Software Engineering

Risk management

Silesian University of Technology

Agenda

What is risk?

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- Impact assessed with relation to the intended goals
- Risk should be concerned with a **choice** and deliberate decision

Aspects of the risk

- **Objective**
- **Subjective**

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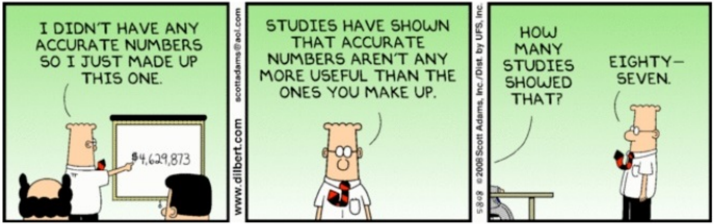

What influences the risk in projects?

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- Innovation level (for research-and-development (R&D) projects)
- Engagement of an investor, users, etc.

Technology readiness level (TRL)

An approach to describe and quantify the maturity of technologies (introduced by NASA). There are nine TRLs:

- TRL I (an initial concept or basic principles observed)
- TRL IX (full technology readiness)

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- Exact definition of subsequent TRLs depends on the application area
  - for example, European Space Agency defines two different scales for TRLs

Example: TRLs in European Space Agency

General scale:

- TRL I: Basic principles observed and reported
- TRL II: Technology concept and/or application formulated
- TRL III: Analytical and experimental critical function and/or characteristic proof-of-concept
- TRL IV: Component and/or breadboard functional verification in laboratory environment
- TRL V: Component and/or breadboard critical function verification in a relevant environment
- TRL VI: Model demonstrating the critical functions of the element in a relevant environment
- TRL VII: Model demonstrating the element performance for the operational environment
- TRL VIII: Actual system completed and “flight qualified” through test and demonstration
- TRL IX: Actual system completed and accepted for flight (“flight qualified”)

Example: TRLs in European Space Agency

Software-related TRLs:

- TRL I: Mathematical formulation
- TRL II: Algorithm formulated
- TRL III: Prototype
- TRL IV: Alpha version
- TRL V: Beta version
- TRL VI: Product release
- TRL VII: Early adopter version
- TRL VIII: General product
- TRL IX: Live product

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- Risk **identification** and **assessment**

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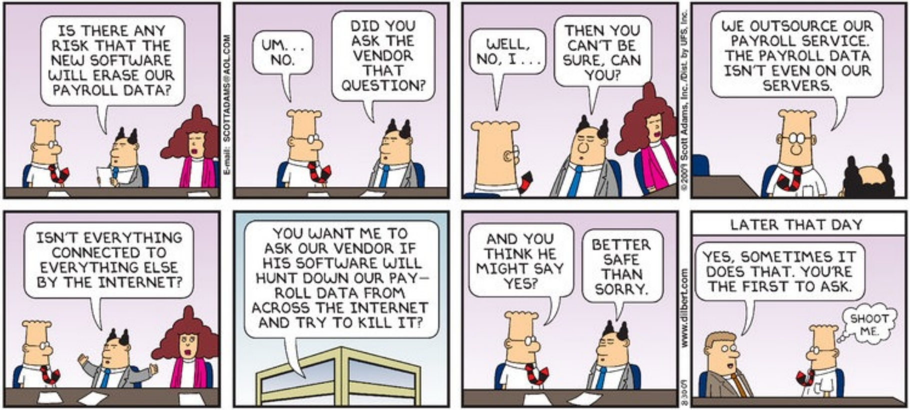
- SWOT analysis
  - Strengths
  - Weaknesses
  - Opportunities
  - Threats

Risk identification



Risk identification—categories

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  - infeasibility of project tasks
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- **Legal risk**
  - intellectual property
  - missed or broken contracts
  - licensing issues

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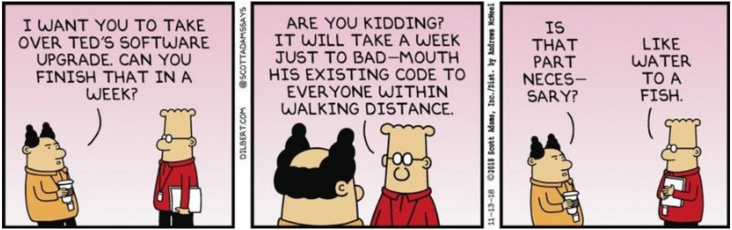

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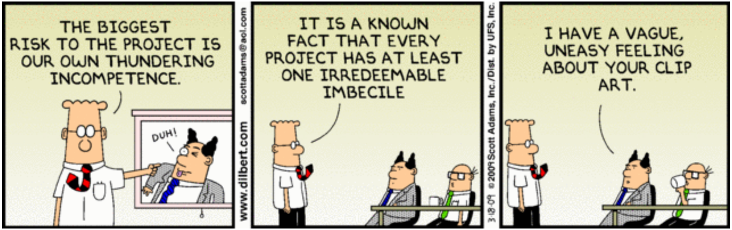

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  - loss of key personnel
  - ineffective cooperation with subcontractors
- **Business risk**
  - changes in the market
  - emerging new competitors
  - time consuming and unsuccessful certification
  - unclear path to market

Risk assessment

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- Qualitative—based on assessment of experts, based on historical data, simulations, etc.
- Quantitative
  - events tree analysis—treating the impact as a result of event chain (with estimated probabilities)
  - faults tree analysis—the other way round (to define a potential impact and analyse the events that may lead to it)

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Drawbacks: insufficient amount of historical data, difficulties in interpretation, bias, etc.

Risk assessment—example

Impact →

Likelihood ↑	Negligible	Minor	Moderate	Significant	Severe
Very Likely	Low Med	Medium	Med Hi	High	High
Likely	Low	Low Med	Medium	Med Hi	High
Possible	Low	Low Med	Medium	Med Hi	Med Hi
Unlikely	Low	Low Med	Low Med	Medium	Med Hi
Very Unlikely	Low	Low	Low Med	Medium	Medium

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- Should use all available knowledge of the project and project domain
- Should be repeatable, transparent, comprehensive, its results should be easy to interpret (ideally: unambiguous)

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- **Exploit** the risk—when a risk can have positive impact, we should have a plan of how to exploit it

Risk management—example

<u>Development risk</u>

The most important risks are summarised in the table below. Severity (S) and likelihood (L) are scaled from 0 to 10, where 0 indicates no severity / zero probability and 10 – the highest severity and certainty. These values are quoted before (S, L) and after (S', L') considering the mitigation action.

Risk	S	L	Description and mitigation action	S'	L'
Requested satellite images are obtained with delays and/or at a higher cost	5	6	Our team is familiar with the process of obtaining satellite images and we have a collection of images built during the SISPARE project. Overall, we will plan to acquire the required images in advance to allow for some delays which will not affect the critical path.	1	2
The scientific papers considered for implementation do not contain sufficient details to reproduce the method	7	4	Unless the authors publish the source code (which is still rather rare), it is difficult to predict whether a certain scientific paper presents all the details on an algorithm necessary to reproduce the quoted results. Following that observation, we do not define it strictly which algorithms our prototype will be based on—instead, we refer to some groups and categories of the state-of-the-art methods. Also, the team members are highly experienced in implementing computer vision algorithms based on scientific papers and can bridge some gaps on their own.	2	3
Poor performance of the algorithms implemented based on the scientific articles	7	5	We will focus on well-published and highly-cited papers first. Also, we will focus on the papers that report research proved successful in some open contests, such as NTIRE 2017, being the part of IEEE CVPR. Also, engaging scientists experienced in SRR, satellite imaging and deep learning reduces severity of that risk, as we can develop our own solutions.	2	2

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- **Regularity**, **reliability**, **precision** and **accuracy** are important features of proper risk management
- *Anything that can go wrong will go wrong...* (Murphy's law)

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2. Risk analysis and assessment
3. Risk management
4. Risk management—summary
5. Acknowledgements

Acknowledgements

1. B. Szlachcic: Analiza ryzyka i zarządzania ryzykiem jako element systemu zarządzania kryzysowego w organizacji, Zeszyt Naukowy UPH 103, s. 229-241, 2014.
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