



R5.3 Innovation solution showcase



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1. Introduction

In the framework of the PackAlliance pilot programme, after the completion of the four competence-based learning modules, the last part of the training course was represented by a practical training. This part consisted of a novel challenge-based training methodology called CHAINS (CHALLENGE INnovation teams). In particular, small, tutored groups of students worked on specific real challenges, proposed by representatives of the plastic packaging sector and related to the sustainability and circularity of packaging, to stimulate innovative and entrepreneurial spirits.

34 students participated in the CHAINS, organized into 6 teams: 1 group from Spain, 2 groups from Poland, 1 group from Finland and 2 groups from Italy. CHAINS teams approached the challenges adopting the Design Thinking methodology, that is a human-focused, prototype-driven, innovative design process. It essentially englobes three phases:

1. Definition phase (1 week): fully understanding of the challenge and information gathering;
2. Ideation phase (4 weeks): includes several divergence and convergence sub-phases to choose and define the idea for the solution;
3. Prototyping phase (4 weeks): validation and manufacturing of the ideated prototype.

2. Glossary of terms, abbreviations and acronyms

Abbreviation / Acronym / Term	Description
CE	Circular Economy
CHAINS	CHallenges INnovation teams. Collaborative teams of students of the PackAlliance postgraduate program to work on a specific industry challenge
HEI	Higher Education Institution
PackAlliance Hubs	Physical places where the academia-industry collaboration within the project will take place
WP	Work Package

Partner shortname	
P1-Campus Iberus	Partner 1 - Campus Iberus (Spain)
P2-Ecoembes	Partner 2 - Ecoembes (Spain)
P3-AGH	Partner 3 - AGH University of Science and Technology (Poland)
P4-Synthos	Partner 4 - Synthos Group (Poland)
P5-TAMK	Partner 5 - TAMK Tampere University of Applied Sciences (Finland)
P6-Pyroll	Partner 6 - Pyroll Group (Finland)
P7-Proplast	Partner 7 - Consorzio per la promozione della cultura plastica - Proplast (Italy)
P8-UNISA	Partner 8 - Università degli Studi di Salerno (Italy)

3.1 CHAINs in Spain

In the first synchronous session the students introduce themselves, to break the ice they are asked to say 3 curious things about themselves but 1 need to be a lie. Then the rest of the team has to indicate what they think is the lie.

With this activity the students get to know each other, they lose their fear and it fosters the bond between them.

The students have completed the exercises whose objective was to get to know each other better. The tools that they have used are:

- Blind drawing: This is an individual activity. In Figure 1 there is one example of the students work

Blind drawing

The blind drawing exercise has different objectives, being from my point of view the most important to observe how communication is done. Not being able to draw any drawing and only being able to use words, communication has a very important role, so that the rest of the people understand what you want to draw, in this case. In other aspects taken to everyday life would be what you want to communicate or explain to the rest of the users present, since in the case of not doing it correctly, it could lead to various problems, such as not being able to perform the work by not understanding what is being requested. That is why knowing how to communicate properly is a relevant aspect in day to day work.

Below are the drawings I have made with the explanations given by my teammates.

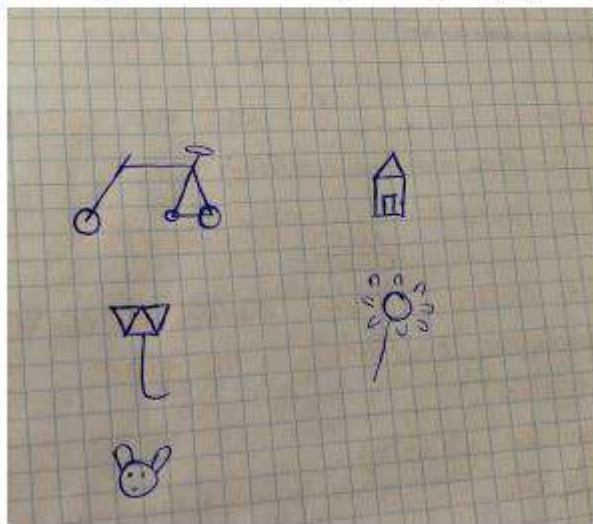


Figure 1 - Example of Blind Drawing activity

- Aircraft accident: In Figure 2 there is the result of this group activity. The students inserted also this text: "They are arranged in ascending order based on the order in

which we rolled them. The one with the fewest points is the first object we throw and the one with the most points is the last one”.

	Ana	Asier	Miniam	Sara	Iñigo	Jose Luis	Mónica	ORDEN
• 1 revolver without ammunition	3	2	2	1	3	3	2	16
• 1 carton of French cigarettes	1	1	1	3	8	7	1	22
• 5 packs of nappies	2	7	3	4	4	2	3	25
• 1 make-up box with 12 colours and brushes	6	6	4	2	7	1	4	30
• The aeroplane's pilot's instruction book (600 pages)	4	5	6	7	5	4	7	38
• The hostess's box containing 500 euros in different currencies	7	4	8	8	6	6	5	44
• 1 box of 50 condoms	5	8	5	5	9	8	6	46
• 1 parachute without instructions	10	10	9	9	2	5	8	53
• 2 bottles of gin, one of which has been started	9	3	7	6	9	9	13	56
• 2 oxygen cylinders	8	9	10	10	1	14	10	62
• 1 compass	13	11	12	12	11	13	9	81
• Nylon thread and hooks	11	12	11	13	14	12	11	84
• 1 solid gold lighter	12	15	13	11	12	10	12	85
• 1 box of concentrated food	14	14	14	14	13	11	14	94
• 20 liters of drinking water	15	13	15	15	15	15	15	103

Figure 2 - Result of the Aircraft Accident

- HBDI, each student took the HBDI test and post it in a forum. In the synchronous session we reflected on the type of profiles, areas of strength and areas of opportunity

3.1.1 Challenge, team's components and mentors

CHALLENGE: How might we show effective environmental information for citizens in the packaging labeling	
TEAM SP-1	
Number of the STUDENTS and their actual roles	
3 Master students	
4 Professionals	
MENTORS	
Linda Pichardo	Industrial Mentor (Ecoembes)
Alberto Navajas	Academic Mentor (University of Navarre)

3.1.2 Definition phase

Students have completed several exercises in this phase.

In Figure 3 they have filled up Stakeholders map with comments divided into Main and Secondary. Regarding “Potential Users” they have added comments in Main and Possible. Finally, in “Target definition”, they have added comments like: “How old?”, “Access to a recycling point?”, “Cultural level?”

- Make a map

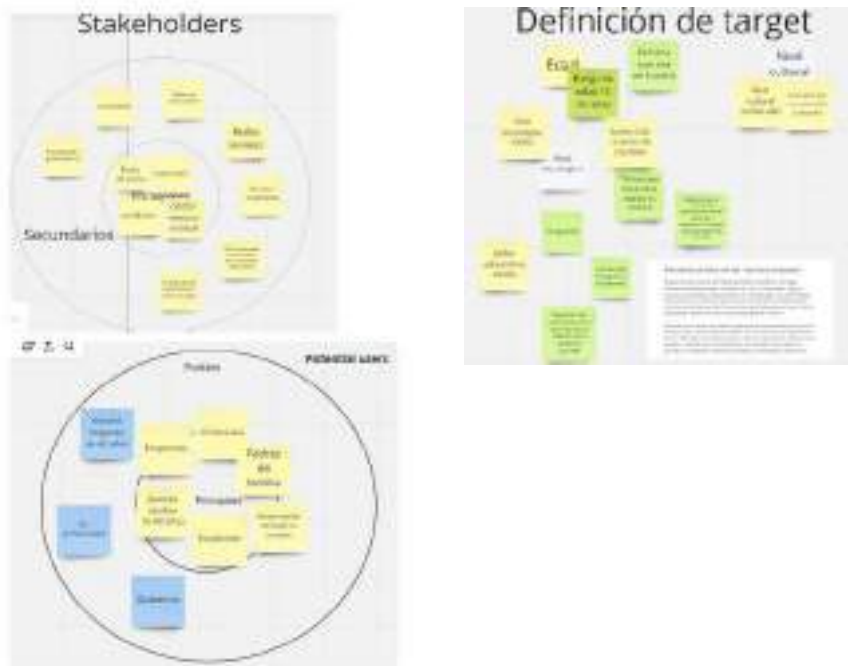


Figure 3 - Make a Map activity

- Target and Buyer person:

In Figure 4 students have added information in the different boxes. For example, in box “Cultural Level” they have specified “Average” and “basic knowledge about recycling and sustainability”. In box “Personality”, they have specified: “Responsible”, “Honest”, “Curious” and “with ethical values”.



Figure 4 - Target and Buyer person activity

- Group map activity

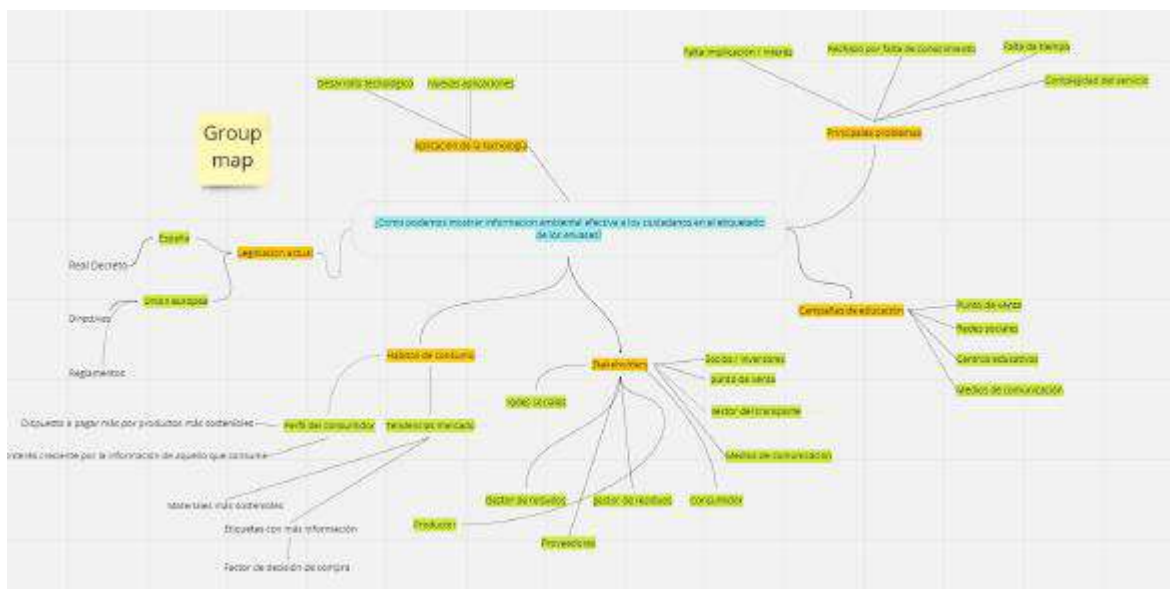


Figure 5 - Group Map activity

In Figure 5 it can be seen the group map activity. From the central point: "How can we show effective environmental information to the citizens on the label of the packaging?" it can be seen that leaves several branches like: "Current legislation", "Consumer behavior", "Stakeholders", "Education campaign", "Main problems", "Technology application", where

students have added several comments like for example, in “Consumer behavior” they have added: “Consumer profile”, “Market trends”. From “Stakeholders”, they have added “Social networks”, “Point of sale”, “Waste manager”,...

3.1.3 Ideation phase

- Crazy 8 activity:

1. Label indicating water consumption, carbon emissions and product waste generation
2. Compostable food packaging
3. Recycling app with artificial intelligence that recognizes the product and indicates where to deposit it
4. Certificate of recycling for schools. In this way the children will learn to recycle and will be motivated to get the certificate.
5. App that reads the barcode and indicates packaging characteristics to inform the consumer
6. Recycling app that, after reading the barcode of the product, proposes alternative products with more sustainable packaging
7. Educational website indicating the best solutions to get rid of waste
8. Certificate for organizations/companies/institutions that make better use of raw materials (make less use of packaging, the packaging they use comes from renewable resources, etc.)

- Solution Sketch Activity:

Idea 1: label that classifies the product container according to its environmental characteristics

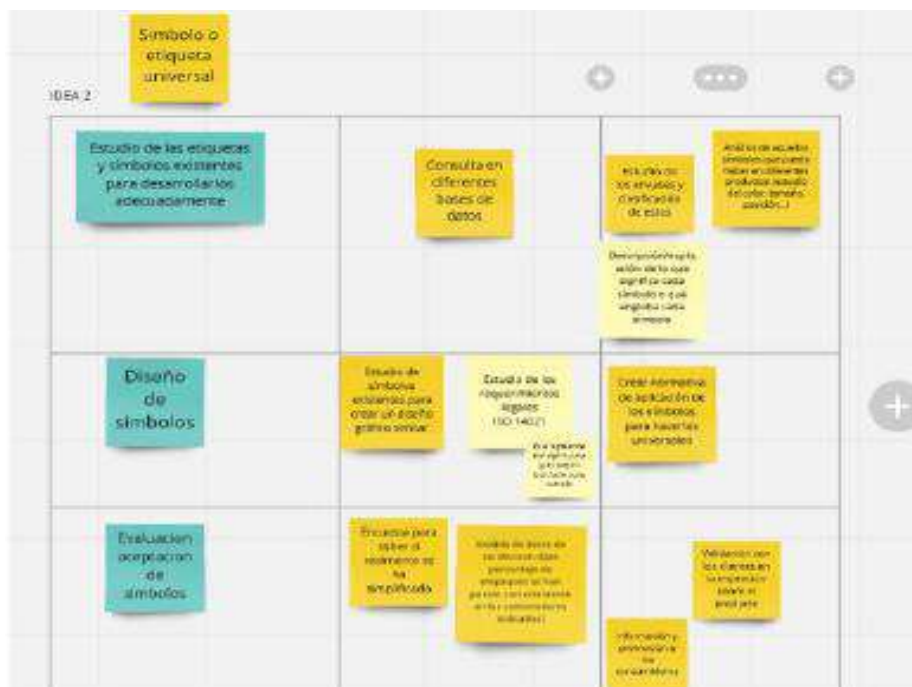


Figure 6 - Solution Sketch Idea 1

In Figure 6 it can be seen that students have added comments like: “Study of the labels and symbols to develop appropriately”, “Symbols design”, “Evaluation of the symbols acceptance”, “Query in different databases”, “Study of existing symbols to create a similar graphic design”, “Study of legal requirements ISO14021”, “Create regulations for the application of symbols to make them universal”, “Study of the containers and classification of these”, and “Validation with customers in printing on the product”.

Idea 2: RFID smart label together with the implementation of RFID reader devices on containers



Figure 7- Solution Sketch Idea 2

In Figure 7 it can be seen that students have been added comments like: “Product security (malware, spyware)”, “Market study: Current applications of RFID labels in packaging”, “Consumer information campaigns”, “Information points of sale, packaging collection points”, “Standards developed by EPC Global”, “Validation with packaging manufacturers”, “Surveys simulations”, “RFID reader in containers”, and “data processors (middleware)”.

Idea 3: application that allows the user to know the impact environmental

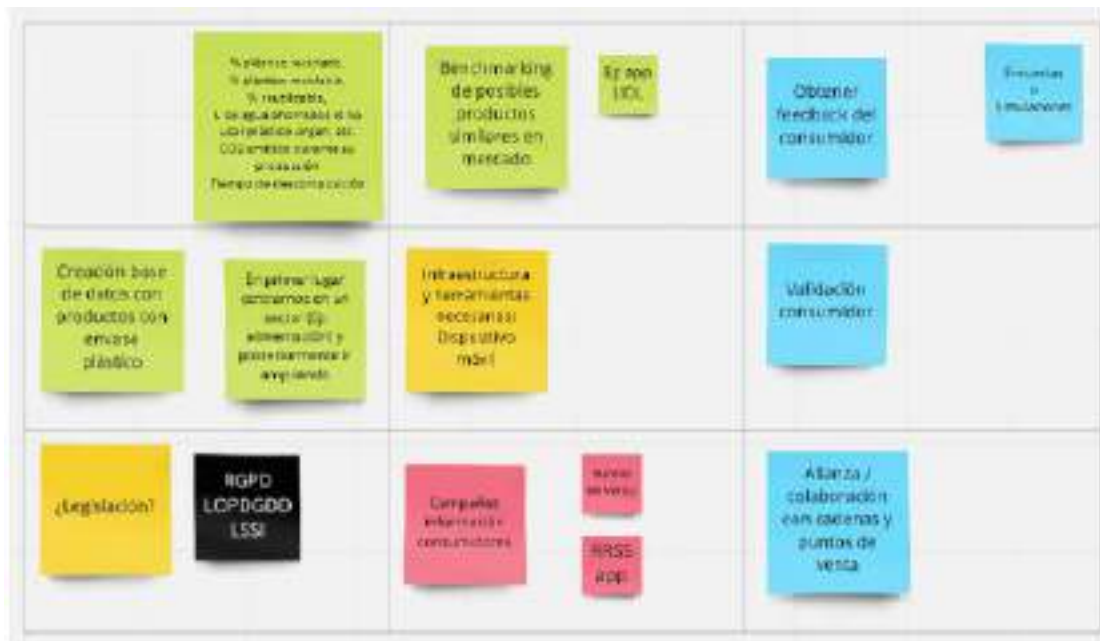


Figure 8 - Solution Sketch Idea 3

In Figure 8 it can be seen that students have been added comments like: “ % recycled plastic, % recyclable plastic, % reusable, L of water saved by not using virgin plastic, etc. CO2 emitted during its production decomposition time”, “Creation of a database with products with plastic packaging”, “In the first place, focus on a sector (eg food) and later expand”, “Infrastructure and tools needed: Mobile device”, “Consumer information campaigns”, “Alliance / collaboration with chains and points of sale”, “Get consumer feedback”, “Benchmarking of possible similar products on the market”, and “Creation of a database with products with plastic packaging”.

- SWOT analysis

After the ideas' presentation with different Ecoembes areas, one idea was chosen. The team realized SWOT analysis of this idea

	OPPORTUNITIES Increased use of applications of the kind that facilitate the purchase of consumers. More and more people have a greater relationship with technology. Liaise with the government to obtain more support. Increased concern about the environment both by the general public and by companies.	THREATS Appearance of new developments Company secret that makes data collection difficult Creation of similar applications Having problems with data protection law. Economically unprofitable application. Lack of good reception by companies.
STRENGTHS Inform the consumer of relevant and reliable data on the packaging of the purchased product. Simplification of information that, on many occasions, is confusing for users. Elimination of the paper ticket on the market.	STRATEGIES TO MAKE OUR OPPORTUNITIES STRENGTHS -Creation of a law that obliges producers to facilitate data and increase transparency. -Collaboration/work with companies to increase their social responsibility and transparency.	STRATEGIES TO PREVENT OUR THREATS WITH STRENGTHS -That the application is easier and more intuitive than that of the competition. -Competent and updated legal team.
WEAKNESSES Having little data (materials with a secret formulation, companies that do not want to be an active part...) Few downloads of the app/unattractive app for the target audience. Confusing application that makes it difficult for potential customers to use.	STRATEGIES TO MAKE USE OF OPPORTUNITIES TO MINIMIZE WEAKNESSES -Campaigns that advertise the most aggressive application. -Awareness raising among the population.	STRATEGIES TO MINIMIZE POTENTIAL DAMAGE FROM THREATS IN SECTORS WHERE WEAKNESSES AND THREATS COME TOGETHER -Creation of a law that obliges producers to provide data and ensures its protection -Work to be as clear as possible and provide a very intuitive application

Figure 9 – SWOT analysis

3.1.4 Prototyping phase

- JOURNEY MAP ACTIVITY

Tool that allows graphically illustrating the individual needs of a client (what is has proposed to achieve), the series of interactions that are necessary to satisfy those needs and the resulting emotional states experienced by this client throughout the process. During the trip or route, all the actions that are necessary and the times required to carry them out are mapped. In short, it serves to ask why the things that are done are done and the way in which they are make.

Journey map of our work



Figure 10 – 1st, 2nd and 3rd stages Journey map

1st stage: Discovery of our product or service by part of the potential consumer/user. In this phase, we ask ourselves how the consumer discovered the existence of our product and why he should start using it. It is necessary to describe what actions the user performs, his needs and fears, how he interacts with the product in this phase and what his feelings or emotions may be. The consumer has environmental concerns and wishes to receive more information about the environmental impact that he causes through his daily actions, such as the products he buys in the supermarket.

2nd stage: In this stage we must try to answer why the consumer should start using our product, that is, why they should trust us to satisfy their needs or desires. This is one of the most critical stages because the user has to carry out a series of steps to be able to use the application, being a process in which we can "lose" him as a consumer of our service. On the one hand, the user wants to have the information at his fingertips, but on the other hand, he wants to be able to understand said information, that is, the level of complexity of the data provided will be a critical aspect.

3rd stage: In this stage the user has already used our application and we have had to be able to make a positive impression so that he becomes a regular consumer. It is also a fundamental stage in which we can receive feedback from the user on possible aspects of improvement that we must take into account for future updates. The user must have been able to visualize the information of interest to him and have understood, through the indicators with which the application works, the environmental impact caused by his decision to purchase some products instead of others.

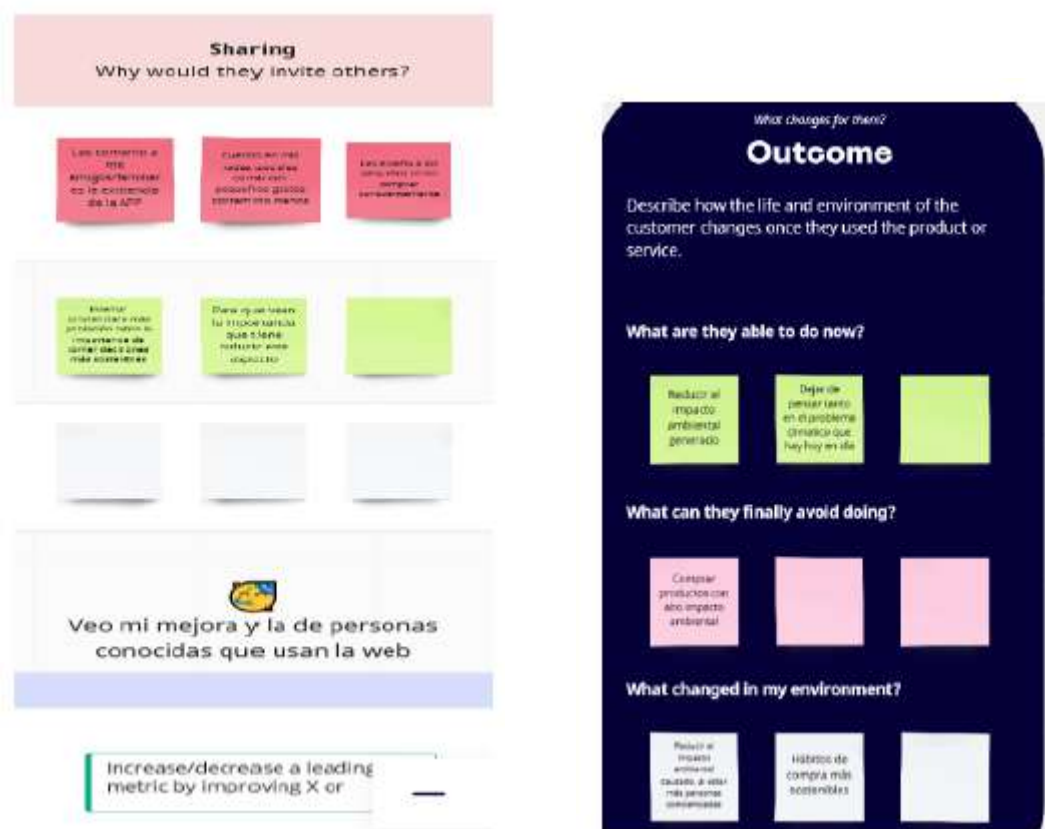


Figure 11 – 4th and 5th stages Journey map

4th stage: this is the user's last step on this journey. If we have managed to make a good impression on him and satisfy his wishes or needs, the person will want to share the service with other people so that they can also obtain the same benefits.

5th stage: In this stage the consumer has more information about the environmental impact generated by the purchases he makes, which will allow him to make better decisions at the time of purchase so that his impact on the environment is less. Through the application it is possible to promote the creation of more sustainable purchasing habits and in the same way the consumer will feel more involved and will be more aware of their impact, where they will be able to quantify, thanks to their sustainable purchase decision, how much impact has been reduced.

3.2 CHAINs in Poland

At the beginning of CHAINs, the students introduced themselves and got acquainted with their teammates as well as Academic and Company Mentors. The students became familiar with each other and with each other's personalities using tools such as "HBDI questionnaire", "Elevator Pitch", "Aircraft accident", and "Personal inquiries". Due to the HBDI questionnaire, the participant could get to know better not only his/her teammates but also himself/herself and one's traits of personality. The tool "Elevator Pitch" enable students to find out more about their teammates and to build a relationship between all the participants. Other tools that have been used in order to ease the students becoming familiar with each other were "Aircraft accident" task and "Personal inquiries". Chosen tasks helped the participants to get to know themselves, other students, and helped them to work as a team.

Students were introduced to the DIP methodology using the experience and knowledge of academic and company mentors especially in the fields of: design thinking; ideation and methodology development; management studies; build-up of business models and development scenarios; product and technology mapping; market research as well as creation of process and products innovations.

3.2.1 Challenge, team's components and mentors

CHALLENGE: How we might affect the improvement of the marketplace of biodegradable packaging in connection with green transformation of enterprises?	
TEAM PO-1	
<i>Number of the STUDENTS and their actual roles</i>	
1 PhD student 2 Professionals	
MENTORS	
<i>Name and Surname</i>	<i>Actual role</i>
Prof. Murat Çolak	Academic Mentor (AGH, University of Science and Technology)
Danuta Ciechańska	Industrial mentor (Synthos)
Jarosław Kurtyka	Industrial mentor (Synthos)

CHALLENGE: How might we increase the share of bio-based polymers as alternatives of synthetic plastics in production of eco- packaging materials?	
TEAM PO-2	
<i>Number of the STUDENTS and their actual roles</i>	
1 PhD student 1 Master student 1 Professional	
MENTORS	
<i>Name and Surname</i>	<i>Actual role</i>
PhD Robert Uberman	Academic Mentor (AGH, University of Science and Technology)
Danuta Ciechańska	Industrial mentor (Synthos)
Jarosław Kurtyka	Industrial mentor (Synthos)

3.2.2 Definition phase

During the first phase, students and mentors introduced themselves and discussed organizational matters. Mission and vision of Synthos company and the Faculty Management of AGH University of Science and Technology were presented. The strategic goals of the Green Company Synthos were outlined as the basis for considering the challenges presented in the Chains module. Within the Definition Phase a Plan of Work of Challenge Teams were demonstrated and communication and operational matters were discussed. Duties of Chains Module as follows were presented:

- Attendance at online consultation with the Business and Innovation Coach
- Work in groups on the Challenges (activities+ expected outcomes+ presentation)
- Activity on the Moodle activities
- Conduct research using materials provided by the Business and Innovation Coach

An important part of the phase was to establish the challenge motivation, the tasks and the expected outcomes. Preliminary consultations of the students' teams with the academic and company mentors were performed.

The tasks (T) and expected outcomes (EO) of the challenges were defined.

Challenge: How might we increase the share of bio-based polymers as alternatives of synthetic plastics in production of eco- packaging materials?

T1. The identification of the most perspective bio-based polymers, incl. biodegradable plastics, that can be used as alternative replacement of petro-based plastics in 'green' packaging sector. i) Overview of plastic packaging in EU – by supplier, use and type of key components (focus on polymers). ii) General characteristics of leading bio-polymers vs. classical ones with focus on biodegradable polystyrene. iii) Key functional requirements in selected segments (based mostly on work done in New materials and bio-based materials) with focus on biodegradable polystyrene.

T2. Defining the advantages and disadvantages of the identified bioplastics and selection of the 5 top bioplastic alternatives for packages i) Customer satisfaction map or another model.

T3. Assessment of supply and demand of the packaging selected segments with market potential for bioplastics.

EO1: Business and Innovation Road Map of bioplastic -based packages – report

EO2: Presentation that summarizes the obtained results.

Challenge: How we might affect the improvement of the marketplace of biodegradable packaging in connection with green transformation of enterprises?

T1. Estimation of the domestic and European market demand for biodegradable food-grade packages. Discussion on business models and competitive advantage. Consideration of economic, social and market aspects.

T2. Analysis of the dynamics of the development of the biodegradable packaging market and business strategies in Poland and the EU. Comparative analysis with the dynamics of development in Asia and North America

T3. Analysis of the state of the art and innovation in the field of biodegradable polystyrene production and its application in food packaging as a bio-replacement for expanded polystyrene (e.g. for hot dishes)

T4. Overview of technological requirements and economical aspects of biodegradable polystyrene manufacturing – round table discussion with representatives of Synthos Company

EO1. Scenarios for the development of biodegradable food packaging in Poland in the perspective of 5 years, considering the development of packages based on biodegradable polystyrene - report.

EO2. The short, medium- & long-term business strategies for developing the ideal business plan of biodegradable food packaging in Poland.

EO3. Presentation that summarizes the obtained results.

3.2.3 Ideation phase

The phase was coordinated by academic mentors in co-operation with company mentors, the tools which were used are as following:

Challenge: How might we increase the share of bio-based polymers as alternatives of synthetic plastics in production of eco- packaging materials?

- Organization. The ideation phase structure was based on product mapping. The following tools were used:
 - a. lecture followed by discussions
 - a) brainstorming
 - b) Group exercises
 - c) debriefing connected with an on-line discussion
 - d) project review
- Students also received various supporting materials such as:
 - a. selected reports from leading business magazines (like from McKinsey Quarterly)
 - b. scientific literature
 - c. official documents of the EU administration
 - d. market data from various sources
 - e. opinions and positions of various stakeholders of the packaging value chain
 - f. sustainability reports (including Synthos strategy EVERGREEN 2030)
- The output consisted of:
 - a. a comprehensive report on mapping of bio-based polymers which could be recognize as alternatives of synthetic plastics in production of eco-packaging materials.
 - b. a draft presentation, summarizing different findings.

Challenge: How we might affect the improvement of the marketplace of biodegradable packaging in connection with green transformation of enterprises?

The project team have used the following methodologies during the challenge process:

- a) literature research
 - b) brainstorming,
 - c) SWOT analysis,
 - d) business strategies models' scenarios for biodegradable and bio-based packaging development - innovation concept idea consultations with company tutors
- Students also received various supporting materials such as:

- a) selected reports from leading business magazines
 - b) scientific literature
 - c) market data from various sources
 - d) documents of the EU administration, such as legal acts, policies, communications etc.,
 - e) opinions and positions of various stakeholders of the packaging value chain, sustainability reports (including Synthos strategy EVERGREEN 2030),
 - f) results of the discussions with Tutors (effects of brainstorming),
 - g) Team's own knowledge, information from organizations where they are working for.
- The output consisted of:
 - a) introductory assumptions of middle and long-term business strategies for a development of the marketplace of biodegradable packaging in connection with green transformation of enterprises in Poland.
 - b) a draft presentation, summarizing different findings.

3.2.4 Prototyping phase

The phase was coordinated by company mentors in co-operation with academic mentors. The Prototyping phase was based on the development and implementation of collected data, information, ideas, the whole work done during the previous phases in order to achieve the final outcomes as was specified in p. 3.2.2.

The students did both the individual exercises and the group exercises. Moreover, besides the lectures and discussions with teammates and the mentors, the discussion with the company's representatives was organized and conducted for both teams. It helped students to get to know the company and its performance better within the researched area. It resulted in better understanding of the challenge, and thus had a beneficial impact on the work processes. In addition, debriefing and project review have been implemented during the CHAINs as the training techniques. Prototyping phase results was targeted to Synthos and its clients.

As part of the prototyping phase, regular meetings were organized during which the current results of the team's work were presented and discussed. Additionally, students and the company's mentors consultation meetings were also organized. The next steps for the development of final prototype products have been talked during these meetings. Within the phase a Round Table discussion was organized with representatives of Synthos' Innovation and Marketing Departments. Students could enlarge knowledge about the company's green strategic plans, especially in the area of PS recycling and the development of the PS product market and also discuss the details of prototypes which was planned to develop under Chains Module.

The students were informed that, as part of the evaluation of the Chains Module, a competition of teamwork was planned. The students were informed on the conditions of the competition and the criteria for the evaluation of prototype solutions. For jury, students have been required to submit two materials:

- a video of their product/service (the solution to the challenge).
- a presentation: they can either present live or record the video presentation and post it on Moodle.

Apart of mentioned materials, the students have been obligated to demonstrate the prototype solutions in Challenge's reports.

Prototype of Team PO 1: DEVELOPMENT OF THE MARKETPLACE OF BIODEGRADABLE PACKAGING IN CONNECTION WITH GREEN TRANSFORMATION OF ENTERPRISES IN POLAND – REPORT

Conclusions and recommendations

At the end of the day it seems that polystyrene, considered as one of the most difficult polymers from the perspective of consumer products value chain (difficult recyclability, ban in the SUP directive, negative public perception with regards to water/beach waste) might be both bio-based and biodegradable.

It seems there is a chance to make PS a sustainable material, at least from the perspective of sourcing and waste management.

Marketing name could be proposed for such bio-based and biodegradable PS: "DUO-BIO-PS". Specific marketing concept and story could be further developed over DUO-BIO-PS. Therefore, DUO-BIO-PS is our answer to the Challenge.

Two scenarios developed during the challenge are the answer for the Synthos company, how to become a modern green factory. Implementation of the newly developed product is always a big risk and extremely expensive operation but we believe that this risk is worth taking and this is the massive step into the factory of the future. How to make it easier and safer? We recommend collaboration with specialists in that field of study and also collaboration with universities. This model allows the company to transfer the development and research part to 3 parties and use their expertise and infrastructure. There are some possibilities to finance the research part from NCBiR grants or modern science university grants also collaborative PHD studies. Such a model will not only finance research but also create a platform for cooperation in which the best scientists will participate and bring their knowledge and experience for free into the company.

Prototype of Team PO-2: BUSINESS AND INNOVATION ROAD MAP OF BIOPLASTIC-BASED PACKAGES – REPORT

Conclusions and recommendations

The idea of Synthos, a partner of this project, is to move from a linear to a circular economy. The company is looking for a sustainable substitute (biodegradable/biobased) for conventional petroleum-based polystyrene. Currently, there is no such product on the market, however, there are some studies on the production of styrene, the precursor to polystyrene, from renewable materials.

Due to the lack of a green substitute for polystyrene on the market, we focused on finding the most appropriate substitute among the biopolymers currently available. In our research, we chose a polystyrene cup, which is a common commercial product, as a representative model. Based on the comparison of selected biopolymers, we found that the most suitable alternatives would be PHB, PLA, and MaterBi. It should be noted, that it would be beneficial to use additives, e.g. plasticizers, elastomers, or other additives to increase the temperature resistance.

However, it should be emphasized that there are also applications of polystyrene, e.g. in the insulation of buildings, where rapid biodegradation is not advisable. Based on the data obtained during the preparation of the project, we conclude that in the case of polystyrene packaging, other biopolymers (eg PLA, PHB, MaterBi) can be used as polystyrene substitutes. Given that the project was educational, we are not able to design biodegradable polystyrene, but only suggest the most appropriate substitutes among existing bio-based or biodegradable materials.

3.3 CHAINS in Finland

The CHAINS in Finland was arranged in a distant mode, with all contact learning sessions organized through Teams. Additionally, voluntary study visits were organized, as majority of the team participants were in Finland. The CHAINS comprised altogether ten contact sessions, two voluntary study visits and a final pitching session according to the program below:

1st week, Session 1: Introduction & team building

1st week, Session 2: The challenges

2nd week, Session 3: Seeking background info

3rd week, Session 4: Background of defining phase

4th week, Session 5: Insights to info seeking, Intro to ideation phase & Sparring session

4th week, Study visit to Pyroll facilities in Tampere (half a day)

5th week, Session 6: Intro to prototyping and validation phases & Sparring session

5th week, Session 7: Introduction to Pyroll package media

6th week, Session 8: Sparring session

7th week, Session 9: Sparring session

8th week, Session 10: Pitching with feedback of all coaches

9th week: Study visit to PacTec fair in Helsinki (all day)

Final event, Jury evaluation of pitching session and video

In between the above-mentioned synchronous learning sessions, the students organized their own meetings and worked on their CHAINS challenge with the help of given exercises and according to their own time schedule. To help the students to progress with their challenge the following rough guideline was given (Figure 11), even though iteration to previous stages was encouraged if needed.

Challenge schedule and steps



Figure 11: The challenge schedule and steps in Finnish CHAINS.

Introduction and team building was organized with the help of two exercises:

- What is your team role?

Each team member made a test of his/her team role, the outcomes were shown, and results discussed together. This exercise helped the team members both to understand their own behavior as a team member as well as to understand the other team members and their behavior better. The result of this exercise revealed that a versatile team with different team roles had been formed (Figure 12).

Your results:



Figure 12. Results of team roles exercise in Finnish CHAINS.

- Tell a story of yourself that contains one lie

Each team member was asked to tell something personal about themselves and added one lie to the story. Other team members tried to guess what part was not true. This exercise got the team members to talk about themselves to each other while encouraging discussion.

3.3.1 Challenge, team's components, and mentors

The Finnish CHAINs team selected a challenge "How might we find clever ways to comply with the SUP directive target of decreasing the number of packages", with the motivation and outcomes explained below in Figure 13.



Figure 13: Description of the Finnish CHAINs challenge.

CHALLENGE: How might we find clever ways to comply with the SUP directive?	
TEAM FI-1	
Number of the STUDENTS and their actual roles	
3 Professionals	
2 Bachelor students	
MENTORS	
Name and Surname	Actual role
Eveliina Asikainen	Academic mentor (TAMK)
Nina Kukkasniemi	Academic mentor (TAMK)
Virpi Rämö	Academic mentor (TAMK)
Sanna Piispa	Industrial mentor (Pyroll)

3.3.2 Definition phase

To define the challenge, the team in Finland first started by empathizing. This could even be considered a separate phase prior to the actual definition phase. It is an important phase as it creates the team a deeper understanding of the starting point of the challenge. To whom is this a challenge? The stakeholders are identified. Why is this a challenge for the given stakeholders? Each of the stakeholders have their own viewpoints and it is important to understand whose viewpoint is considered and how to sell the solution to a right stakeholder. Results of the empathizing exercise are shown below in Figure 14.



Figure 14. Results of the Finish CHAINs empathizing exercise.

As the next step, the team started to define the challenge by thinking what facts about the challenge they know already and what is important to find out to be able to define the challenge better. They were also delegating tasks for each team member for the next session. Outcomes of this exercise are shown below in Figure 15.



Figure 15: Outcome of a definition phase exercise of the Finnish CHAINS.

A further exercise given for the team to better define their challenge was “a speedboat”, where the team identified and quantified different restriction “anchors” that currently prevent the challenge from being solved. The outcomes of this exercise are shown below in Figure 16.



Figure 16. The results of the speedboat exercise of the Finnish CHAINS team within the defining phase.

As the outcome of these joint exercises, the team decided to narrow down the originally given challenge into a more concrete case study on developing minced meat packages in the

direction of decreased number of packages. This scoping documentation is shown below in Figure 17.

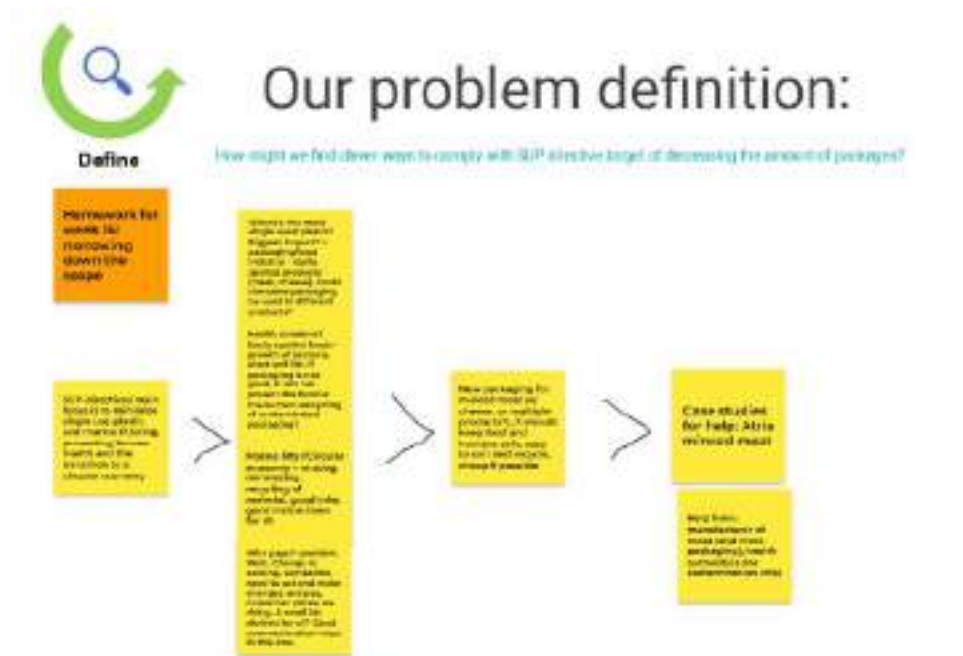


Figure 17. Outcome of the Finnish CHAINS definition phase.

3.3.3 Ideation phase

The ideation phase in the Finnish CHAINS was organised as a facilitated brainstorming session. The following instructions were given, and a facilitator kept timing.

Brainstorming session rules:

1. Keep your definition as the headline - focus on this problem only, not all other problems
2. Do not exceed the time limit of 30 minutes (5 + 5 + 10 + 10)
3. No criticism - weird ideas are welcome, the more ideas the better
4. Build on others' ideas to get more ideas

Instructions:

- A. Individual ideation (5 minutes) - ideate any solutions for your defined problem
- B. Group ideation - go through individual ideas together (5 min) - Add more ideas while discussing together (10 min)
- C. Categorise & Prioritise - Group the different ideas and prioritise the best ones together (10 min)

The outcomes of the very productive brainstorming session are shown below in Figure 18.



After the idea generation and grouping the associated topics together, the team decided to each give a certain number of votes to ideas that they consider the best ones. This way they ended up selecting jointly the priority ideas of the group. These are highlighted with pink color in the Figure 18.

In the prototyping phase, the team started by discussing how the solution would look like. As the solutions contained a machine, and packages, the team needed to decide the features of both before they could sketch a version of it. For the sketching, the team first looked for existing similar solutions from different fields to give them inspiration how the machine could look like. Results of the prototyping phase discussion are shown below in Figure 19.

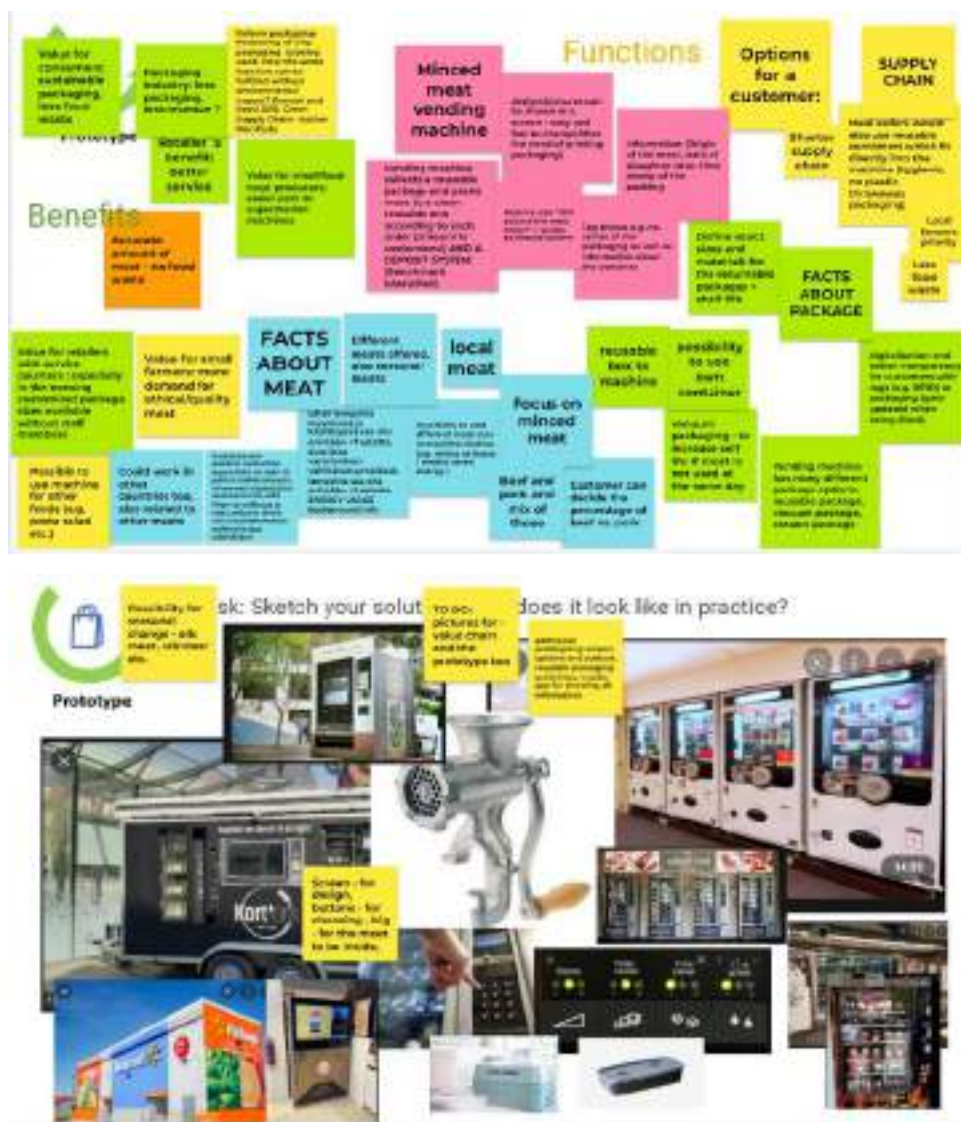
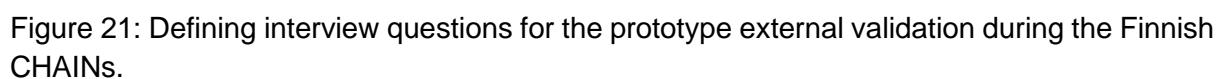


Figure 19. Results of the prototyping phase exercise of the Finnish CHAINs team.

To define sales arguments for their solution, the team finally filled in a customer value canvas that nicely connected the customer pains and gains to their solutions pain relievers and gain creators (Figure 20). This acted as a good starting point to the final pitching session storyline.



When the prototype was ready, the team validated the solution by discussing it through with external people by interviewing them and asking for feedback. The team's ideation for suitable interview questions is shown below (Figure 21). Here again, the team consensus of the best questions was reached by voting.



With these interviews, the team received a lot of valuable feedback on their prototype and was able to iterate and improve their solution for the final pitching session based on the received feedback. The results of the interviews are shown below in Figure 22.

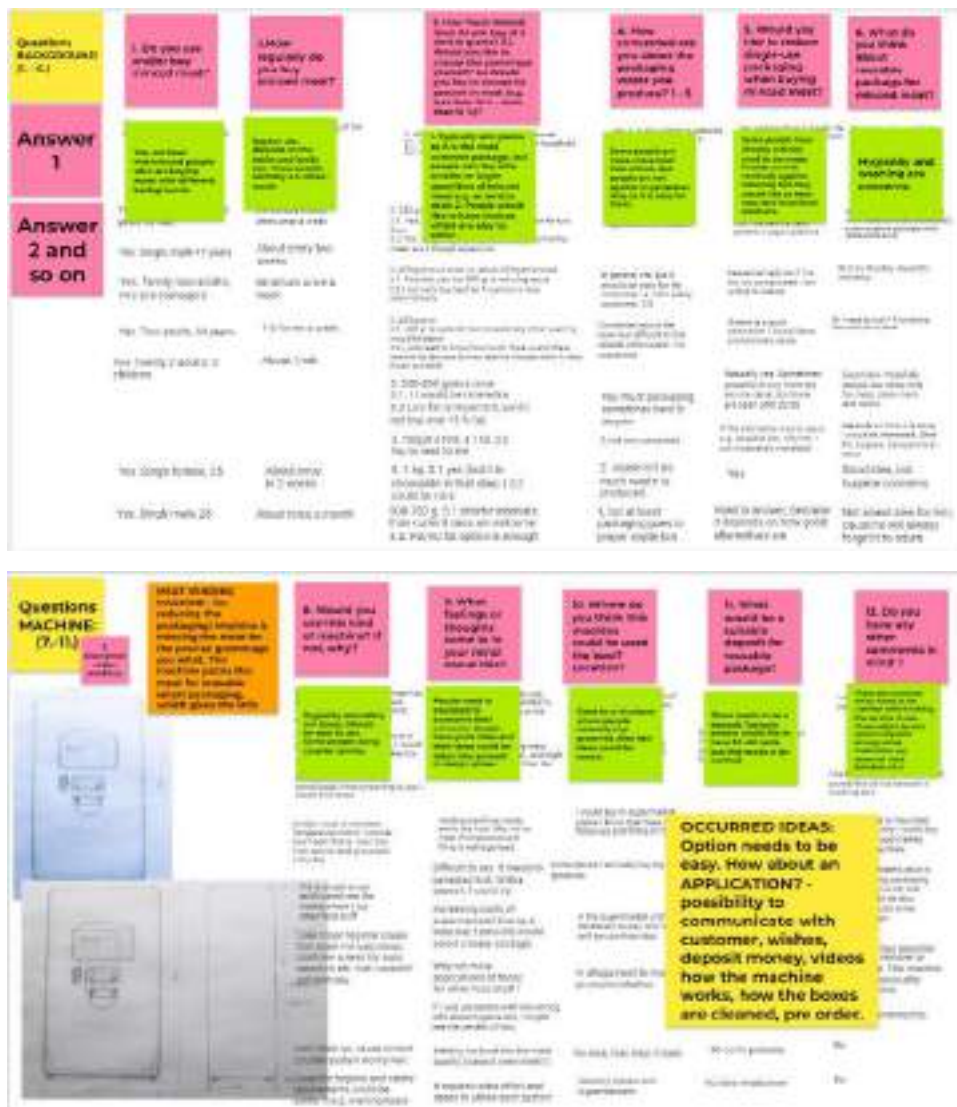


Figure 22: Interview results of the Finnish CHAINs prototype validation.

3.4 CHAINS in Italy

Since the Design Thinking methodology is focused on a strong and constructive interaction of the participants in each working group, a preliminary steering phase was carried out. In particular, during the first online meeting of the Italian CHAINS, mentors (both academic and industrial ones) proposed to the students some exercises aimed to facilitate the interaction and to enable the team formation. The group activities consisted in exercises of the type of the “Elevator Pitch” and to answer some attitudinal questionnaires. The aim of these activities, to which also the mentors actively participated, was to learn more about the team members and to get to know each other having a nice time. In particular, the students were asked to fill in an HBDI questionnaire. These short self-assessment surveys were useful to identify the main personal characteristics of the team’s members, evidencing who is more rational, intuitive, creative or realistic, so to take advantage of these different personalities in facing the challenges.

During the second day, the industrial mentor presented herself and her company, moreover in collaboration with the academic mentor, they explained to the students the Design Thinking methodology that was going to be used to face the challenges. An expert on Design Thinking approach was also invited and, in particular, she showed the students how to apply the DIP (Define - Ideate - Prototype) methodology to face a simple challenge, as an exercise to become familiar with this approach.

Finally, since the CHAINS activities were planned remotely, the digital interactive whiteboard Miro was presented and explained to the students, as a useful tool to enable visual collaboration for teams during the online meetings.

3.4.1 Challenge, team’s components and mentors

CHALLENGE: How a proper eco design strategy could induce consumers to be actively part of the packaging waste management?	
TEAM IT-1	
<i>Number of the STUDENTS and their actual roles</i>	
5 Master students 2 Professionals	
MENTORS	
Prof. Ing. Luciano Di Maio	Academic mentor (University of Salerno)
Dr. Maria Teresa Scrivani	Industrial mentor (Proplast)

CHALLENGE: What is the best strategy to increase the amount of plastic collection and recyclability?	
TEAM IT-2	
<i>Number of the STUDENTS and their actual roles</i>	
2 Master students 1 Master graduated 1 Bachelor graduated 2 Bachelor students 2 Professionals	
MENTORS	
Prof. Ing. Luciano Di Maio	Academic mentor (University of Salerno)
Dr. Maria Teresa Scrivani	Industrial mentor (Proplast)

3.4.2 Definition phase

During this phase, first of all the members of each team collected information in order to fully understand the challenges and they shared these knowledges each other. Then, using the tool “**Start at the end**”, they defined the long-term objectives (optimistic hat) they wanted to reach in order to solve the challenges, and accordingly they generated a list of problems, impediments and/or risks (pessimistic hat) in achieving these objectives. Starting from these lists, they reformulated the obstacles with the intention of turning them into design opportunities, using the tool “**How might me**”. Finally, since problem statement must be done in a human-centered manner, the students also accounted for the stakeholders interested in the challenges, evidencing which of them (using the tool “**Pick a target**”) are mainly involved.

In the following, some screenshots of the online Miro interactive whiteboard, illustrating the work developed by the members of the two Italian teams during the defining phase, are reported.

1. *Start at the end*





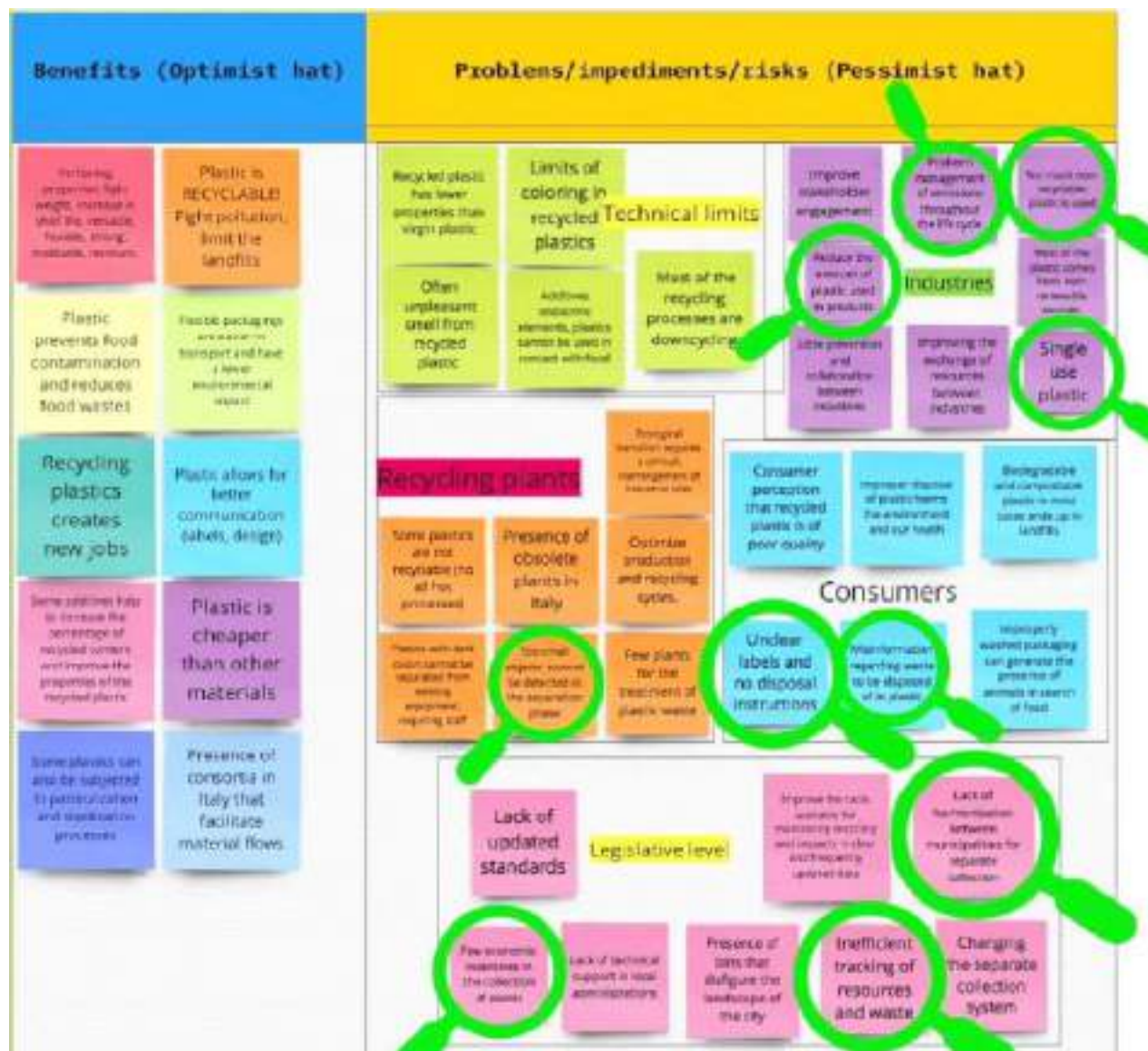
3. Stakeholders



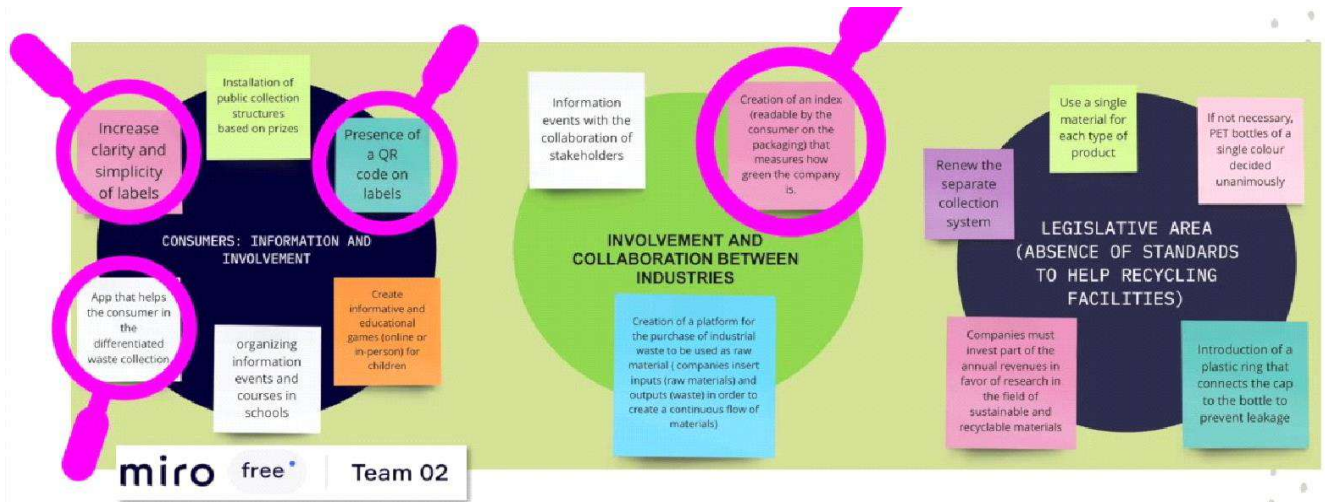
4. Pick a target



1. *Start at the end*



2. How might we?



3. Stakeholders



4. Pick a target



3.4.3 Ideation phase

In the Design Thinking process, the Ideation stage formally follows the Define phase, but in practice there is a significant overlap between these two stages. In fact, interpreting information/defining the challenges and ideation both drive the generation of problem solutions.

Brainstorming was the tool used by the CHAINS Italian teams to generate many ideas by leveraging the collective thinking of the group, engaging with each other, listening, and building on other ideas. This method involved focusing on each aspect of the challenges at a time, while team members built on each other's responses and ideas with the aim of generating as many potential solutions as possible. Participants then selected the best, the most practical, or the most innovative ideas from the options they'd come up with. Finally, the "**SWOT analysis**" was used to develop the ideas completely, generating strategies to improve the *Strengths* and *Opportunities* and deal with the *Threats* and *Weaknesses*.

In the following the selected ideas for each challenge and the corresponding SWOT analysis, conducted by both the Italian teams, are reported.

SWOT analysis on the selected idea for Team IT-1



Challenge for Team IT-2: What is the best strategy to increase the amount of plastic collection and recyclability?

SWOT analysis on the selected idea for Team IT-2



3.4.4 Prototyping phase

The prototyping phase theoretically represents the final stage of the DIP methodology, but as it was already evidenced, the Design Thinking approach is actually not a sequential process, but an iterative one. In particular, the prototyping involves producing an early, inexpensive, and scaled down version of the product(s), based on the selected idea to solve the challenge. Prototyping offers designers the opportunity to bring their ideas to life, test the practicability of the current design, and to potentially investigate how a sample of users think and feel about this solution.

At the conclusion of the CHAINs activities the students represented in a visual form the developed ideas. The sketches of the products, proposed by the Italian teams to face the challenges assigned, are reported in the following.

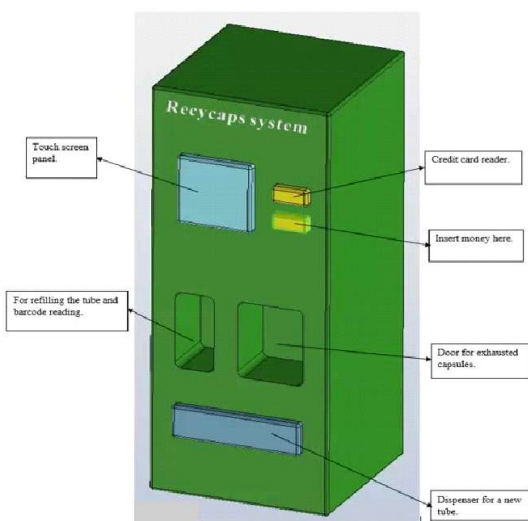
Challenge solution for Team IT-1: RECYCAPS



- Thin wall of rigid PP (injection moulding)
- Thin layer of evoh (co-injected)
- Lid film in flexible PP (with AlOx deposition)
- Material suitable for the recycling PP stream



- **See-it-through tube in rigid PP:** consumer check the amount of capsules left (tube can be opened on both sides through screw caps).
- **A plastic mobile separator creates two different zones in the tube** (upper for new capsules and lower for used ones), **no contamination**.
- **Bar code system** – interaction machine/consumer
- Additional labels made out of soluble water-based inks/adhesives with a **non-dark colour** to maximise recyclability (according to Ceflex guidelines).
- The consumer does not have to sort the waste, but has just to **put the pod back in the tube** (reducing the inconvenience of throwing the product away).



Vending machines installed in selected stores and supermarkets



It provides new tubes, capsules and collects the used ones



The display provides commercial and sustainability information (n° of capsules collected – CO2 saved) **(CONSUMER EDUCATION ON SUSTAINABILITY)**.



It provides capsules of different brands and flavours, compatible with the tube and "recyclable ready" (Rigid PP)



It reads the bar code and collects «coffee points» for every tube recharge: every 5 recharges the consumer gets 10 capsules for free **(ECONOMICAL INCENTIVE for CONSUMERS)**.

Challenge solution for Team IT-2: SUSTAINABILITY INDEX

Italian IT-2 proposed as solution of the assigned challenge a “**Sustainability Index**”, i.e. each product has a label with a rating according to the sustainability of its packaging. A color scale assesses the sustainability of industries and their packaging: the colors are green, yellow, orange and red, in descending order of sustainability. Each packaging must show all the colored scale in plain sight and the corresponding color must be highlighted.

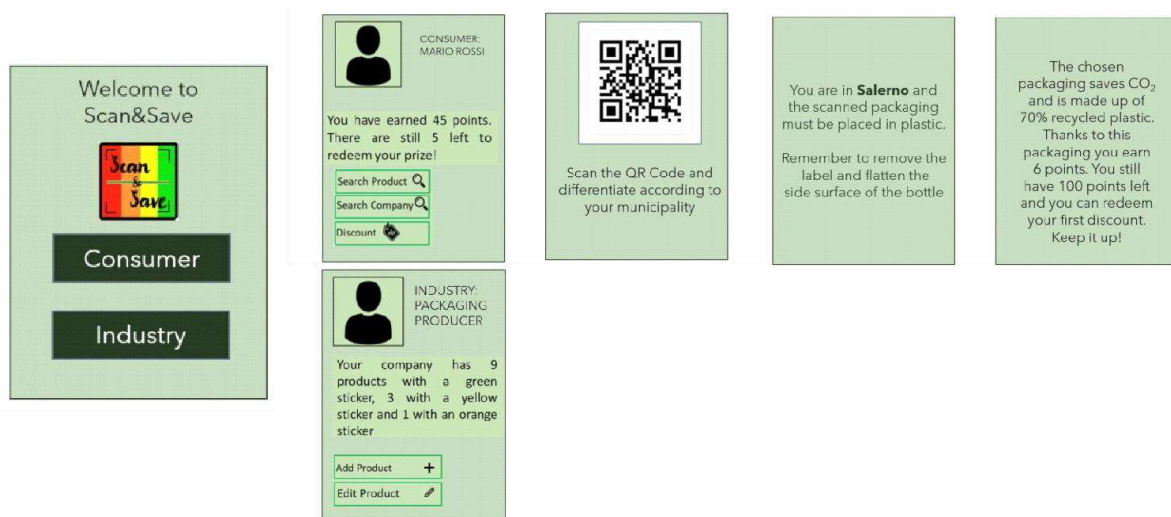
A coordinated and integrated collection system with QR CODE and talking labels allows to easily understand where to deliver empty packaging and take in relation one company with the others and with consumers in a virtuous collection system and circular economy. The creation of an app allows to scan the codes, so to provide indications on how to differentiate the packaging and to assign points to the consumers and companies. As a consequence:

- companies are encouraged to produce greener and easy to recycle products to improve their rating and pay less taxes, improving their appealing to consumers eye.
- families are incentivized to buy greener in order to improve their rating and be entitled to discounts.

EXTERNAL LABEL:



INTERNAL LABEL:



4. Conclusions

The best innovative ideas, proposed by the students within the CHAINs activities, were selected and awarded. For this evaluation, students were required to submit two materials:

- a video of their product/service (the solution to the challenge).
- a presentation reporting in details the challenge resolution: the initial objectives and what has been achieved with the proposed idea; the potential users and their characteristics; strengths/benefits/opportunities and weaknesses/threats of the proposed idea; the visual representation of the developed idea)

A group of international judges, made up of both academic and industrial representatives, evaluated the proposed ideas and awarded the following prizes:

- 1st prize to the Italian IT-2 Team
- 2nd prize to the Finnish FI-1 Team
- 3rd prize to the Italian IT-1 Team

All the video on the challenges' solutions are reported as Annexes of this document.

List of Annexes

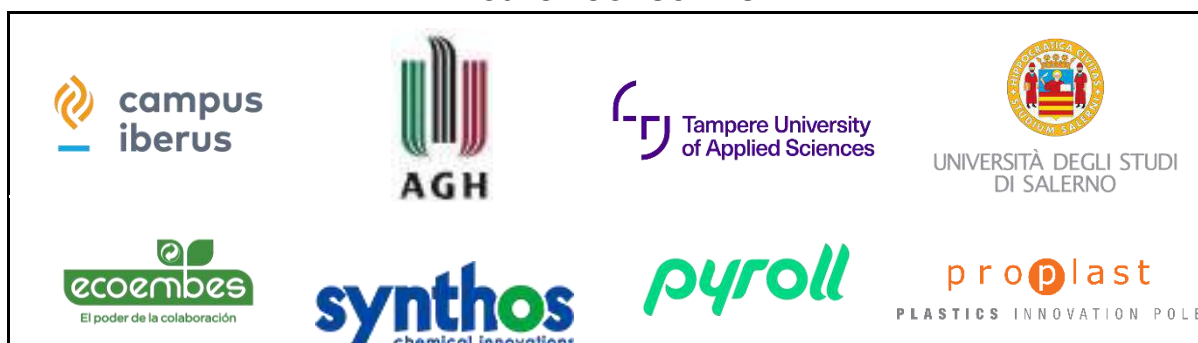
- Team SP-1 Presentation
- Team SP-1 Solution Video
- Team PO-1 Presentation
- Team PO-1 Solution Video
- Team PO-2 Presentation
- Team PO-2 Solution Video
- Team FI-1 Presentation
- Team FI-1 Solution Video
- Team IT-1 Presentation
- Team IT-1 Solution Video
- Team IT-2 Presentation
- Team IT-2 Solution Video

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