4. Risk Management

4. 1. Introduction

Risk = **possible** event with **positive** or **negative** impact on project objectives

Usually, only risks with negative impact are documented

Risks

- **known**: were identified and analyzed
- **unknown**: were not identified and analyzed

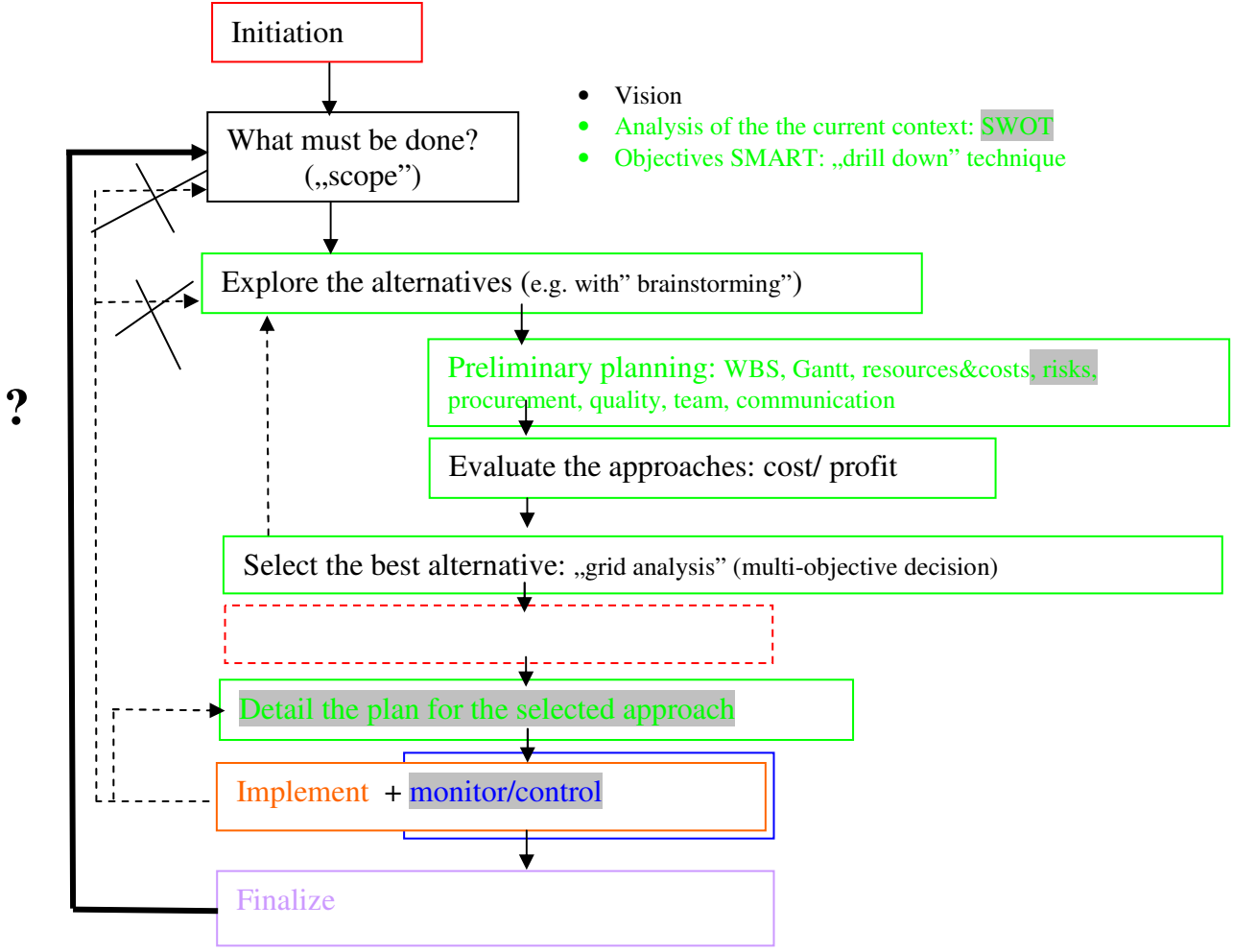
Trigger = something launching a risk (see symptoms indicating that a risk is occurring)

4. 2. Risk Management Processes

= the processes which ensure risk identification and analysis, finding proper responses to risks, risk monitoring and control

risk management planning (PN)	indicate how the risks should be managed within the project
risk identification (PA)	risk identification + documenting
qualitative analysis (PA)	indicate the priority of risks (based on impact and frequency)
quantitative analysis (PA)	estimate the probability of occurrence and the impact

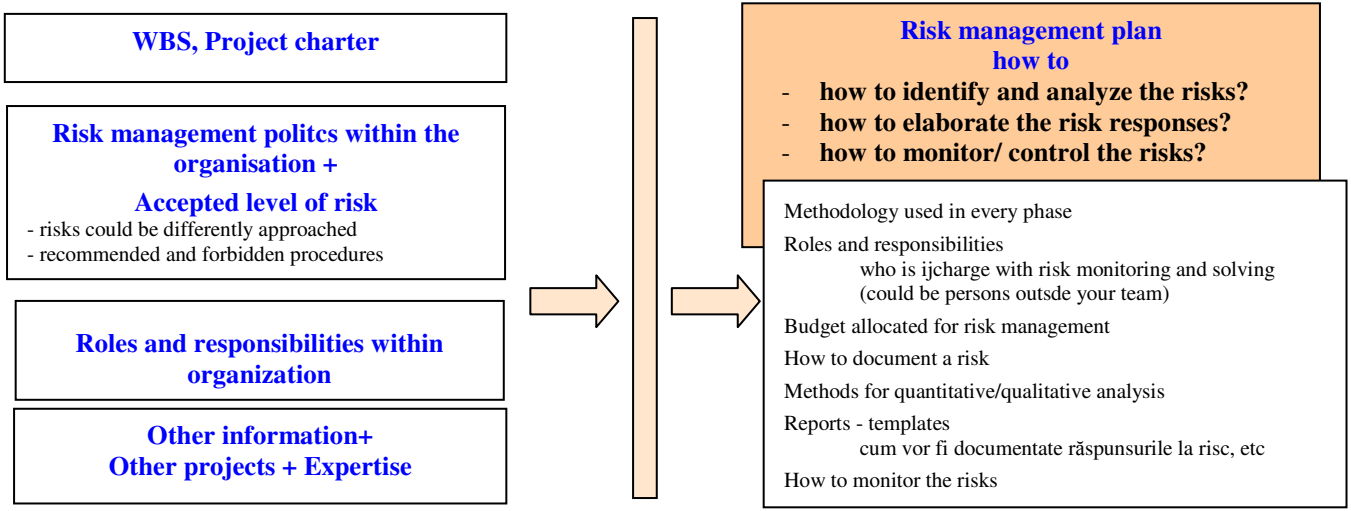
risk response planning (PA)	find response alternatives subject to minimizing the negative impact (whilst maximizing the positive impact)
risk control (C)	risk monitoring
	new risk identification
	execute risk response plans and evaluate their efficiency


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

4. 2. 1 Risk Management Planning (PN)

= set the procedures for risk management

HOW RISKS WILL BE MANAGED?



Working procedures + recommendations for elaborating the risk management plan

>> usually, a risk does not affect your project, only!!!

>> risk management is unitary approached within the organization

- Use templates existing within the organization
- **Organize meetings** with persons involved in risk management (e.g.: team leaders, key stakeholders) for discussing/agreeing on methodologies, coordinators, forms etc
- Separate the elaboration of risk management plan from other risk management processes such as identification and analysis.

4. 2. 2. Risk Identification(PA)

= identify + document the risks

WHAT RISKS CAN OCCUR?

Categories of risks:

- **Technical, related to quality**
  E.g: new technology insufficiently understood, high complexity level
- **Related to project management**
  E.g: indiscipline, wrong planning, inefficient human resource allocation
- **Organizational** (possible cause: superficial analysis before initiation)
  E.g: financing interrupts, conflict in accessing resources shared between multiple projects, the project is not desired anymore
- **External** – without those related to natural calamities or wars
  E.g: law change, market change, state risk changed, meteorological event

The most frequent risks in software projects

- Requirements: not completely understood, incomplete, vague
- Team: conflicts, fluctuations
- Underestimate the complexity level
- Dependence to other projects or operation of the company: delays, the received deliverables are wrong/unstable
- Business: reorganization, product difficult to sale, undesired project
- Client: unfriendly

Boehm's Top 10

1. Team: without experience, frequently changed, incorrectly sized
2. Schedule, budget: wrong estimations
3. Functionality: requirements badly understood
4. Improper interfaces
5. Gold plated requirements
6. Volatile requirements
7. + 8. Components (executed externally) + Wrong activities
9. Weak real time performances
10. Unstable application

Risk identification methods

Step 1: identify the risk in cooperation with your team

Step 2: improve the list via discussions with key stakeholders

Step 3: consult external experts (unbiased opinions)

- **„checklist" method:** lists built using the experience, information available from different organizations, similar projects, various public information (such as (commercial data bases, benchmarks, studies)

  Advantage: quick , simple, useful for the beginning of step

  Disadvantage: specific risks could be missed

- **hypothesis analysis** >> verify if the project assumptions are surely met

  risk to meet incomplete, inconsistent hypothesis

  risk to partially violate the hypothesis

- **information gathering**

  Brainstorming (consult the team, other experts)

  Delphi Technique

    Advantages: anonymous responses are helpful for identifying "uncomfortable"; many persons could be consulted

  Interviews/ consulting – with experts (fewer persons)

  SWOT analysis

    Strength - advantages found inside the organization

    Weakness – disadvantages found inside the organization

    Opportunities – advantages found outside the organization

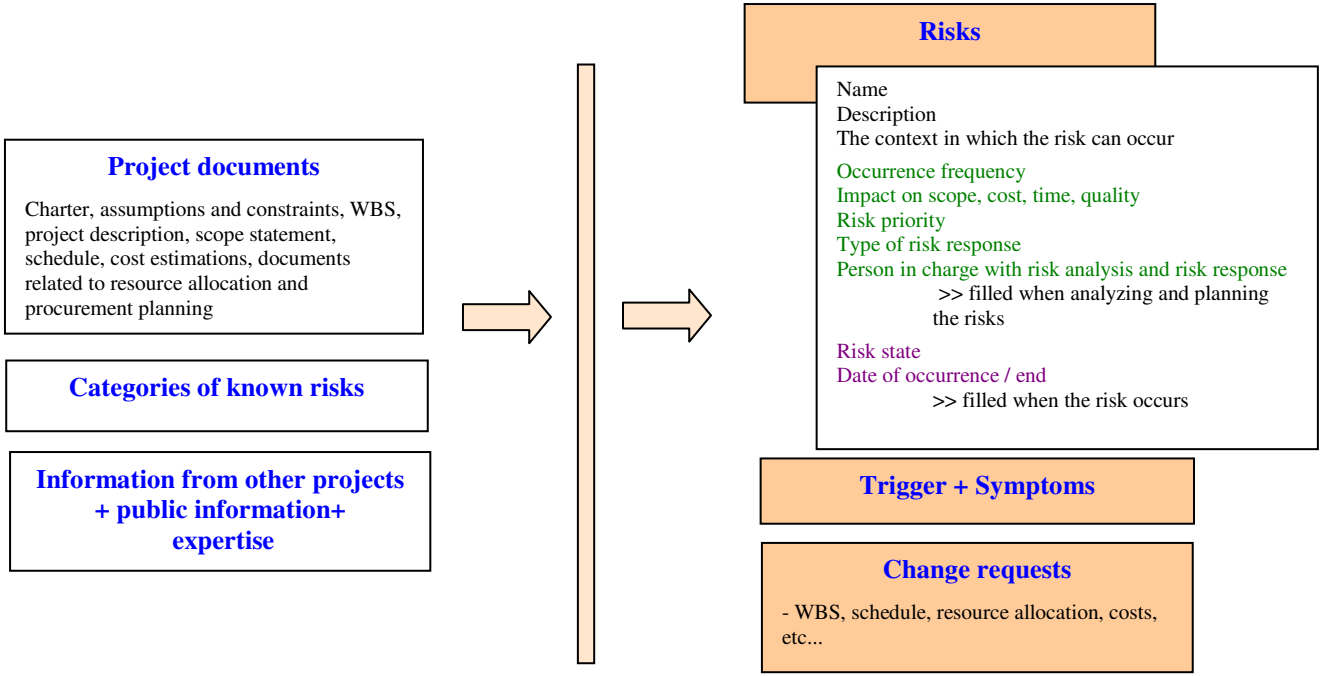
    Threats - disadvantages found outside the organization

Recommendations

- Work with your **team**, consult the stakeholders and the experts:
  >> key of success: communication, team work!!!!

- Read carefully the project documentation

- **Apply multiple identification methods**


Project documents
Charter, assumptions and constraints, WBS, project description, scope statement, schedule, cost estimations, documents related to resource allocation and procurement planning
Categories of known risks
Information from other projects + public information+ expertise
Risks
Name
Description
The context in which the risk can occur
Occurrence frequency
Impact on scope, cost, time, quality
Risk priority
Type of risk response
Person in charge with risk analysis and risk response
>> filled when analyzing and planning the risks
Risk state
Date of occurrence / end
>> filled when the risk occurs
Trigger + Symptoms
Change requests
- WBS, schedule, resource allocation, costs, etc...

4. 2. 3. Risk Qualitative Analysis (PA)

= qualitative investigation of risk importance (occurrence frequency and impact)

WHAT RISKS ARE DANGEROUS /helpful ?

Analysis method description:

Step. 1 – evaluate the risk rating

(3- 5 values, linearly/nonlinearly distributed)

	very rare	rare	moderate	often	very often
linearly	0.1	0.3	0.5	0.7	0.9
nonlinearly	0.05	0.1	0.2	0.4	0.8

Step 2. evaluate the risk impact subject to

scope? quality? schedule? costs?

//"impact ranking"

(3- 5 values, linearly/nonlinearly distributed)

	very low	low	moderate	high	very high
linear	0.1	0.3	0.5	0.7	0.9
nonlinear	0.05	0.1	0.2	0.4	0.8

Recommendation for impact ranking:

	very low impact	**low impact**	**moderate impact**	**high impact**	**very high impact**
Scope	Insignificant change	Minor aspects changed	Large areas affected	Changed unaccepted by the client	The project becomes useless
Quality	Insignificant reduction	Few requirements affected	Client accept is required	The product is not accepted y the client	The project develops an useless
Schedule	Insignificant deviations	Deviations <5%	Deviations 5-10%	Deviations 10-20%	Deviations >20%
Costs	Insignificant increasing	Increasing <5%	Increasing 5-10%	Increasing 10-20%	Increasing >20%

Step 3 – set the grades associated to each level of priority (fill the grade matrix illustrating the risk importance)

Importance_grade = rate_rank * impact_rank

impact	occurrence frequency					
		0.05	0.1	0.2	0.4	0.8
	0.9	0.045	0.09	0.18	0.36	0.72
	0.7	0.035	0.07	0.14	0.28	0.56
	0.5	0.025	0.05	0.10	0.20	0.40
	0.3	0.015	0.03	0.06	0.12	0.24
	0.1	0.005	0.01	0.02	0.04	0.08

>> reduced importance grade $\in$ [0; 0.04]
>> mean importance grade $\in$ (0.04; 0.15)
>> high importance grade $\in$ [0.15,1]

Remarks: approximately the same number of elements on each priority level

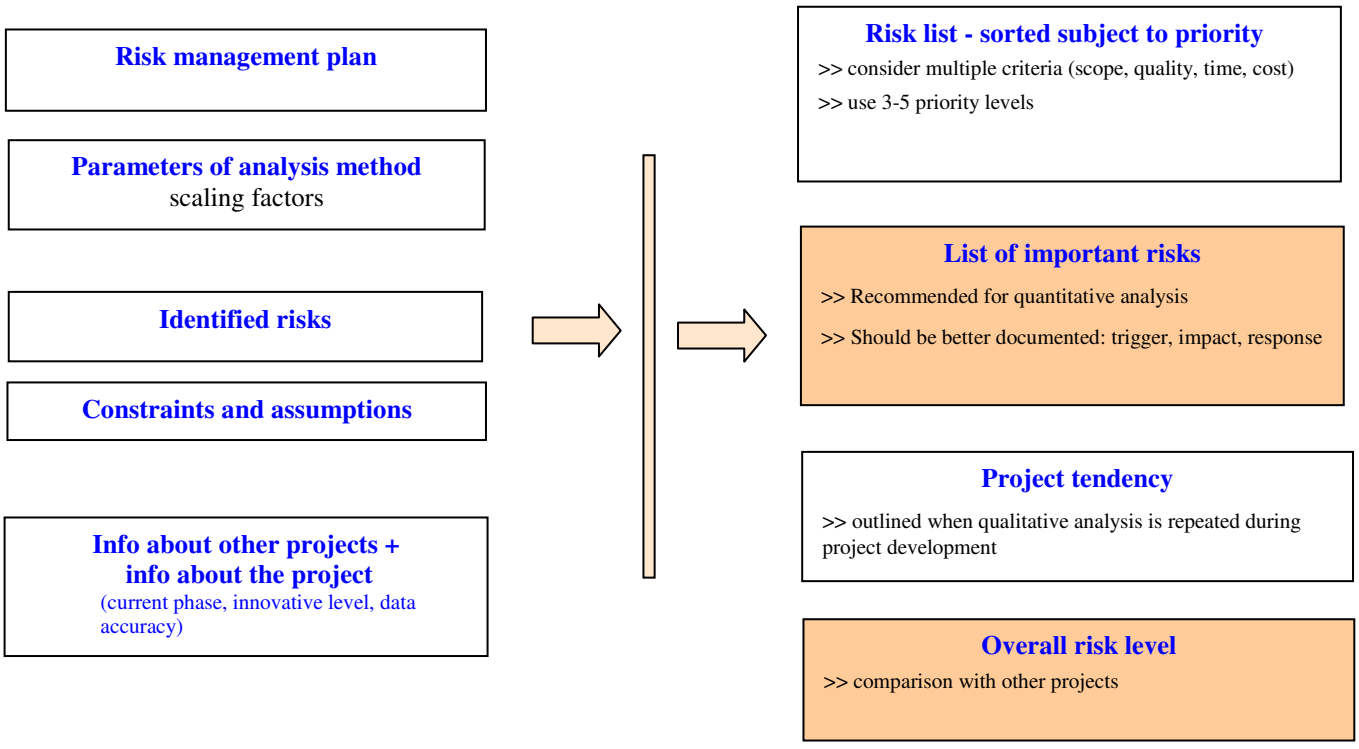
Step. 4 – set the importance of each risk subject to scope, schedule, budget, quality

Risk	Rating rank	Impact tank				Importance grade			
		scope	schedule	costs	quality	scope	schedule	costs	quality
……..	0.1	0.1	0.5	0.9	0.1	low	average	average	low

Step 5. Sort (separately) the list according to 4 criteria (importance grade computed in relation to quality, schedule, costs, scope)

Step 6. Extract the list of important risks + document important risks

Step. 7. Set the overall grade of the project and the tendency


Risk management plan
Parameters of analysis method
scaling factors
Identified risks
Constraints and assumptions
Info about other projects +
info about the project
(current phase, innovative level, data accuracy)
Risk list - sorted subject to priority
>> consider multiple criteria (scope, quality, time, cost)
>> use 3-5 priority levels
List of important risks
>> Recommended for quantitative analysis
>> Should be better documented: trigger, impact, response
Project tendency
>> outlined when qualitative analysis is repeated during project development
Overall risk level
>> comparison with other projects

Recommendations:

- Involve the team
- The analysis should be repeated (every phase)!!!!

4. 2. 4 Risk Quantitative Analysis (PA)

= determine the exposure of every risk

WHAT IS RISK PROBABILTY OF OCCURRENCE?
WHAT COSTS ARE INVOLVED?

Assumptions: data are correct, systematically collected, undisturbed

Risk exposure = occurrence probability * loss/profit

Project exposure = sum of risk exposures for all known risks

Recommended methods

- **Interviews + consultations with stakeholders and experts**

  First step of the analysis

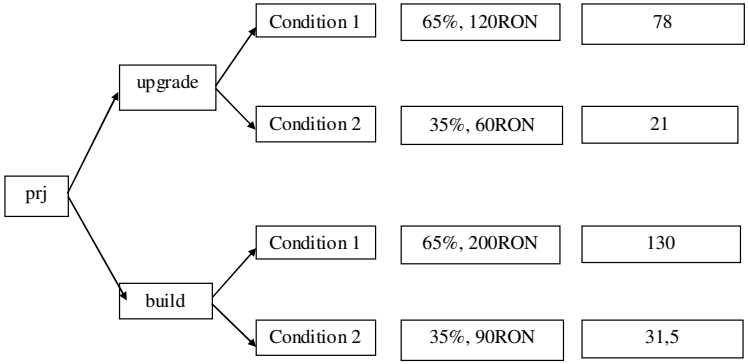
  if the type of risk distribution probability is known, you can find its preliminary parameters (e.g., beta distribution - optimistic, pessimistic, and most frequent case)

- **Sensitivity analysis**

  analyze the variations of project objectives when a single risk occurs

- **Build decision trees**

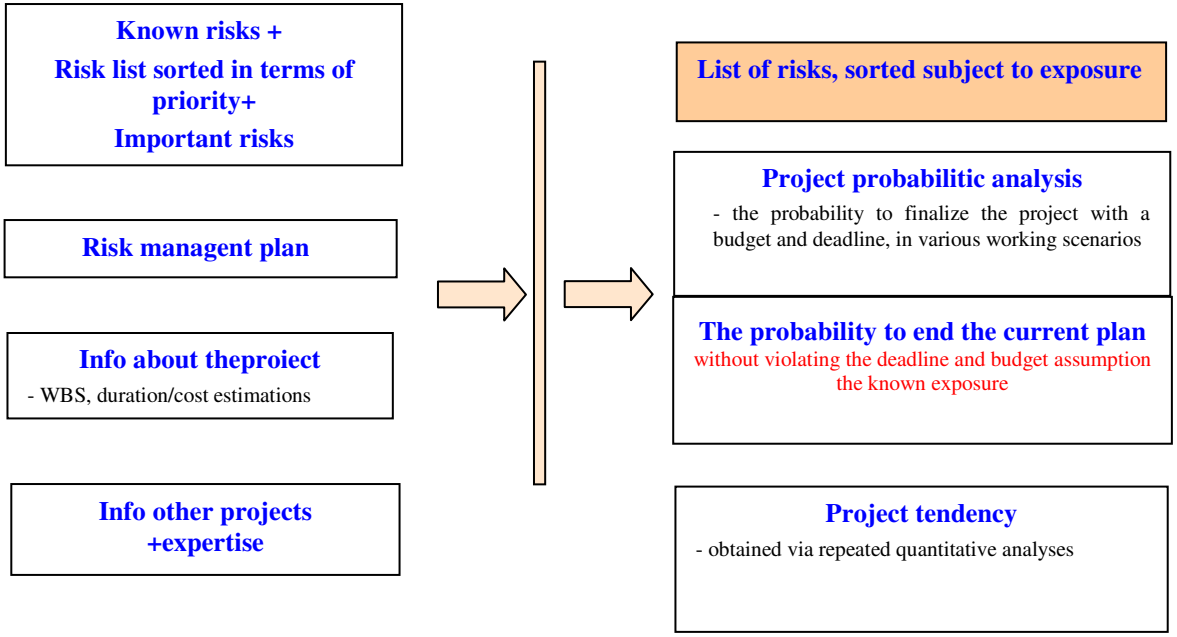
  The decision tree indicates, for every potential management decision, the risk occurrence probability and the loss



- **Simulation**

  Perform Monte Carlo experiments in order to analyze the influence of the risks on costs and schedules

  >> e.g., find the probability to end the project before a deadline, with a predefined budget


Known risks +
Risk list sorted in terms of priority+
Important risks
Risk managent plan
Info about theproiect
- WBS, duration/cost estimations
Info other projects +expertise
List of risks, sorted subject to exposure
Project probabilitic analysis
- the probability to finalize the project with a budget and deadline, in various working scenarios
The probability to end the current plan
without violating the deadline and budget assumption the known exposure
Project tendency
- obtained via repeated quantitative analyses

4. 2. 5 Risk Response Planning (PA)

= indicate the road of the project as protection to negative impact of risks

HOW CAN YOU REDUCE THE THREATS?
how can you use the opportunities?

Risk response methods:

- **Eliminate the risks** („avoidance")= change the plan such that to eliminate the conditions in which the risk occur or to eliminate its impact

  >>!!elimination or strong reduction – to unimportant grade

  Ex:
  Risk of unknown methodologies: use known approaches (less innovative)
  Risk of technically unprepared team: training + experts
  Risk of insufficient resources in the final phases: add resources from the beginning
  Risk of failed objectives: eliminate challenging objectives, clarify the requirements

- **Transfer the risk to other organizations**

  E.g.:
  insurances
  provider warranty (+ clear expected performances)
  transfer the cost risks to the client – the client will support any additional costs (e.g.: banks, constructions)
  prototype (shared risk)

- **Risk reduction** („mitigation")>> diminish the occurrence probability or the impact

  E.g.:
  use prototype, incremental or spiral development model
  select stable known providers
  accept some redundancies
  make more & better tests

- **Risk acceptance** >> the baseline is kept unchanged, but a contingency plan is prepared to be used when the risk occurs

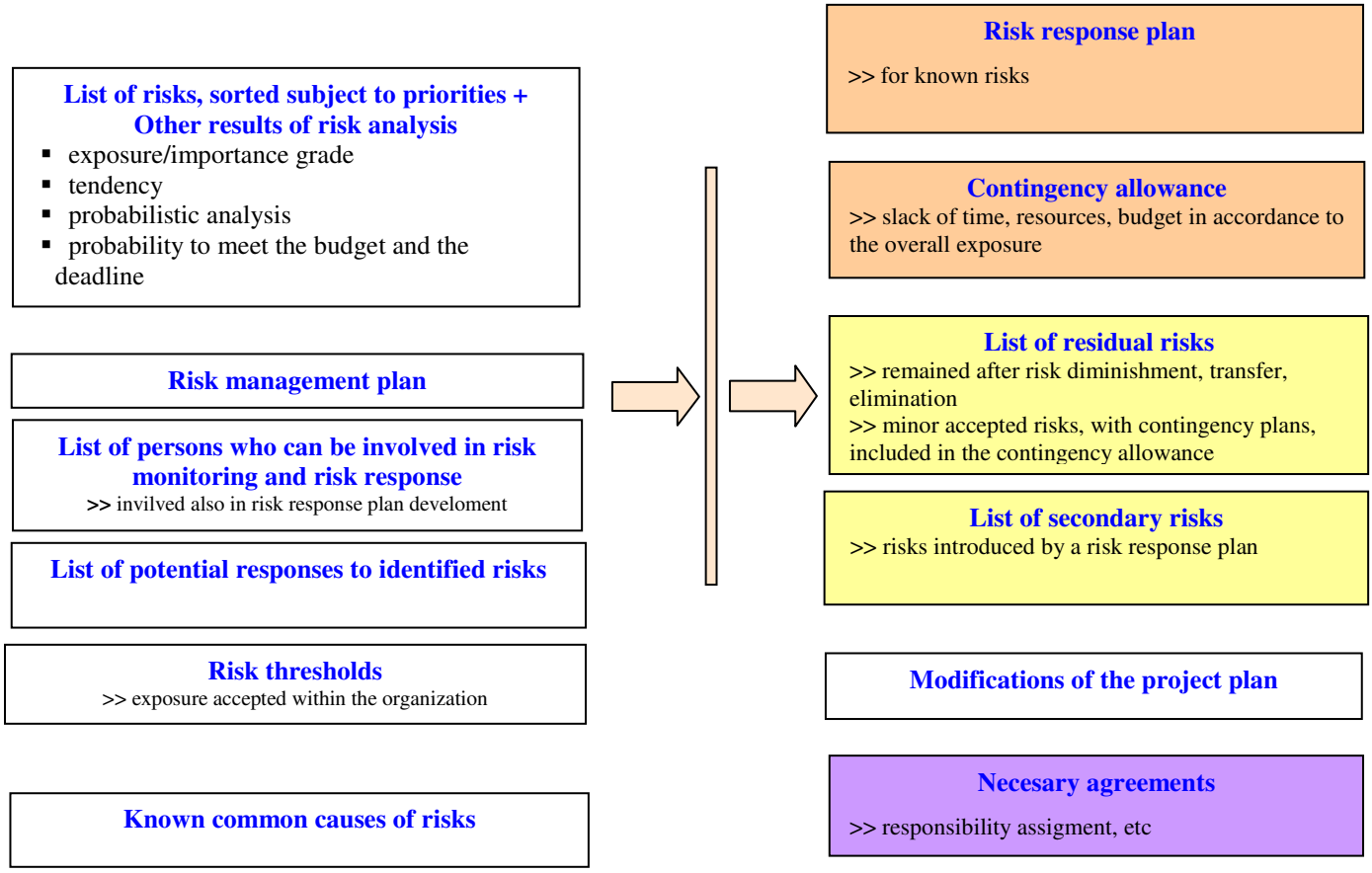
Attention:

- Contingency plans increase the duration and the cost of the project, usually
- You can include time and costs slacks for accepted and unknown risks (**„contingency allowance”**)

e.g.: risk team change
complete activity documenting + documenting monitoring
frequent working meetings
back-up persons for important tasks

Structure –Risk response plan („risk register”)

Identified risk
Reference to risk documentation
name
description
persons in charge with risk monitoring and response risk plan implementation
causes of occurrence, context of occurrence
impact,
occurrence frequency, interval on which the risk could remain active
priority
Description of risk response and contingency plan, including schedule, budget
Residual risk (unsolved), secondary risks


List of risks, sorted subject to priorities + Other results of risk analysis
exposure/importance grade
tendency
probabilistic analysis
probability to meet the budget and the deadline
Risk management plan
List of persons who can be involved in risk monitoring and risk response
>> invilved also in risk response plan develoment
List of potential responses to identified risks
Risk thresholds
>> exposure accepted within the organization
Known common causes of risks
Risk response plan
>> for known risks
Contingency allowance
>> slack of time, resources, budget in accordance to the overall exposure
List of residual risks
>> remained after risk diminishment, transfer, elimination
>> minor accepted risks, with contingency plans, included in the contingency allowance
List of secondary risks
>> risks introduced by a risk response plan
Modifications of the project plan
Necesary agreements
>> responsibility assigment, etc

Remarks:

- Proactive attitude is better
- Identify and document the **residual and secondary risks**
- Set the risk allowance without exaggerating
- Indicate all necessary plan changes
- Indicate what agreements must be set/changed

Recommendations:

- Include enough milestones in your plan if you want a careful monitoring and high pressure of deadlines (more work for you – more detailed plan)
- Pay attention to **critical path**
- Look to features/requirements
  - find traditional requirements
  - find minimal requirements – the most important (sometimes the other requested features have no huge impact on the client)

    >> find simplified alternatives (simple and cheap)

    >> if you want to cut some features, sometimes is better to cut it from the beginning
  - be prepared!!!!, about 25% requirements will be changed (causes: marketing, clients, developers)

- use an adequate software development model

Software development model

- waterfall
- prototype
- incremental
- spiral
- RUP

4. 2. 6 Risk Monitoring and Control(C)

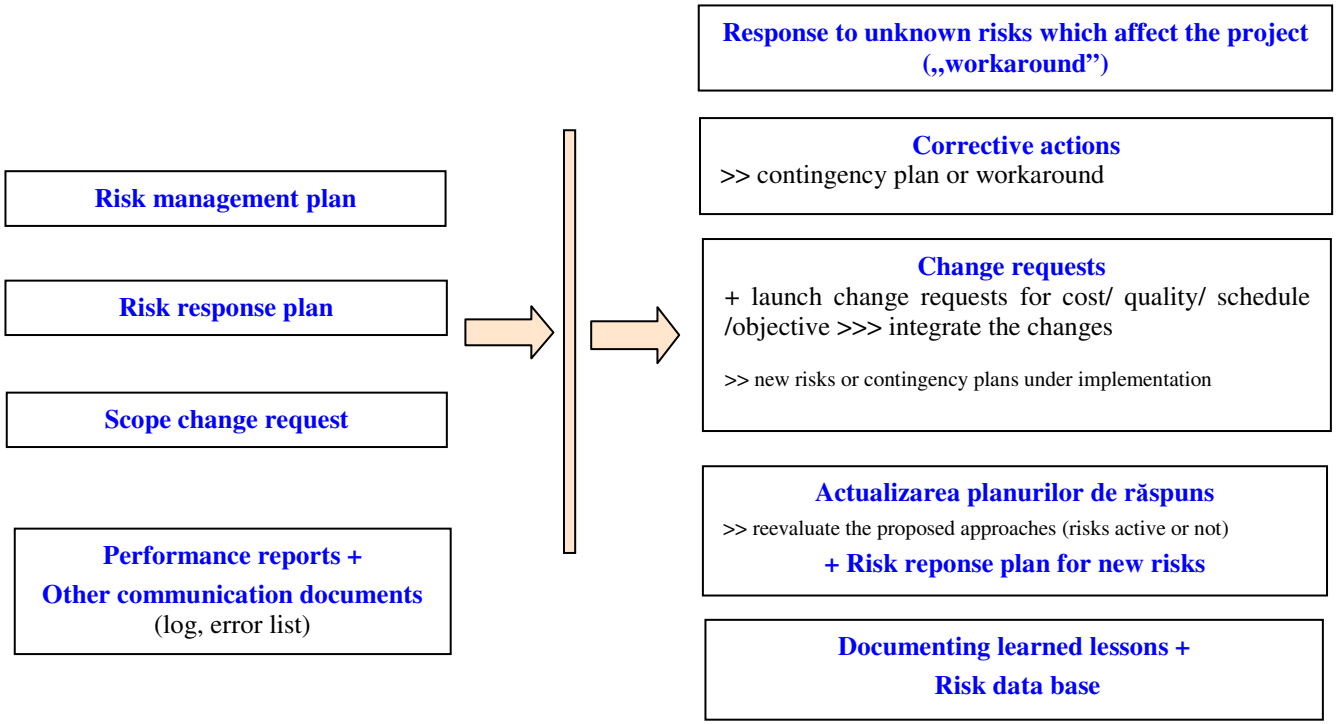
= monitor the occurrence of known risks
+ identify new risks
+ determine the residual risks for all known risks
+ execute risk response plans and evaluate their influence

Risk monitoring:

- monitor risk response implementation – it follows the plan and produces expected effects?
- verify assumptions validity
- monitor risk exposure
- detect the symptoms associated to known risks
- detect unknown risk which affect the project
- monitor if risk management procedures are correctly used

Risk control involves:

- implementation of risk response plans,
- improvement of risk response plans
- applying corrective actions (together with necessary re-planning)


Risk management plan
Risk response plan
Scope change request
Performance reports +
Other communication documents
(log, error list)
Response to unknown risks which affect the project („workaround")
Corrective actions
>> contingency plan or workaround
Change requests
+ launch change requests for cost/ quality/ schedule /objective >>> integrate the changes
>> new risks or contingency plans under implementation
Actualizarea planurilor de răspuns
>> reevaluate the proposed approaches (risks active or not)
+ Risk reponse plan for new risks
Documenting learned lessons +
Risk data base

Recommendations:

- **Risk monitoring** demands:
  - careful evaluation of technical performances for an earlier detection of symptoms

    >> e.g: milestones violation = symptom for the risk of incomplete scope
  - repeated risk analysis (qualitative and quantitative)
- For **newly identified risks**

  >> find response plans +
  document all risk responses for an easy implementation
- Discuss with key stakeholders for finding **new risks & symptoms of known risks**
- **Notify** the changes produced by risk responses to all stakeholders

- **Scope changes demands to repeat risk management processes**: identification, analysis, risk response planning

Revision

Definitions, taxonomy:

risk (see categories), trigger, secondary risk, residual risk

risk identification (checklist, hypothesis analysis, information gathering: brainstorming/ Delphi/ interview/ SWOT)

importance grade, exposure

contingency plan, contingency allowance

Risk management processes: risk management planning (PN), risk identification (PA), risk qualitative analysis (PA), risk quantitative analysis (PA), risk response planning (PA), risk control (C)

Documents

Risk management plan

Risk documenting– list of identified risks

Matrix of grades (exposures)

Risk response plan