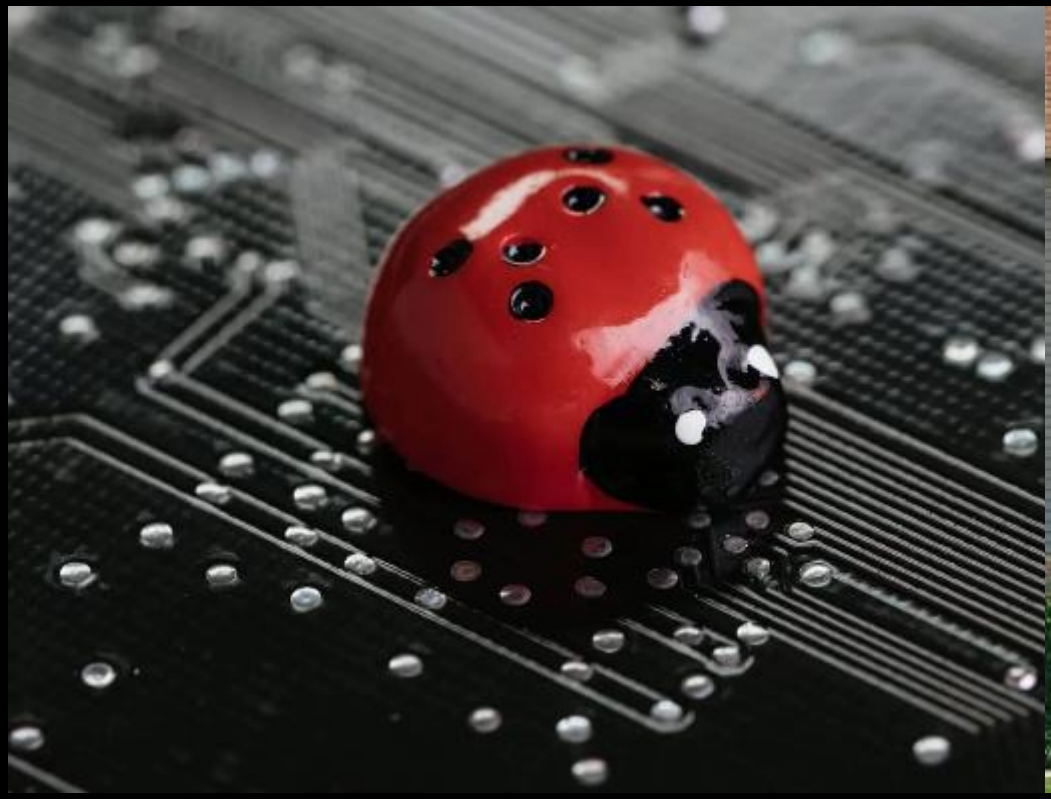
Welcome

to Software Testing And Risk assessment



Milan Lopuhaä-Zwakenberg

Formal Methods & Tools

Today's agenda

1. Introduction to course and course organization
2. Intro lecture on risk

- ***No risk, no fun! (Carpe diem, YOLO…)***
- ***Better safe than sorry***

Taking risk: a daily thing

#NoRiskNoFun

#BetterSafeThanSorry

Course objective: Take better risks

Preventing & managing risk: daily life

Lock doors

Make back ups

Safety devices

Double check

Insurance

Face masks

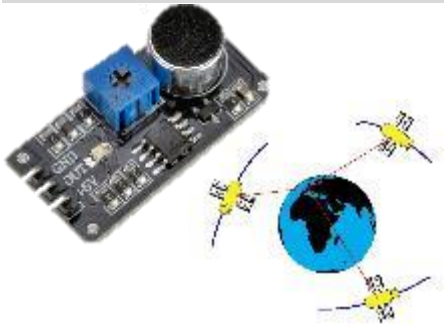
Key: Are we taking the right measures?

Taking risk: autonomous cars

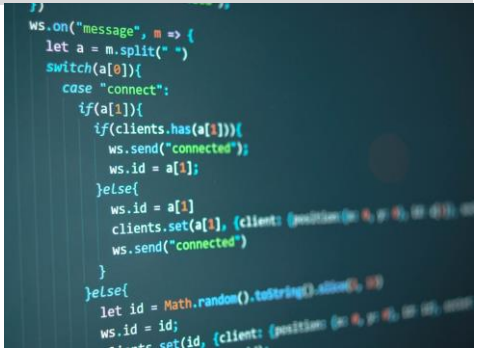
Self driving cars

Object detection

Sensors & GPS



35M LoC



Key: How to minimize the risk and maximize the fun?

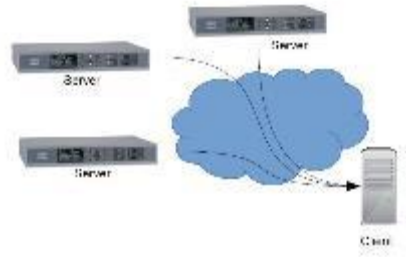
Preventing & managing risk: high tech systems

Testing

Verification

Monitoring

Redundancy



Diversification

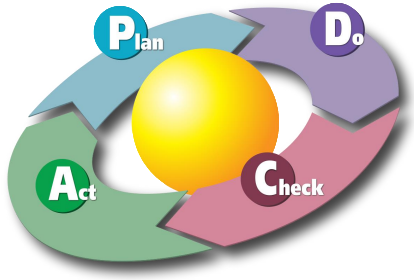
Fail safe

Objective: identify, analyze risk + countermeasures

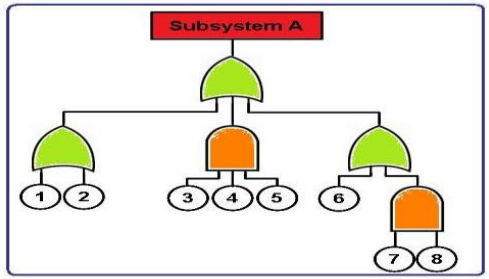
Preventing & managing risk: 2 course topics

Course topic 1: risk assessment

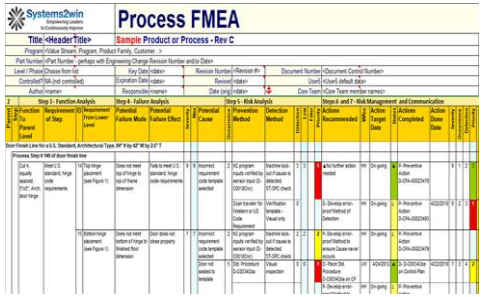
Intro



Fault trees



FMEA

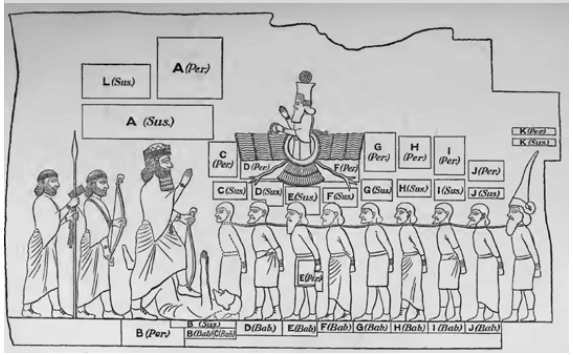


Learning objectives

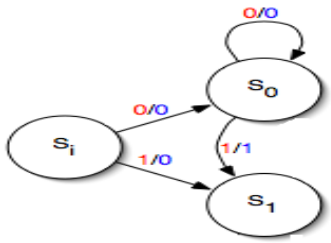
- Take better risks
- Identify risks and devise suitable measures

Course topic 2: software testing

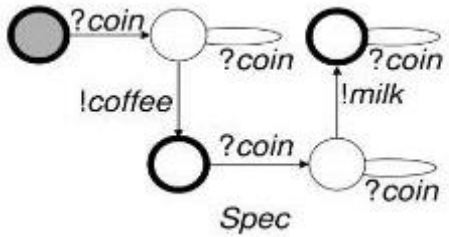
Classical



Fin State Machine



Labeled Trans System



Learning objectives

- Test software better & faster
- Derive effective test suites

Previous editions

- Students more interested in testing
- More testing, less risk
- (Risk can be emphasized in in project)

Activities

Theory

Case studies & applications

Tooling

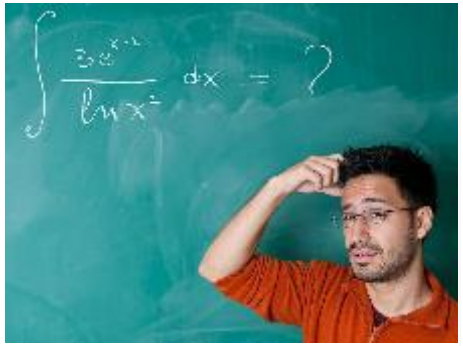
Activities

Videos on Canvas

- Part of course content
- Watch **before** lecture

Lectures

- TUE 6/7
- By MLZ (usually)
- Guest lecture attendance compulsory



Exercise classes

- THU 8/9
- By Lisandro & Tannaz
- Make exercises, ask questions about homework

Homework + Project homework

- Weekly,
- Due Tuesdays before class
- Teams of 2
- Compulsory (effort-based)

Project

- Teams of 6
- 30% of grade
- >= 5.5

Exam

- 70% of grade
- >= 5.5

Typical week

Tuesday

1. Before lecture:
   - Hand in homework
   - Hand in project homework
   - Watch videos
2. Lecture
3. After lecture:
   - Homework+exercise solutions online
   - New homework+exercises online

Thursday

1. Tutorial:
   - Ask questions on last week's solutions
   - Ask questions on this week's homework
   - Student presentations (sometimes)

Planning

Week	date	Tuesday	Lecturer	Thursday	TA
1	Feb 7			Lecture: intro	MLZ
2	Feb 14	Fault trees	MLZ	Exercises	Matthias Volk
3	Feb 21	Dynamic FTs, FMEA	MLZ	Exercises	LJR
	Feb 28	**BREAK**			
4	Mar 7	Classical testing	MLZ	Exercises	LJR,TZ
5	Mar 14	State machines	MLZ	Exercises	TZ
6	Mar 21	Model-based testing	Petra van den Bos	Exercises	TZ
7	Mar 28	Student presentations	You guys	Exercises	TZ
8	Apr 4	Guest lecture: mutation testing	Infosupport	Exam practice	LJR, TZ

Workload estimation

Activity	Hours
Weekly lectures + exercise classes: 8 weeks * 2 activities * 1,75 hours	28
Homework assignments: 8 weeks * 3 hours	24
Project	40
Study for the exam	28
Miscellaneous	20
TOTAL	140

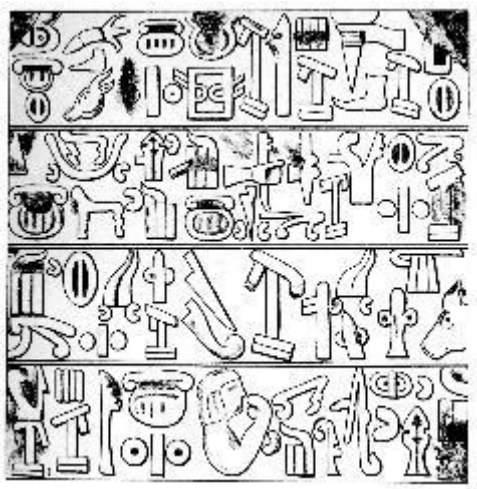
Teaching team

Lisandro Jimenez Roa
PhD student
Topic: Predictive Maintenance

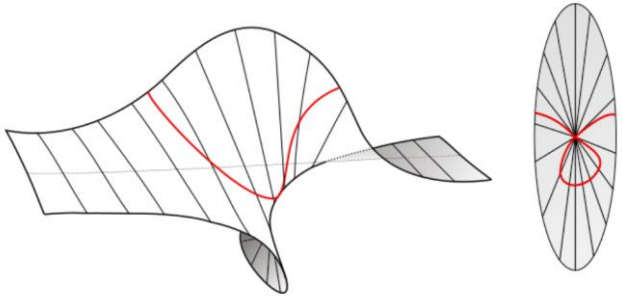
Tannaz Zameni
PhD student
Topic: Model-based testing

Milan Lopuhaä-Zwakenberg
Assistant professor
Mathematical risk models

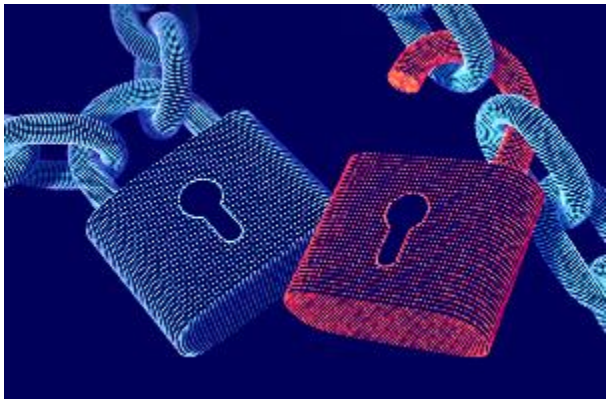
WHO AM I ?



Maths & historical linguistics
Leiden



PhD in algebraic geometry
Nijmegen



Postdoc in privacy
Eindhoven

2021 – now

Research

- Mathematical models of risk management
- Safety-security interactions

Teaching

- This wonderful course
- Aspiring CS high school teachers (Inf4All)


PLEASE
DISTURB
we are here
TO HELP
YOU !

Today's agenda

1. Introduction to course and course organization
2. Lecture on risk

What is risk? Definitions

- **Haller (1975):** Risk is the possibility that positive expectations will not be realized.
- **Wilson & Crouch (1982)**: Risk is probability times impact.
- **ISO (2002):** the combination of the probability of an event and its consequences
- **ISO 31000 (2009):** the effect of uncertainty on objectives
    - Both positive and negative impact
    - Emphasis on goals.
        - Helps to focus
        - No goal = no risk

What is risk? Observations

2 main ingredients

- (Negative) impact
- Uncertainty

Application independent

- ***All domains:*** High-tech, financial, security, …

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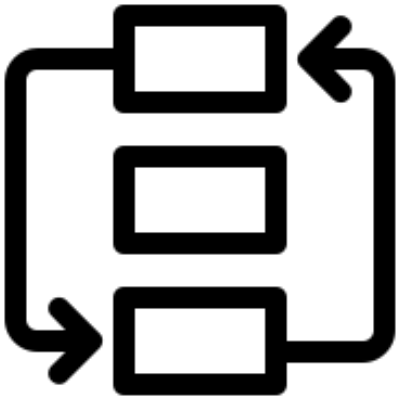
- ***All systems:*** products, processes, services, missions, activities …



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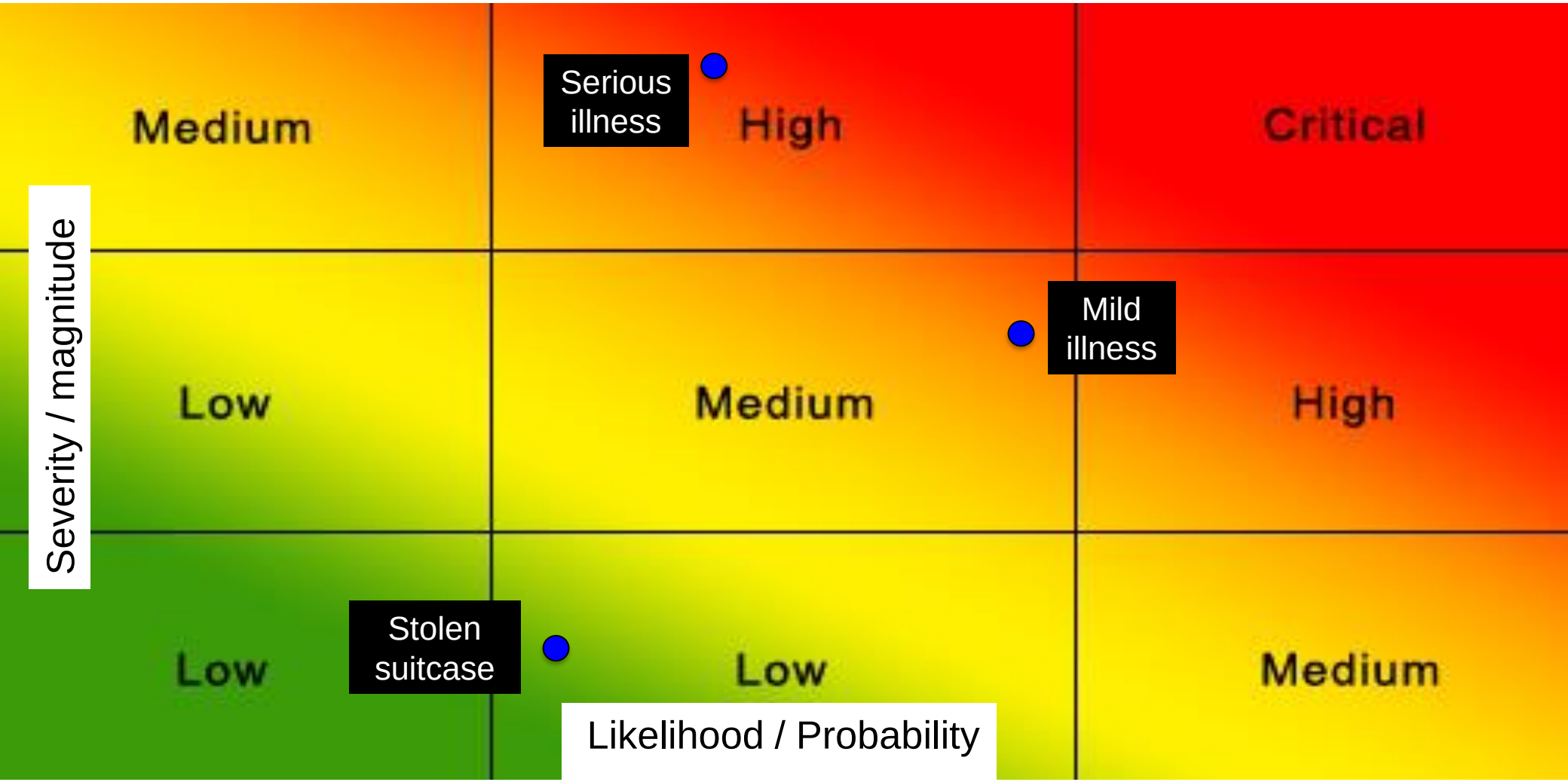
Application independent

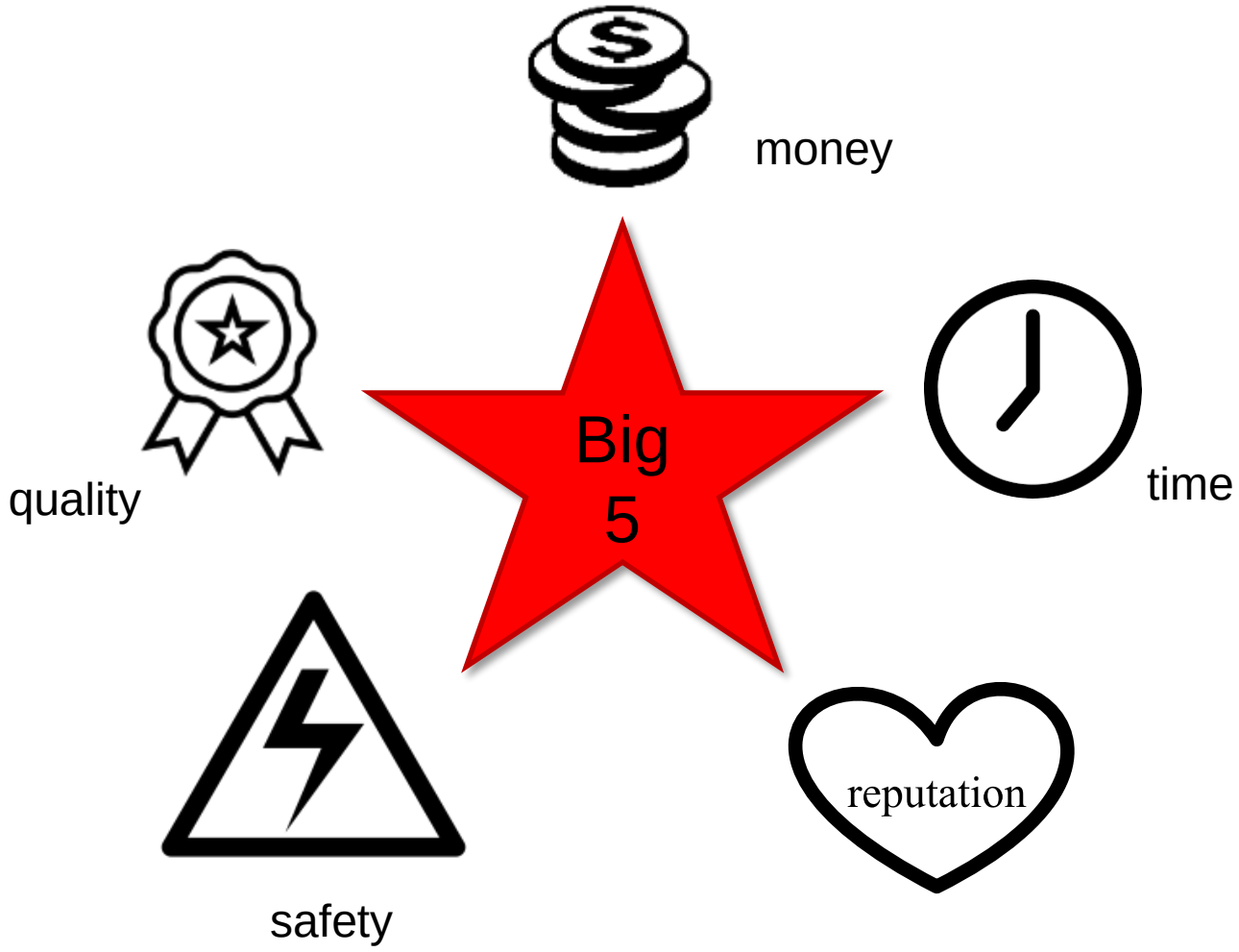
- ***All domains:*** High-tech, financial, security, …
- ***All systems:*** products, processes, services, missions, activities …
- ***All phases:*** design, implementation, operation, dismantling

→ Same definition and principles apply

RISK Matrix


Medium
Serious illness
High
Critical
Severity / magnitude
Low
Medium
Mild illness
High
Low
Stolen suitcase
Low
Medium
Likelihood / Probability

Ingredient 1: impact



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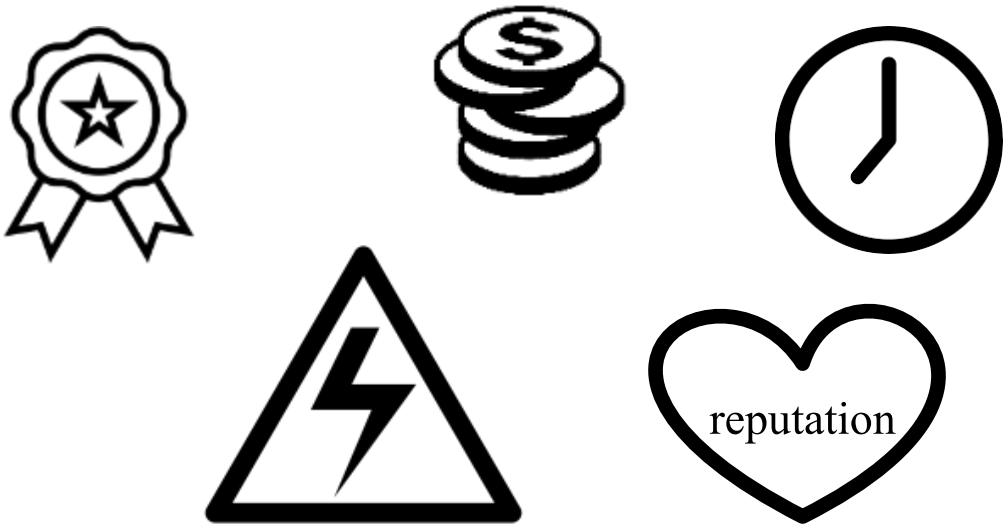


- Focus on negative impact
- Contexts determines priorities

Ingredient 1: impact

Qualitative impact

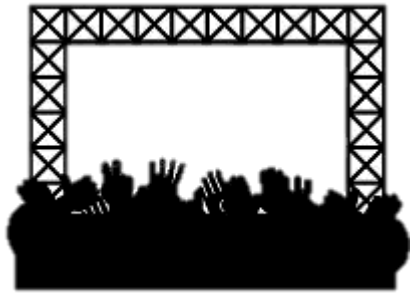
- Which impact?

Quantitative impact

- How bad?
- Number of scale

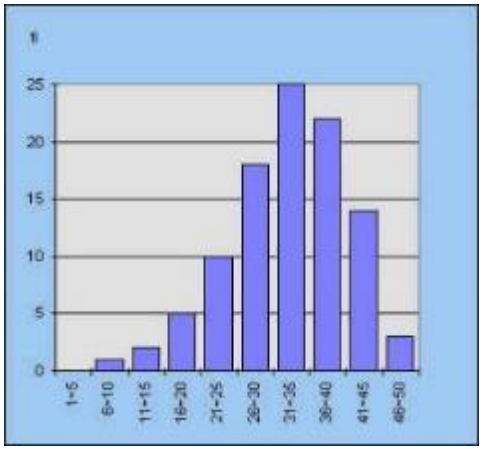
Scale	Patient safety
1: Minor	Discomfort
2: Moderate	Light injury
3: Critical	Permanent injury
4: Catastrophic	Catastrophic: patient death

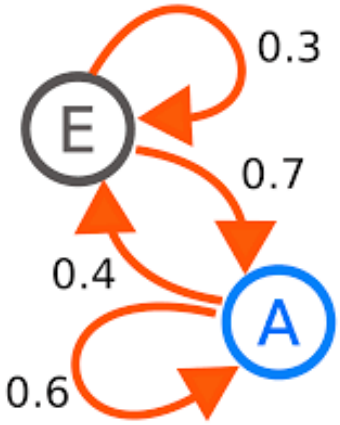
Ingredient 2: uncertainty



Ingredient 2: uncertainty

Scale	Probability of Occurence
1: Very unlikely	Never occurred in our field
2: Possibly	Has occurred once in 10 years
3: Once in a while	Every few years
4: Often	Several times a year
5: Regularly	Several times a month





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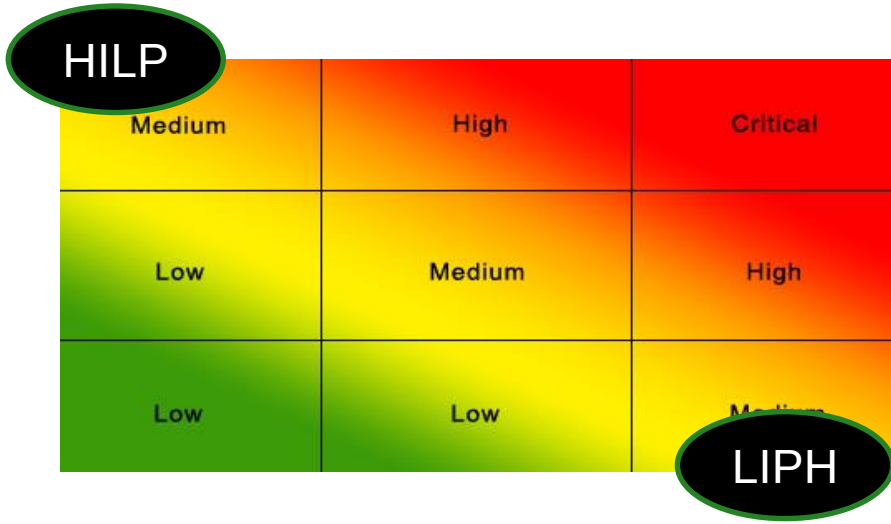
  - Reduces risk to single number **Risk Level**
  - Probability and impact vary over time
  - HILP versus LIHP
  - Useful, but mind the pitfalls



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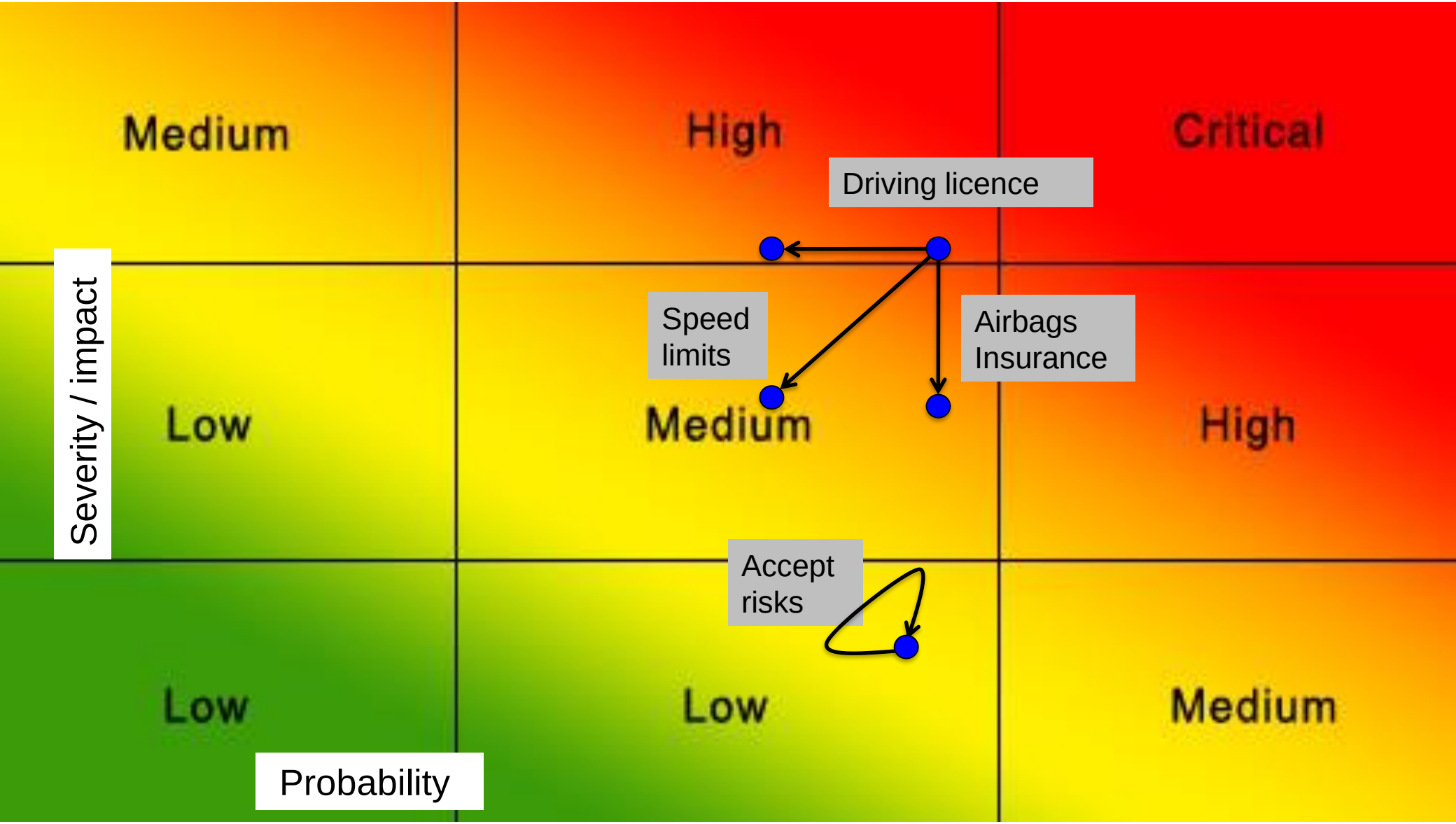
A. Aleatoric/Stochastic/Objective:
   - Effect of randomness
   - Is the result of my coin flip heads or tails?

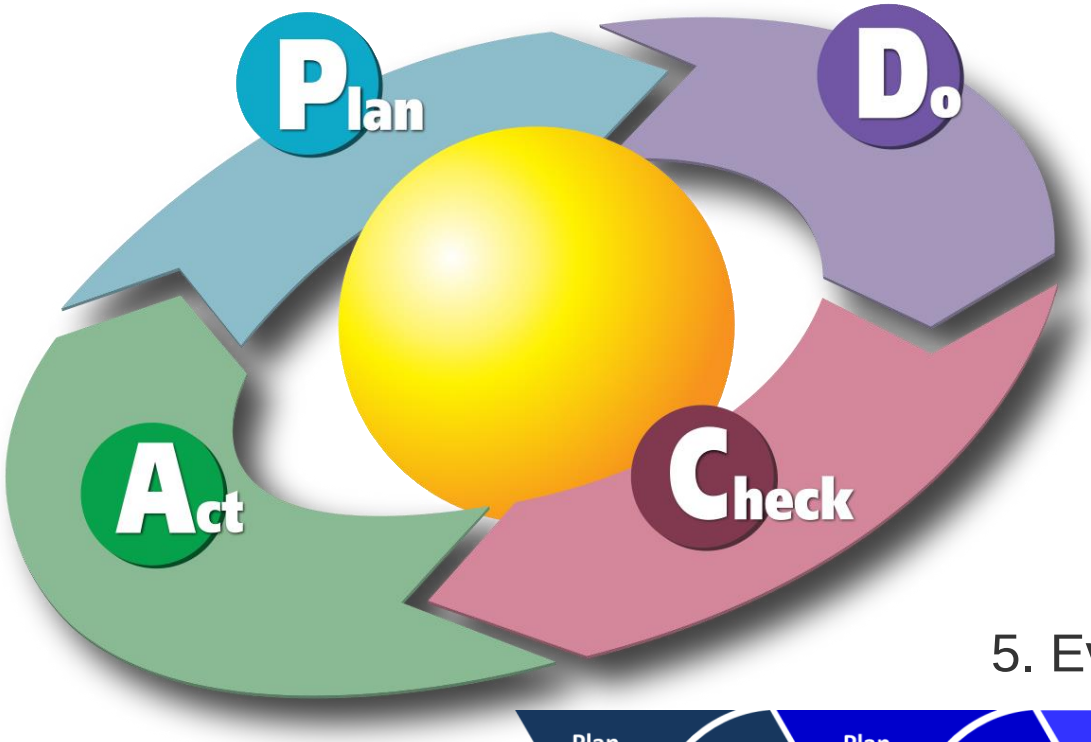
B. Epistemic / Bayesian / Subjective
   - Effect of ignorance
   - Does Cree *mistikwân* mean *head* or *tail*?

Heat map: visualize both ingredients



Demming cycle

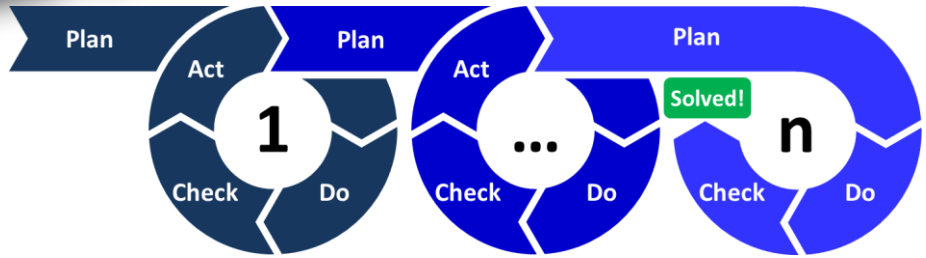
1. Determine goals



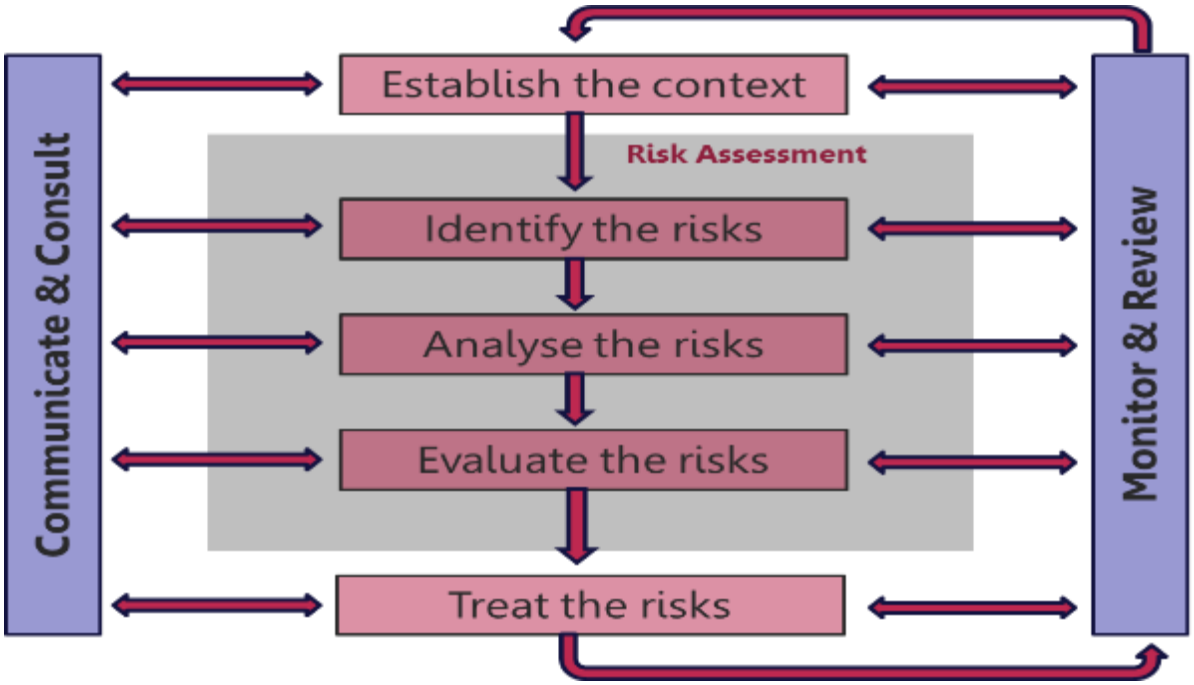
2. Identify risks
3. Prioritize risks
4. Design measures

6. Implement
7. Document, communicate

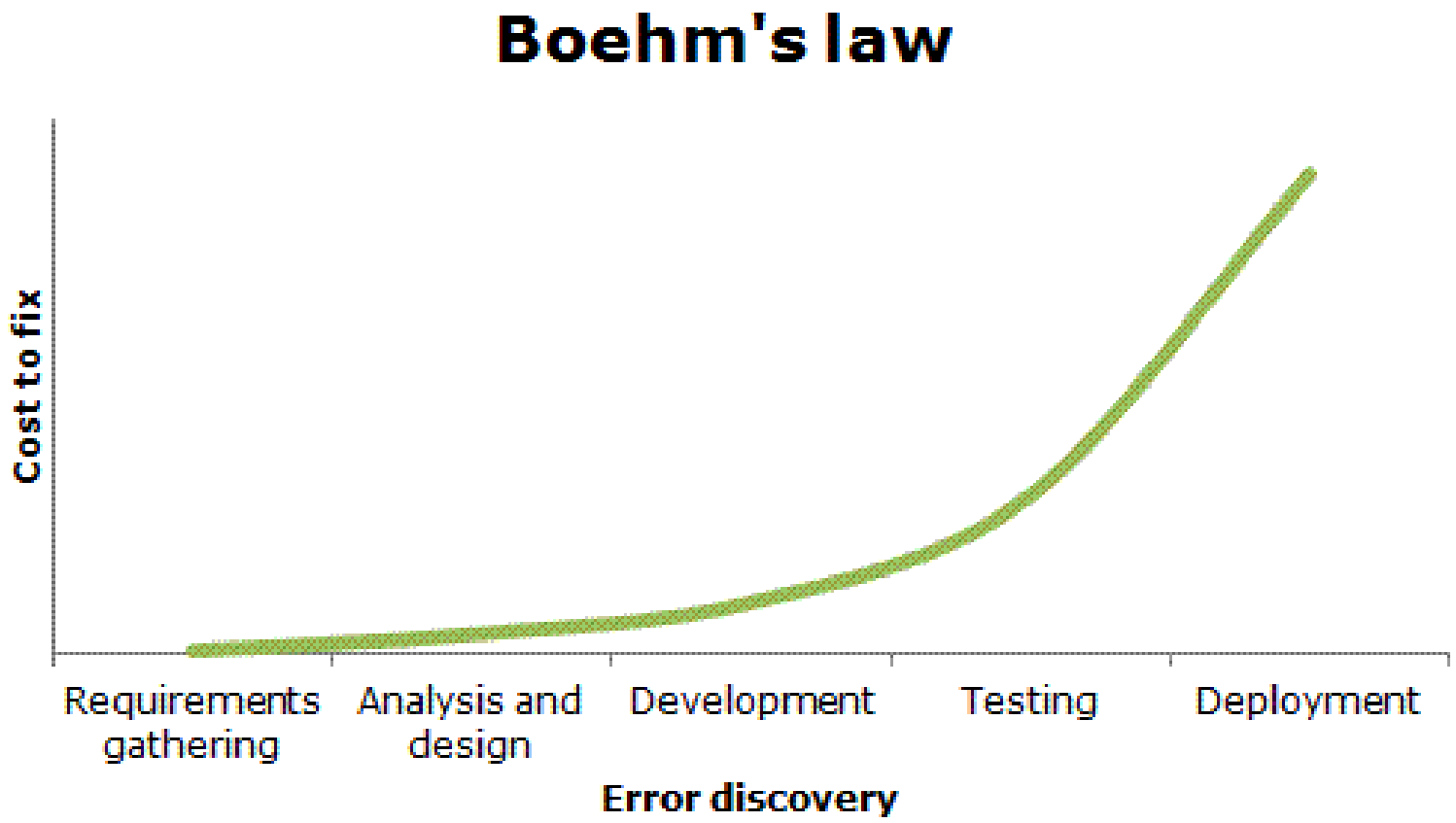
5. Evaluate effectiveness



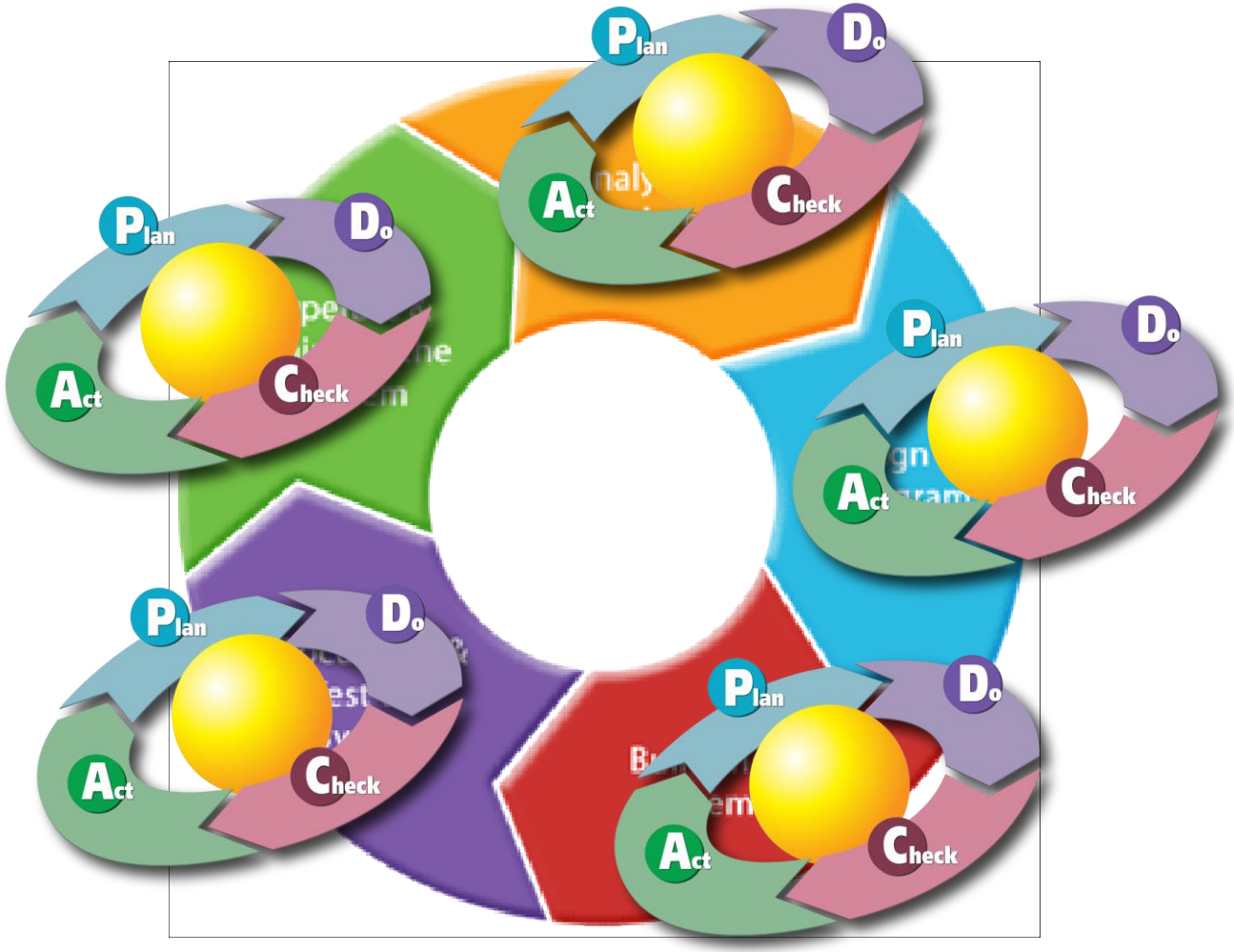
Risk management standards



When do you do risk assessment?



When to perform risk management?



4 risk strategies

- **Tolerate**
  - Accept the risks
  - Eg: going to the supermarket during Covid
- **Terminate**
  - Stop / do not start the activity
  - Eg: the lock down
- **Treat**
  - A: Reduce likelihood of occurrence: redundancy,
  - B: Reduce impact: airbags, rain coats, monitoring
- **Transfer**
  - Transfer the risk to someone else.
  - Eg: insurance, outsourcing, certification / supervision

Risk carrousel

Risk Step 1: Intended purpose / result. *Describe this clear and concrete, if possible, SMART: specifically, measurable, acceptable, realistic and time-bound.*					
Risk Step 2a: Risk Description from the intended target / result. *Describe as specifically as possible one relevant uncertain event or a situation having an impact (- or +) on the target / result.*					
Risk Step 2b: Causes of the risk. *Describe them as sharp as possible: M = human cause, Org = organization cause, T = technical cause, O = other.*					
1: 2: 3: 4:					
Risk Step 3a: Classification probability of occurrence, cross to the right. *Give a brief explanation below.*	Unlikely Has never occurred	Possible has occurred in a given context	Once in a while often occurred in a given context	annually occurred in a given context	Monthly occurred in a given context
Risk Step 3b: Classification result (s) to occur. Use a 5-point scale, from 1 (low) to 5 (high) *Give a brief explanation below.*	Safety	Quality	Cost	Time	Reputation
Risk Step 4: Dealing with the risk, or not take action. *Describe below 4T realistic options for dealing with the risk (and who could take if those measures). Who could implement these measures when?*					
Tolerate: Accept					
Treat: Risk Reduction					
Treat: Effect Reduction					
Transfer: Transfer					
Terminate: Stop					

Summary

- Several definitions of risk exist
  - Uncertainty
  - (Negative) impact
- Heat map
  - Quick overview
- Risk management
  - Deming cycle
  - Deploy throughout the SW development cycle
- 4 risk treatment strategies
  - Terminate, tolerate, treat, transfer

Quiz

Categorize COVID measures

- Wearing face masks
- Social distancing
- Financial support to pubs and restaurants
- Closing pubs and restaurants
- Vaccination
- Transfer of Covid patients between hospitals
- New treatment for COVID patients

A. tolerate
B. terminate
C. transfer
D. treat: reduce impact
E. treat: reduce probability

Quizz

Categorize hightech measures

- Code reviews
- Thorough testing
- Using of-the-self-components rather than developing themselves
- The UT banning smoking on campus
- Redundant components in a data center
- Back up your software
- Using cloud services for your back up
- UT using gmail accounts for students

A. tolerate
B. terminate
C. transfer
D. treat: reduce impact
E. treat: reduce probability

Homework: 3 types

- **Multiple choice quizzes**
  - On Canvas
  - Theory, practice only
- **Exercises**
  - Teams of 2
  - Theory
  - 1 homework exercise, rest practice
- **Project**
  - Teams of 5
  - Pick a project of your choice
  - Deliverables
    - Project presentation
    - Project report
    - Project homework

Bring your own code

Code base

- Will be used in various assignments and the project
- The code base can be
  - a project from an earlier course,
  - open source software
  - software from a job (if your employer agrees! must be accessible to all project members).

Requirements

- You must be able to execute unit tests
- The code must be large enough, say at least 1000 lines
- There must be several modules

In case you have troubles with your code base, then contact us

This week's homework

- Homework (2 people):
  - Risk assessment
  - Due on Tuesday 13:00 via Canvas
  - Example solutions online after lecture
- Project homework (5 people):
  - Form groups
  - Find code
  - Look at project topics
  - Introduce your team in 1 min sharp →next tutorial


ENJOY YOUR
WEEK