Six Sigma Green Belt - Study Guides

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Project Charter

- A project charter is a document that formally authorizes a project. (PMBOK) It includes:

    ◦ The business need that the project was undertaken to address
    ◦ The product description

- The project charter provides a project manager with the authority to get resources for project activities.

Charter Negotiation

- Creation of the project charter from a Six Sigma project perspective includes several issues that need to be discussed and negotiated by relevant stakeholders. Some important issues which need to be negotiated include:

  - Objectives : Quantifiable criteria that must be met for the project to be considered successful
  - Scope: This is a measure of the work required to complete the project successfully.
  - Boundaries: Project boundary states explicitly what is in scope and what is out of scope of the project
  - Resources: While creating the project charter, critical resources (including people and funding required) are negotiated to ensure that appropriate resources are available.
  - Project closure activities
  - Project transition activities

Initiating Teams

Understanding key elements of Iinitiating teams and their importance:

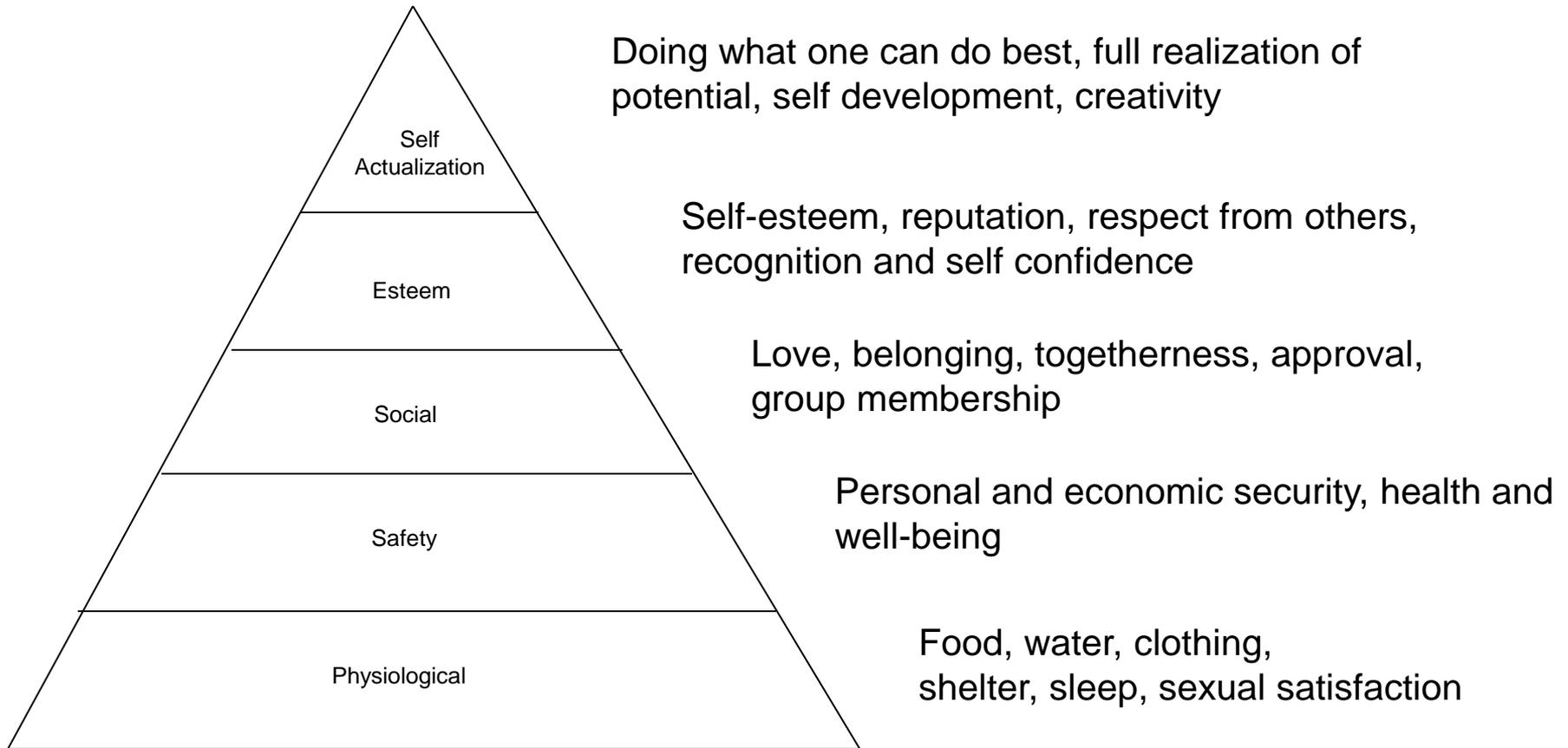| Elements of team initiation	Importance
Clear purpose and goals	The project charter must clearly specify the objectives of the project to provide direction to team members. Clearly stated goals improve accountability and probability for success of the project.
Roles and responsibilities	Each team member should be formally provided with knowledge of his/her role in the project and associated responsibilities. If necessary, proper training may be provided to ensure that team members can undertake the responsibilities assigned.
Management support and team empowerment	No Six Sigma project can succeed without management commitment and support. Management must designate a sponsor who should ensure that the project team gets necessary support and is empowered to get information and resources from within the organization as required.

Stages of Team Evolution

- Team evolution in Six Sigma projects usually follows 6 stages :

    ◦ **Forming** : Team members begin to know each other and their reason for being together. Usually, there is confusion around roles and responsibilities. This stage includes **avoidance of conflict** as team members get to know each other.

    ◦ **Storming**: As team members get to know each other, there is growing awareness of hidden agendas and if goals are not well defined, **conflict may occur**. Although there is conflict, typically there is advancement in task functions and roles.

    ◦ **Norming**: Individual needs for getting tasks done leads to resolution of conflicts and a desire for cooperation. This stage is marked by **harmonious cohesiveness** as team members engage in free flow of information, ideas and constructive feedback.

Stages of Team Evolution (continued)

- **Performing**: During this stage, the team becomes **truly collaborative**. All team members share similar objectives and work towards the successful implementation of the project. There is a feeling of satisfaction and fulfillment as objectives are achieved.

- **Adjourning**: Either after completion of tasks or changes team members leave for other tasks, or new members are hired. There may be **discontent with doing the same repetitive tasks,** and unless the group is consciously redeveloped, it will regress to Forming / Storming stages.

- **Recognition**: This stage is towards the end of the project, where objectives are achieved and the project team and its members get **recognition for their performance**.

Maslow's Hierarchy Of Needs (Needs of people in an organization)

Doing what one can do best, full realization of potential, self development, creativity

Self-esteem, reputation, respect from others, recognition and self confidence

Love, belonging, togetherness, approval, group membership

Personal and economic security, health and well-being

Food, water, clothing, shelter, sleep, sexual satisfaction

Self Actualization

Esteem

Social

Safety

Physiological

Herzberg's Theory of Motivators and Hygiene Factors

Herzberg (1959) constructed a two-dimensional paradigm of factors affecting people's attitudes about work. He concluded that such factors as company policy, supervision, interpersonal relations, working conditions, and salary are hygiene factors rather than motivators. According to the theory, the absence of hygiene factors could create job dissatisfaction, but their presence did not motivate or create satisfaction.

In contrast, he determined from the data that the motivators were elements that enriched a person's job. He found five factors in particular that were strong determiners of job satisfaction: achievement, recognition, the work itself, responsibility, and advancement. These motivators (satisfiers) were associated with long-term positive effects in job performance while the hygiene factors (dissatisfiers) consistently produced only short-term changes in job attitudes and performance, which quickly fell back to its previous level.

In summary, satisfiers relate to the tasks being performed. Dissatisfiers, on the other hand, relate to the context or environment in which the task is being performed. (The satisfiers related to what a person did while the dissatisfiers related to the situation in which the person performed his tasks).

Handling Conflicts

Blake and Mouton have delineated five modes for handling conflicts:

- **Withdrawal:** retreating or withdrawing from a potential disagreement.

- **Smoothing**: de-emphasizing or avoiding areas of difference and emphasizing areas of agreement.

- **Compromising**: bargaining and searching for solutions that bring some degree of satisfaction to the parties in a dispute. Characterized by a "give and take" attitude.

- **Forcing:** exerting one's viewpoint at the expense of another. Often characterized by competitiveness and a win-lose situation.

- **Confrontation**: facing the conflict directly, which involves a problem- solving approach, whereby affected parties work out their disagreements.

Conflict Intensity

- Understanding conflict intensity helps Six Sigma project teams resolve the most important issues which may impact team performance. Most of the conflicts occur over the following issues:
  - Schedules
  - Priorities
  - Manpower
  - Technical issues
  - Administration
  - Personality conflict
  - Cost

Highest Intensity

Lowest Intensity

Source: Project Management - A Systems Approach to Planning, Scheduling and Controlling, Page 390

Management/Leadership Styles

- Some common management/leadership styles are:
  - **Autocratic** (manager makes decisions himself - allows subordinates little involvement and discussion before a decision is made)
  - **Laissez faire** (manager does not interfere with subordinates – so subordinates are largely unsupervised; may lead to anarchy)
  - **Democratic** (manager allows subordinates to discuss issues and reach decisions although he will guide and advise)
  - **Discussing** (two-way communication and discussion between manager and subordinates)
  - **Directing** (managers tell people what tasks will be performed and when and how they will be done)
  - **Delegating**
  - **Coaching** (providing instruction to others)
  - **Facilitating** (coordinating inputs from several sources before taking a decision)
  - **Participatory**
  - **Supportive**
  - **Task-oriented**
  - **Team-based**
  - **Assertive**

Roles Played by People in a Project

Understanding the different roles played by team-members helps a Six Sigma project manager to improve constructive behavior towards achieving team goals.

- Destructive Roles

  - Aggressor
  - Dominator
  - Devil's Advocate
  - Topic Jumper
  - Recognition Seeker
  - Withdrawer
  - Blocker

- Constructive Roles

  - Information Seekers
  - Information Givers
  - Encouragers
  - Clarifiers
  - Harmonizers
  - Consensus Takers
  - Gate Keepers
  - Initiators

Brainstorming

- A very popular method to generate ideas about a particular topic, and to find creative solutions.

- Steps followed:
    - Topic selection: An appropriate topic is selected for the brainstorming session.

    - Idea generation: Every individual in the team is asked to think creatively and write down as many ideas as possible.

    - Regrouping ideas: A facilitator coordinates a brainstorming session where all individuals are allowed to discuss their ideas. Inputs from all individuals are captured on a board which everyone can review. Proper care is taken to ensure that there is no criticism of any of the ideas and everyone is allowed to be creative. Also, no single person or group of persons is allowed to dominate the discussion

    - Validation: Methods like Multivoting (discussed later) are used to validate and rank the ideas generated.

Nominal Group Technique (NGT)

- Developed by Delbecq, Van de Ven and Gustafson in 1971, NGT is used as a consensus planning tool to prioritize issues. It facilitates decision-making and organizational planning where creative solutions are sought. It is usually carried out early on in a Six Sigma project to get feedback and buy-in from team members about creative ideas in the team.

- Procedures followed:
  - Generating Ideas: All the members of the team are asked to generate ideas and write them down without consulting others.
  - Recording Ideas: The inputs from all members are publicly displayed and each person is asked to provide more clarification about their feedback in a round-robin feedback session.
  - Discussing Ideas: Each recorded idea is then discussed to obtain clarification and evaluation. This is usually a repetitive process.
  - Voting on Ideas: Individuals vote privately on the priority of ideas, and a group decision is made based on these ratings.

- Benefits:
  - Balances participation across members – reduces bias and conforming influence created in traditional interacting groups.
  - Encourages participants to confront issues on a problem-solving basis rather than on a personal assault basis.
  - Leads to a greater sense of accomplishment for all participants and more creative solutions.

Force Field Analysis

- Developed by Kurt Lewin, force field analysis can be used for getting alignment on all facets of a desired change. Since Six Sigma involves changes in the organization, force field analysis helps in effectively managing such changes.

- There are both Driving Forces and Restraining Forces for every proposed change:

    ◦ Driving forces: Driving forces tend to initiate a change and keep it going. This could include actions, skills, equipment, procedures, culture, people, etc. e.g. for a technical project, increased productivity, lowering of costs and decreased cycle time may be the driving forces.

    ◦ Restraining forces: Restraining forces tend to restrain or decrease the driving forces e.g. for a technical project, need for additional funding, training, and potential loss of jobs may be some restraining forces.

- The objective of force field analysis is to clearly identify the driving forces and restraining forces. Thereby we can try to maximize the driving forces for the changes and minimize the restraining forces.

Multivoting

- In a Six-Sigma project, there may be several ideas to choose from e.g. after a brainstorming session or Nominal Group Technique. Most of these ideas may not be feasible or desirable. Multivoting helps the group to narrow down the list of options which can be taken up for serious consideration or further study.

- Multivoting process:

  ◦ Count the number of options and divide by 3 – this gives the number of potential votes per team member.

  ◦ Each of the team members is asked to vote on the list of options. They can spread their vote across the options depending on how important they think the solution to be. They can assign more than one vote to a particular option if they so desire.

  ◦ After getting votes from each individual member, all the votes are grouped and counted. The options which get the highest number of votes are taken up for further study.

Project Planning Tools – PERT, CPM

- PERT (Project Evaluation and Review Techniques): This uses a weighted average duration estimate to calculate activity durations. – (from PMBOK)

- CPM (Critical Path Method): Calculates a single, deterministic early start and finish date for each activity based on specified sequential network logic and a single duration estimate. – (from PMBOK)

PERT

PERT Calculations for each task

Term	Formula Used
PERT Value (Expected duration)	$\dfrac{\text{(Pessimistic+ 4*(Most Likely) + Optimistic)}}{6}$
Standard Deviation (Sigma)	$\dfrac{\text{Pessimistic – Optimistic}}{6}$
Variance	$(\text{Standard Deviation})^2$

For more than one Tasks (e.g. for a project where all tasks lie on the critical path)

Term	Formula Used
PERT Value	Sum of PERT Values of individual tasks
Standard Deviation	Sum of Variances of all the tasks
Variance	Sum of variances of all the tasks

Project Planning Tools - Network Diagrams

Late Start (LS)		Late Finish (LF)
	Task Name, Duration (D)	
Early Start (ES)		Early Finish (EF)

$$EF = ES + D$$

$$LS = LF - D$$

Float, Total Float, Slack, Path Float:
- Total amount of time that a project can be delayed from its early start without delaying the project finish date.
- $= LF - EF = LS - ES$

Free Float:
- Total amount of time that an activity can be delayed without delaying the early start of any activity which follows immediately

Project Float:
- Total amount of time that the project can be delayed without delaying the externally imposed project completion date required by the customer or sponsor.

# How to calculate the Critical Path for a Network Diagram

- Find out the length of all the paths in the network diagram

- The longest path is the critical path

# Performing Network Analysis

Let us try to do this through an example.

For the table below, we have to calculate

- Critical Path
- Slack for all the tasks
- The customer wants a completion date within 25 days, so we also have to calculate the project float

10 days

Task 2

4 days

3 days

Task 5

Task 1

6 days

8 days

Task 3
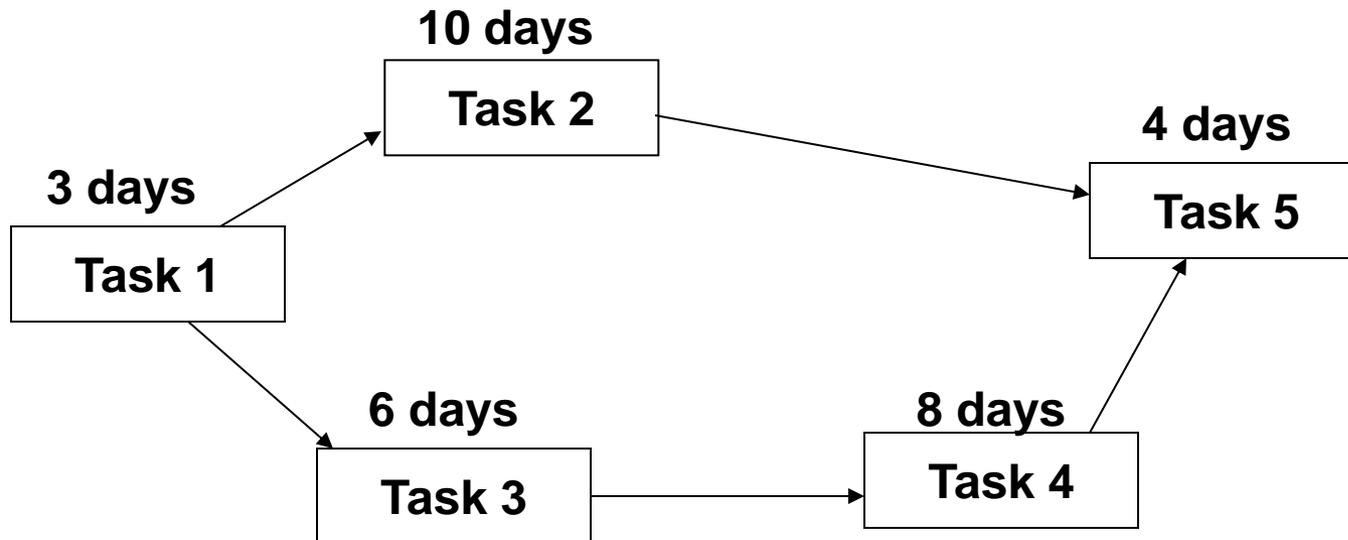
Task 4

Step 1: Draw a Network Diagram (Forward pass, calculate the ES and EF dates)
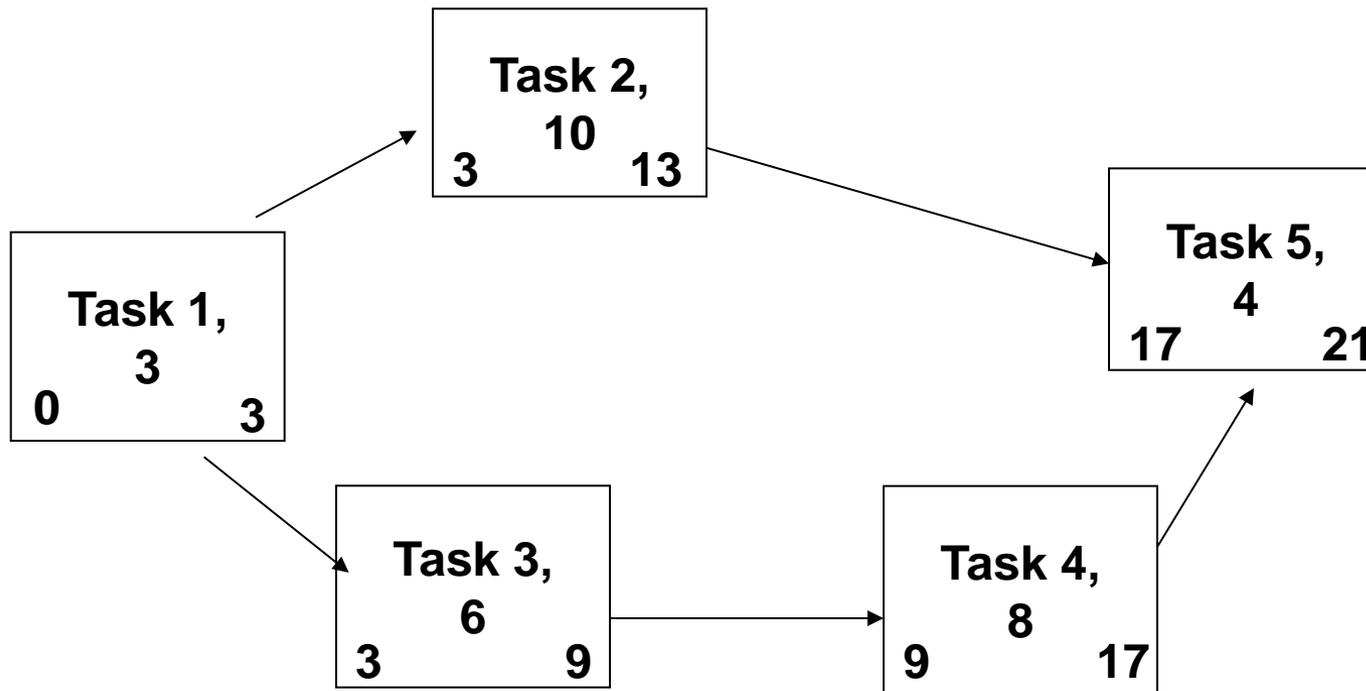
- Please note: Task 5 can only begin after Task 2 and Task 4 are complete.So, the ES for Task 5 is 17 days (because Task 4 ends after 17 days)
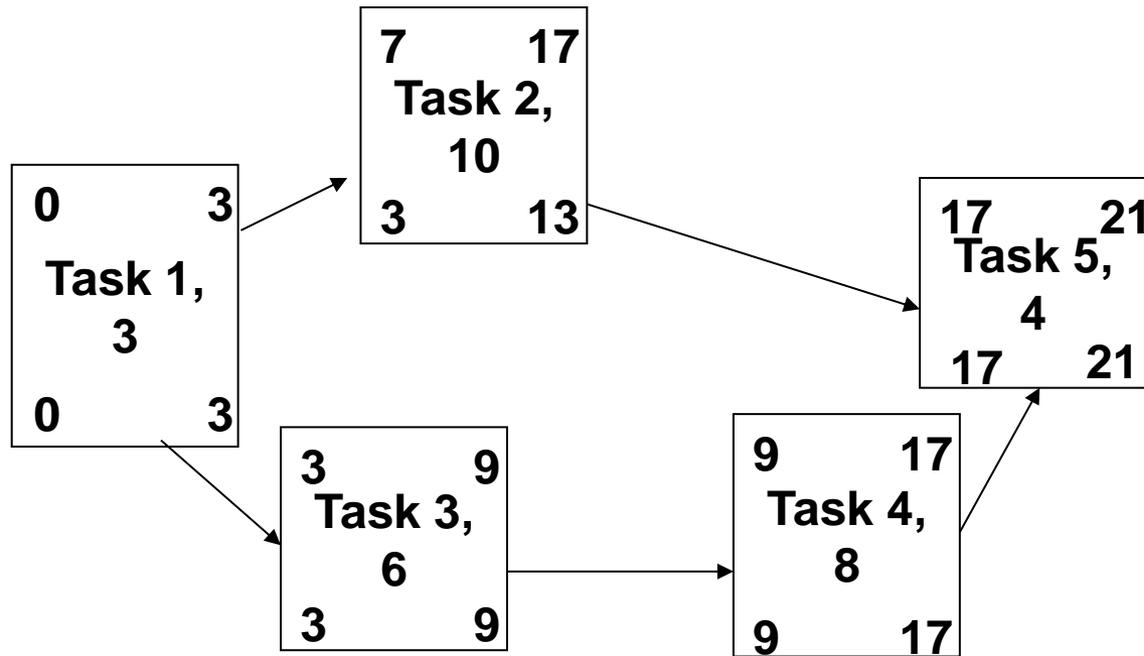
Step 2: Calculate the length of all the paths, determine Critical Path

Length of all tasks
• Task1 -> task2 -> task5 : 3+10+4 = 17 days
• Task1 -> task3 -> task4 -> task5 :3+6+8+4 = 21days
• Critical path = longest path = 21 days

- Please note that this is similar to the result we got while calculating the EF for task 5 (i.e. 21 days)

Step 3: Calculate Float in all tasks – Backward Pass

```
                    ┌─────────────┐
                    │ 7        17 │
                    │  Task 2,    │
                    │   10        │
                    │ 3        13 │
                    └─────────────┘
┌─────────────┐                         ┌─────────────┐
│ 0         3 │                         │ 17       21 │
│  Task 1,    │                         │  Task 5,    │
│   3         │                         │    4        │
│ 0         3 │                         │ 17       21 │
└─────────────┘                         └─────────────┘
          ┌─────────────┐   ┌─────────────┐
          │ 3         9 │   │ 9        17 │
          │  Task 3,    │   │  Task 4,    │
          │   6         │   │   8         │
          │ 3         9 │   │ 9        17 │
          └─────────────┘   └─────────────┘
```

Please note:
- For all tasks in the Critical Path (i.e. Task1, Task 3, Task 4, Task 5, in this example) EF = LF and ES = LS
- Hence, Slack for tasks on Critical Path = LF – EF = LS – ES = 0

- Slack for Task 2 = LF – EF = 17 – 13 = 4

Step 4:Calculate Project Float

- Customer wants an end date of 25 days.
- Hence project float:

  - = Total amount of time that the project can be delayed without delaying the externally imposed project completion date required by the customer.
  - = 25 – 21 days = 4 days.

- Please note: The project float can be negative, i.e. the date imposed by the customer is before the duration required in the project schedule. In that case, the project needs to be crashed or fast-tracked.

Project Planning Tool - Crashing

- If we have to decrease the duration of the project, then it may be necessary to assign additional resources to tasks and decrease the duration required for those tasks. This is referred to as crashing.

- Calculation for crashing is usually a simple exercise, where we try different alternatives to determine how to get the desired duration compression with the minimal increase in cost.

Affinity Diagrams

- Developed by Kawakito Jiro, Affinity diagrams or KJ diagrams are widely used in Six Sigma projects to categorize ideas from brainstorming sessions into groups and subgroups depending on their relationships.

- Important steps followed in creation of affinity diagrams:

    ◦ Jot down all ideas generated after a brainstorming session.
    ◦ Ask the team to group ideas together into relevant groups and subgroups.
    ◦ Use multivoting to get inputs from all individuals about the groups and subgroups, and in creation of affinity diagrams.
    ◦ Once the affinity diagram is created, it typically looks like an organization chart which shows how the opinions and ideas are related to each other.

Process Decision Program Charts (PDPCcharts)

- PDPC charts are an effective tool to map conceivable events and contingencies that may occur in any implementation plan. In a Six Sigma project, the charts help in determining the potential problems before they occur so that corrective action can be taken.

- PDPC process:
  - Select a team which is aware of the process and possible risks.
  - Create a flow chart which shows the activities of a project plan – place them in a flow chart.
  - For each task in the plan, jot down what could possibly go wrong, and mention that in the plan.
  - Determine possible explanations for, or solutions to the problems identified.

- Inputs from the PDPC process could be valuable in creation of a Risk Management or Risk Mitigation plan later in the project.