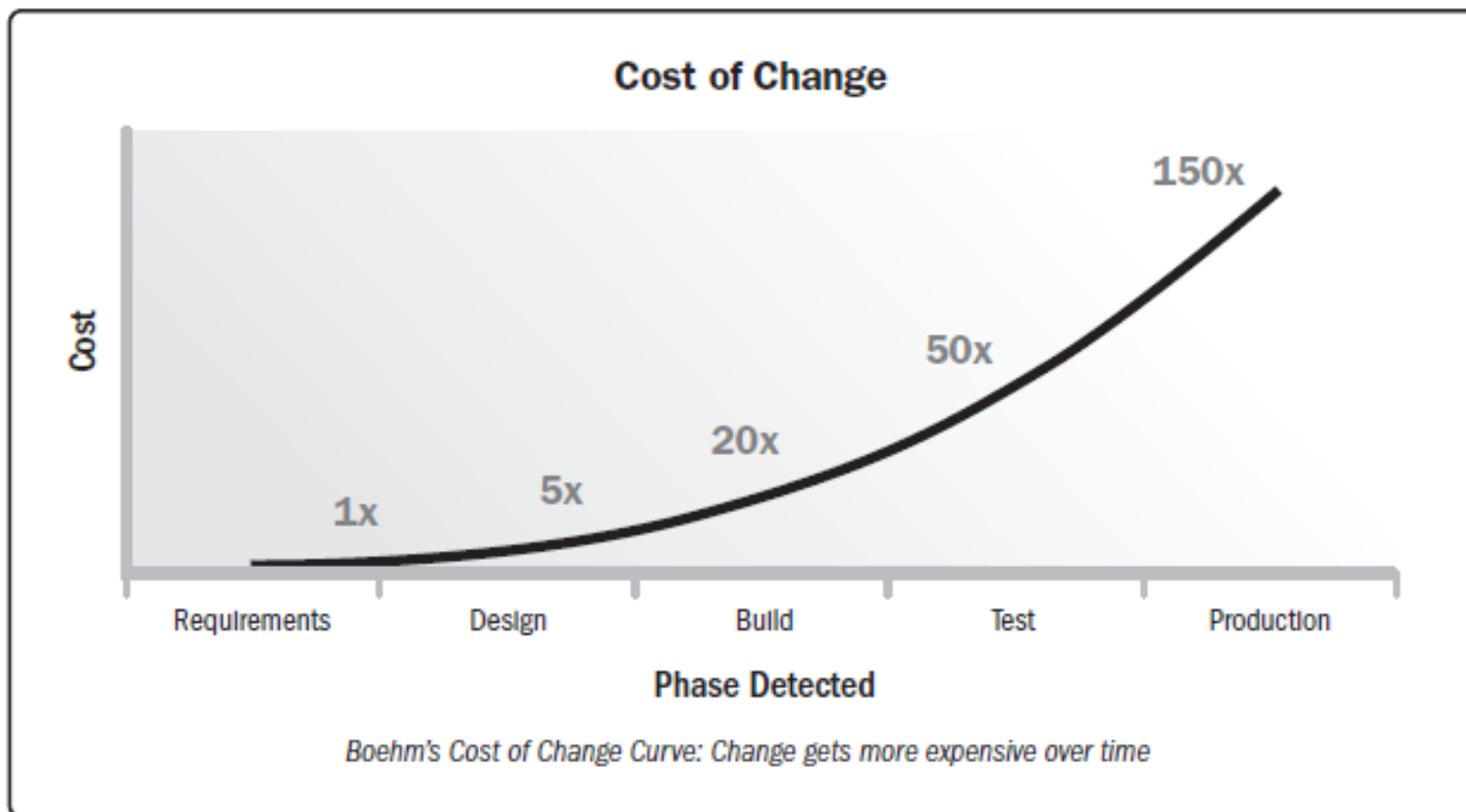
- ▶ **Internal Failure.** Internal failure costs are associated with finding and correcting defects before the customer receives the product. These costs are incurred when the results of work fail to reach design quality standards. Examples include:
 - ▷ **Waste,** such as performance of unnecessary work or holding enough stock to account for errors, poor organization, or communication;
 - ▷ **Scrap,** such as defective product or material that cannot be repaired, used, or sold;
 - ▷ **Rework or rectification,** such as correction of defective material or errors; and
 - ▷ **Failure analysis,** such as activities required to establish the causes of internal product or service failure.

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Delivery performance domain – Quality: Cost of quality

- ▶ **External Failure.** External failure costs are associated with defects found after the customer has the product and with remediation. Note that to consider these failures holistically requires thinking about the project's product while it is in operation after months or years, not just at the handover date. External failure costs occur when products or services that fail to reach design quality standards are not detected until after they have reached the customer. Examples include:
 - ▷ **Repairs and servicing**, for both returned products and those that are deployed;
 - ▷ **Warranty claims**, such as failed products that are replaced or services that are reperformed under a guarantee;
 - ▷ **Complaints**, for all work and costs associated with handling and servicing customers' complaints;
 - ▷ **Returns**, for handling and investigation of rejected or recalled products, including transport costs; and
 - ▷ **Reputation**, where reputation and public perception can be damaged depending on the type and severity of defects.

Delivery performance domain – Quality: Cost of Change



Delivery performance domain – Quality: Cost of Change

<https://dralavipour.com/blog/view/Total-quality-management>

ارزیابی اقتصادی روش مدیریت کیفیت جامع (TQM) در پروژه



۱۲ بهمن ۱۴۰۰

مدیریت کیفیت | مدیریت مالی و هزینه

سید محمدرضا علوی پور



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6. Checking results

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Delivery performance domain – Suboptimal outcomes

- ❑ All projects attempt to deliver **outcomes**,
though **some may fail** to do so or **may produce suboptimal outcomes**.
- ❑ The potential for suboptimal outcomes exists in **every project**.
 - ❖ Companies that produce **new medicines** or **compounds** may experience **several failures** before finding a successful formula.
 - ✓ **Effective project management** can minimize **negative outcomes**,
but such possibilities are part of the **uncertainty of attempting**
to produce a **unique deliverable**.

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Delivery performance domain – Interactions with other performance domains

- ❑ The **Delivery Performance Domain** is the **culmination** of the work done in the **Planning Performance Domain**.
- ❑ The **Project Work Performance Domain** enables the **deliveries** by **establishing** processes, managing physical resources, managing procurements, and so forth.
- ❑ **Project team members** perform the work in **this performance domain** for the **relevant stakeholders**.

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Delivery performance domain – Checking results

Outcome	Check
Projects contribute to business objectives and advancement of strategy	The business plan and the organization's strategic plan, along with the project authorizing documents, demonstrate that the project deliverables and business objectives are aligned.
Projects realize the outcomes they were initiated to deliver	The business case and underlying data indicate the project is still on track to realize the intended outcomes.
Project benefits are realized in the time frame in which they were planned	The benefits realization plan, business case, and/or schedule indicate that the financial metrics and scheduled deliveries are being achieved as planned.
The project team has a clear understanding of requirements	In predictive development, little change in the initial requirements reflects understanding. In projects where requirements are evolving, a clear understanding of requirements may not take place until well into the project.
Stakeholders accept and are satisfied with project deliverables	Interviews, observation, and end user feedback indicate stakeholder satisfaction with deliverables. Levels of complaints and returns can also be used to indicate satisfaction.

(Domain 6: Delivery Performance Domain)

Construction Extension to the PMBOK Guide
(Project Quality Management)

Project quality management in construction

- ❑ The performing organization implements the **quality management system** through the policy, procedures, and processes of quality planning, quality assurance, and quality control,
and undertakes **continuous improvement activities** throughout the project.
- ❑ **Project Quality Management** shares many **common characteristics** with Project **Safety Management and Project Environmental Management**.

Let's talk about:

1. Quality requirements
2. Modern quality management

Project quality management in construction – Quality requirements

- ❑ **Project Quality Management** applies to **all attributes of project management**.
- ❑ In the **construction industry**, this consists of addressing the following distinct (and **sometimes conflicting**) sets of requirements:
 - ❖ Mandatory statutory quality requirements
 - ❖ Customer quality requirements
 - ❖ Specific requirements of the performing organization
 - ❖ Specifications of quality management standards
 - ❖ Industry-specific codes and standards

Having or not having ISO means we perform in **compliance with the requirements?**

Project quality management in construction – Quality requirements

It should be noted that the lack of an ISO quality management program or system does not necessarily mean the system employed by the performing organization is ineffective. Likewise, having an ISO-compliant quality management system or program does not mean the performing organization will produce a quality-compliant product.

The ISO 9000 series has been revised to make it application-area specific, which is the reason for the vast array of standards associated with the ISO 9000 series. For construction projects, material testing is a common and often mandatory requirement. ISO/IEC 17025 on General Requirements for the Competence of Testing and Calibration Laboratories addresses the unique competency and operational requirements for material testing laboratories. However, as stated previously, having an ISO/IEC 17025-compliant testing laboratory management system is not equivalent to a project-compliant system, as customer requirements often exceed the basic requirements detailed in ISO/IEC 17025. The scope of requirements for a project-compliant system is dependent on the requirements of the industry application area, project sponsor/owner requirements, and/or the performing organization's scope of ISO 17025

Project quality management in construction – Modern quality management

- ❑ Modern quality management **complements** project management.
- ❑ For example, both disciplines recognize the importance of the following:
 1. Prevention over inspection
 2. Risk management

Let's see

1. Project quality management planning
2. Project quality management executing
3. Project quality management control



Project quality management planning

1. Contract requirements
2. Project stakeholder requirements
3. Quality policy
4. Quality assurance measurements
5. Quality checklist
6. Project requirements review
7. Quality management plan

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Project quality management planning

1. Contract requirements
2. Project stakeholder requirements
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7. Quality management plan

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Project quality management planning – Project requirements review

- ❑ A project requirements review includes an **assessment** and **determination** of the following:
 1. Characteristics and criteria of each component of the product(s) or project and how to satisfy them
 2. Applicable verification criteria
 3. Alternative review and selection

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Project quality management planning – Project requirements review

- **Characteristics and criteria of each component of the product(s) or project and how to satisfy them.** The contractor's staff or a third-party entity performs a **constructability review** of the **designer's documents** to ensure the intent of the design is **understandable and feasible**. An **early review**, suggestions to the designers, and some minor changes to the design can help to **improve** quality and maintain the project within **schedule and cost limits**.
- **Applicable verification criteria.** This includes criteria required to demonstrate that **acceptance and performance characteristics** are **fulfilled**.
- **Alternative review and selection.** In construction projects, it is **common for some activities** to be performed with **different processes or arrangements** for achieving the same result or output. This applies equally to **quality management**. Examples include:
 - **Rock formations** that can be removed by **blasting or** by using **pneumatic breakers**;
 - **Effluents from chemical pipe cleaning** that are treated at an **onsite waste treatment works or** taken to an **external treatment facility**;
 - **Materials that are tested at an onsite laboratory or sent to an external laboratory** for testing; and
 - **Inspections** that can be carried out by **independent inspection organizations** or undertaken by those **carrying out the work**, provided the competence of the latter has been determined, assessed, and agreed.

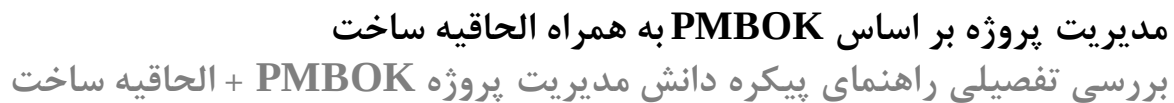
Project quality management planning

1. Contract requirements
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Project quality management planning – Quality management plan

- ❑ The **project quality management plan** defines the monitoring and controlling activities to be employed, especially the following:
 - ❖ **Item of work** to be monitored;
 - ❖ Reference to the **applicable document**, specification, or standard and acceptance criteria;
 - ❖ **Applicable verification activities** that are conducted and **times** when these activities are performed in relation to the overall process;
 - ❖ **Responsible parties** for the work and verification activities;
 - ❖ **Applicable characteristics and measurements** that are taken or recorded; and
 - ❖ **Applicable supporting documentation**, which is generated to demonstrate satisfactory or unsatisfactory performance.



Project quality management planning – Quality management plan

Project quality management planning

1. Contract requirements
2. Project stakeholder requirements
3. Quality policy
4. Quality assurance measurements
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7. Quality management plan

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Project quality management executing

- ☐ The **quality management plan** describes **how quality assurance** is applied and performed on the project.
- ☐ **Performing quality assurance** in construction projects enforces the **prevention** of quality problems.

What performing quality assurance involves?

Project quality management executing

❑ **Performing Quality Assurance** involves the following:

- ❖ **Applying** the planned, systematic quality activities to ensure that the project employs all processes needed to meet quality requirements;
- ❖ **Determining** whether these processes (and their integration) are effective in ensuring the project management system will fulfill the quality requirements of the project and the product of the project; and
- ❖ **Evaluating** the results of quality management on a regular basis to provide confidence that the project will satisfy the relevant quality standards.

Two processes should be performed:

- 1. Quality audits**
- 2. Quality management reviews**

Project quality control

❑ **Quality control** involves the following:

- ❖ **Determining** and **applying** the measures for monitoring the achievement of specific project results throughout the project to identify compliance with the requirements and unsatisfactory performance;
- ❖ **Identifying** **techniques** to eliminate causes of unsatisfactory performance, which includes identifying failures on the part of quality planning and quality assurance; and
- ❖ **Delivering** a quality dossier that compiles all quality control outputs and is an important input to validate the project.

What are the examples of nonconformance reports?

Project quality control

- **Field deficiency reports (FDRs).** FDRs record product or workmanship defects. Repeated field deficiencies could lead to the matter being elevated to the status of a nonconformance report, because this would indicate problems with the process or system being employed.
- **Nonconformance reports (NCRs).** NCRs record system deficiencies or estimate the cost of rework to fix deficiencies, such as those identified during audits. Repetitive nonconformance issues could result in the matter being elevated to that of a contract violation notice, indicating the existence of problems with the management of component parts for the product.
- **Contract violation notices (CVNs).** CVNs record principle contract document violations, which would indicate failure on the part of the performing organization regarding the overall requirements of the contract. The issue may be elevated to other contract actions such as notification of default, cure notice, and termination if the contractor does not correct the conditions.

Remember them in Claim Management Course?

Project quality control

- **Observation reports (ORs).** ORs are compiled by architecture and engineering teams, typically, and are not necessarily deficiency reports, but rather observations of the site, providing both good and bad information.
- **Submittals.** Verifying conformance of construction materials with the contract requirements begins with the contractor sending product submittals to the designers. The submittals identify the specific products that will be used, detail how they will be installed, and indicate if there is any variance from the specified material. The architects and engineers check the submittals for conformance with the contract documents and note discrepancies so the contractor can bring the product into compliance with the contract prior to purchasing the materials. This process helps to avoid rework that would be caused if the contractor ordered nonspecified materials and the designer did not see until they were installed on the job site.

Remember them in Claim Management Course?

Project quality control

Issues related to NCRs or CVNs for work on contracts require formal contract correspondence on the noted nonconformance to requirements. Rework is the action taken to bring defective or nonconforming items into compliance with the regulatory requirements or project specifications. Rework, especially unanticipated rework, increases costs and causes schedule overruns on construction projects.

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A Guide To the Project Management Body of Knowledge

(Domain 7: Measurement Performance Domain)

Measurement performance domain



Measurement performance domain

MEASUREMENT PERFORMANCE DOMAIN

The Measurement Performance Domain addresses activities and functions associated with assessing project performance and taking appropriate actions to maintain acceptable performance.

Effective execution of this performance domain results in the following desired outcomes:

- ▶ A reliable understanding of the status of the project.
- ▶ Actionable data to facilitate decision making.
- ▶ Timely and appropriate actions to keep project performance on track.
- ▶ Achieving targets and generating business value by making informed and timely decisions based on reliable forecasts and evaluations.

Measurement performance domain



The following definitions are relevant to the Measurement Performance Domain:

Metric. A description of a project or product attribute and how to measure it.

Baseline. The approved version of a work product used as a basis for comparison to actual results.

Dashboard. A set of charts and graphs showing progress or performance against important measures of the project.



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Measurement performance domain

- ❑ The **Measurement Performance Domain** evaluates the degree to which the work done in the Delivery Performance Domain is meeting the **metrics** identified in the Planning Performance Domain.
 - ❖ *For example, performance can be measured and evaluated using **baselines** identified in the Planning Performance Domain.*

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Measurement performance domain

- ❑ Measures are used for multiple **reasons**, including:
 - ▶ Evaluating **performance** compared to plan;
 - ▶ Tracking the utilization of **resources**, **work completed**, **budget expended**, etc.;
 - ▶ Demonstrating **accountability**;
 - ▶ Providing information to **stakeholders**;
 - ▶ Assessing whether **project deliverables** are on track to deliver planned benefits;
 - ▶ Focusing **conversations** about trade-offs, threats, opportunities, and options; and
 - ▶ Ensuring the project deliverables will meet customer **acceptance criteria**.

Measurement performance domain

This performance domain focuses on measures for active projects. A portfolio leader may want to include measures that address the success of the project after it is completed, such as whether the project delivered the intended outcomes and benefits. Portfolio leaders may assess if the project outcome increased customer satisfaction, decreased cost per unit, or other measures that are not available until after the project has closed. Similarly, business managers may assess the project from the perspective of the value the outcome brings to the organization. Business measures might include the increase in market share, increase in profit, or decrease in cost per unit. The Measurement Performance Domain addresses measures and metrics that are used during the project.

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Measurement performance domain

□ We will talk about the following in this section:

1. Establishing effective measures
2. What to measure
3. Presenting information
4. Measurement pitfalls
5. Troubleshooting performance
6. Growing and improving
7. Interactions with other performance domains
8. Checking results

Measurement performance domain – Establishing effective measures

- ☐ Stakeholder
- ☐ Timely decisions and effective actions
 1. Key performance indicators
 2. Effective metrics

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Measurement performance domain – Establishing effective measures: Key performance indicators

- ☐ KPIs used to evaluate the success of a project
- ☐ Two types:
 1. Lagging indicators
 2. Leading indicators

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Measurement performance domain – Establishing effective measures: Key performance indicators

- ▶ **Lagging indicators.** Lagging indicators measure project deliverables or events. They provide information after the fact. Lagging indicators reflect past performance or conditions. Lagging indicators are easier to measure than leading indicators. Examples include the number of deliverables completed, the schedule or cost variance, and the amount of resources consumed.

Lagging indicators can also be used to find correlations between outcomes and environmental variables. For example, a lagging indicator that shows a schedule variance may show a correlation with project team member dissatisfaction. This correlation can assist the project team in addressing a root cause that may not have been obvious if the only measure was schedule status.

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Measurement performance domain – Establishing effective measures: Effective metrics

- **Leading indicators.** Leading indicators predict changes or trends in the project. If the change or trend is unfavorable, the project team evaluates the root cause of the leading indicator measurement and takes actions to reverse the trend. Used in this way, leading indicators can reduce performance risk on a project by identifying potential performance variances before they cross the tolerance threshold.

Leading indicators may be quantifiable, such as the size of the project or the number of items that are in progress in the backlog. Other leading indicators are more difficult to quantify, but they provide early warning signs of potential problems. The lack of a risk management process, stakeholders who are not available or engaged, or poorly defined project success criteria are all examples of leading indicators that project performance may be at risk.

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Measurement performance domain – Establishing effective measures: Effective metrics



Lagging indicators
assess the current
state of business

Leading indicators
predict future conditions

**KPIs are simply measures that have no real use
unless and until they are used**

Measurement performance domain – Establishing effective measures: Key performance indicators

- ❑ Measure only what is **relevant** and ensure that metrics are **useful**.
- ❑ **Characteristics** of effective metrics (or SMART criteria) include:
 - ▶ **Specific.** Measurements are specific as to **what to measure**. Examples include the number of defects, the defects that have been fixed, or the average time it takes to fix defects.
 - ▶ **Meaningful.** Measures should be tied to the **business case**, baselines, or requirements. It is **not efficient** to measure product attributes or project performance that do **not lead to** meeting objectives or improving performance.

Measurement performance domain – Establishing effective measures: Key performance indicators

❑ **Characteristics** of effective metrics (or SMART criteria) include:

- ▶ **Achievable.** The target is **achievable** given the people, technology, and environment.
- ▶ **Relevant.** Measures should be **relevant**. The information provided by the measure should provide value and allow for actionable information.
- ▶ **Timely.** Useful measurements are **timely**. Information that is old is not as useful as fresh information. Forward-looking information, such as emerging trends, can help project teams change direction and make better decisions.

Measurement performance domain – Establishing effective measures: Key performance indicators



The SMART acronym described previously can use alternative terms. For example, some people prefer “measurable” instead of *meaningful*, “agreed to” instead of *achievable*, “realistic” or “reasonable” instead of *relevant*, and “time bound” instead of *timely*.



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Measurement performance domain

□ We will talk about the following in this section:

1. Establishing effective measures
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Measurement performance domain – What to measure

❑ Common categories of metrics include:

- ▶ Deliverable metrics,
- ▶ Delivery,
- ▶ Baseline performance,
- ▶ Resources,
- ▶ Business value,
- ▶ Stakeholders, and
- ▶ Forecasts.

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Measurement performance domain – What to measure: Deliverable metrics

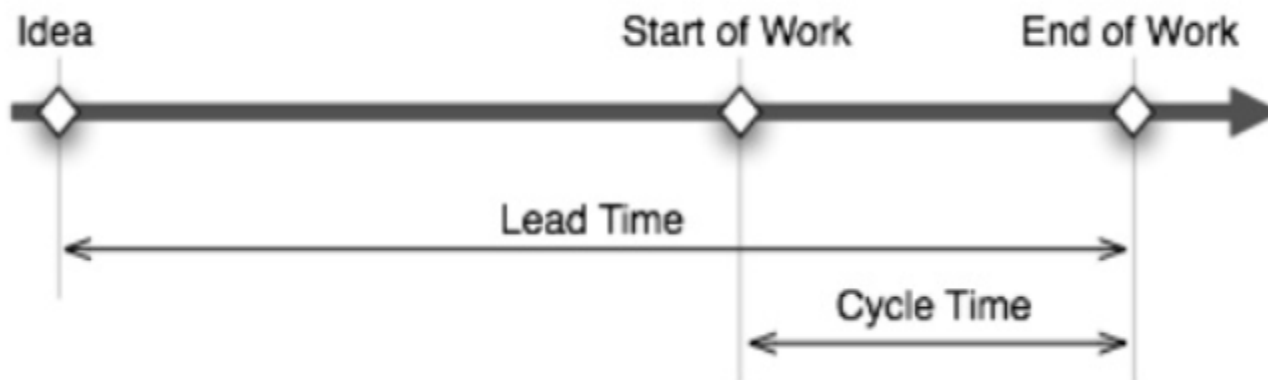
❑ Customary measures include:

- ▶ **Information on errors or defects.** This measure includes the **source** of defects, number of defects identified, and number of defects resolved.
- ▶ **Measures of performance.** Measures of performance **characterize physical or functional attributes** relating to the system operation. Examples include size, weight, capacity, accuracy, reliability, efficiency, and similar performance measures.
- ▶ **Technical performance measures.** **Quantifiable measures** of technical performance are used to ensure system components meet technical requirements. They provide insights into progress in achieving the technical solution.

Measurement performance domain – What to measure: Delivery

- ❑ Delivery measurements are **associated with work in progress**.
- ❑ These measures are **frequently used** in projects using **adaptive approaches**.
 - ▶ **Work in progress.** This measure indicates the **number of work items** that are being worked on at any given time. It is used to help the project team limit the number of items in progress to a manageable size.
 - ▶ **Lead time.** This measure indicates the amount of **elapsed time** from a story or chunk of work entering the backlog to the end of the iteration or the release. Lower lead time indicates a more effective process and a more productive project team.
 - ▶ **Cycle time.** Related to lead time, cycle time indicates the amount of time it takes the **project team to complete a task**. Shorter times indicate a more productive project team. A consistent time helps predict the possible rate of work in the future.

Measurement performance domain – What to measure: Delivery



Measurement performance domain – What to measure: Delivery

❑ These measures are **frequently used** in projects using **adaptive approaches**.

► **Queue size.** This measure tracks the number of items in a **queue**. This metric can be compared to the work in progress limit. Little's Law states that queue size is proportional to both the rate of arrival in the queue and the rate of completion of items from the queue. One can gain insights into completion times by measuring work in progress and developing a forecast for future work completion.

► **Batch size.** Batch size measures the estimated amount of work (level of effort, story points, etc.) that is expected to be completed in an **iteration**.

Measurement performance domain – What to measure: Delivery

❑ These measures are **frequently used** in projects using **adaptive approaches**.

► **Process efficiency.** Process efficiency is a ratio used in **lean systems** to optimize the flow of work. This measure calculates the ratio between value-adding time and non-value-adding activities.

Tasks that are waiting increase the non-value-adding time.

Tasks that are in development or in verification represent value-adding time. Higher ratios indicate a more efficient process.

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Measurement performance domain – What to measure: Baseline performance

- ❑ The **most common baselines** are cost and schedule.
- ❑ Projects that track a **scope or technical baseline** can use information in the deliverable measures.
- ❑ Most schedule measures track **actual performance to planned performance** related to:
 - ▶ **Start and finish dates.** Comparing the actual start dates to the planned start dates and the actual finish dates to the planned finish dates can measure the extent to which work is accomplished as planned. Even if work is not on the longest path through the project (the critical path), late start and finish dates indicate that the project is not performing to plan.

Measurement performance domain – What to measure: Baseline performance

- ❑ Most schedule measures track **actual performance to planned performance** related to:
 - ▶ **Effort and duration.** Actual effort and duration compared to planned effort and duration indicates whether estimates for the amount of work and the time the work takes are valid.
 - ▶ **Schedule variance (SV).** A simple schedule variance is determined by looking at performance on the critical path. When used with earned value management, it is the difference between the earned value and the planned value.
 - ▶ **Schedule performance index (SPI).** Schedule performance index is an earned value management measure that indicates how efficiently the scheduled work is being performed.

Measurement performance domain – What to measure: Baseline performance

- ❑ Most schedule measures track **actual performance to planned performance** related to:
 - ▶ **Feature completion rates.** Examining the rate of feature acceptance during frequent reviews can help assess progress and estimate completion dates and costs.

Common cost measures include:

- ▶ **Actual cost compared to planned cost.** This cost measure compares the actual cost for labor or resources to the estimated cost. This term may be referred to as the burn rate.

Measurement performance domain – What to measure: Baseline performance

- ❑ Most schedule measures track **actual performance to planned performance** related to:
 - ▶ **Cost variance (CV).** A simple cost variance is determined by comparing the actual cost of a deliverable to the estimated cost. When used with earned value management, it is the difference between the earned value and the actual cost.
 - ▶ **Cost performance index (CPI).** An earned value management measure that indicates how efficiently the work is being performed with regard to the budgeted cost of the work.

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Measurement performance domain – What to measure: Baseline performance

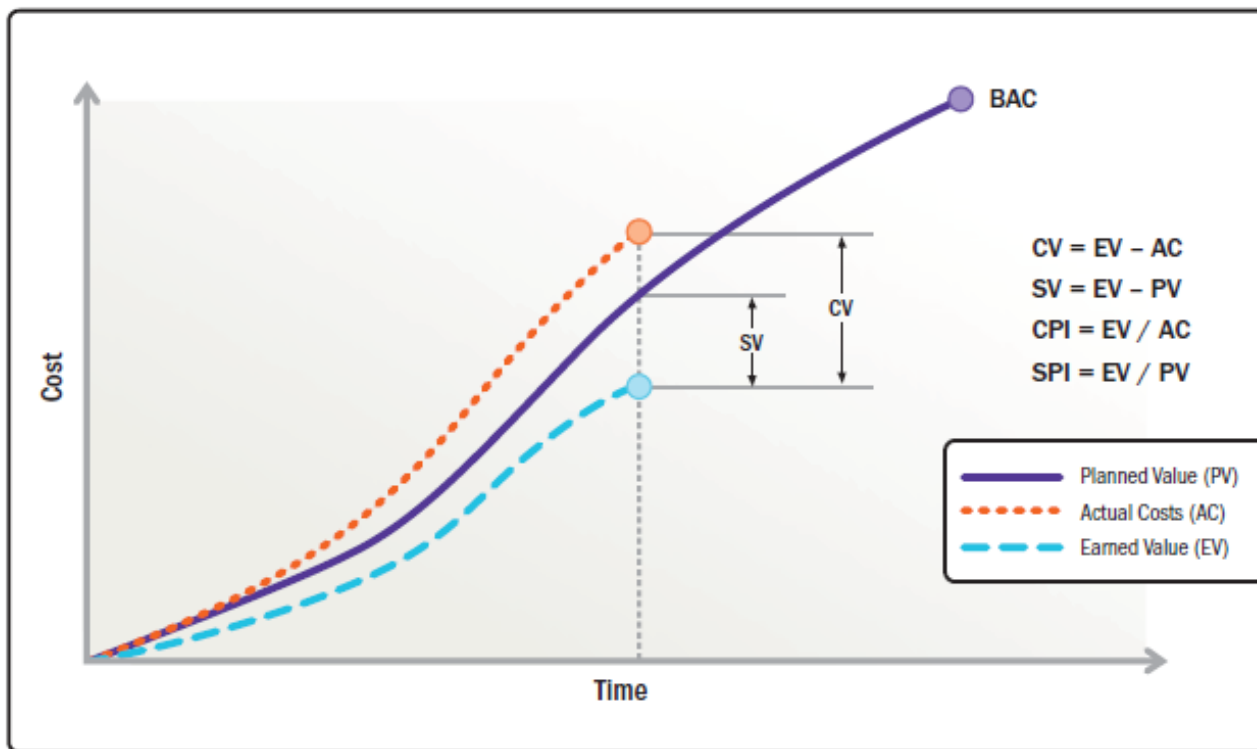


Figure 2-24. Earned Value Analysis Showing Schedule and Cost Variance

Remember Financial Management Course?

Measurement performance domain – What to measure: Resources

- ❑ Resource measurements may be a **subset of cost measurements**

since **resource variances** frequently **lead to cost variances**.

❖ The **two measures** evaluate price variance and usage variance.

- ❑ Measures **include**:

- ▶ **Planned resource utilization compared to actual resource utilization.** This measurement compares the actual usage of resources to the estimated usage. A usage variance is calculated by subtracting the planned usage from the actual usage.

- ▶ **Planned resource cost compared to actual resource cost.** This measurement compares the actual cost of resources to the estimated cost. Price variance is calculated by subtracting the estimated cost from the actual cost.

Measurement performance domain – What to measure: Business value

- ❑ **Business value measurements** are used to ensure the project deliverable stays **aligned** to the business case and the benefits realization plans.
- ❑ Business value has many aspects—both financial and nonfinancial.
- ❑ Metrics that measure **financial business value** include:
 - ▶ **Cost-benefit ratio.** This is a measure of the expected present value of an investment with the initial cost. The cost-benefit ratio is used to determine if the costs of a project outweigh its benefits. If the costs are greater than the benefits, the result will be greater than 1.0. In this case, the project should not be considered unless there are regulatory, social good, or other reasons to do the project. A similar measure is a benefit-cost ratio. The same measures are used, but the benefits are in the numerator and the costs are in the denominator. For this measure, if the ratio is greater than 1.0, the project should be considered.

Is it always true? What if we have three alternatives?

Measurement performance domain – What to measure: Business value

❑ Metrics that measure **financial business value** include:

► **Planned benefits delivery compared to actual benefits delivery.** As part of a business case, organizations may identify value as the benefit that will be delivered as a result of doing the project. For projects that expect to deliver benefits during the project life cycle, measuring the benefits delivered and the value of those benefits,

then **comparing** that information to the business case, provides information that can justify the **continuation** of the project, or in some cases, the **cancellation** of the project.

Measurement performance domain – What to measure: Business value

❑ Metrics that measure **financial business value** include:

► **Return on investment (ROI).** A measure of the amount of financial return compared to the cost, **ROI is generally developed** as an input to the decision to undertake a project. There may be estimates of ROI at different points in time across the project life cycle. By **measuring ROI** throughout the project, the project team can determine if it makes sense to continue the investment of organizational resources.

رویکردی جامع برای ارزیابی اقتصادی در پروژه همراه با آموزش مدل سازی در اکسل (Excel)
ارزیابی اقتصادی: تصمیم گیری بین گزینه های مختلف سرمایه گذاری

Equal life - Rate of return (ROR)

- One rates of return (ROR)**
 - ❖ It means, the cumulative cash flow does **not switch** between – (negative) and + (positive) **more than once**.
✓ Internal rate of interest (IRR)
- Multiple rates of return:**
 - ❖ It means, the cumulative cash flow switches between – (negative) and + (positive) **more than once**.
✓ External rate of return (ERR)

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Kordani, M.Sc., PMP

Measurement performance domain – What to measure: Business value

❑ Metrics that measure **financial business value** include:

► **Net present value (NPV).** The difference between the present value of inflows of capital and the present value of outflows of capital over a period of time, NPV is generally developed when deciding to undertake a project. By measuring the NPV throughout the project, the project team can determine if it makes sense to continue the investment of organizational resources.

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Equal life - PW or NPV

1. Determine present value (at beginning of the study period) for **each alternative's cash flows**
2. Select alternative with **largest NPV**
 - ❖ If:
 1. $PW_{income}(MARR) - PW_{expenditure}(MARR) > 0$ or $NPV > 0$:
 - ❖ Alternative has return $>$ MARR
 - ❖ Good
 2. $PW_{income}(MARR) - PW_{expenditure}(MARR) = 0$ or $NPV = 0$:
 - ❖ Alternative has return $=$ MARR
 - ❖ Do nothing
 3. $PW_{income}(MARR) - PW_{expenditure}(MARR) < 0$ or $NPV < 0$:
 - ❖ Alternative has return $<$ MARR
 - ❖ Not desirable

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Measurement performance domain – What to measure: Stakeholders

❑ Related metrics:

► **Net Promoter Score® (NPS®).** A Net Promoter Score measures the degree to which a stakeholder (usually the customer) is willing to recommend a product or service to others. It measures a range from -100 to +100. A high Net Promoter Score not only measures satisfaction with a brand, product, or service, it is also an indicator of customer loyalty.

► **Mood chart.** A mood chart can track the mood or reactions of a group of very important stakeholders—the project team. At the end of each day, project team members can use colors, numbers, or emojis to indicate their frame of mind. Figure 2-25 shows a mood chart using emojis. Tracking the project team's mood or individual project team member's moods can help to identify potential issues and areas for improvement.

موسسه مهندسی و مدیریت ساخت علوی پور (ACEMI)

دفتر آموزش



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