

# Value of Failure

## Students Course

### Module 5: How to detect failure

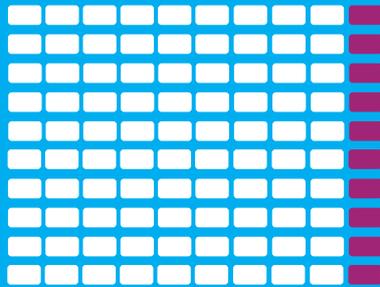
## Students Workbook

Learner Name: \_\_\_\_\_

Assessor/Tutor: \_\_\_\_\_



Did you know that...



...in some sectors up to  
90 % of new businesses fail  
in the first 5 years?

# Table of Content

I	Working with this Workbook	5
II	About the Project	7
III	About this Course	11
IV	About this Module	13
V	Learning Achievements	15
	Module 5: How to detect failure	17
5.1	Risk assessment	17
5.2	Methods of hazard identification	23
V	Disclaimer	42

Did you know that...



...the **value of failure** makes re-starters grow faster and stronger than first-timers?

# I Working with this Workbook

Learning without additional working materials does seldom lead to learning success. The Value of Failure Project therefore designed additional workbooks for tutors as well as for learners to support a fast and productive learning environment. Those workbooks follow the structure of the Value of Failure Learning Resources and give additional information and content.

The Students Workbooks for each of the modules should be seen as a helping hand for learners. They provide help, tasks and additional information. Free pages give room for your individual notes.

We also recommend to study the additional literature and online resources provided on the Value of Failure Website and the Value of Failure Pearltrees Account.

Following resources are provided on the project website:

- Tutors Workbooks
- Learners Workbooks
- Presentations

To enrich the learning experience we are looking forward to your feedback:

 [www.valueoffailure.com](http://www.valueoffailure.com)

## Legend

Presentation 

Workbook 

Example 

Remember 

Digression 

Law 

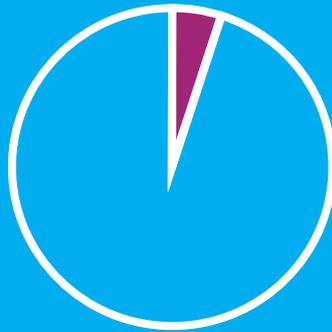
Learned 

Checklist 

Link 

Video 

Did you know that...



...only about **8 %** of failed entrepreneurs start over again?

# II About the Project

Value of Failure is a European Union funded grass roots initiative to support a better framework for so called failed or second chance entrepreneurs. The idea is to implement a new positive approach to failure in general and to business failure in specific. The project is funded by the European Union within the Erasmus+ framework.

The approach of the project is to address this important topic from two different sides:

1. **Regional alliances** involve all important stakeholders to set up more a failing- friendly environment and funding framework. The project develops a tool-kit for other regions to develop franchises of the alliances on their own.

2. A set of **learning resources** addressing students as well as second chance entrepreneurs are set up to implement a seed for a new thinking about failure and providing in depth knowledge about failure and how to cope with it.

All materials produced are open source and can be used by anyone according to the rules provided in the disclaimer at the end of this publication.

More information about the project, the e-learning courses and the regional alliances can be found on the project website

↶ [www.valueoffailure.com](http://www.valueoffailure.com)

The project is developed, designed and implemented by an experienced international consortium of universities, business development agencies, consulting companies and SMEs (small and medium sized enterprises) coming from Germany, Northern Ireland and Poland:

## 1. University of Szczecin, Poland (Project Leader)

The University of Szczecin (US) is the most powerful organisation in the West Pomeranian region. Presently over 30.000 students are following full-time, evening & part-time studies in 27 subject areas at 13 faculties. One of the most important objectives of the University is education of students and their preparation for entering labour markets. International cooperation com-

prises an extremely important aspect of US's activity. The top priorities are joint research and student & staff mobility programs.

↶ [www.english.usz.edu.pl](http://www.english.usz.edu.pl)

## 2. Canice Consulting, Northern Ireland

Canice Consulting is a small yet established private company based in Northern Ireland which operates in the fields of local and regional development, enterprise education and management and technical support to EU networks and programmes.

Canice Consulting provides a broad range of modern learning services to predominantly the EU market place. Services include training solutions, e-learning content creation, learning technologies and learning strategy design and consulting. Learning technologies include learning portals, learning management systems, content development systems, performance support tools, virtual classroom tools and more.

↶ [www.caniceconsulting.com](http://www.caniceconsulting.com)

## 3. Creo Mind S.C., Poland

CREO MIND (CM) is a civil partnership established from two sole traders: Wojciech Brażuk and Prestige Brand Mariusz Woźniak. The company has wide experience in consulting services in the area of marketing, business development, strategic management and skills development. The owners of CREO MIND have been closely collaborating with the Northern Chamber of Commerce, providing their services for the largest regional chamber of commerce in Poland. Therefore CREO MIND has a strong potential in networking of entrepreneurs and in building relations among various stakeholders of regional market. CREO MIND has elaborated number of analysis and expertise on business and markets. CREO MIND is also recognized on the regional market from elaborating and realizing creative and innovative marketing campaigns and events.

↶ [www.websitecreomind.com](http://www.websitecreomind.com)

Did you know that...



...31% of projects fail?

#### **4. Enterprise Northern Ireland, Northern Ireland**

Enterprise Northern Ireland was established in 2000 to represent the network of Local Enterprise Agencies in Northern Ireland, and is the only membership body in Northern Ireland for organisations providing enterprise support. Enterprise Northern Ireland holds national contracts with various public sector organisations which it delivers primarily through its member agencies. These contracts include the Regional Start Initiative; Social Entrepreneurship, Exploring Enterprise, Tradelinks programme and Business Bootcamp. All of these programmes are further supported by access to finance through the ENI Loan Fund and the Northern Ireland Small Business Loan Fund.

As the only membership body in Northern Ireland for organisations providing enterprise support, Enterprise Northern Ireland is at the heart of a dynamic, high profile network. Enterprise Northern Ireland also represents the interests of the wider small business sector through policy and business development, research and quality assurance, and has a strong lobbying and campaigning remit.

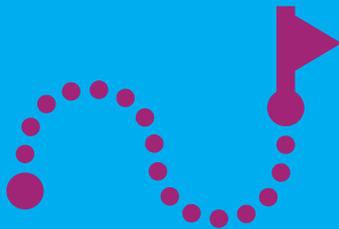
↻ [www.enterpriseni.com](http://www.enterpriseni.com)

#### **5. The visionworks, Germany**

The Visionworks is a small company specialized on consulting, coaching, marketing and project management especially for (micro) SMEs and Start-ups. For its clients the visionworks develops investor ready business plans and financing concepts and accompanies founders until the closing of financing. The visionworks has international contacts to public and private investors and has also worked extensively with all relevant regional stakeholders and institutions which are relevant for the regional Second Chance Entrepreneurs Alliance. Despite that the visionworks has great experience in developing learning courses and learning environments for adult education as well as for students.

↻ [www.thevisionworks.de](http://www.thevisionworks.de)

Did you know that...



...88% of projects  
are past the deadline?

# III About this Course

## Course Overview

The Value of Failure Course was designed for adult learners, including high-school teachers, undergraduates and the interested public. For teachers and tutors, the course will look at advances in psychological knowledge about failure which helps them to integrate this important topic into their teaching. For adult learners, it will help them to appreciate the positive effects of failure and their potential impact on their everyday life. The goal of the course is to make the existing positive effects of failure accessible to everybody.

The course can be used in a classroom environment as well as a self-contained distance learning course. Distributed free of charge on the Value of Failure project website.

← [www.valueoffailure.com](http://www.valueoffailure.com)

## Course Components

The syllabus of the Value of Failure course is divided into seven different units called modules Each of them focussing on different aspects of failure.

**Module 1:** Basics of failure

**Module 2:** What is Failure

**Module 3:** Causes of Failure

**Module 4:** Preventing Failure

**Module 5:** How to detect Failure

**Module 6:** Coping with Failure

**Module 7:** Learning from Failure

Each module is divided by sub-sections and can be used as a stand-alone learning session. Therefore each module starts with an introduction about the course which can be skipped if you have studied the previous modules already . All modules include additional resources such as videos and also provides questionnaires, examples and tests where appropriate.

Did you know that...



...the average cost overrun  
of projects is **189%**?

# IV About this Module

## Module5: How to detect failure

### Introduction

In the last modules we learned a lot about failure in general, how we attribute success and failure and how project management helps to prevent failure by planning in the first place.

But in fact, not all failures can be prevented by planning in the forehand. We cannot plan every possible circumstance - even if we try. Therefore it is important to try to realize upcoming hazards and failure as soon as possible.

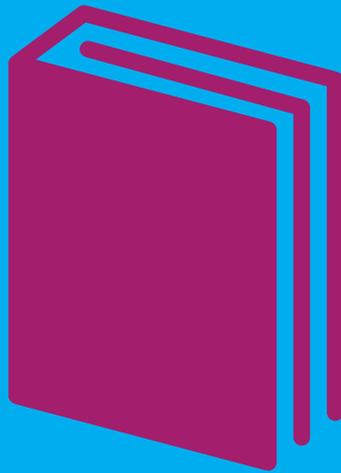
In this module we will explore different methods to identify and track risks and their development over time. This is important to not get surprised by hazards unprepared.

**Additional information can be found on our website and our Pearltrees-Account:**

↶ [www.valueoffailure.com](http://www.valueoffailure.com)

↶ [www.pearltrees.com/thevalueoffailure/](http://www.pearltrees.com/thevalueoffailure/)

Did you know that...



...Stephen King threw away his entire draft of “Carrie”? His wife found it in the trash and the book later launched his career with now more than 350 Million books sold.

# V Learning Achievements



In this module you will learn about:

Achieved

Date

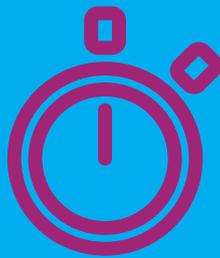
## 1. Risk assessment

You will learn how to summarize and categorize different possible risks using a risk matrix.

## 2. Hazard identification

You will practice different methods of hazard identification such as HAZOP analysis, index-based methods, or fault tree analysis.

Did you know that...



...the average time overrun of projects is **222%**?

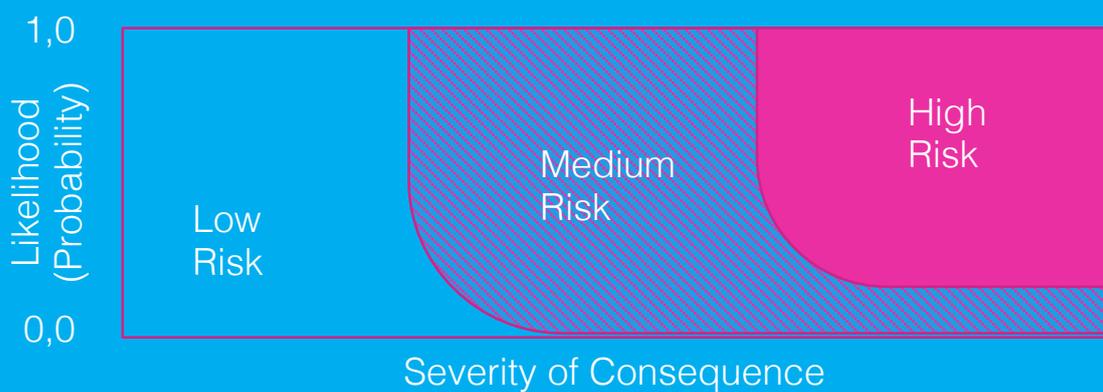
## Module 5: How to detect failure

### Chapter 5.1 Risk assessment

Not all risks are equal. Some are more likely to happen than others, or have the potential for hazardous consequences. Therefore it is important to individually analyse risks and to track their development over time.

- Risks are assessed by characterizing the probability that a project will experience an undesired event and the consequences, impact or severity of the undesired event, if it occurs.
- Risks can be compared on iso-curves consisting of a likelihood measure and a consequence measure.
- Since the assessment of the likelihood and consequence of a risk is both subjective and has significant uncertainty the characterization of risk is qualitative (low medium or high) or semi-quantitative (risk are captured on a matrix)

Figure 4.1: Categorization of risks by likelihood and severity of consequence



Not all risks require the same attention. It is important to analyse them in a risk assessment process, to decide whether actions need to be prepared or not.

Process of risk assessment:

1. System definition
2. Hazard identification
3. Analysis of accident scenarios
4. Estimation of accident frequencies
5. Consequence analysis and modelling
6. Risk estimation

Summarizing the different risks in a matrix provides a quick visual comparison of all important risks. Figures 4.2 and 4.3 show an example of NASA how you can execute risk assessment and visualize it in a matrix.

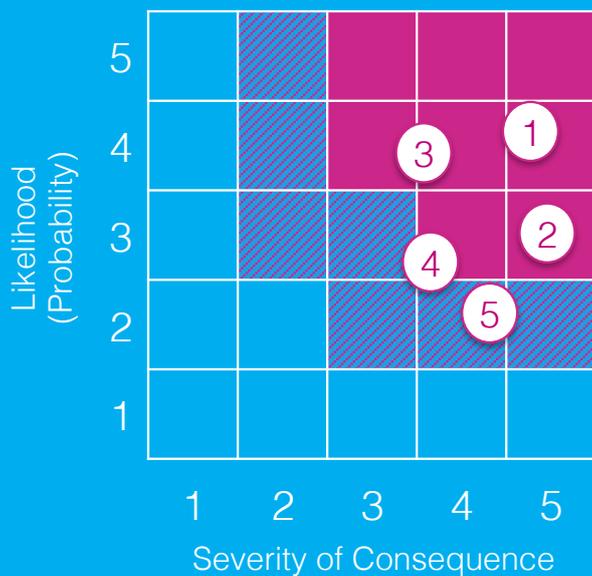
Did you know that...



...that James Dyson created  
**5,126** failed prototypes of his  
vacuum cleaner before succeeding?

Probability of Occurrence	
Scale	Measure
5	Near certain to occur (80-100%).
4	Highly likely to occur (60-80%).
3	Likely to occur (40-60%).
2	Unlikely to occur (20-40%).
1	Not likely; Improbable (0-20%).

Impact of Consequences			
Class	Technical	Schedule	Cost
Class I Catastrophic (Scale 5)	A condition that may cause death or permanently disabling injury, facility destruction on the ground, or loss of crew, major systems, or vehicle during the mission	launch window to be missed	cost overrun > 50 % of planned cost
Class II Critical (Scale 4)	A condition that may cause severe injury or occupational illness, or major property damage to facilities, systems, equipment, or flight hardware	schedule slippage causing launch date to be missed	cost overrun 15 % to 50 % of planned cost
Class III Moderate (Scale 3)	A condition that may cause minor injury or occupational illness, or minor property damage to facilities, systems, equipment, or flight hardware	internal schedule slip that does not impact launch date	cost overrun 2 % to 15 % of planned cost
Class IV Negligible (Scale 2)	A condition that could cause the need for minor first aid treatment but would not adversely affect personal safety or health; damage to facilities, equipment, or flight hardware more than normal wear and tear level	internal schedule slip that does not impact internal development milestones	cost overrun < 2 % of planned cost



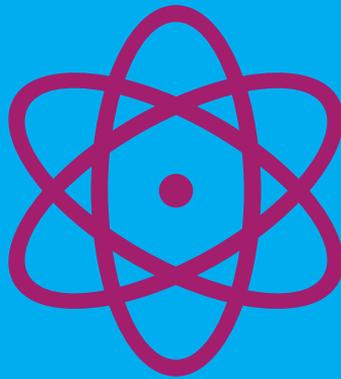
Rank & Trend	Risk ID	Approach	Risk Title
1	DFRC-34	R	Landing gear door system failure
2	DFRC-12	M	Cost growth for engine components
3	DFRC-07	W	Quality control resources insufficient
4	DFRC-24	A	Avionics software behind schedule
5	DFRC-01	W	Limited flight envelope, due to technical issues

Risk Level	Risk Trend	Risk Approach
High risk	Decreasing (Improving)	M Mitigate
Medium risk	Increasing (Worsening)	W Watch
Low risk	Unchanged	A Accept
	New since last period	R Research

### Task 5.1 Risk assessment

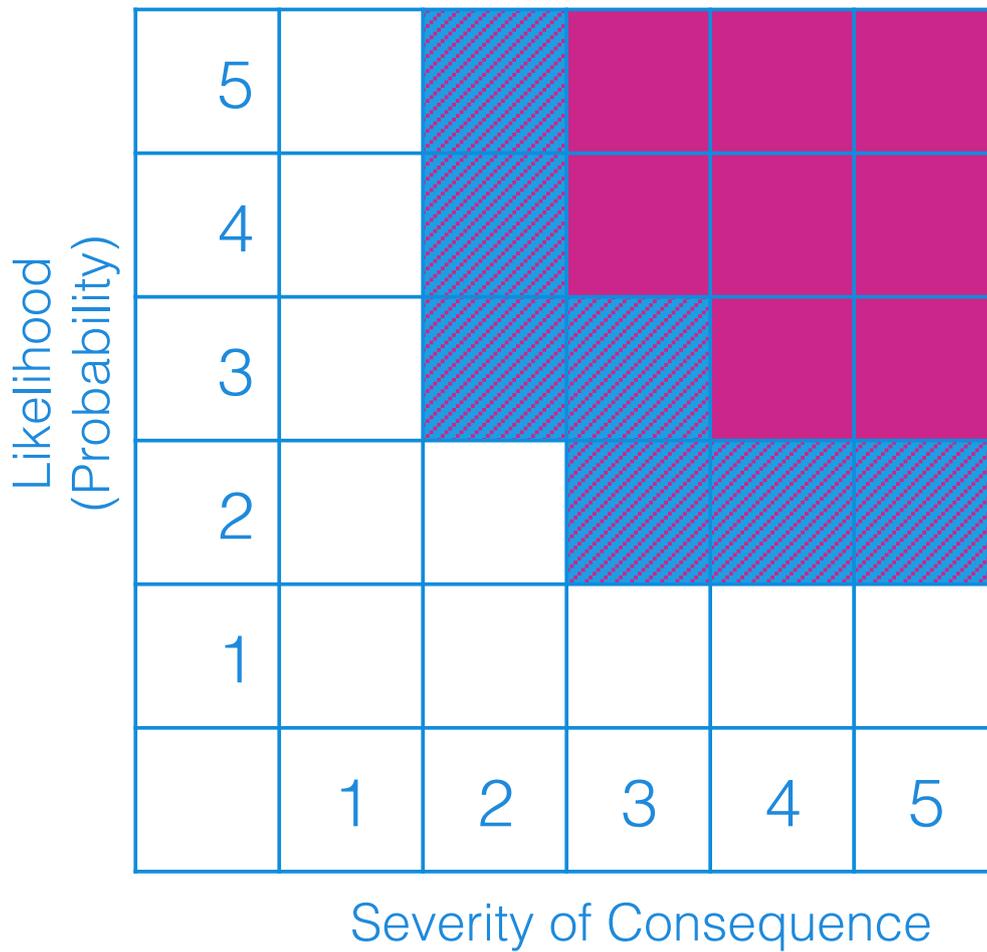
Think about a difficult task you are facing at the moment and summarize the related risks in the following table and visualize them in the matrix.

Did you know that...

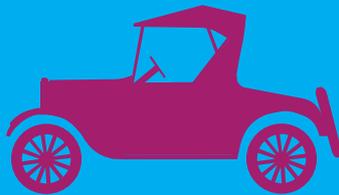


...Albert Einstein had some communication and learning difficulties in school?

Rank & Trend	Risk ID	Approach	Risk Title
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			



Did you know that...



...Henry Ford failed with a couple of automobile businesses before he learned from his failures and revolutionized the automotive industry?

## Chapter 5.2 Methods of hazard identification

### Definition hazard identification:

Hazard identification is a collective term that encompasses all activities involved in identifying hazards and evaluating risk for projects. The evaluation takes place throughout the whole life cycle of a project or task and involves risks for the project itself but also for related stakeholders (employees, the public, or the environment). The risks are consistently controlled within a defined risk tolerance.

Hazard identification address three main risk questions to a level of detail commensurate with analysis objectives, life cycle stage, available information, and resources.

The three main risk questions are:

1. Hazard – What can go wrong?
2. Consequences – How bad could it be?
3. Likelihood – How often might it happen?

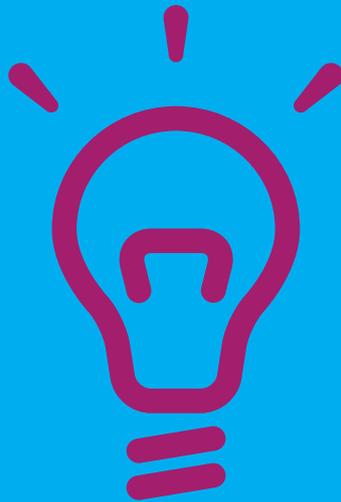
When answering these questions, the objective is to perform only the level of analysis necessary to reach a decision, because insufficient analysis may lead to poor decisions and excessive analysis wastes resources. The following chapters show different methods to analyse potential hazards.

### Chapter 5.2.1 HAZOP analysis

A hazard and operability study (HAZOP) is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent risks. HAZOP is often used in construction but can also be adopted to other purposes. HAZOP is executed in 6 main steps:

1. **Project exploration**  
Identification of inherent hazards of the project (process, facility, suitability and probable environmental impact).
2. **Project definition**  
To identify and reduce significant hazards associated with items and areas, check conformity with relevant standards and codes of practices.
3. **Design and procurement**  
To examine the design in detail for identification of deviations capable of causing operability problems or hazards.
4. **Check for steps 1-3**  
During final stages of project completion: check if all recommended and accepted actions recorded in steps 1-3 are implemented.
5. **Check for safety**  
During finishing the project: check that all relevant safety requirements have been acknowledged and all installed safety systems are reliably working.
6. **Check for changes in operation**  
During normal operation, some time after finishing the project (especially if any modifications have been made): check if changes in operation has not invalidated the HAZOP report of step 1-3 by introducing new hazards.

Did you know that...



...Thomas Edison has been told by his teachers to be “too stupid to learn” before he invented some world-changing gadgets and applied for more than 1000 patents?

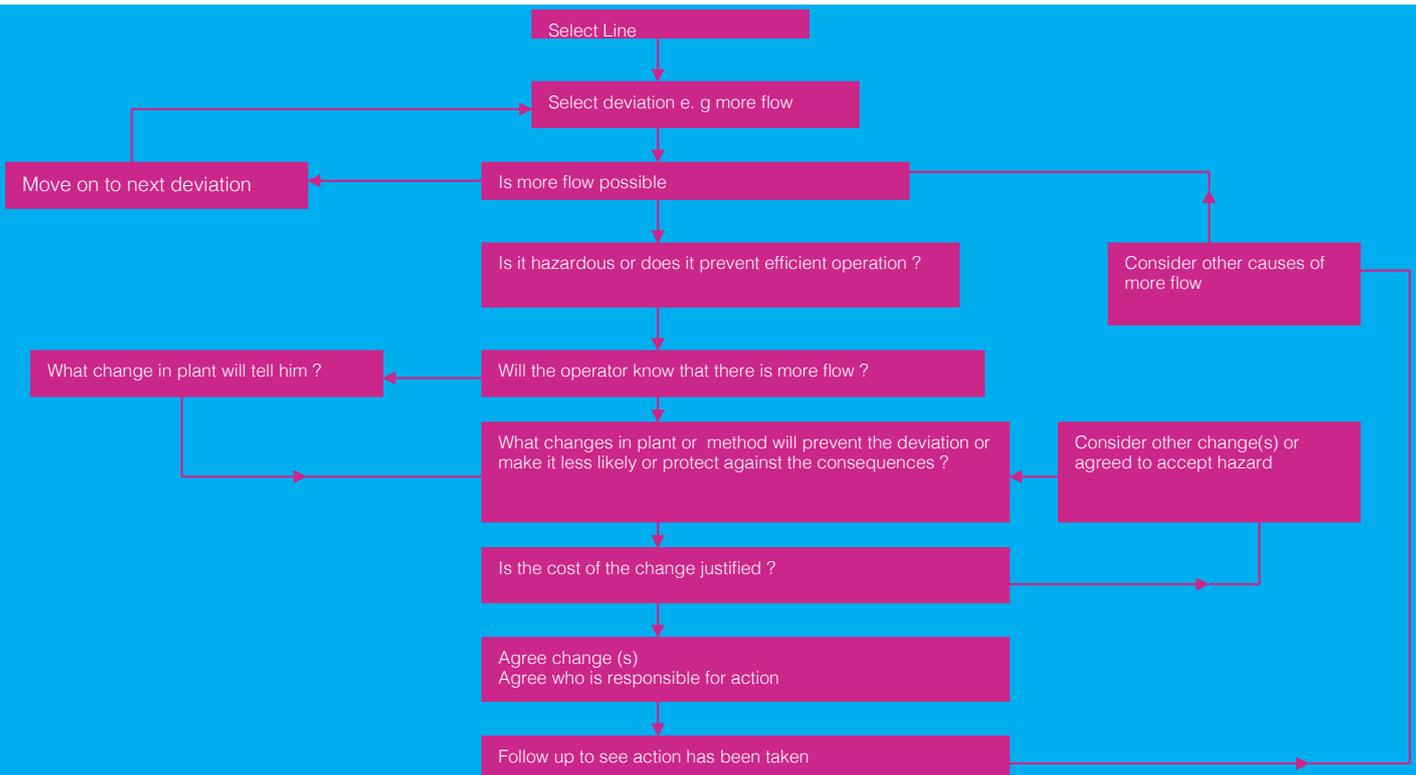
The analysis itself is executed by using so called **guide words**. To prompt discussion, or to ensure completeness, it may also be helpful to explicitly consider appropriate parameters which apply to the design intent. Guide words are general words such as flow, temperature, pressure, composition. The current standard notes that guide words should be chosen which are appropriate to the study and neither too specific (limiting ideas and discussion) nor too general (allowing loss of focus). All possible variables of a process are then “challenged” with the guide words (see figure 4.3):

Figure 4.3: Examples of guide words (HAZOP of a pipe and pump system)

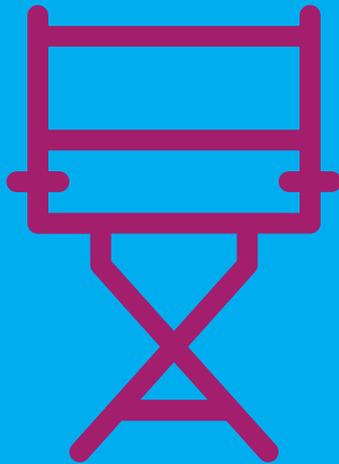
		Guide words						
		No	Low	High	Part of	Also	Other than	Reverse
Process variable	Flow	No flow	Low flow	High flow	Missing ingredient	Impurities	Wrong material	Reverse flow
	Level	Empty	Low level	High level	Low interface	High interface	-	-
	Pressure	Open to atmosphere	Low pressure	High pressure	-	-	-	Vacuum
	Temperature	Freezing	Low temp.	High temp.	-	-	-	-

Potential hazards are then simulated in a flow chart to develop and agree on potential strategies.

Figure 4.4: Example of a flow chart



Did you know that...



...Steven Spielberg was rejected by the University of Southern California School of Cinematic Arts multiple times before he won three Academy Awards?

In order to quantify the effects of failures, so that priorities to reduce the probability or to mitigate the severity can be taken, an additional criticality analysis needs to be carried out.

**An example formula for criticality might be:  $Cr = P \times B \times S$**

Cr: criticality number

P: probability of occurrence in an year

B: conditional probability that the severest consequence will occur

S: severity of the severest consequence

The criticality number...

- is used to rank the identified deviations in a HAZOP study
- cannot be used as a risk measure
- is a product of three rough estimates

Before a criticality analysis can be performed guidelines have to be developed on how to determine P, B and S. There are no generally accepted criteria for criticality applicable to a system. An example for interpretation of values of P, B and S might be:

Probability (P)

- very rare - less than once in 100 years
- rare - between once in 10 y. and once in 100 y.
- likely - between once a year and once in 10 years
- frequent - more frequent than once a year

Conditional probability (B)

- very low - less than once every 1000 occurrences of the cause
- low - less than once every 100 occurrences of the cause
- significant - less than once every 10 occurrences of the cause
- high - more than once every 10 occurrences of the cause

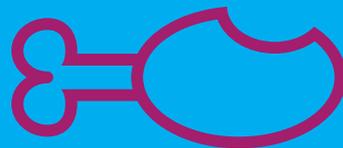
Severity (S)

- low - no or minor economical loss/small, transient environmental damage
- significant - considerable economic losses/considerable transient environmental damage/ slight non-permanent injury
- high - major economic loss/considerable release of hazardous material/serious temporary injury
- very high - major release of hazardous material/permanent injury or fatality

Figure 4.5: Criticality Numbers - values for P, B and S

Categories					
Probability P		Conditional Probability B		Severity S	
Very rare	1	Very low	1	Low	1
Rare	2	Low	2	Significant	2
Likely	3	Significant	3	High	3
Frequent	4	High	4	Very high	4

Did you know that...



...Colonel Harland David Sanders  
was fired from dozens of jobs before  
founding KFC - one of the worlds best  
known franchise brands?

After defining the criticality numbers, a decision strategy needs to be developed. This helps to fasten and to objectify decision making processes. It might be necessary to formulate some additional criteria (for instance: every deviation for which the severity is classified as “very high severity” shall be evaluated to investigate the possibilities of reducing the undesired consequences).

Figure 4.6: Example for decision rules in HAZOP-Analysis

Criticality	Judgment	Meaning
$Cr < X$	Acceptable	No action required
$X < Cr < Y$	Consider modification	Should be mitigated within a reasonable time period unless costs demonstrably outweigh benefits
$Cr > Y$	Not acceptable	Should be mitigated as soon as possible

## Chapter 5.2.2 Index based methods

In risk management, indexes are used to quantify and rank risks and to draw decisions from those rankings.

Usage of an index for risk assessment:

- Indexes can be used for risk ranking
- Process units can be assigned a score or index based on
  - type of substance (flammable, explosive and/or toxic properties)
  - type of process (pressure, temperature, chemical reactions)
  - quantity
- Ranking of the hazards
- Focus attention on hazard analysis for the most hazardous units

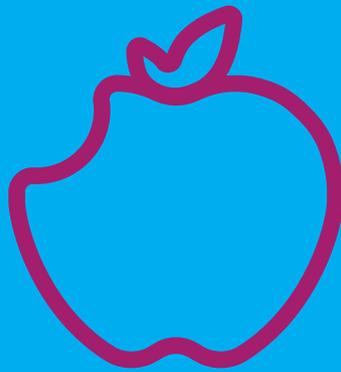
Professional risk indexes are available for many topics already (e.g. for material risks) - but you might also develop your own index.

Examples of substance indexes:

- **Substance Hazard Index (SHI):** Proposed by the Organization of Resources Counsellors (ORC) to OSHA. Based on a ratio of the equilibrium vapour pressure (EVP) at 20 °C divided by the toxicity concentration.
- **Material Hazard Index (MHI):** Used by the state of California to determine threshold quantities of acutely hazardous materials for which risk management and prevention programs must be developed.
- **Dow Fire and Explosion Index (F&EI):** Evaluates fire and explosion hazards associated with discrete process units.
- **Mond Fire and Explosion Index:** Developed by ICI's Mond Division, an extension of the Dow F&EI.

The last two indexes focus on fire and explosion hazards, e.g. Butane has a Dow Material Index of 21, and Ammonia 4.

Did you know that...



...Sir Isaac Newton failed miserably running the family farm after being pulled out of school by his mother? Later she realized that he was not a farmer at all and she let him finish his education.

## Chapter 5.2.3 Fault tree analysis

### Definition fault tree:

Graphical representation of the logical structure displaying the relationship between an undesired potential event (called “top event”) and all its probable causes.

### Fault tree analysis is...

- a top-down approach to failure analysis
- starting with a potential undesirable event (top event)
- determining all the ways in which the top event can occur
- used so mitigation measures can be developed to minimize the probability of the undesired event

### Fault tree can help to...

- quantify probability of top event occurrence
- evaluate the architecture of a plan, strategy or system
- Assess design modifications and identify areas requiring attention
- Comply with qualitative and quantitative safety/reliability objectives
- qualitatively illustrate failure condition classification of a top-level event
- establish maintenance tasks and intervals from safety/reliability assessments

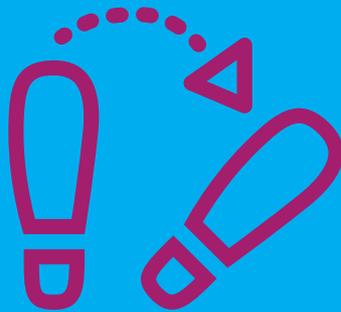
The fault tree follows a defined structure with defined symbols visualizing the different ways a top event can occur. You might add or develop own symbols according to your needs.

Figure 4.7: Symbols in fault tree analysis

Name	Look	Description
AND gate		To show that the output event occurs only if all the input events occur
OR gate		To show that the output event occurs only if one or more of the input events occurs
Basic event		A basic event requires no further development because the appropriate limit of resolution has been reached
Intermediate event		An intermediate event occurs because of one or more antecedent causes acting through logic gates
Transfer		A triangle indicates that the tree is developed further at the occurrence of the corresponding transfer symbol
Underdeveloped event		A diamond is used to define an event which is not further developed either because it is of insufficient consequence or because of insufficient information

Using this structure, you can already draw a fault tree. To make it as usable as possible, you should follow some additional guidelines:

Did you know that...

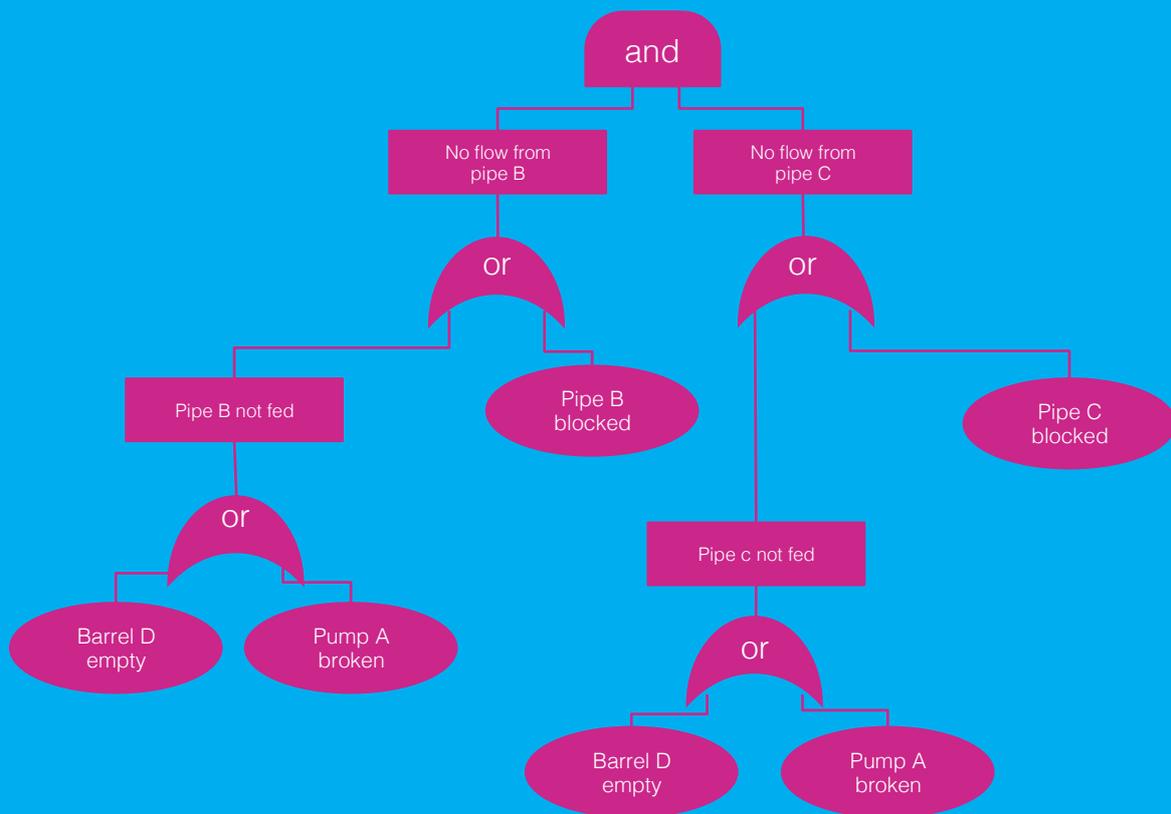


...Fred Astair has been judged as follows after his first screen tests:  
“Can’t sing. Can’t act. Slightly balding.  
Can dance a little.”

### Guidelines for fault trees:

- be as specific as possible
  - Replace abstract events by less abstract events
- use classifications
  - Classify an event into more elementary events
- identify distinct causes for an event
- couple trigger events with “no protective action”
- find co-operative causes for an event
- pinpoint a component failure event

Top event: No flow into barrel E



### Task 5.2 Fault tree

Think about an upcoming, complicated task you are facing.

1. Think about 3 possible top events and write them down below.

- Top event Nr. 1:

- Top event Nr. 2:

- Top event Nr. 3:

2. Develop a fault tree for all 3 top events on the following free pages.

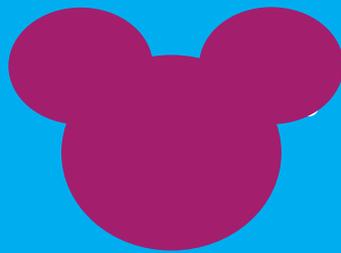
Did you know that...



...R.H. Macy failed with a couple of businesses before he started Macy's and became Americas No.1 retailer with about 800 stores?

Fault tree Nr. 1:

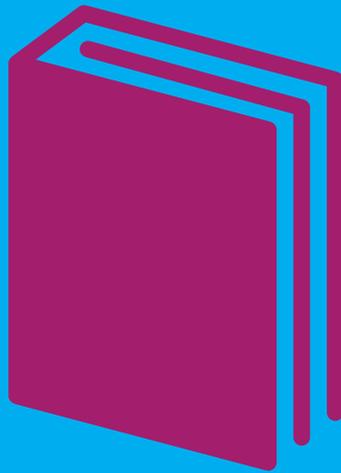
Did you know that...



...Walt Disney failed with several businesses and got fired by a newspaper because he lacked imagination and had no good ideas?

Fault tree Nr. 2:

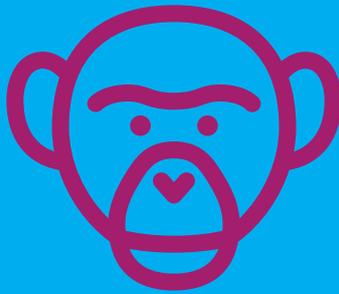
Did you know that...



...Stephen King threw away his entire draft of “Carrie”? His wife found it in the trash and the book later launched his career with now more than 350 Million books sold.

Fault tree Nr. 3:

Did you know that...



...Charles Darwin was considered an average student and dropped out of University to become a parson before he started to study nature and changed science with his discovery of evolution?

## Summary

The goal of this module was to understand the basics of risk management and different methods of hazard identification. This is important to not get surprised by risks during a task.

**Additional information, literature and resources can be found on our website and our Pearltrees-Account:**

 [www.valueoffailue.com](http://www.valueoffailue.com)

 [www.pearltrees.com/thevalueoffailure/](http://www.pearltrees.com/thevalueoffailure/)

# V Disclaimer

The Value of Failure Project has been funded with support from the European Commission. The author is solely responsible for this publication (communication) and the Commission accepts no responsibility for any use may be made of the information contained therein.



Erasmus+



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The Visonworks  
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