Co-funded by the
Erasmus+ Programme
of the European Union

Project management

Part 2

Prof. Dr. sc. Ing. Nadezhda Kunicina
Nadezda.Kunicina@rtu.lv
Dr. sc. Ing. Anatolijs Zabasta
Anatolijs.Zabasta@rtu.lv

Riga Technical University

Co-funded by the Erasmus+ Programme of the European Union

“IMPROVEMENT OF MASTER-LEVEL EDUCATION IN THE FIELD OF PHYSICAL SCIENCES IN BELARUSIAN UNIVERSITIES” ERASMUS+ PROJECT “PHYSICS” 561525-EPP-1-2015-1-LV-EPPKA2-CBHE-JP – ERASMUS+ CBHE

Teachers training event

Riga Technical University

12/1, Azenes Street Riga, Latvia

February 5th – 9th, 2018

Co-funded by the Erasmus+ programme of the European Union

Co-funded by the
Erasmus+ Programme
of the European Union

The human mind is the source of all works of art and inventions

Anatolijs Zabasta,
Dr.sc.ing., MBA, leading researcher
Faculty of Power and Electrical Engineering,
Institute of Industrial Electronics and Electrical Engineering,
12/1 Azenes Str., office 503, Riga, Latvia,
Contacts: +371-29232872
anatolijs.zabasta@rtu.lv

Nadezhda Kunicina,
professor, Dr.sc.ing., leading researcher
Faculty of Power and Electrical Engineering,
Institute of Industrial Electronics and Electrical Engineering,
1, Kalku Str., office 218, Riga, Latvia,
Contacts: +371-26162662
nadezda.kunicina@rtu.lv

Program

Co-funded by the
Erasmus+ Programme
of the European Union

- **1st**: Introduction to the project management
- **2nd**: Idea generation
- **3rd** : New product development
- **4th**: PM methods. Projects selection and evaluation. Launch of product

Introduction

Co-funded by the Erasmus+ Programme of the European Union

- Riga Technical University (RTU) is placed in the group of universities ranked 201–250 in one of the world's leading university rankings – Times Higher Education (THE) BRICS & Emerging Economies University Rankings 2017 TOP 300. Development of structured education courts in innovation up-taking by university students is a challenge for nearest future.

Introduction

Co-funded by the
Erasmus+ Programme
of the European Union

- RTU is a research institution, with high rate of applied researches, but now the students and in particular students from electrical engineering are involved in the innovation based education only on master and PhD stages, there is no reliable system for undergraduates, and more actually for engineers to realize of his idea in the University.

Introduction

Co-funded by the
Erasmus+ Programme
of the European Union

- Scientific institutes at the Riga Technical University are the basis for the development of both financial and human resources. And it is very important to ensure the sustainability of the educational process and the scientific environment precisely in institutions and, in particular, in the Institute of Industrial Electronics and Electrical Engineering.

Introduction

Co-funded by the Erasmus+ Programme of the European Union

- Education for Sustainable Development (ESD) is about enabling us to constructively and creatively address present and future global challenges and create more sustainable and resilient societies.
- UNESCO has been recognized globally as the lead agency for ESD. It coordinates the implementation of the Global Action Programme (GAP) on ESD, as official follow-up to the United Nations Decade of ESD (2005-2014).

Introduction

Co-funded by the Erasmus+ Programme of the European Union

- For example, it is concluded in, that the proportion of theoretical and practical training for master level students is recommended from 1/3 to 2/3 – the number of hours for laboratory/practical training must exceed the number of lectures at least by 30 %. Measures will require systematic changes in the approach to the teaching process of master students. It is required to go from the “lectures” way of training to a more balanced approach involving both practical and theoretical training of master students.

Training approach

Co-funded by the
Erasmus+ Programme
of the European Union

- The study of the problem of positive motivation in educational activity is carried out in indissoluble connection with their formation. Pedagogical practice shows that in this case it is advisable to adhere to a certain algorithm, which includes several relatively independent, but mandatory organizational and pedagogical actions.

Training approach

Co-funded by the
Erasmus+ Programme
of the European Union

- The use of Project Based Learning (PBL) method is one of the most important methodological issues for acquisition of transferable skills by the students of electrical engineering branch. The PBL approach in RTU is extremely important, for developing innovations and technical progress in Latvia.

Training approach

Co-funded by the
Erasmus+ Programme
of the European Union

- PBL in general provides complex tasks derived from challenging questions or problems that involve the students in problem solving, decision making, investigative activities, and reflection that include teacher facilitation, but not direction.
- PBL is focused on the questions that drive students to encounter the central concepts and principles of a subject hands-on.

Training approach

Co-funded by the
Erasmus+ Programme
of the European Union

- Cognitive skills via PBL is associated with increased capability on the part of students for applying those learning's in novel, problem-solving contexts. PBL approach supports students learning and practicing skills in problem solving, communication, self-management, it encourages the development of habits of mind associated with lifelong learning, civic responsibility, and personal or career success.

Training approach

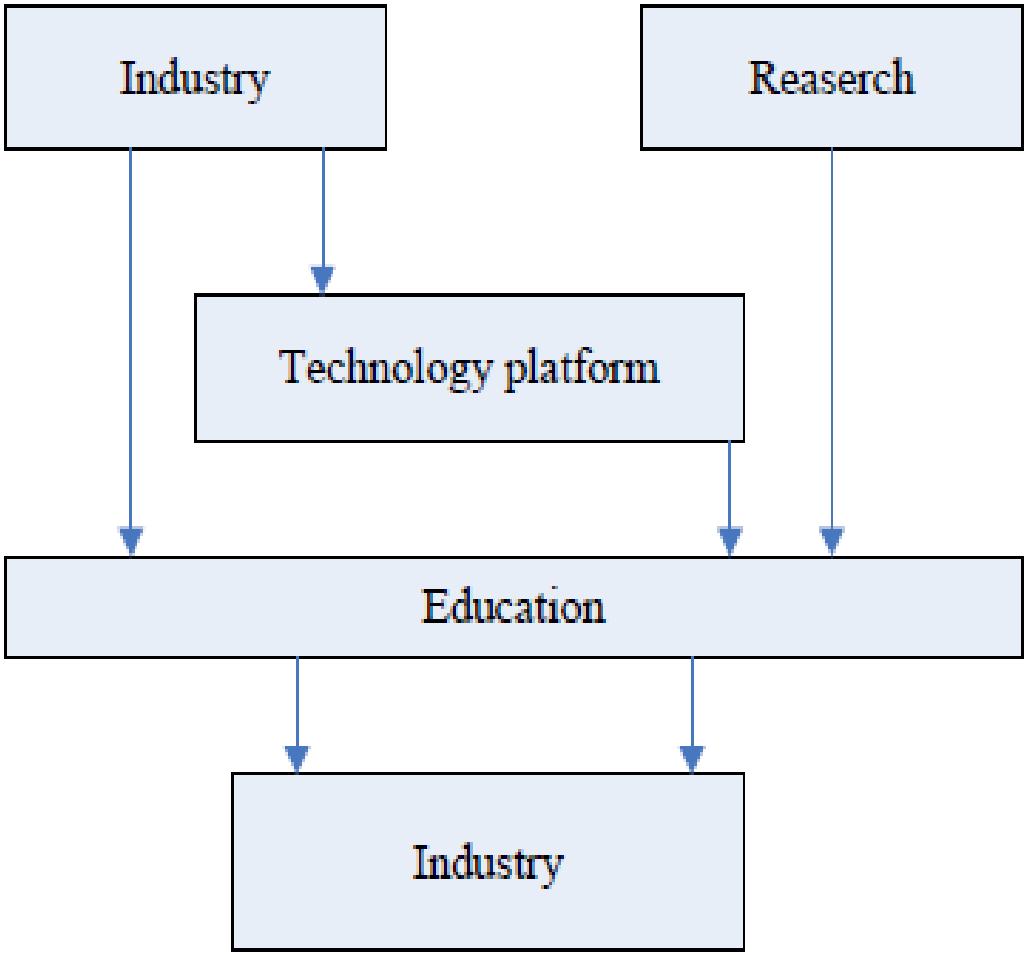
Co-funded by the
Erasmus+ Programme
of the European Union

- Application of PBL in RTU encouraged creation positive communication and collaborative relationships among diverse groups of students, because it met the needs of learners with varying skill levels and learning styles. However the main problem of introducing PBL in RTU is changing the thinking way of academic staff and students.

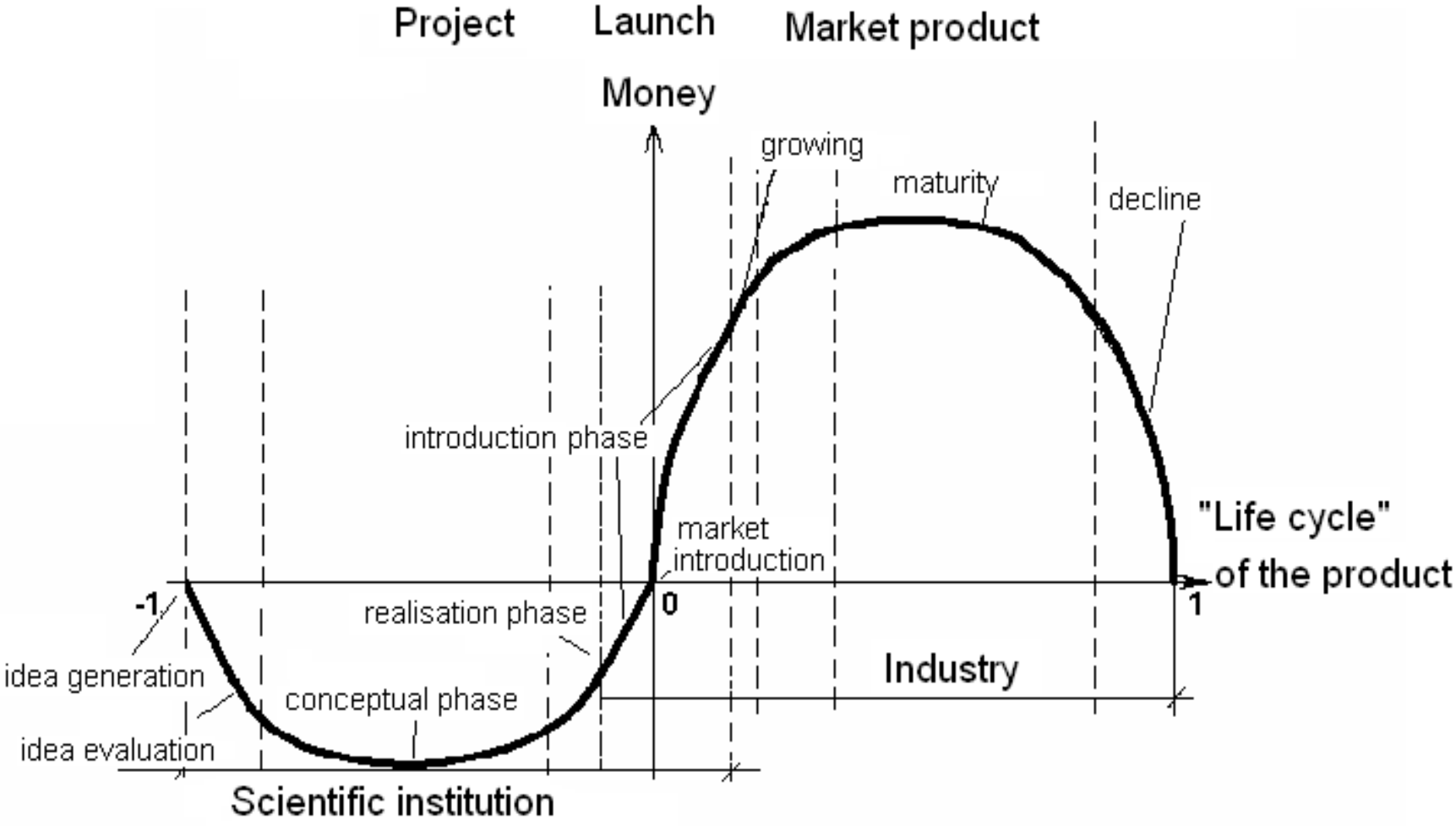
Training approach

Co-funded by the Erasmus+ Programme of the European Union

- The most advanced students could be authorized to independently manage a project team. Therefore student step by step moves forward starting from the projects to commercialisation of own developments



Co-funded by the
Erasmus+ Programme
of the European Union



Program

Co-funded by the Erasmus+ Programme of the European Union

- **1st**: Introduction to the project management
- **2nd**: Idea generation
- **3rd** : New product development
- **4th**: PM methods. Projects selection and evaluation. Launch of product

Home reading

Co-funded by the
Erasmus+ Programme
of the European Union

Product Design and Development

Irwin McGraw-Hill

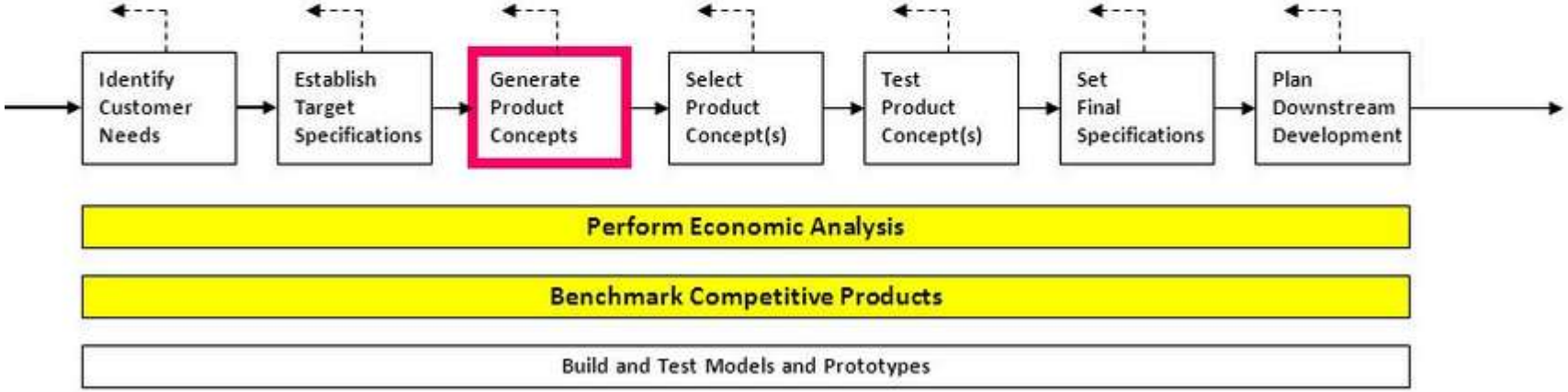
Product Design and Development
Irwin McGraw-Hill

Co-funded by the Erasmus+ Programme of the European Union

1. Introduction
2. Development processes and organizations
3. Product Planning
4. Identification of customer needs
5. Product specification
6. Creating a Concept
7. Concept selection
8. Concept development
9. Product architecture
10. Industrial design
11. Production plan
12. Sample design
13. Goods development economics
14. Project management

Co-funded by the
Erasmus+ Programme
of the European Union

The concept development process



Need finding

Co-funded by the
Erasmus+ Programme
of the European Union

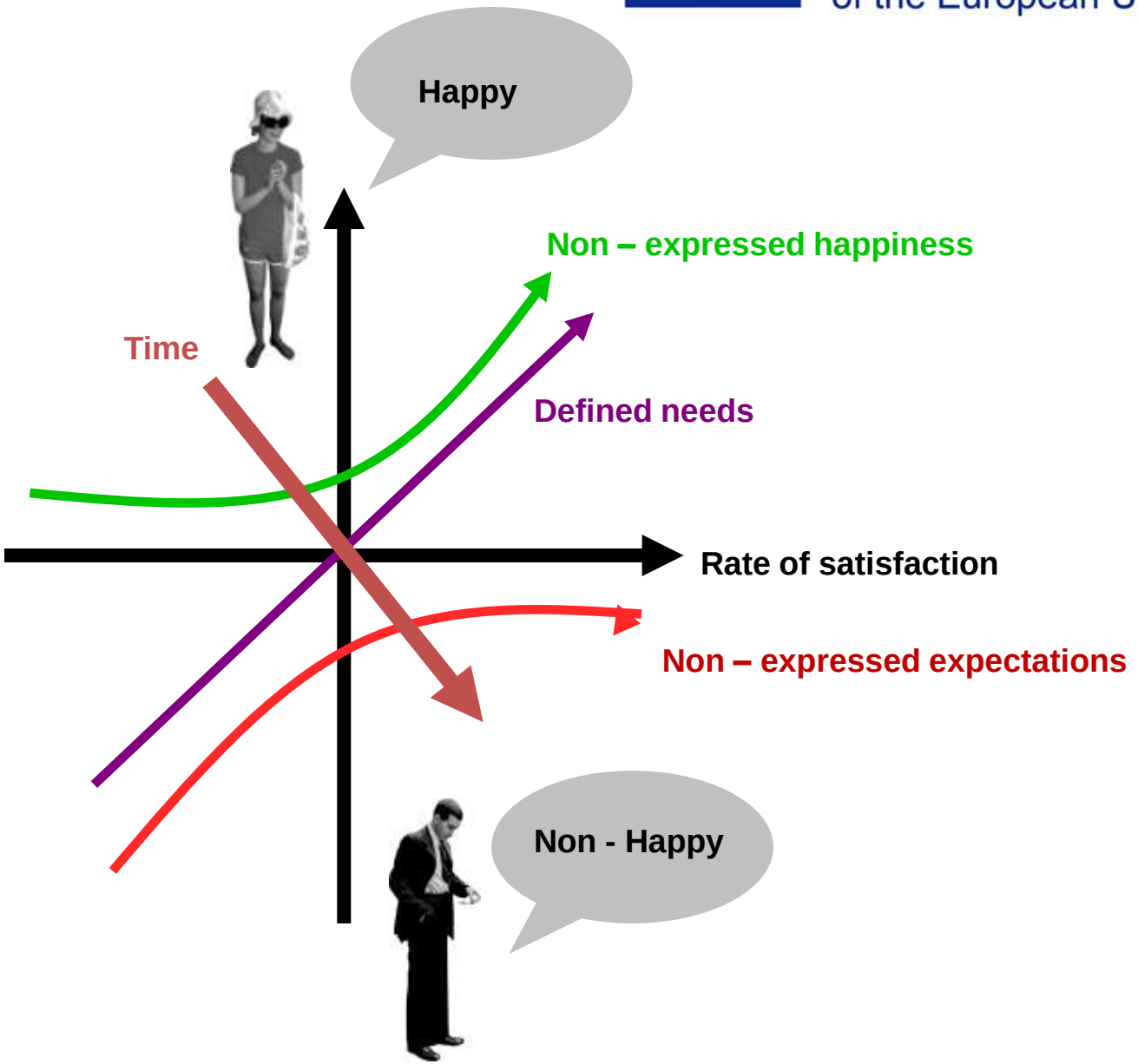
- The most important thing about need finding in design thinking is that we look without knowing what we are looking for. We trust that our ability to define the problem will emerge during the need finding process.

MAIN PRINCIPLES

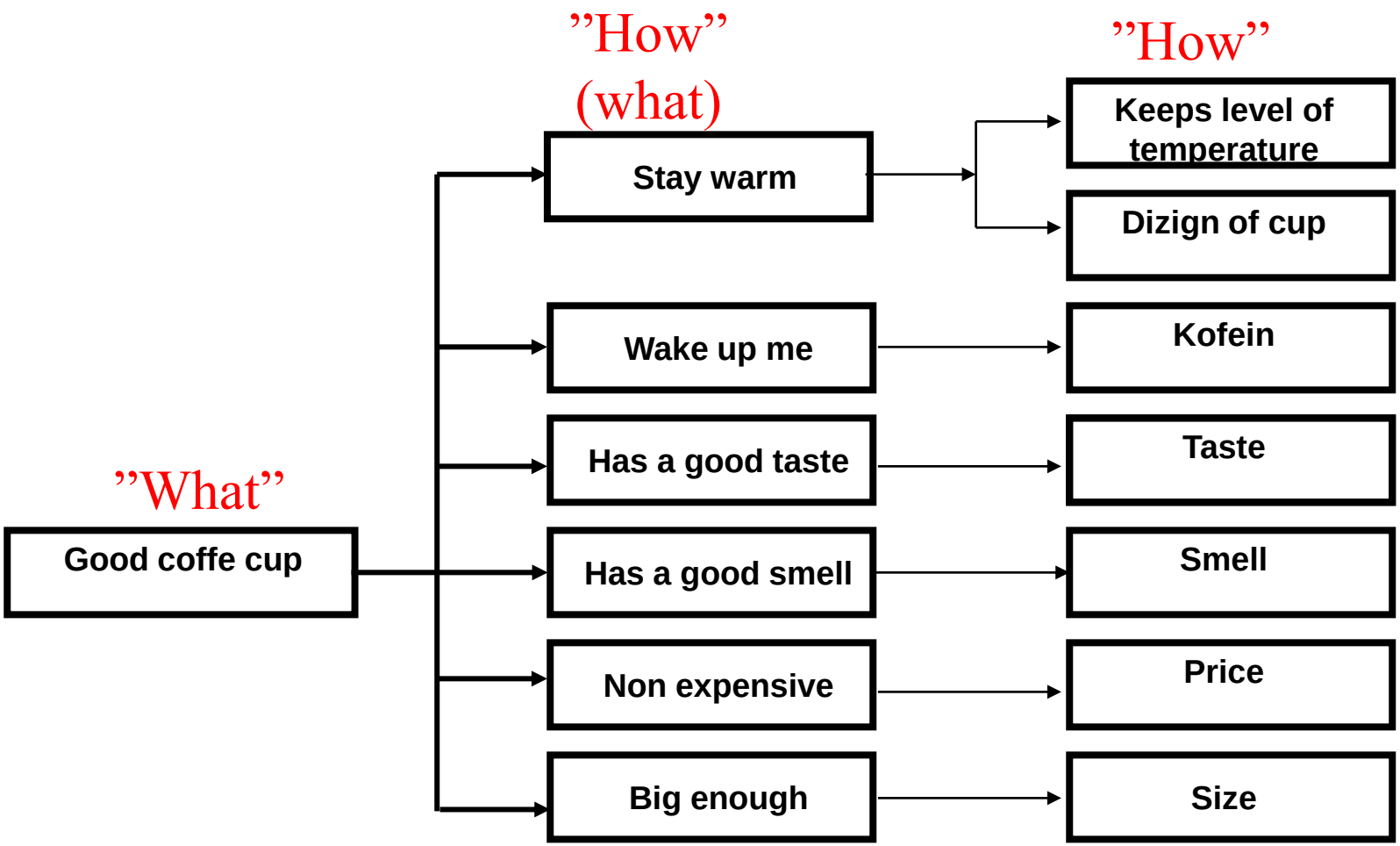
- Human Centered Design (Look to users for design inspiration.)

KANO MODEL

Co-funded by the
Erasmus+ Programme
of the European Union



Co-funded by the
Erasmus+ Programme
of the European Union



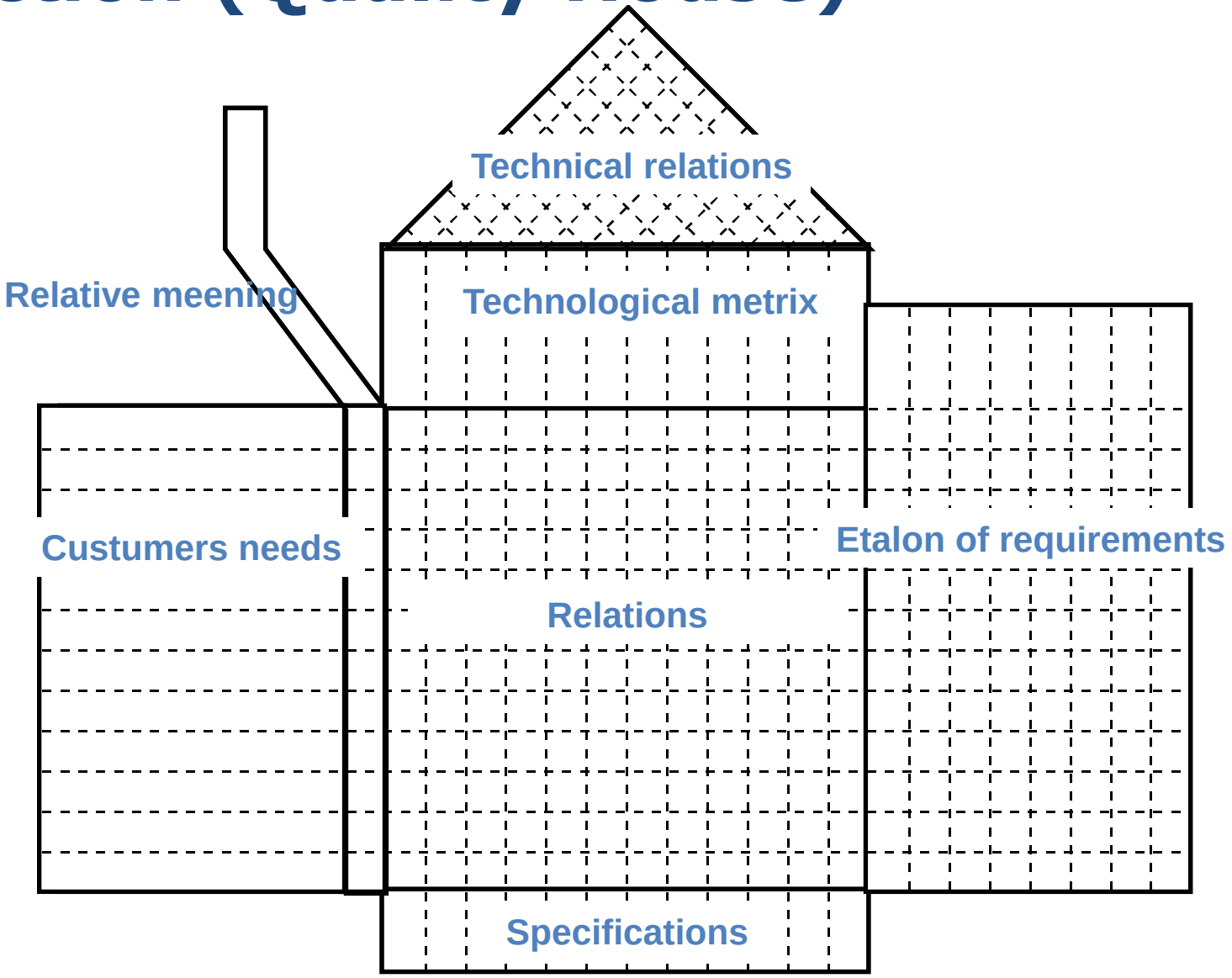
Co-funded by the
Erasmus+ Programme
of the European Union

Product development specification

- Develop planned specifications
  Based on customer needs and competing products
  For each need to develop a metric
  Identify the ideal and acceptable values of values
- Improve specifications
  Based on the chosen concept and feasibility study
  Technical modeling
  Going out is critical
- Consider the results and process
  Critical for continuous improvement

Expansion of Quality Function (Quality House)

Co-funded by the Erasmus+ Programme of the European Union



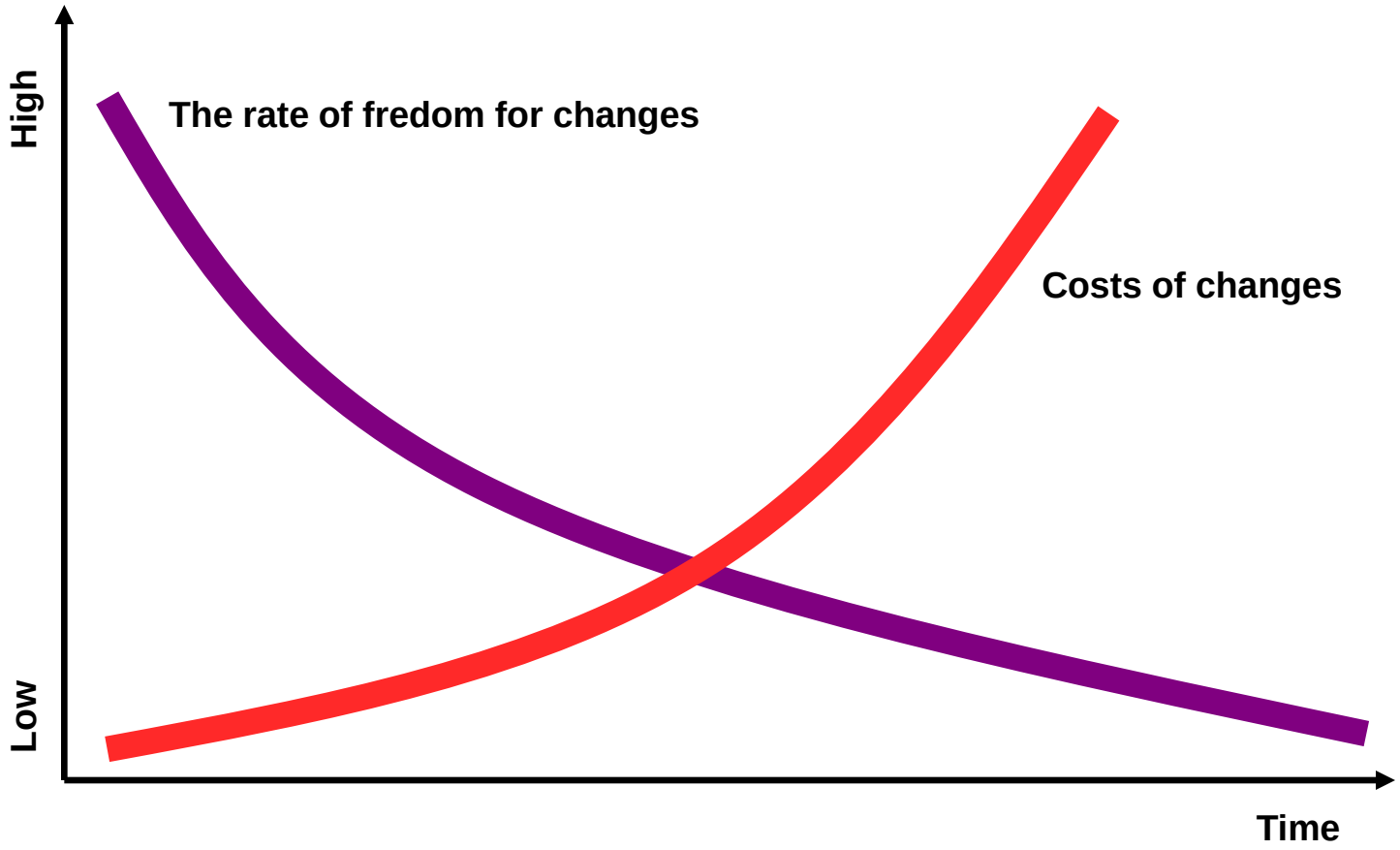
«World-class concept» development

Co-funded by the Erasmus+ Programme of the European Union

- World-class products have winning concepts and robust design
- A mistake that is corrected when a product is on the market costs 10,000 times more than the concept development phase.
- Engineers (product creators) often make mistakes because they have made too many conclusions

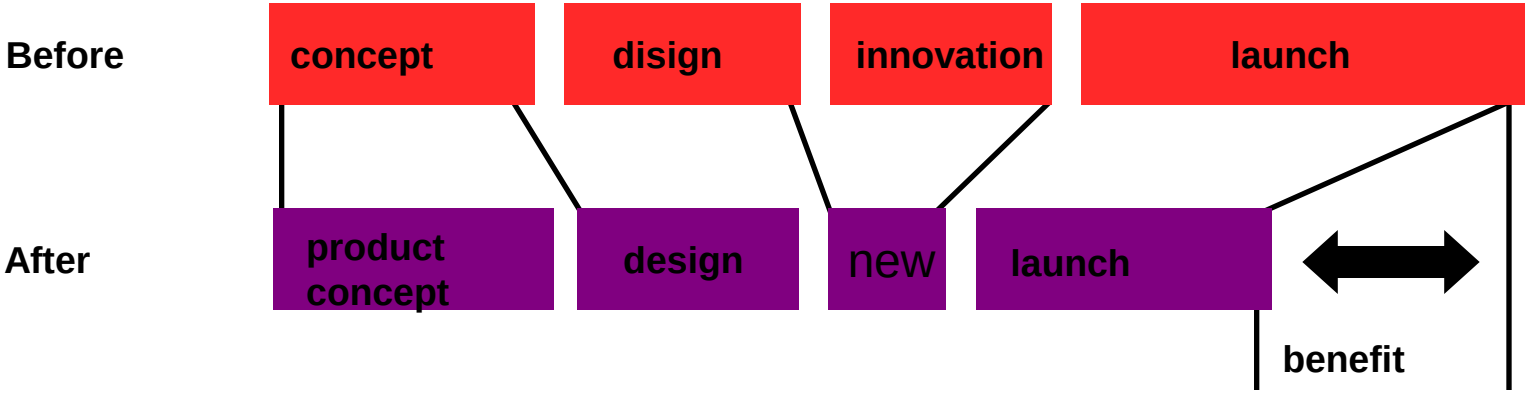
Concept phase

Co-funded by the
Erasmus+ Programme
of the European Union

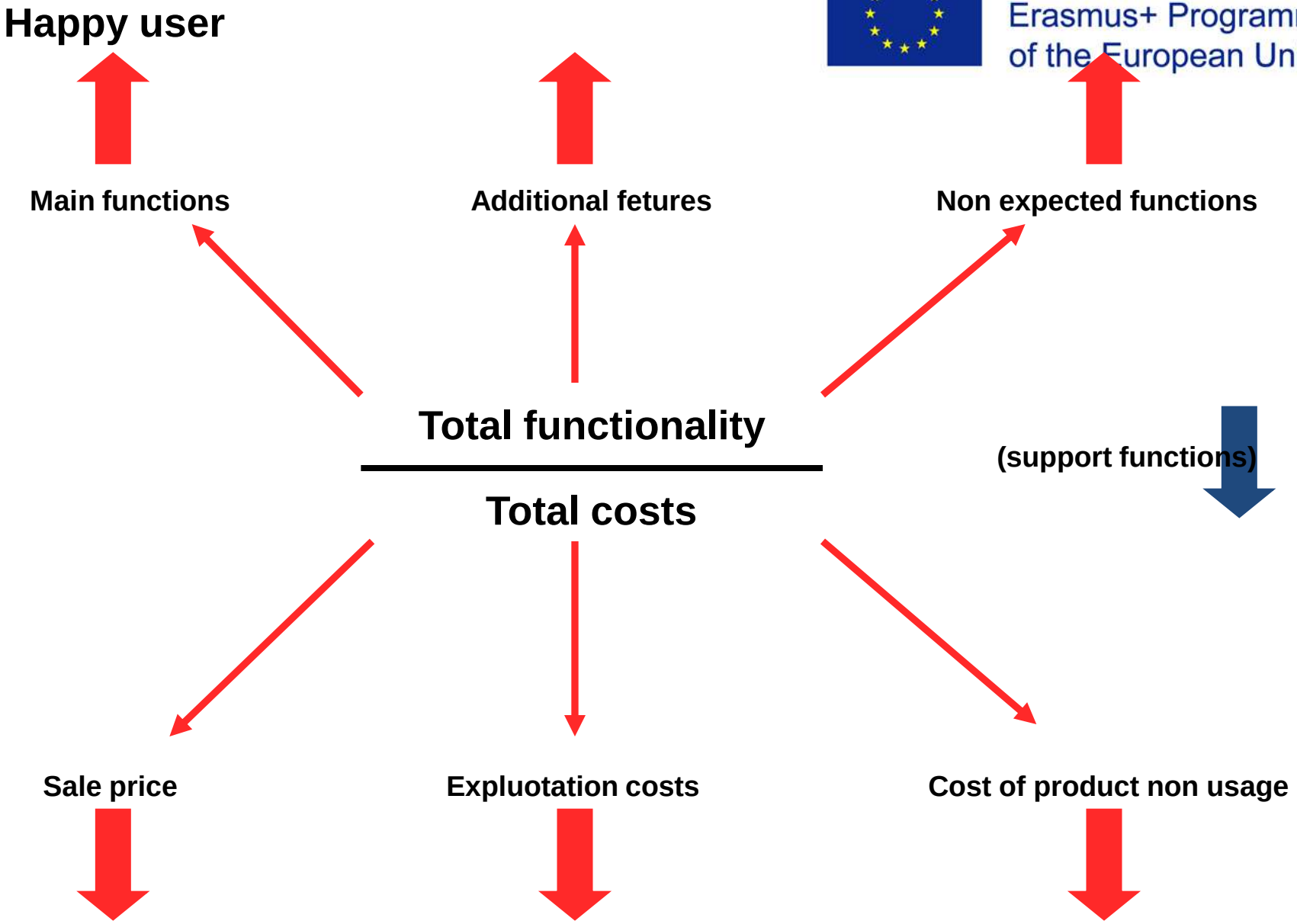


Concept phase

Co-funded by the
Erasmus+ Programme
of the European Union



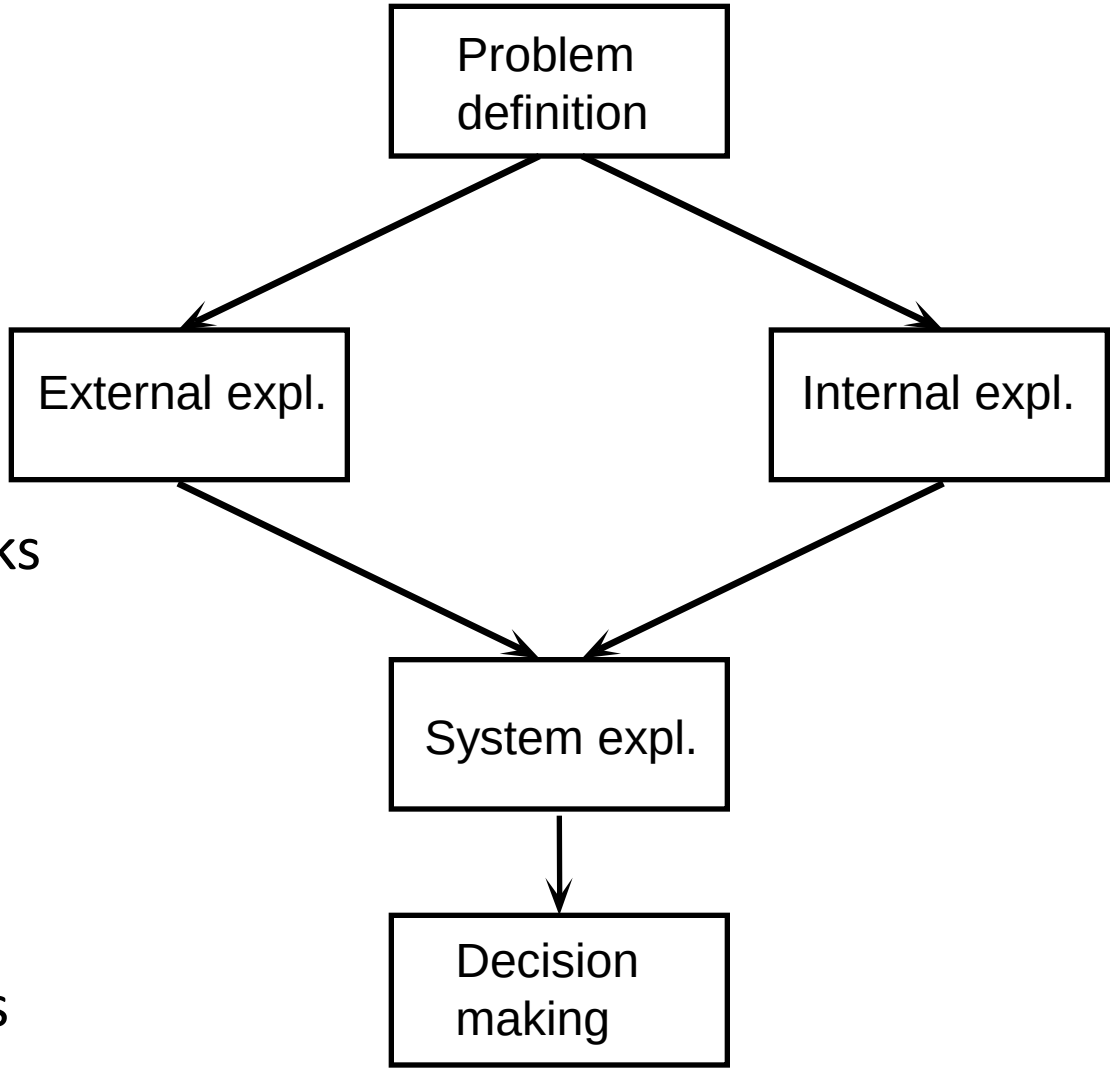
Co-funded by the
Erasmus+ Programme
of the European Union



Conception creation process

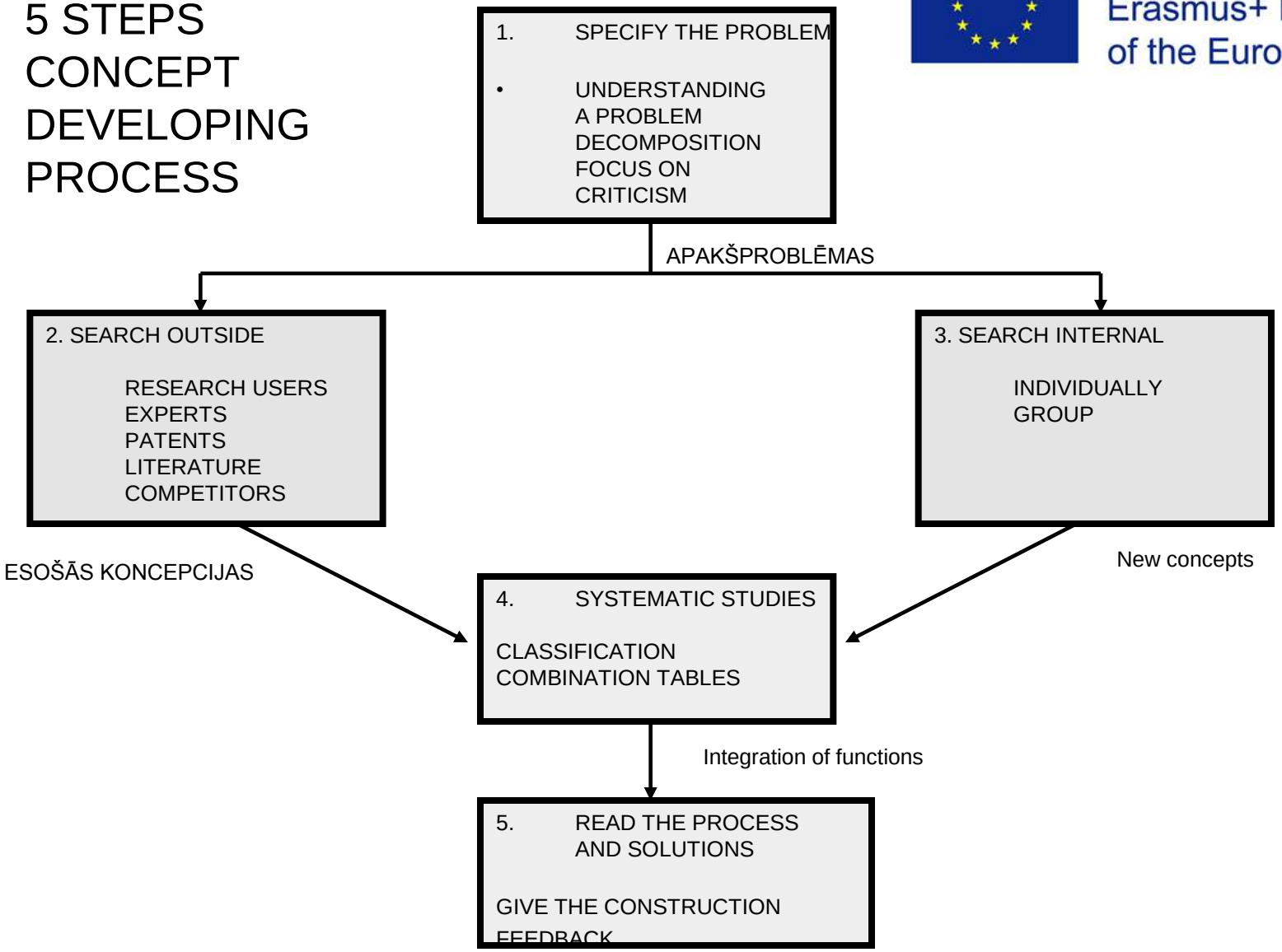
Co-funded by the Erasmus+ Programme of the European Union

Find out the problem
Task decomposition
External study
The main users
Experts
Patent
Literature
Comparison with benchmarks
Internal study
Individual methods
Group methods
Systematic research
Classification tree
Combination table
Consideration of the process
Continuous refinement



5 STEPS CONCEPT DEVELOPING PROCESS

Co-funded by the Erasmus+ Programme of the European Union



State of the art – SWOT analysis

Co-funded by the Erasmus+ Programme of the European Union

	Strengths	Weaknesses
Opportunities	(SO)	(WO)
Threats	(ST)	(WT)

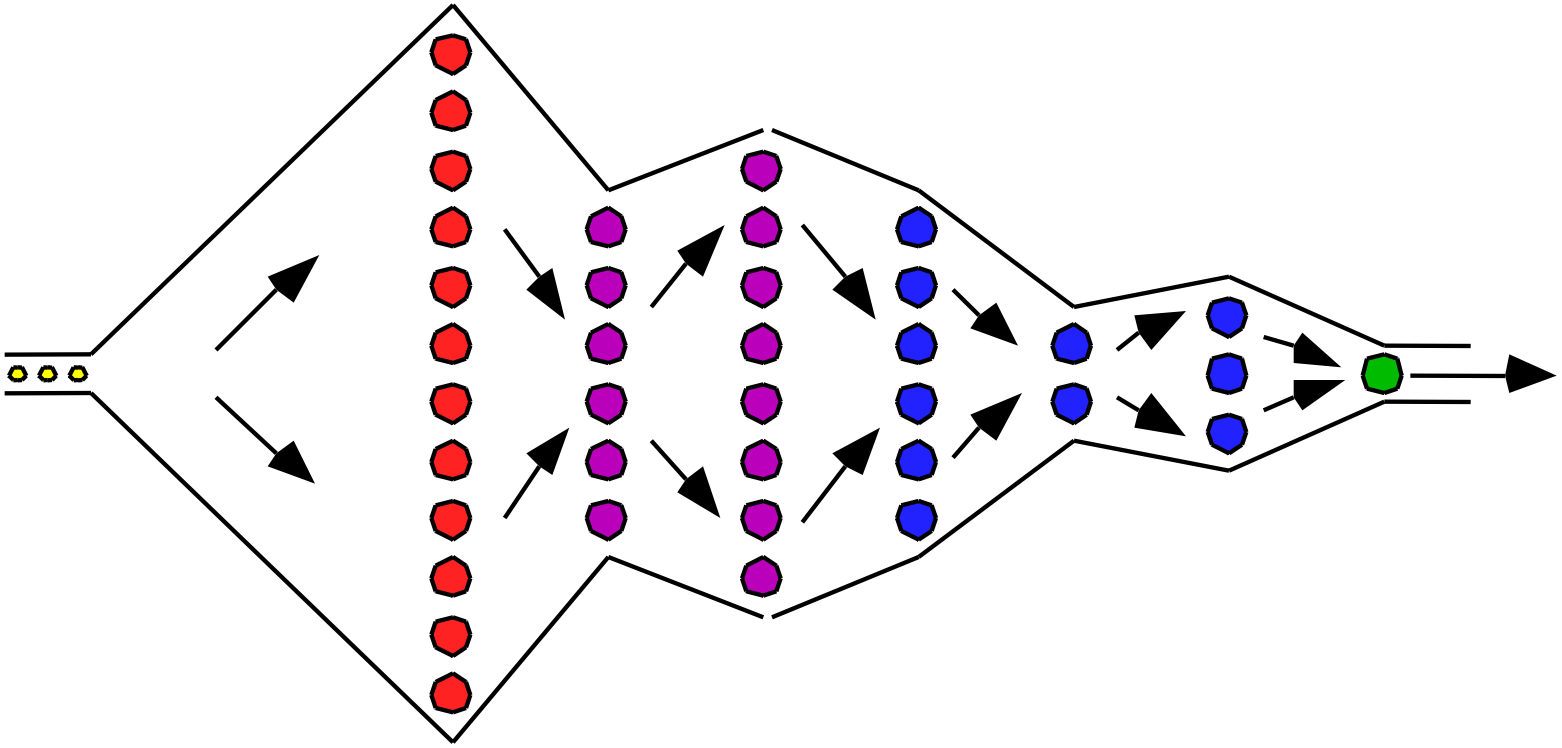
Strengths: characteristics of the business, or project team that give it an advantage over others
Weaknesses (or Limitations): are characteristics that place the team at a disadvantage relative to others
Opportunities: external chances to improve performance (e.g. make greater profits) in the environment
Threats: external elements in the environment that could cause trouble for the business or project

Co-funded by the
Erasmus+ Programme
of the European Union

Scope of the project
State of the art
Steps beyond state of the art

- Scope of the project limits the area of research;
- State of the are show, that project team is familiar with existing research results as well as with priorities in research topic;
- Steps beyond state of the art shows, that project team knows hove to achieve foreseen results within defined quality;

Conception evaluation process



Definnition of concept

Reviewing the concept

Evaluation of concept

Testing of the concept

TRIZ - ALTSHULLERS CONTRADICTION TABLE

Co-funded by the Erasmus+ Programme of the European Union

WHAT GETS DEGRADED (39 PARAMETERS)

WHAT YOU WANT TO IMPROVE (39 PARAMETERS)

	LENGTH OF AN OBJECT	SPEED	FORCE	STRESS	WEIGHT OF AN OBJECT	STRENGHT	TEMPARATURE	POWER	WASTE OF TIME	RELIABILITY	MEAS. ACCURACY	EASE OF MANUF.	COMPLEXITY
LENGTH OF AN OBJECT													
SPEED													
FORCE													
STRESS													
WEIGHT OF AN OBJECT													
STRENGHT													
TEMPARATURE													
POWER													
WASTE OF TIME													
RELIABILITY													
MEAS. ACCURACY													
EASE OF MANUF.													
COMPLEXITY													

INVENTIVE PRINCIPLES
(DERIVED FROM 40.000 INNOVATIVE PATENTS)

Co-funded by the
Erasmus+ Programme
of the European Union

SCRECH OF CONCEPT

ROBUSTS DISIGN	LOWlevel (TRIZ is not used)	HIGHlevel (TRIZ IR PIELIETOTS)
no	Trash	There is some problems ig superdesign
yes	Optimised trash	World class disign

- Fast,
- Low costs,
- Very reliable complete product development
- Low cost

Example: Conceptual evaluation

		Concepts							
		A (reference) Master Cylinder		**DF Lever Stop**		**E Swash Ring**		**G+ Dial Screw+**	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Ease of Handling	5%	**3**	0.15	3	0.15	4	0.2	4	0.2
Ease of Use	15%	**3**	0.45	4	0.6	4	0.6	3	0.45
Readability of Settings	10%	2	0.2	**3**	0.3	5	0.5	5	0.5
Dose Metering Accuracy	25%	**3**	0.75	3	0.75	2	0.5	3	0.75
Durability	15%	2	0.3	5	0.75	4	0.6	**3**	0.45
Ease of Manufacture	20%	**3**	0.6	3	0.6	2	0.4	2	0.4
Portability	10%	**3**	0.3	3	0.3	3	0.3	3	0.3
	Total Score	2.75		3.45		3.10		3.05	
	Rank	4		1		2		3	
	Continue?	No		Develop		No		No	

Co-funded by the
Erasmus+ Programme
of the European Union

Remember…

The purpose of the concept is not
Choose the best concept.

The purpose of the concept is to
Develop the best concept.

Therefore, remember to combine and improve
these concepts in order to develop better!

Alerts

Co-funded by the
Erasmus+ Programme
of the European Union

Find out the best "average" products.

- Choose a concept for each different customer group and compare the results.
- Compare the degree of choice with significance ratings and grades.
- At the final stage of the selection, you may want to use all the detailed requirements.
- Mark the qualities that can be applied to other concepts.

The purpose of the experiments developed

Co-funded by the Erasmus+ Programme of the European Union

- Modeling
  Understanding the relationship between design parameters and product performance
  Understanding the effects of disturbing factors
- Optimization
  Reduce product or process variations
  Optimization of nominal efficiency

Co-funded by the
Erasmus+ Programme
of the European Union

Approximate development

- A roughly developed product or process works correctly even under the influence of disturbance factors.

- Disturbing factors can be as follows:`

- parameter variations
- environmental changes
- operating conditions
- manufacturing process variations

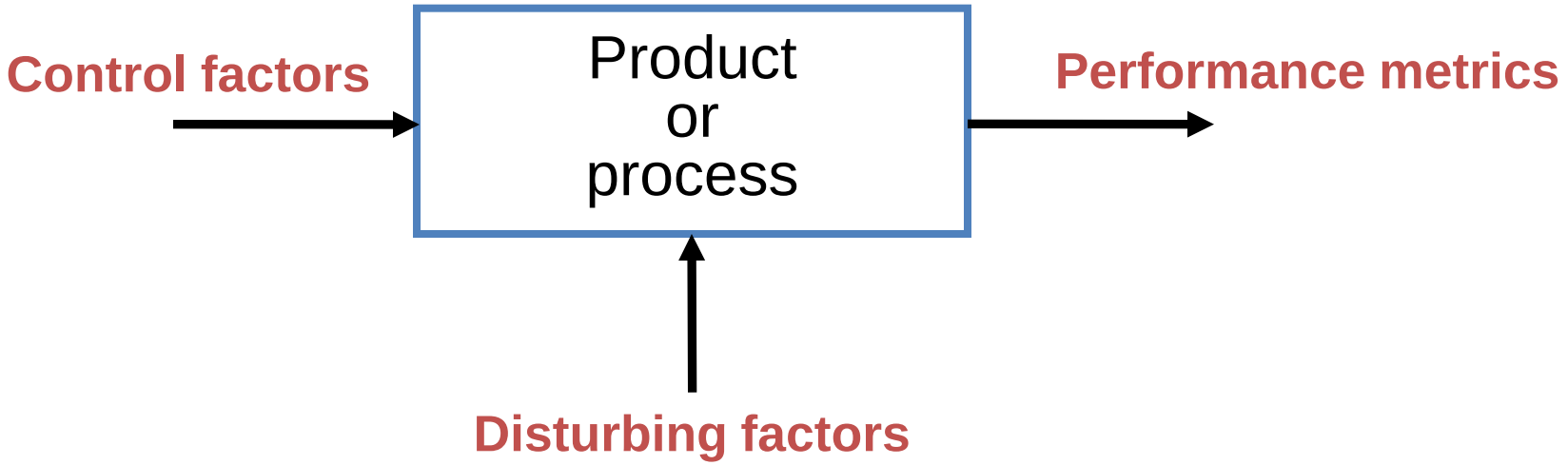
Imperical development procedure Step 1: Parameter Chart

Co-funded by the Erasmus+ Programme of the European Union

- Step 1: Choose the appropriate control mechanism, response, and experimentally investigate disturbing factors.
  - Control factors (input parameters)
  - Delusional factors (uncontrollable)
  - Performance Measurement (Response)

“P” diagramm

Co-funded by the
Erasmus+ Programme
of the European Union



Example of parametrs diagramm

Control factors

Strength of lumbar fabric
Lumbar fabric friction
Lumbar tightening force limiter
Upper support stiffness
Strength of the buckle
Front seat backrests under the head
Litter Friction
Attachment geometry

Passenger cars movements foreclosure the process

Disturbing factors

Rear seat shape
Seat cloth type
Collision shock degree
Component wear
Position of the passenger
Belt spacing
Passenger body parameters
Kind of cloth
Changes in the development of lumbar spine
Lock manufacturing variations

Performance metrics

Back angle
Seat slip
Bending bend
Projection of roads

Co-funded by the
Erasmus+ Programme
of the European Union

Imperical development procedure Step 2: Target function

Step 2: Define the target function (response) to optimize it.

increase the efficiency of the desired activity

reduce variations

target value

signal / interference ratio

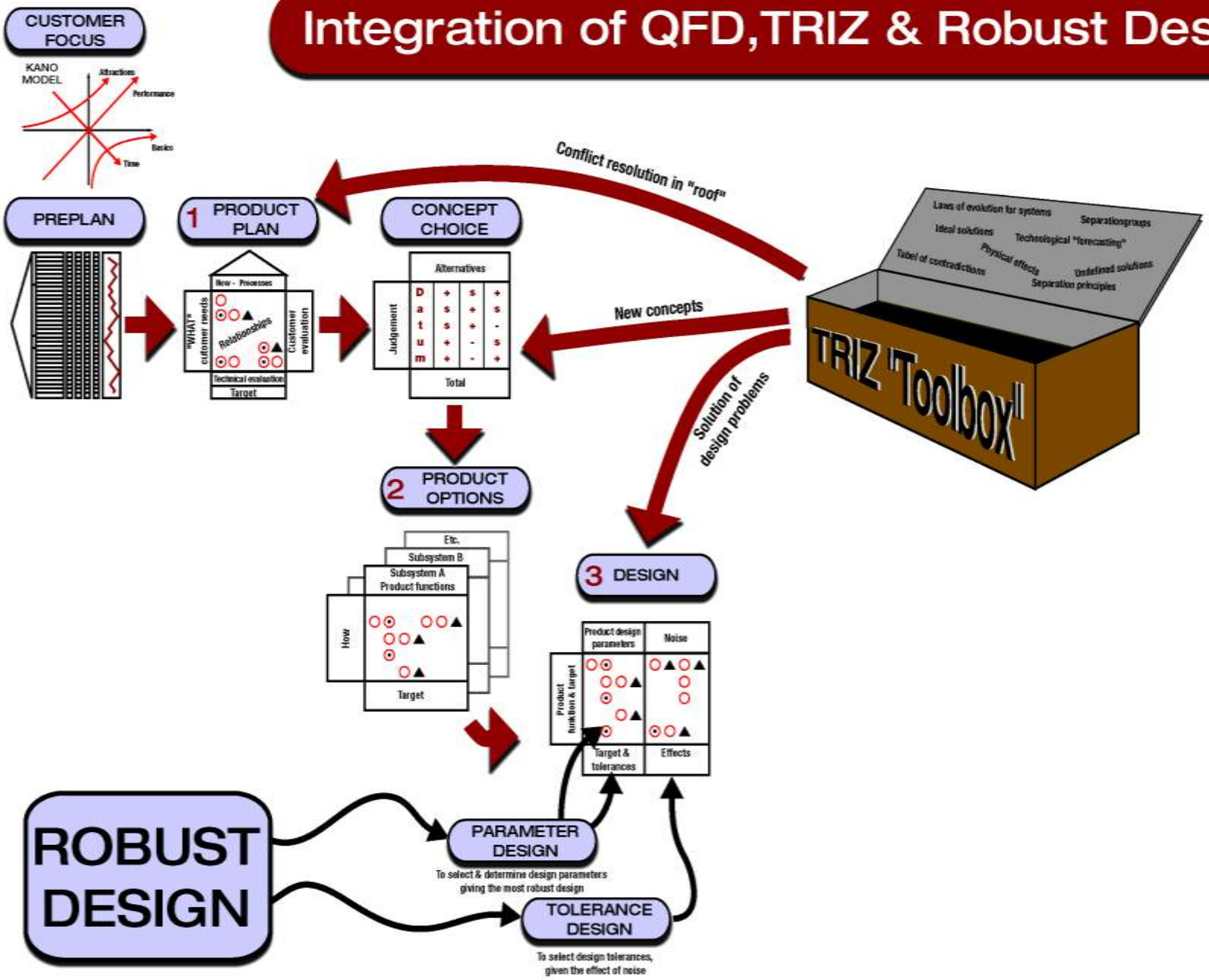
Imperical development procedure Step 3: Planning of experiment

Co-funded by the Erasmus+ Programme of the European Union

Step 3: Schedule experimental sessions to find out the desired effects.

- Use whole or partial factory design projects for interconnection.
- Use rectangular layouts to identify key effects with minimal number of trials.
- Use internal and external layout to view the effects of disturbing factors.

Integration of QFD,TRIZ & Robust Design



PASS team presents

Colour Smart Insole

Make your life better

Pavel Karpach, Andrei Buzhan, Aliaksandr Patapchyk, Aliaksandr Kravchenko

Co-funded by the
Erasmus+ Programme
of the European Union

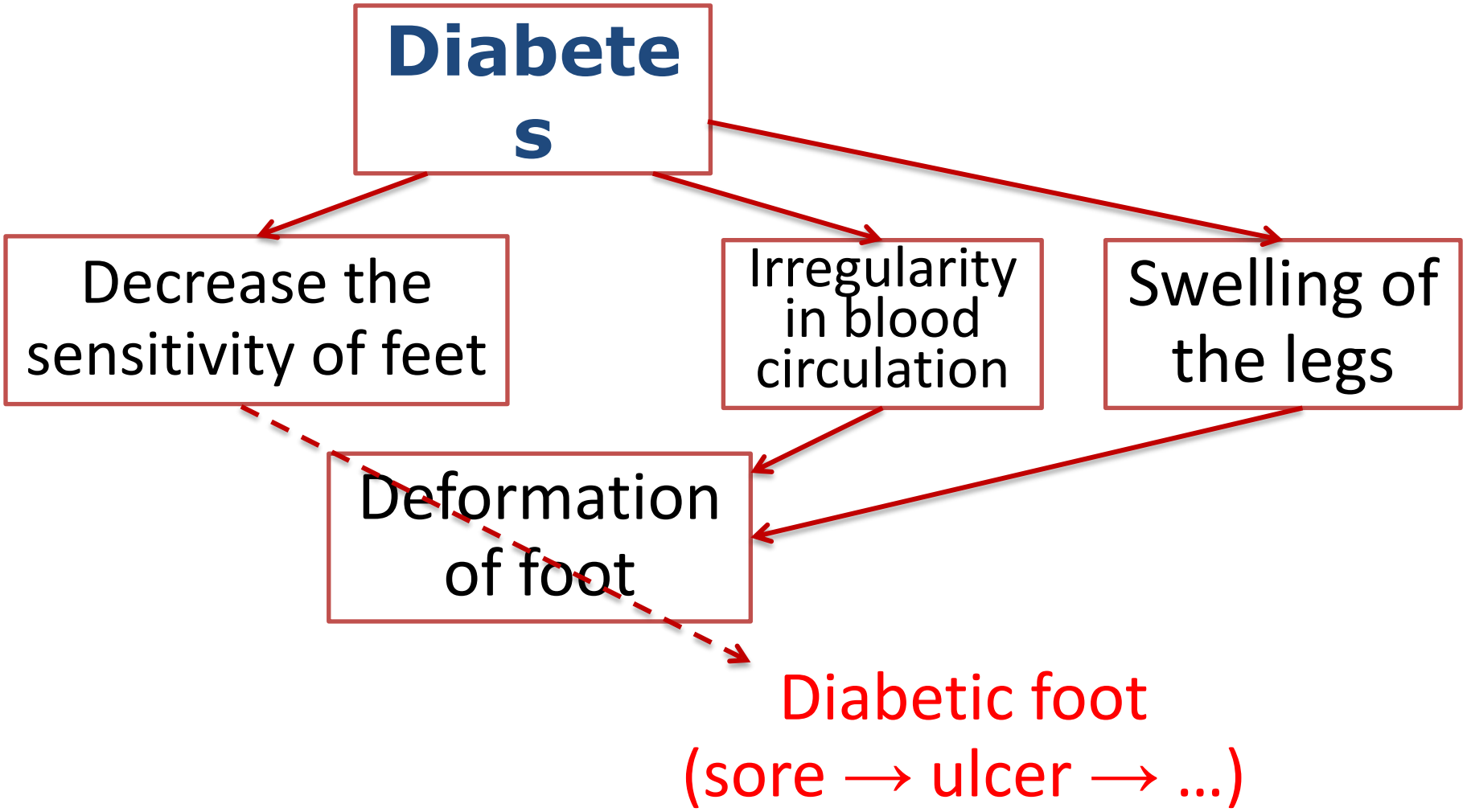
How are you feeling?

Co-funded by the
Erasmus+ Programme
of the European Union

Do you know, that

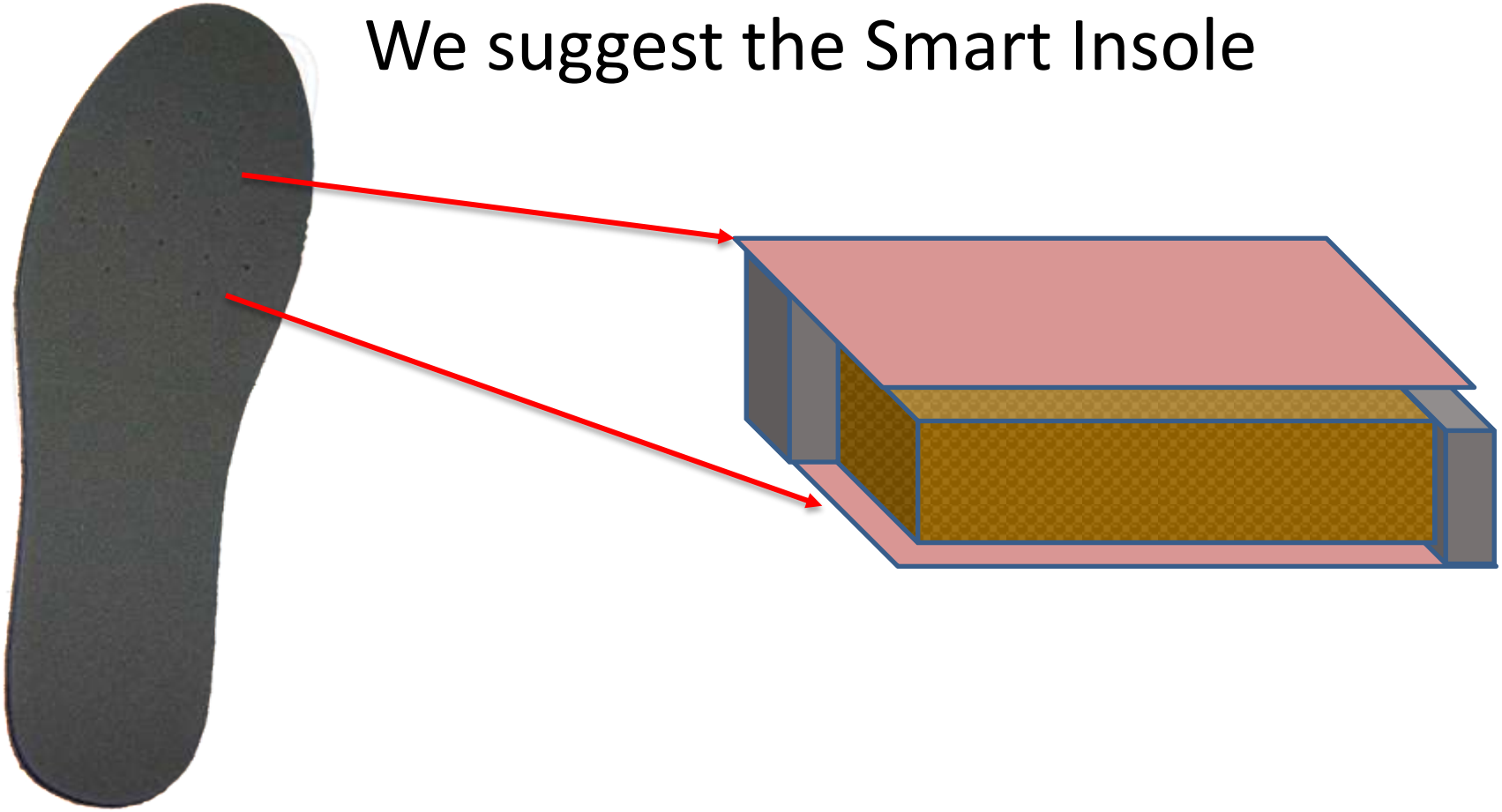
9% of the world’s population saffers from diabetes

Co-funded by the
Erasmus+ Programme
of the European Union



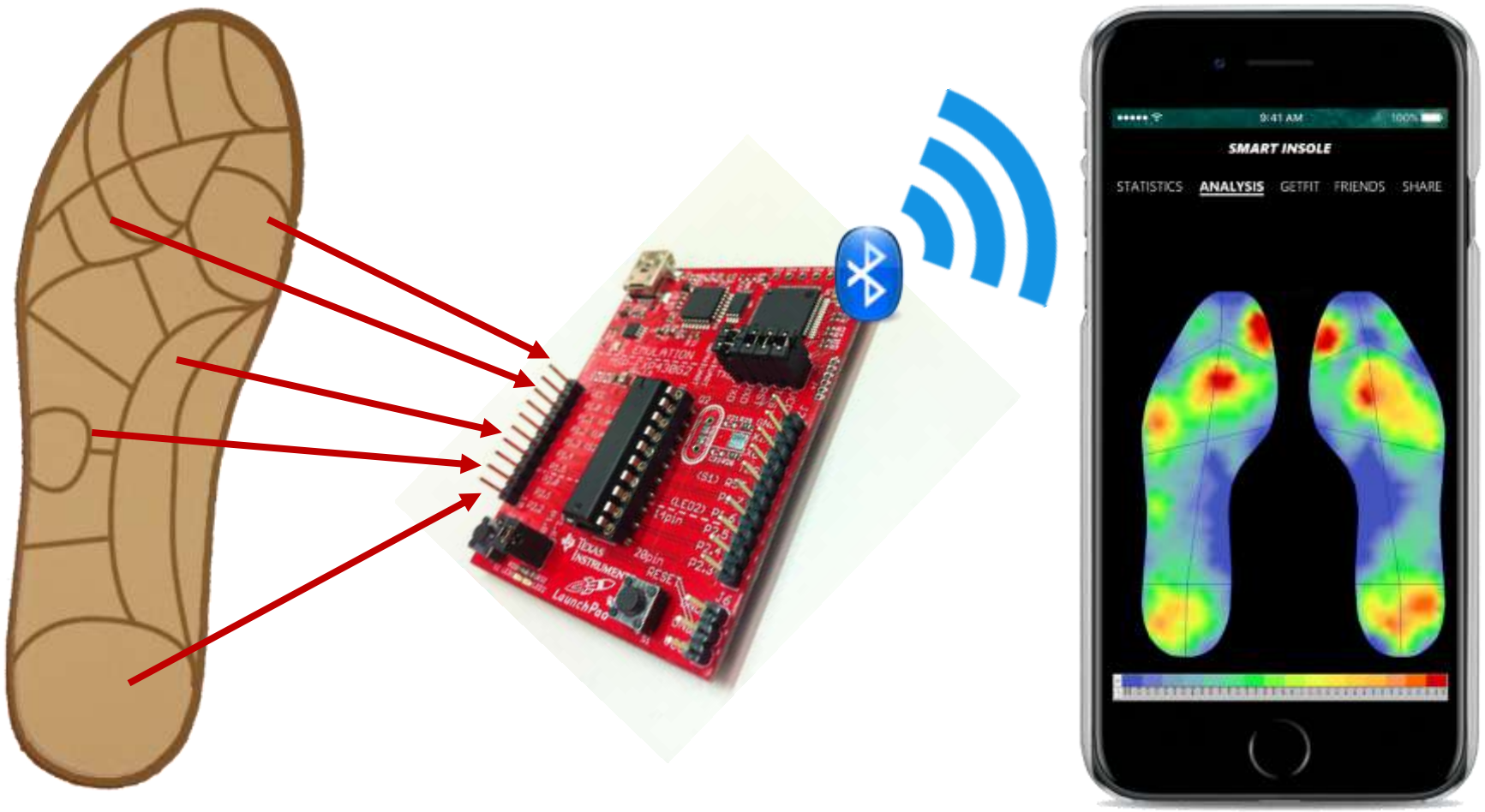
Co-funded by the
Erasmus+ Programme
of the European Union

We suggest the Smart Insole



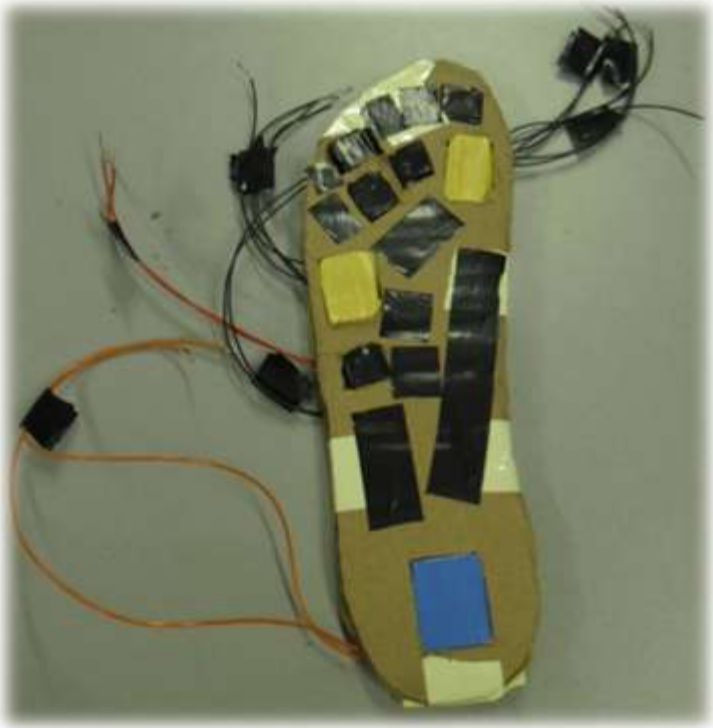
Co-funded by the
Erasmus+ Programme
of the European Union

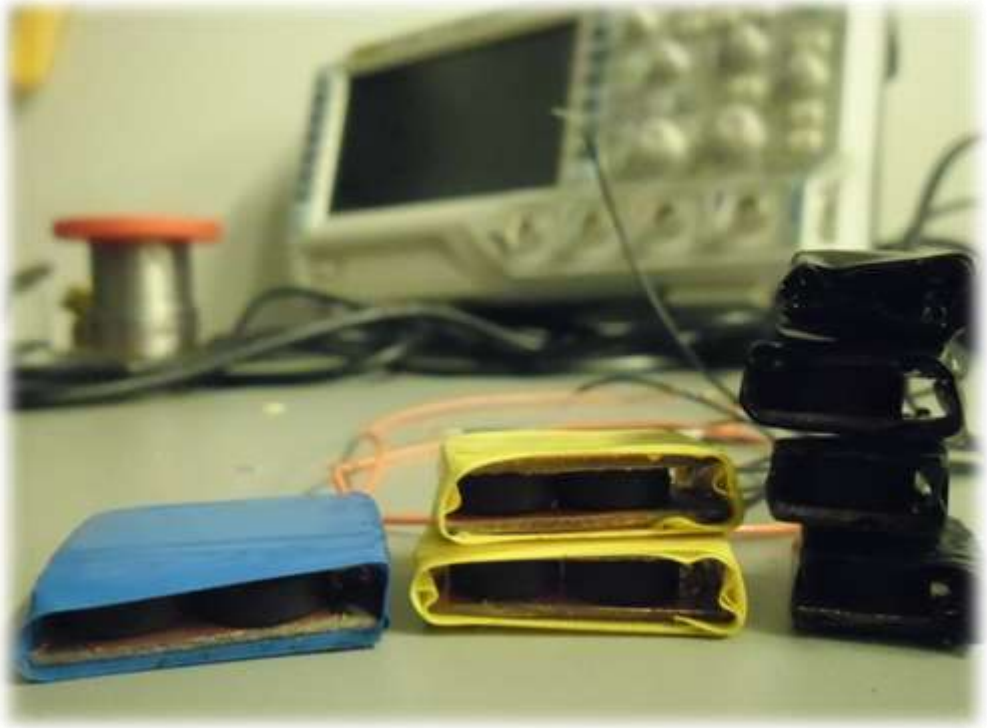
We suggest the Smart Insole



Device prototype

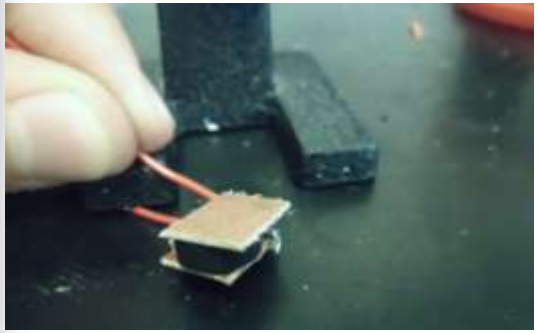
Co-funded by the
Erasmus+ Programme
of the European Union





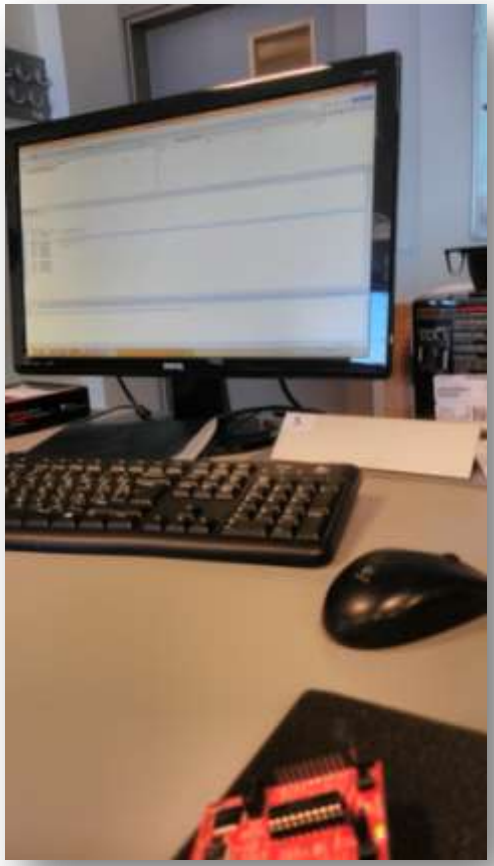
Co-funded by the
Erasmus+ Programme
of the European Union

How it's made?



Co-funded by the
Erasmus+ Programme
of the European Union

What’s next?



- More sensors
- More features
- Less cost

Co-funded by the
Erasmus+ Programme
of the European Union

Thank you for attention!

Using semiconductors for devices which regulate heat flows in closed spaces of spacecrafts

Project made by Belarusian State University,

Gomel State University

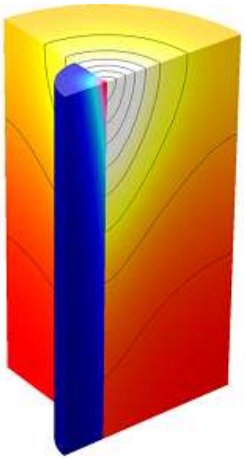
Halauchuk Victoryia
Pashkevich Aleksey
Pekarevich Uladislay
Talkachov Anton

Riga, 2017

Co-funded by the
Erasmus+ Programme
of the European Union

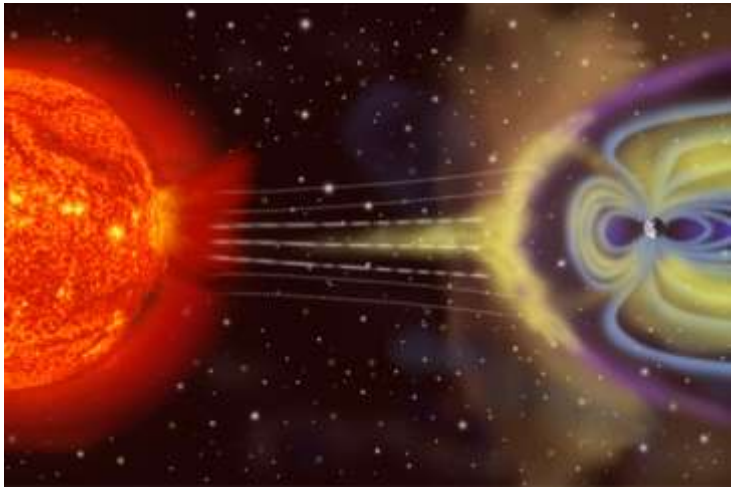
Challenges:

- **Electronic devices must operate at a certain range of temperatures**



- **Heterogeneous heating of spacecraft**

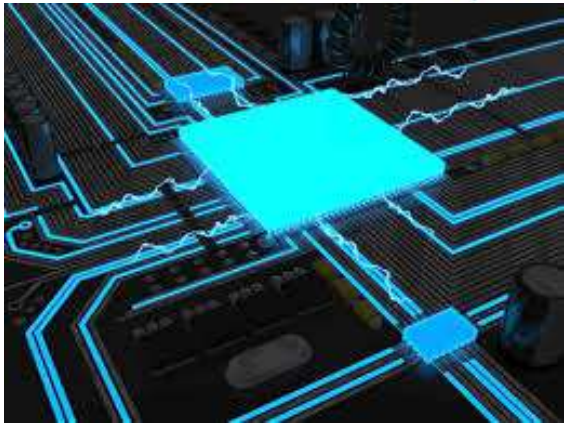
- **Electronic degradation under influence of cosmic radiation**



Co-funded by the
Erasmus+ Programme
of the European Union

Objectives

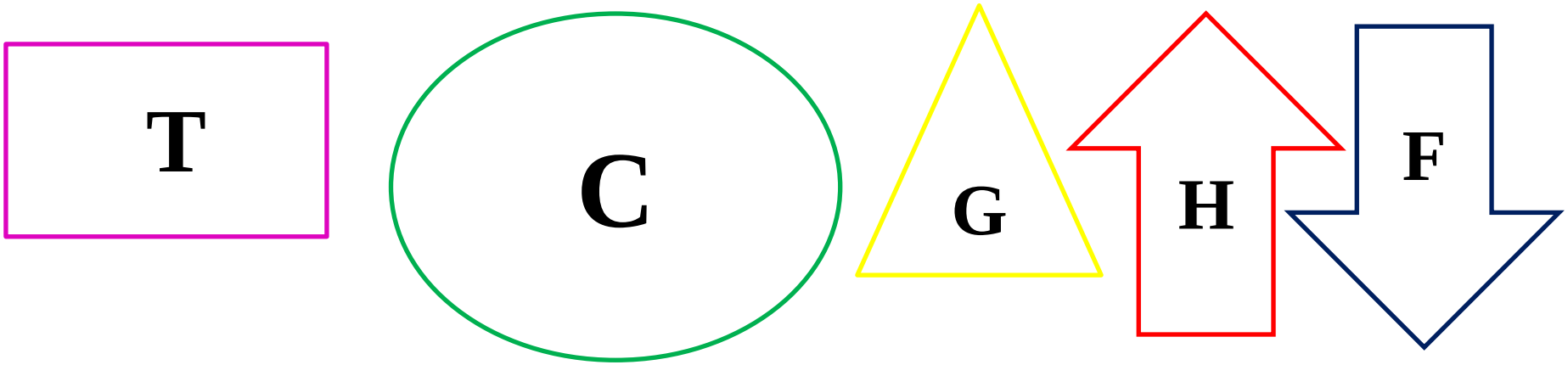
- **Create a system for regulating the thermal conditions of electronic devices**



- **Create a protection against cosmic radiation for our device**

Co-funded by the
Erasmus+ Programme
of the European Union

Main components of regulating system



T - temperature sensor; **C** — controller;

G - generator; **H** – heater; **F** – fridge.

Co-funded by the
Erasmus+ Programme
of the European Union

Temperature sensor

- choose from temperature range of the devices

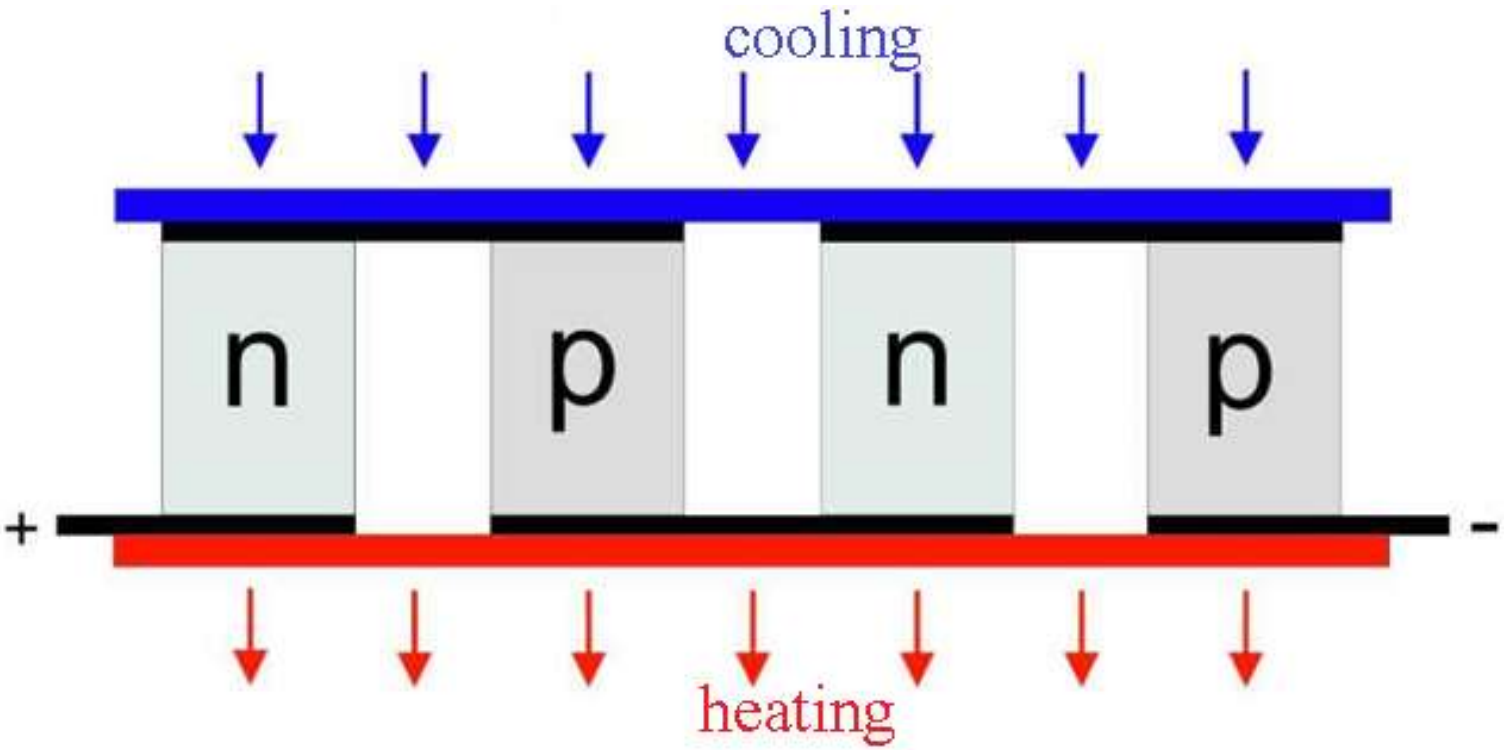
- resistant to space radiation (we plan to cover main elements with bismuth films and also use optocouplers to transfer information)

Heater and fridge

Co-funded by the Erasmus+ Programme of the European Union

- Heaters and coolers are based on the Peltier effect

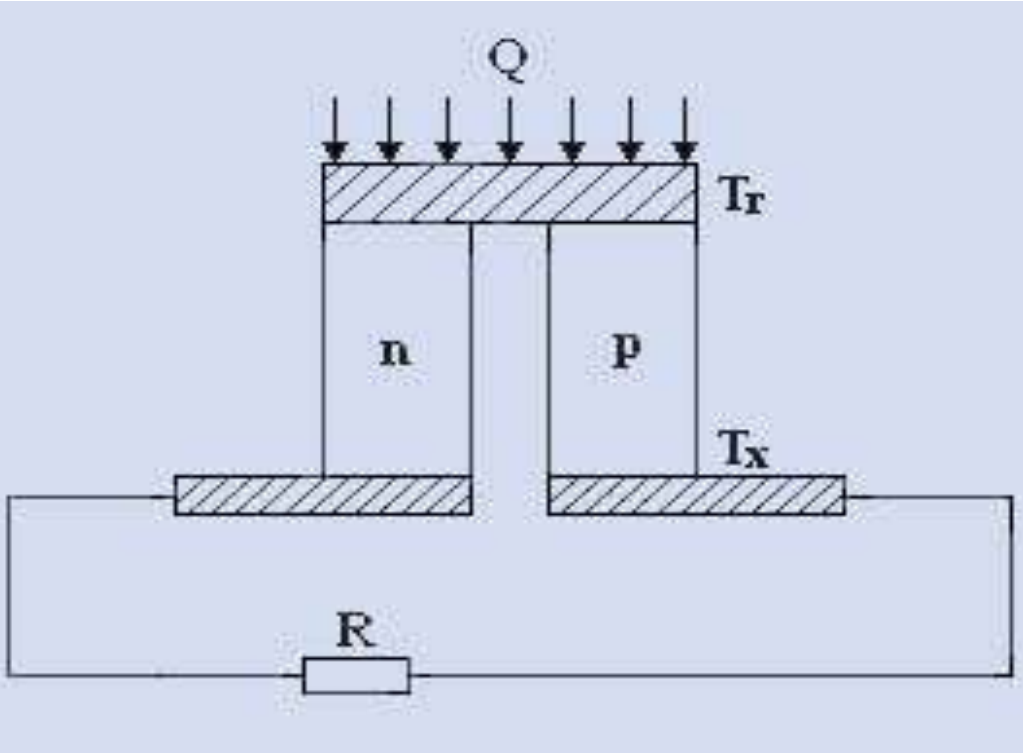
- The number of elements n-type and p-type semiconductors depends on the required voltage.

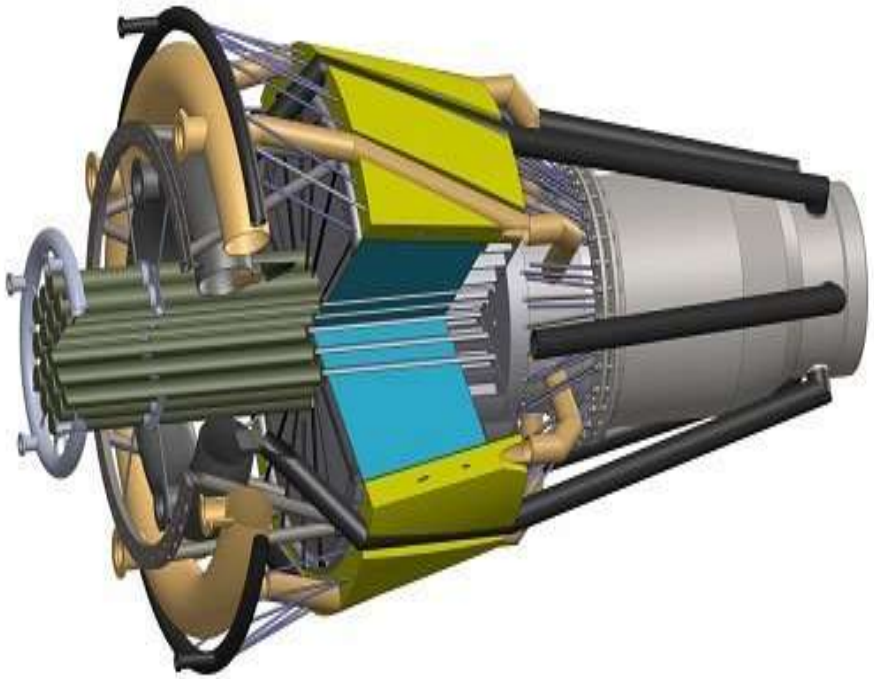


Thermoelectric generator

Co-funded by the Erasmus+ Programme of the European Union

TEG working on the basis of the Seebeck effect is necessary for converting the heat received from the action of solar radiation and the operation of a nuclear reactor

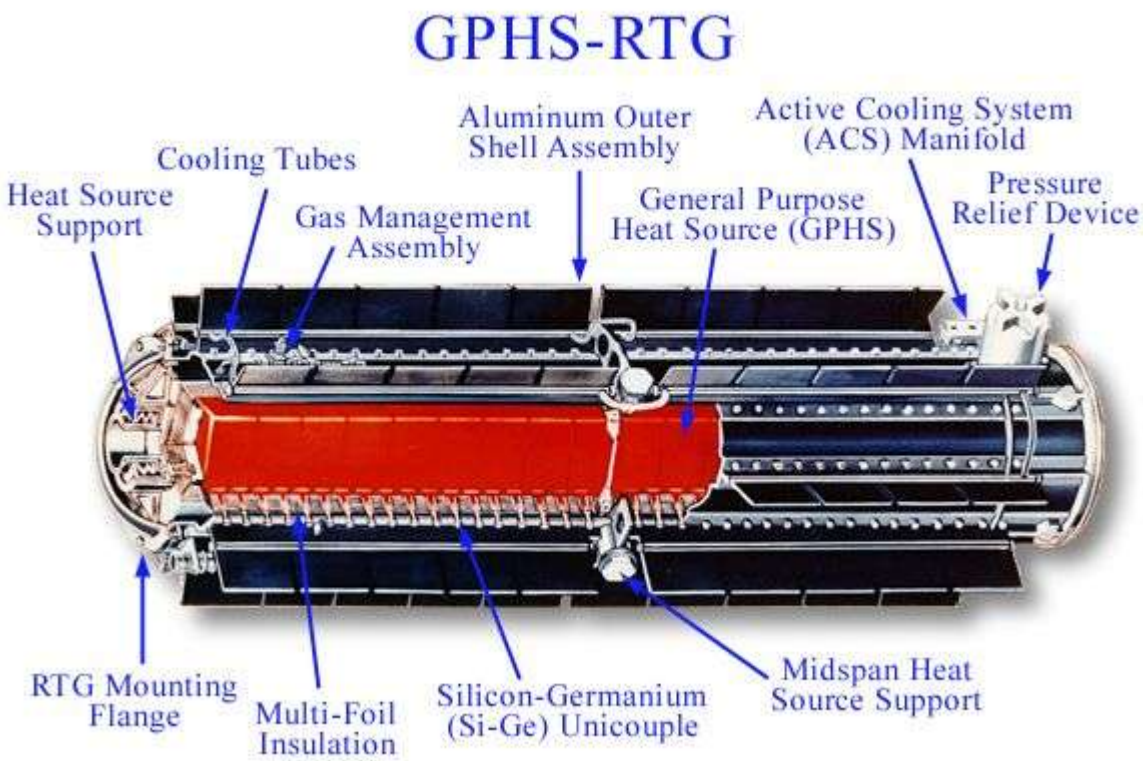




Radioisotope thermoelectric generator

Co-funded by the Erasmus+ Programme of the European Union

Uses an array of thermocouples to convert the heat released by the decay of a suitable radioactive material into electricity. This generator has no moving parts. (Cassini–Huygens, New Horizons)



Co-funded by the
Erasmus+ Programme
of the European Union

Partners

Large companies, such as SpaceX, NASA , EKA, NSAU, Роскосмос, UNOOSA.

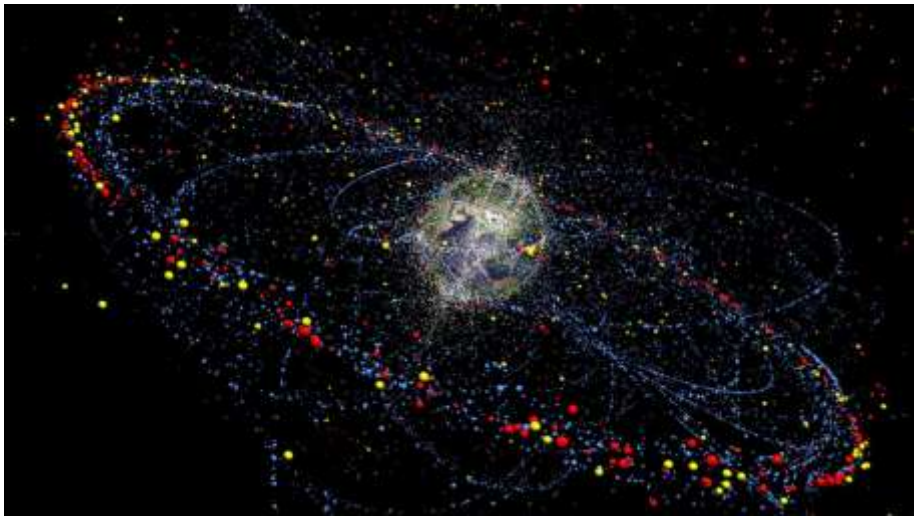
Co-funded by the
Erasmus+ Programme
of the European Union

Thank you for attention!

Co-funded by the
Erasmus+ Programme
of the European Union

Apparatus for collecting and destruction space debris

- Mikhalka Ivan
- Harmilin Yahor
- Ramanchuk Alexander
- Serpikova Vlada



Co-funded by the
Erasmus+ Programme
of the European Union

Space debris in the Earth's orbit appeared at the same time when the first spacecraft began to be launched. But for today this problem has acquired a truly menacing scope. The problem of space debris was brought to the international arena on December 10 1993, Secretary-General of the United Nations. The report was called "The impact of space debris on the environment."

Space debris means all artificial objects in space that no longer function and can no longer serve any useful purposes: all kinds of fragments of satellites, rocket stages, etc.

Co-funded by the
Erasmus+ Programme
of the European Union

Space debris poses a potential threat to spacecraft due to the possibility of collision. Since fragments of space debris move in their orbits with very high velocities, they can cause serious damage to spacecraft, even with a low mass. In 1983, a small grain of sand (less than 0.2 mm in diameter) left a serious crack on the shuttle's porthole.

In addition, space debris can pose a danger to the Earth: in case of incomplete combustion in the atmosphere when it falls to the ground, garbage can also contain radioactive and toxic substances.

The table shows that the vast majority of space debris is less than 10 cm in diameter.

Composition and amount of space debris for 2010

Composition of space debris	Amount of space debris
<1 cm	>100 000 000
1-10 cm	>500 000
>10 cm	>21 000

Device prototype

We offer our prototype of a space debris collection and destriction apparatus. It consists in the impact on objects of space debris magnetic field by an electromagnet mounted on an unmanned spacecraft. When exposed to metal space debris by a magnetic field, two scenarios are possible: 1) we draw garbage to a magnet and collect it for further processing; 2) we reduce the kinetic energy of the object, which leads to the impossibility of its further movement in orbit.

Co-funded by the
Erasmus+ Programme
of the European Union

The conditions for finding the body in the Earth's orbit as a satellite are found from the following equation (air resistance is neglected):

$$G\frac{m * M}{r^2} = \frac{m * v^2}{r}$$

G – gravitational constant;

M – mass of the Earth;

m – mass of object;

r – distance to the center of the Earth;
v – velocity of object.

From this equation we find the velocity of the body:

$$v = \sqrt{G\frac{M}{r}}$$

Co-funded by the
Erasmus+ Programme
of the European Union

If we reduce the speed of the body, then it can no longer remain in orbit and will begin to fall. We are going to change the speed of space debris using an electromagnet. The device in orbit will also have a very high speed, so the relative speed of debris and apparatus will be small. As an electromagnet it is possible to use a copper wire wound on a core of transformer steel. In fact, it will be a solenoid with a core. The induction of the magnetic field inside the solenoid is found from the formula:

$$B = \mu\mu_0 \frac{N}{l} I$$

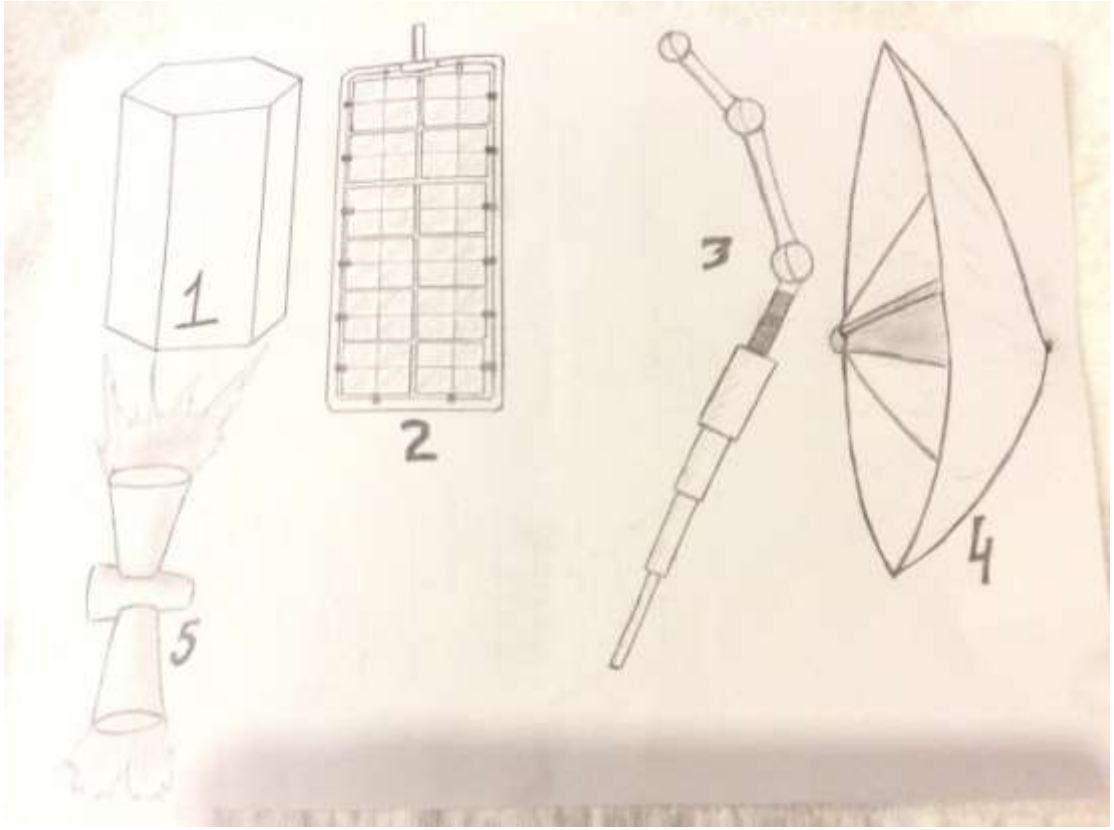
Co-funded by the
Erasmus+ Programme
of the European Union

μ_0 - magnetic constant;
μ - magnetic permeability of the core material;
N - number of turns of wire;
l - solenoid length;
I - amperage.

Since most of the garbage objects are less than a centimeter across, in most cases, the magnitude of the magnetic induction will not be too high.

Co-funded by the
Erasmus+ Programme
of the European Union

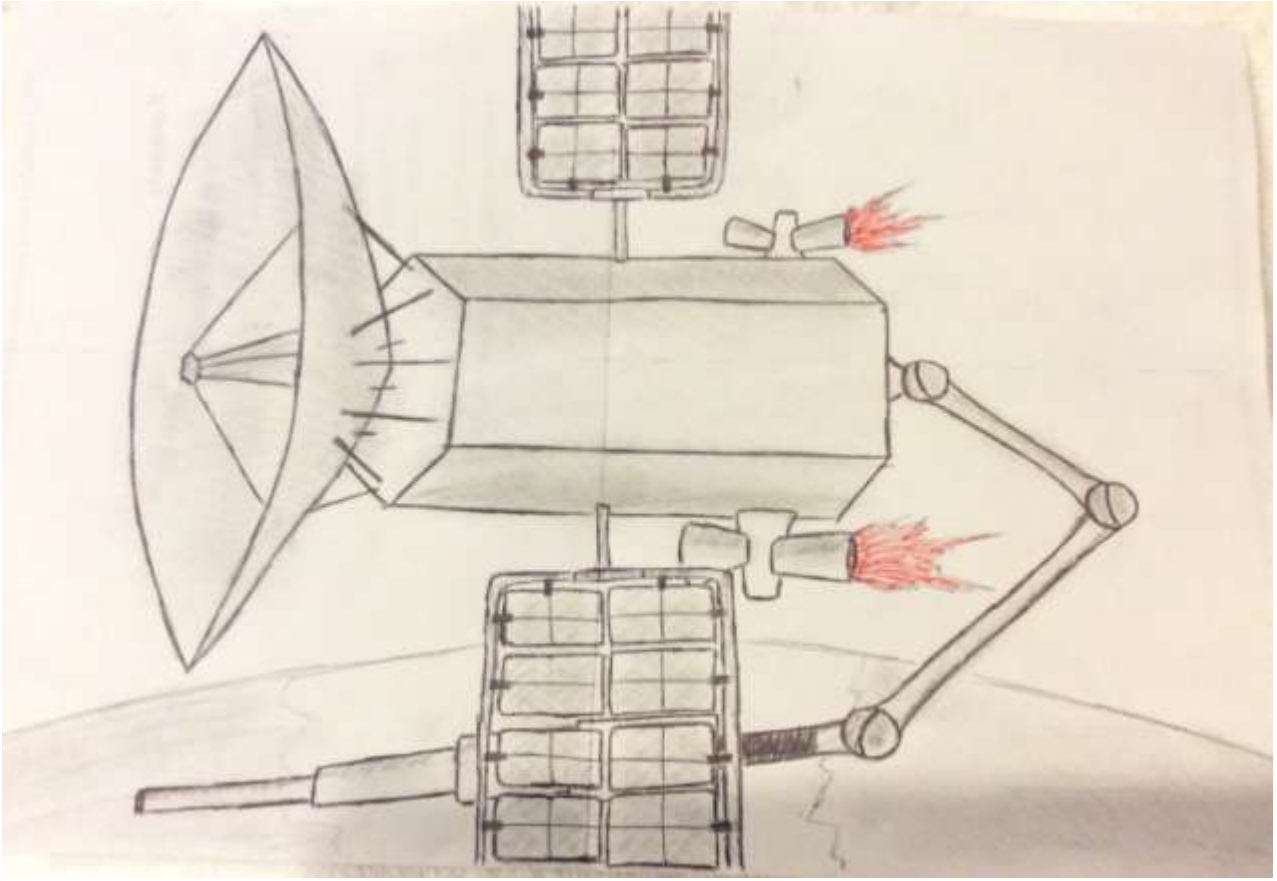
The main parts of the apparatus



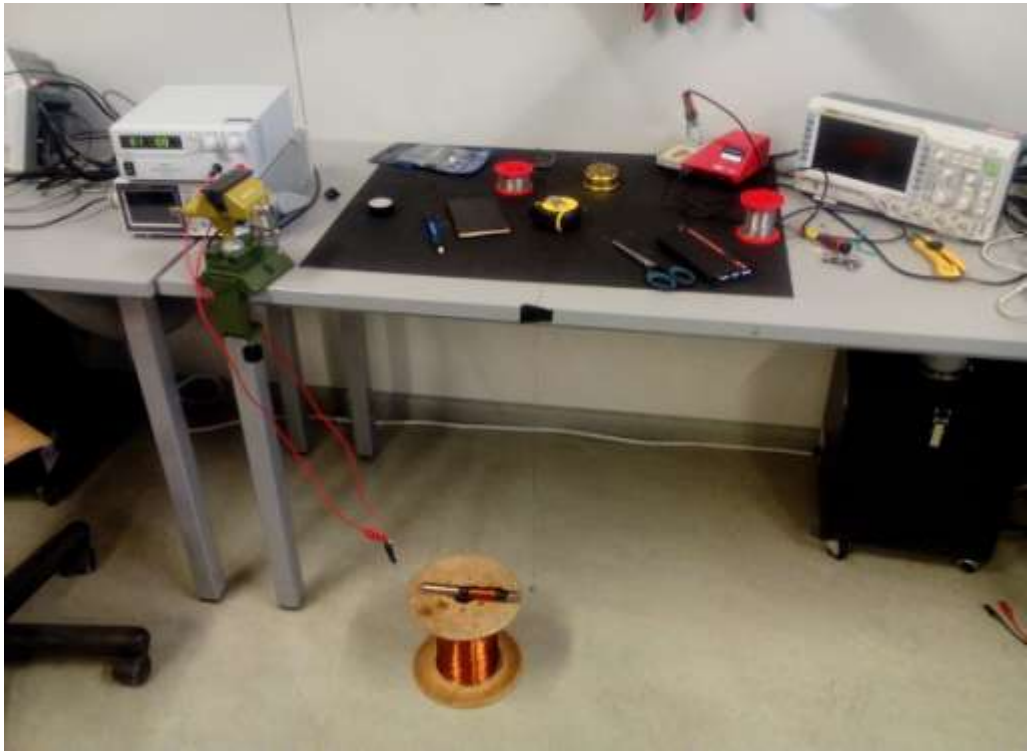
1- Body
2- Solar panels
3 - Electromagnet on movable manipulator
4 – Locator
5 - Shunting engines

Co-funded by the
Erasmus+ Programme
of the European Union

Sketch of apparatus



For the copper winding, a cooling system and protection against external damage should be provided. Various modifications are possible for the device: it is possible to equip a container for collecting garbage, a more perfect magnet, etc. All these are questions for further development.



Co-funded by the
Erasmus+ Programme
of the European Union

Thank you for attention!

Exoskeleton for disabled people prototype

Co-funded by the
Erasmus+ Programme
of the European Union

Introduction

Many people suffer from different injures e.g. damages of spinal cord or nerves. Due to these injures people aren’t able to walk, run and they can’t do everyday things as earlier. So, we have an idea to create modern exoskeleton which could give them the ability to stay on their own feet again.

Co-funded by the
Erasmus+ Programme
of the European Union

Challenges and objectives

As mentioned before, we want to help people which lost the ability to move by their own legs. Our challenge is to create modern exoskeleton which can convert electrical impulses from the brain into the electrical signals identified by special devices. This is a market need, especially in medicinal and military fields.

Co-funded by the
Erasmus+ Programme
of the European Union

Technical goals

- The technical goal is to use novel developments which can “convert” thoughts to reality in our prototype. We want to bring an opportunity to injured people to walk in exoskeleton themselves without any crutches, joysticks and so on. We’re thinking now to use special bracers to transport the converted signal to legs.

Co-funded by the
Erasmus+ Programme
of the European Union

Partnership

- Now we have a humble list of potential partners. We should partner with different Research Institutes of Biomechanics, Physics, Medicine, Electronics and so on. Could be good to obtain some data in these fields of science.

Economical impact

Co-funded by the
Erasmus+ Programme
of the European Union

Finally we want to produce an exoskeleton with a possibility to move by the mental power. As we know the technology to do some things by the mental power due to novel devices exists nowadays.

Our prototype is just an idea and we don’t know about the cost of it production and the price of final product. This exoskeleton costs $40000. We want to produce the budget version: the similar cost but the new technology.

Co-funded by the
Erasmus+ Programme
of the European Union

Contacts

- Sachyshyn Alexander, sachishin1996@gmail.com, +37525-604-50-27
- Shumski Alexey, shellover19@mail.ru, +37529-785-70-94
- Opekun Alexey, opekun1997@gmail.com
- Harahliad Maria, ms.janeseymour08@mail.ru, +37533-381-30-03

Thanks for attention!

Co-funded by the
Erasmus+ Programme
of the European Union

Thank you for your attention!

Prof. Dr. sc. Ing. Nadezhda Kunicina
Nadezda.Kunicina@rtu.lv
Dr. sc. Ing. Anatolijs Zabasta
Anatolijs.Zabasta@rtu.lv