مدیریت پروژه بر اساس PMBOK به همراه الحاقیه ساخت

(ویرایش هفتم)

بخش چهارم:

بررسی تفصیلی راهنمای پیکره دانش مدیریت پروژه PMBOK + الحاقیه ساخت

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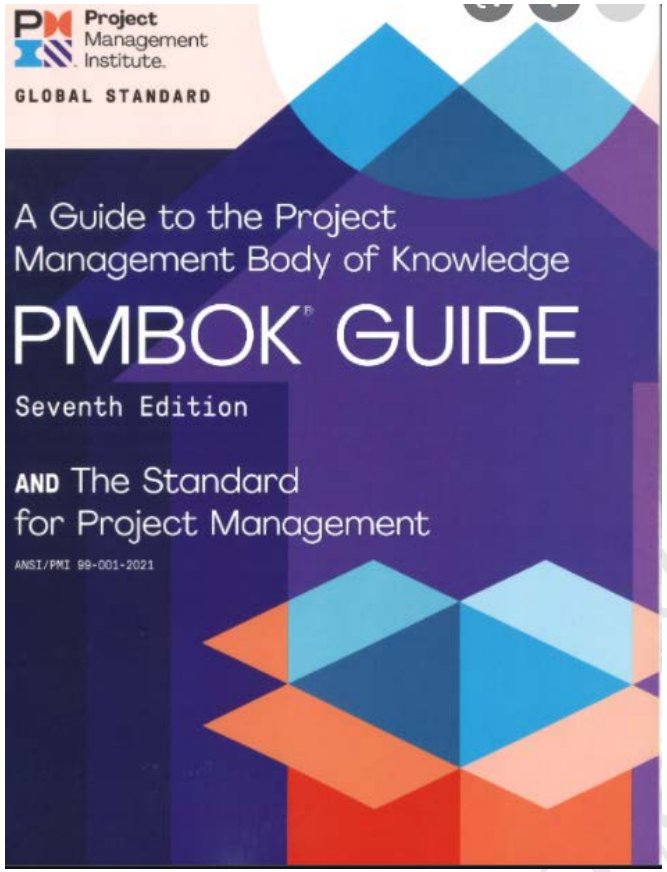
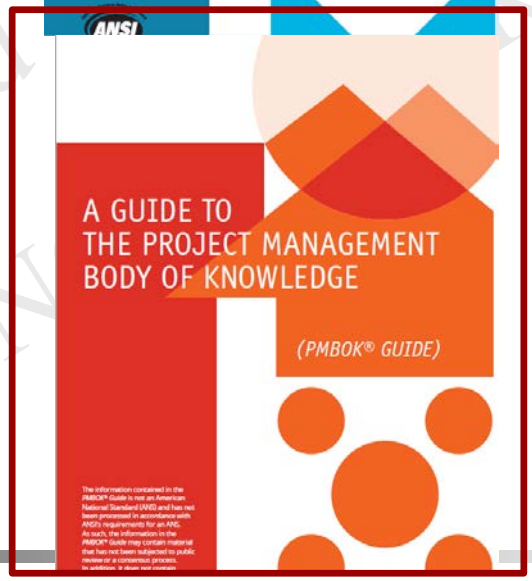
What we will learn?

- 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)

Introduction

A guide to the project management body of knowledge in PMBOK 7th Edition





What is the difference with 6th Edition?

Development approach and life cycle performance domain

- We will talk about the following in this section:

1. **Development, cadence, and life cycle relationship**
2. **Delivery cadence**
3. **Development approaches**
4. **Considerations for selecting a development approach**
5. **Life cycle and phase definitions**
6. **Aligning of delivery cadence, development approach, and life cycle**
7. **Interactions with other performance domains**
8. **Measuring outcomes**

Development approach and life cycle performance domain – Aligning of delivery cadence, development approach, and life cycle

- In this example, there are four products and services: the building, the community action patrol (CAP) training, the senior services, and the website. Table 2-4 describes the delivery cadence and the development approach.

Table 2-4. Delivery Cadence and Development Approach

Deliverable	Delivery Cadence	Development Approach
Building	Single delivery	Predictive
Senior services	Multiple deliveries	Iterative
Website	Periodic deliveries	Adaptive
Community action patrol training	Multiple deliveries	Incremental

Development approach and life cycle performance domain – Aligning of delivery cadence, development approach, and life cycle

- Based on this information, a potential life cycle might be:

- **Start Up.** Entry criteria for this phase are that the business case has been approved and the project charter has been authorized. In this phase, the high-level roadmap is developed, initial funding requirements are established, project team and resource requirements are defined, a milestone schedule is created, and planning for a procurement strategy is defined. These deliverables should be complete prior to exiting the start-up phase. Exit criteria will be reviewed at an origination phase gate review.
- **Plan.** In this phase, the high-level information for the building is decomposed into detailed plans. A detailed design document for the CAP training is completed. An analysis of the senior services offering is completed along with a gap analysis. The initial wireframe for the website is created. These deliverables should be complete prior to exiting the planning phase. Exit criteria will be reviewed at a planning phase gate review.

Development approach and life cycle performance domain – Aligning of delivery cadence, development approach, and life cycle

- Based on this information, a potential life cycle might be:

  - **Development.** This phase will overlap with the test and deploy phases since the deliverables have different delivery cadences and different approaches. The website will have early deliveries to inform the public of the progress for the community center. Some senior services and the CAP training may begin prior to the opening of the community center. Each deliverable may have a separate review prior to entering the testing phase.
  - **Test.** This phase will overlap with the development and deploy phases. The type of test will depend on the deliverable. This phase includes inspections for the building, a beta delivery of the CAP courses, small-scale trials for the senior services, and operating in a test environment for each release for the website. Each deliverable will go through the applicable testing prior to moving to the deploy phase.

Development approach and life cycle performance domain – Aligning of delivery cadence, development approach, and life cycle

- Based on this information, a potential life cycle might be:

- **Deploy.** This phase will overlap with the development and test phases. The first deployment of the website may be somewhat early in the project. Activities in this phase will iterate as more deliverables become available. The final deployment for the project will be the opening of the community center. Ongoing updates to the website and the senior services will be part of operations once the community center is open.
- **Close.** This phase takes place periodically as deliverables are completed. When the initial website has been deployed, project personnel (including contractors) will be released and retrospectives or lessons learned for each deliverable will be completed. When the entire project is done, information from the various phase gate reviews and an overall evaluation of project performance compared to baselines will be conducted. Prior to final closeout, the project charter and the business case will be reviewed to determine if the deliverables achieved the intended benefits and value.

Development approach and life cycle performance domain – Aligning of delivery cadence, development approach, and life cycle

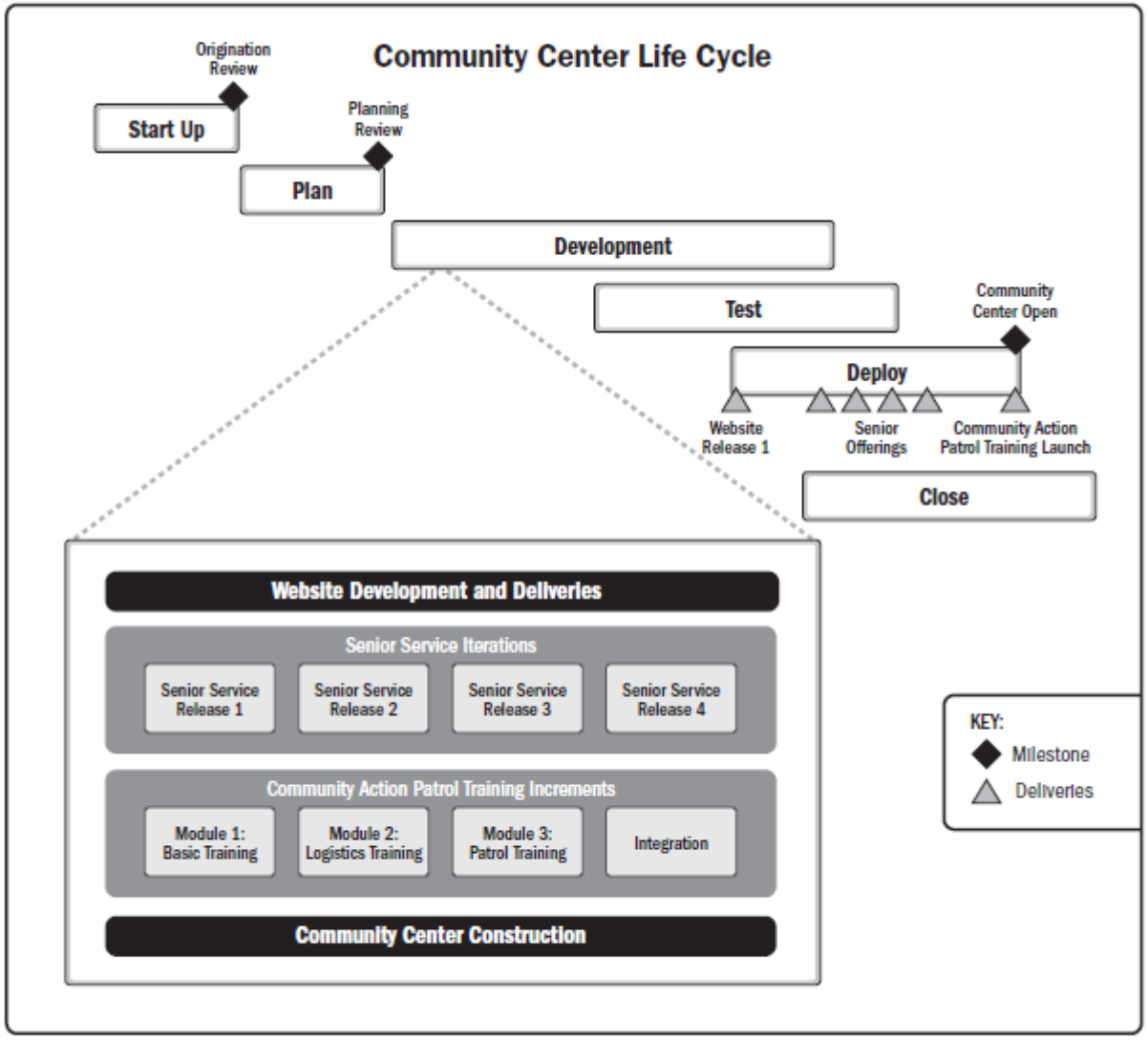


Figure 2-12. Community Center Life Cycle

Development approach and life cycle performance domain – Aligning of delivery cadence, development approach, and life cycle

What's in a Name? Not all project practitioners differentiate between the development approach and the life cycle. Some practitioners will say a project follows an agile life cycle when they are actually talking about the development approach. Some practitioners refer to predictive approaches as *waterfall*. Adaptive development approaches may also be known as evolutionary approaches.

Because project management is evolving, the language used continues to evolve. The best way to understand what a person is referring to is to determine how they are developing deliverables and ask them the names of the phases in the life cycle. This can help frame the project and understand how people are using terms.

Development approach and life cycle performance domain

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8. **Measuring outcomes**

Development approach and life cycle performance domain – Interactions with other performance domains

- The **Development Approach** and **Life Cycle Performance Domain interacts** with the Stakeholder, Planning, Uncertainty, Delivery, Project Work, and Team Performance Domains.
- The **life cycle** selected impacts the way in which planning is undertaken.
- **Predictive life cycles** undertake the bulk of the planning up front and then continue to **replan** by using rolling wave planning and progressive elaboration.

  Plans are also updated as **threats** and **opportunities** materialize.

Development approach and life cycle performance domain

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8. **Measuring outcomes**

Development approach and life cycle performance domain – Measuring outcomes

Table 2-5. Checking Outcomes—Development Approach and Life Cycle Performance Domain

Outcome	Check
Development approaches that are consistent with project deliverables	The development approach for deliverables (predictive, hybrid, or adaptive) reflects the product variables and is appropriate given the project and organizational variables.
A project life cycle consisting of phases that connect the delivery of business and stakeholder value from the beginning to the end of the project	Project work from launch to close is represented in the project phases. Phases include appropriate exit criteria.
Project life cycle phases that facilitate the delivery cadence and development approach required to produce the project deliverables	The cadence for development, testing, and deploying is represented in the life cycle phases. Projects with multiple deliverables that have different delivery cadences and development methods are represented by overlapping phases or phase repetitions, as necessary.

How this life cycle related to construction industry?

Let's see PMBOK EXTENSION

(Domain 3: Development Approach and Life Cycle Performance Domain)

Construction Extension to the PMBOK Guide

(The Construction Project Environment)

Introduction

- This section describes
  1. Most common **construction project life cycle** strategic approaches
  2. **Delivery methods** and how they affect other aspects of the project

Construction projects

- While **construction projects fit** the **generic life cycle structure** described in the **PMBOK® Guide** from initiating to closing,

  the **details of the construction project life cycle** from conceptualization to closing may vary widely depending on factors such as

  - ✓ Type of facility being built,
  - ✓ Project delivery method, and
  - ✓ Type of contract between owner (buyer) and contractor (seller)

Who makes this decision?

Construction projects

- These decisions are usually made by the executive management of the owner's organization, based on the balance among the strategy, value, and risk of the project.

This decision is usually made by CM!

What categories construction projects include?

Construction projects

- Construction projects can be **classified using different approaches**, for example, by
  1. Type of facility (buildings, infrastructure, industrial projects) or
  2. Type of specialty (oil and gas, real estate)

What delivery methods exist for construction projects?

ACEMI

Project delivery methods

Some of the most common project delivery methods include:

- **Design-bid-build.** The owner purchases the design of a facility, and uses this product to purchase the construction of the designed facility. The design contractor may be different from the construction contractor.
- **Design-build.** The owner purchases the design and building of the facility with a single contractor or contracted team based on concept design and or performance specification provided by the owner.
- **EPC (engineering, procurement, and construction).** EPC is a prominent delivery method in the construction industry. The engineering and construction contractor carries out the detailed engineering design of the project, procures all required equipment and materials, and delivers a functioning facility or asset to the client(s). Companies that deliver EPC projects are commonly referred to as EPC contractors.
- **Self-performance.** The owner does not hire a contractor, but instead performs the project directly. This delivery method is commonly applied in small maintenance projects.
- **IPD (integrated project delivery).** IPD can be considered a multiparty contract in which owner, architect, contractor, and eventually other key stakeholders sign a single agreement. In this agreement, risks and compensations are not assigned to an individual stakeholder, but rather to the team as a whole on the basis of the overall project performance.
- **PPP (public-private partnership).** Governments have been developing a set of project delivery methods generally known as PPPs. Within the realm of PPPs, the typical project delivery methods include concessions, BOT (build, operate, and transfer), and DBOM (design, build, operate, and maintain).

How it differs with CMAA?

Construction project delivery systems

Based on CMAA

- **Many approaches** exist to deliver a successful project, but it is possible to **reduce the number of methods** to several basic delivery forms by defining who has responsibility for construction performance, i.e., the actual delivery of the project.

  - ✓ These include:
    - **Traditional Approach or Design-Bid-Build (D-B-B)**
    - **Multiple-Prime Contracting (Multi-Prime)**
    - **Construction Management at-risk (CMAR) – also referred to as CM/independent contractor, CM/GC, or CM guaranteed maximum price (GMP)**
    - **Design-Build (D-B) – traditional or progressive**
    - **Other Methods:** Engineering, Procurement, Construction (EPC); Engineering, Procurement, Construction Management (EPCM); Integrated Project Delivery (IPD); Job Order Contracting (JOC)

Why do we need different variations?

Construction project delivery systems

- **Common reasons** for basic delivery method **variations** include:
  - » **Different forms** of professional and **construction contracts**
  - » The degree of care, responsibility, and risk assumed by the **parties involved**
  - » **Pricing** alternatives and methods of compensation
  - » Fast tracking
  - » Scope bidding

How about organizational structures?

Organizational structures

- The **PMBOK® Guide** establishes the **most common types of organizational** structures, ranging from **functional to projectized** organizations.
  - In the context of **construction projects**,

    most owners (including owner support organizations such as project management consultants or insurers, for example)

    work in **matrixed or composite** arrangements,

    with **designated project management roles** and teams for construction projects.

How about the PMOs?

ACEMI

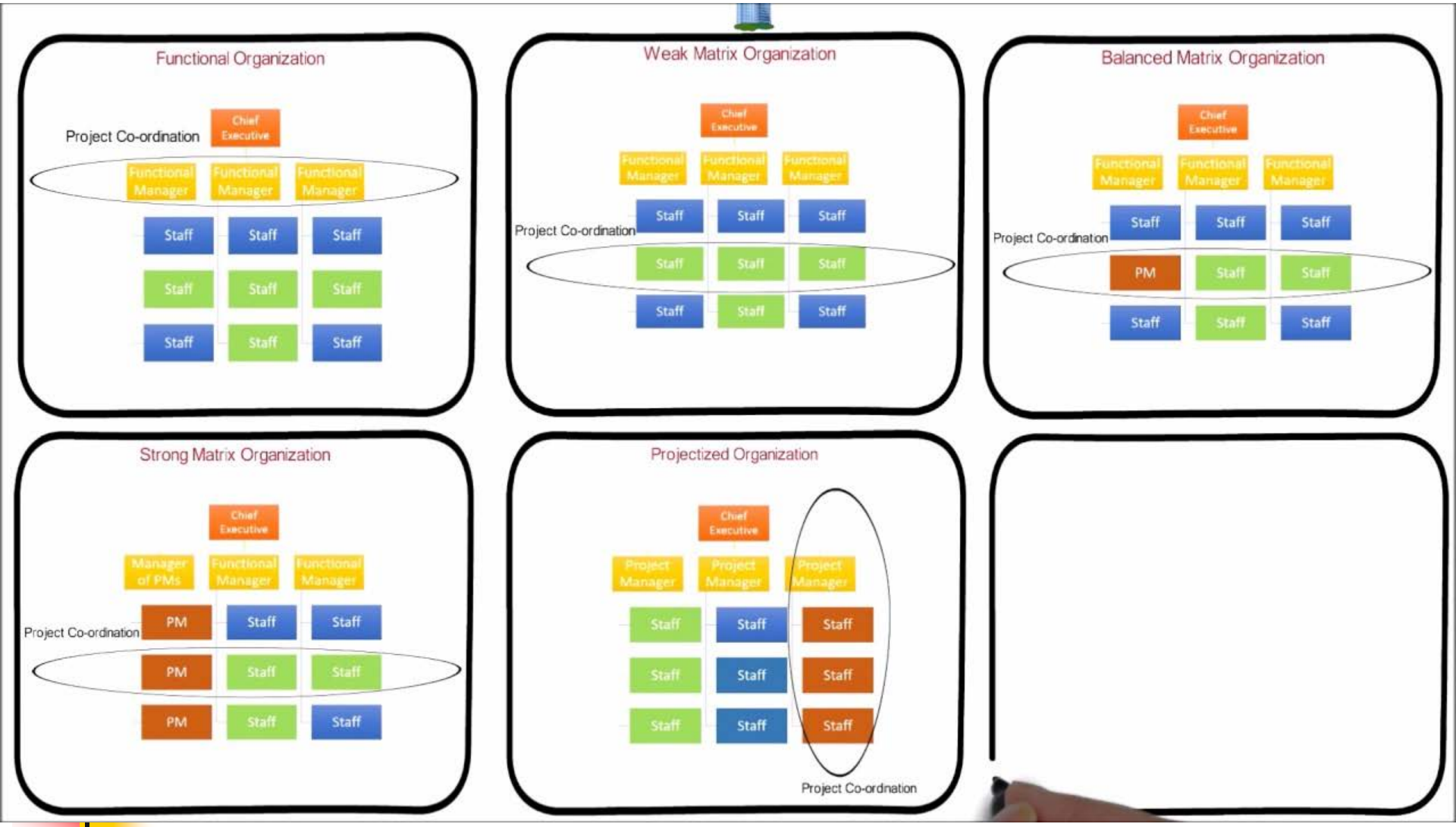
Organizational structures

- **Both** owner and contractor organizations may include **project management offices (PMOs).**
- While the **former tend** to have **controlling** or **directive PMOs**,

  the latter have strong **matrixed** or **fully projectized** organizational structures and

  may use **multiple PMOs** of the **supportive type** as a natural complement to their organizational structures.

Organizational structures



Organizational structures

Organization Structure / Project Characteristics	Functional	Matrix			Projectized
		Weak Matrix	Balanced Matrix	Strong Matrix	
Project Manager's Authority	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Resource Availability	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Who controls the project budget	Functional Manager	Functional Manager	Mixed	Project Manager	Project Manager
Project Manager's Role	Part-time	Part-time	Full-time	Full-time	Full-time
Project Management Administrative Staff	Part-time	Part-time	Part-time	Full-time	Full-time

Organizational structures

Organizational structures

- **Some contractors' PMOs** may
  1. Have a **pool of project managers**
  2. Require **compliance** with some **information** and **process** standards

- **While others** have **directive PMOs** acting as **knowledge repositories** for the **entire project portfolio** of the construction company.

Organizational structures

- **Some PMOs** for **capital projects** may be more **directive**, as the owner's business is usually **not directly related** to the performance of construction projects,

  thus making it **more effective** to concentrate knowledge and expertise for construction project management in **a specific group** (the directive PMO).

- Other organizations (**particularly government and public entities**) usually operate as **functional organizations** and tend to have a **supportive PMO.**

Let's see the correlation between

1. **Type of organizational structure**
2. **Type of PMO**

Organizational structures

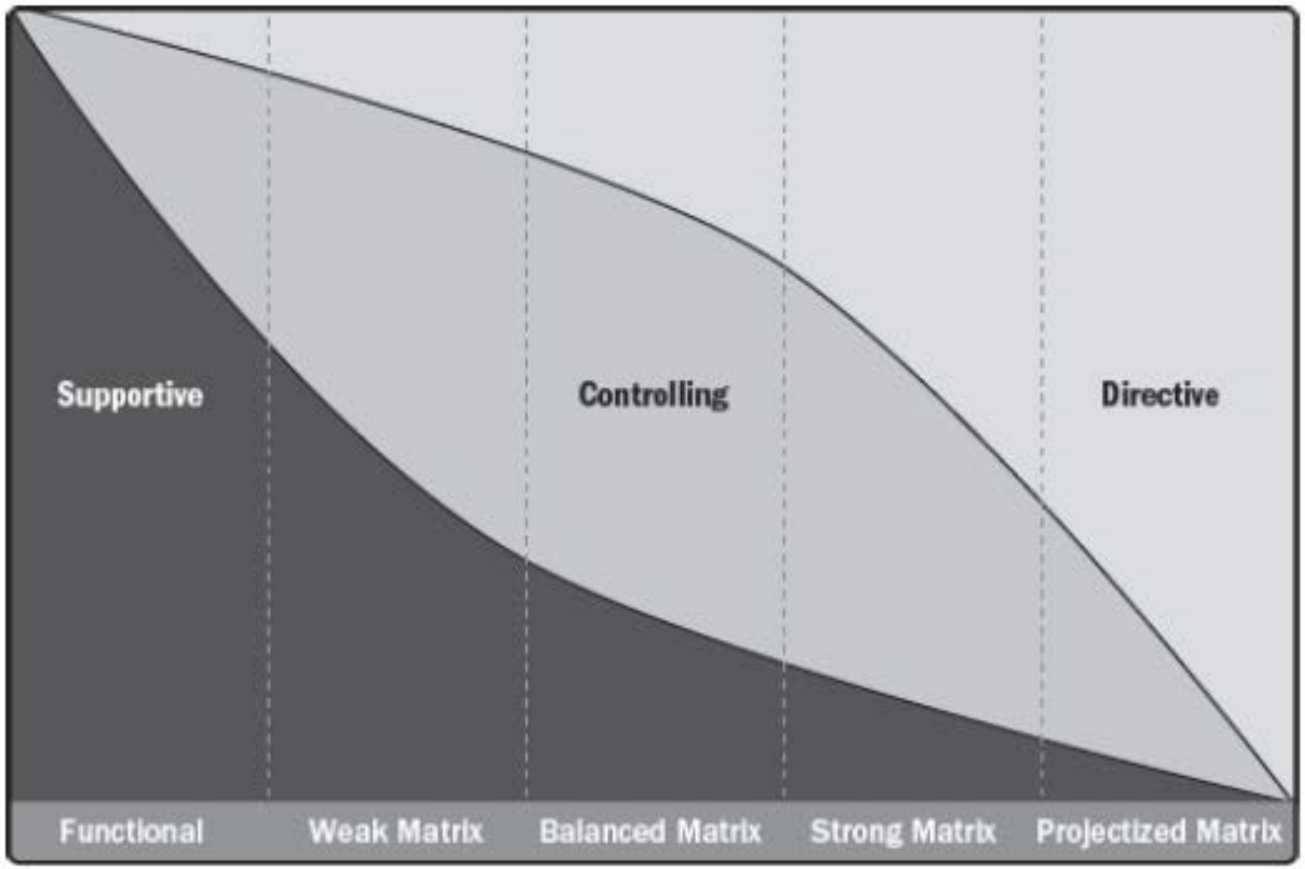


Figure 2-1. Correlation Between Organizational Structure and Type of PMO

Enterprise environmental factors

- As in other projects, **EEFs influence** construction project outcomes, for example,
  1. Economic aspects
  2. Financial aspects
  3. Site location

Let's see the project life cycle

Project life cycle

- **Most construction projects** have a life cycle consisting of conception, design, construction, commissioning, and closeout, although the industry practice is to **break down some** of those phases.

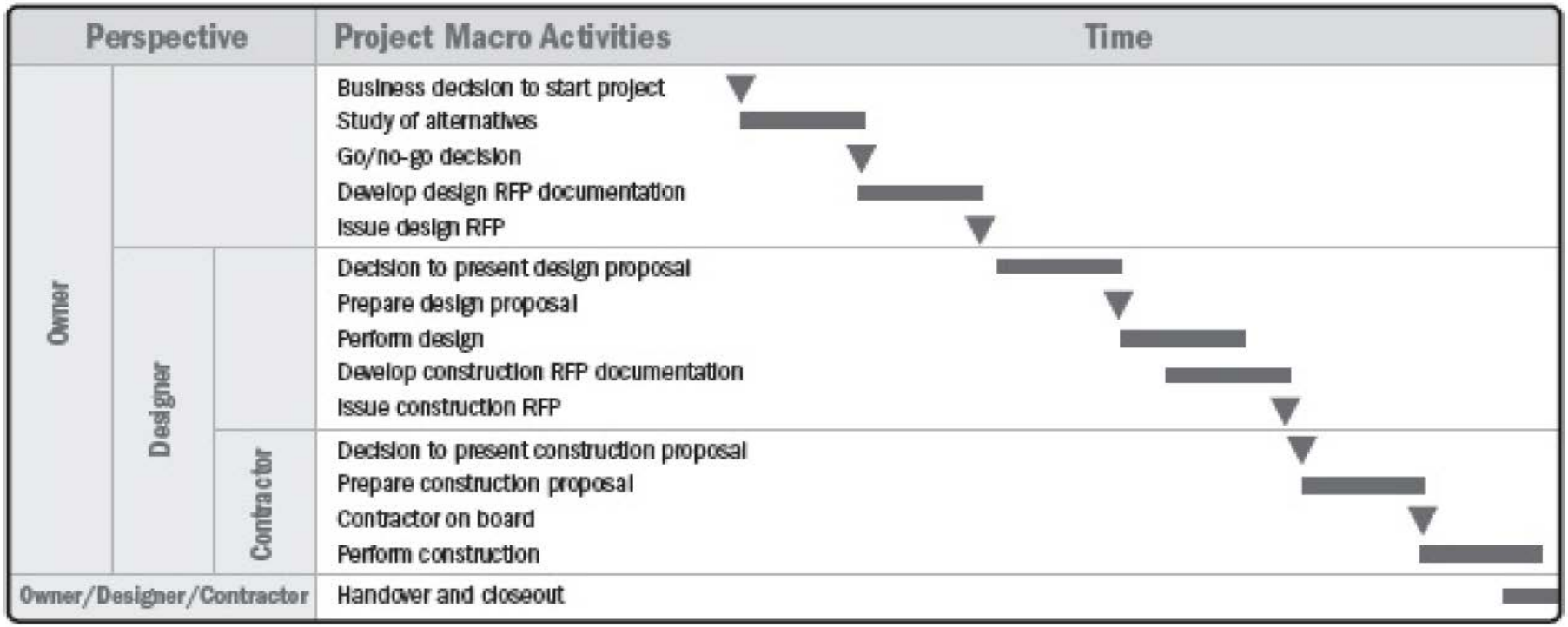


Figure 2-2. Example of Various Perspectives for Project with Predictive Life Cycle

Project life cycle

- **From the owner's point of view**,

  the project life cycle starts when the owner formally decides to **undertake the project;**

- **From the contractor's perspective**,

  the life cycle starts when they **decide to bid**, and moving from the bid phase to the design, procurement, and/or construction phase occurs **if the contract is awarded.**

Project life cycle – Construction extension

- Two types mentioned in **PMBOK Extension**
  1. Front-End Loading (FEL)
  2. Adaptive Life Cycles

Project life cycle – Front end loading (FEL)

- In some industries with **major capital projects**,

  processes that have **predictive** life cycles are **used in order to**

  1. Reduce risk
  2. Maximize the probability of success
     - These time-bound processes are known as
       1. Front-end loading (FEL) or
       2. Pre-project planning

          which refers to performing solid planning and design in early stages (the front end of the project).

Project life cycle – Front end loading (FEL)

- The **FEL process** includes **decision gates (PDRI in CII)** (usually three) at well-defined milestones, where a **go/no-go decision is made**.
- The application of FEL enables team members to **think about all project subsystems and components**;

  to be aware of various scenarios involving complexity, ambiguity, and risk; and to anticipate the process implementation framework.

Table 2-1. FEL Stage Gate Deliverables

FEL 1	FEL 2	FEL 3
• Performance objectives • Assessment of technology alternatives • Feasibility studies • Milestone schedule • Estimated capital expense (±50%), operating expense (±100%)	• Conceptual and basic engineering • Technical assessments • Conceptual schedule • Budget estimates (±30%) • Identification of long-lead items	• Front-end engineering design (FEED) (P&, data sheets, etc.) • Preliminary procurement plan • Scope of work • Resource-loaded schedule • Definite estimate (±10%)

Project life cycle – Front end loading (FEL)

This is a FRONT END PLANNING (FEP) that Construction Industry Institute (CII) provided a Best Practice for.

I am going to teach in Consulting Course!

Project life cycle – Adaptive life cycles

- **Adaptive life cycles** (also known as change-driven or agile methods) are intended to facilitate change and require a high degree of on**going stakeholder involvement.**
- **Adaptive methods** are generally preferred when dealing with a **rapidly changing environment**, **when**
  1. Requirements and scope are **difficult to define in advance**
  2. It is **possible** to define small incremental improvements that will **deliver value to stakeholders**

Let's see an example.

Project life cycle – Adaptive life cycles

- **Architectural and engineering design** is iterative by nature.
  - For example, an **equipment data sheet** is first issued in an as-designed or basis-of-design version,

    then in an as-purchased version;

    differences between the two versions may **impact**

    downstream activities such as early procurement, supply chain planning, and foundation design.

Do you know Lean Project Delivery System (LPDS)?

Project life cycle – Adaptive life cycles

- **Construction**, on the other hand, is an activity of a deterministic nature.
  - **Changes** in construction projects are **directly affected** by the degree of overlap between **project phases**.
    - ✓ Depending on the project's objectives and aspects,

      the **traditional predictive life cycle model** may be replaced by a **more concurrent one**

      where **phases may overlap**, giving way to iterative, incremental, and adaptive life cycles.

      Under iterative and incremental life cycles, detailed design and planning may be done **iteratively** through a series of **repeated cycles** as the project progresses.

Project life cycle

- Known in many context in construction industries

The Life Cycle of the Construction Project © Ray Lemming

TIMELINE	Start----->----->	----->	----->	----->	----->	----->	Finish
Phase	Decision to Build	Schematic Design	Preliminary Design	Final Design	Bid	Construction	Post Construction
Estimating	Wish Price	Parametric Est. (Square Foot Estimate)	Initial Line Item Est.	Final Line Item Est (Engineer's Estimate)	Contractor's Bid Est.	Change Order Est.	Forensic Est.
Contingency	50-100%	30-40%	20-30%	10%	0%	0% (Owner budgets contingency for Change Orders)	0%

A Guide To the Project Management Body of Knowledge

(Domain 4: Planning Performance Domain)

Project performance domains

Planning performance domain

PLANNING PERFORMANCE DOMAIN

The Planning Performance Domain addresses activities and functions associated with the initial, ongoing, and evolving organization and coordination necessary for delivering project deliverables and outcomes.

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

- The project progresses in an organized, coordinated, and deliberate manner.
- There is a holistic approach to delivering the project outcomes.
- Evolving information is elaborated to produce the deliverables and outcomes for which the project was undertaken.
- Time spent planning is appropriate for the situation.
- Planning information is sufficient to manage stakeholder expectations.
- There is a process for the adaptation of plans throughout the project based on emerging and changing needs or conditions.

Figure 2-13. Planning Performance Domain

Planning performance domain

The following definitions are relevant to the Planning Performance Domain:

Estimate. A quantitative assessment of the likely amount or outcome of a variable, such as project costs, resources, effort, or durations.

Accuracy. Within the quality management system, accuracy is an assessment of correctness.

Precision. Within the quality management system, precision is an assessment of exactness.

Crashing. A method used to shorten the schedule duration for the least incremental cost by adding resources.

Fast Tracking. A schedule compression method in which activities or phases normally done in sequence are performed in parallel for at least a portion of their duration.

Budget. The approved estimate for the project or any work breakdown structure (WBS) component or any schedule activity.

Planning performance domain

- We will talk about the following in this section:
  1. **Planning overview**
  2. **Planning variables**
  3. **Project team composition and structure**
  4. **Communication**
  5. **Physical resources**
  6. **Procurement**
  7. **Changes**
  8. **Metrics**
  9. **Alignment**
  10. **Interactions with other performance domains**
  11. **Checking results**

Planning performance domain

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10. **Interactions with other performance domains**
11. **Checking results**

Planning performance domain – Planning overview

- The purpose of planning is to **proactively develop** an approach to create the **project deliverables.**
- **High-level planning** may begin **prior** to **project authorization**.
- The project team **progressively elaborates** initial project documents, such as
  1. Vision statement,
  2. Project charter,
  3. Business case, or
  4. Similar documents

  to identify or define a **coordinated path** to achieve the desired outcomes.

Planning performance domain – Planning overview

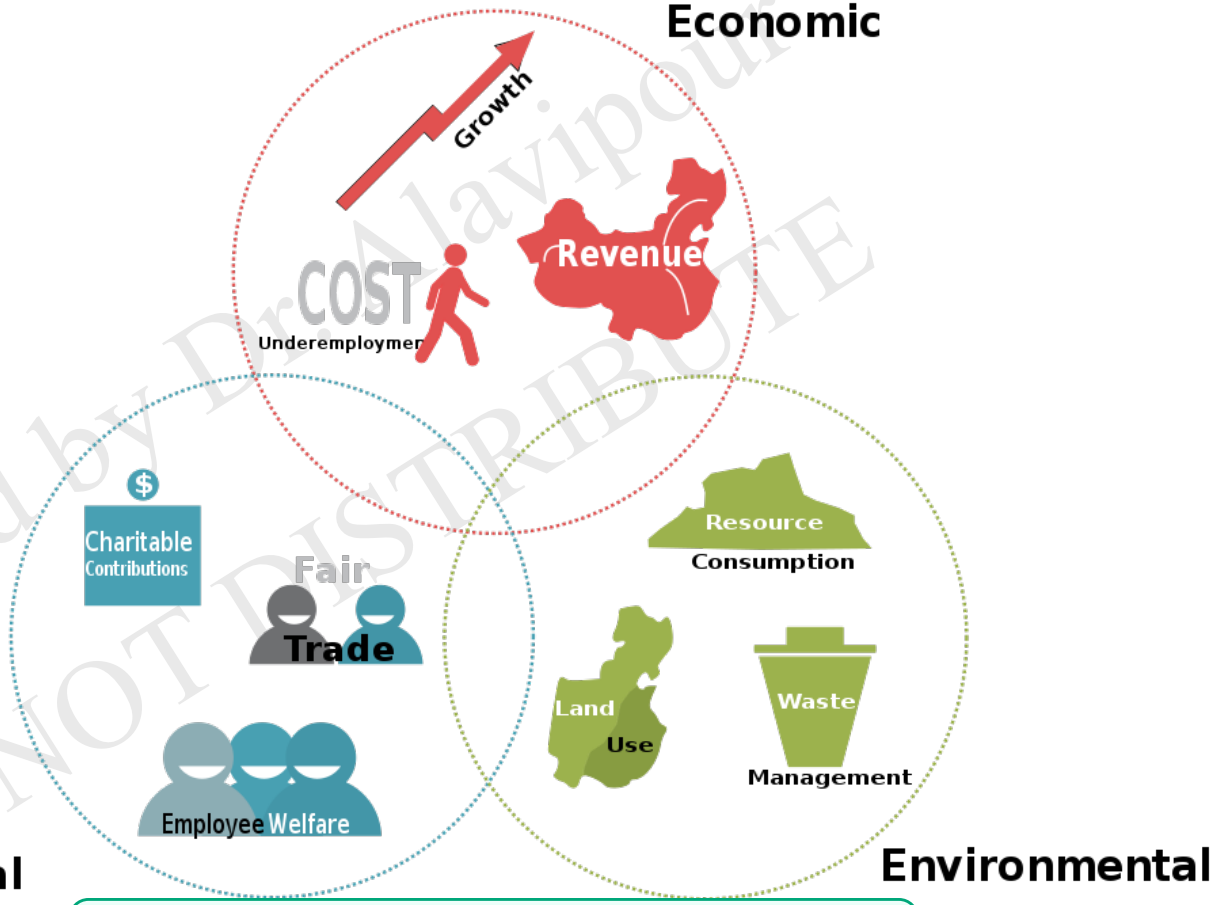
It is becoming more common for initial planning to consider social and environmental impacts in addition to the financial impacts (sometimes referred to as the triple bottom line). This may take the form of a product life cycle assessment which evaluates the potential environmental impacts of a product, process, or system. The product life cycle assessment informs the design of products and processes. It considers the impacts of materials and processes with regards to sustainability, toxicity, and the environment.

Planning performance domain – Planning overview

- **TBL** or **3BL**

- Accounting framework with **three parts**:
  1. Social
  2. Environmental (or ecological)
  3. Financial

- **Some organizations** have adopted to **create greater business value** and **evaluate their performance** in this new framework.



Remember I fully taught this to you?

Planning performance domain

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  1. Planning overview
  2. Planning variables
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  4. Communication
  5. Physical resources
  6. Procurement
  7. Changes
  8. Metrics
  9. Alignment
  10. Interactions with other performance domains
  11. Checking results

Planning performance domain – Planning variables

- **Variables** that influence **how project planning** is conducted include, but are not limited to:
  - **Development approach.** The development approach can influence how, how much, and when planning is conducted. Examples include:
    - A specific phase for planning or organizing early in the life cycle. In these situations, much of the planning is performed up front. The initial plans are progressively elaborated with more detail throughout the project, but there is little change to the original scope.
    - An approach with high-level planning up front, followed by a design phase where prototyping is used. After the project team and stakeholders agree to the design, the project team completes more detailed planning.
    - Adaptive approaches where the project team conducts iterations. Some planning occurs up front to establish release plans and further planning occurs at the beginning of each iteration.

Planning performance domain – Planning variables

- **Variables** that influence **how project planning** is conducted include, but are not limited to:
  - **Project deliverables.** Often the project deliverables necessitate planning in a specific way. Construction projects require significant up-front planning to account for design, approvals, materials purchasing, logistics, and delivery. Product development or high-technology projects may use continuous and adaptive planning to allow for evolution and changes based on stakeholder feedback and technological advances.
  - **Organizational requirements.** Organizational governance, policies, procedures, processes, and culture may require project managers to produce specific planning artifacts.
  - **Market conditions.** Product development projects can take place in a highly competitive environment. In these situations, project teams can undertake a minimum amount of up-front planning as the emphasis is on speed to market. The cost of delay that extensive planning entails exceeds the risk of potential rework.
  - **Legal or regulatory restrictions.** Regulatory agencies or statutes may require specific planning documents before granting an authorization to proceed or to secure approval to release the project deliverable into the market.

Let's see what should be planned!

Planning performance domain – Planning variables

1. **Delivery**
2. **Estimating**
3. **Schedules**
4. **Budget**

Planning performance domain – Planning variables: Delivery

- **Planning begins** with understanding the business case, stakeholder requirements, and the project and product scope.
  - **Product scope** is the features and functions that **characterize** a product, service, or result.
  - **Project scope** is the work performed to **deliver** a product, service, or result with the specified features and functions.

Predictive planning approaches start with the high-level project deliverables up front and decompose them into more detail. This approach can employ a scope statement and/or a work breakdown structure (WBS) to decompose the scope into lower levels of detail.

Scope versus a Statement of Work

Planning performance domain – Planning variables: Delivery

Scope of Work

The Scope of Work is the range of services that are to be performed and the limit to which these services can be changed.

When soliciting for services, a description of the scope of work usually appears as a scope statement in the solicitation document (e.g. Request for Proposal or Invitation to Bid), under the heading of "Intent," "Purpose," "Overview," or "Background." The text of the scope statement usually describes the general type of services, provides an overview of the performance outcomes expected by ODOT, and may identify some of the technical requirements. The general scope statement provides enough information so that prospective Consultants can (1) understand what services ODOT is seeking, (2) decide if they are qualified and capable of performing the services required, and (3) decide if they wish to compete for the contract(s).

When a Contract is awarded through a solicitation process, the scope of work is usually communicated in more detail in the Contract than in the solicitation document (i.e. Request for Proposal or Invitation to Bid). The scope of work described in the Contract Statement of Work must be consistent with the scope of work described in the solicitation document.

Statement of Work

The Statement of Work is the primary means through which ODOT communicates performance obligations and duties. The Statement of Work describes in detail the work to be performed and ODOT's performance expectations. The Statement of Work communicates ODOT objectives related to the cost and schedule for completion of services. The Statement of Work must be clear enough for the parties to understand their obligations and duties. A clear, concise Statement of Work helps create a Contract that is legally enforceable should performance issues arise during the Contract period. All services included in a Statement of Work must fall within the scope of work described in the solicitation.

How the planning performed in iterative or incremental approaches?

Planning performance domain – Planning variables: Delivery

Projects that use iterative or incremental approaches can have high-level themes or epics that are decomposed into features, which are then further decomposed into user stories and other backlog items. Work that is unique, significant, risky, or novel can be prioritized to reduce the uncertainty associated with project scope at the start of the project before significant investment has taken place. Project teams plan routine work based on the concept of last responsible moment. This approach defers a decision to allow the project team to consider multiple options until the cost of further delay would exceed the benefit. It reduces waste by not expending time in developing plans for work that may change or may not be needed.

Planning performance domain – Planning variables: Estimating

- **Planning** entails developing **estimates** for work effort, duration, costs, people, and physical resources.
- **Estimates** are a **quantitative assessment** of the likely amount or outcome of a variable,

  such as project costs, resources, effort, or duration.

How the project's phase in the life cycle impacts four aspects associated with estimating?

Planning performance domain – Planning variables: Estimating

- **Range.** Estimates tend to have a broad range at the start of the project when there is not much information about the project and product scope, stakeholders, requirements, risks, and other information. Figure 2-14 shows a range of -25 to +75% at the start of exploring a project opportunity. Projects that are well along in their life cycle may have an estimating range of -5 to +10%.
- **Accuracy.** Accuracy refers to the correctness of an estimate. Accuracy is linked to range in that the lower the accuracy, the larger the potential range of values. An estimate at the start of the project will have less accuracy than one that is developed halfway through the project.
- **Precision.** Precision is different from accuracy (see Figure 2-15). Precision refers to the degree of exactness associated with the estimate. For example, an estimate of 2 days is more precise than "sometime this week." The precision of estimates should be compatible with the desired accuracy.
- **Confidence.** Confidence increases with experience. Experience working on a previous, similar project can help with the level of confidence required. For new and evolving technology components, the confidence in estimates is expected to be low.

What is the difference between these concepts and ones provided by AACE?

Planning performance domain – Planning variables: Estimating

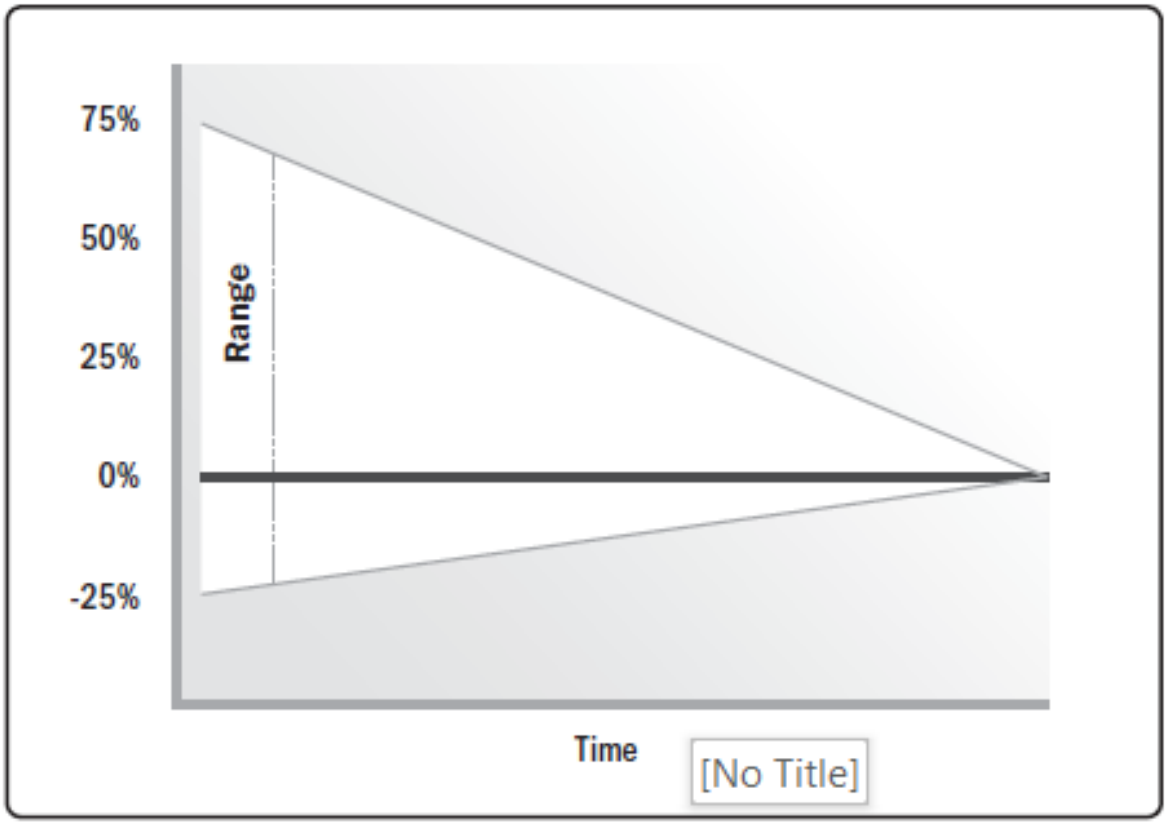
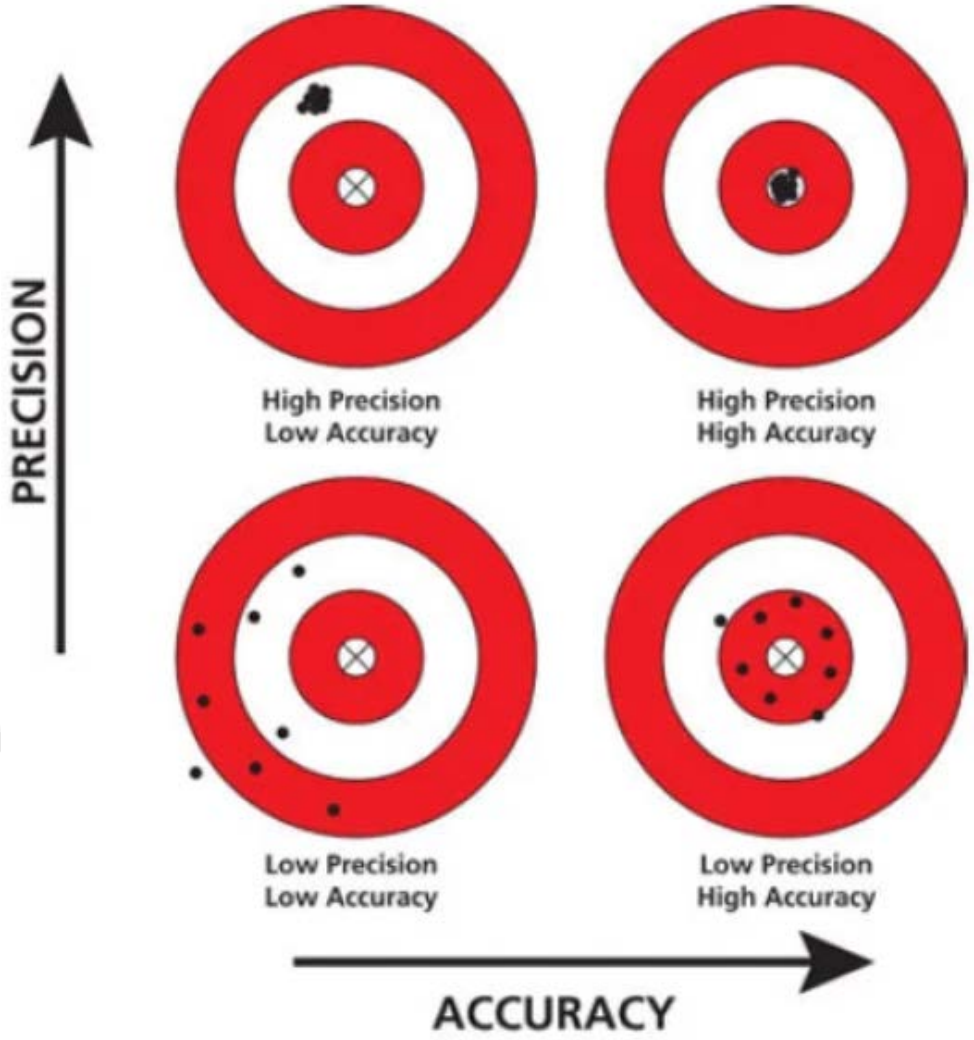


Figure 2-14. Estimate Range Decreases over Time

What was the range for construction projects?
Remember Accounting and Financial Management Course?

Planning performance domain – Planning variables: Estimating



Planning performance domain – Planning variables: Estimating

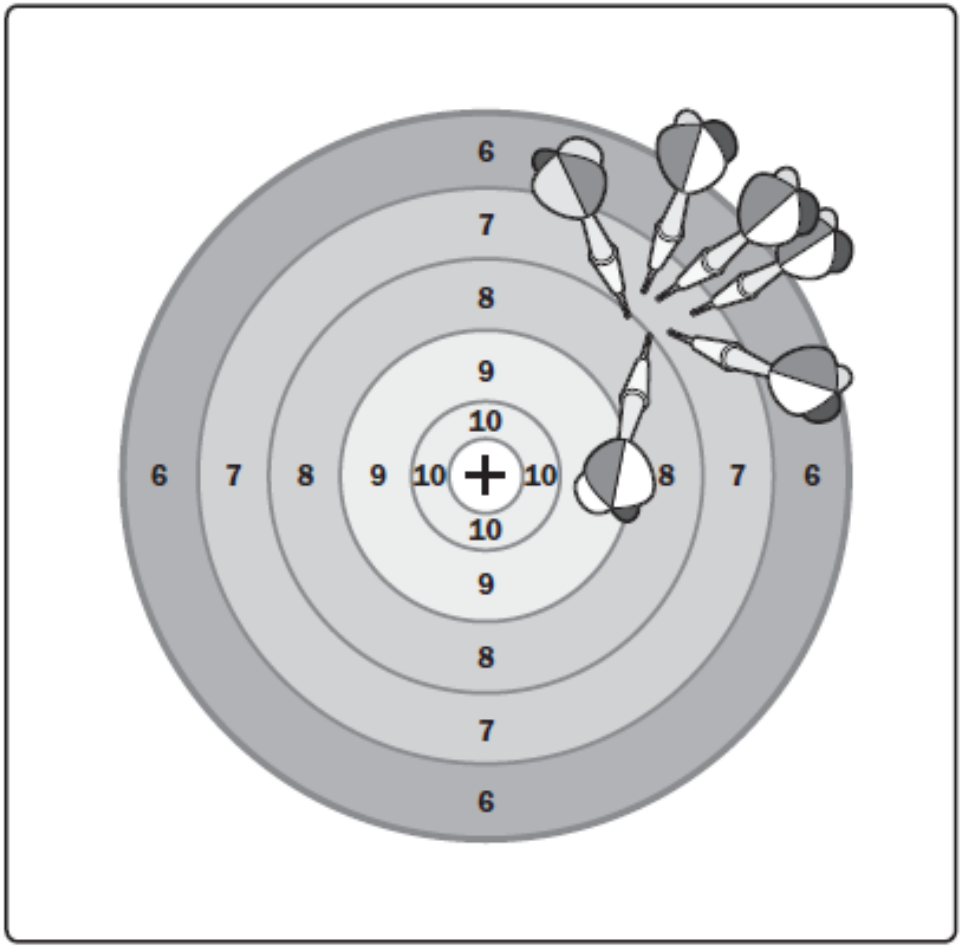


Figure 2-15. Low Accuracy, High Precision

Planning performance domain – Planning variables: Estimating

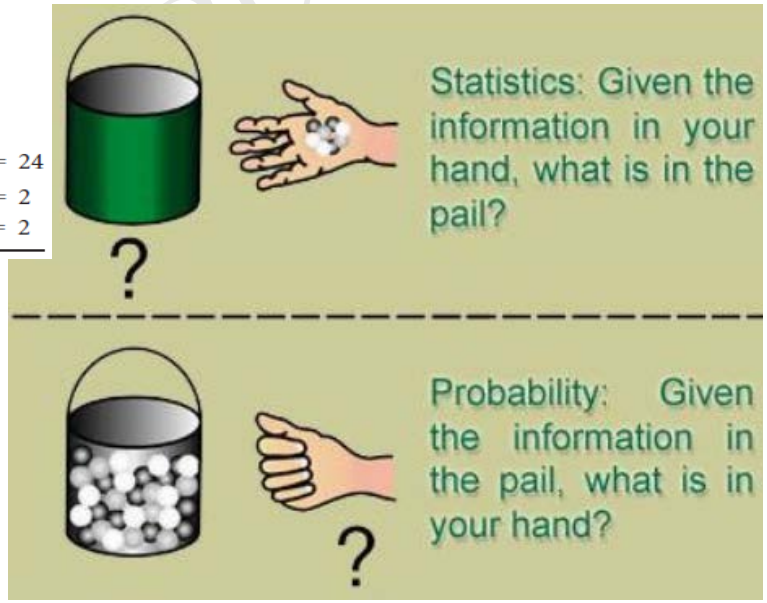
- There are **different ways** of presenting and/or adjusting estimates:
  1. Deterministic and probabilistic estimating
  2. Absolute and relative estimating
  3. Flow-based estimating
  4. Adjusting estimates for uncertainty

Planning performance domain – Planning variables: Estimating

- **Deterministic and probabilistic estimating.** Deterministic estimates, also known as point estimates, present a single number or amount, such as 36 months.

  Probabilistic estimates include a range of estimates along with the associated probabilities within the range. They can be developed manually by (a) developing a weighted average based on multiple likely outcomes, or (b) running a simulation to develop a probability hedule.

	Masonry Data		Carpet Data	
Project #	Duration (Dur)	$(Dur-Mean)^2$	Duration (Dur)	$(Dur-Mean)^2$
1	14	36	18	4
2	17	9	21	1
3	27	49	19	1
4	16	16	22	4
5	18	4	17	9
6	25	25	22	4
7	23	9	21	1
	$Sum_1 = 140$	$Sum_2 = 148$	$Sum_1 = 140$	$Sum_2 = 24$
	$Mean_1 = 20$	$(Sum_2/n-1)^{1/2} = 4.97$	$Mean_1 = 20$	$(Sum_2/n-1)^{1/2} = 2$
	$n = 7$	Std. Dev. = 5 (approx.)	$n = 7$	Std. Dev. = 2



Remember I fully taught this to you?

Planning performance domain – Planning variables: Estimating

A probabilistic estimate derived from a computer simulation has three associated factors:

1. A point estimate with a range such as 36 months +3 months/-1 month.
2. A statement of confidence such as a 95% confidence level.
3. A probability distribution describing the dispersion of the data within and around the given range.

Together these three items form a complete metric describing a probabilistic estimate.

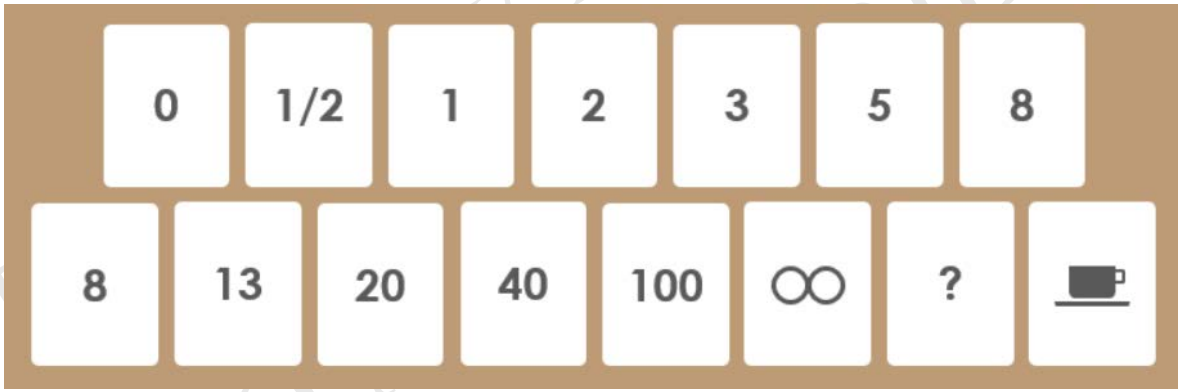
Planning performance domain – Planning variables: Estimating

- **Absolute and relative estimating.** Absolute estimates are specific information and use actual numbers. An absolute estimate for effort might be shown as 120 hours of work. One person working full time could accomplish the work in 15 workdays, assuming 8 hours of productivity per workday.

  While absolute estimates are specific, relative estimates are shown in comparison to other estimates. Relative estimates only have meaning within a given context.

Planning performance domain – Planning variables: Estimating

One form of relative estimating is planning poker. In planning poker, the project team performing the work comes to a consensus on the effort that is necessary to deliver value. Using story points to estimate work could result in 64 story points being assigned for that work. New work is estimated using the amount of estimated work compared to points assigned to previous work. Therefore, new work effort is compared to previously known work effort.

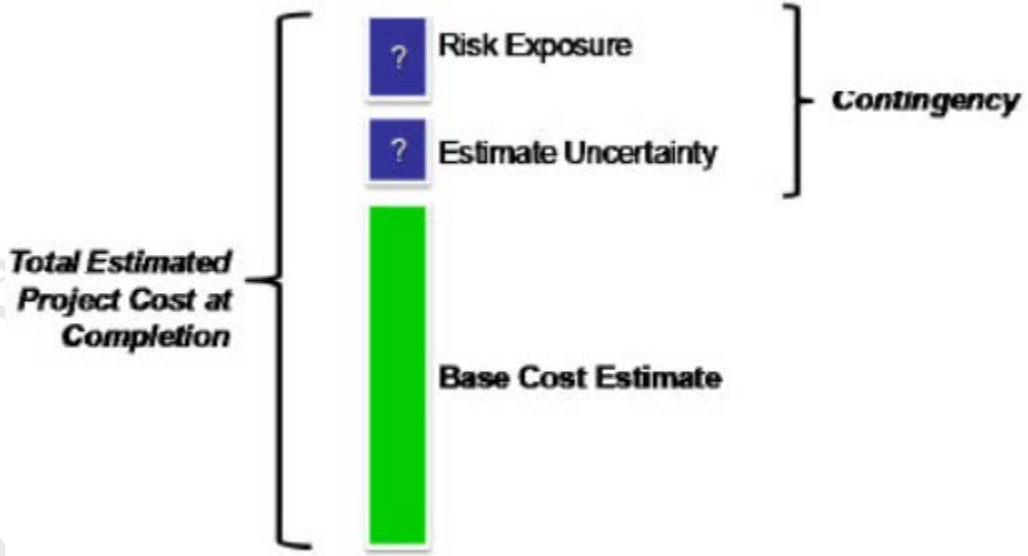


Planning performance domain – Planning variables: Estimating

- **Flow-based estimating.** Flow-based estimates are developed by determining the cycle time and throughput. Cycle time is the total elapsed time it takes one unit to get through a process. Throughput is the number of items that can complete a process in a given amount of time. These two numbers can provide an estimate to complete a specified quantity of work.

Planning performance domain – Planning variables: Estimating

- **Adjusting estimates for uncertainty.** Estimates are inherently uncertain. Uncertainty by definition is associated with risk. Key deliverable dates or budget estimates may be adjusted, or contingency time or funds may be added, based on the outcomes of a simulation conducted to establish the range of uncertainty for these parameters.



What is the difference between these concepts and ones provided by AACE?

RP No. 56R-08 – Cost estimate classification matrix for building and general construction industries

1. Classes 5 and 4: **Pre-design** and **Schematic** design
2. Classes 3, 2, and 1: **Preliminary** and **Engineering** design

	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges [a]
Class 5	0% to 2%	Functional area, or concept screening	SF or m^2 factoring, parametric models, judgment, or analogy	L: -20% to -30% H: +30% to +50%
Class 4	1% to 15%	or Schematic design or concept study	Parametric models, assembly driven models	L: -10% to -20% H: +20% to +30%
Class 3	10% to 40%	Design development, budget authorization, feasibility	Semi-detailed unit costs with assembly level line items	L: -5% to -15% H: +10% to +20%
Class 2	30% to 75%	Control or bid/tender, semi-detailed	Detailed unit cost with forced detailed take-off	L: -5% to -10% H: +5% to +15%
Class 1	65% to 100%	Check estimate or pre bid/tender, change order	Detailed unit cost with detailed take-off	L: -3% to -5% H: +3% to +10%

Note: [a] The state of construction complexity and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual cost from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

Planning performance domain – Planning variables: Schedules

- A schedule is a model for **executing the project's activities**, including durations, dependencies, and other planning information.

- Schedule planning can use **predictive** or **adaptive** approaches.

Planning performance domain – Planning variables: Schedules

Predictive approaches follow a stepwise process as follows:

- **Step 1.** Decompose the project scope into specific activities.
- **Step 2.** Sequence related activities.
- **Step 3.** Estimate the effort, duration, people, and physical resources required to complete the activities.
- **Step 4.** Allocate people and resources to the activities based on availability.
- **Step 5.** Adjust the sequence, estimates, and resources until an agreed-upon schedule is achieved.

What if the schedule does not meet the initial desired end date?

Planning performance domain – Planning variables: Schedules

If the schedule model does not meet the initial desired end date, schedule compression methods are applied. Crashing is a schedule compression method that seeks to shorten the duration for the least incremental cost. Crashing can include adding people to activities, working overtime, or paying to expedite deliveries.

Fast tracking is a schedule compression method in which activities or tasks that are normally done in sequence are performed in parallel, at least for a portion of their duration. Fast tracking often entails applying leads and lags along a network path. A *lead* is where the work of a successor activity is accelerated, such as starting a successor activity before the predecessor has finished. In Figure 2-16, there is a lead between the finish of Task 2 and the start of Task 4.

Remember what you have learned in Planning and Scheduling Course?

Technique	Description	Side effects
Crashing	Add resources to time-dependent activities to complete work faster	Requires additional resources and thus increases costs; may also reduce quality if activities are executed faster and with less-experienced labor
Fast tracking	Reduce the sequential dependencies between activities to partial dependencies. For example, F–S logic is reduced to S–S logic to force parallel work	Resources may become overallocated; quality may also be reduced and risk introduced if activities ideally executed in sequence are now executed in parallel
Split long activities	Split long activities into shorter activities that can be worked in parallel	Resources may become overallocated
Review constraint and lag assumptions	Reassess assumptions related to forcing activities to begin on certain dates	If the original date constraint or lag is justified, removing the constraint or lag may not be realistic

Planning performance domain – Planning variables: Schedules

A *lag* is a delay of a successor activity. An example of using a lag would be changing the type of relationship between activities, and then applying a lag. For example, rather than waiting for an activity to finish before the next one starts (a finish-to-start relationship), change the relationship to have the end of the successor activity finish a determined amount of time after the end of the predecessor (a finish-to-finish relationship). The network logic would show a lag between the finish of the predecessor and the finish of the successor activities. There is an example of a finish-to-finish relationship with a lag in Figure 2-16 between Task 8 and Task 7. A lag can also be applied between the start of one activity and the start of another activity (a start-to-start relationship).

Remember the secrets I taught you?

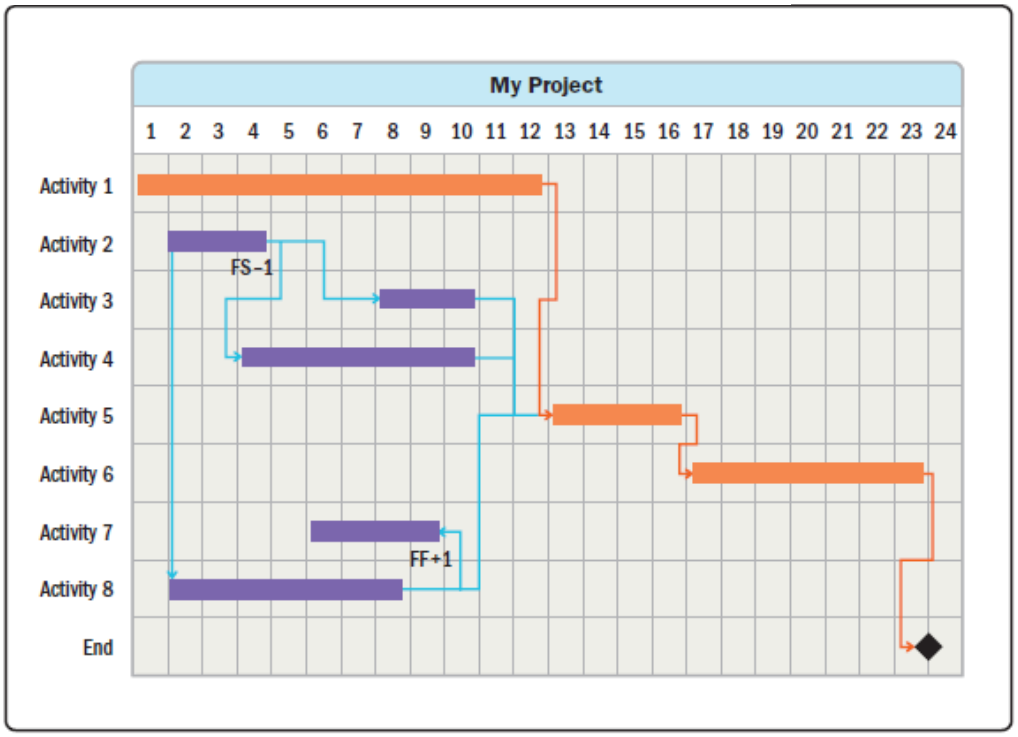


Figure 2-16. Fast Tracking Examples

Planning performance domain – Planning variables: Schedules

When compressing the schedule, it is important to determine the nature of the dependencies between activities. Some activities cannot be fast tracked due to the nature of the work—others can. The four types of dependencies are:

- **Mandatory dependency.** A relationship that is contractually required or inherent in the nature of the work. This type of dependency usually cannot be modified.
- **Discretionary dependency.** A relationship that is based on best practices or project preferences. This type of dependency may be modifiable.
- **External dependency.** A relationship between project activities and non-project activities. This type of dependency usually cannot be modified.
- **Internal dependency.** A relationship between one or more project activities. This type of dependency may be modifiable.

Remember the complexity I taught you here?

How do they affect delay analysis?

Planning performance domain – Planning variables: Schedules

Adaptive schedule planning uses incremental planning. One such scheduling approach is based on iterations and releases (see Figure 2-17). A high-level release plan is developed that indicates the basic features and functionality to be included in each release. Within each release, there will be two or more iterations. Each iteration adds business and/or stakeholder value. Value may include features, risk reduction, experimentation, or other ways of delivering or protecting value. The planning for the work in future releases is kept at a high level so the project team does not engage in planning that could change based on feedback from earlier releases.

Planning performance domain – Planning variables: Schedules

Adaptive approaches often use timeboxes. The work in each timebox is based on a prioritized backlog. The project team determines the amount of work they can do in each timebox, estimates the work, and self-manages to accomplish the work. At the end of the timebox, the project team demonstrates the work completed. At that point, the backlog and estimates of work available to be done may be updated or reprioritized for the next timebox.

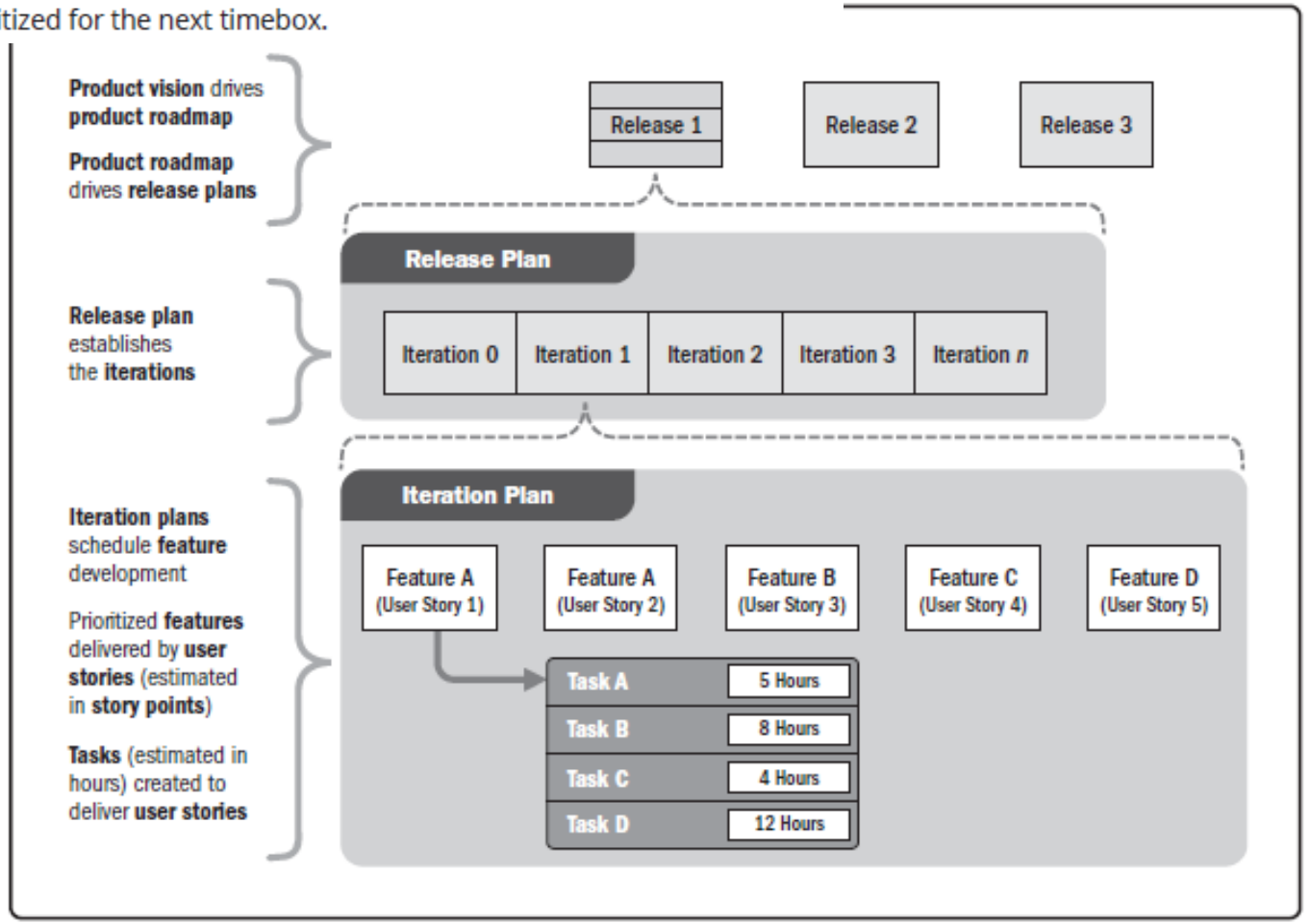


Figure 2-17. Release and Iteration Plan

Planning performance domain – Planning variables: Budget

- **Cost estimates** are then aggregated to develop the **cost baseline**.
  - The **cost baseline** is often allocated across the **project schedule** to reflect when the costs will be incurred.
- Project budget should include contingency reserve funds to allow for **uncertainty**.
  1. **Contingency reserves** are set aside to implement a **risk response** or to respond to **risk events** should they occur.
  2. **Management reserves** are set aside for **unexpected activities** related to **in-scope work.**

Depending on the organization's policies and organizational structure, management reserves may be managed by the project, the sponsor, product owner, or the PMO at the program and portfolio level.

Planning performance domain – Planning variables: Budget

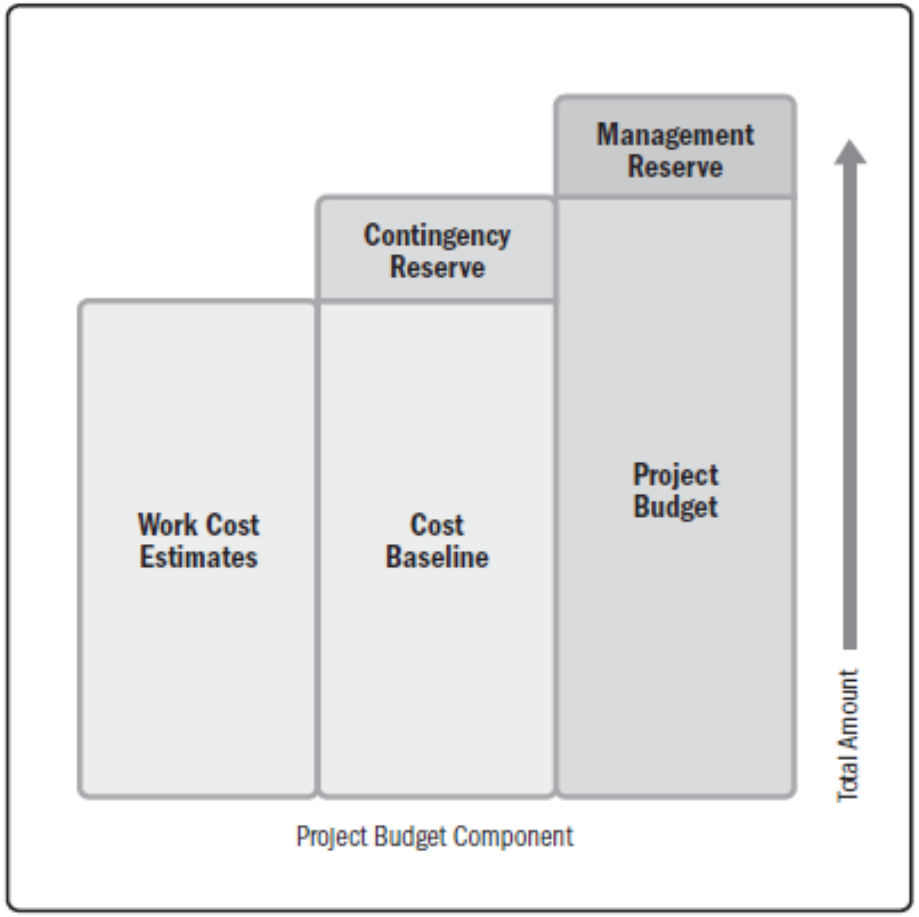


Figure 2-18. Budget Build Up

Remember what you have learned in Accounting and Financial Management Course?

Planning performance domain

- We will talk about the following in this section:
  1. Planning overview
  2. Planning variables
  3. Project team composition and structure
  4. Communication
  5. Physical resources
  6. Procurement
  7. Changes
  8. Metrics
  9. Alignment
  10. Interactions with other performance domains
  11. Checking results

Planning performance domain- Project team composition and structure

- **Planning** for project team composition begins with identifying the **skill sets** required to accomplish the project work.

- This entails evaluating **not only the skills**,

  but also the **level of proficiency** and **years of experience** in similar projects.

Planning performance domain

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11. Checking results

Planning performance domain – Communication

- **Communication planning overlaps** with stakeholder identification, analysis, prioritization, and engagement.
- **Communication** is the most important factor in **engaging with stakeholders** effectively.
- **Planning communication** for the project entails considering the following:
  - Who needs information?
  - What information does each stakeholder need?
  - Why should information be shared with stakeholders?
  - What is the best way to provide information?
  - When and how often is information needed?
  - Who has the information needed?

Planning performance domain

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  10. Interactions with other performance domains
  11. Checking results

Planning performance domain – Physical resources

- **Physical resources** apply to any resource that is **not a person**.
- It can include materials, equipment, software, testing environments, licenses, and so forth.
- Planning for **physical resources** entails estimating,

  as well as supply chain, logistics, and management.
- Planning for physical resources includes taking into account lead time for delivery, movement, storage, and disposition of materials, as well as a means to track material inventory from arrival on site to delivery of an integrated product.

Remember Lean?

Planning performance domain

- We will talk about the following in this section:
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  2. Planning variables
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  6. Procurement
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  10. Interactions with other performance domains
  11. Checking results

Planning performance domain – Procurement

- Once the **high-level scope** is known, project teams conduct a **make-or-buy analysis**.
  - This includes identifying those deliverables and services that will be developed in-house, and

    those that will be purchased from external sources.
  - This information impacts the project team and the schedule.
  - Contracting strategy

Planning performance domain

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  6. Procurement
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  10. Interactions with other performance domains
  11. Checking results

Planning performance domain – Changes

- Results of
  - A **risk event** occurring or a project environment change
  - Developing **deeper understanding** of requirements
  - **Customer requests**

- Projects that have a contractual element may need to **follow a defined process** for contract changes.

Planning performance domain

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Planning performance domain – Metrics

- **Linkage** between planning, delivering, and measuring work
- **“only measure what matters.”**
- **Metrics** associated with the product are specific to the **deliverables** being developed.
- **Metrics** associated with schedule and budget performance are often driven by **organizational standards.**
- As part of planning, the metrics, baselines, and thresholds for performance are established, as well as any **test** and **evaluation** processes and procedures that will be used to measure performance to the specification of the project deliverable.

Very superficial

Planning performance domain

- We will talk about the following in this section:
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  11. Checking results

Planning performance domain – Alignment

- **Planning** activities and artifacts need to remain **integrated** throughout the project.
  - This means that **planning** for the performance in terms of scope and quality requirements aligns with

    delivery commitments, allocated funds, type and availability of resources, the uncertainty inherent in the project, and stakeholder needs.
- **Large projects** may combine the planning artifacts into an **integrated project management plan.**
- For **smaller projects**, a detailed project management plan will be inefficient.

- **Regardless** of the timing, frequency, and degree of planning,

  the **various aspects** of the project need to **remain aligned and integrated**.

Planning performance domain

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  9. Alignment
  10. Interactions with other performance domains
  11. Checking results

Planning performance domain – Interactions with other performance domains

- **Planning** occurs throughout the project and integrates with each performance domain.
- At the start of the project, the **expected outcomes** are identified and high-level plans to achieve them are **developed**.
- Depending on the **selected development approach** and **life cycle**,

  intensive planning may be **conducted up front**, and then plans may be adjusted to **reflect the actual environment**.
- **Other life cycles** encourage **just enough planning** at various points throughout the project with the expectation that plans will evolve.

Planning performance domain

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  11. Checking results

Planning performance domain – Checking results

Table 2-6. Checking Outcomes—Planning Performance Domain

Outcome	Check
The project progresses in an organized, coordinated, and deliberate manner.	A performance review of project results against the project baselines and other measurement metrics demonstrates that the project is progressing as planned. Performance variances are within thresholds.
There is a holistic approach to delivering the project outcomes.	The delivery schedule, funding, resource availability, procurements, etc., demonstrate that the project is planned in a holistic manner with no gaps or areas of misalignment.
Evolving information is elaborated to produce the deliverables and outcomes for which the project was undertaken.	Initial information about deliverables and requirements compared to current information demonstrates appropriate elaboration. Current information compared to the business case indicates the project will produce the deliverables and outcomes it was undertaken to deliver.
Time spent planning is appropriate for the situation.	Project plans and documents demonstrate that the level of planning is appropriate for the project.
Planning information is sufficient to manage stakeholder expectations.	The communications management plan and stakeholder information indicate that the communications are sufficient to manage stakeholder expectations.
There is a process for the adaptation of plans throughout the project, based on emerging and changing needs or conditions.	Projects using a backlog show the adaptation of plans throughout the project. Projects using a change control process have change logs and documentation from change control board meetings that demonstrate the change control process is being applied.

(Domain 4: Planning Performance Domain)

Construction Extension to the PMBOK Guide

(Project Scope Management)

Introduction

- **Scope** can be managed in **various ways**

  depending on the construction project requirements and the performing organization (owner, contractor, construction manager, etc.).

  - For a contractor, the scope of work most often comes from
    1. Contract
    2. A set of design drawings and specifications

- In construction,
  1. Scope planning,
  2. Scope definition, and
  3. Work breakdown structure (WBS)

  Set the early tone for the project framework

Project scope management in construction

- In the construction industry,
  1. Contract documents,
  2. Specifications, and
  3. Design drawings

  define the scope.

Project scope management in construction

- **Primary scope document** in construction is the contract—whether it is a
  1. Construction contract between the owner and the contractor
  2. Design contract between the owner and the architect/engineer

- **Secondary** documents include drawings and specifications.
  - Design drawings for constructing a facility (e.g., a residential condominium development, a hydroelectric dam, or a petrochemical facility) identify
    - ✓ Scope of work,
    - ✓ Level of quality,
    - ✓ Tolerances,
    - ✓ Preferences for materials and equipment, and
    - ✓ Testing and inspection requirements.

Project scope management in construction

- **Early scope definition** is critical in controlling project **costs**.
- **Changes** on a construction project,
  when resolved **mutually** and **amicably**,
  generally result in change orders.
- **Claims** occur when the appropriate parties **cannot agree** upon the changes.
- A **battery limit** is a physical location where the **scope ends**.

Project scope management in construction

- The following **PMBOK® Guide Process Groups** are addressed in this Knowledge Area:
  1. Planning, and
  2. Monitoring and Controlling.

Project scope management planning

- A **make-or-buy decision** to subcontract portions of work
  1. Creates **new interfaces** and
  2. Increases the **probability of issues** related to battery limits and division of responsibilities,

     all of which **pose additional challenges** to scope management.

  - **Practitioners** should be mindful that **while outsourcing decisions** transfer part of the scope to third parties,

    they create **additional management activities** to consider when planning for scope management.

Project scope management planning – Define scope

- Define scope
  - Statutory requirements
  - Stakeholder requirements
  - Design specifications and drawings
  - Life cycle costing, value engineering, and constructability analysis
  - Project management aspects

Project scope management planning – Define scope

- Create WBS
  - **Some construction projects** in the residential, commercial, and institutional sectors **may not include an official WBS**,

    but **may follow** the format of specifications.
    - ✓ These **specifications** utilize a unique numbering system (called a **division**)

      depending on the **discipline of the construction trade**.

Remember CSI?

Project scope management planning – Define scope

- Create WBS
  - In the WBS, these may be **divided into** construction work packages (CWPs) to aid in scope control.

Remember Planning packages?

  - **Some owners** provide the contractors with a **predefined WBS** for the project.
    - ✓ Working with an **unfamiliar WBS** may create an added **challenge** for a contractor.

Project scope management planning – Define scope

- Create WBS
  - It is **not uncommon** in the construction industry to create a WBS with a breakdown of deliverables

    that **directly compose** the facility to be built.
    - ✓ **Deliverables** related to project management,

      such as performance reports, invoices, etc., may be **left out of the WBS** in those cases.
      - This does **not mean** that such deliverables have become exclusions;

        they **just do not appear** in that particular representation of the project scope.

How about monitoring and control?

Project scope monitoring and control

- **Controlling project scope** Ensures
  1. All **requested changes** and
  2. **Recommended corrective** or preventive actions

  are **processed** through integrated change control process.

How to perform in different contracts?

Project scope monitoring and control

- Unit price contracts, scope monitoring and control may involve **actual measuring of quantities**.
  - For example, total cubic meters/feet/yards of poured concrete can be measured and compared against the baseline to check for any deviation.

- Reimbursable contracts where scope is **loosely defined**,
  reviewing performance reports aids in determining whether scope reduction or scope addition is needed **depending** on if the project is **under or over budget**.

How to perform scope validation/verification?

Project scope monitoring and control – Scope validation/Verification

- **Formalizing acceptance** of completed **project deliverables**
- Construction projects have **clearly defined phases** and **required verification steps**.

1. The **first phase** is at the end of the concept phase when the project is approved.
   - The construction **contractor may or may not be involved** in this process, but it results in a preliminary scope and a contract that generally outlines **what is to be constructed.**

Project scope monitoring and control – Scope validation/Verification

- **Formalizing acceptance** of completed **project deliverables**
- Construction projects have **clearly defined phases** and **required verification steps**.

2. The next phase is a **definition phase**,

where **sufficient plans and specifications** are developed to

provide a baseline criteria, budget, and schedule.

Project scope monitoring and control – Scope validation/Verification

- **Formalizing acceptance** of completed **project deliverables**
- Construction projects have **clearly defined phases** and **required verification steps**.

3. The **final phase**, the acceptance of the project, should be properly completed in **accordance with the contract**.
   - **Completion of each of these phases** should be marked by a formal verification process before proceeding to the next phase.

In construction projects, quantity measurements are typically performed to verify installed quantities of materials. The bill of materials (BOM) and material take-offs (MTOs) are material quantity measurements from the drawings. For example, the number of piles installed can be compared against the number of piles within the scope as shown on construction drawings.

Remember RFI in claim management course?

Project scope monitoring and control – Scope creep and change management

- **Change** is an aspect of every project and may be beneficial;

  scope creep is not.

  - Some common examples are design errors/omissions, unclear battery limits, and unrecognized/uncontrolled accumulation of changes by the owner.
  - Scope creep changes may come from project stakeholders (additional recognized needs, incomplete design work, incomplete project documentation, contractor's change requests, etc.), from project conditions (lack of materials, labor issues, new legislation, regulations, etc.), and from project constraints (financing issues, societal issues, environmental issues, etc.).
    - ✓ *Therefore, construction projects require robust change management processes.*

Remember the change order procedure?

(Domain 4: Planning Performance Domain)

Construction Extension to the PMBOK Guide

(Project Schedule Management)

موسسه مهندسی و مدیریت ساخت علوی پور (ACEMI)

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