Project Management Fundamentals

Fondamenti di Project Management

2023

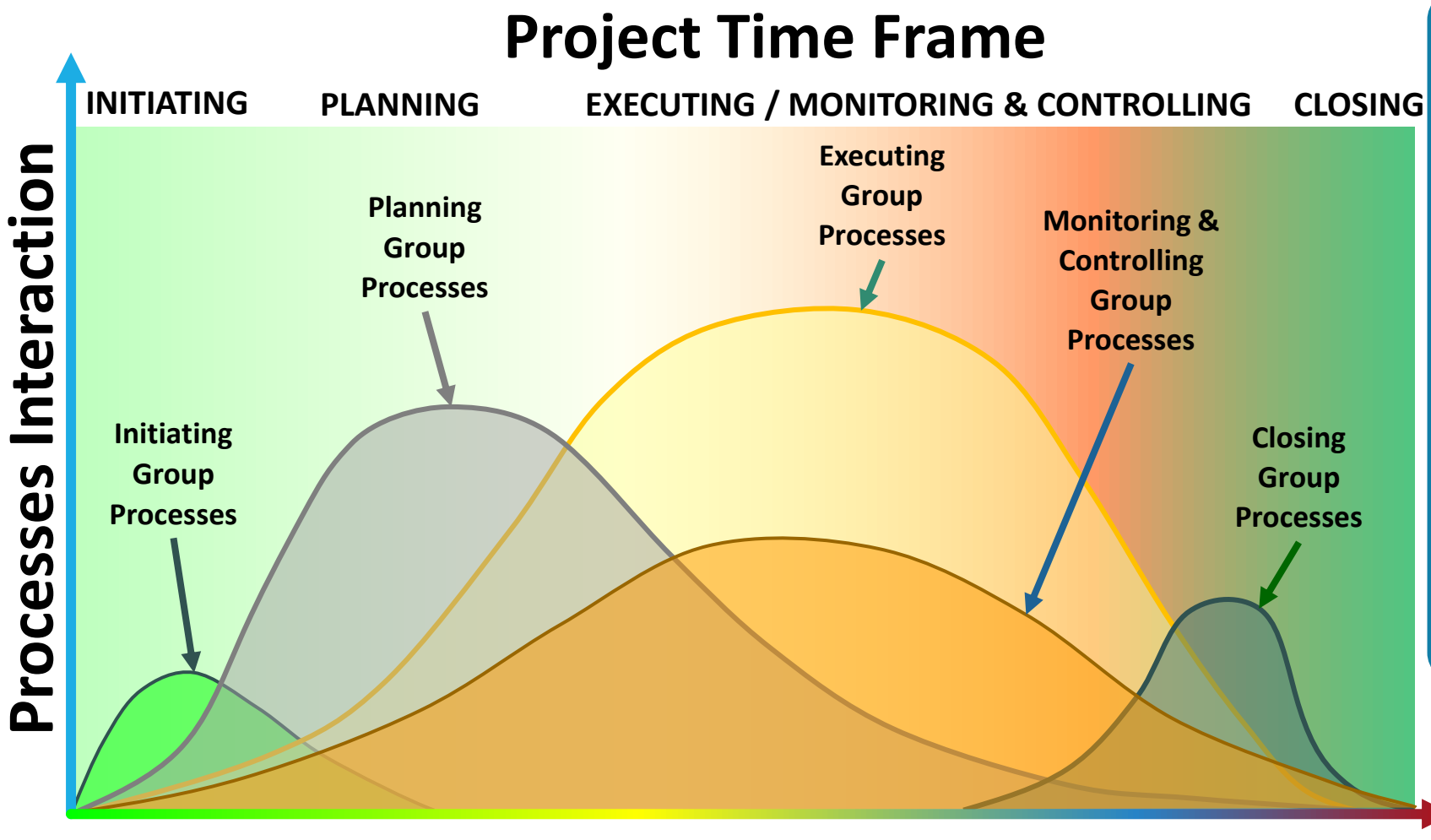
PART 3 – METHODOLOGY 2ND – PLANNING

Seminar Part 3 Topics

Part 3 – Methodology 2nd – Planning

1) Project Life-Cycle
2) WBS
3) P.E.R.T.
4) Critical Path
5) Milestones
6) GANTT
7) Baseline
8) Costs
9) Risks
10) A glimpse on software

Project Life-Cycle: Processes involved

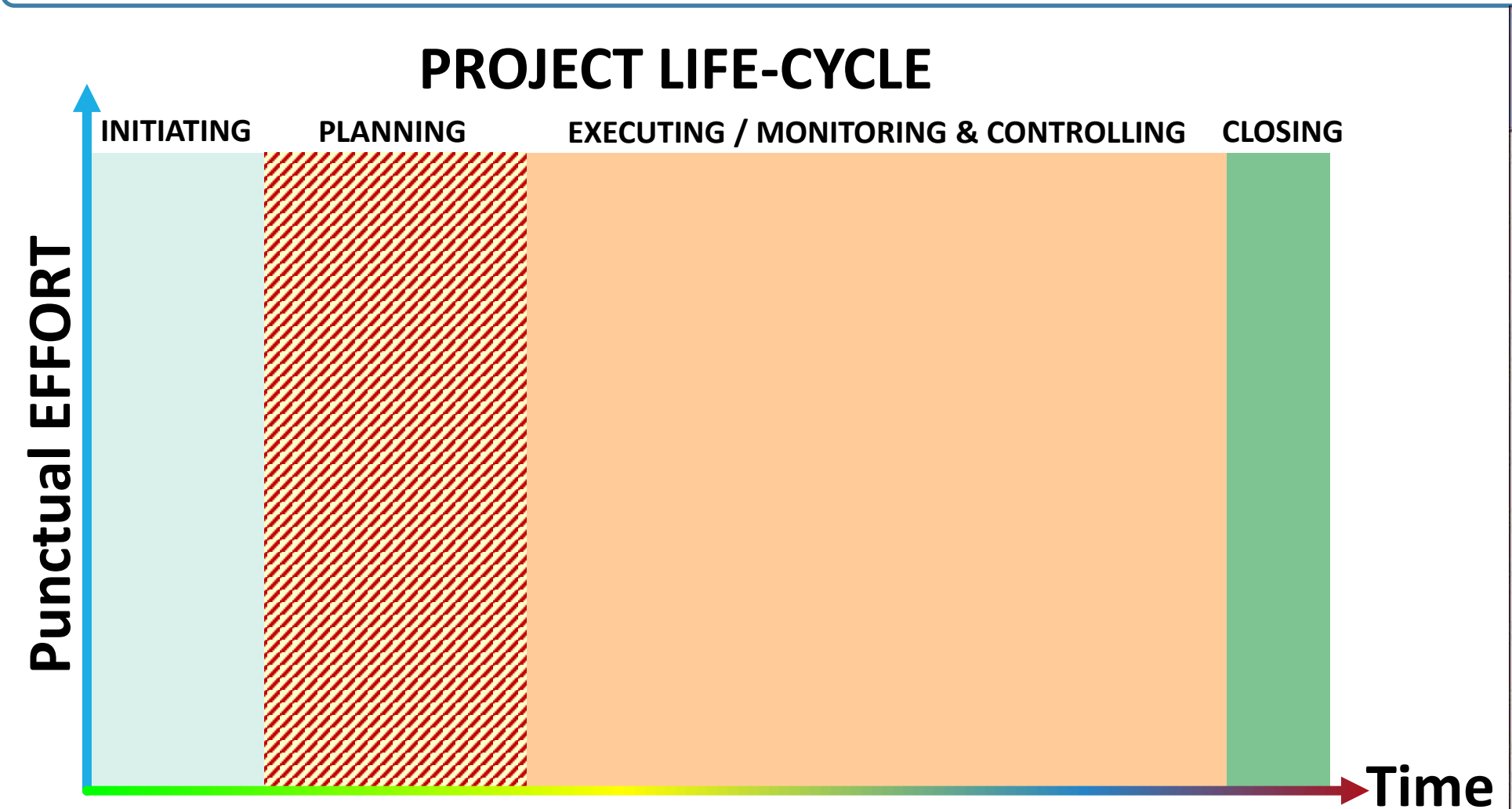


The most important part of the Project Life-Cycle could be Planning.

This part is vital for the rest of the project, since in a predictive approach here is the moment to predict and to set:

- the work to be done
- the expected deliverables to get the output specified in the project charter
- the costs estimated
- The time planning

Project Life-Cycle: Step 1



Planning Process Group
5.1 Develop Project Management Plan
5.2 Plan Scope Management
5.3 Collect Requirements
5.4 Define Scope
5.5 Create WBS
5.6 Plan Schedule Management
5.7 Define Activities
5.8 Sequence Activities
5.9 Estimate Activity Durations
5.10 Develop Schedule
5.11 Plan Cost Management
5.12 Estimate Costs
5.13 Determine Budget
5.13 Determine Budget
5.14 Plan Quality Management
5.15 Plan Resource Management
5.16 Estimate Activity Resources
5.17 Plan Communications Management
5.18 Plan Risk Management
5.19 Identify Risks
5.20 Perform Qualitative Risk Analysis
5.21 Perform Quantitative Risk Analysis
5.22 Plan Risk Responses
5.23 Plan Procurement Management
5.24 Plan Stakeholder Engagement

Predictive Approach – t Management Processes

Table 1-4. Process Groups and Project Management Processes

Project Management Process Groups				
Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4.1 Develop Project Charter	5.1 Develop Project Management Plan	6.1 Direct and Manage Project Work	7.1 Monitor and Control Project Work	8.1 Close Project or Phase
4.2 Identify Stakeholders	5.2 Plan Scope Management	6.2 Manage Project Knowledge	7.2 Perform Integrated Change Control	
	5.3 Collect Requirements	6.3 Manage Quality	7.3 Validate Scope	
	5.4 Define Scope	6.4 Acquire Resources	7.4 Control Scope	
	5.5 Create WBS	6.5 Develop Team	7.5 Control Schedule	
	5.6 Plan Schedule Management	6.6 Manage Team	7.6 Control Costs	
	5.7 Define Activities	6.7 Manage Communications	7.7 Control Quality	
	5.8 Sequence Activities	6.8 Implement Risk Responses	7.8 Control Resources	
	5.9 Estimate Activity Durations	6.9 Conduct Procurements	7.9 Monitor Communications	
	5.10 Develop Schedule	6.10 Manage Stakeholder Engagement	7.10 Monitor Risks	
	5.11 Plan Cost Management		7.11 Control Procurements	
	5.12 Estimate Costs		7.12 Monitor Stakeholder Engagement	
	5.13 Determine Budget			
	5.14 Plan Quality Management			
	5.15 Plan Resource Management			
	5.16 Estimate Activity Resources			
	5.17 Plan Communications Management			
	5.18 Plan Risk Management			
	5.19 Identify Risks			
	5.20 Perform Qualitative Risk Analysis			
	5.21 Perform Quantitative Risk Analysis			
	5.22 Plan Risk Responses			
	5.23 Plan Procurement Management			
	5.24 Plan Stakeholder Engagement			

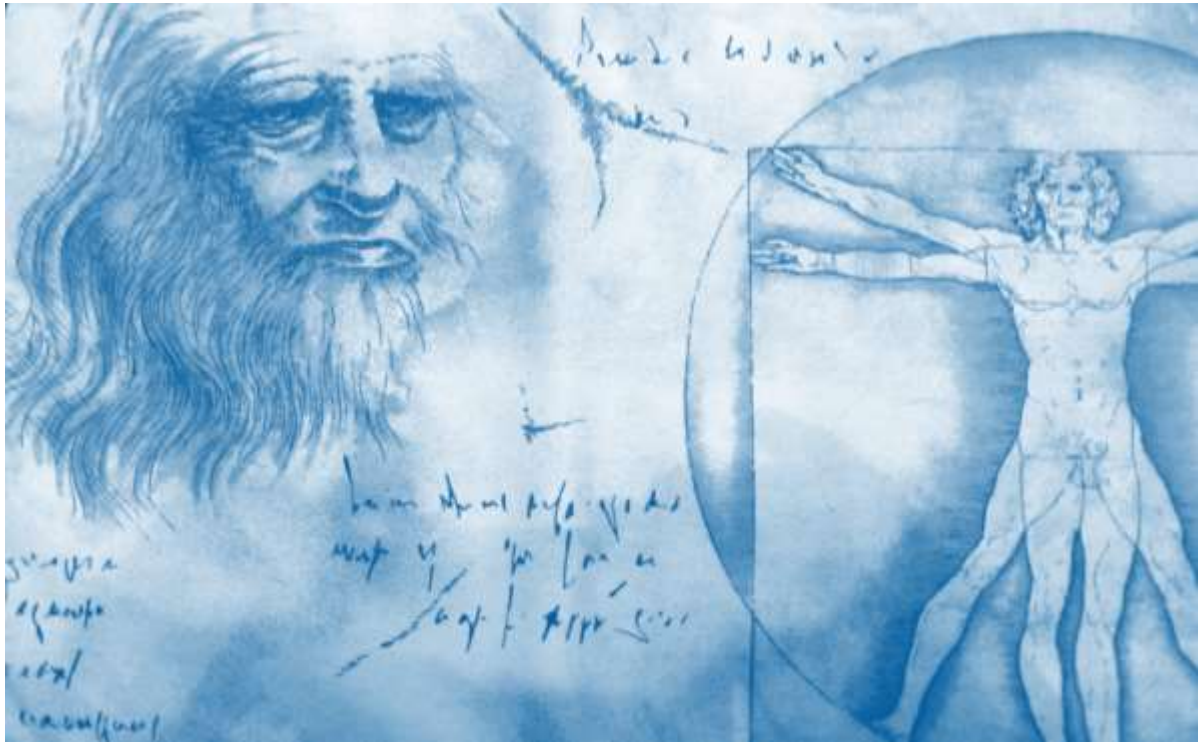
The most impacting work on a project is clearly:
PLANNING

«By failing to plan, you are preparing to fail.»
Benjamin Franklin

«He who fails to plan is planning to fail.»
Winston Churchill

Looking Forward

The one who does not foresee distant things exposes himself to near-by unhappiness **[Confucio]**



Quelli che si innamorano di pratica senza scienza, son come il nocchiere, ch'entra in un navilio senza timone o bussola, cha mai ha certezza dove si vada. Sempre la bona pratica deve essere edificata sopra la bona teoria. **[Leonardo Da Vinci]**

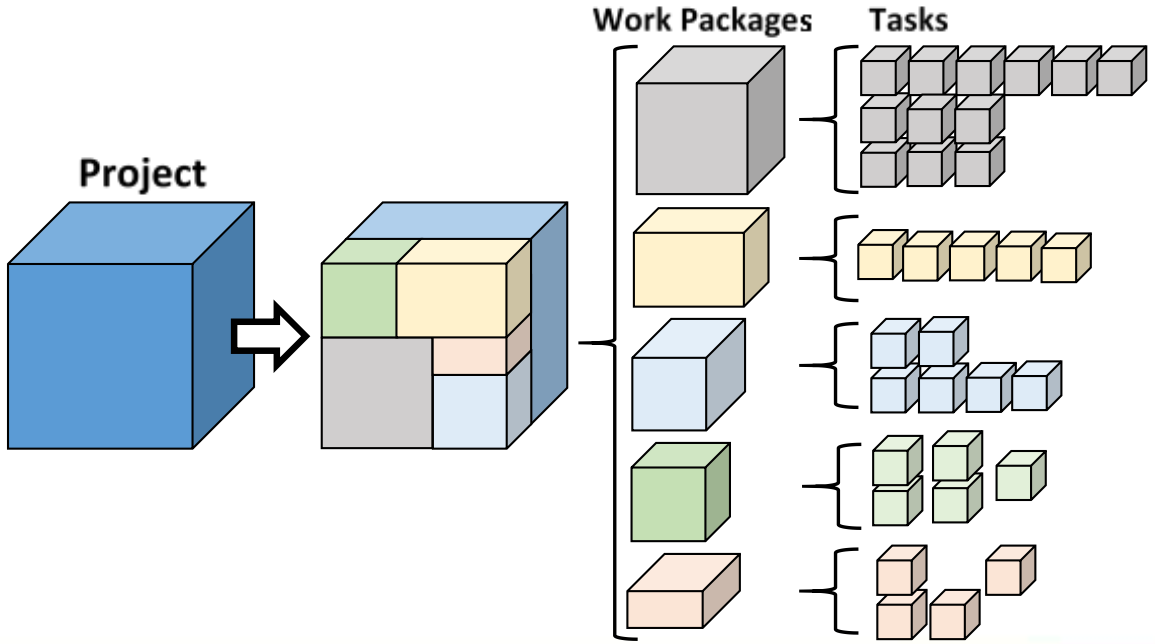
5.5 WBS

Def. 16: Work Breakdown Structure (WBS) (Practice Standard for Work Breakdown Structure, 3rd Ed.)
WBS is a hierarchical decomposition of the total scope of the work to be carried out by the project team to accomplish the project objectives and crate a required deliverables.
The WBS establishes the framework for planning, controlling, executing, and managing the project's work to its completion and successfully handing over its deliverables.

The WBS elaborates the total scope or the project by defining and hierarchically organizing it.

The WBS represents the entirely of the work specified in the current approved project scope.

- What is in the WBS is part of the project
- What is non in the WBS is not part of the project



Principal Breakdown Structures used in Projects

- **WBS (Work Breakdown Structure):** Methodology that decompose in littler part the project effort of any kind, needed to the project completion. It is fundamental in defining the activities and task to comply. For the high level / first step decomposition may be better to starto from a logical approach based on 1st level deliverable or result expected.
- **PBS (Product Breakdown Structure):** Methodology that allows to decompose the whole product in fanfictions and subfunctions, to reach a conventional minimum dimension, assignable to a material or virtual (es. Software) sub component or assembly no more reducible from the Physical/logical/functional point of view.
- **RBS (Risk Breakdown Structure):** Methodology that allows to identify Risks (Threats and Opportunities) that can affect the Project. This decomposition need to be pushed forward and is hierarchically ordered, to determine the original causes of Risks that can jeopardize or promote the Project results.
- **CBS (Cost Breakdown Structure):** Methodology that allows to estimate Project costs through Project decomposition in singular components and their economic evaluation. The global cost evaluation come from the reaggregation of estimated components, and can be linked to the time plan and on the calendar with the moment cost arise.
- **OBS (Organization Breakdown Structure):** Methodology that represents the organizational structure and its components, the result is quite similar to a company organization chart, albeit referred to the project only. It sets the people assignment to the various phases and activities of the project.
- **SBS (Stakeholders Breakdown Structure):** Methodology that aim to identify every stakeholder and to represent their reciprocal connections. From this analysis is fulfilled the stakeholders register, evaluating their impact, interest and power, and their influence on the project.

From the risk point of view the WBS is a practical tool allowing the project planning team to overcome large uncertainties, by converting an uncertain challenge into a series of challenges with lesser uncertainties. By this method the project scope is converted into a series of smaller components called "work-packages", that could be more easily:

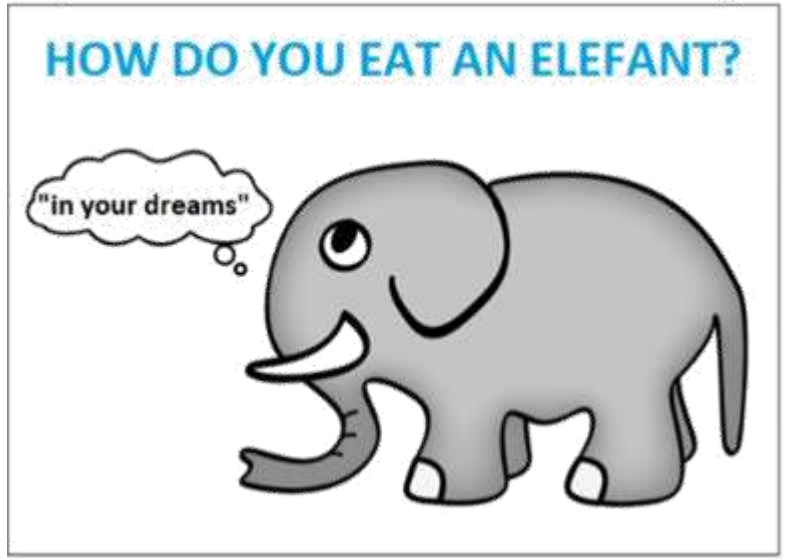
- assessed,
- measured,
- managed
- communicated.

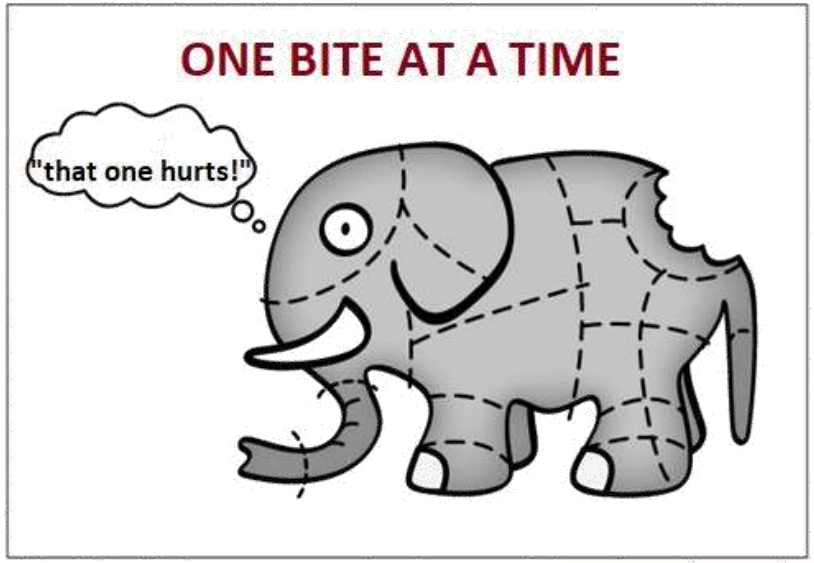
It helps in defining and understanding the relationships between:

- scope
- time
- costs

and is essential for a successful

- project planning.



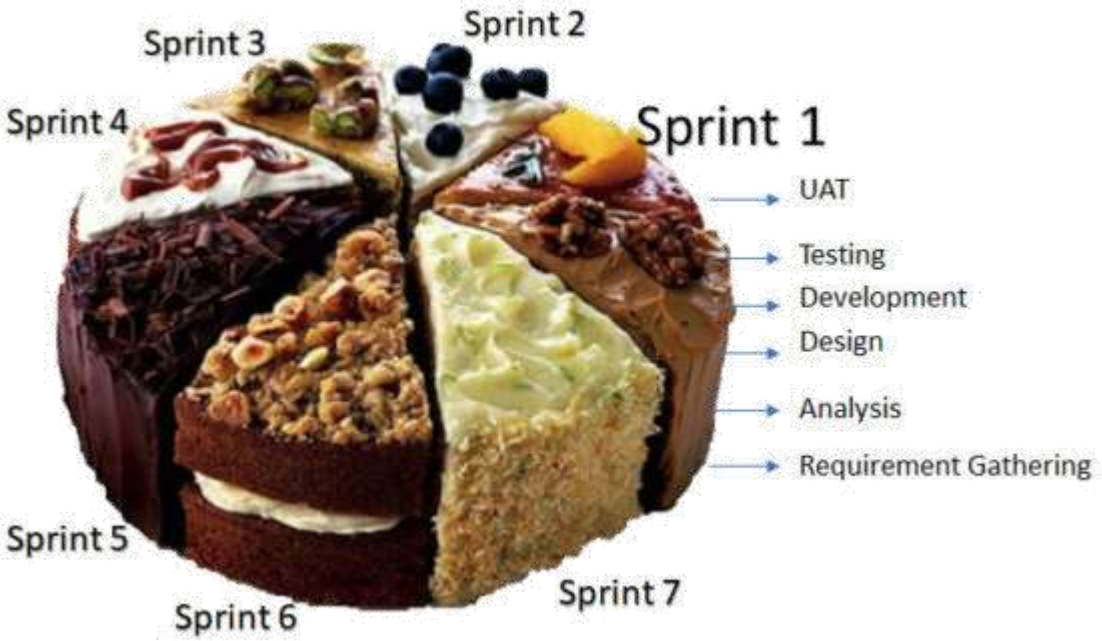


5.5 Deliverables

Def. 17: Deliverable (Practice Standard for Work Breakdown Structure, 3rd Ed.)
Any unique and verifiable product, result or capability to perform a service that is produced to complete a process, phase or project.

A deliverable can be an output directly shipped to the customer or a contribution to the project to be used internally. Can be part of the Project Result, a subsidiary thing or something that is needed but not directly involved in the final result.

In Agile is used the term: P.S.P.I
Potentially Shippable Product Increment, that is the contribution to the overall project result that can be added to the software already built, with the possibility to be delivered with an increment of value



5.5 WBS impact

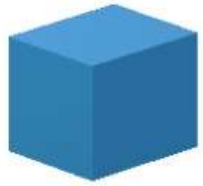
WBS is essential because planning process not based on well-designed hierarchical structure of the project's scope – fully accepted and commonly used by all project functions and stakeholders – are likely to be inaccurate, inconsistent, and result in poor planning deliverables.
These deliverables, in turn, will not allow for effective and efficient control processes, possibly resulting in poor decision making, inability to achieve project objectives, and scope creep.

Since communication is one of the discipline that has the highest impact on project success, WBS serves as a critical project communication mechanism that helps convey the scope of the project through its graphical depiction.
WBS helps communicate:

- the work to be accomplished
- the interim and end-point deliverables to be completed

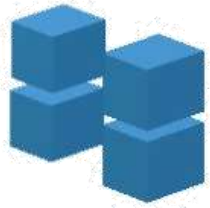
WBS Levels

Level 1: Project



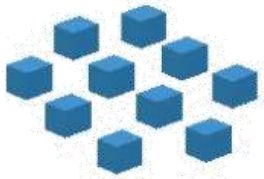
The full scope of work (direct or indirect) necessary to produce the product, service, or result.
Level 1 is the overall object, always a single WBS element

Level 2: Main Deliverables



Major areas in the scope of works.
Project phases, major project deliverables, or releases.
Often includes integration and project management work

Level 3: Work-Package



Specific, tangible deliverables of the project effort

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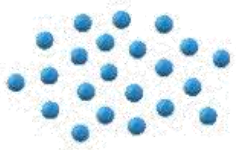
Work-Packages

Level 4: Tasks



Work packages

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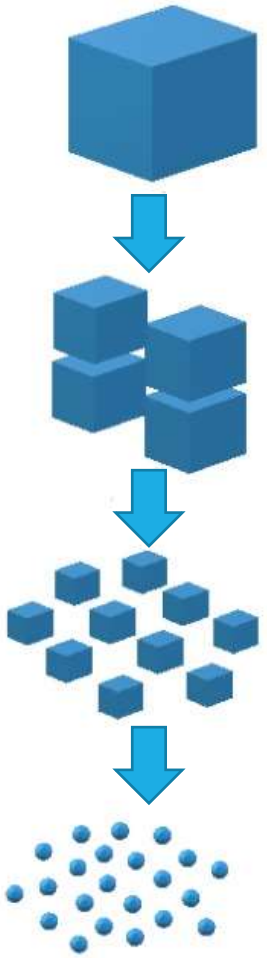
Tasks

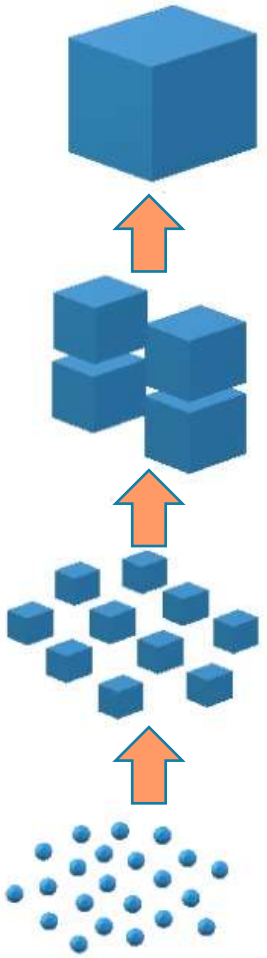
Top-Down Approach



Step 1 – Identify the final product, service or results of the project.
Step 2 – Define the project's major or interim deliverables.
Step 3 – Decompose major deliverables to a level of detail appropriate for management and integrated control.
Step 4 – Review and refine WBS until project stakeholders agree that project planning can be successful completed , and that execution and control successfully produce the desired deliverables and results.

The 100% rule:
The sum of elements at each level represent 100% of the work below

Bottom-Up Approach

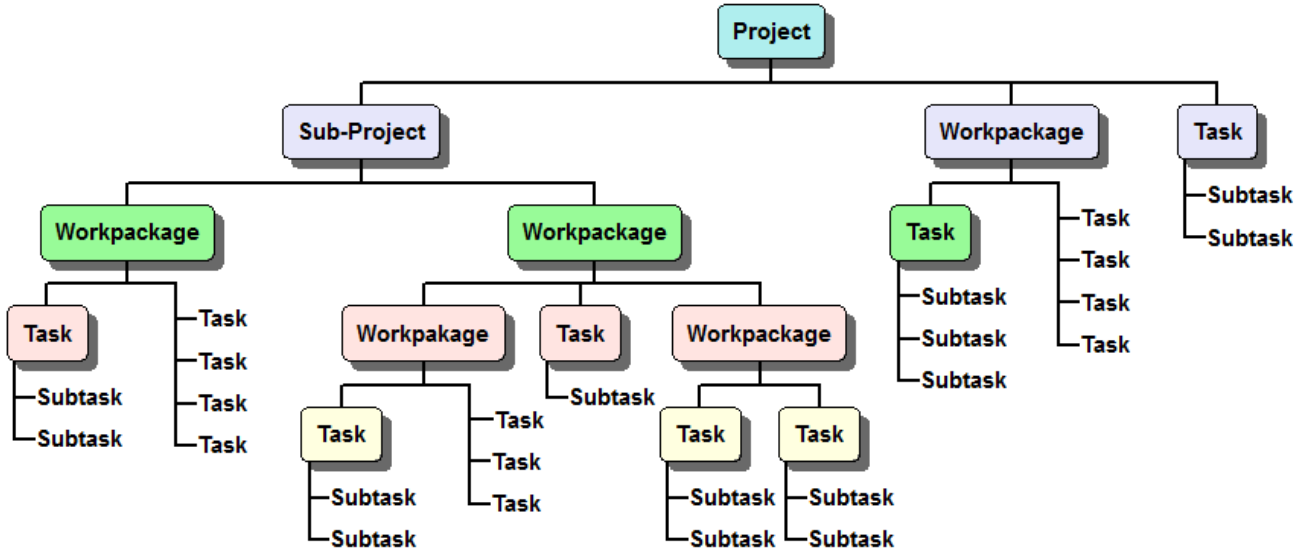


Step 1 – Identify the deliverables (work packages or user stories involved in the project)
Step 2 – Logically group related work packages (deliverables or user stories) together.
Step 3 – Aggregate deliverables to the next level, for instance, the parent level.
Step 4 – Once a given group has benne aggregated to a parent level, analyze the subset to ensure that all the work has been encompassed.
Step 5 – Repeat until all sub elements aggregate to a single parent level representing the project, including the whole project scope.
Step 6 – Review and refine WBS until project stakeholders agree that project planning can be successful completed , and that execution and control successfully produce the desired deliverables and results.

Practical WBS

Usually a number of post-it are used to represent the different levels of a WBS.
There isn't a fixed way to generate a WBS, is a team work and could be revised several time before it could appropriately represent the whole project scope and the work needed to deliver it.

Once defined by the team, it could be represented with some tree defining software, with mind-mapping or with a multilevel spreadsheet like excel, calc etc.



Typical WBS Element

Reference Code

Work Package

(Name, Description)

Timing

Responsible

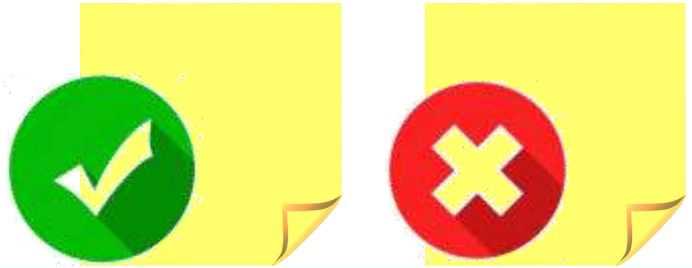
Notes…..

Post-it find their use in WBS creation since the very beginning, they represent the elements and bring on them some fundamental information that allow to

- Quantify
- Estimate
- Prioritize

The work-packages represented

On the back could be indicated some acceptance criteria for every single activity (AGILE call these information «definition of done»



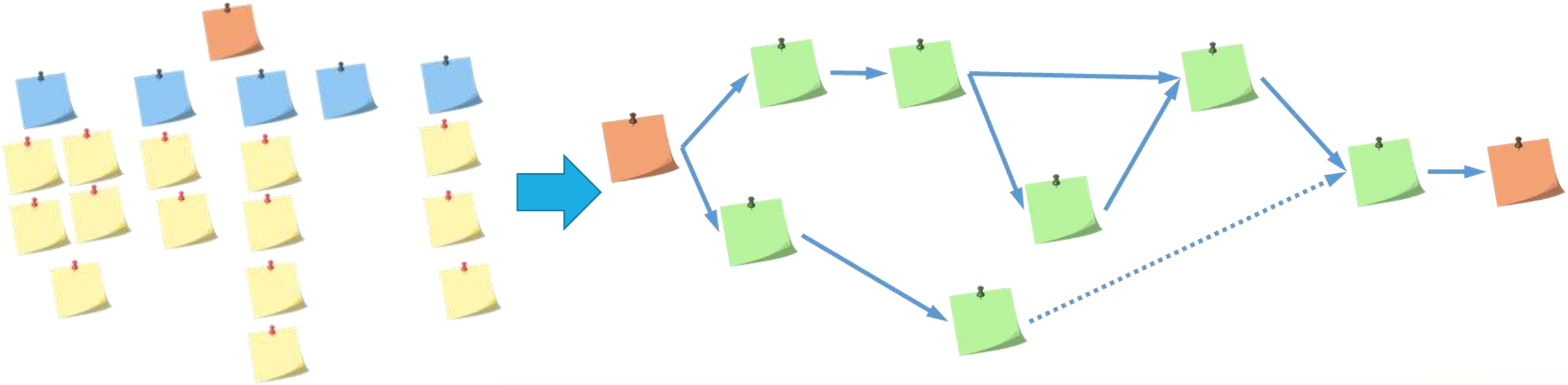
Estimation

Evaluating the WBS single components it is fundamental the estimation, that means the evaluation of the variable the element represent.
Evaluation means measuring an unknown parameter with a percentage of uncertainty.
To reduce uncertainty the single element can be compared on something similar, or could be evaluated with mathematical techniques or evaluated through statistical analysis. Anyway experience of the team pays a fundamental role in the effectiveness of the estimation.

Very important in temporal estimations is the prospective effect.
This is a bias that induce people in underestimate an event as more as it is far in time.
For that reason this event could be considered less impacting, and shorter.

Reticular diagrams (Graph Theory)

When the WBS is defined and refined the result is a list of work-packages defined by some key variables.
Unfortunately WBS is a hierarchical structure, that doesn't give information about work-packages consequential and temporal dependencies
For that reasons were used reticular diagrams that put in place dependencies, priorities and constraints among the WBS elements.



P.E.R.T.

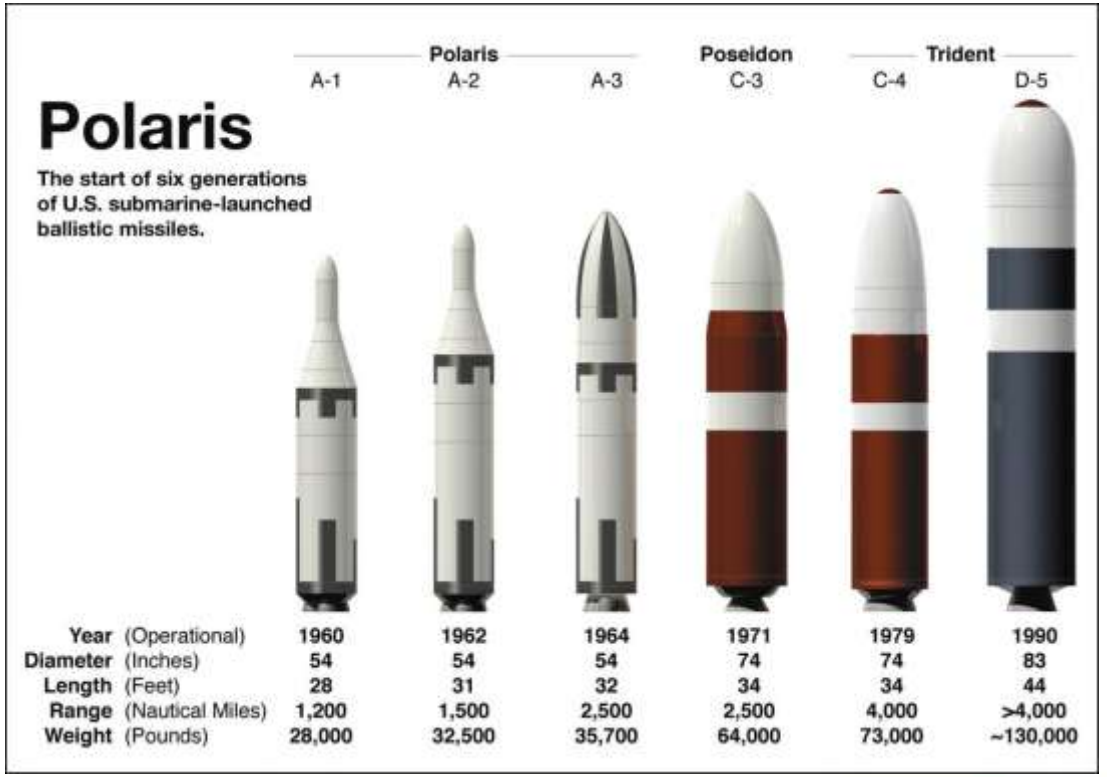
This technique was developed in the 1957 by Booz, Allen & Hamilton, Inc. (an engineering consultancy firm) for the U.S. Navy Special Projects Office to support the U.S. Navy's Polaris project meant to create a new nuclear missile for submarine use, able to take-off from underwater, reducing project time from 5 years at the beginning to 3 at the end .

- **PERT** (Project Evaluation Review Technique)

Is a reticular diagram, basically made by nodes and connection lines, that organize the elements of a WBS and allow to find the better combination with priorities, dependencies and time

- **CPM** (Critical Path Method) = time is represented on the connection arrows
- **PDM** (Precedence Diagramming Method) = time is represented on nodes

The result is more or less the same, but is different the computation to get there.



CPM: Critical Path Method

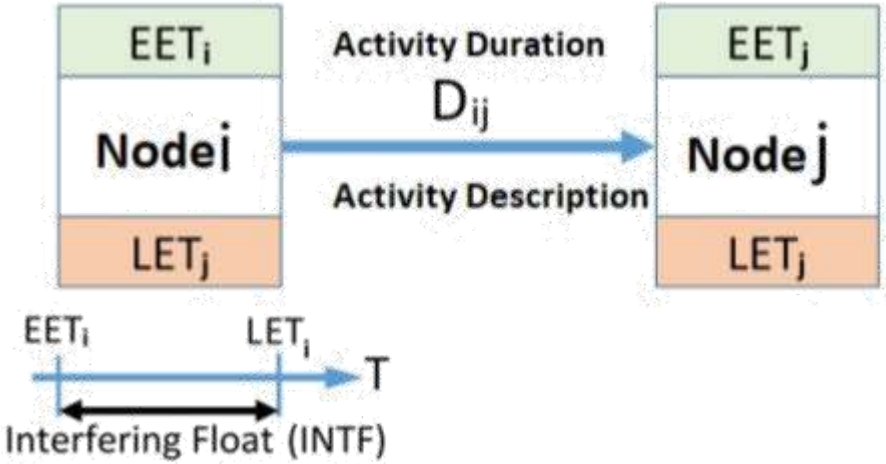
- Nodes represent the events, and contain the information related to the moment in which the event take place.
  EET(i): "Early Event Time " / LET(j): "Late Event Time"
- ➔ Arrows represent the activities and contain the duration, that means the time span that lies between events.

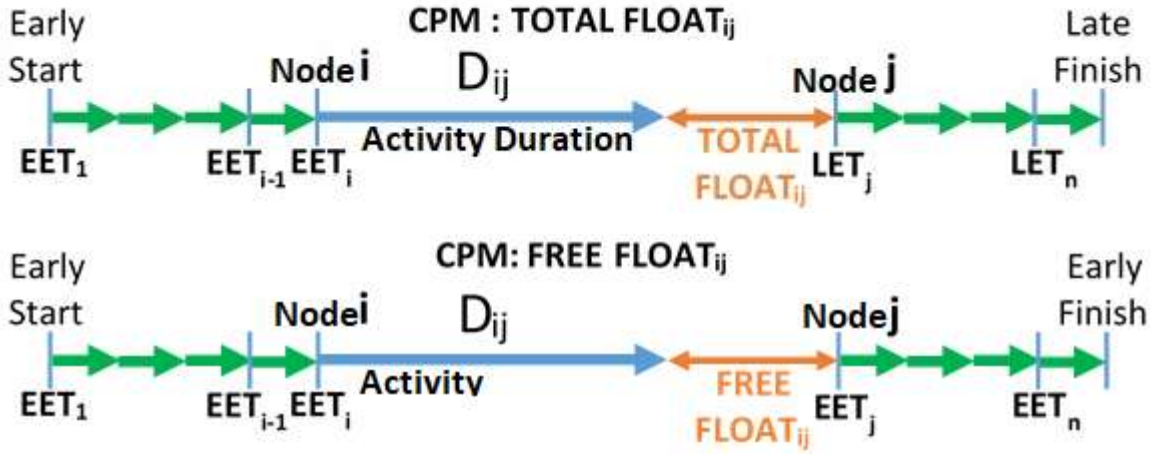
TOTAL FLOAT (TF) = TFij=LETj-EETi-Dij, it represents the maximum theoretical time gap in case all previous activities are executed with minimum duration and the following are executed with maximum duration

An Activity with TOTAL FLOAT = 0 is called critical and a delay on it means a delay on the whole project

FREE FLOAT (FF) = FFij=EETj-EETi-Dij, it represents the total maximum theoretical time gap if all previous and following activities are executed in with minimum duration

INTERFERING FLOAT (INTF): is part of TF shared between two activities, is the variability in happening due to the node





3 Kind of links:

- **NET**: Not Earlier Than
- **NLT**: Not Later Than
- **RCD**: Required Completion Date

PDM: Precedence Diagramming Method

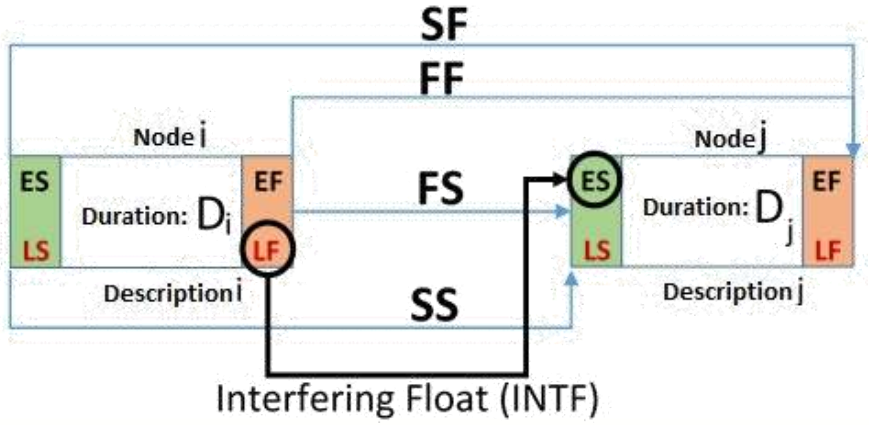
- Nodes represent the events, and contain the information related to the moment in which the event take place and their duration. For every node could be identified:
  ES = Early Start / EF = Early Finish LS = Late Start / LF = Late Finish Di = Actvity duration (which links start and finish)
- ➜ Arrows represent links and logical connection between activities, no duration is involved

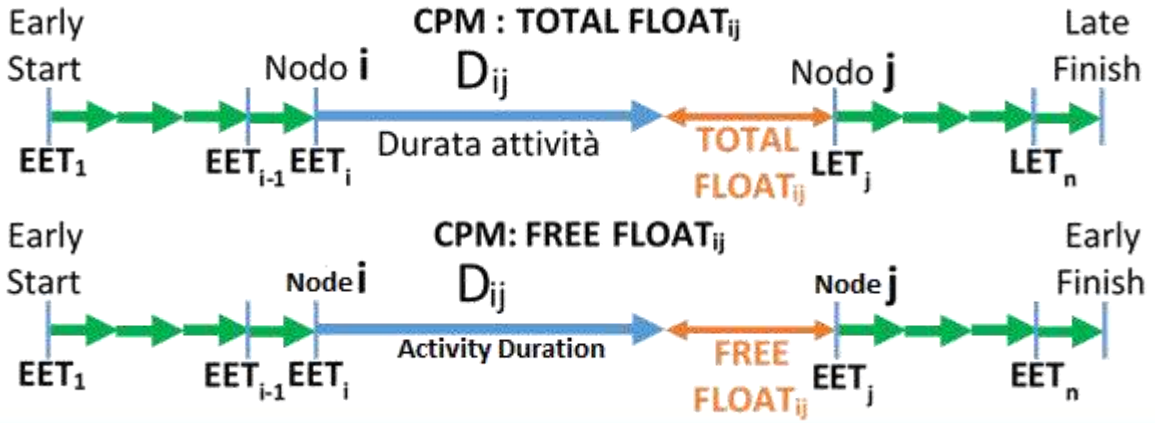
TOTAL FLOAT (TF) = TFij=LFj-ESj-Dj, it represents the maximum theoretical time gap in case all previous activities are executed with minimum duration and the following are executed with maximum duration

An Activity with TOTAL FLOAT = 0 is called critical and a delay on it means a delay on the whole project

FREE FLOAT (FF) = FFj=ESj+1-ESj-Dj, it represents the total maximum theoretical time gap if all previous and following activities are executed in with minimum duration

INTERFERING FLOAT (INTF): is part of TF shared between two activities, is the variability in happening due to the node





3 Kind of links:

- **NET**: Not Earlier Than
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3-value estimates

There are some techniques that interpolate a trusted duration starting from 3 following reference values:

- Optimistic Duration (a): minimum span of time requested to complete a certain activity considering most favorable conditions (probability assigned: 0,01)
- Probable Duration (m): most reasonable span of time requested to complete a certain activity
- Pessimistic Duration (b): maximum span of time requested to complete a certain activity considering less favourable conditions (probability assigned: 0,01)

Triangular Distribution:
Based on a triangular probability function:

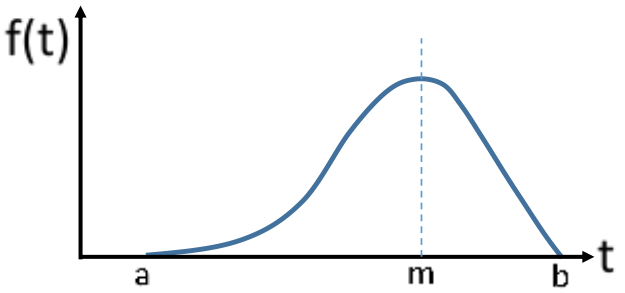
Time expected: $t_e = \frac{(a + m + b)}{3}$

Beta Distribution:
Based on Beta-curve Distribution :

$$f(t) = \begin{cases} K(t-a)^{\alpha}(b-t)^{\gamma}, a < t < b \\ 0, \quad t < a \cup t > b \end{cases}$$

Time expected: $t_e = \frac{a + 4m + b}{6}$

Variance: $\sigma^2(t_e) = \left[\frac{b-a}{6}\right]^2$

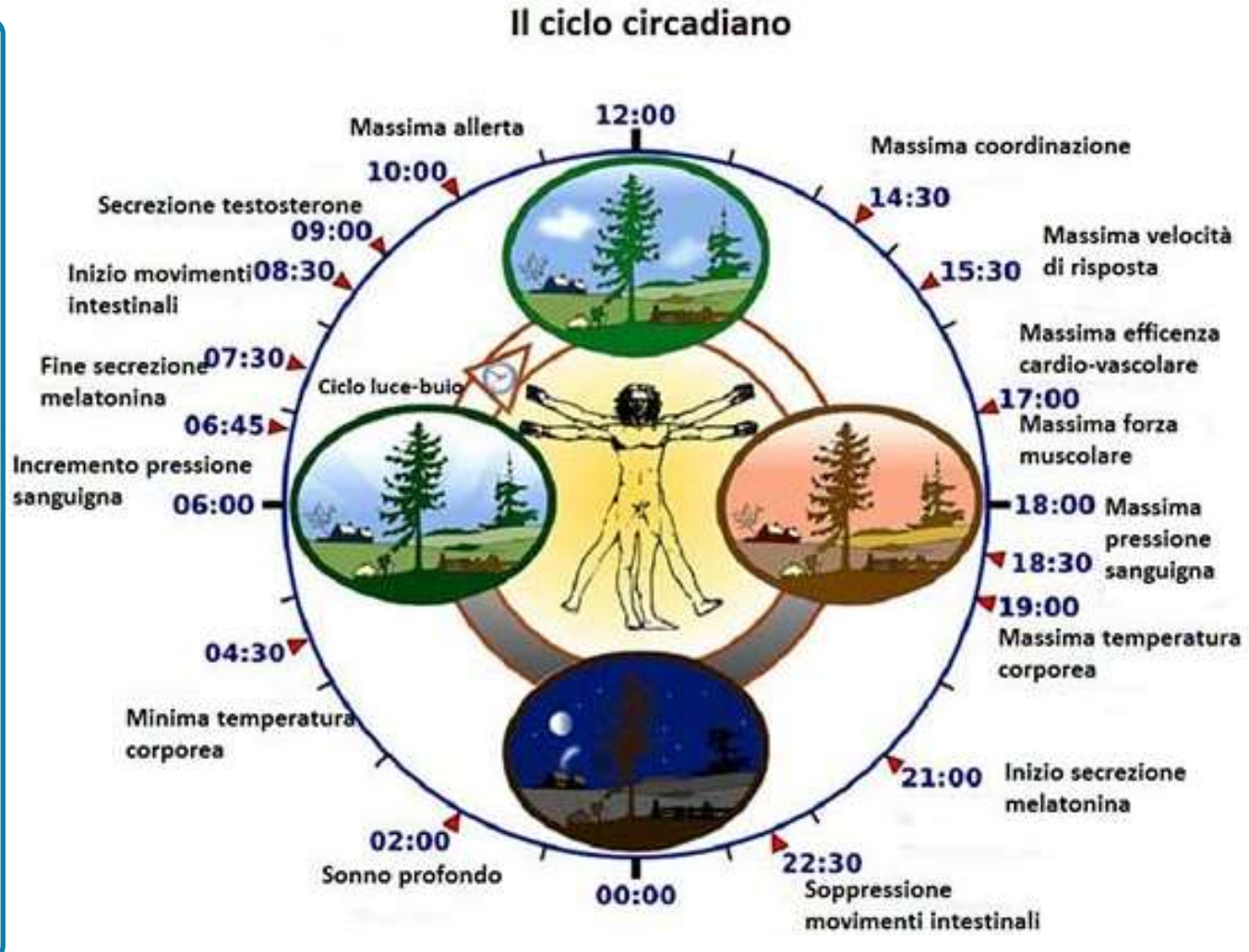


Note: At least 15 measurements are needed to calibrate the Beta curve

Circadian rhythm

How human beings understand time?
"Human biological clock" and the "common time perception" are based on the circadian rhythm.
That means a 24 hours loop that align a person with the solar cycle and the light-dark alternation (since the human is fundamentally a diurnal animal).

What comes out is that estimations based on a reduced number of 24 hours cycles are far more precise than estimation on longer temporal units. Since projects have usually long temporal path, from weeks to years, this should be considered to rectify estimations.



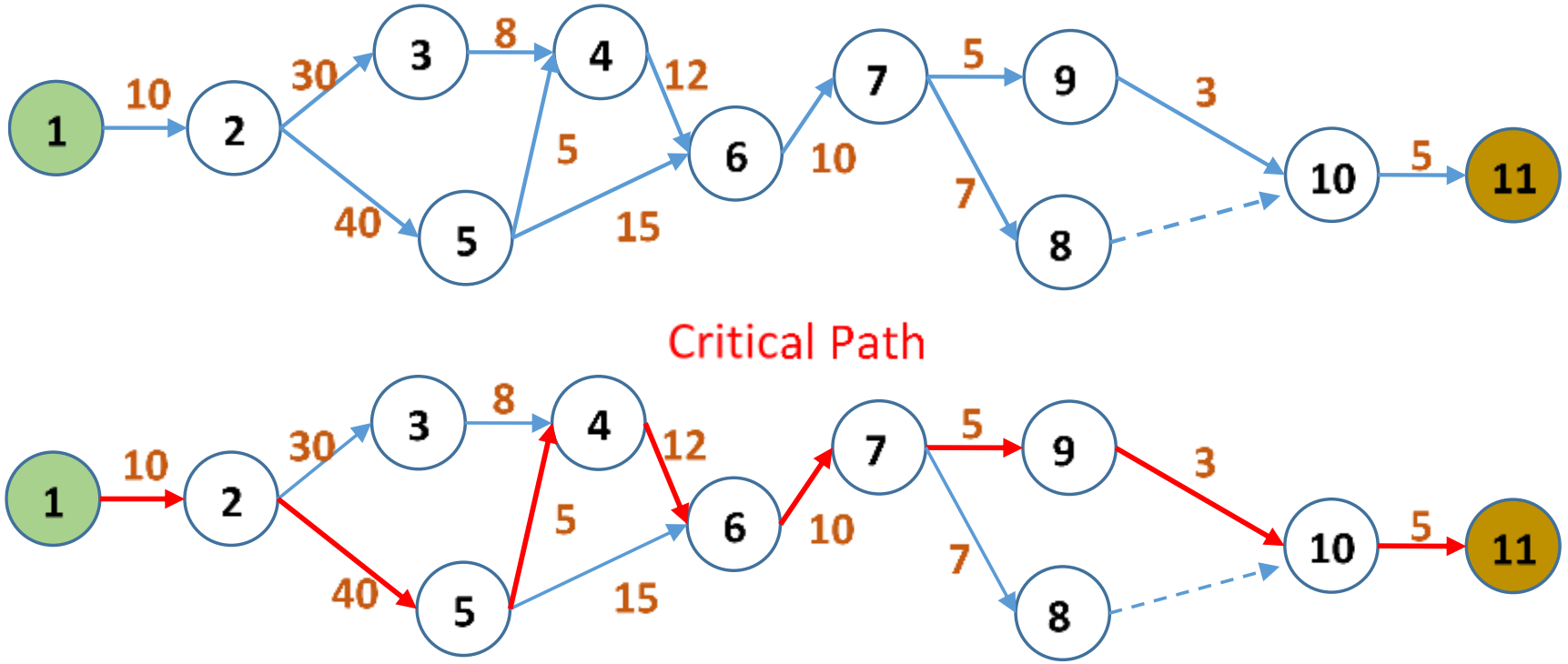
Critical Path

Def. 18: Critical Path (PMBoK 7th Ed.)

The sequence of activities that represents the longest path through a project, which determines the shortest possible duration.

The possible float present in the P.E.R.T. is called «slack».

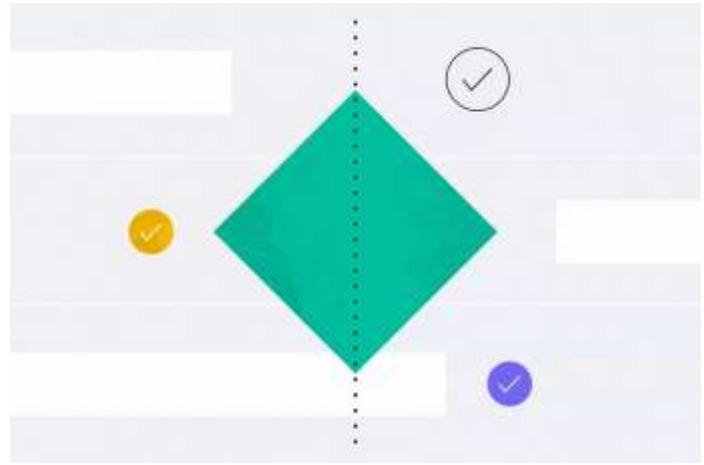
P.E.R.T. diagram is based on the CPM method, so it could be visually represented like here on the side.



Milestones

Milestones are pivot points fixed by the customer (es requested date of release), by the technology (maturation time for the concrete), by P.E.R.T, by standards (APQP), by methods (stage-gate) or other constraints.
These are check-points that articulate the planning and set a road map and a pace during the planning phase and the subsequentially execution.
Usually these check points have to be placed and verified before closing a phase and start another one.

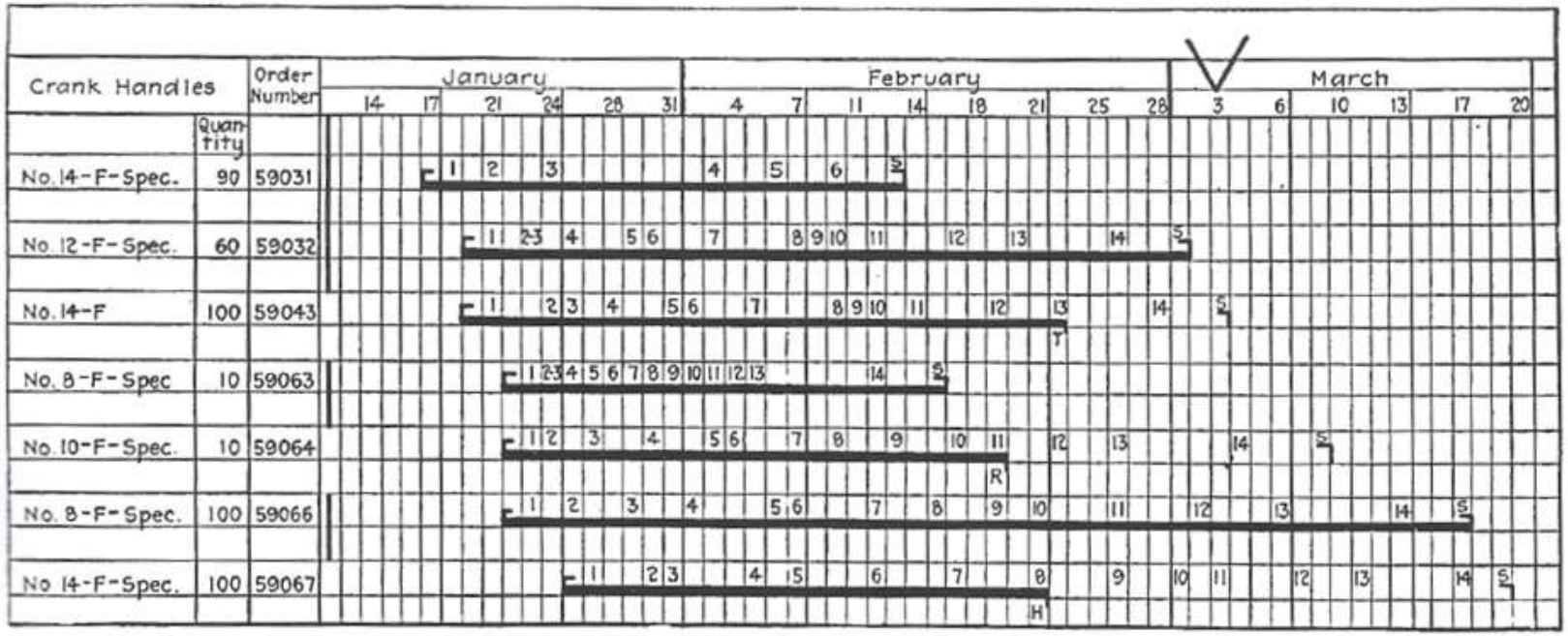
Milestones should be agreed and approved by all parts actively involved in a project, and should be integral part of the project charter and the contract.



Gantt Chart

The most well known and less understood tool used in project management is the Gantt Chart.
In 1917 the america engineer Henry Laurence Gantt, used a orizontal caledar distribution diagram to put in evidence the time reationship of every commitment producing boats to transport soldiers from USA to Europe, to fight in the WW1

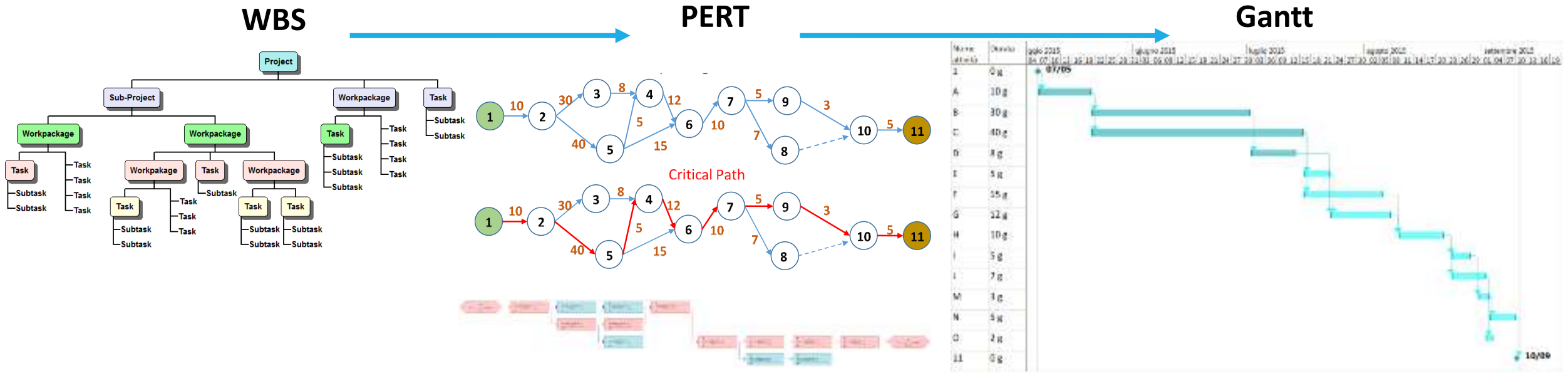
The first version of the Gantt chart was only a temporal planning, without any reticular diagram under it.
Was only aimed to put in evidence the planning of different activities or projects.



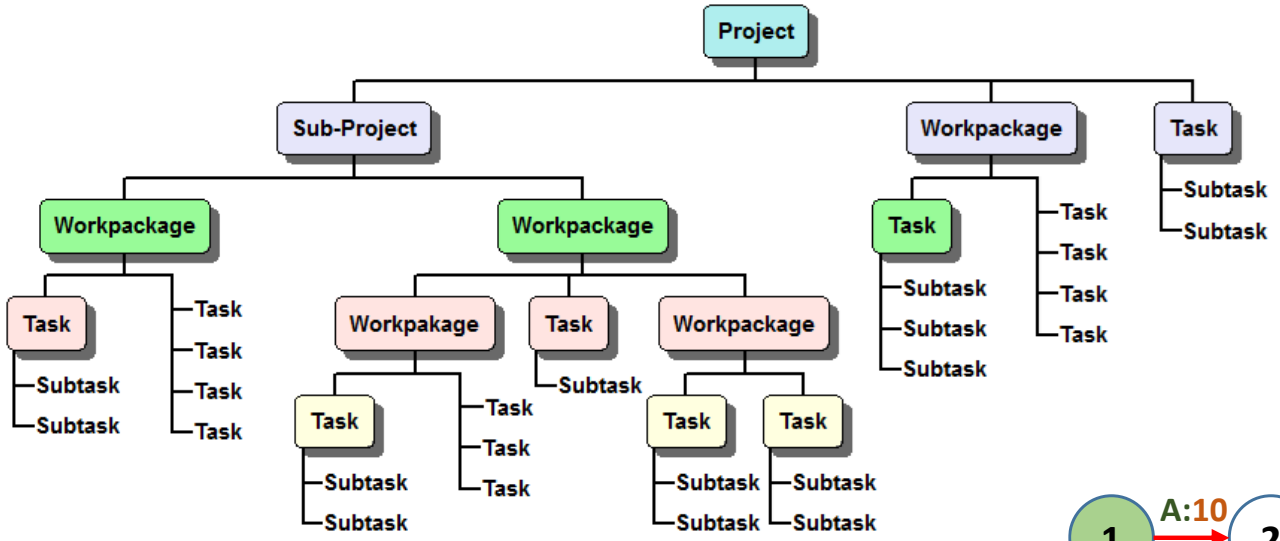
Modern Gantt Chart

Thanks to graph theory, the gantt chart was implemented with a number of information, link and dependencies. The commonly used Gant chart is the graphical time planned picture of a PDM (Precedence Diagramming Method), because:

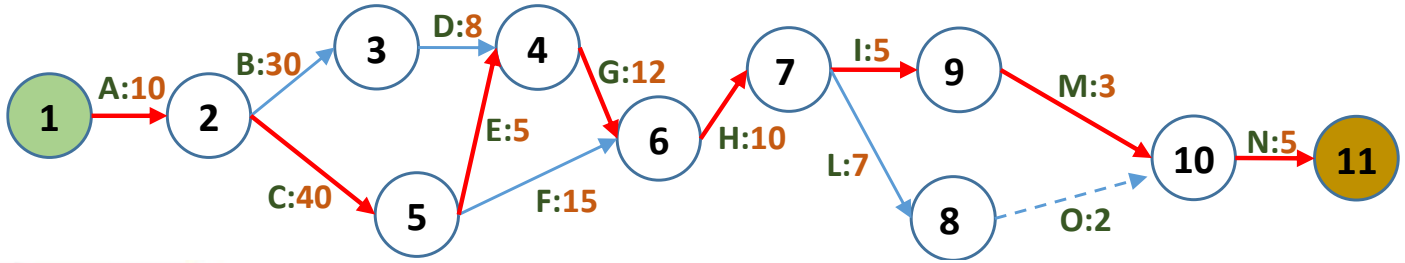
- Activities (work packages) contains both the situation related to the events and the information related to their duration
- Arrows instead give information on the relationships with activities and their constraints.

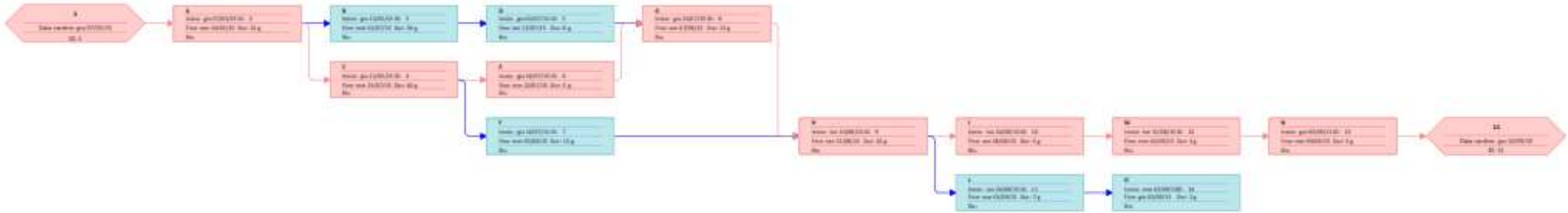


WBS → PERT → GANTT → Critical Path

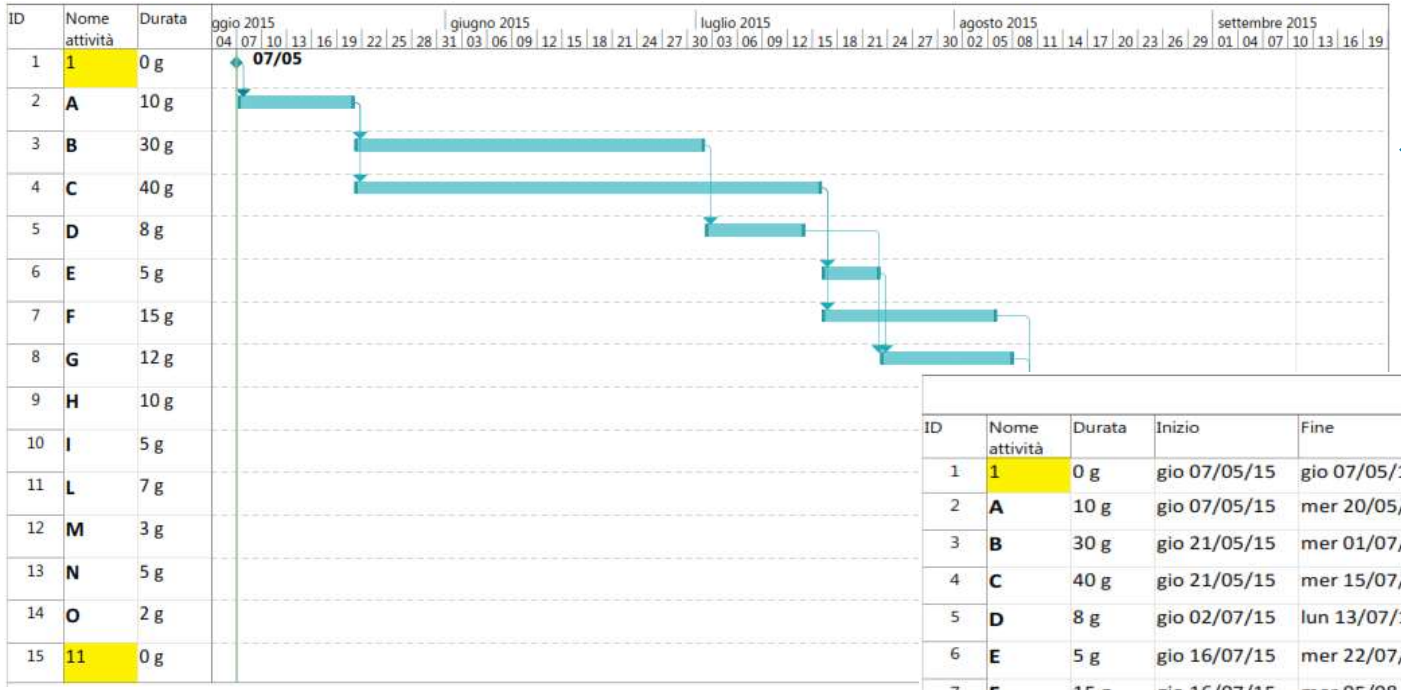


From WBS the element found and estimated take place in the P.E.R.T.
Through P.E.R.T. can be optimized the Critial Path.





WBS → PERT → GANTT → Critical Path

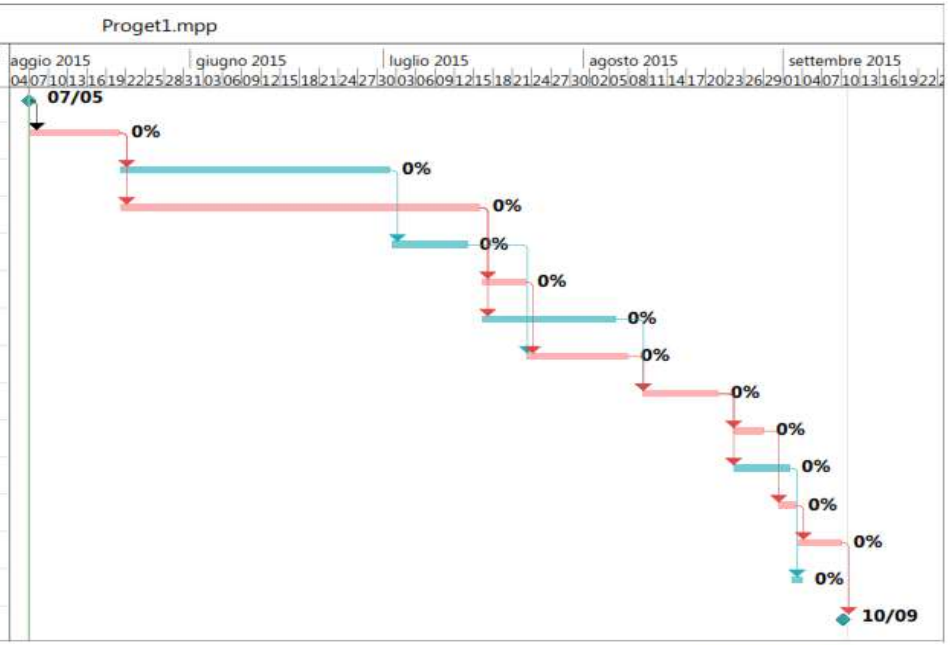


With dimensioned, linked and prioritized activities, is possible to create the Gannt Chart, converting the P.E.R.T. into a timetable.

Once the relationships among activities are clear, the critical path can be represented on calendar

Proget1.mpp

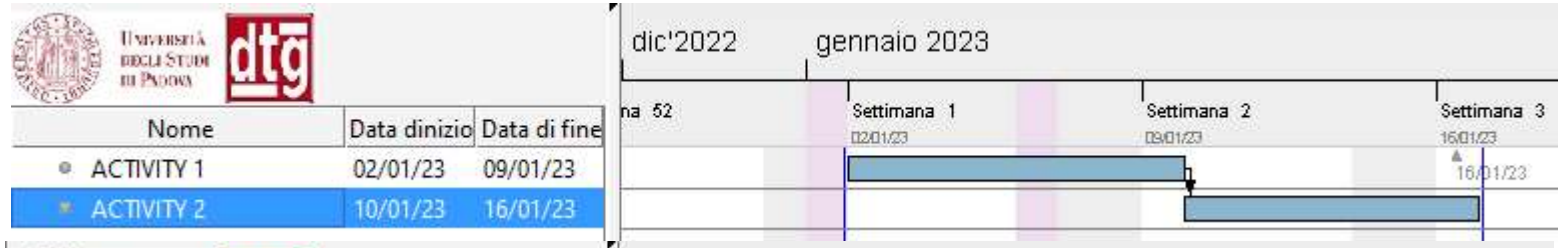
ID	Nome attività	Durata	Inizio	Fine	Predecessori
1	1	0 g	gio 07/05/15	gio 07/05/15	
2	A	10 g	gio 07/05/15	mer 20/05/15	1
3	B	30 g	gio 21/05/15	mer 01/07/15	2
4	C	40 g	gio 21/05/15	mer 15/07/15	2
5	D	8 g	gio 02/07/15	lun 13/07/15	3
6	E	5 g	gio 16/07/15	mer 22/07/15	4
7	F	15 g	gio 16/07/15	mer 05/08/15	4
8	G	12 g	gio 23/07/15	ven 07/08/15	5;6
9	H	10 g	lun 10/08/15	ven 21/08/15	8;7
10	I	5 g	lun 24/08/15	ven 28/08/15	9
11	L	7 g	lun 24/08/15	mar 01/09/15	9
12	M	3 g	lun 31/08/15	mer 02/09/15	10
13	N	5 g	gio 03/09/15	mer 09/09/15	12
14	O	2 g	mer 02/09/15	gio 03/09/15	11
15	11	0 g	gio 10/09/15	gio 10/09/15	13



CONNECTIONS - During planning an appropriate connection between every stage should be chosen

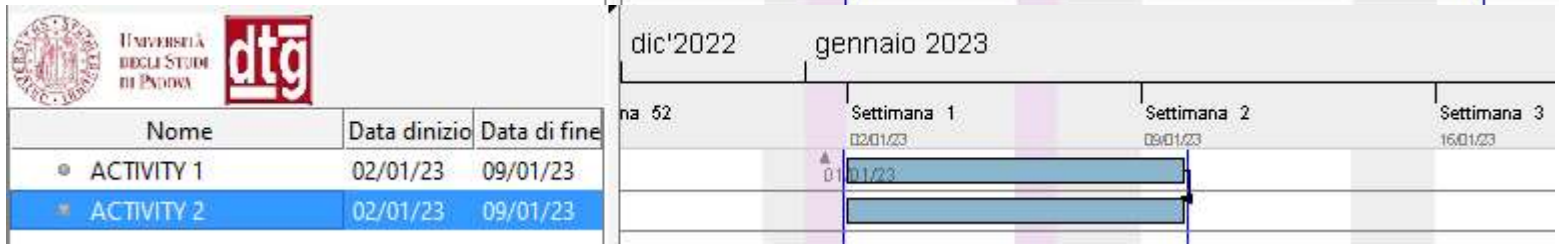
E-S: End to Start

Activity strictly consequential, the second will start after the end of the first



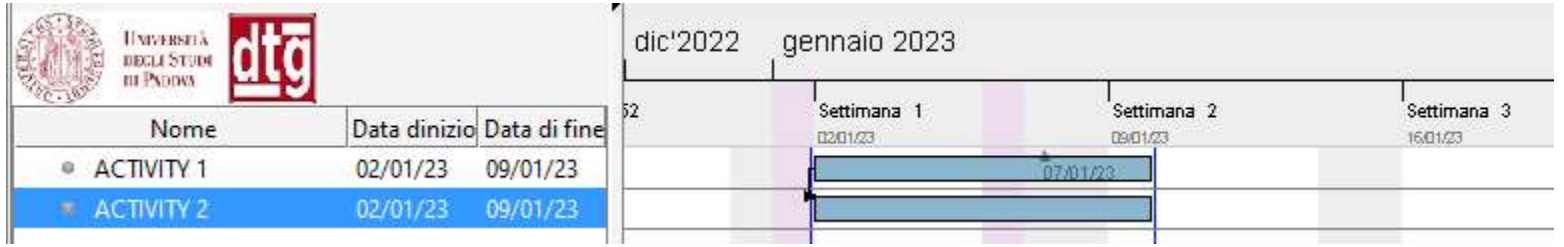
E-E: End to End

Two activities are forced to end in the same moment



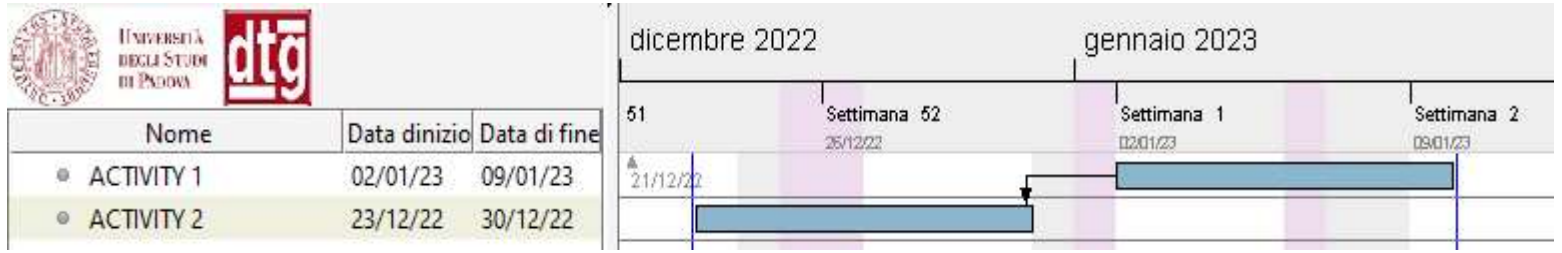
S-S: Start to Start

Two activities are forced to start in the same moment



S-E: Start to End

That is a backward connection, to force the second to move forward ending when the first start

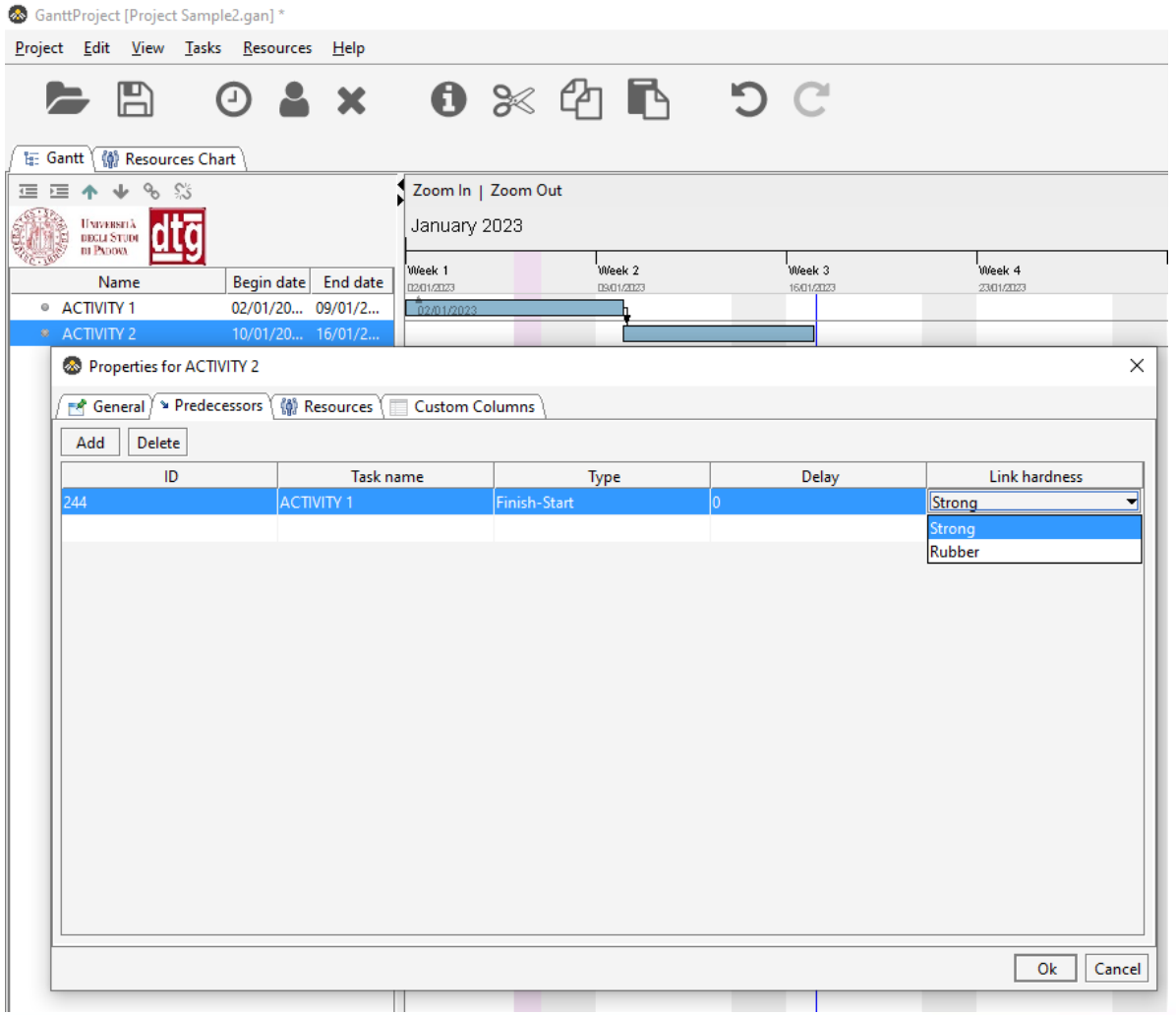


CONNECTIONS - Strenght

The links between activities can have a different level of strength.

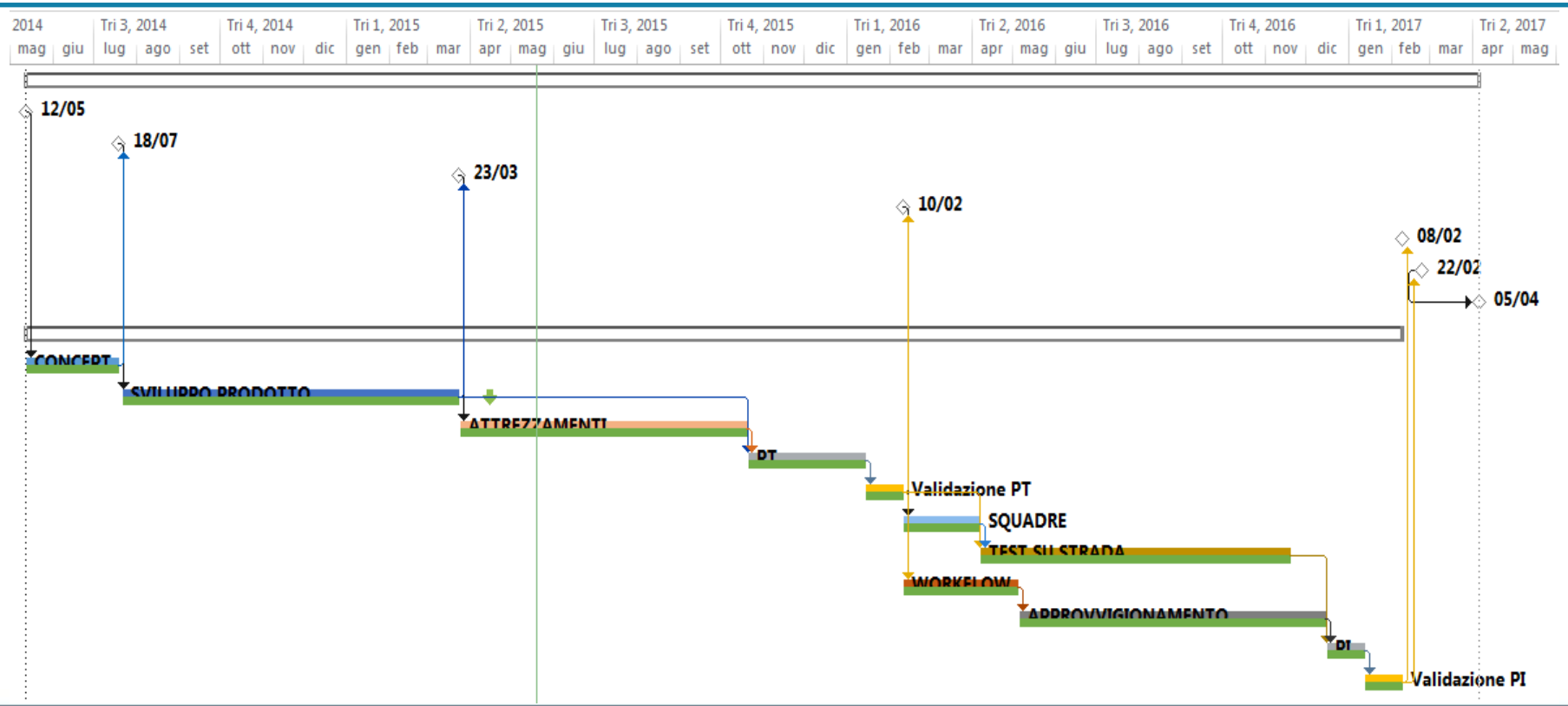
Depending on the software a different number of possibilities are possible, but basically there are 2 possibilities:

- Strong: will force the connection considition adapting the position of the task (like E-S will bringing an activity far in the future in contact with the precedessor)
- Weak: that will non force or move activities still maintaining the sequence and the priority (like E-S will leave the successor in his place till it will be following predecessor, or force it forward when the link will not be respected eg. when precedessor will overtake the successor)



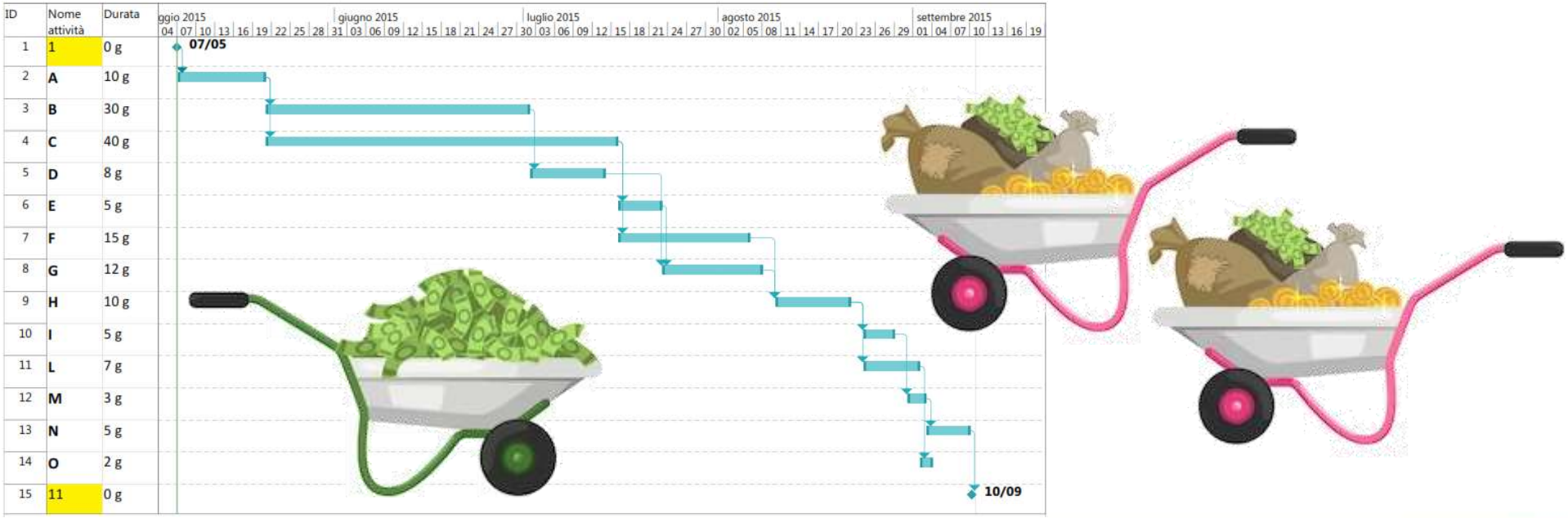
Baseline

The Baseline is a picture of the Gantt Chart taken in a specific time (e.g. the beginning).
The baseline is useful to compare the actual evolving situation with a previously one, immediately showing if the project is on track or if it is drifting.

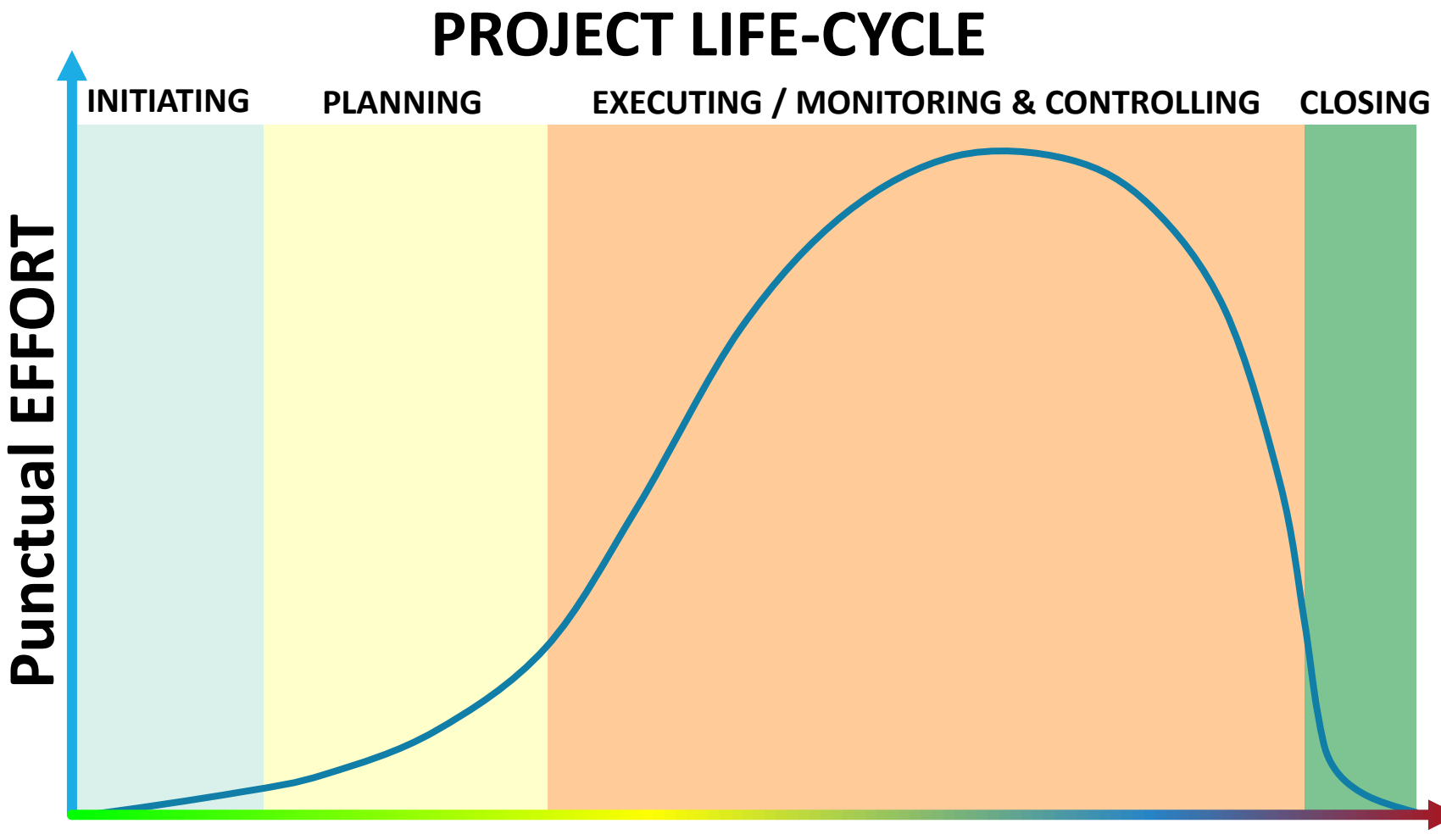


Cost management

Starting from the WBS with elements completely defined and estimated, is possible to evaluate the impact of costs on general project budget.
Calculating the position on the temporal plan is possible to forecast when every costs should emerge on the project lifespan, the need for cash in any moment, and also cumulate the punctual costs and the total costs.
During the executing a technique will allow to immediately identify the situation of the project to correct the trajectory and avoid to have the project out of rails.



Costs – punctual impact

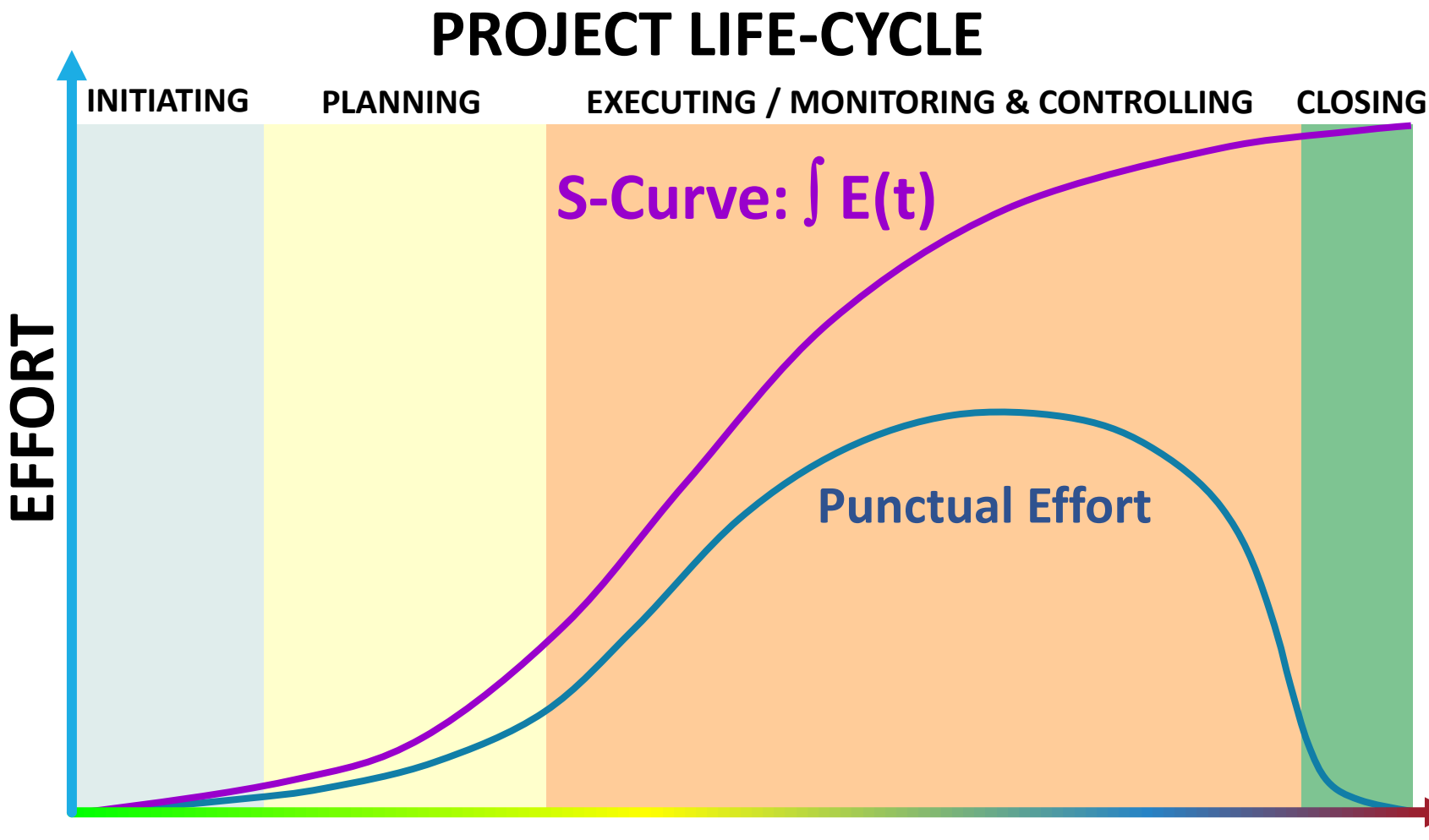


Simplifying a general project timetable can be identified 4 different temporal phases.

Thanks to this could be easily understood the different magnitude of the necessary effort to compete every phase.

Moving forward, an increasing amount of resources should be involved, that means a costs' increment.

Project Life-Cycle: The "S-Curve"



The integration of the punctual effort gives the idea on how costs are correlated to time.

This involves a great consideration on the facts that decision on going forward or stop the project should be performed as early as possible.

Consider that what is already spent is practically lost, if the project could not be completed that is a waste.

What is a Risk?

Def. 19: Risk (PMBoK 7th Ed.)

A risk is an uncertain event or condition that, if it occurs, can have a positive (opportunity) or negative (Threat) effect on one or more objects.

Project Teams seek to maximize positive risks and decrease exposure to negative risks.

- An event is something that could happen during a project.
- A risk is a consequence of an event.

Opportunities

- Reduced time
- Reduced cost
- Improved performance
- Increased market share
- Enhanced reputation

Threats

- Delay
- Cost overrun
- Technical failure
- Performance shortfall
- Loss of reputation

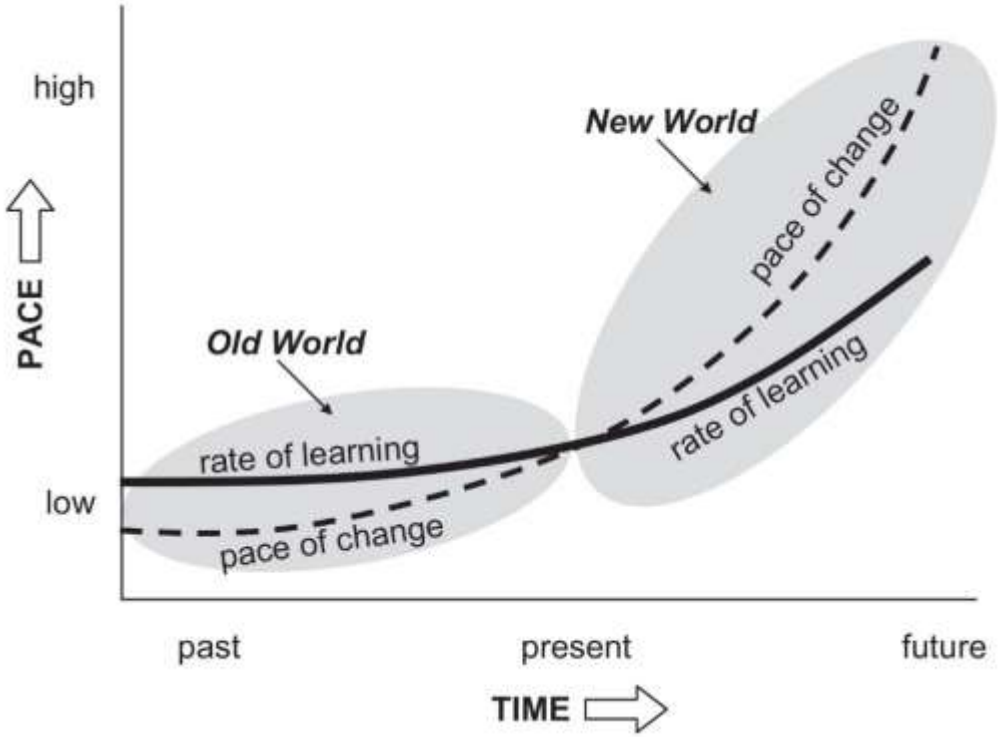
RISK Management

Def. 20: Risk Management (Managing Risk in Projects)
Enable individuals, groups and organizations to make appropriate decisions in the light of the uncertainties that surround them.

V.U.C.A. teach that things are changing.

Old World: business were able to stay ahead of the curve by learning faster than their competitors and adapting to change as it occurred.

New World: rapid change, gaps appear as the ability of organizations to respond falls behind the pace change (Obeng, 1997)



Qualitative RISK assessment

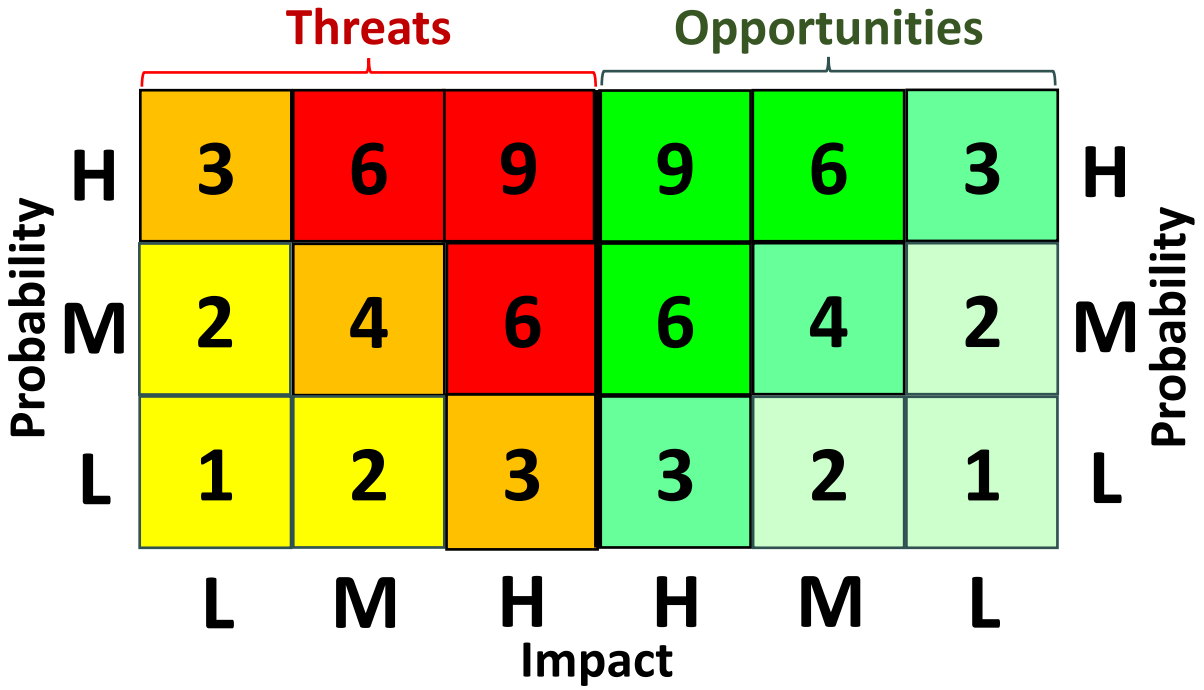
Risks have to be identified by the team, one way can be the RBS (Risk Breakdown Structure).
Risks have to be evaluated, considering 2 variables: Probability, Impact.
After the list is prioritized can be crated a table to explicit risk and decide how to deal with them.

A simplified risk analysis:

- Identify the risk
- Identify if it is a Threat or an Opportunity
- Evaluate in a scale from 1 to 3:
  - Probability
  - Impact

1= Low (L) 2=Medium (M) 3=High (H)

- Place it in the table



RISK Response Plan

Once identified and prioritized risks is necessary to prepare an answer.
There are some possibilities regarding what type of response is more appropriate.
The choice is up to the team, but driven by business aim, possibilities, contingency, boundary conditions.

Opportunities

- Exploit: make it definitely happen
- Share: involve other party in managing the risk to enhance the effect/probability
- Enhance: try to increase the effect
- Accept: let it happen

Threats

- Avoid: eliminate the risk from the project
- Transfer: put the risk in someone else hands (e.g. insurance)
- Reduce: try to minimize the effect suffered
- Accept: accept consequences

Software

Project Management

Microsoft Project

ORACLE
PRIMAVERA P6
Professional Project Management

OpenProject

ProjectLibre™

GanttProject

https://www.ganttproject.biz/

Project Portfolio Management

PROJECT OBJECTS

GFT

Cardinis

clarizen

TALAI Open PPM
Do the right thing

Agile PM

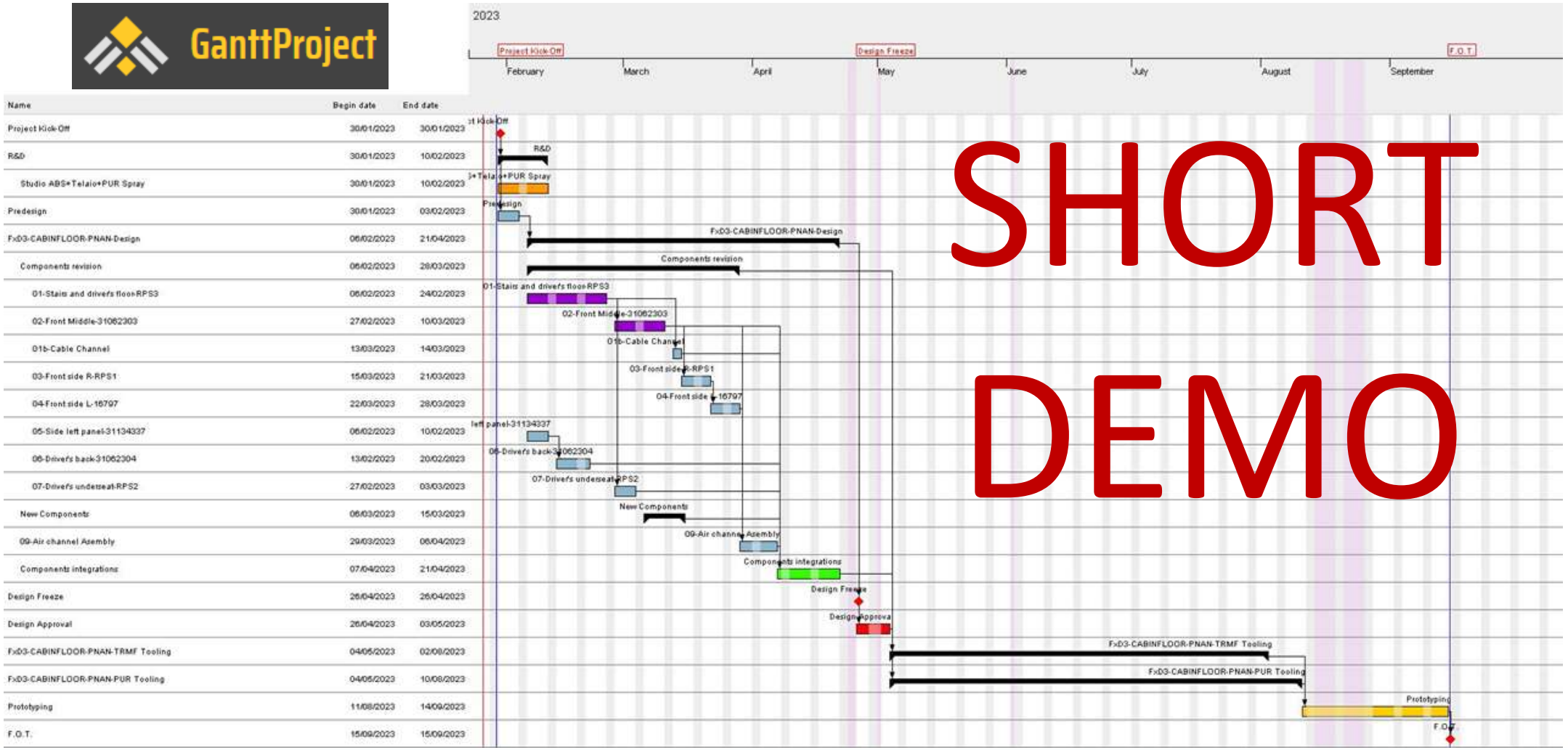
Jira Software

Trello

...

Software

GanttProject



Thank you for your attention