

SW2: Problem

Situation analysis

- Method to understand how different elements of an intricate scenario interact and influence one another over time
- Made for the mitigation of a project without implementations

Problem = Difference



Questions for problem solving:

- How is the actual state?
- What are the difficulties of the unused chances?

SW3: Delimitations

Actual state analysis.

- System delimitation
- System consideration (intervention + environ.)
- Strength/weakness analysis

System delimitation (1/2)

Intervention system - shows where interventions and modifications related the problem can be made

Surrounding system - all parts of the system outside the intervention system

Environment - the parts of the surrounding system relevant to the interventions assessed

Area of investigation - intervention system and environment together are the area of investigation

Area of solution - part of the intervention system that is used for the solution (determined when finding sol.)

Actual vs. desired state

- Situation evolution in short/mid/long time!
- Which are the opportunities and threats for the actual state?
- Is an urgent solution necessary?

ACTUAL
surveys and investigations

PROBLEM
difficulties, unused changes, opportunities

DESIRED
new regulations, technological advances, societal changes

ENVIRONMENTAL / economic and social constraints with diff. stakeholders with diff. desires

Central question for delimitate an intervention system:

- Where are the modification and interventions possible?
- Which are the degrees of freedom?
- Where is the system open for solutions?

Future analysis:

- Prognosis regarding environmental behaviour
- Effects on the uninfluenced system
- Recognizing opportunities + threats

Main questions regarding future developments:

- Which factors of a changing environment have an effect on the unchanged system?
- What trends in the environment should be considered?
 - (Technology, politics, competition, ecology, economy,...)
- What changes can be predicted that have an effect on the system?
- Which are the biggest uncertainties? Can these uncertainties be qualified?

Area of investigation:

Wider → high possibilities to find effective solutions to the problem

Examples:

Intervention:

- Prices of rare metals are high
- Recycling of metal from slag is introduced

Opportunity:

- Waste heat from incineration process is sold to utility
- Incentives to connect to district heating grid are high

SWOT

Strengths:

- Advantages
- Capabilities
- Resources

Weaknesses:

- Disadvantages
- Vulnerabilities
- Limits

Opportunities:

- Chances
- Developments
- Risks

5C analysis

- Company** (Investors, partnerships)
- Collaborators** (Investors, partnerships)
- Customers** (after project is based, need and want)
- Climate** (Environment, global/specific impact)
- Competitors** (Marketing strategies)

STEPS FOR HIERARCHY SYSTEM:

- A system (problem/solution) is structured in a rough manner by being a manageable set of elements and by dividing the relations that exist between them into more detailed elements.
- Dividing the system into sub-systems
- Dividing each sub-system into even smaller sub-systems in more detailed manner.
- Dividing each system into even smaller systems so that they can be operated independently in their own purpose. However, together these systems produce an additional/greater benefit.
- SYSTEM OF SYSTEMS (SoS): A system consisting of several individual systems - each single system is SoS if it has its own purpose and it is able to work independently.

DEFINITION: We take one element and we treat it as a system. If you know about more detailed elements that are connected to it, then we can call it a sub-system.

How will climate change impact the plant's operation as well as supply + demand?

Can excess energy be reasonably stored? Will there be excess?

Trends in desired form? Will heating become less of a priority?

Could another plant open? Are nearby plants likely to be disconnected soon?

Will waste production grow or decrease?

Will incentives change? Because more/less desirable?

How soon will the grid capacity be reached? Age of workforce/retirement?

New hires/cost of training?

SURROUNDING SYSTEM
all parts of the system outside the intervention system

ENVIRONMENT - parts of the surrounding system relevant to the intervention assessed

Ex: climate / nature
• Energy supply existing
• Energy demand (existing)
• heat/electricity/nearby indust.
• laws and regulations
• funding

• building conditions
• available waste-fuel
• transportation of waste

• incentives and subsidies
• nearby incineration plant -techs and other energy sources around

• sale of energy + its distribution
• socio-economic factors + customer preferences + attitudes (social/eco.)

INTERVENTION SYSTEM
Shows where interventions and modifications related to the problem can be made

AREA OF SOLUTION
Ex: new power plant/fix the old one!

Ex: additional heat and electricity supply options and capacity
+ improved flue gas purification

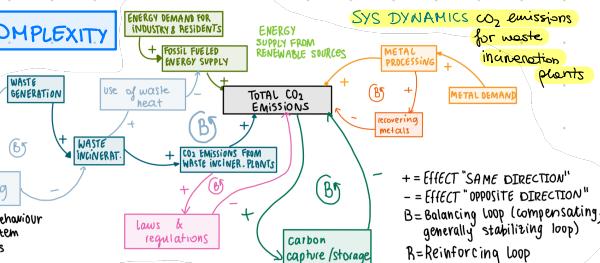
+ option refurbish vs rebuild

Can the operation be automated? What's the cost and how fast will it pay off?

Technologies - will there be more storage options in the future?

How is the population density changing?

many options for making changes select one for the solution



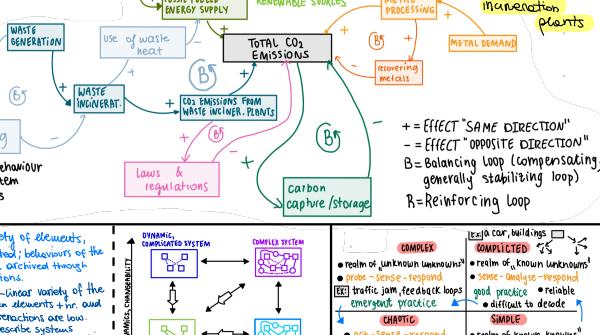
= EFFECT "SAME DIRECTION"

- EFFECT "OPPOSITE DIRECTION"

B= Balancing loop (compensating, generally stabilizing loop)

R= Reinforcing loop

SW7: Complexity



EX: car, buildings

COMPLEX

• prob. of unknown unknowns

• sense - analyse - respond

good practice → reliable

• difficult to decide

CHARTIC

• act - sense - respond

emergent practice

• realm of known knowns'

• sense - analyse - respond

best practice

SIMPLE

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

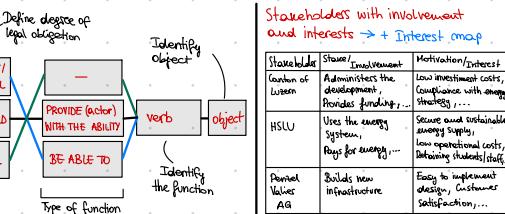
• sense - analyse - respond

good practice

• easy to decide

• realm of known knowns

SWG



Stakeholders with involvement and interests → Interest map

Stakeholder	Stakeholder's involvement	Motivation/interest
Canton of Lucerne	Administrator of development, Provides funding,...	low investment costs, compliance with energy strategy,...
HSLU	Uses the energy system, pays for energy,...	Secure and reliable energy supply, low operational costs, defining students/staff...
Private Values AG	Builds new infrastructure	Easy to implement, customer satisfaction,...
Municipality of Horw	-	Show consideration, benefits of the new energy system, meet their needs, conduct on area of interest,...

Engagement strategies

Stakeholder	Engagement strategies
Canton of Lucerne	Participate in personal contact, involve in decision making, frequent update, consider their options, ask what they would do differently, show consideration,...
HSLU	Secure and reliable energy supply, low operational costs, defining students/staff...
Private Values AG	Show consideration, benefits of the new energy system, meet their needs, conduct on area of interest,...
Municipality of Horw	-

Verification techniques:
Did we build it right, in accordance to requirements?

Review of Design: shall consist of using approved records or evidence that unambiguously show that the requirement is met.

Analysis: shall consist of performing theoretical or empirical evaluation using techniques agreed with the customers

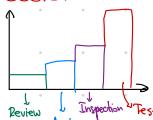
Inspection: shall consist of visual determination of physical characteristics.

Test: shall consist of measuring product performance and functions under representative simulated environments

- Test environment
Validation → did we built the right thing? = customer feedback

INCOSE

- Inspection:** visual/dim. examination (Swg, 12m, low, green)
- Analysis:** Analytical evidences, logic
- Demonstration:** Shows correct operation without physical ones.
- Tests:** Tested in real conditions
- Analogy:** based on previous experiences
- Simulation:** analysis sub-set based on mockups
- Sampling:** based on verification of characteristics based on samples

Costs:

REQ. NR.	REQ. TEXT	COMPLIANCE STATUS	COMPLIANCE COMMENT	VERIFICATION METHOD	VERIFCAT. IN DOC	VERIFICATION STATUS
FUNCTIONAL REQUIREMENT						
SYS-FUN-001	The Locarb-OT shall collect garbage deposited in its container and compact it along side of Swar and sound.	C		X X X	TBD	OPEN
SYS-FUN-002	The Locarb-OT shall compact the garbage in its container in order to minimize the overall truck length (and by that minimize energy consumption)	C		X X X X	TBD	OPEN

Evaluation matrix

Concept Criteria	0	△	□	◇	★
A	+	-	+	-	+
B	-	++	+	-	S
C	+	--	-	+	-
D	++	+	+	-	S
$\Sigma +$	4	3	3	1	1
$\Sigma -$	1	3	1	3	1
ΣS	-	--	-	-	2

Functional structure

Energy connection
Physical connection
Mass flow
Information flow