European Commission

PM²

Project Management Tools & Techniques

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Introduction

The purpose of the PM^2 Project Management Methodology is to enable European Commission Project Managers (PMs) to deliver solutions and benefits to the European Commission through the effective management of project work.

This document presents a set of Tools & Techniques addressing different areas related to project management and project portfolio management.

Each Tool & Technique is summarised in 2 or 3 pages. It provides a high-level overview and summary guidelines on how to use it as well as relevant references and sources for further reading.

The set of tools presented is by no means the complete set of tool used in project management - new tools will be added as their description becomes available.

We hope that you find the first version of this publication useful and complementary to all our other publications, that you have fun exploring further the Tools & Techniques and that you increase your productivity by using them!

The CoEPM^2 Team.

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1. The GROW Model

Description and Purpose

Knowledge area: Benefit Realization and Measurement

The GROW Model was introduced by John Whitmore to facilitate the setting of goals and the designing of plans on how to achieve them. GROW is an acronym for **G**oal, **R**eality, **O**bstacles/**O**ptions and **W**ill/**W**ay Forward. When applied within the context of a project, the GROW model enables the project teams to set goals and review the action plans in order to achieve them. These goals can be related to both the outcomes of the project (project goals) as well as to the individual performance of team members (individual goals).

The four key elements of the GROW Model are described below:

- **G**oal: An objective that the project team aims to achieve.
- **R**eality: An assessment of the current situation, issues and challenges faced.
- **O**bstacles/**O**ptions: Roadblocks in achieving the goals and options on how to overcome them.
- **W**ill/**W**ay Forward: Action plans to overcome the obstacles to move ahead in a project.

The goals set by the project team should be specific and monitored from time to time. The goal setting can be done through the use of frameworks like **SMART**, **PURE** and **CLEAR**. At any stage of the project a review could be done of the current environment to understand the problems or issues faced by the project team. The project team lists the current and expected future obstacles to achieving the stated goal, and brainstorms on the different options that can be taken to overcome them. Action plans are designed and executed based on the options identified. The goals are reviewed again at a later stage in the project and the cycle is repeated.

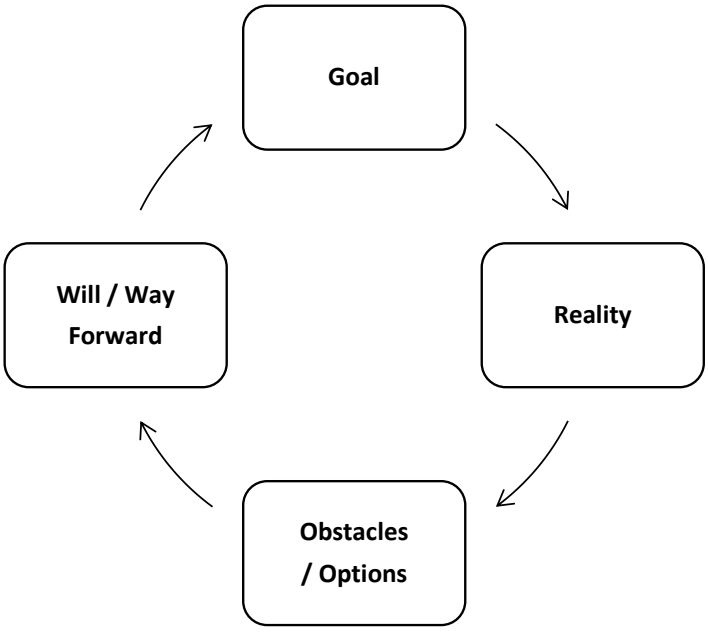

Figure 1.1: John Whitmore Model

Using the Tool/Technique

Below are the steps to set goals and review the actions using the GROW Model.

Step 1: Set the goals

- Project goals should be set by the Project Managers (PMs) in consultation with the project team. Effective goal setting can be done through the use of frameworks such as SMART, PURE or CLEAR.

SMART Goals:

- **S**pecific: The goals should be clear and unambiguous.
- **M**easurable: There should be a well-defined criterion for measuring progress of goals.
- **A**ttainable: The objective should be realistic and not extreme so that it can be achieved.
- **R**elevant: The goals should be aligned to the effort and time being invested.
- **T**ime Bound: Target date should be set for all the goals so that there is a constant focus.

PURE Goals:

- **P**ositively Stated: The goals should be stated in a positive rather than a negative way.
- **U**nderstood: The goals need to be interpreted by everyone in the same manner.
- **R**elevant: The goals should focus on the wider vision and be aligned to other goals.
- **E**thical: Goals should be aligned to the best practices of the larger organisation.

CLEAR Goals:

- **C**hallenging: The goals should stretch and push the team so that there is constant focus.
- **L**egal: Goals should abide the law of the land and be in line with the larger organisation.
- **E**nvironmentally sound: Goals should keep the environmental aspects in consideration.
- **A**ppropriate: Goals should be appropriate and relevant to the larger organisation.
- **R**ecorded: Goals should be written down and visible so that the focus is not lost.

Step 2: Understand the reality

- The current situation should be assessed carefully as to identify the faced issues and challenges. A good understanding of the circumstances is important to effectively use and execute the GROW model.

Step 3: Identify the obstacles and options

- Identify risks and issues that may arise during the life of the project or activity, as well as propose the actions necessary to manage these.

These risks and issues are the obstacles, and the proposed actions are options in order to achieve the goals.

Step 4: Plan the way forward

- An action plan as to overcome the identified obstacles and options needs to be outline in order to move forward and to attain the overall project goals or objectives.

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- **John Whitmore. Coaching for Performance: Growing People, Performance and Purpose**. WS Bookwell © 2006.
- **Goal Setting: How to Create an Action Plan and Achieve Your Goals (Second Edition)**. Michael S. Dobson, Susan B. Wilson. American Association Management © 2008.

2. CIPP Model

Description and Purpose

Knowledge area: Project Reviews and internal Audits

The CIPP Model is a framework for project evaluation at different stages of a project. The model takes into consideration the following elements of a project: Context, Input, Process and Product. The model was developed by Daniel Stufflebeam in 1960s and is now used to evaluate various project scenarios.

The CIPP model project evaluation is relevant to the needs of the decision makers during different phases and activities of a project. It provides an assessment of a project scenario with feedback on the project's effectiveness for continuous improvement. Below are the descriptions of the different elements which are considered during the evaluation.

- **Context**
  Assess project needs, problems, assets and opportunities to define goals and actions.
- **Input**
  Assess feasible and cost-effective plans for achieving project goals and objectives.
- **Process**
  Assess actions and implementations of project plans that are being carried out.
- **Product**
  Assess and identify short term and long term outcomes of the project.

The overall goal of the CIPP model is to use the observable information regarding the context, input, process and product of a project in order to evaluate process efficiency.

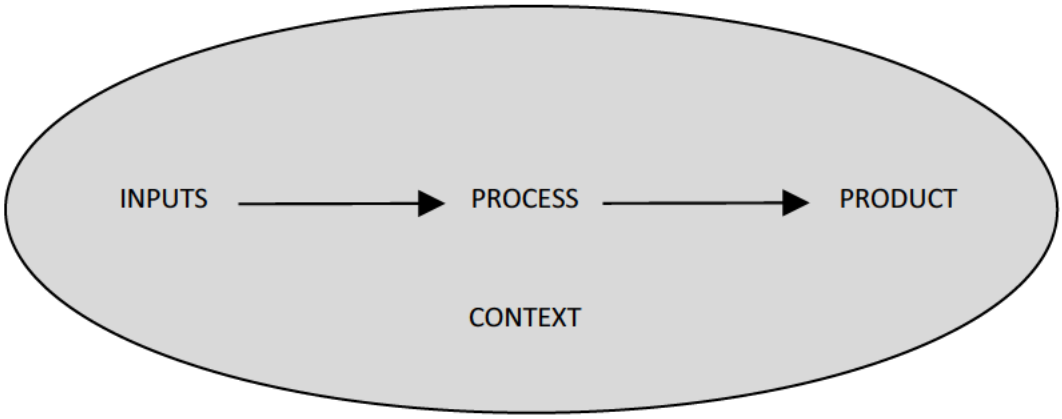

Figure 2.1: CIPP Model

Using the Tool/Technique

The CIPP model helps to assess the overall project success factors and the process efficiency. A description of all the steps to follow can be found below.

Step 1: Evaluate the Context

- Collect and analyse data to determine project goals, priorities and objectives. Common methods of data collection are research surveys, literature reviews, and collating expert opinions. Project Managers (PMs) or decision makers determine the strategies to overcome the problem components.

Step 2: Evaluate the Inputs

- This step evaluates the plan for achieving the project objectives by analysing the feasibility and cost-effectiveness of the plan. It includes comparing competing plans, funding proposals,

allocating resources, scheduling work and assigning human resources. Project Managers (PMs) set up and confirm the plans and budgets before taking any action.

Step 3: Evaluate the Process

- **Data is** collected to analyse the actions and implementation plans are designed to achieve the project objectives. Common methods of data collection are baseline observations, test results that can be compared against a time frame sequence, and comparing stated objectives with observed effects. It helps the Project Managers (PMs) to measure the process efficiency.

Step 4: Evaluate the Product

- This step evaluates the outcomes of the project, both for short and long term. Data is collected from testing the complete design and comparing it with other designs and projects. It measures the overall success of the project in achieving the desired goals and objectives.

Measuring the outcomes of the project and comparing them with the project objectives provides Project Managers (PMs) inputs whether to continue, modify or drop an existing project. However the CIPP model is complete and robust, there are a few limitations in the process involved. The process of getting the requirement details from several stakeholders can be slow, costly and complex. It can also be difficult to measure the process efficiency due to the complexity of the processes or due to internal political issues.

Overall the CIPP Model is a systematic and standardised process for any project evaluation.

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3. PESTEL Analysis

Description and Purpose

Knowledge area: Requirements Gathering and Management

The PESTEL Analysis is a used tool to understand how an objective/goal is impacted by the environment one is operating in. It provides information about five factors: **P**olitical, **E**conomic, **S**ocial, **T**echnological, **E**nvironmental, and **L**egal that could have an impact on the project. This analysis helps to brainstorm about the influence of each factor, as well as drawing a conclusion from it. This tool can be used in any type of project where external factors could have an impact on the objective or execution of the project.

The PESTEL analysis helps the project team to take into account changes in environment positively, so that there is a higher probability of success. Understanding the environment factors, which are beyond one's control, helps to make a plan to tackle difficult potential scenarios. This analysis should be free of assumptions and based on realities of the current environment.

The project team first identifies which of the factors are relevant for the current project objective. The team then starts to brainstorm on the identified factors and assembles information on each factor. Afterwards, this information is used in order to establish conclusions on the impact of each of the five factors. In addition, these conclusions will feed the process of designing a plan on how to tackle potential risk scenarios.

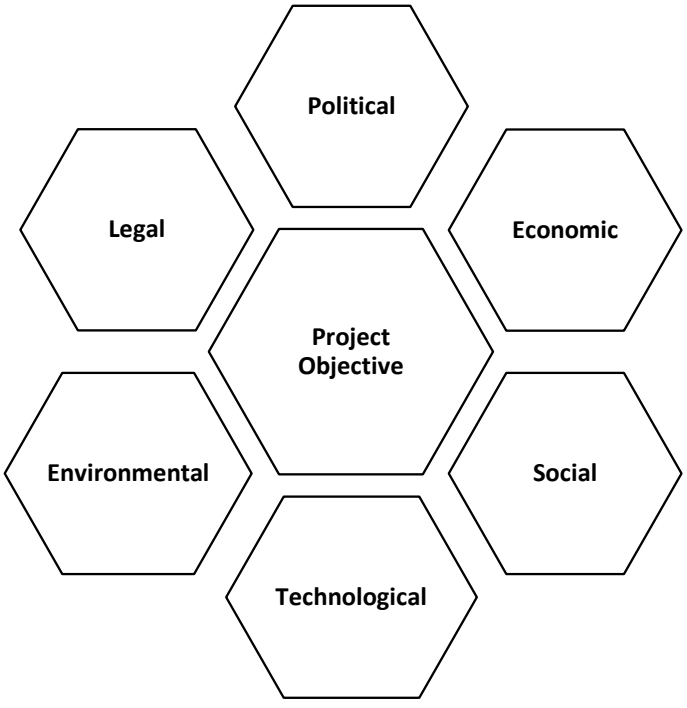

Figure 3.1: PESTEL Framework

Using the Tool/Technique

The PESTEL Analysis considers the five factors below that could impact the project objective or execution and helps the project team in understanding the current environment:

Political

- These are factors which could have an impact on the project through a related tax or labour policy, market regulations or other political governance issues.

Economic

- These are factors which could have an impact on the execution of the project. These include factors related to economic growth, interest rates, budget cycles and other economical governance issues.

Social

- These are socio-cultural factors that could have an impact on the project objective. These factors could consist of the population growth rate, age distribution, social attitudes and preferences, lifestyle choices, cultural changes, etc.

Technological

- These factors relate to the technological aspects, for example: research and development activity, automation changes, emerging technology, outsourcing decisions, etc.

Environmental

- These factors include ecological and environmental aspects, which might have an impact on some industries like tourism, farming, insurance, which may be related to the project. The factors include changes in weather, climate, landscape, etc.

Legal

- These factors relate to which legal bindings operate the execution of the project. This could include discrimination law, consumer law, antitrust law, employment law, health and safety law or other legal governance issues.

The PESTEL model covers almost all the factors that could have an impact on the project objective. In some cases of use, the PESTEL model has been extended to STEEPLED model, adding Ethics and Demographics factors as well. However, the project team only needs to consider the factors which are relevant to the current project objective or execution and to list down the factors impacting it. This results in planning the right actions for countering any factors adversely impacting the project.

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4. Organising a To-Do List

Description and Purpose

Knowledge area: Time Management

Projects are not run in a vacuum; they are run in an organisational context. As a result, during the life of the project, the Project Manager (PM) and team will get lost in the day-to-day activities and get sucked into spending time on activities that do not directly contribute to the project goals. It is important to manage available time well during projects by understanding the priority of activities. It helps to organise a To-Do list by focussing on which activities need urgent attention and are important for achieving project goals.

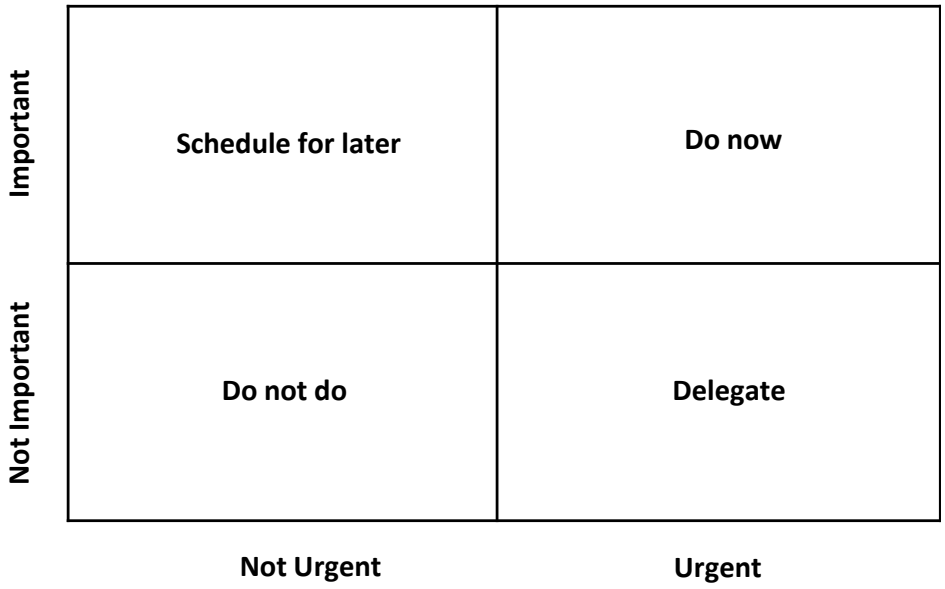

Figure 4.1: Eisenhower Matrix

A To-Do list can be organised using an Eisenhower Matrix as shown in Figure 4.1 above. The matrix categorises tasks into different quadrants based on importance and urgency. It is important to understand these two types of categories in order to organise activities during projects:

- **Important**: These activities have a direct effect on the outcome and achievement of the project goals.
- **Urgent**: These are activities that demand immediate attention before their consequences affect project goals.

Based on the urgency and importance of activities, the Eisenhower Matrix categorises activities in the following four quadrants:

- **Do Now**: Urgent, Important activities that are **Critical Activities** of the project.
- **Schedule for later**: Not Urgent, Important activities that are **Important Goals** of the project.
- **Delegate**: Urgent, Not Important activities that are **Interruptions** of the project.
- **Do not do**: Not Urgent, Not Important activities that are **Distractions** of the project.

Once the activities or tasks of a project are categorised, the Project Manager (PM) can easily organise a To-Do list and optimise his or her time.

Using the Tool/Technique

The Eisenhower Matrix is a simple tool to organise a To-Do list to effectively manage time during the execution of a project. Below are the steps to create and use the Eisenhower Matrix.

Steps

- List all the day-to-day activities that need to be completed for the project.
- Rate the importance of each activity on a scale of 1 (Low) to 5 (High).
- Rate the urgency of each activity on a scale of 1 (Low) to 5 (High).
- Plot the activities on the Eisenhower Matrix (Urgency Rating, Importance Rating).
- Organise a To-Do list according to the categorisation of activities in the four quadrants.

Different strategies should be employed for the activities categorised in the four quadrants.

Do Now - Critical Activities – Urgent, Important

- These are activities which are unexpected and unplanned but are both important and urgent.
- The Project Manager (PM) or person organising this To-Do list should take care of these activities immediately – all other activities should be put on hold.

Schedule for later - Important Goals – Not Urgent, Important

- These are important activities that help to achieve the project goals.
- Time should be allocated to complete these activities before they become urgent issues, and it is important to not allow a backlog of these activities to build.

Delegate - Interruptions – Urgent, Not Important

- These are activities that must be done urgently, but that do not directly contribute towards the achievement of project goals.
- These activities should be delegated so that they are urgently taken care-of.
- How important a task can be before it is not delegated is up to the person doing the to-do list, however keep in mind that managing the importance of delegated tasks is a key aspect of project team management and can directly affect team morale.

Do not do - Distractions – Not Urgent, Not Important

- These are activities that are not urgent and have no relation to the project objectives or goals.
- These activities should be avoided as much as possible.
- The Project manager should either cancel or ignore them. If such activities are handled accordingly, others may not request for action on such activities in future.

It is easy to get lost in the day-to-day and a linear list of to-do's that grows on a daily basis. It is important to prioritise activities and understand what contributes to the project and what does not. Using a standard prioritising method like the Eisenhower Matrix helps to keep the focus on important activities that lead to the achievement of project goals and objectives.

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5. FSNPA Model of Team Performance (Tuckman's Model)

Description and Purpose

Knowledge area: Human Resources Management

In the context of a project, teamwork should be effective and well guided by the project Manager. However, it usually takes time and effort before a good level of effective teamwork can be achieved, as team members go through different stages of group development with regard to understanding the group behaviour and supporting each other in the establishment of project deliverables.

The FSNPA model was developed by Bruce Tuckman in 1965. He stated that any group goes through five different phases of team building before it can start performing effectively. It is important for a project Manager to understand these stages in order to guide the group towards an improved project team performance. The five stages of group development are described below.

- **Forming**: Team members meet each other and gather information about the project.
- **Storming**: Differences and conflicts arise between members regarding project issues.
- **Norming**: Teams settle down differences and start contributing towards the deliverable.
- **Performing**: The team performance level is at its peak and team members are highly motivated to contribute in the finalisation of the deliverable.
- **Adjourning**: Team members separate from each other after completion of the project.

It ultimately becomes the responsibility of the Project Manager (PM) to help the team reach the performing stage as early as possible in the project and sustaining it as long as necessary. Project Managers (PMs) should be able to adapt their management approach according to the stage the project team is in order to facilitate the team development.

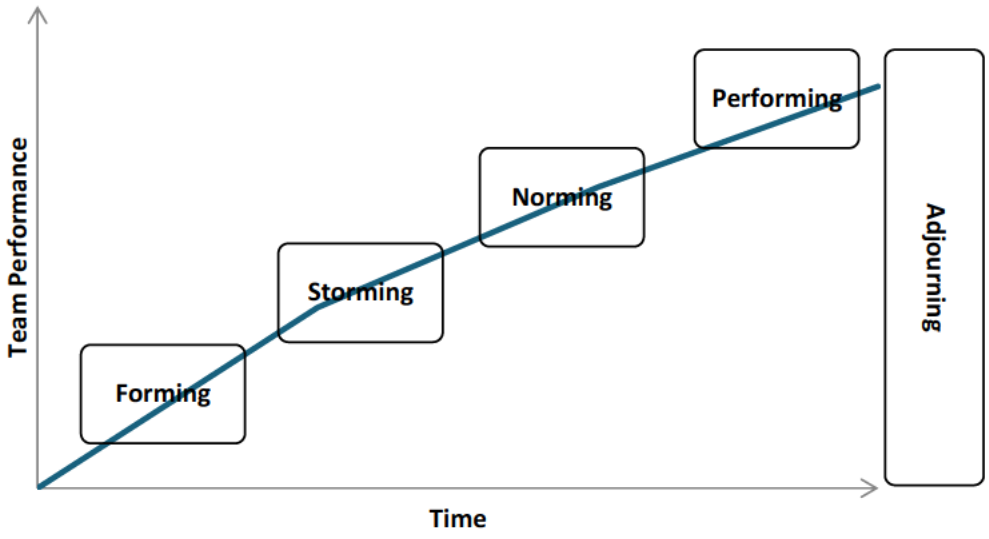

Figure 5.1: The Tuckman Model (FSNPA)

Using the Tool/Technique

Below are the five stages of team development, within the Tuckman's Model, that project teams undergo with the aim of reaching a high level of team performance.

Stage 1: Forming

Team members:

- The team members gather information about the project and scope of activities.
- They behave quite independently and form an impression about other team members.
- The behaviour of the group is driven by a desire to get acceptance from others.

Project Manager:

- Project Managers (PMs) need to be directive in this phase as team members work individually.

Stage 2: Storming

Team members:

- In this phase ideas and solutions from team members may compete against each other.
- The team addresses project issues (leadership model, communication channel etc.).
- Differences, issues and conflicts stimulate the development of project team members.

Project Manager:

- Project Managers (PMs) should provide guidance on professional behaviour during this time.

Stage 3: Norming

Team members:

- Team members start respecting other views or opinions and come to an agreement.
- Trust begins to develop through the valuable contribution of team members.
- Individual team members play a greater role in handling project responsibilities.
- Team members start supporting each other in the establishment of project deliverables.

Stage 4: Performing

Team members:

- The team is highly motivated and knowledgeable resulting in a peak performance.
- Members are now competent, autonomous and able to make decisions on their own.
- High degree of comfort in the group is stimulating the completion of project tasks.

Project Manager:

- Project Managers (PMs) contribute as team members rather than as supervisors.

Stage 5: Adjourning

Team members:

- This stage is about completion and disengagement from project activities and members.
- Individuals recognise their effort as part of the group and move on to other projects.
- Also described as the Deforming and Mourning stage as team members get separated.
- This phase can be difficult for team members who developed close work-relations.

In order to improve the project team performance, the main focus of the project Manager should be to understand the stage of group development the project team is currently in. The model also states that due to changes in the project environment, the group may tend to return to the previous stage of the Tuckman Model. These changes in the project environment could be a new project Manager, a change in project team members or changes in the project goals or objectives. Whenever this occurs it is important to go through the different stages of the Tuckman model again.

References & Sources for Further Reading

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6. Effective Communication

Description and Purpose

Knowledge area: Stakeholders management and communication

Communication is the process of exchanging information and ideas. It is an active process as it involves encoding, transmitting and decoding of messages.

The sender of the information will, first of all, transform the message in a way the receiver can understand it. Secondly he needs to find a mean to transmit it to the receiver. And the third step is the receiver who has to decode the message to understand it.

This is a process that everybody does on a daily basis and we hardly think about it when performing it.

Communication becomes effective once the message is understood by the receiver as intended by the sender. This entails that the sender (in verbal communication) has to consider the following skills:

Figure 6.1: Effective communication

Some of the skills are briefly discussed hereafter:

- Eye contact & visible mouth: look at your audience/person and don't hide your mouth.
- Body language: your body speaks to your audience so align the body language to your speaking language (don't say that the figures are excellent while looking sad).
- Silence: when asking questions or feedback give the audience the time to react/reflect.

Also bear in mind that the more persons or groups are at the receiver's side the harder it becomes to have your message transferred in a clear and concise manner. So try to limit the audience for your message and send maybe several messages to smaller groups.

Effective communication helps in problem solving and conflict management.

Using the Tool/Technique

Effective communication is not a tool that you can download and run every time you have a message to transmit. It is more a technique where guidelines can be given and it is up to the sender to decide what the best way is to communicate the message to the receiver(s).

As stated in the previous paragraph effective communication happens in 3 steps. Each step is elaborated hereafter.

Step 1: Encoding the message

- Encode the message according to the following principles:
  Messages must be direct: state what you want instead of sending hints.
- Own your messages: say what you think/want and do not say the team, some people, etc.
- Messages must be complete and specific: do not leave out important information.
- Messages must be clear and consistent: avoid ambiguity and leaps of logic.
- Separate facts from your opinion.
- Focus on one thing at the time.
- Find the proper granularity for your audience (remind that less is better).
- Adapt the style of communication to the listeners (formal, scientific, aesthetics).

Step 2: Transmitting the message

- The message is now in the right format. The next step is to transmit it to your audience.
- When transmitting a message keep in mind the following equation:
- 40% of the message is what you hear: tone of voice, vocal clarity, verbal expressiveness.
- 50% of the message is what you see or feel: facial expression, dress and grooming, posture, eye contact, gesture.
- Only 10% of the message is about the words you're saying.
- As a consequence be concise of the impact of all the other aspects besides the wording.
- Decide on the medium to use for the communication. Some media allow to have direct reaction/contact whilst others not (e.g. live presentation versus an email).
- When the receivers cannot react instantly to your communication then state clearly how one can react and specify a timeframe for the reactions.
- Decide on the right timing for your message. Be aware that no other communication of a higher importance is sent at the same time so that your message is neglected.

Step 3: Decoding the message

- The receiver got the message and now has to take out all the "noise" of the message. Noise refers to external influences that prevent the correct interpretation of the communication.
- Noise is categorised in the following groups:
- Psychological noise: this comes from our assumptions, stereotypes, reputations and you can become blinded for the original message. It is difficult to free yourself from this.
- Physical noise: any external or environmental sound that distracts you.
- Semantic noise: caused by the sender because of specific grammar or technical language that the receiver does not understand.
- The receiver will now read and hopefully understand the message.

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- **In the Company of Others: An Introduction to Communication**, Rothwell Dan J. McGraw Hill © 2004.

7. Project Stakeholder Matrix (PSM)

Description and Purpose

Knowledge area: Stakeholder Management

A project stakeholder matrix (PSM) is a specific artefact in the PM² methodology. This chapter starts with the PSM as defined in the guide and adds another dimension to it.

This dimension is more a personal view of the project manager on the stakeholders. This overview can also be useful in case the project manager is changed during the project as a handover document. Keep in mind that this part of the Project Stakeholders Matrix is confidential and should not appear in a public part of the project repository.

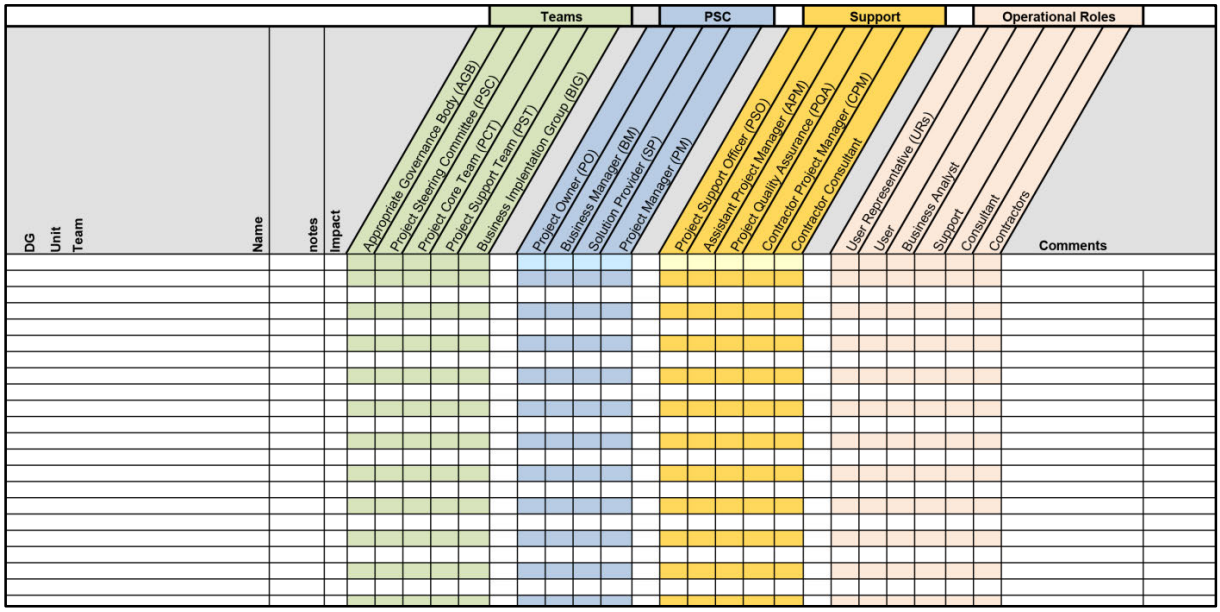

Figure 7.1: Example of Project Stakeholder Matrix

Using the Tool/Technique

Step 1: Start with the existing project stakeholder matrix (PSM)

- The existing PSM is taken as the basis.

Step 2: Take the second sheet of the template

- Go to the second sheet of the template.
- Define how many top stakeholders you have (suggestion to take between 3 and 5).
- Make a copy of this sheet for each of the defined stakeholders.

Step 3: Fill in the fields (for each identified stakeholder) following the guidelines given hereafter

The fields are grouped into several logical units. Every unit /field is explained hereafter.

- Personal information: contains additional fields (e.g. email, mobile, etc.).
- Active: to indicate for each phase the expected involvement of the stakeholder. The value is translated in a colour line to give a clear picture of the involvement over time.
- Communication profile: used to detail the ways of communication and the frequency of it for this stakeholder. Information is taken from the communication plan and specific information can be added (e.g. a face-to-face (FTF) in case of a crisis).

- Influence: this topic has 3 sub-topics. The first one being the power the stakeholder has on the project to Make/force decisions. The second one is about the interest he/she has in the project (e.g. the outcome can help in having a promotion). The last one is the influence to guide/direct the project.
- Risk appetite: for the 3 main areas (budget, timing, and scope) the risk appetite of the stakeholder can be given. This can be useful when a change/issue is encountered to predict the possible reaction of the stakeholder.
- Concerns and needs: here you can add specific concerns needs that the stakeholder expressed to you (e.g. GO LIVE date cannot change due to legal constraints).
- Details: any interesting fact you learn about your stakeholder can be put under this topic. It can go from the names of the children up to hobbies.

Step 4: Protect the document

- As this document contains personal and subjective information put a password on it.
- Store this document in a private folder and not on the project server.

References & Sources for Further Reading

- Stakeholder analysis in projects: Challenges in using current guidelines in the real world**,** Jepsen Anna Lund , Eskerod Pernille.©2008

8. Stakeholder Importance-Influence Matrix (SIIM)

Description and Purpose

Knowledge area: stakeholder management, communication, requirements management

This technique is used to facilitate and document the analysis of the influence and the importance of each stakeholder in the project. As Project Manager (PM) it is out most important to know your stakeholders and what they can mean/do for your project. This can be in a positive and in a negative way.

The importance of a stakeholder indicates the extent to which his needs and interests will be prioritised by planned activities. This means that a stakeholder is considered important when his needs and interests will get a higher priority when creating/revising the planning. As a consequence he will be faster contacted when a revision of the planning is possibly needed to get his/her feedback.

The influence of a stakeholder for the project is the power he has over the planning and implementation of activities. A stakeholder that can demand a change in the planning has a big influence on the project. Most of the time the person(s) that can allocate money and/or resources to the project is (are) considered to have a high influence.

Using the Tool/Technique

Step 1: List the stakeholders for the project

- Take from the Project Stakeholders Matrix (PSM) all stakeholders and put them on a list.
- If a stakeholder is not a physical person but a group then take the person who represents the group.

Step 2: For each stakeholder access the importance of the project

- For everybody on the list rate the importance of him/her to the project between 1 and 5 where 5 is very important to the project and 1 is hardly important to the project.
- Put the number next to the name of the stakeholder.

Step 3: For each stakeholder access the influence he has on the project

- Do the same as in step 2 but now for the influence the person has over the schedule of the project. Again 5 means that she/he has large influence over the schedule and 1 means nearly no influence over the schedule.

Step 4: Plot the position in the matrix as shown hereafter

- With the two numbers obtained from the previous steps plot the results in the matrix as shown hereafter.
- Check for each stakeholder in which group he is and read the suggestions put hereafter.
- If you created a Project Stakeholders Matrix (PSM) then add the numbers obtained also in the PSM.

Step 5: Read the specification for every stakeholder

- For every stakeholder read the possible points of attention as described hereafter.
- Deduce actions from these points of attention.
- Put these actions in your personal agenda.

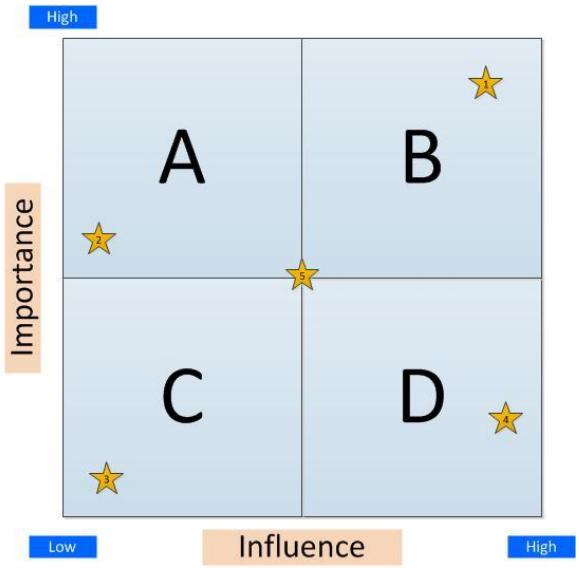

Figure 8.1: Stakeholder Importance/Influence Matrix

The four major parts in the table and the way to handle them are briefly described hereafter.

Part A: PROTECT: consists of stakeholders that have a great importance in the project but, unfortunately, have low influence. Special attention is needed to protect their interests as they don't possess the required influence to protect their own needs.

Part B: GOOD RELATION: these stakeholders have a huge interest and also a big influence in the project. You need to set-up a close working relationship with them. Also agree the ways of communicating with them besides the standard communication agreements. This can be a face-to-face update on a daily/weekly basis.

Part C: LOW PRIORITY: this group has a low priority for the project and practically no influence so your involvement in them should be a minimum. However be aware that they keep a positive attitude to your project so don't neglect them.

Part D: MONITOR: this group may be a source of risk as their influence is high but the importance of the project is low for them. So they need to be carefully monitored and managed to make sure that they don't lose their interest in the project or, even worse, become a blocking factor.

References & Sources for Further Reading

- http://www.icra-edu.org/objects/anglolearn/Stakeholder_Matrices-Guidelines(new).pdf
- http://www.apmasnetwork.org/node/80

9. Running Effective Meetings

Description and Purpose

Knowledge area: Progress Reporting

Running a project and more so with running many projects, means running and attending many meetings. Typical project meetings include:

- Project team meetings.
- Steering Committee Meetings.
- Status meetings.
- PMO meetings.
- Cross-project synergy meetings.
- Programme Management Meetings.

The ability and habit of running these meetings efficiently and effectively means that they are more focused, achieve results, help the project and actually positively contribute to time management of the team.

In several organisations, employees can lose a lot of time in project related meetings that lack a clear agenda or finish without a set of follow-up actions. It is first important to understand the objectives of meeting in order to design the meeting in the most effective manner. The following list provides a description of the most common types of meeting:

- **Action-Oriented Meetings** are intended to solve a time sensitive problem where it is important to come up with quick solutions rather than debating on alternative solutions – at the end of the meeting there should be a clear action list with action owners.
- **Brainstorming or Creative Meetings** tend to be longer and focus on creating an open and innovative environment to generate ideas – for these meetings it is useful to employee frameworks and tools, such as affinity diagrams, to manage the discussion.
- **Short-Term Planning Meetings** include representatives from different departments, and aim to take decisions on short term goals, to escalate other decisions to senior management – the outcome of the meeting should be a clear agreed-upon plan with milestones and stakeholders.
- **Long-Term Planning Meetings** should include high level executives, and generally revolve around defining the organisational goals and strategy – the outcome of the meeting should include a distribution of the ownership of these goals and high level activities.

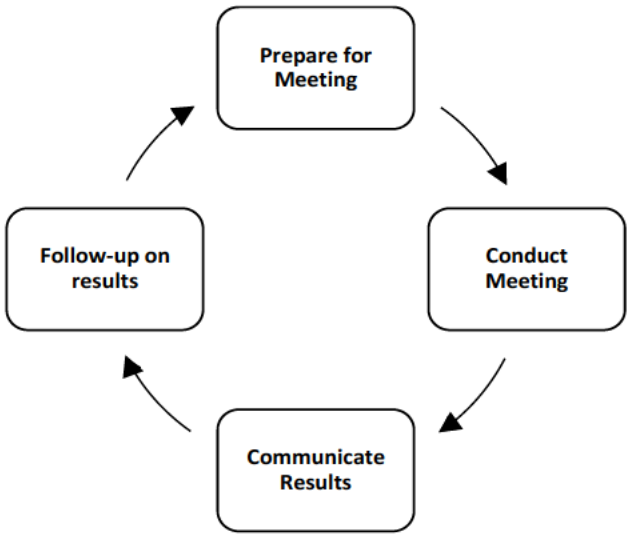

Figure 9.1: Meeting Process

Figure 9.1 provides a set of general steps that should be taken to ensure that meetings are run efficiently and effectively. This model focuses on thoroughly preparing the meeting to ensure attainment of the objectives, and to improve communication and follow-up past meeting. The overall concept is to be more focused and concise, and to ensure that meetings result in a set of key actions.

Using the Tool/Technique

Running effective and efficient meetings helps the project to progress at a faster pace with limited usage of resources and time. Below are the steps to conduct an effective meeting:

Step 1: Prepare for Meeting

- Define the objectives of the meeting.
- Define the type of meeting and any important tools to aid in running the meeting.
- Prepare an agenda stating the meeting objectives and expectations.
- Define a list of invitees, keeping in mind that it is better to only invite the necessary stakeholders, and that smaller meetings are more effective.
- Send the agenda along with the invite.

Step 2: Conduct Meeting

- State the meeting objectives and set the ground rules for the meeting at its beginning (for example no food, no usage of electronic devices).
- Strictly follow the set agenda and try to minimise discussions out of scope.
- For a meeting with several objectives, it is important to prioritise discussions.
- Define speaking time as a means of time-boxing discussion and avoiding deviation from the main topics.

Step 3: Communicate Actions

- Have someone in the meeting take minutes, as well as log decision, issues, risk, and actions discussed during the meeting.
- Send the minutes of the meeting as soon as possible after the completion of the meeting.

Step 4: Review Actions

- Action items of the meeting notes should be reviewed as per the target dates.
- Reminders should be sent to the concerned members, who need to take actions.
- Review of work done and work pending should be conducted in follow up meetings.

For larger or longer meetings, and particularly for brainstorming meetings, it is helpful to have supporting staff performing all the record keeping and assisting in the facilitation of the meeting. These roles include:

- **Timekeeper**: Reminds the facilitator about the time allotted for key agenda items.
- **Notes Taker**: Records and summarises the meeting minutes and distributes meetings notes.
- **Whiteboard Notes Taker**: Writes ideas on the whiteboard during brainstorming sessions and records the final points from the board to send to all invitees.

The organiser should take charge of the meeting and ensure that the discussion runs smoothly. Do not hesitate to table, or put aside, topics that do not contribute to the meeting objectives, or are not part of the agenda. The focus of the meeting should be to collect constructive inputs from everyone present, and at the end of the meeting everyone should be aware of the key decisions and actions that must be taken care-of.

References & Sources for Further Reading

- http://www.openforum.com/articles/how-to-run-an-effective-meeting-a-small-business-guide/
- http://www.mindtools.com/CommSkll/RunningMeetings.htm
- http://www.inc.com/guides/2010/08/how-to-run-effective-meeting.html
- **Successful Meetings: How to Plan, Prepare, and Execute Top-Notch Business Meetings**, Shri Henkel. Atlantic Publishing Group © 2007.
- **The Manager's Guide to Effective Meetings,** Barbara J. Streibel. CWL Publishing © 2003.

10. Work Breakdown Structure

Description and Purpose

Knowledge area: Scope management, Planning

A Work Breakdown Structure (WBS) consists of logically decomposing a project into smaller work components. It is the first step to organise work, taking into account extensive details, in a structured format. A Project Manager (PM) may use a WBS to decompose a project in stages, deliverables, activities, tasks, business units, etc. However a WBS is a good way to define a decomposition of the project work, it does not provide information on time, sequence or dependency of the work. The role of the project team members is to support the Project Manager (PM) in identifying the lower level activities and tasks of the project.

Different WBS techniques can be used to decompose a large project into smaller and identifiable activities. Below are some of the commonly used techniques used by Project Managers (PMs) to create a comprehensive and specific WBS.

- **Project Stages**: Work is broken down into different stages
- **Project Outputs**: Work is divided based on several project outputs or deliverables
- **Work Packages Breakdown**: Work is divided into a list of work packages and tasks
- **Organisation Breakdown**: Work is divided based on departments or business units

WBS is a formal project deliverable and any changes to it should go through a change control process. It is important for the Project Manager (PM) to review the WBS with the project team and the other stakeholders before executing the project.

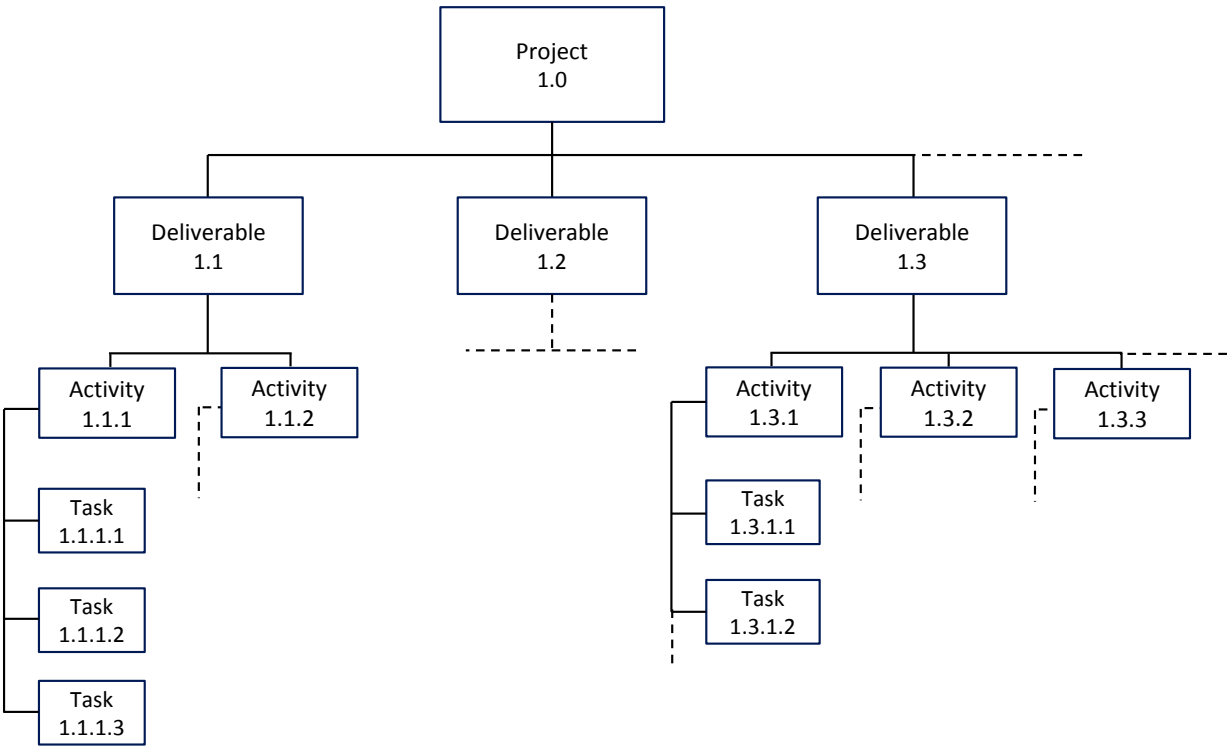

Figure 10.1: Work Breakdown Structure

Figure 10.1 above is an example of a WBS which breaks down the work into work packages and respective activities and tasks.

Using the Tool/Technique

Creating a WBS helps the Project Manager (PM) to logically decompose the project work in order to be both complete and specific while managing a project activities or tasks. Below are the steps to create and use a Work Breakdown Structure in a project.

Step 1: Identify project goal

- Identify the project goals and objectives and the scope of the work involved

Step 2: Determine the breakdown model

- Depending on the scope of the work, determine the break down technique
- Work can be categorised in project stages, outputs, packages, departments, etc.
- Break down the project work into a first level based on the selected WBS technique

Step 3: Divide the work components

- Break down the first level of the WBS into smaller and identifiable work components
- Depending upon the required detail, break down the WBS into a second, third or lower level of work
- A general rule for the decomposition of project work is that each identified element of the lowest level of the WBS, referred to as tasks in the example of Figure 10.1, and cannot involve more than 80 hours. If needed, an additional WBS level will be created.

Step 4: Review the WBS

- Review the complete WBS covering all components linked to the scope of the work
- Include other project activities like periodic reviews or trainings in the overall structure
- Verify that all activities are identifiable and well defined
- The Project Manager (PM) should ensure the completeness of the WBS.

Project Managers (PMs) can use the WBS as a basis to assign different responsibilities, tasks or deliverables in the project.

References & Sources for Further Reading

- http://www.projectsmart.co.uk/work-breakdown-structure-purpose-process-pitfalls.html
- http://www.cmguide.org/archives/1401
- http://www.netmba.com/operations/project/wbs/
- **Work Breakdown Structures: The Foundation for Project Management Excellence**, Eric S. Norman, Shelly A. Brotherton and Robert T. Fried. John Wiley & Sons © 2008.
- **Building a Project Work Breakdown Structure: Visualizing Objectives, Deliverables, Activities and Schedules**, Dennis P. Miller. CRC Press © 2009.

11. Product Breakdown Structure (PBS)

Description and Purpose

Knowledge area: Planning and control

Product Based Planning is a technique that is, amongst other institutions, recommended by Prince2©. A Product Breakdown Structure (PBS) is an essential part for this technique. Its purpose is to define the products (deliverables) of a project and how they relate to each other. The PBS provides an exhaustive, hierarchical tree structure of deliverables (physical, functional or conceptual) that make up the entire project.

Prince2© describes a PBS as “a hierarchical structure that breaks down a final product into its constituent sub-products. It helps the planner to think of what other products are needed to build the final product and to clarify all necessary work for the creation of that final product".

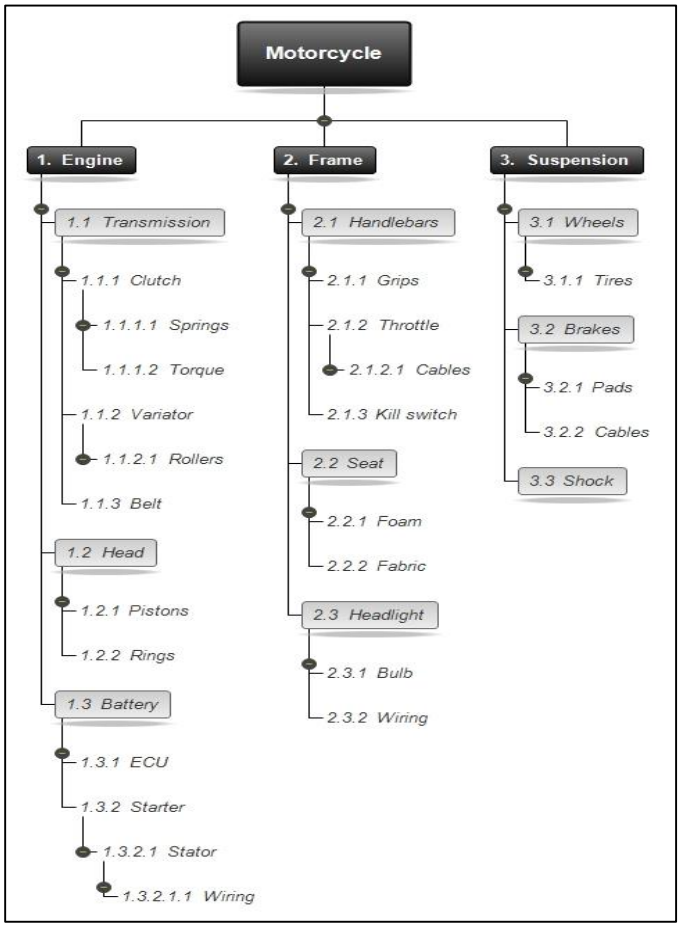

Figure 11.1: Product Breakdown Structure

The Product Breakdown Structure has a similar structure as the Work Breakdown Structure but it is used at a different step in the planning process. The PBS precedes the WBS and puts the focus on representing the desired outputs (products) needed for the project. This feeds the creation of the WBS which identifies the tasks and activities required to deliver these outputs.

Quote: the PBS defines where you want to go and the WBS tells you how to get there.

Using the Tool/Technique

The drawing after the steps presents a product breakdown structure for the simple creation of a motorcycle.

Step 1: Define the high level product

- Define the global outcome of your project meaning what "product" your project will deliver. This can be a software, a building, a document, a conference,…
- Put this on the top of the list
- In the example a motorcycle is taken which is the final product of the project

Step 2: Define the sub parts

- Define all the sub-parts your final product is made of
- Add them at the second level of the WBS
- Connect them with the top level
- The sub parts in the example are 1. the engine, 2. the frame and 3. the suspension

Step 3: Define the sub levels up to the leaves

- For every sub part you keep on dividing this into smaller parts until you have a product that is atomic or can be considered as such, e.g. 3.1.1 tires
- When creating a software system this can be a specific module or a test cycle that generates a report

Step 4: Review the PBS

- Once all parts are known the review of the visual representation of the PBS can be started
- Re-arrange the parts and sub-parts so that a balance is made in the presentation

After these steps the PBS can be used to derive the tasks/activities needed for the WBS or for a product based planning.

Note: There are several tools available on the market to perform this kind of representation (e.g. Visio, PowerPoint, mindmapper, etc.).

References & Sources for Further Reading

- **Effective work breakdown structures (project management essential library)**, Gregory T. Haugan, ©2001

12. Efforts and Costs estimates

Description and Purpose

Knowledge area: Planning and control

This technique has as predecessor the work breakdown structure (see chapter 10). The outcome of the Work Breakdown structure is used as the input for the Cost and Estimates technique.

All the work items are estimated for the required effort to perform this work and the associated cost. The required effort is then matched to the availability and the capability of the resources.

The Project Manager (PM) coordinates the estimation of the effort and cost for each task. This is done in close collaboration with the task owners or other experts for each impact area (who are usually members of the Project Core Team (PCT)).

There are different approaches when estimating time and cost for the finest detail level of tasks of a Work Breakdown:

- Based on expert advice.
- Based on historical information.
- Based on similarity to other tasks.
- Based on the Function Point Analysis (FPA) method (IT projects).
- Based on other tool or commonly acceptable methods.
- Based on resource cost information (pricelists, outsourcing contracts…)

Note: the accuracy of the WBS is of the highest importance to get adequate estimates. When creating the WBS with the stakeholders bear in mind to mention to them that the better the WBS the better the estimates.

Using the Tool/Technique

Based on the above chosen approach or a combination of them, the following steps are needed.

Step 1: Look at the lowest level of the Work Breakdown.

- The calculation starts at the bottom of the work breakdown. This ensures to have the most accurate estimate

Step 2: Estimate the likely amount of effort

- Estimation aims at getting as closest to reality as you know in this point of time. Estimates are never correct
- For each activity estimate the effort that will be required
- When performing this step bear also in mind the availability and the skills of the required resource
- It is possible that additional training is required. Add this effort also to the activity

Step 3: Include contingency

- Task owners might calculate contingency time (buffer) that can be added to the activity duration in recognition of schedule risk. This is typically a percentage of the estimated effort
- Verify if the task owners have added contingency. If no then add a percentage to each activity
- Allocate time for reviews and rework as the first version of a deliverable is rarely the final one

Step 4: The task owners must validate the effort estimates.

- Once the calculation is done request a validation for each task by his task owner, like that a strong commitment is made

Step 5: Estimate the likely cost to be incurred on the activity (if it must be traced).

- If the Project Owner(PO) does not want detailed traceability for the cost per activity then you can go to Step 6
- For each activity add the cost of one workday (WD) times the number of needed workdays
- Create the total cost for all activities

Step 6: Add non people cost

- Finally add the related cost for any non-people related activity if necessary (hardware, software, buying/renting of material, assets…)
- If some items are regularly used you can consider to create a WBS dictionary containing fixed prices for specific items (e.g. one test cycle)

Step 7: Finalise the estimate

- The last step is to sum all different parts together and the total amount of effort and cost for your project is available

Hereafter a table is presented that shows the relationship between the level of accuracy and the size of projects.

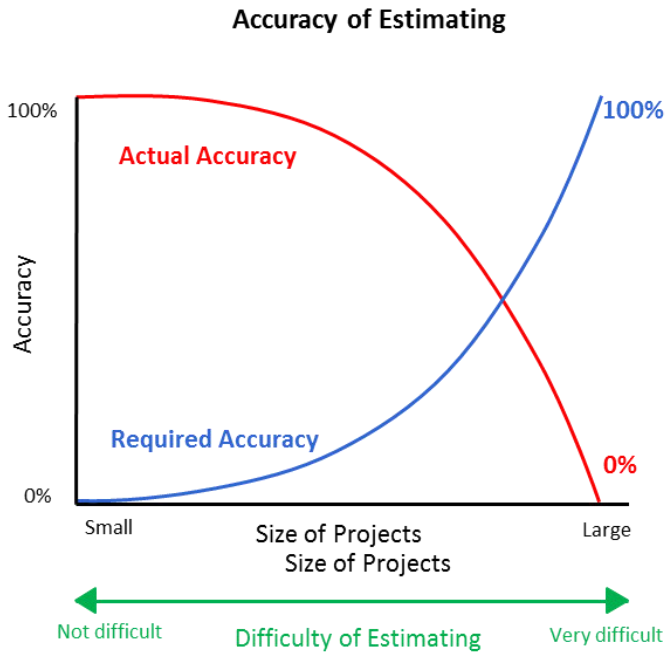

Figure 12.1: Size of projects versus Accuracy

References & Sources for Further Reading

- http://www.projectsmart.co.uk/project-cost-management.php, Joseph Phillips ©2010
- **Secrets to mastering the WBS in real-world projects**, Liliana Buchtik, ©2010

13. Three-Point Estimates using PERT

Description and Purpose

Knowledge area: Planning

Estimating project cost or duration is most often done based on estimates, and there can be various amounts of uncertainty on the accuracy of these estimates. The Three-Point Estimate is a technique that forms part of the PERT (Project Evaluation and Review Technique) toolset, and is used to provide a weighted average of the various estimates of project time or cost.

To perform a Three-Point Estimate, a project team is asked to provide 3 estimates for the duration of each activity defined in the Work Breakdown Structure (WBS). These estimates are then weighed to provide a weighted average of their effort, cost or duration. In addition, these estimates can be used to calculate a standard deviation, which can then be used to estimate confidence levels of the weighted average per activity as well as to build simple statistical models of task time and cost. In very advanced project management practices, these statistical methods are applied to project management in order to forecast and mitigate risk, and to assign buffers to tasks.

The table below shows a three-point estimate calculation for a project with five activities (A through E). The numbers in the table represent the expected cost of each activity in man-days.

Activity	Predecessor	a (best-case)	m (most-likely)	b (worst-case)	E (expected)	SD (standard deviation)
A	-	10	13	17	13.17	1.17
B	A	8	9	13	9.50	0.83
C	A	6	7	12	7.67	1.00
D	D	14	15	17	15.17	0.50
E	B,C,D	4	8	13	8.17	1.50

Figure 13.1: Three-Point Estimate Table

These activities can be represented in a simple network diagram, and using the expected duration calculated, it is then possible to provide a simple view the Critical Path (CP) of the project. Figure 13.2, below, shows an Activity on Node (AON) network diagram for this example project of five activities. The red arrows show the Critical Path (CP) of the project based on the expected duration calculated above.

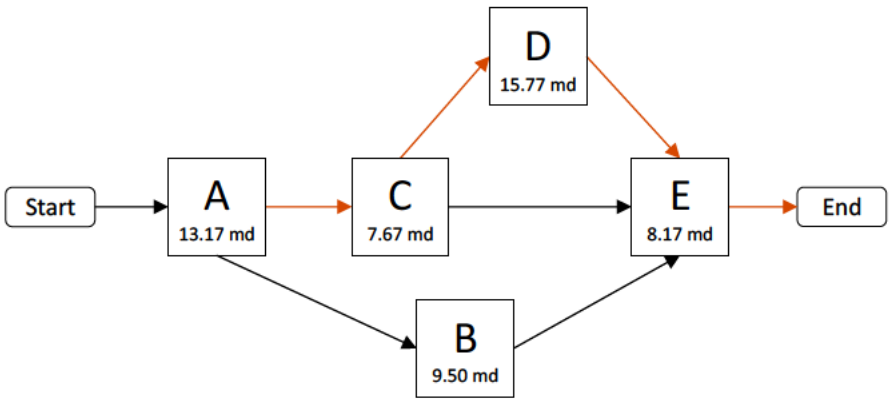

Figure 13.2: AON Network Diagram

Using the Tool/Technique

The three-point estimate technique is part of the PERT toolset and is commonly used, in conjunction with Network Diagrams, by Project Managers (PMs) to better estimate cost or duration of projects.
The three-point estimate is basically a weighted average of several estimates of activity duration or cost. The expected duration and standard deviation of a project's cost or duration using the three-point estimate is calculated by the formulas below:

$$E = (a + 4m + b)/6$$

$$SD = (b - a)/6$$

Where, *E* is the expected duration, *a* is the optimistic estimate of cost or duration, *m* is the most likely estimate, *b* is the pessimistic estimate, and *SD* is the standard deviation. The three estimates forming the three-point estimate are defined as follows:
Optimistic value *(a)*:

- The minimum cost or effort that can be achieved in case that only good performance is realised throughout the process. The probability of achieving this estimate should not be more than 1% (i.e. there is 99% probability that the cost/effort or duration of this activity will be larger than this estimate).

Most likely value *(m)*:

- The most probable cost or effort that the person, that is best qualified to judge, would expect. This estimate would also occur most often in case that the activity could be repeated numerous times under the same conditions.

Pessimistic value *(b)*:

- The maximum cost or effort needed in case that unusually bad performance is realised. The probability of realising this estimate should not be more than 1% (i.e. there is 99% probability that the cost/effort or duration of this activity will not exceed this estimate).

It is important to note that a basic assumption in the estimating process is that the three estimates are based on the same level of effort, for example the same number of persons working or the same number of shifts and days per week (i.e. 1 man day = 7,5 hours).

In addition, the three-point estimate is designed to capture and mitigate the uncertainty of providing a single estimate, and is not designed to provide forecasts of buffers to mitigate changes to the fundamental conditions of the project. For example, the technique can be used because the project team is unsure of the difficulty of implementing some aspect of the project and is not used to capture the effects of a change in the scope of the implementation.

Lastly, it is also important to note that the three-point estimate technique does not mean that expert advice is no longer necessary to build project cost and duration estimates. While the technique provides a weighted average of three estimates, a large standard deviation will mean that the likelihood of achieving this expected cost or duration is very low. Involving experts to provide the three-estimates will increase the accuracy of the three-point estimate and reduce the risk or uncertainty of the project.

References & Sources for Further Reading

- http://project-management-knowledge.com/definitions/t/three-point-estimates/
- http://www.netmba.com/operations/project/pert/
- http://gates.comm.virginia.edu/rrn2n/teaching/gantt.htm
- **Project Management Fundamentals: Key Concepts and Methodology (Second Edition).** Haugan, Gregory T. Management Concepts. © 2011.

14. Project Scheduling

Description and Purpose

Knowledge area: Project planning and control

The objective is to identify dependencies between tasks, assign resources for each task, identify task start and end dates and work out the overall project duration.

Scheduling can be done for the entire project upfront or for portions thereof, such as individual stages or iterations. Most of the time a high level schedule is established for the entire project and a detailed schedule is created for the upcoming months.

Different scheduling methods and representations can be used. For instance, a list of dates/deadlines, milestone plans, bar charts, network diagrams and linked bar charts can be used, and very often can be seen as complementary to each other. The information requirements and effort for the application of the various scheduling methods differ from one project to another. Similarly the effectiveness of each scheduling method (or combination) depends on the type, size, complexity and dynamics, and documentation and control requirements of each project.

Regarding scheduling there is thus not one technique that works for all projects. It is up to the project manager to decide which tool(s) and/or technique(s) to use for his specific project.

Using the Tool/Technique

Hereafter a list of steps is mentioned to create a project schedule. The sequence of the steps also can be different per project and some steps can be considered as optional.

Step 1: Review for completeness

- Conduct an internal review with the key resources and experts to see if all the elements of the project scope are included in the project work plan (and/or WBS).
- Check if the following activities are properly added:
    - Testing and training activities
    - Relevant business implementation activities
    - Transition activities
    - Quality activities

Step 2: Identify the dependencies and sequence between tasks:

- For each task identify any dependency with other tasks. Most tasks are related to others. The dependency can be one of the following:
    - Start to start: both tasks have to start at the same moment
    - Start to finish: the task can only start once the other is finished
    - Finish to start: the task can only finish after the start of another task
    - Finish to finish: both tasks need to finish at the same moment
- Sequence all tasks. Here are two possibilities. The first one is that you start scheduling forwards and the second one is to start scheduling backwards (sometimes referred to as reversed scheduling). The second one is used when a given deadline needs to be respected meaning you start scheduling from that deadline with the last task to execute and you work your way through till the start of the project. This can also give an indication on what is the latest moment in time to start the project. A combination of both ways of scheduling is sometimes used.
- Review the linked list to see if all tasks were taken into consideration and there are no loose items

Step 3: Identify the critical path

During the monitoring and control the project manager must have special attention to all tasks that are on this critical path.

- The critical path can be identified when following the reference: **Error! Not a valid bookmark self-reference.**.

Step 4: Identify the resources for each task

- Appoint resources for each task (hardware, software or persons)
- Add the name if known
- If this is not the case then specify the profile of the needed resources (e.g. developer, analyst, translator,…)

Step 5: Availability of resources

Once the complete schedule is developed the name of the resources needs to be known.

- Check and agree on the availability of every resource
- If resources are over allocated figure out ways to level them to the right amount of work
- After this levelling ensure that the critical path has not changed
- If the critical path has changed see if other resource(s) can take up the work or parts of it

Step 6: Official approval of the schedule

A very important step in every project is the official approval of the project schedule (this includes the availability of the resources).

- Get the approval by the Project Owner
- The project schedule is now base lined
- Any change to the schedule needs to follow the change management process from this moment onwards

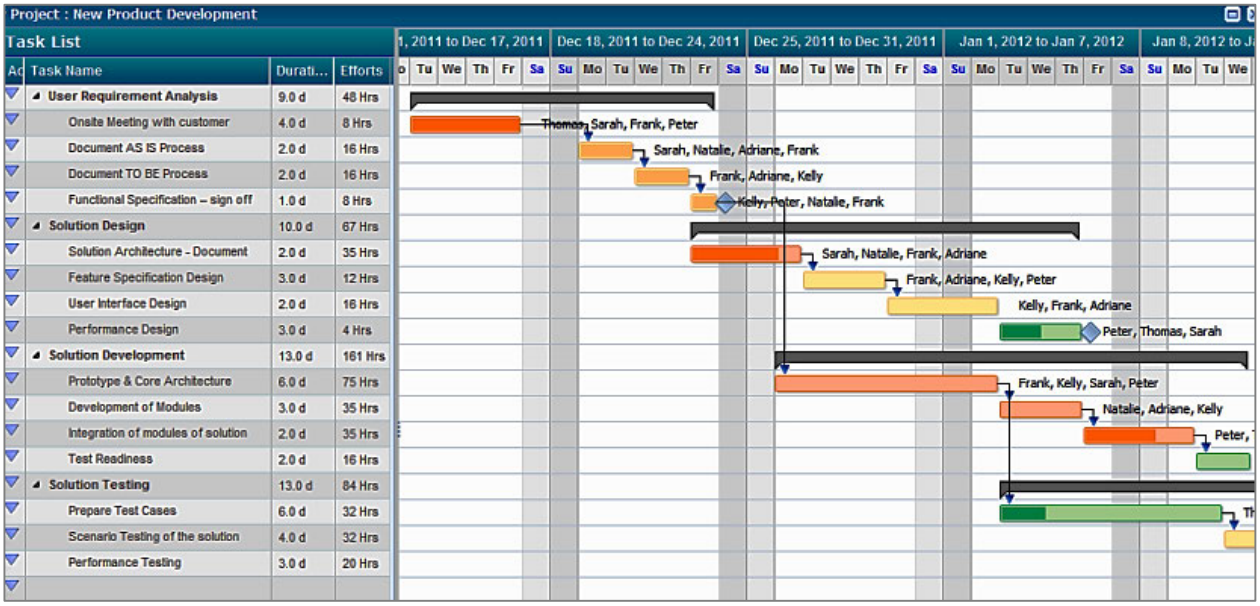

Figure 14.1: Project schedule

References & Sources for Further Reading

- http://www.businessdictionary.com/definition/critical-path.html#ixzz3LJIxdWgk
- http://www.projectinsight.net/project-management-basics/project-management-schedule

15. Critical Path Method

Description and Purpose

Knowledge area: Planning and Control

The Critical Path Method (CPM) is a modelling technique that uses a mathematically based algorithm to calculate the total duration of a project. CPM calculates the longest necessary path (longest unavoidable duration) of planned activities from beginning to end of the project, otherwise known as the critical path of the project.

CPM is used widely in projects where enough detail can be derived and estimates can be relatively accurate. CPM is particularly useful in projects with many concurrent activities, or in organisations running many concurrent projects. In these cases, resources are often shared across multiple activities or projects, and understanding where there is a critically for timeliness is crucial to preparing the resource management plan.

Since the critical path represent the longest necessary path of activities, it also represent the shortest possible duration of the project to completion. When this duration is beyond what is required, activities can be prioritised in order to shorten the duration of the critical path. This is done by pruning the critical path activities, performing more activities in parallel (Fast tracking) or shortening the duration of the critical path activities by adding more resources (Crashing the Critical Path).

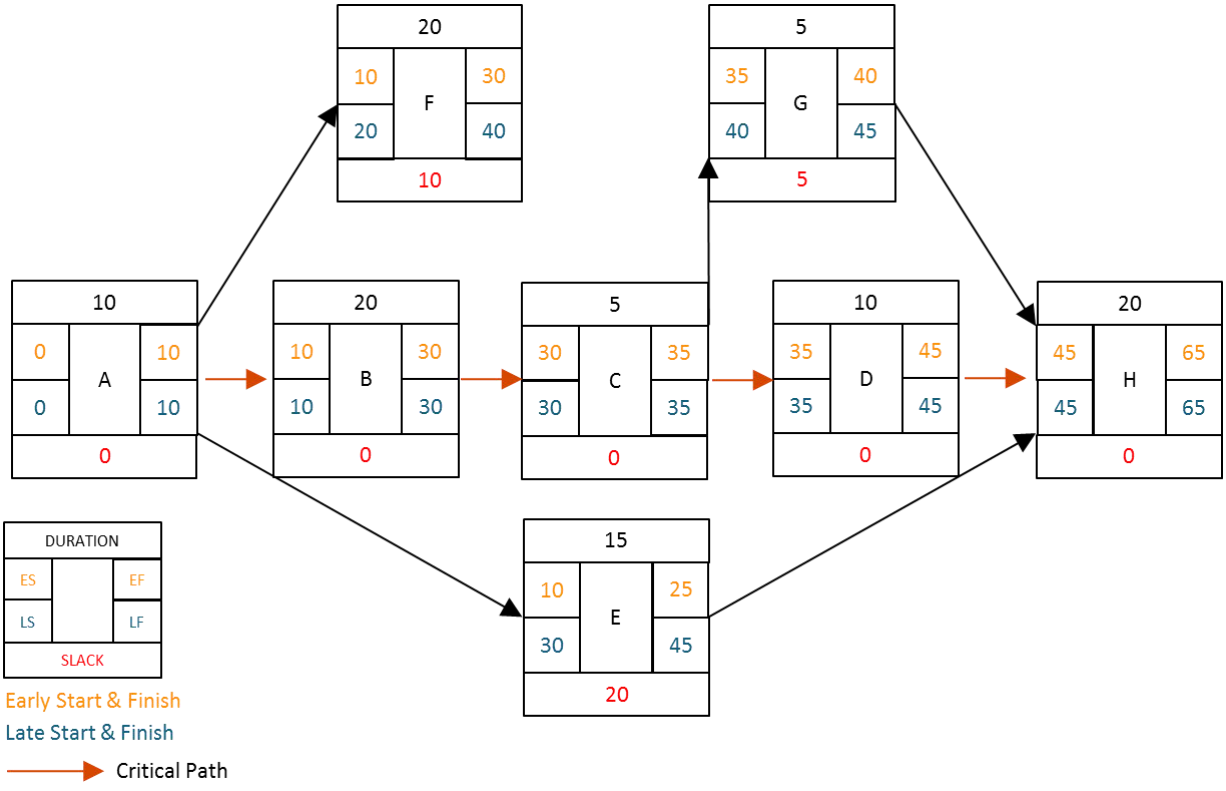

Figure 15.1: Critical Path Diagram

Figure 15.1 shows an example network diagram with a set of activities A through H, along with the respective duration and inter-dependencies and the basic CPM analysis performed to find the critical path. The activities A, B, C, D and H form the longest path or the Critical Path (CP), whereas the other activities (E, F and G) are off the critical path and can be delayed or extended until a certain point without delaying the completion of the overall project.

Using the Tool/Technique

The Critical Path Method is used to define the longest necessary path of activities for a project, and to understand which activities have a critical influence on the overall duration of the project. Below are the steps to identify the Critical Path:

Step 1:

- Breakdown the project into a set of activities
- Identify the dependencies amongst the activities
- Estimate duration for each activity identified

Step 2:

- Map the sequence of activities in a Network Diagram as shown in Figure 15.1

Step 3:

- Perform a "Forward Pass" and a "Backwards Pass"
- Calculate the slack of each activity
- Find and signal the critical path

CPM Parameters	Description of the Parameters
Early Start (ES)	Earliest Time that an activity can start given that its precedent activities are completed
Early Finish (EF)	Earliest Start Time + Duration of the activity (EF = ES + DUR)
Late Start (LS)	Latest Finish Time - Duration of the activity (LS = LFT – DUR)
Late Finish (LF)	Latest time at which an activity can be completed without affecting the overall duration of the project
Slack (SL)	Time between the Early and Late Start or between the Early and Late Finish of an activity, and denotes the amount of delay the task can incur without affecting the overall completion of the project
Critical Path (CP)	The longest necessary path of activities to complete the project, or the shortest possible time to complete the project - the path of activities with the least amount of slack, generally zero - often indicated with red arrows
Duration	Time that an activity takes to complete

Figure 15.2: CPM Key Parameters

To perform a "forward pass" start from the first activity, A, and note the ES and EF, then move on to the next activity, for example B. The ES of following activity will be the same as the EF of the previous one. Continue until all activities have an ES and EF.

Now perform the "backward pass". Start with the last activity, E in Figure 15.1, and find the LF, which is the same as the EF for the last activity only, and then calculate the LS for the last activity. Moving backward, move to the previous activity, in this example Activity D, and note its LS and LF. The LF for previous activity will be the same as the LS of the following activity.

The CPM method requires some accuracy or certainty of estimates regarding activity duration. In simpler projects, or in instances where there is high uncertainty regarding the estimates, it is advisable to use the three-point estimate and a simple network diagram to define the critical path. As estimates increase in accuracy, then use the CPM to ensure the scheduling of project activities and to confirm the duration of the project based on a more accurate critical path calculation.

References & Sources for Further Reading

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- http://www.netmba.com/operations/project/cpm/
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16. Gantt Charts

Description and Purpose

Knowledge area: Planning and Control

A Gantt chart is a graphical representation, generally a type of horizontal bar chart, which illustrates a project plan and the duration of tasks against the progression in time. This project management tool, originally developed by Henry Gantt at the beginning of the twentieth century, focuses on the sequence of tasks necessary for completion of the project at hand.

The Gantt chart can be a very powerful visual to represent duration, sequence, dependency and status of the terminal or/and summary elements of an entire project. A Gantt chart visually represents the entire work breakdown of a project, and allows the terminal elements (the lowest level of detail in the Work Breakdown, ex. task) and the summary elements (the aggregate levels in the WBS, ex. Activity) to be easily identified.

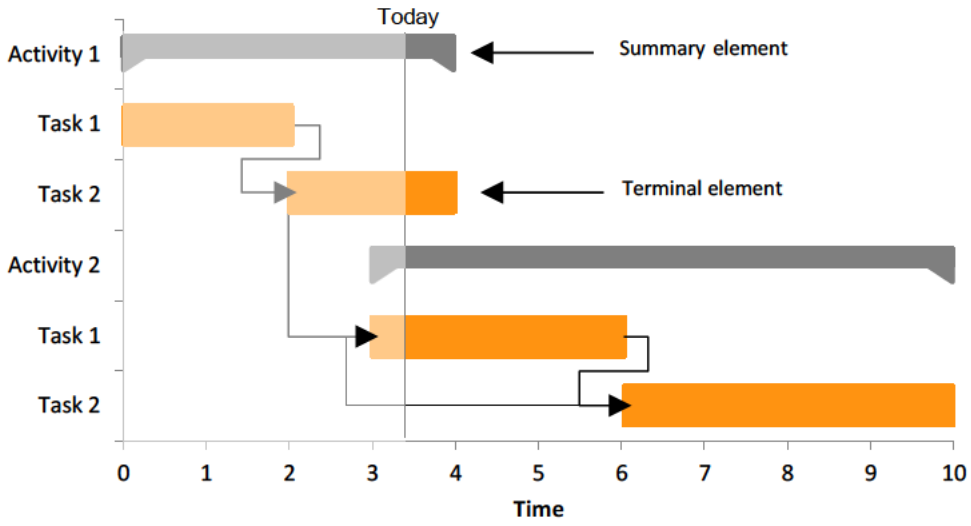

Figure 16.1: Gantt chart

In a Gantt chart, such as the example in Figure 16.1 above, each activity is represented as a single horizontal bar on an X-Y chart. The horizontal axis (X-axis) represents the time scale and the beginning and ending dates of the project, as well as that of the individual tasks. In respect to that, the length of each activity bar is related to the duration of that particular activity, or the time that is necessary for completion. Different colours (for example grey as used in Figure 16.1) or percentage numbers in the bars can represent the status or level of completion of an activity. Arrows connecting the bars are used to indicate a dependency between tasks.

Using the Tool/Technique

The Gantt chart is a common project management technique used to represent the schedule, phases and activities of a project in a single visual. Gantt charts visually represent project sequence, duration, dependency and status in a manner that is easy to understand.

The Gantt chart represents the order in which activities need to be carried out and provides an overview of what should have been achieved at any point in time. Furthermore, Gantt charts can be used to show current schedule status by adding percent-complete shadings and a vertical "Today" line. Another clear strength of the Gantt project management technique is the ability to display the status of each activity at a glance.

Overall, a Gantt chart is a useful technique which can also be used for planning and communication purposes. However, Gantt charts for a larger project with many tasks can become crowded and lose the positive aspect of simplicity. In these large Gantt charts, choosing the right level of granularity is crucial to ensure that the visual remains useful and easy to communicate.

Note, however, that projects are often much more complex than what can be represented even in a detailed Gantt chart. In such cases, a Gantt chart cannot be used on its own as it cannot include all the critical information and project dynamics required for managing a project, particularly larger or more complex projects.

The following steps are typically used to create a Gantt Chart:

Step 1:

- Define the project's Work Breakdown (WB)

Step 2:

- Identify the duration of each task

Step 3:

- Identify the dependencies between tasks and activities in the WBS

Step 4:

- Define the sequence of tasks in the project

Step 5:

- Map the summary and terminal elements of the WBS on the Y-axis of a graph, and the duration on the x-axis of the graph

Step 6:

- Create horizontal bars to depict the length of each WB element, and connect the dependencies identified in step 3

Currently, the most simplistic method to create a Gantt chart for a small project, as it does not involve many parallel tasks, is by the use of a spread sheet software tool. In the case of large organisations or projects, the use of dedicated tools that include Gantt chart capabilities is more advisable. In addition, dedicated tools provide many other views of a project than simply a Gantt chart, which is a very useful feature for those with knowledge of using the tool.

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- **Project Management Fundamentals: Key Concepts and Methodology**. Haugan, Gregory T., Second Edition. Management Concepts. © 2011.

17. Resource Levelling

Description and Purpose

Knowledge area: Time Management, Planning

Resource Levelling is a technique used to analyse the unbalanced use of project resources and to resolve conflicts related to resource allocation. The resources could consist of FTEs, material or equipment to be used during an activity of a project.

During the project planning, the Project Manager (PM) will end-up scheduling several activities in parallel in order to reduce the duration of the project. This scheduling may result in an uneven allocation of resources, with resource needs per activity which might require an even higher number of resources than available. In complex scenarios, resources could also be allocated to multiple projects, which could result in a shortage of material, labour or equipment. In such scenarios resource levelling is used to optimise allocation and resolve related conflicts.

Consider the resource allocation histogram in Figures 17.1 and 17.2 below, which show the resource requirement for a project with breakdown of activities A-F over time. The total amount of required resources over a period of 6 days is 28. Hence, in an ideal situation one would have 5 resources per day (28/6) to complete the project. However, in most cases the activities are interdependent. In addition, in case of FTE resources, different skillsets might be required to complete an activity so that the ideal situation is not representative. As a consequence, resource levelling could delay the project end date in case that a critical path activity would be impacted, as shown in Figure 17.2 where two additional days are required to complete all activities with the available FTE resources.

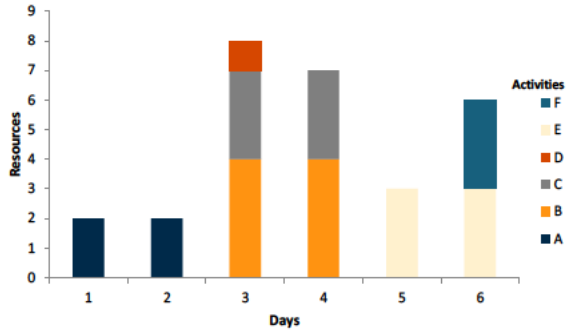

Figure 17.1: Resource Histogram (1)

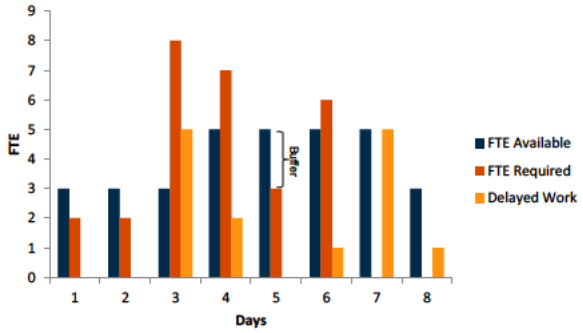

Figure 17.2: Resource Histogram (2)

Using the Tool/Technique

As mentioned, resource levelling focuses on an efficient and optimal resource allocation, so that the project can be completed in the defined timeline.

In order to be able to optimise resource allocation Project Managers (PMs) analyse dependencies between projects or activities as to ensure that activities can be executed within the foreseen timespan. During this process, the Project Manager (PM) could be faced by constraints related to the sort the activities of a project, which can be mandatory, discretionary or external.

Mandatory:

- Constraints could arise due to the obligatory nature of the work being done, which often involves a physical limitation. For example: a test case needs to be defined before testing.

Discretionary:

- Constraints could arise based on the preferences or decisions taken by the Project Manager (PM) or team. For example: a decision is taken to document a process before executing it.

External:

- Constraints could arise based on the desires and needs of a third party involved. For example: equipment has to be purchased from a third party before you are able to start the configuration of the equipment.

Taking into account the identified constraints, resources levelling can be performed. Resource levelling can for example require the delay of tasks until resources are available. Within a larger organisation, resources could also be allocated across multiple, simultaneous projects. Therefore, resource levelling could result in a delay of the project finish date if the tasks affected would be within the critical path.

The Critical Path Method is commonly used as a basis for levelling. Project Managers (PMs) use the following techniques in order to resolve resource constraints:

- Increasing the timeline or schedule of the project so that both cost and scope of the project are respected
- Reducing the scope of the project so that both time and cost of the project are respected
- Increasing the cost so that both the time and scope of the project are respected. Techniques to this are:
    - Fast Tracking: The critical path tasks are performed in parallel (instead of sequential). This increases the risk and the possibility of rework.
    - Crashing: More resources are added to the critical path tasks to maintain the project timeline. This results often in higher costs.

Certain IT tools, such as Microsoft Project, provide functionality to automatically level resources by making one of the three project constraints (cost, scope and time) variable.

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18. Critical Chain Method

Description and Purpose

Knowledge area: Planning and Control

The Critical Chain Method (CCM) is a modelling technique used to plan and schedule a set of activities or projects. The tool is similar to the Critical Path Method (CPM), but takes into account resources and their levelling, as well as the behaviour of the Project Manager (PM) when estimating duration of activities in a project. It has been observed that applying CCM has resulted in finishing projects 10% to 50% faster than when simply using traditional methods, such as CPM.

E. Goldratt first introduced the concept of CCM in 1997. His study showed that the activity time estimates for any project are usually padded by Project Managers (PMs) to take care of uncertainty. It was observed that the time estimates were close to double the time required to complete the activities. Goldratt's study also found other reasons that lead to a delay in a project:

- **Project Scheduling**: Early finish of an activity is rarely taken advantage of elsewhere
- **Multitasking**: Working on one or more activities concurrently introduces major delays
- **Student Syndrome**: People start to fully apply themselves on a task at the last moment
- **Parkinson's Law**: Work tends to expand to fill the allocated time for any activity

The CCM assumes that a Project Manager (PM)'s estimates of duration for activities are padded as found in Goldratt's study, and immediately reduces them. Additional buffers are then added to account for reduction in project estimates. Three kinds of buffers used in CCM are:

- **Project Buffer**: The difference between original schedule and new schedule estimates
- **Feeding Buffer**: Activity safety margins are put in a non-critical chain and placed in the path where the activity feeds back into the critical chain path
- **Resource Buffer:** Make sure that resources (human or equivalent) are available when required

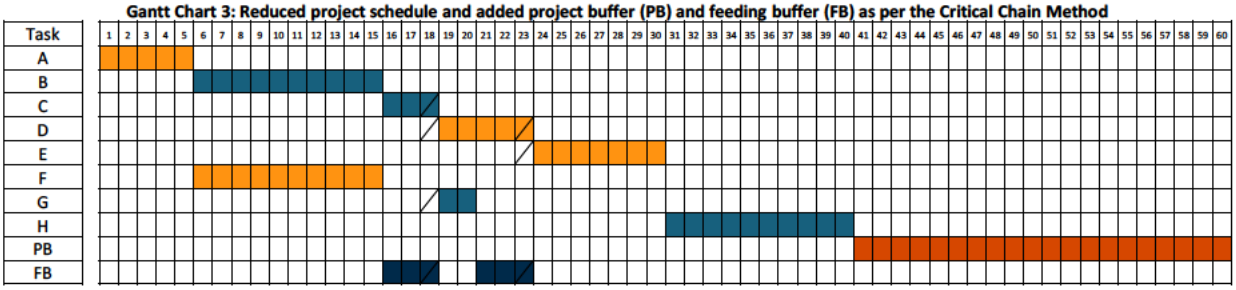

Figure 18.1: Critical Chain Method Gantt Chart

Figure 18.1 shows a CCM Gantt chart for the same example project as shown for the Critical Path Method using Figure 18.1. The duration of the CPM example was calculated in 65 days. However, assuming that there are two resources available (R1 in yellow, R2 in green) with tasks allocated as shown in Figure 18.2, due to resource constraints the project will actually have duration of 80 days.

Task	Successor	CPM Duration	CCM Duration	Resource
A	B, E, F	10	5	R1
B	C	20	10	R2
C	D	5	2,5	R2
D	H	10	5	R1
E	H	15	7,5	R1
F	G	20	10	R1
G	H	5	2,5	R2
H	-	20	10	R2
PB	-	-	20	-
FB	-	-	5	-

Figure 18.2: Critical Chain Method Table

Using the Tool/Technique

Described below are the steps to apply the Critical Chain Method using the example shown in Figures 18.1 and 18.2.

Step 1: Build a CPM network diagram

- Identify the sequence of the project's tasks
- Estimate the duration of each task
- Build the CPM network diagram
- The result is a project with a duration of 65 days and a critical path of activities A,B,C,D and H

Step 2: Assign resources to tasks and level resources

- Assign the available resources to the project tasks
- Schedule activities on a Gantt chart
- Level resources so a single resource is not working on multiple tasks at the same time
- Identify the new critical path based on the resource constrained project schedule
- The result is a project with a duration of 80 days and a critical path of activities A,B,C,D,E ,H

Step 3: Reduce activity estimates

- Reduce the duration of project activities by 50%
- The result is a project with a duration of 40 days and a critical path of activities A,B,C,D,E,H

Step 4: Add buffers to the schedule

- Add a project buffer at the end of the project of 20 days, equal to 50% of the revised duration
- Add feeding buffers to the non-critical chain after tasks F and G to account for potential delays
- The result is a project with a duration of 60 days and a critical path of activities A,B,C,D,E and H, which is 25% less than before applying CCM

When applying CCM it is important to always keep in mind that resources allocated to an activity are encouraged to complete work at the fastest speed possible, and are not allowed to work on multiple tasks at the same time. In addition, it is important to openly communicate with resources and to provide them with clear and aligned priorities about the status of the critical chain, so that they are only focussed towards the project deadline.

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19. Earned Value Management

Description and Purpose
Knowledge area: Managing Project Finances, Monitoring and Control

Earned Value Management (EVM) is a technique used to monitor and control the performance of projects. EVM provides an objective view of performance based on the project financials. Therefore, in EVM the concept of cost and time are both measured in terms of cost units (e.g. Man-Days or Euros).

EVM allows Project Managers (PMs) to manage project scope, cost and time, as well as the impact of risks. EVM metrics provide relatively objective indicators regarding past and current project performance, and provides forecasts of future project performance. These metrics are often used as Key Performance Indicators in project status reporting.

These metrics also enable Project Managers (PMs) to foresee deviations from the project baseline plan in terms of cost and schedule, and to make decisions early in order to put the project back on track.

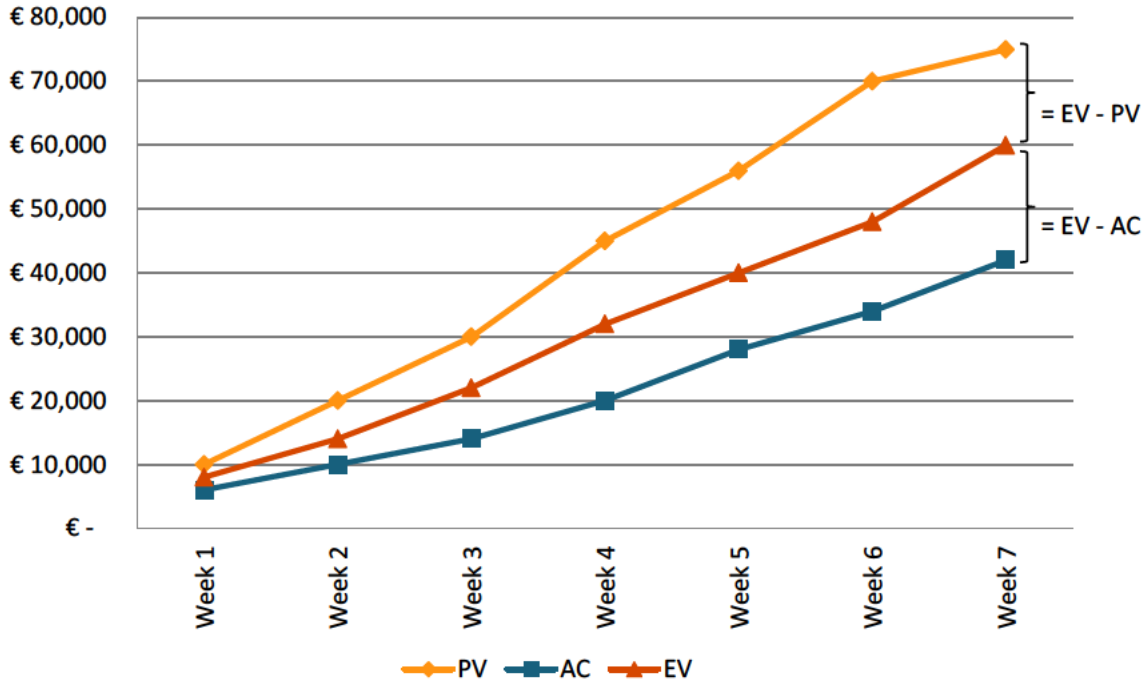

Figure 19.1: Earned Value Graph

Traditionally, project management metrics concentrated on a total budget (PV) and actual cost (AC). Consider Figure 19.1 above. Using these metrics, it would appear that the project in question is doing well under-budget. Using EVM, it is then possible to see that the project team has thus far been efficient in terms of cost (EV>AC), but that the project is lagging behind in terms of schedule (EV<PV). A pro-active measure that could then be taken by management is to allocate additional resources to the project in order to deliver on time and still be on budget.

Using the Tool/Technique

As mentioned, EVM provides Project Managers (PMs) with a set of relatively objective metrics, or key performance indicators, to "proactively" manage project performance.

The metrics used in EVM are found in the table below:

EVM Metric	Description of the Metric	Source/Calculation
BAC	Budgeted at Completion – Total baseline budget	Input
EV	Earned Value – The perceived valued earned at a point in time in the project	% complete * BAC
PV	Planned Value – The incremental or per period value that is planned in the Project Planning Phase	Input
AC	Actual Cost – The incremental or per period cost incurred at a given point in time in the project	Input
CV	Cost Variance – The difference between what has been achieved and how much it has cost at a given point in time in the project	EV – AC
SV	Schedule Variance – The difference between what has been achieved and what should have been achieved at a given point in time in the project	EV – PV
CPI	Cost Performance Indicator – A measure of efficiency of cost – the amount of EV units earned per 1 AC unit spent	EV/AC
SPI	Schedule Performance Indicator – A measure of efficiency of schedule – the amount of EV units earned per 1 PV unit spent	EV/PV
EAC	Estimate at Completion – A revised estimate of the total cost based on the current efficiency (CPI)	AC + ((BAC – EV)/CPI)
ETC	Estimate to Completion – The amount of cost yet to be incurred based on the revised budget (EAC)	EAC - AC
TCPI – BAC	Total-Cost Performance Index (based on the BAC) – Provides an estimate of the CPI necessary to complete the project in the BAC	(BAC – EV)/(BAC – AC)
TCPI – EAC	Total-Cost Performance Index (based on the EAC) – Provides an estimate of the CPI necessary to complete the project in the EAC	(BAC – EV)/(EAC – AC)

Despite its benefits, it is important to understand the drawbacks of Earned Value Management (EVM).

EVM uses cost units as its only measurement, hence even schedule oriented metrics such as SPI and SV are not expressed in time units. Therefore, SV and SPI will not tell a project Manager the delay in calendar days that a project may suffer. Moreover, EVM does not consider qualitative elements like project quality and team dynamics as measured metrics.

Even though EVM metrics are largely objective, they are still subject to not only interpretation, but also estimation error or bias on behalf of the Project Manager. Namely, EV is derived based on the % complete of a work package, and is an estimate provided by the Project Manager and the project team. In addition, the accuracy of PV is subject to the experience and information available to the Project Manager during the planning phase of the project. PV and EV are then most accurate when the Work Breakdown Structure (WBS) is very detailed and work packages are small in cost and duration.

Overall, EVM is a useful tool to manage project financials and performance. However, it only takes into account quantitative aspects and ignores qualitative KPIs reflective of domains such as quality. EVM is demanding in terms of project set-up because it requires a good reliable project plan, and in terms of project monitoring and controlling because it requires measuring, gathering and tracking all necessary indicators.

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20. Ishikawa/Fishbone Diagram

Description and Purpose
Knowledge area: Project Risk Identification and Management

Ishikawa or Fishbone diagrams are cause-and-effect diagrams that identify potential factors which cause an overall effect or problem. Such diagrams are commonly used in process design or quality defect prevention to identify the root causes related to the problems. These diagrams were created by Kaoru Ishikawa in 1968.

Project teams may want to identify a risk and understand what the root causes of the risk are and how these can be tackled within the project. In order to find root causes of a problem, the following categories can be used as to organise the cause analysis in an organised way:

- **People** (Resource Availability, Skill Sets, Efficiency, Workplace Culture etc.)
- **Process** (Accountability, Duration, Hand Offs, Documentation, Re-work involved etc.)
- **Policy** (Working Hours, Expense Reimbursements, Time Offs, Dress Code etc.)
- **Management** (Employee Involvement, Recognitions, Trainings etc.)
- **Environment** (Work environment, External factors, Client related factors etc.)
- **Equipment** (Computer configurations, Access to advanced technology tools etc.)

These categories and their applicability can differ depending on the nature of the project. The same analysis of root causes is repeated for each individual cause category as to find out the primary and secondary cause impacting the project. This analysis of decomposing and detailing cause and effects is called the Fishbone diagram as it is represented by the skeleton of a fish.

After having analysed the decomposition of a problem, thus identified the root causes through the use of the Fishbone diagram as shown in Figure 20.1, the project team can take into account and minimise the impact of each major cause on the project.

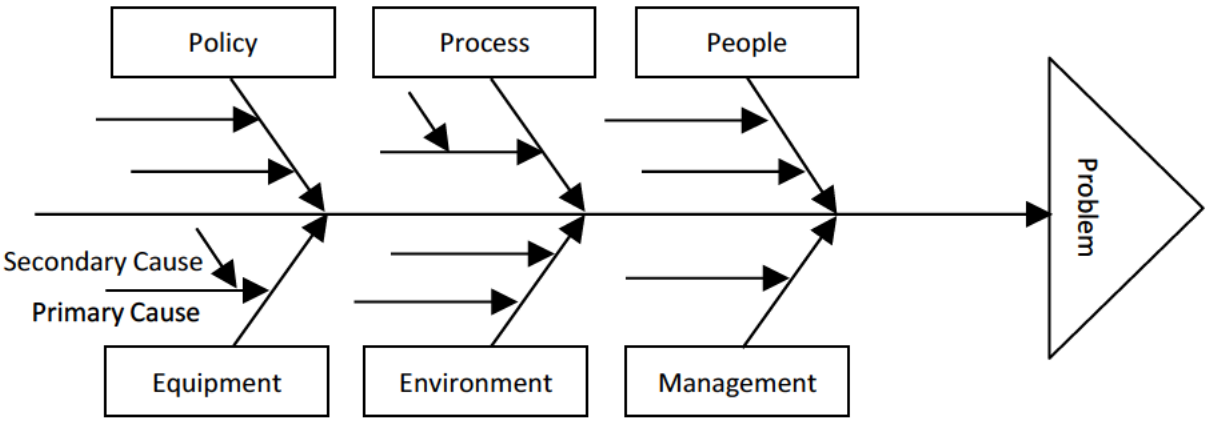

Figure 20.1: Ishikawa Diagram

Using the Tool/Technique

The Ishikawa or Fishbone diagram is used to find the root cause of a problem in a project. Project Managers (PMs) may involve a small team to brainstorm on the problem statement so as to take into account and minimise the impact of each major cause on the project. The Fishbone diagram can be used for different purposes in a project:

- To analyse and identify root causes of a problem
- To identify bottlenecks in business processes throughout the organisation

Following are the steps to analyse and identify root causes by the use of a Fishbone diagram:

Step 1:

- Identify the problem in the project and the different cause categories, such as the nature of issue, frequency, and people involved in the process, etc.

Step 2:

- Analyse the cause categories involved in the problem
- These cause categories could differ for each and every problem or project

Step 3:

- Start analysing the primary and secondary causes for each cause identified
- The problem statement, the primary and secondary causes are illustrated on the Fishbone diagram

Step 4:

- The Fishbone diagram is analysed by the project team focussing on one factor at a time
- For detailed investigations, action items are noted for each factor in terms of additional information required (ex.: surveys to be conducted, questionnaires to be sent, etc.)
- Solutions on how to tackle the identified cause and effects within the project are developed

While analysing a problem using a Fishbone diagram, the scope should be manageable. The factors should not be too broad so that it does not make the analysis difficult using the diagram. The team should not spend too much time debating on where to place a primary or secondary cause. However, it is important to build the right diagram for a thoughtful discussion. It is also important to find solutions for each of the identified cause and effects of the problem statement.

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21. Delphi Technique

Description and Purpose
Knowledge area: Project Scope Management

The Delphi technique can be used by a project team to understand and estimate the impact of future events, which may be positive or negative for a project. This allows the Project Manager (PM) to plan for any unforeseen circumstances accordingly. An experienced panel, which is moderated by a facilitator, exchanges views anonymously about the assumptions on the project. The facilitator reviews the feedback and builds a consensus in the panel and issues a summary report.

The Delphi technique uses experts that are put in a panel to discuss circumstances for two or more rounds in order to come to a consensus. The opinions in each round are shared anonymously through questionnaires or surveys. In each round, the experts are aware of all the opinions that are made regarding the project. Nevertheless, the experts do not know the source. This anonymity ensures that influences of others are avoid and enables the panel to discuss openly and revise any errors in previous opinions. The results of each round are fed as inputs in the next round till a consensus is reached.

Consider the Delphi technique as an iterative process to identify areas of agreement and disagreement regarding assumptions of a project. Once there is a consensus in the panel, the facilitator issues a report regarding the analysed potential events or circumstances and how those may impact the project.

Please find an illustration of the Delphi technique in Figure 21.1 below.

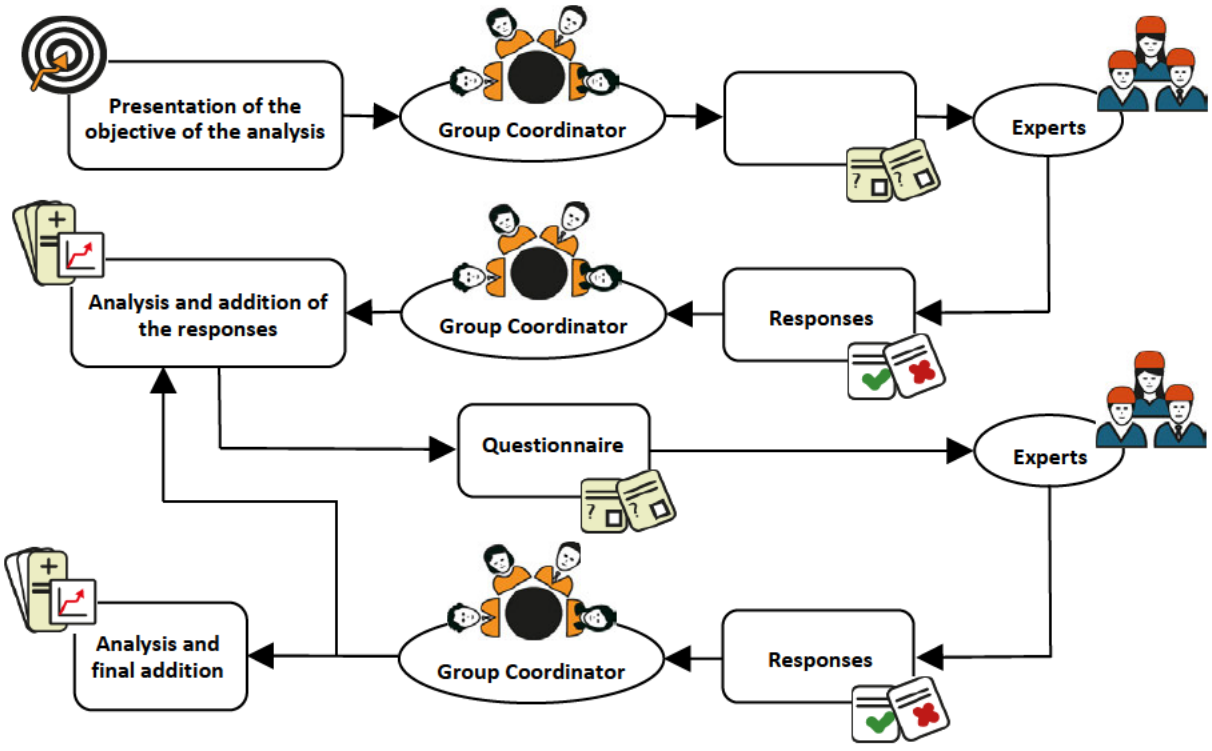

Figure 21.1: Delphi Technique Process

Using the Tool/Technique

Described below are the steps to be followed when using the Delphi technique:

Step 1:

- Choose a facilitator who can moderate a panel discussion based on research, data collection and feedback from experts

Step 2:

- Identify the experts for the panel discussion
- The panel may include the project team, client, industry experts, subject matter experts

Step 3:

- The facilitator presents the problem to the panel, so that the panel understands the issue at hand and that the experts can express their views clearly

Step 4:

- The facilitator issues questions for Round N (1, 2, 3…) to the panel through questionnaires or surveys
- The panel provides the feedback anonymously

Step 5:

- Based on the feedback from the previous round, the facilitator moderates the discussion
- The facilitator collects and summarises the discussion in order to build a consensus

Step 6:

- If consensus is not reached, the process is repeated as of Step 4
- If consensus is reached, the facilitator concludes the discussion and issues a summary report containing future events, as well as a plan to tackle each impact to the project

Although the Delphi technique cannot predict the exact future events with certainty, it can however, based on the opinion of an expert panel, help the project team to understand and take into account the impact of potential future events, resulting in a more effective and efficient completion of the project.

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22. Plan-Do-Check-Act Method

Description and Purpose
Knowledge area: Planning and Control, Quality Management

PDCA (**Plan**, **Do**, Check, **Act**) is an iterative method that is used for project management process improvement. This was developed by Deming, who is known for introducing process or quality control techniques to the Japanese manufacturing industry successfully.

The fundamental principle of the PDCA method is iteration. Once a problem is identified in a process, a potential solution is tested. The result of the solution is checked and analysed, in order to see whether the solution can be further improved. The solution is then applied to the problem again. Through the iterative nature of this method, the desired control or business processes can be achieved.

The PDCA cycle can be used by the Project Managers (PMs) in the following scenarios:

- Management or development processes which need continuous improvement in order to increase efficiency
- Identifying a range of solutions to problems which occur very frequently, so as to choose the best solution for implementation
- To optimise the use of resources in a large scale project implementation where a pilot is run to test a solution

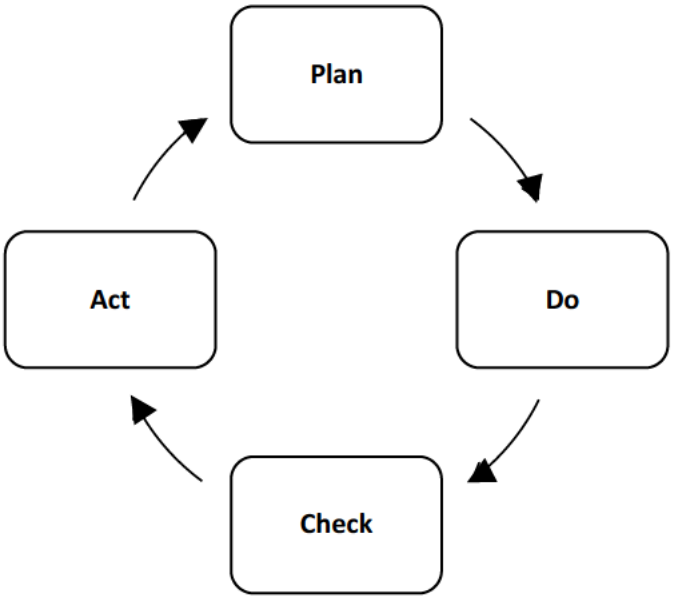

Figure 22.1: PDCA Framework

Using the Tool/Technique

The PDCA cycle enables a project Manager to be methodical in the approach of process improvement or control. The following are the key steps involved in the PDCA cycle:

Plan:

- This step identifies problems related to the achievement of a project objective or execution. This can be found out by several methods like the 5 Whys, Root Cause Analysis, and Fishbone Diagrams, which are also described in this document. The problem statement outlines the expected output from the solution.

Do:

- In this step, several possible solutions are identified. The best alternative is chosen and applied within the project. This small scale pilot could be involving few resources, limited geographic area, new business processes, etc.

Check:

- This step measures the effectiveness of the solution applied and analyses the outcome. It identifies the areas of improvement in the solution and refines the processes. The "Do-Check" steps are repeated until a feasible solution is reached which is in line with the expected output defined in the Plan phase.

Act:

- The solution, with corrective actions identified in the previous phase, is now implemented to the problem as a whole. The process may not end at this step. In case of continuous process improvement, the complete PDCA cycle is repeated to keep improving the project management processes.

The Project Manager (PM) will define any process improvement objectives and run through the PDCA cycles to achieve each of the improvement objectives. The PDCA cycle can be run or cycled multiple times to ensure that the team achieves the improvement objectives. This iterative exercise is a structured way to find and evaluate solutions before any of these solutions are implemented without proper analysis, foresight and control.

Though the PDCA cycle is a well-structured and methodological process, it has a few limitations. This method cannot be applied in emergency situations where a quick fix needs to be applied. The process is time consuming and hence needs to be applied in projects where there is time available for brainstorming and the implementation of pilot runs. The PDCA cycle is also not effective in adaptive scenarios where finding a solution is difficult due to high complexity or uncertainty in the system.

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23. Make or Buy Analysis

Description and Purpose
Knowledge area: Project Procurement Management

A Make or Buy Analysis helps the organisation to take an informed decision about what to outsource and what not to outsource. In organisations, portfolio managers and project sponsors are often faced with the dilemma to make or buy, considering the availability and skills of resources at hand. Project teams can also use this tool to justify the reasons for the project in a business case, whereby the "buy" option is an alternative to the preferred choice to "make".

The following lists the potential reasons for which organisations may go ahead with either a Make or a Buy decision:

Potential reasons to make:

- Cost effectiveness
- Intellectual property concerns
- Quality control issues
- Supplier unreliability

Potential reasons to buy:

- Cost considerations
- Lack of technical expertise
- Supplier technical experience
- Insufficient resources in house

The changes in the external environment trigger the question of Make or Buy. The various factors that should be considered for this analysis are: cost comparison, technology and business processes, supplier related information, and support systems. A final decision on Make or Buy is made after a detailed analysis of the previous mentioned factors and the effect on the overall performance measures related to the project. Figure 23.1 below illustrates the Make or Buy Analysis framework to make a decision.

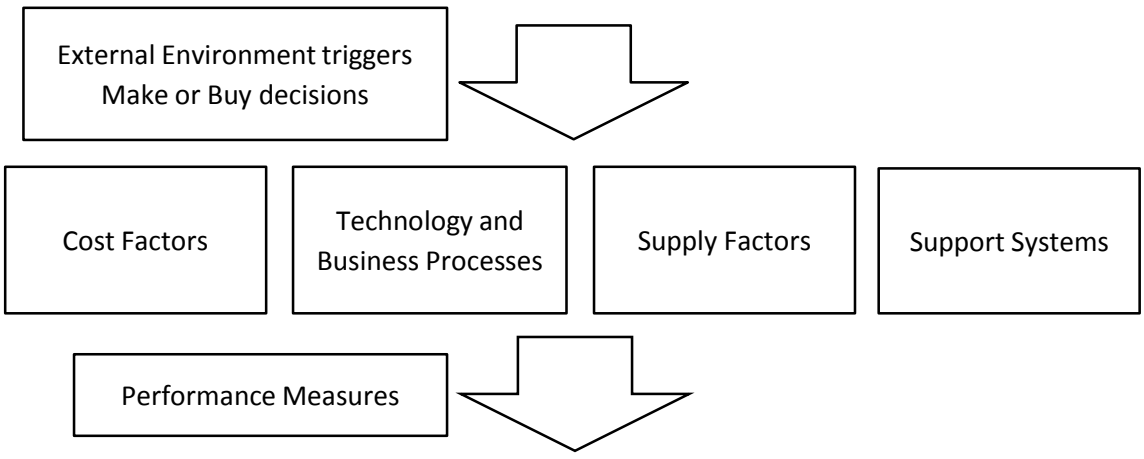

Figure 23.1: Make or Buy Analysis Framework

Using the Tool/Technique

The Make or Buy Analysis is performed in order to analyse critical factors within the external environment which could have an impact on the cost structure, quality or supplier relationship of the organisation. These external factors consist of the competition, political elements, social benefits, environmental elements etc.

Following steps are used to conduct a Make or Buy Analysis:

Step 1: Preparation

- A team is created for the analysis to be done, with an assigned team leader and a defined objective. The team leader assigns roles and responsibilities for each team member to carry out during the analysis

Step 2: Data Collection

- With relation to the total cost of ownership or the life cycle cost, the team collects data on several factors in order to obtain a solid basis for the Make or Buy analysis.
    - **Cost Factors:** In House Cost, Acquisition Cost
    - **Technology and Business Processes:** Technical Skills, Quality Measures, Technology, Process Ownership
    - **Supply Factors:** Supplier Capabilities, Supplier Selection, Quality Control
    - **Support Systems:** Information System, Quality Check System, Technical Support

Step 3: Data Analysis and Decision

- Weights and Ratings are applied to qualitative factors to compare the metrics. Overall cost Figures are calculated for In House cost and Acquisition cost. It is made sure that all the relevant factors are accounted for in the data analysis. A decision is made to Make or Buy. A sensitivity analysis is done to test the robustness of the final decision

Step 4: Feedback

- Feedback concerning the final Make or Buy decision is provided to relevant stakeholders. The decision is supported with the analysis of all the factors involved

The large availability of specialised suppliers delivering high quality solutions, as well as the proliferation of easily configurable out of the box solutions, often makes the buy option lower in cost. As a result, it is often difficult to justify taking the make option as the preferred way forward. Conducting the make or buy analysis generates more informed decisions, and adds to the transparency of the process of selecting new products or services.

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24. 10 Cs of Supplier Evaluation

Description and Purpose
Knowledge area: Project Procurement Management

The 10 Cs of the supplier/contractor evaluation technique has been developed by Ray Carter. This evaluation technique is composed out of ten factors that should be considered when selecting the supplier of a tool used in a project, or selecting the supplier to carry out the project (outsourcing).. These factors ensure that a standard technique is adopted in the evaluation of all suppliers in consideration. The ten factors are listed below.

10 Cs of Supplier Evaluation

- Competency
- Capacity
- Commitment
- Control
- Cash
- Cost
- Consistency
- Culture
- Clean
- Communication

This checklist is used by the project stakeholders in order to analyse every supplier with respect to delivery and reliability for the products or services to be procured. It is useful to compare various suppliers on each factor, thereby selecting the most preferred supplier. In addition, the result of this technique can be used to negotiate prices with suppliers as the project stakeholders will have quotation marks on each factor from all suppliers along with the price offer. This technique can also be used as a standard tendering process for supplier evaluation in an organisation.

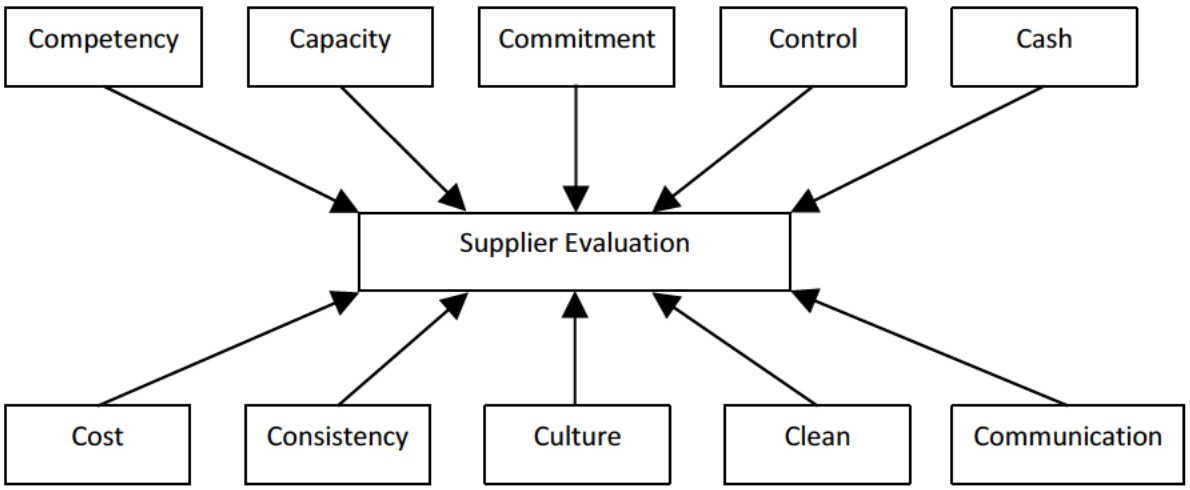

Figure 24.1: 10 Cs of Supplier Evaluation

Using the Tool/Technique

The 10 Cs of supplier evaluation technique is a comprehensive list to standardise the evaluation of suppliers. The description of each of the ten factors of this technique is provided.

Competency

- This evaluates whether the supplier has the capabilities to deliver the products/services to be procured. For example, views from other customers regarding the supplier can be considered.

Capacity

- This factor indicates whether the supplier has enough capacity to fulfil the requirements. For example, the supplier should be flexible so that it can handle fluctuations in demand.

Commitment

- The supplier should ensure that it has proper standards and quality systems in place to ensure a continuous supply of qualitative products or services.

Control

- This factor evaluates the control capability of the supplier regarding its policies, procedures and processes in order to ensure a consistent performance.

Cash

- The supplier should be financially strong in order to survive through a rough economy, without jeopardizing the requested qualitative products or services.

Cost

- This is the total cost of all products or services to be supplied. The cost, along with all the other factors, should be considered while evaluating a supplier.

Consistency

- The supplier should demonstrate that it has proper procedures and processes in place to ensure a timely supply of qualitative products or services.

Culture

- To ensure a good relationship, the supplier should have similar cultural values as the organisation. This ensures that both value the same principles for a lasting relationship.

Clean

- The supplier should ensure that is has sustainability policies in place related to environment laws and best industry practices.

Communication

- This factor relates to the communication channels to be used by the supplier for notifications, handling crisis situations and who would be the point of contact within the organisation.

The 10 Cs of supplier evaluation technique tends to change the focus compared to traditional ways of evaluation, which mainly look at the cost. All factors are important with regards to supplier evaluation, which would result not only in lower costs but also in consistency and reliability of the supply of the requested qualitative products or services.

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25. Proposal Evaluation Techniques

Description and Purpose

Knowledge area: Project Procurement Measurement

Despite the various procurement methods, upon receiving the proposal of a prospective supplier, it is important to correctly evaluate the proposal and assess whether the supplier can successfully perform the tasks required by the Request for Proposal (RFP) specifications.

Generally, there are two main techniques to make a decision in regards to a supplier's proposal, both requiring a slightly different set of evaluation criteria and weights.

- **Trade-Offs:** The contract is awarded to a supplier who may not quote the lowest price, but other factors lead to its selection. In this case the evaluation criteria consider trade-offs between price and other factors, such as quality, reputation, time, political pressures, etc.
- **Lowest Price, Technically Acceptable (LPTA):** The contract is awarded to a supplier who quotes the lowest price and has enough technical capabilities to produce the result stated in the RFP specifications. This method is adopted when requirements are not complex, and when the technical and performance risks are minimal. With LPTA, if multiple suppliers are to be evaluated, often a short-list is created using the same criteria as in the Trade-Offs technique, and then the short list is ranked by price.

The approach of conducting the proposal evaluation is decided by the Proposal Evaluation team. It consists of subject matter experts having experience of different organisation functions. The stakeholders of the project are taken into confidence before awarding the contract.

Evaluation Criteria	Weight	Score Proposal 1	Score Proposal 2	Score Proposal 3
Criterion 1				
Criterion 2				
Criterion 3				
Criterion 4				
Total score	**100%**			

Figure 25.1: Proposal Evaluation Matrix

Figure 25.1, above, shows a simple matrix evaluating the proposals of 3 different suppliers, based on 4 different weighted criteria.

Some recommended and best practice criteria to use are:

- Price
- Quality assurance procedures
- Risk management procedures
- Contract management procedures
- Skill capabilities (certificates)
- Quality and number of project references
- Clarity of proposal (writing and message)
- Feasibility of schedule and plan
- Other qualitative criteria

Using the Tool/Technique

Proposals should be evaluated in a standardised manner so that there is fairness and openness about the complete selection process. Following, are the steps to evaluate proposals:

Step 1: Plan and design the Request for Proposal and the Evaluation

- Identify the project or contract objectives and the purpose it will serve in the long term
- Determine the evaluation criteria covering all project objectives
- Criteria could include several factors like cost, capability, duration and resource skills
- Prepare evaluation matrix with weights for each criterion and each supplier
- The criteria are reviewed with the central procurement team or other stakeholder
- Design the RFP and send it to all the identified vendors or suppliers

Step 2: Form the Evaluation Team

- As per the criteria identified include subject matter experts in the evaluation team
- Determine team approach in deciding on number of panels and members in the panel
- Assign roles and responsibilities to each team member with decision-making authority

Step 3: Conduct the Evaluation

- Collate data from RFPs and calculate Total Score for each proposal using the matrix
- Analyse the Total Scores of each proposal and any trade off scenarios for each supplier
- Document results and different business scenarios with advantages and disadvantages

Step 4: Finalisation

- Publish the final results
- Hold negotiations with prospective suppliers for any clarifications required based on the inputs provided in the RFP
- Assign a contract or project to the best identified vendor or supplier based on the negotiations and feedback

Some key points should be kept in mind during the process of the proposal evaluation:

- A well-defined evaluation criteria should be outlined in the RFP for supplier selection
- It is important to document shortfalls, assumptions and areas of risk for each proposal
- The RFP specifications must be clear and avoid ambiguity
- Evaluation ratings and weights of criteria should be applied consistently for all suppliers
- It is important to define a minimum acceptable score per criteria and in total, particularly if only one supplier is answering to the RFP

While using the trade-off method for proposal evaluation, there may not always be a clear recommendation. There may be risks and uncertainties attached to costs, benefits or both. Some of quantify certain areas of the proposal in order to fit the criteria and evaluation matrix. Qualitative notes should be prepared taking assistance of subject matter experts for these factors.

Updates to the evaluation criteria or the proposal evaluation process should be documented, so that it can be used in the next cycle of proposal evaluation.

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26. Pareto Chart

Description and Purpose

Knowledge area: Quantitative Risk Analysis

The Pareto principle states that generally 80% of the effects come from 20% of the causes. In terms of project management, the same principle applies. For example, 80% of costs may be attributed to 20% of activities, or 80% of the effects of risks may be attributed to just 20% of the identified risks. This analysis is called a Pareto Analysis and is illustrated by a Pareto Chart.

The Pareto analysis is a formal technique to identify those issues that cause the majority of problems in a project. Focussing on these top issues will lead to addressing almost 80% of the problems. Once the top issues are identified, the root cause analysis can be performed in order to address them. The application of a Pareto Analysis helps to focus on those risks that cause the most impact on a project.

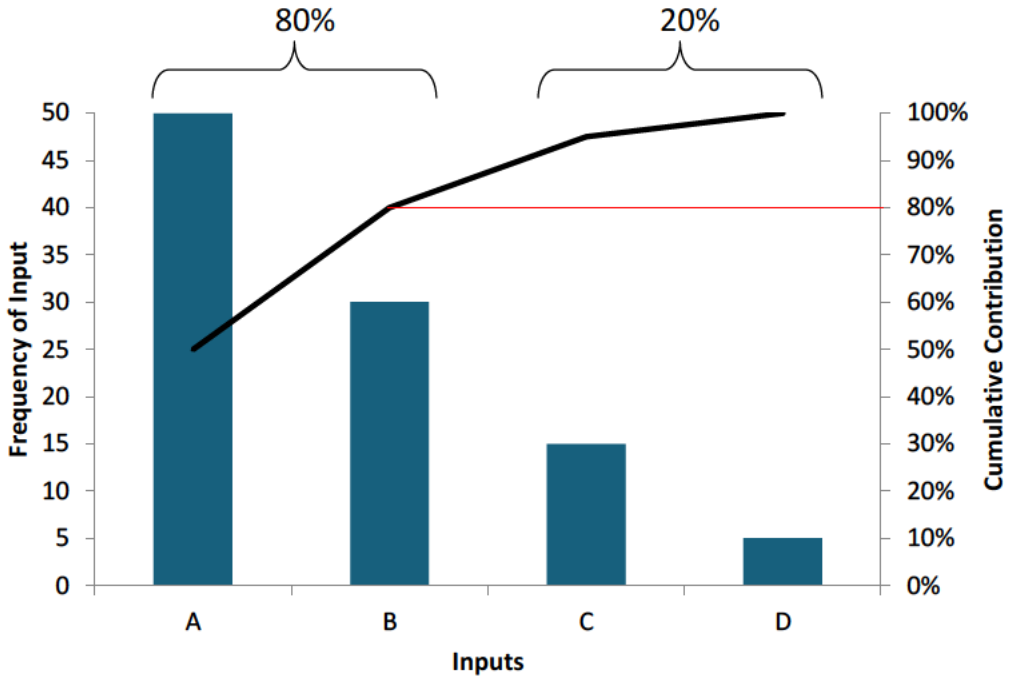

Figure 26.1: Pareto Chart

Consider the Pareto Chart in the Figure 26.1 above. This chart is prepared once the problems and inputs related to them are identified. The horizontal axis (X-Axis) is the list of all inputs that are potential causes of the problems. The left vertical axis (Y-Axis) is the total number of times an input has caused the problem or its frequency. The right vertical axis (Y-Axis) depicts the cumulative percentage contribution of causes by all the inputs. Hence, in the chart above inputs A and B account for around 80% of the issues in the system and need to be addressed.

Using the Tool/Technique

The Pareto Analysis provides insights about the top issues impacting the project and prioritises the actions to be taken. Following are the steps to perform the Pareto Analysis:

Step 1:

- Define the problem statement and decide on how to classify the causes

Step 2:

- Create a list of cause categories covering all identified causes in Step 1

Step 3:

- Determine the frequency of occurrence for each cause category identified in Step 2

Step 4:

- Arrange the cause categories on a histogram with the highest to the lowest frequency of occurrence
- Add a cumulative contribution in percentage terms on the right vertical axis to complete the Pareto Chart

Step 5:

- Identify the top problem categories contributing to 80% of the causes from the Pareto chart
- Use root cause analysis methods to drill down on these top causes to find solutions

Sometimes the top problem category identified may be too broad to address. In this case a second level Pareto analysis may be conducted on the large problem category. This enables to break down the analysis so as to apply the right solution to the right problem category.

One of the limitations of the Pareto analysis is that it might overlook smaller project issues, which actually grow bigger with time. Due to low probability or existence of such an issue, it might not get addressed. However, a small issue might be the root cause of a large problem in the future. In such cases the Pareto Analysis can be performed at different time intervals in order to understand the top issues in different phases of the project.

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27. Project Assessment and Effectiveness Measurement

Description and Purpose
Knowledge area: Benefit Realisation and Measurement

Projects are often assessed in terms of performance during their execution or after the project closure as to identify possible improvement areas within the project management process. Generally this assessment is done in relation to the EVM method. However, it is also important to assess a project based on its effectiveness in relation to achieving its stated goals or objectives.

Project effectiveness can be measured both in qualitative and quantitative terms, both during and after the project. However, defining these measurements and metrics must be done up-front during the pre-project phase. The Project Assessment and Effectiveness Measurement cycle runs in parallel to the execution of the project, and the cycle can be launched at any time.

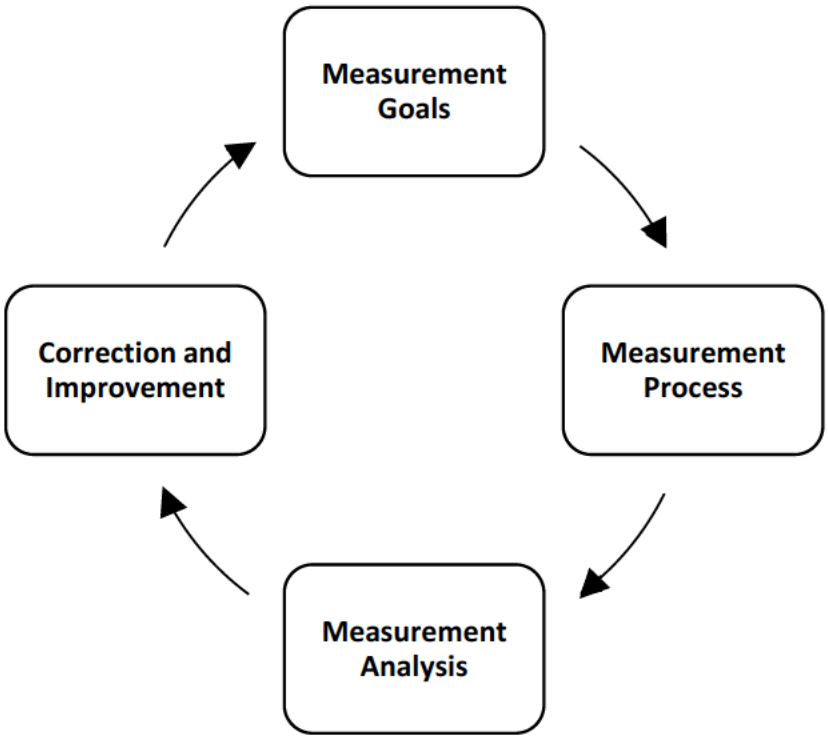

Figure27.1: Process Effectiveness Measurement Framework

Figure 27.1 shows the framework to assess a project and measure its effectiveness. It is a four step process similar to the Quality Circle (Plan-Do-Check-Act method). The important concept of the framework is that it is continuous, and not linear. Corrections and improvements in the project must be done during its lifetime, and these must be reassessed on a continuous basis.

Using the Tool/Technique

Each step of the project assessment and effectiveness measurement framework, shown in Figure 27.1, is explained in more detail below:

Step 1: Measurement Goals

- The Project Management structure – including roles and responsibilities - should be well defined as to provide support to the entire team
- Define the organisation of decision making for each role within the team
- Identify project goals and objectives as well as any operational issues
- Request the commitment of all project team members for active participation

Step 2: Measurement Process

- Data on various project functions, as defined in the measurement goals, is collected
- Project team members are encouraged to be open and objective in sharing the data
- The data is collated and organised to feed into the measurement analysis

Step 3: Measurement Analysis

- The data is analysed in the quantitative and qualitative forms, composed out of metrics and qualitative notes
- These metrics and notes are then compared to the project goals and objectives
- The measurement criteria of the metrics are also analysed in order to identify the possible need of changing them

Step 4: Correction and Improvement

- The stakeholders of the project or the Project Managers (PMs) are provided with the analysis of the corresponding metrics
- Corrective actions are defined and recommended in order to enable process improvement
- The team also suggests improvements for the overall measurement process as to meet the needs of the stakeholders and Project Managers (PMs)

A checklist can be used to quickly identify whether all activities of the measurement process have been completed. The checklist should have several questions to assess the way the process of measurement was conducted.

With the changing project environment the measurement process and criteria also need to keep changing and evolving. Ensuring that the Project Assessment and Effectiveness measurement process in in place and adopted can greatly increase the likelihood that the organisation benefits from the project.

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28. SECI Model - The Knowledge Spiral

Description and Purpose
Knowledge area: Knowledge Management and Lessons Learned

The SECI (**S**ocialisation, **E**xternalisation, **C**ombination, and **I**nternalisation) model is a framework within the practise of knowledge creation. New knowledge is created by moving from tacit to explicit knowledge and back as a continuous process. Understanding the knowledge creation process in a project is very important so that the project team is able to generate and share knowledge.

Understanding how knowledge and skills evolve and are transferred in and between project team members is key to ensuring consistent and continuous levels of project performance and quality.

The continuous process of knowledge creation in a project involves two types of knowledge:

- **Tacit Knowledge**: personal, context specific, hard to formalise and communicate
- **Explicit Knowledge**: easily transmittable in a formal and systematic language

The SECI Model postulates that knowledge creation takes place when tacit and explicit knowledge interact. There are four ways in which knowledge can be created:

- **Socialisation**: Tacit to Tacit knowledge transfer happens through face-to-face interactions or knowledge sharing experiences
- **Externalisation**: Tacit to Explicit knowledge transfer happens through writing or publishing documents, images, concepts, etc.
- **Combination**: Explicit to Explicit knowledge transfer happens by organising or combining different sources of explicit knowledge
- **Internalisation**: Explicit to tacit knowledge transfer happens through receiving knowledge and applying that in a real scenario

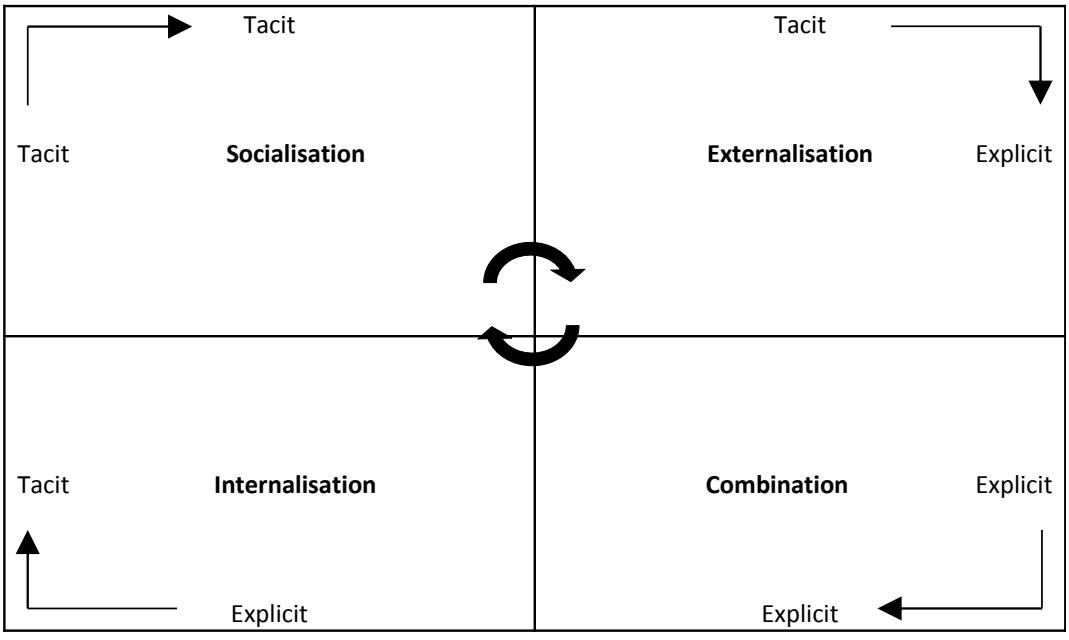

Figure 28.1: SECI Model

Using the Tool/Technique

The SECI Model explains the theory of knowledge creation through a continuous process. Project team members go through different stages of knowledge creation while working on a project. Below is a description of the four stages of the SECI Model:

Step 1: Socialisation

- During the first stage of the process the knowledge is in the tacit form. The key to acquire such knowledge from an expert is through socialising by face-to-face interactions, meetings, brainstorming workshops and sharing knowledge experiences

Step 2: Externalisation

- The next step of converting tacit to explicit knowledge can be done through capturing the acquired tacit knowledge in written or graphical formats. The project team captures the knowledge gathered in the first stage by documenting concepts, models, hypothesis, graphics, analogies, metaphors, etc.

Step 3: Combination

- This stage combines explicit knowledge, captured from several sources, into one area. Knowledge documented from various sources is synthesised as to compare different models, concepts or hypothesis. This generalises several theories and compares the advantages and disadvantages of different elements

Step 4: Internalisation

- By putting this model into practice, the concepts and processes combined from different sources in previous stages can be taken to the next level. Through action and reflection of applying the knowledge, the information is internalised. This leads to the creation of new tacit knowledge, after which the cycle is repeated by going back to Step 1

The knowledge created in a subsequent cycle of the SECI model will always be a higher level. The more this cycle is repeated, the better the generated knowledge will be. Each stage, iteration and implementation leads to new knowledge.

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29. Lessons Learned

Description and Purpose

Knowledge area: Knowledge Management and Lessons Learned

Capturing the lessons learned of a project is often overlooked and ignored. Project Managers should encourage team members to capture lessons from projects. These project lessons can lead to identifying several areas for improvement, which can be useful when executing other similar projects. Information that can be captured includes lessons learned from dealing with risks, quality issues, outsourcing or contractor issues, change requests, etc.

The project team can captures ideas through brainstorming sessions, project reports and logs, project questionnaires, etc., during the lifecycle of the project. The Project Manager can also organise meetings as to stimulate the process of capturing lessons and identifying development ideas. Project Managers (PMs) should conduct these meetings efficiently to capture constructive inputs from the whole team. The project team should be open to discuss the shortcomings of the project and how they were overcome. The identified areas for improvement can be grouped afterwards and prioritised in order to understand and act upon the top improvement areas. In addition, action items for follow-up can be assigned to team members as to work on areas for improvement. The captured lessons, as well as any derived action items, can be reviewed in follow up meetings.

Project Details		**Project Name, Project Manager, Team Members**					
Area/Process	**Issue that occurred**	**Actions taken**	**What worked well**	**What can be improved**	**Other comments**	**Shared learning**	**Recommended follow-up actions**
Area 1							
Area 2							
Process 1							
Process 2							

Figure 29.1: Project Lessons Template

In order to capture lessons learned during long projects it is advisable that the project Manager, alongside with the project team, utilise a template as illustrated by the example in Figure 29.1.

Using the Tool/Technique

Capturing lessons learned is a way of identifying development areas within a project. Below are the key steps of capturing lessons from a project through the use of meetings.

Step 1: Kick Off

- The process of capturing lessons learned is initiated with the definition of the expected goals or results to be achieved by the exercise
- Information can also be captured through a project closure questionnaire

Step 2: Capture Ideas

- Improvement ideas and lessons are captured throughout the duration of the project
- The project team can keep track of the ideas through a capturing lessons template
- Different themes and lessons are captured from the project closure survey
- The Project Manager brainstorms together with the project team as to capture any additional development ideas or lessons

Step 3: Group into Opportunities

- The ideas are grouped based on common themes and related project lessons
- The Project Manager facilitates the process of grouping the opportunities and lessons learned in order to eliminate duplication

Step 4: Prioritise

- Once the opportunities and lessons learned are grouped, they are prioritised for greater focus
- This also serves as a review session for all lessons learned and prioritised opportunities

Step 5: Identify and Assign Actions

- For the high priority opportunities, the team brainstorms on how to approach them
- Actions to be taken, as well as target dates regarding specific opportunities, should be assigned to team members or Project Managers (PMs)
- Reviews for each of the priority opportunity areas should be conducted when appropriate actions have been taken

Lessons learned can also be captured on a regular basis and archived. This archive could serve as a starting documentation for project teams to execute similar projects.

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