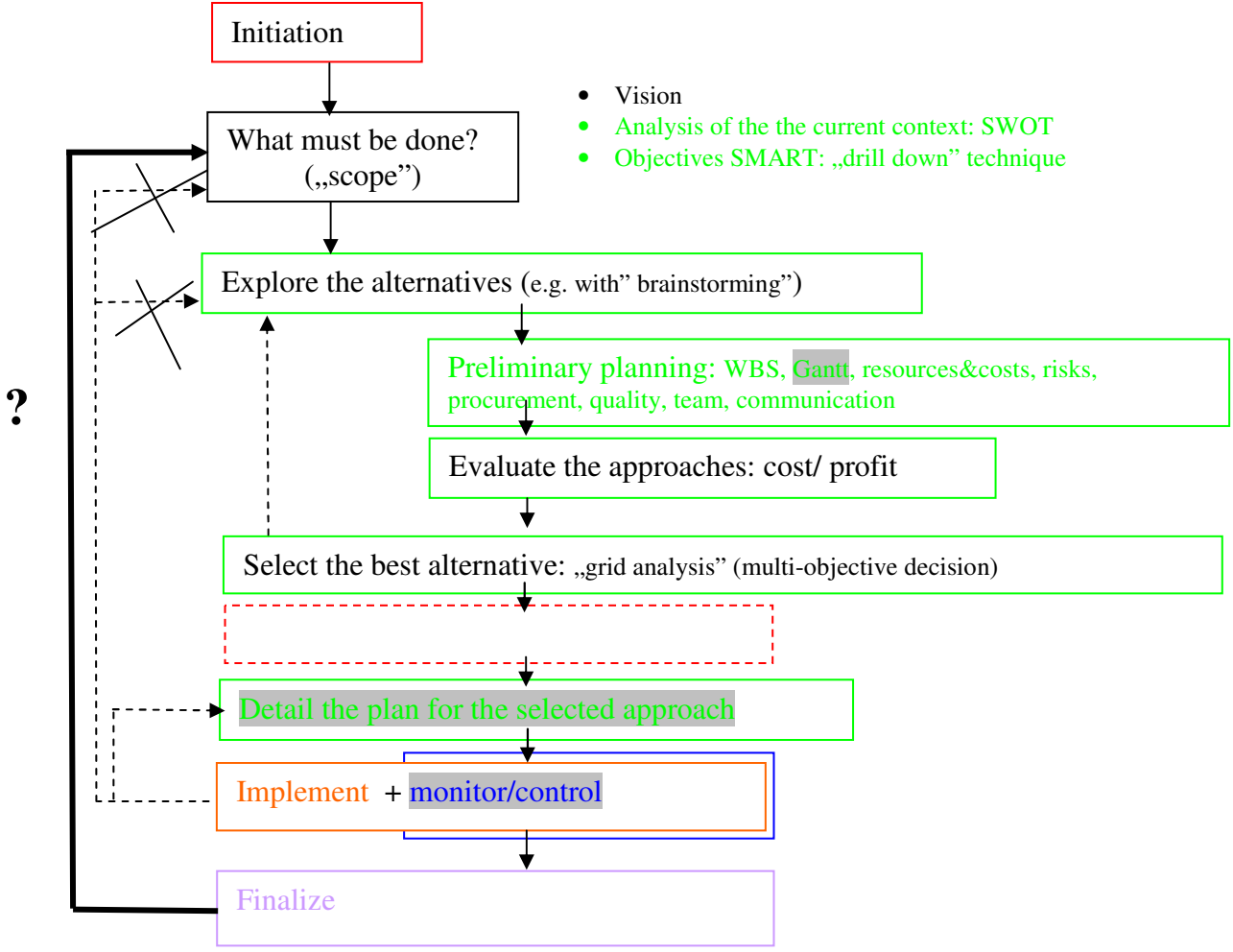
3. Time Management

3. 1. The processes of time management

= the processes which ensure in-time project finalization

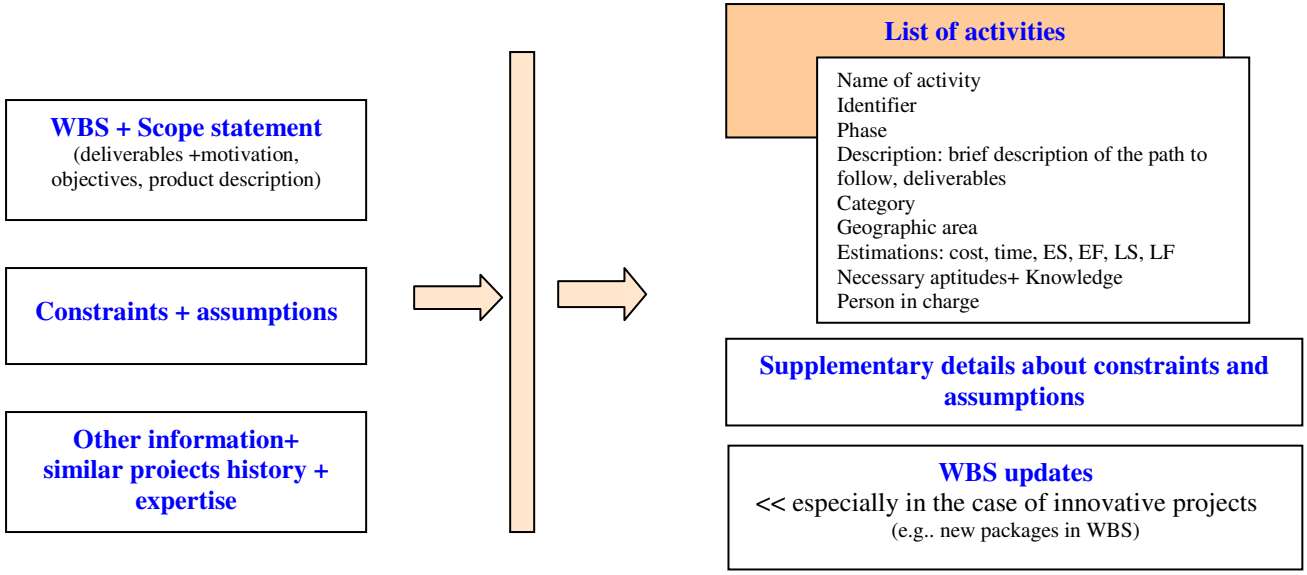
activities definition (PN)	identify the activities needed within the project
activities sequencing(PN)	find the dependencies between activities
effort estimation (PN)	estimate the amount of working hours needed for each activity
schedule development(PN)	find T_start&T_stop for each activity
time control (C)	manage the changes of the schedule


Initiation
What must be done? („scope")
Explore the alternatives (e.g. with" brainstorming")
Preliminary planning: WBS, Gantt, resources&costs, risks, procurement, quality, team, communication
Evaluate the approaches: cost/ profit
Select the best alternative: „grid analysis" (multi-objective decision)
Detail the plan for the selected approach
Implement + monitor/control
Finalize
?
Vision
Analysis of the the current context: SWOT
Objectives SMART: „drill down" technique

3. 1. 1 Activities Definition (PN)

= identify + document the activities which are necessary for reaching the objectives of the project (obtain all requested deliverables from WBS)

WHAT ACTIVITIES ARE NECESSARY?



Working procedure + recommendations:

- Start from WBS and list the activities required for obtaining each (leaf) work package

  - Satisfy the rule 8/80 ($8h\ work \le \Delta t_{activity} \le 80h\ work$)
    or rule 5/10 ($5\ days\ work \le \Delta t_{activity} \le 10\ days\ work$)

    !! Take into account the complexity of the task, the experience of teh team, the degree of novelty, etc.
    !! 90% Syndrome

  - Allocate same category of workers to a certain activity

- Use templates >> parts of the project should be similar to previous projects developed within the company
- For novel projects – pay attention to avoid omitting important activities
  >> **work with your team** – „brainstorming", experience + expertise
  >> think what you must not do
- Separate activities identification from activities sequencing

3. 1. 2. Activities Sequencing (PN)

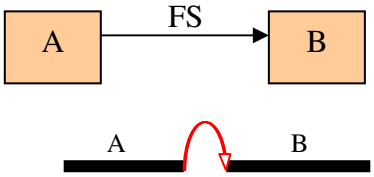
= identify + document the dependences between activities

HOW THE ACTIVITIES CAN BE SEQUENCED?

Activities A and B can be:

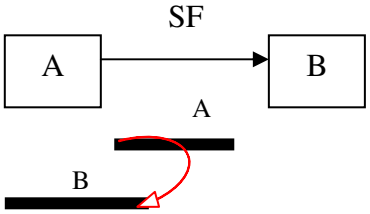
- **dependent**: sequentially performed
  B depends on A if
  - B waits for a results produced by A
  - B waits A to release a resource A
- **independent:** performed in parallel

Between two arbitrary activities, 4 types of dependences could be met:



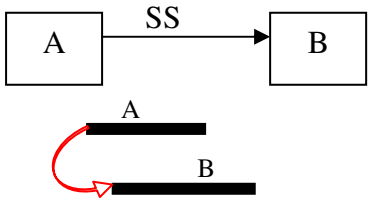
Finish to start: A must finish, in order to allow B start

e.g. design before implementation



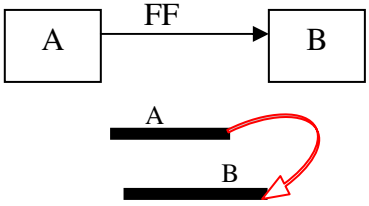
Start to finish: A must start in order to allow B end

e.g.: shift II must arrive before shift I departure



Start to start: A should start in order to allow B start

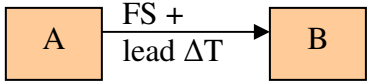
e.g: network cabling should be finished before starting system configuration



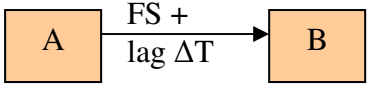
Finish to finish: A must finish in order to allow B end

ex: the last chapter of the book should be finalised before ending the content of the book

Lead: B can start in advance - with „lead" ΔT - before A's end



Lag: B must start with a delay – with „lag" ΔT - after the finalization of A



There are:

- **mandatory, hard dependences**

  << inherent, imposed by physical & technological limitations

  e. g: implement the module before testing

- **soft, optional dependences**

  << recommended by successful good practices

  set by the team, by PM

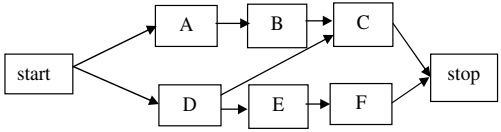
A project can have **external dependences** (= between project activities and activities of other projects or operations carried out outside the project)

Network diagram

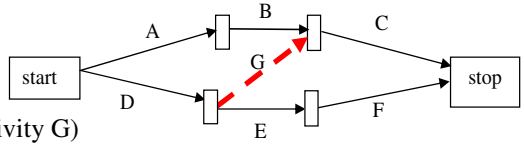
= schematic representation of activities' dependencies

Types of diagrams

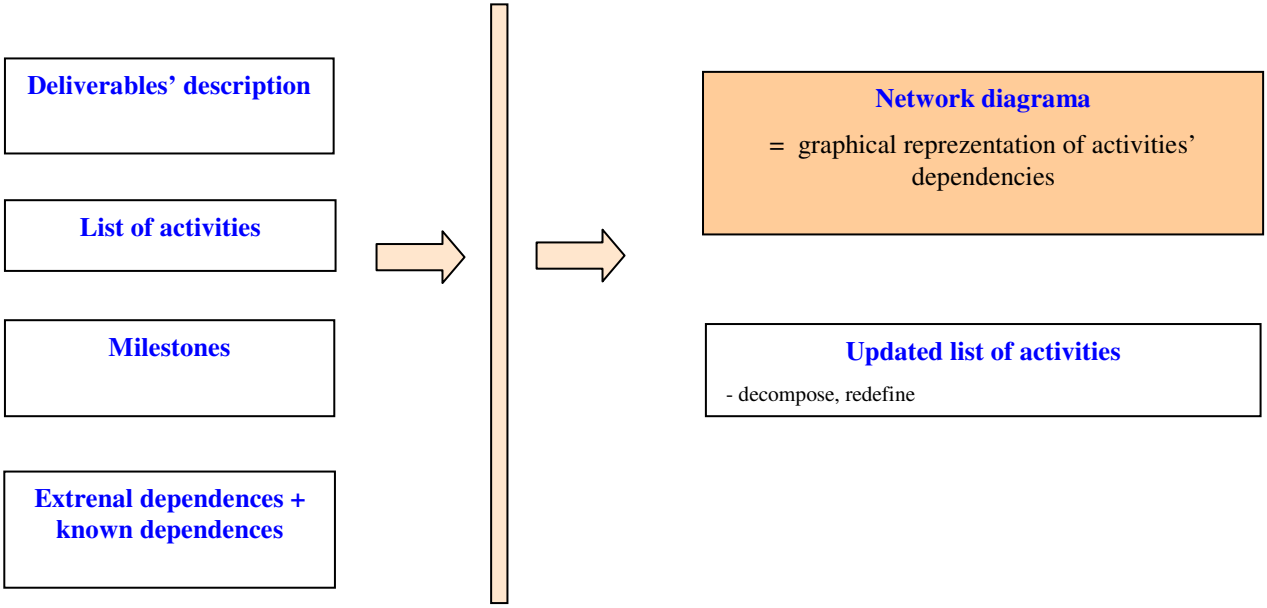
- **AON („Activity on node")** - based on precedence
  activities in nodes,
  unidirectional links for
  SF, FF, FS, SS dependences (default, FS)



- **AOA („Activity on arrow")**
  activities on unidirectional links,
  a node for each start/end of an activity
  !! virtual activities are necessary (see picture on right - activity G)



- **conditioning diagrams**: with conditional and cycling structures


Deliverables' description
List of activities
Milestones
Extrenal dependences + known dependences
Network diagrama
= graphical reprezentation of activities' dependencies
Updated list of activities
- decompose, redefine

Recommendations for elaborating the network diagram:

- Use specific software tools (e.g.: MS Project)
- Use especially FS dependencies (clearer)
- Substitute the cycling sequences with un-cycling ones (by repeating the activities corresponding to each iteration)
- Use templates (at least for parts of the diagram)
- Verify if the milestones can illustrate all the results expected at that instant

3. 1. 3. Effort/duration Estimation (PN)

= estimate the amount of working hours needed for each activity

HOW MANY WORKING HOURS ARE NECESSARY?

Effort

working hours/activity considering that a single person is allocated

≠

Duration

working hours/activity considering that all human resources are allocated

$$duration > \frac{effort}{no.persons}$$ - some time is spent for communication

The estimation could be done with 6 working h /day (instead of 8 h)

Estimation methods - probabilistic or deterministic

According to the idea of the approach:

Top down □□ Bottom up

Analogy + Expertise:

- identical conditions are rarely found, the difference are sometimes difficult to estimate

>> consider the average reported in previous similar projects and team recommendations

Parametric methods

- for software

Attention: the errors could be very large (25-100%) – amount of reused code, the experience of the team, use of automatic code generation, etc.

- KLOC – the estimation is difficult and dependent on the programming language

- „functional points" – complexity dependent (no. of in, out, tests, files, interfaces – with specific weights)

PERT „Program Evaluation and Review Technique" Method (probabilistic)

The effort is distributed according to beta probability distribution

Probability density**:**

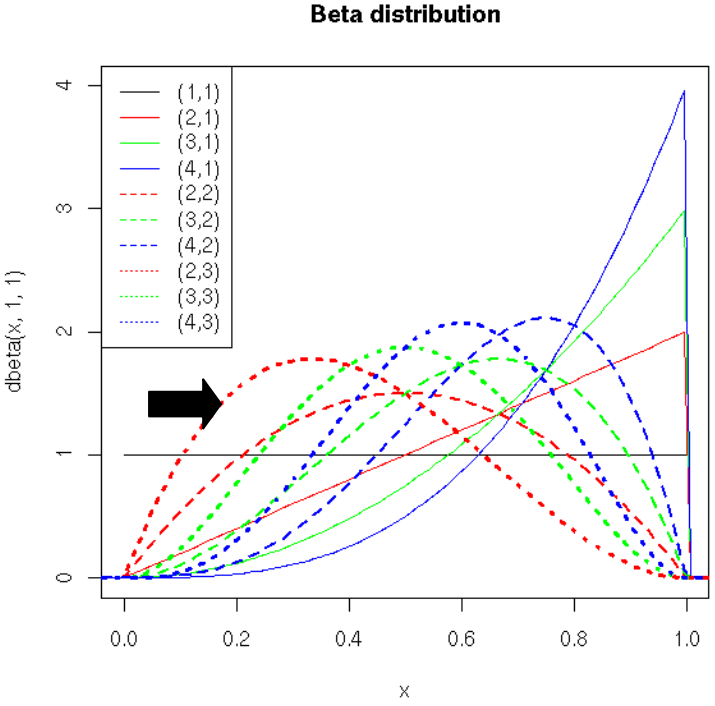
$$p(x) = x^{\alpha-1}(1-x)^{\beta-1}\frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\cdot\Gamma(\beta)}, \quad \Gamma(z) = (z-1)!, \quad x \in (0,1)$$

Delphi technique could be used for determining

- effort A – the most optimistic one $P(t < A) = 1\%$
- effort B – the most pessimistic one $P(t > B) = 1\%$
- effort M – the most frequent one

Then, effort and spread are computed according to:

$$T_{estimated} = \frac{A + 4M + B}{6}, \qquad \sigma = \frac{B - A}{6}$$

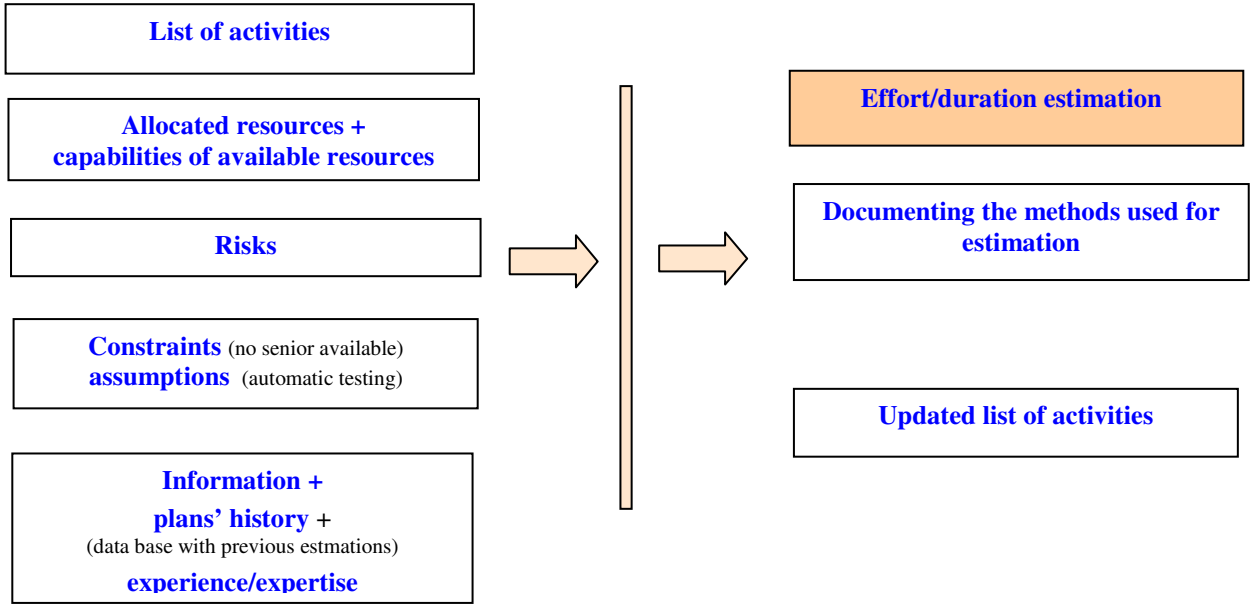

Beta distribution
(1,1)
(2,1)
(3,1)
(4,1)
(2,2)
(3,2)
(4,2)
(2,3)
(3,3)
(4,3)
dbeta(x, 1, 1)
0
1
2
3
4
0.0
0.2
0.4
0.6
0.8
1.0
x

Remarks:

- Estimation ≠ exact evaluation!!!
- **A team** can produce a better estimation than a single person
- Apply multiple estimation methods – for verification
- Use time slacks

  >> joined in virtual activity

  Parkinson Law: any announced time slack will be immediately consumed
  Student syndrome: the activities will be finalized in the last second


List of activities
Allocated resources +
capabilities of available resources
Risks
Constraints (no senior available)
assumptions (automatic testing)
Information +
plans' history +
(data base with previous estmations)
experience/expertise
Effort/duration estimation
Documenting the methods used for estimation
Updated list of activities

3. 1. 4 Schedule Development (PN)

= set the day of start and the day of end for each activity

WHEN THE ACTIVITIES SHOULD PERFORMED?

Time constraints associated to activities can be

- **flexible**
  the start/stop set based on precedence constraints only
  MsPrj:
  „as soon as possible" (elaborate the schedule start>>stop)
  „as late as possible" (elaborate the schedule stop>>start)
- **semi-flexible**
  activities should start/finish after/before a certain date
  MsPrj:„start /finish no earlier/later than...")
- **inflexible**
  fix start/stop days
  MsPrj: „must start /finish on..."

Time constraints influenced by:

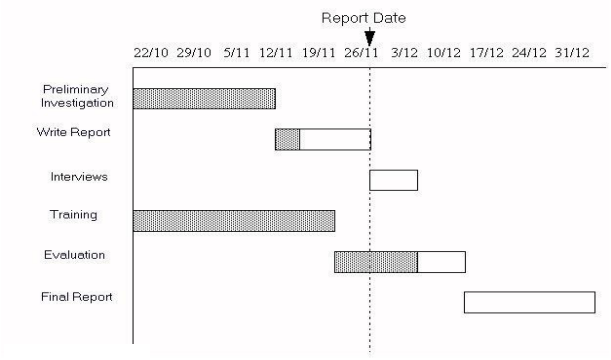
- **organization** (synchronization with other projects, key events imposed by the sponsor/client) or **social/economic/politic context** (e.g. laws, market opportunities, etc.)
- **project management decisions** (e.g. time slacks for results validation, synchronization with other activities of the project, etc)
- **technical conditions and resources availability** (e.g.: meteorological conditions, procurement, temporizations imposed by technological processes)

The schedule indicates the start and stop dates for each activity

- **general/in detail**
- **graphical form**
  - network diagram with start/stop dates
  - Gantt chart

In traditional approach:

- with start/stop dates,
- without dependences,
- without showing the critical path etc.



- Milestone table

∇=planned, ♦=current

U1,…= time units

(months, weeks)

Events	Responsible	U1	U2	U3	U4	U5	….	
……	……	∇♦						
				∇				

Recommendations regarding schedule elaboration

1. write on the network diagram (AON preferred) the effort, the number of allocated persons, the durations

2. build the schedule by means of **critical path method**

- find **the critical paths** = the longest paths (indicating the duration of the project)
  - critical activities = activities from the critical paths
- scan the activities start>>stop („feed forward") and determine ES (earliest start), EF (earliest finish)
  the first activity has ES = 1,
  then, EF = ES + duration – 1, ES = max ($EF_{predecessors}$) + 1,
- scan the activities stop>>start („backward") and determine LS (latest start), LF (latest finish)
  last activity has LF = the deadline of the project,
  then, LS = LF - duration + 1, LF = min ($LF_{successors}$) - 1,

- determine the time slacks = LF- EF = LS- ES

  remark: the smallest slacks are obtained for the critical paths

  project slack = how long the project can be delayed without violating its deadline

  free slack = how long an activity can be delayed without impeding any of its successors start

  total slack= how long an activity can be delayed without violating project deadline

3. correct the conflicts: holidays, business cycles, etc

4. risks analysis: realistic allocations of resources, realistic estimations, too many concurrent activities? >> pay attention to critical activities
   If changes are necessary, go to 2

5. the reduction of project duration is desired?
   No: go to 6
   Yes: apply method for reducing project duration, such as:

fast tracking method

= overlay parts of the activities by means of leads

disadvantages: high risk of failure or re-working

e.g.: implementation started before completing the whole design

crashing method

= add resources in order to reduce activity duration

disadvantages: limitations related to available working space
communication needs increase
higher costs

Attention: when adding new persons on fly:
- new persons need a time for adaptation
- new persons can reduce the productivity of the rest of the team

„*Adding people to a late project only makes it later*"

the working speed - proportional with $\sqrt{\text{size\_team}}$

6. (optional) apply **PERT („Program Evaluation and Review Technique") method**

Let us assume the critical path with the activities A_1, A_2, ...A_n having the mean durations t_1, ...t_n and the spreads computed according to PERT method described in 3.1.3.

start /end instants are normally distributed $p(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(x - medie)^2}{2\sigma^2}\right)$

- compute the mean duration of the project = the mean duration of the critical path $T_m = \sum_{i=1}^{n} t_i$

- compute project spread $\sigma^2 = \sum_{i=1}^{n} (\sigma_i)^2$ - on the critical path

- find T_d such that $p(T < T_d) = \text{predefined}$ or find $p(T < T_d)$, for predefined T_d:

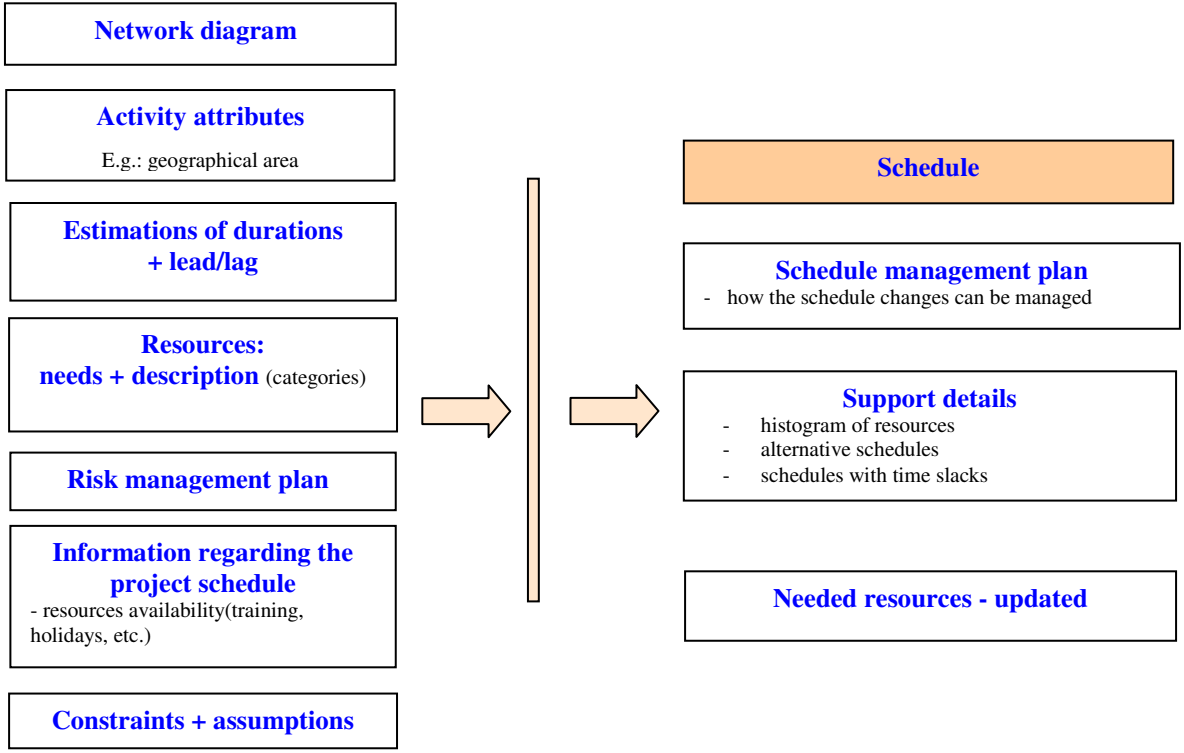
$p(T \le T_m) = 50\%$!!!!!!! and $p(T_m - \sigma \le T \le T_m + \sigma) \cong 68\%$!!!!!!!

7. (optional) insert a **time slack** equal to 10-15% project duration (and monitor its consumption)

remember: Parkinson law + student syndrome

Other remarks:

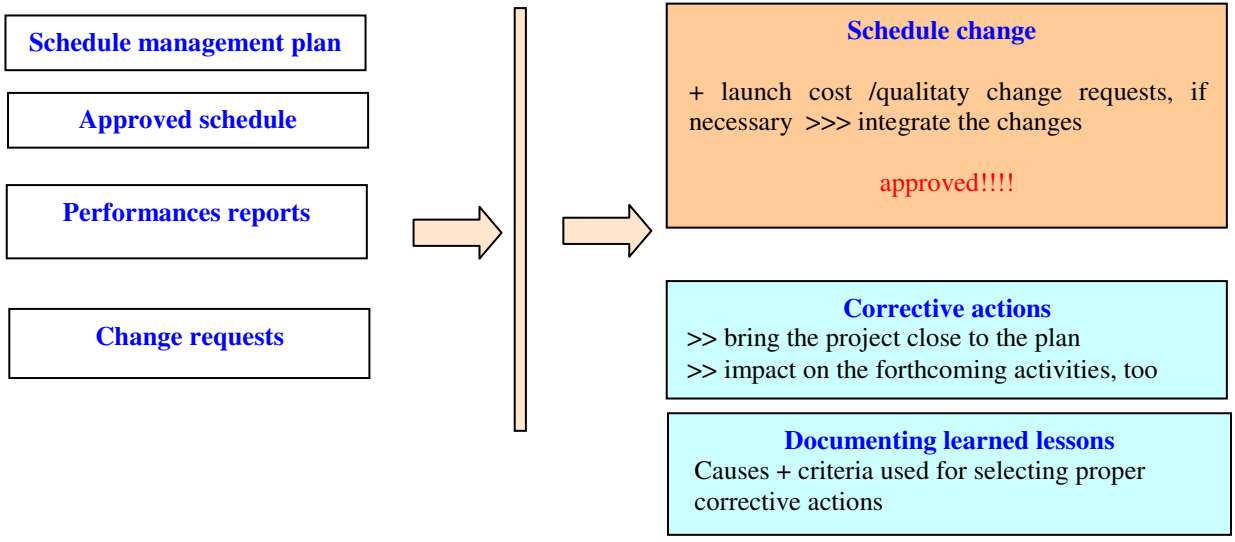
- Use software tools
- Look for automatic working procedures for duration reduction!!!
- Pay attention to resource allocation
  - For human resources – optimal schedule usually involves unbalanced, non-uniform usage of the team
  - Duration can be reduced working in shifts, during the weekends (if additional material/human resources are not available)
- Allow a simple monitoring (90% syndrome)


Network diagram
Activity attributes
E.g.: geographical area
Estimations of durations + lead/lag
Resources: needs + description (categories)
Risk management plan
Information regarding the project schedule
- resources availability(training, holidays, etc.)
Constraints + assumptions
Schedule
Schedule management plan
- how the schedule changes can be managed
Support details
- histogram of resources
- alternative schedules
- schedules with time slacks
Needed resources - updated

3. 1. 5 Time Control (C)

= identify the changes
+ verify if the change is desired /accepted
+ manage the change

ACTIVITIES ARE EXECUTED IN TIME?


Schedule management plan
Approved schedule
Performances reports
Change requests
Schedule change
+ launch cost /qualitaty change requests, if necessary >>> integrate the changes
approved!!!!
Corrective actions
>> bring the project close to the plan
>> impact on the forthcoming activities, too
Documenting learned lessons
Causes + criteria used for selecting proper corrective actions

Recommendations:

- Monitor more attentively the critical activities (performance evaluation + analysis of any variation from plan)
- Use only agreed procedures for schedule change –according to the Plan for managing schedule changes
- **Notify** all the changes to stakeholders
- Schedule change demands additional planning:
    - modify the start/end of the activities

    or

    - modify the diagram + estimate/re-estimate the durations + modify the start/end of the activities

    >> + integrate all the changes
- Use software tools

Revision

Definitions, terminology: effort/duration, dependences between activities, network diagram, critical path, time slacks, PERT, „fast tracking", crashing", time constraints

Time management processes: activity definition, activity sequencing, effort/duration estimation, schedule development, time control

Documents

List of activities

Network diagram

Schedule (Gantt)