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NextGEng

International Cooperation Framework for Next Generation Engineering Students

CEL implementation Guide

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

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1. Introduction

The objective of this guide is to provide guidance for the implementation of Cases for Experiential Learning (CEL) projects, developed within the framework of the NextGEng project [1]. It begins by outlining how experiential learning models, created in previous European initiatives involving the partner universities, contributed to the development of CEL. It then defines what a CEL project is and explains how it should be carried out. Next, it summarizes the two rounds of implementation conducted within the NextGEng project, followed by a presentation of the main results and participants' feedback. The report concludes with key lessons learned from this experience. In addition, the CEL Guide includes three annexes:

- Annex 1 provides an example of a schedule of activities conducted during a CEL intensive week.
- Annex 2 contains sample surveys administered to students and supervisors.
- Annex 3 presents examples of results from projects proposed by research groups, specifically CEL2-TUCN RG and CEL6-UJA RG.

2. New models for experiential learning

The university partners of the NextGEng project had already been cooperating for several years before its launch, during which they worked on improving university teaching in engineering. One of the lines of action was the development of experiential learning models.

It is well known that experiential learning is a pedagogical approach where students learn by doing reflecting on real or simulated experiences to strengthen understanding and improve future practice [2]. It is characterized, first and foremost, by the **active participation of students**. Rather than being passive recipients of information, learners are directly engaged in practical tasks, projects, or problem-solving activities. Another defining feature is its **real-world relevance**. Activities are designed around authentic professional contexts or simulations that closely mirror industry challenges. A third characteristic is the **feedback**. Students are encouraged to analyze their

experiences, identify strengths and weaknesses, and draw conclusions that will guide their future actions. Experiential learning also fosters the development of **transversal or soft skills** such as teamwork, communication, problem-solving, and critical thinking [3]. Because learners work collaboratively and often in multidisciplinary or international teams, they cultivate skills that are essential in today's labor market [4].

All of the above is present in the CEL projects and in the previous developments that inspired their origin. New models for experiential learning were first introduced in the RePCI project as multidisciplinary Real-Life Problem Solving (RLPS) [5]. Here, engineering students from the mechanical degree and from different institutions formed mixed groups to tackle challenges proposed by companies, with the company selecting the best solution. Later, in the HEIBus project, the approach expanded beyond other engineering disciplines, and even incorporated a virtual format for students unable to travel [6]. The NextGEng project has advanced the model further by involving not only company-driven challenges but also research group projects [7], [8].

The evolution of these models has led to the development of the CEL projects, a consistent model that has been widely welcomed by all project participants. Table 1 compares three experiential learning by highlighting how student groups are structured, how they work, and who proposes the project topics.

Project/Model	**Number of groups**	**Student per group**	**Group characteristics**	**Modality**	**Intensive weeks**	**Topic**
RePCI /RLPS	2	8 (4 from HEI X + 4 from HEI Y)	Teams formed between two universities (Same studies and international)	Mixed: on-site (intensive weeks) + virtual (distance work)	2 (one at HEI X and one at HEI Y)	Company

HEIBus / RLPS	3	6 (2 from HEI X + 2 from HEI Y + 2 from HEI Z)	Teams formed from 3 universities (Multidisciplinary and international)	2 mixed groups (on-site + virtual) and 1 fully virtual group	1 (at HEI X)	Company
NextGEng / CEL	3	6 (similar to HEIBus)	Teams formed from 3 universities (Multidisciplinary and international)	Mixed, no fully virtual groups	1 (at HEI X)	Company or Research group

Table 1. Comparison of structures in experiential learning models

3. Description of CEL projects

As mentioned before, a CEL project is a collaborative educational model that connects universities and companies through real-world problem solving. In a CEL, students from different universities and disciplines are grouped into international teams to address a challenge proposed either by a company or a research group.

The process begins with an **intensive kickoff week** at the host institution, where students receive targeted training and define their project plan. Teams then **work remotely** for several weeks, guided by academic supervisors and company experts. Finally, they **present their solutions** in a virtual seminar and the proposing organization evaluates and selects the most effective one (Figure 1).

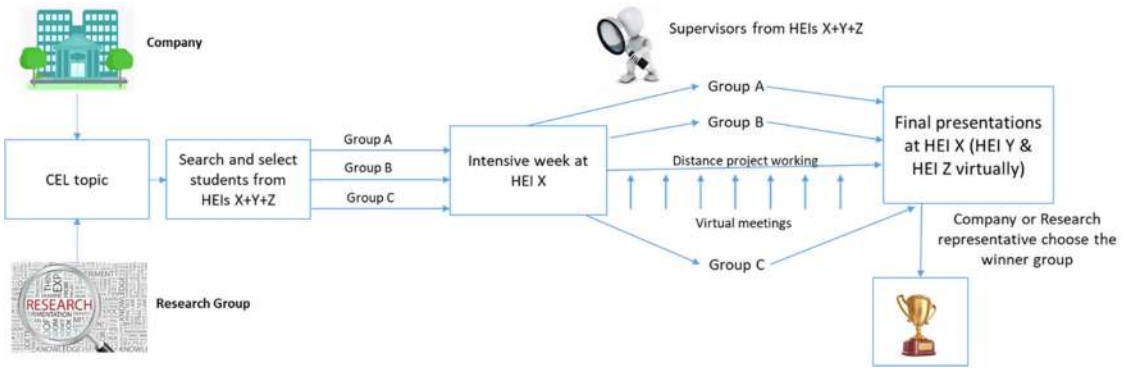

Figure 1. CEL project description

CEL projects combine active learning, industry relevance, and international collaboration, allowing students to apply theory to practice, develop technical and transversal skills, and experience authentic teamwork in a multicultural environment. Figure 2 illustrates the structure of a CEL project. Each CEL project involves at least 25 participants. This includes:

- At least one company or research group supervisor, who proposes the real-life case to be solved.
- Six academic supervisors, with two professors from each of the three participating universities (UJA – University of Jaén, JAMK – University of Applied Sciences, and TUCN – Technical University of Cluj-Napoca).
- Eighteen students, organized into three international and multidisciplinary teams (Group A, Group B, and Group C).

Considering the implementation of the six CEL projects, more than 150 participants have benefited from this activity.

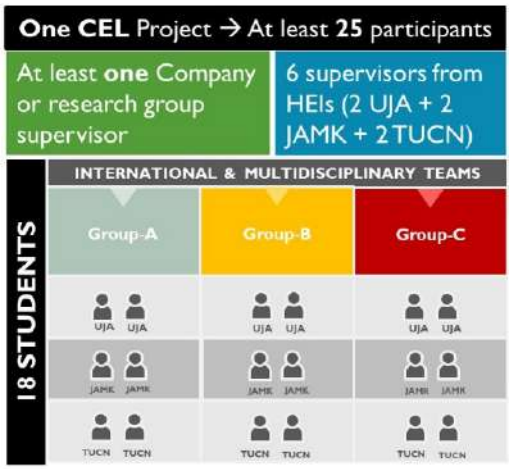

Figure 2. Structure of a CEL project

4. Implementations in NextGEng

The six CEL projects were delivered in two rounds, each comprising three projects. The first-round projects run from February to April 2024 and the second one in the same period but in 2025. A brief summary of these implementations is now described.

4.1 CEL1-ISR

ISR company proposed a topic related with the agri-food sector: the design of a machine vision system for the inspection of fruits, to be installed at the reception yard in an oil mill and it was hosted by UJA. The **intensive week** began with an institutional welcome and a project introduction by ISR representatives. Students attended two tailored seminars (on hyperspectral technology and computer vision/image processing) and participated in six project work sessions, including an image acquisition session to collect fruit images for later algorithm development. The week concluded with group presentations to supervisors and ISR representatives, outlining plans for the distance phase and draft solutions. Figure 3 shows an example of the activities carried out during the intensive week.

Figure 3. Activities during the CEL1-ISR intensive week. Left: company visit; Right: seminar with the hyperspectral system

Students valued the experience, highlighting the usefulness of the seminars, the organization of the week, and the opportunity to collaborate internationally. They suggested extending the intensive week by one or two days to allow more time for face-to-face work and group integration. Supervisors and company experts echoed these points, recommending additional working hours,

simple group dynamics to accelerate student integration, and separating kick-off weeks for different projects. Both groups praised the motivation of the teams and the quality of ideas presented.

During the virtual work, students met three times with supervisors and company experts. Finally, students presented their final work in a **virtual seminar** on 19 April 2024. Evaluation criteria covered the quality of reports, presentations, and answers to questions.

4.2 CEL2-TUCN RG

The topic was proposed by the research group of Applied Mechatronics Research Laboratory, from TUCN and was hosted by this university. The main objective was the design a 3-axes GANTRY ROBOT subjected to a predefined requirement. The **intensive week** began with registration, a welcome session, and presentations on the project and its goals. A tailored lecture was delivered on Modeling Mechatronic Systems using Matlab/Simscape Toolbox. Students participated in six project work sessions, where they developed work plans, assigned team roles, generated and analyzed solution concepts, selected a final concept, and created initial virtual models. The week ended with group presentations of draft solutions and plans for remote work. A cultural and social activity in Cluj-Napoca complemented the academic program. Figure 4 shows an examples of the activities developed during the intensive week.

Figure 4. Activities during the CEL2-TUCN RG intensive week. Left: Laboratory visit; Right: Participants welcome

It was successfully implemented according to plan, with overall positive feedback from both students and supervisors. Social activities contributed to networking and collaboration but it was need additional face-to-face time.

After the virtual work, supervised by expert and the RG representative, students presented achieved results in a **virtual seminar** held on April 18, 2024. They were assessed according to clear criteria focused on system design, specifically addressing its advantages, drawbacks, and limitations. There were also identified areas for improvement, particularly regarding time allocation and clearer reporting guidelines.

4.3 CEL3-Valmet

The Finish company, Valmet, proposed the topic: pressing manufacturing test object, with a variety of designed geometries, for new pulp-based manufacturing technology and it was hosted by JAMK. The **intensive week** included introductions, a presentation from Valmet on the project challenge, one tailored lecture on project work and iterative design, six project work sessions, a company visit to Valmet, and final group presentations. A social event was also organized. Afterward, virtual meetings with supervisors and company representatives, along with a final seminar, were scheduled. Figure 5 shows examples of these activities.

Figure 5. Activities during the CEL3-Valmet intensive week. Left: company visit; Right: project work

Both students and supervisors valued the intensive week positively. Students appreciated the guidance and lectures but felt the schedule was too short and would benefit from more days of

face-to-face work and social interaction. Supervisors highlighted the good organization, student motivation, and collaboration achieved, while also recommending more time for group integration and project work. In general, the experience was considered enriching and well-structured, with room for improvement by extending its duration.

After the distance work, students presented their results in a **virtual seminar** on April 26, 2024. Evaluation criteria included innovativeness, report quality, and presentation performance.

There were also identified areas for improvement. Students highlighted the need for clearer and more detailed instructions for the final report, as some found the guidelines too broad. Additional support from supervisors at the beginning of the project was recommended, since the topic was wide and difficult to focus on without guidance. Supervisors noted the importance of including proper references in final reports and ensuring that oral presentations follow a clear structure with all essential sections. Another observation was to avoid overloaded slides with too many graphics or unclear explanations. Finally, they suggested incorporating simple group dynamics at the beginning to help students integrate more quickly into international teams.

4.4 CEL4-Bosch

The CEL4 project, carried out with Bosch Cluj Plant, focused on evaluating screw tightening and elongation in PCB mounting operations, aiming to identify the optimal tightening range for M6 screws. The **intensive week** was hosted by TUCN and the program began with a welcome session, a project briefing by Bosch experts, and the first part of a tailored lecture on “Problem-solving in Engineering.” Students were divided into international teams, defined roles, and planned their project approach. On the second day, participants visited the Bosch plant for a factory tour and continued the problem-solving training (Figure 6). The last two days were dedicated to intensive team project work, cultural activities in Cluj-Napoca, and final presentations where students demonstrated technical understanding and teamwork. Supervisors and company experts provided feedback and evaluation.

Students appreciated the balance between technical and social activities, though some suggested extending the week or receiving more technical data earlier. Supervisors and company experts also

gave strongly positive feedback. They endorsed the student selection and team composition, found the agenda effective, and confirmed that students gained new competencies and were highly engaged. The social events were considered beneficial for collaboration.

Figure 6. Activities during the CEL4-Bosch intensive week. Left: company visit; Right: project work

Once the virtual phase of the project was completed, the outcomes were formally presented in a **virtual seminar** held on April 10, 2025. Student teams were assessed on two main aspects. First, the quality of their reports was examined, considering both strengths and weaknesses as well as the overall completeness. Second, their presentations were evaluated in terms of content, duration, clarity of development, and the ability to respond effectively to questions from supervisors. Finally, when choosing the winning group, an additional element was considered: the potential of each proposed solution for industrial application.

4.5 CEL 5-JAMK

The topic was the design of a cleaning mechanism for the blade change device. The **intensive week** was organized by JAMK and it began with an introduction to the project and team formation. A tailored lecture on iterative design, which also introduced the company's targets, was delivered. Students then engaged in seven structured project work sessions, each with clear objectives. They visited VALMET facilities and JAMK laboratories, and participated in a social activity including an evening meal and sauna (Figure 7). The week concluded with team presentations where students proposed draft solutions and received feedback, followed by the scheduling of virtual meetings for ongoing supervision.

Students and supervisors expressed very high satisfaction with the intensive week. The agenda and activities were seen as well-structured and engaging, support was valued, teamwork was effective, and the overall organization was considered excellent.

Figure 7. Activities during the CEL5-Valmet intensive week. Left: company visit; Right: project work

The **virtual seminar** took place on April 11, 2025. Students were evaluated on the quality of their reports, the content and structure of their presentations, and their ability to answer questions from supervisors and company experts, with additional consideration given to the potential for industrial application of their solutions. The strengths of the project included innovative technical proposals, effective teamwork, strong support from supervisors and Valmet experts, and high levels of student satisfaction. Areas for improvement focused on providing presentation materials earlier, offering more detailed guidance at the start of the project, and strengthening collaboration within some teams during the distance work phase.

4.6 CEL6-UJA RG

The project was proposed and hosted by the INGEMER research group from UJA. The topic was focused on redesign through additive manufacturing. The **intensive week** program included two tailored seminars: one on jet engine fundamentals and mockup requirements, and another on design for manufacturing (DFM) and detailed design (Figure 8). Students also carried out CAD-CAE-CAM mockup work, completed six project sessions, and used 3D printing to create mockups. Each group presented their draft solutions, simulations, and work plans for the distance phase. Company visits to Meltio and Sicnova, both experts in additive manufacturing, and a social event in Jaén city center complemented the technical program.

Figure 8. Activities during the CEL6-UJA RG intensive week. Left: group picture; Right: project work

Both students and supervisors expressed strong satisfaction with the intensive week. The agenda and support were highly valued, participants gained new competences, and the organization was praised, though some students suggested lighter workloads.

The final **virtual seminar** was held on April 11, 2025. Students were assessed on the quality of their written reports, the content and clarity of their presentations, and their ability to respond to questions, with additional consideration of the industrial applicability of their solutions. The main strengths highlighted were the challenging and motivating topic, the effective international teamwork, the support from supervisors, and the acquisition of both technical and soft skills. Suggestions for improvement focused on providing clearer information about the project objectives before the intensive week and extending the duration of the on-site activities to allow a more balanced workload.

5. Results and discussion

The comparative Table 2 shows the results achieved in the six CEL projects. The winner team in CEL1 built a complete olive quality control system that combined mechanical, pneumatic, and computer vision components into a functional design. The winner team in CEL2 designed and validated a gantry robot with advanced kinematic modeling and Matlab simulations. In CEL3, students developed a foldable box test object with pivoting action and adaptability, which was recognized as both practical and creative. The best team in CEL4 project focused on PCB screw tightening,

identifying dimensional tolerance issues and proposing an industrially viable adjustment to housing diameter. In CEL 5, the winner team produced an innovative dual-scraper modular system with vacuum integration, considered robust, adaptable, and efficient. Finally, in CEL6, the winner team delivered diverse outputs including DEM simulations, mockups, and CFD analyses that showcased strong analytical depth.

Overall, the results confirm the effectiveness of experiential learning projects: they provide tangible technical solutions while simultaneously preparing students with the professional skills needed in engineering practice.

Project	Topic	Winner	Main Results
CEL1 – ISR	Olive quality control system	Group C	Complete design: mechanical, pneumatic, and electrical calculations; fully developed and validated computer vision system.
CEL2 – TUCN	Design of 3-axes gantry robot	Group B	H-bot system with additional belt for Z-axis; validated in Matlab.
CEL3 – Valmet	Pulp-based manufacturing test objects	Group B	Foldable box with pivoting action and large surfaces; innovative and adaptable.
CEL4 – Bosch	PCB mounting: screw tightening	Group C	Identified dimensional tolerances as main issue; viable solution: increasing housing diameter.
CEL5 – JAMK	Cleaning mechanism for blade change device	Group A	Innovative dual-scraper modular mechanism with vacuum integration; durable and adaptable.

CEL6 – UJA RG	Product redesign via Additive Manufacturing	Group B	A: DEM simulation; B: complete analysis with mockup; C: CFD simulations.

Table 2. CEL Projects Results

Table 3 shows the target quality indicators and the results achieved after the completion of the projects. All six projects reached a 100% pass rate, surpassing the target of 90%, which confirms that the academic objectives were fully met. In terms of feedback and support, results varied slightly: projects like CEL5 (JAMK) and CEL6 (UJA RG) reached excellent levels with close to or full agreement from both HEI supervisors and company experts, while CEL4 (Bosch) showed lower satisfaction from company support (63.6%), suggesting an area for improvement.

Regarding soft skills, all projects exceeded the 70% target. CEL4 and CEL5 stood out with unanimous agreement from supervisors, while CEL6 showed slightly lower figures (80%), though still above the target. For technical competences, again the projects performed well, with CEL4 and CEL5 achieving 100% supervisor agreement. CEL6 recorded the lowest score at 87.5%, still comfortably meeting the expected threshold.

Project	**Q1 – Feedback & Support**	**Q2 – Pass Rate**	**Q3 – Soft Skills**	**Q4 – Technical Competences**
Target	≥50% positive feedback from students	≥90% of students pass	≥70% students improve soft skills	≥70% students improve technical competences
CEL1 – ISR	78.2% agree about HEI support; 86.6% agree about company support	100%	90.9% of supervisors agreed	81.8% of supervisors agreed
CEL2 – TUCN	78.2% agree about HEI support; 86.6%	100%	90.9% of supervisors agreed	81.8% of supervisors agreed

	agree about RG support			
CEL3 – Valmet	78.2% agree about HEI support; 86.6% agree about company support	100%	90.9% of supervisors agreed	81.8% of supervisors agreed
CEL4 – Bosch	90.9% agree about HEI support; 63.6% agree about company support	100%	100% of supervisors agreed	100% of supervisors agreed
CEL5 – JAMK	100% agree about HEI support; 100% agree about company support	100%	100% of supervisors agreed	100% of supervisors agreed
CEL6 – UJA RG	100% agree about HEI support; 92.3% agree about company support	100%	80% of supervisors agreed	87.5% of supervisors agreed

Table 3. Comparative Table – Indicators (Target vs. Achieved)

6. Conclusions

The CEL projects implemented within the NextGEng framework demonstrate the successful evolution of experiential learning models. Building on previous initiatives such as RePCI and HEIBus, the CEL format has proven to be an effective structure that combines intensive kickoff weeks, distance teamwork, and virtual seminars to address real industrial and research challenges. The strengths of this model lie in its strong alignment with real-world contexts, the development of both technical and transversal skills, and the opportunities it creates for multicultural collaboration.

The structure of student groups has evolved across the different models. In RePCI/RLPS, two large groups of eight students were formed, each comprising participants from two universities within the same engineering discipline. The HEIBus/RLPS project advanced this model by creating three smaller, multidisciplinary, and international groups of six students each, including one fully virtual team. NextGEng/CEL retained the three-group structure of around six students but removed the fully virtual option, relying instead on mixed formats. This evolution reflects a clear trend toward smaller, more diverse, and flexible learning environments.

The implementation of the six CEL projects also highlighted consistent strengths. All projects achieved a 100% pass rate, exceeding the target of 90%. Students improved their technical competences and soft skills, with supervisors confirming these results across all cases.

When comparing the first round of projects (CEL1, CEL2, CEL3) with the second round (CEL4, CEL5, CEL6), clear progress can be seen. In the first round, the main challenges were related to time constraints, limited integration of international teams, and the need for clearer reporting structures. These observations were addressed in the second round, where agendas were more structured, supervisor and company involvement was more consistent, and teamwork was reinforced, leading to higher levels of satisfaction and stronger outputs. The fact that CEL5 and CEL6 achieved unanimous or near-unanimous agreement from supervisors on both technical and soft skill improvements indicates that the lessons from the first round were successfully integrated into the second.

By contrasting the projects proposed by research groups and those proposed by companies, a clear distinction emerges. The research group projects (CEL2 and CEL6) are characterized by a strong academic innovation component, with a focus on modeling, simulation, and experimental prototyping. However, they show certain limitations in terms of practical validation and industrial maturity.

In contrast, the projects proposed by companies (CEL1, CEL3, CEL4, and CEL5) are more directed toward solving immediate challenges with direct industrial applications. Their results tend to be

more easily transferable and applicable in production environments, though they involve less conceptual exploration than those driven by research groups.

In summary, the CEL projects reaffirm the value of experiential learning as an effective pedagogical strategy in engineering education. They not only foster exploratory and innovative solutions but also deliver tangible technical outcomes with clear industrial relevance, all while preparing students for professional practice in international and multidisciplinary contexts.

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Annex 1

Three CEL project schedules are presented as examples of activities carried out in each of the partner countries. The rest can be consulted at: https://nextgeng.eu/cases-for-experiential-learning-projects/.

The ISR CEL Project (University of Jaén, February 2024) combined a balanced structure of seminars, laboratory work, and presentations. After an introductory session and a tailored seminar on computer vision and hyperspectral imaging, students engaged in intensive project work, organized by teams. The agenda allocated long blocks of time for hands-on laboratory activities, complemented by discussions with supervisors. In addition, the program incorporated social activities, including a visit to ISR facilities and a networking dinner, which provided opportunities for informal interaction and cultural exchange. The project concluded with oral presentations and structured feedback, making this agenda highly intensive and enriched by social engagement.

The TUCN CEL Project (Technical University of Cluj-Napoca, February 2024) offered a slightly different balance. The agenda began with a longer introductory phase, including a specialized seminar on modeling mechatronic systems using Matlab/Simscape. Project work focused on the development of virtual models, with dedicated sessions for supervisor discussions and laboratory visits. Compared to Jaén, the workload was more evenly distributed across theory, practical modeling, and cultural activities, including a guided tour of the city center. This agenda reflected a medium-to-high level of complexity, combining technical development with cultural immersion, while maintaining steady progress in project implementation.

The Valmet CEL Project (JAMK University of Applied Sciences, Jyväskylä, February 2025) was conducted in the second round and therefore incorporated feedback from the surveys of the first round, where both supervisors and students highlighted the need for one additional day in the intensive week. The agenda reflected this improvement, offering a more extended program that allowed for deeper project development. After the initial introduction and team formation, students attended a comprehensive seminar on iterative design, directly linked to industrial practices. The schedule included visits to Valmet and JAMK laboratories, along with long sessions of project work. Social and cultural activities also played an important role, with an evening sauna event fostering

team building and informal networking. This agenda placed strong emphasis on iterative design, practical application and industry collaboration team building and informal networking.

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AGENDA - ISR CEL Project

Event : ISR CEL Project
Location : University of Jaén, Building A3 - Campus Las Lagunillas
Period : 11 – 15 February 2024

Sunday – 11 Feb	Monday – 12 Feb	Tuesday -13 Feb	Wednesday -14 Feb	Thursday -15 Feb
Participants arrival to Jaén	9.00-9.30 Introduction to CEL intensive week (A3-D165) 9.30-9.45 Introduction of the participants 09.45 -10.30 Project topic presentation 10.30-11.00 – Coffee Break (A3-D158) 11.00 – 12.00 Tailored course (Seminar) – Computer vision foundations & *Hiperspectral Images (Tecnology & Image Acquisition)*(A3-D165) 12.00 -13.00 Project work (labs: Group A: A3-D264, Group B: A3-D265-266, Group C: A3-D269-270) *- define the team's work plan for the Intensive week* *- Choosing of team leader and group members roles*	9.00-10.00 Tailored course (Seminar) – Image processing (A3-D165) Discussion with Supervisors (labs) 10.30-11.30 Project work (labs) *- chose the developed concepts and further detail them* 11.30 – 13.00 Image acquisition (labs)	9.00-9.30 Discussion with Supervisors (labs) 9.30-11.00 Project work (labs) *- define tasks and deadlines for the remote work period* 11.00-13.00 Project work (labs) *- create the ppt for the oral presentation*	Participants departure
	13:30-14:30 Lunch Break	13:30-14:30 Lunch Break	13:30-14:30 Lunch Break	
	15.00 -17.00 Project work (labs) *- define multiple concepts for the proposed task* *- analyze the strengths and weaknesses of the proposed solutions*	15.00 -18.00 Project work (labs) *- initial steps in developing the concepts*	15.00 - 17.00 - Oral presentations (A3-D165) *- team A (25 min)* *- team B (25 min)* *- team C (25 min)* 17.00-17.30 Feedback and discussions (A3-D165)	
	17:30 – 19:00 ISR visit	19.00 - Social event & Dinner		

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Figure 9. Agenda CEL1-ISR

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AGENDA – TUCN CEL Project

Event : TUCN CEL Project
Location: Technical University of Cluj-Napoca, Muncii Blvd., No. 103, Building C, Room C304
Period : 12 – 16 February 2024

Monday -12 Feb	Tuesday – 13 Feb	Wednesday – 14 Feb	Thursday – 15 Feb	Friday - 16 Feb
Participants arrival to Cluj	8.45-9.00 Participants welcome and registration *(Room C304)* 9.00-9.30 Start of the intensive week *(Room C304)* *Introduction to CEL intensive week* *Introduction of the participants* 09.30 -10.20 Project topic presentation *[Prof.Olimpiu Hancu]* *(Room C304)* 10.30 – 12.30 Tailored course - *Modeling mechatronic systems using Matlab/ Simscape Toolbox* *[Prof.Olimpiu Hancu]]* *(Room C304)*	8.30-9.30 Discussion with Supervisors 9.30-11.30 Project work *(Labs)* *- chose the developed concept and further detail it* 11.30 – 12.30 TUCN Laboratory visit	8.30-9.30 Discussion with Supervisors 9.30-11.30 Project work *(Labs)* *- development of the virtual model* *- define tasks and deadlines for the remote work period* 11.30-12.30 Project work *(Labs)* *- create the ppt for the oral presentation*	Participants departure
	12.30 Lunch Break	12.30 Lunch Break	12.30 Lunch Break	
	14.00 -16.30 Project work *(Labs)* *- define the team's work plan for the Intensive week* *- Choosing of the team leader and group members roles* *- define 2/3 concepts for the proposed task* *- analyze the strengths and weaknesses of the proposed solutions*	14.00 -16.30 Project work *(Labs)* *- initial steps in developing the virtual model* 16.30 - Social event: *Travel to the city centre, student Guided tour of Cluj-Napoca*	14.00-14.30 Project work *(Labs)* *- prepare the oral presentation* 14.30- 16.00 - Oral presentations *- team A (25 min)* *- team B (25 min)* *- team C (25 min)* 16.00-16.30 Feedback and discussions	
		19.00 Dinner		

Figure 10. Agenda CEL2-TUCN RG

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AGENDA - VALMET CEL Project in Jyväskylä

Event : Valmet CEL Project
Location: Jamk University of Applied Sciences, Rajakatu 35, Jyväskylä
Period : 10 – 14 February 2025

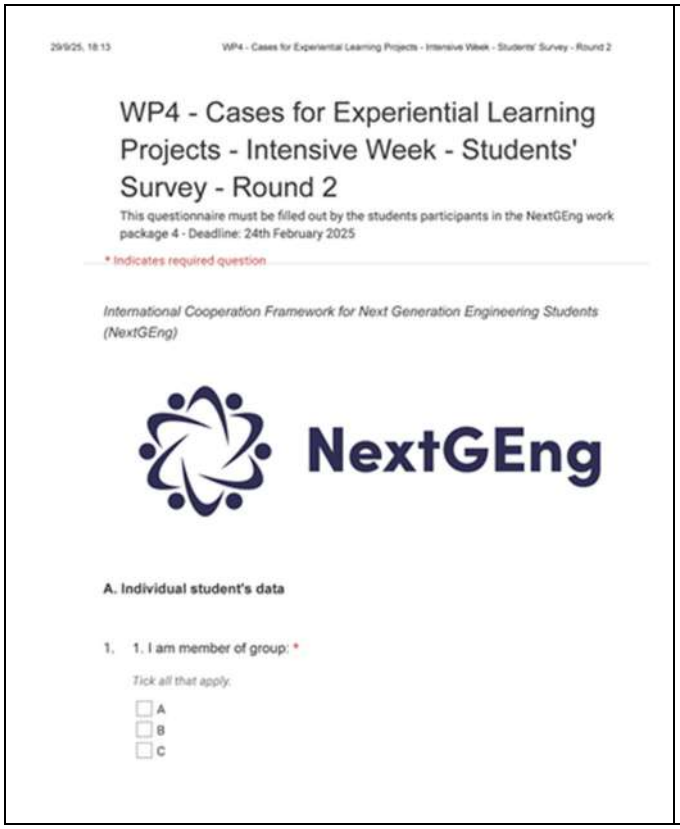
Monday -10 Feb	Tuesday – 11 Feb	Wednesday – 12 Feb	Thursday – 13 Feb	Friday – 14 Feb
Participants arrival to Jyväskylä	9:00-9:30 Introduction to CEL intensive week at D149 9:30-10:15 Introduction of the participants 10:15 -10:30 Define the teams 10:30-10:45 – Break 10:45 – 12:00 Tailored course – *Project work and iterative design* Project topic presentation *- define the team's work plan for the intensive week* *- Choosing of team leader and group members roles* 12:00-12:30 Transportation to VALMET	9:00-9:30 Discussion with Supervisors at FK14 9:30-12:30 Project work *- define multiple concepts for the proposed task cont.* *- analyze the strengths and weaknesses of the proposed solutions choose the developed concepts and further detail them*	9.00-9.30 Discussion with Supervisors at D149 9.30-11.00 Project work *- identify and analyze the potential issues with the developed concepts and further detail them* *- analyze the process and propose potential solutions* 11.00 – 12.00 JAMK Laboratory tour	9:00-10:00 Project work at D148 *- create the ppt for the oral presentation* 10:00-12:00 Oral presentations and discussions *- team 1 (25 min)* *- team 2 (25 min)* *- team 3 (25 min)* 12.00-12.30 Feedback and discussions
	Lunch at VALMET	Lunch at JAMK	Lunch at JAMK	Lunch at JAMK
	13:30 – 16:00 *- background info and Valmet targets for the intensive week* 16:00-16:30 Transportation back to JAMK 16:30-18:00 Project work *- define multiple concepts for the proposed task*	13:30 -16:00 Project work *- initial steps in developing the concepts* 18:00 – Social event: Evening meal and sauna evening	13.30-16.30 Project work *- analyze the process and propose potential solutions* *- define tasks and deadlines for the remote work period* 16:30-18:00 Project work *- create the ppt for the oral presentation*	

Figure 11. Agenda CEL5-JAMK&Valmet

Annex 2

Four examples of surveys are here presented. Table 4 and Table 5, respectively, show the student and expert / supervisors surveys designed to assess the intensive week. Table 6 presents the student survey after the virtual seminar. Finally, Table 6 and Table 7, respectively, show the student and expert / supervisors surveys designed to assess the CEL projects in the virtual seminar.

The survey questions were useful for gathering information on the qualitative indicators of the activities carried out within the framework of the NextGEng project



29/9/25, 18:13 WP4 - Cases for Experiential Learning Projects - Intensive Week - Students' Survey - Round 2

WP4 - Cases for Experiential Learning Projects - Intensive Week - Students' Survey - Round 2

This questionnaire must be filled out by the students participants in the NextGEng work package 4 - Deadline: 24th February 2025

* Indicates required question

International Cooperation Framework for Next Generation Engineering Students (NextGEng)

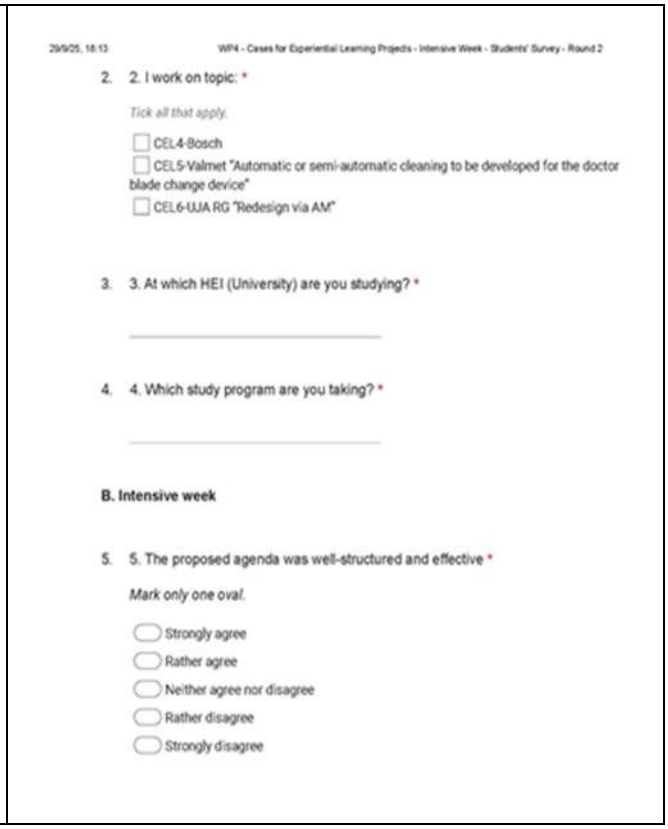
NextGEng

A. Individual student's data

1. 1. I am member of group: *

Tick all that apply.

- [ ] A
- [ ] B
- [ ] C



29/9/25, 18:13 WP4 - Cases for Experiential Learning Projects - Intensive Week - Students' Survey - Round 2

2. 2. I work on topic: *

Tick all that apply.

- [ ] CEL4-Bosch
- [ ] CEL5-Valmet "Automatic or semi-automatic cleaning to be developed for the doctor blade change device"
- [ ] CEL6-UJA RG "Redesign via AM"

3. 3. At which HEI (University) are you studying? *

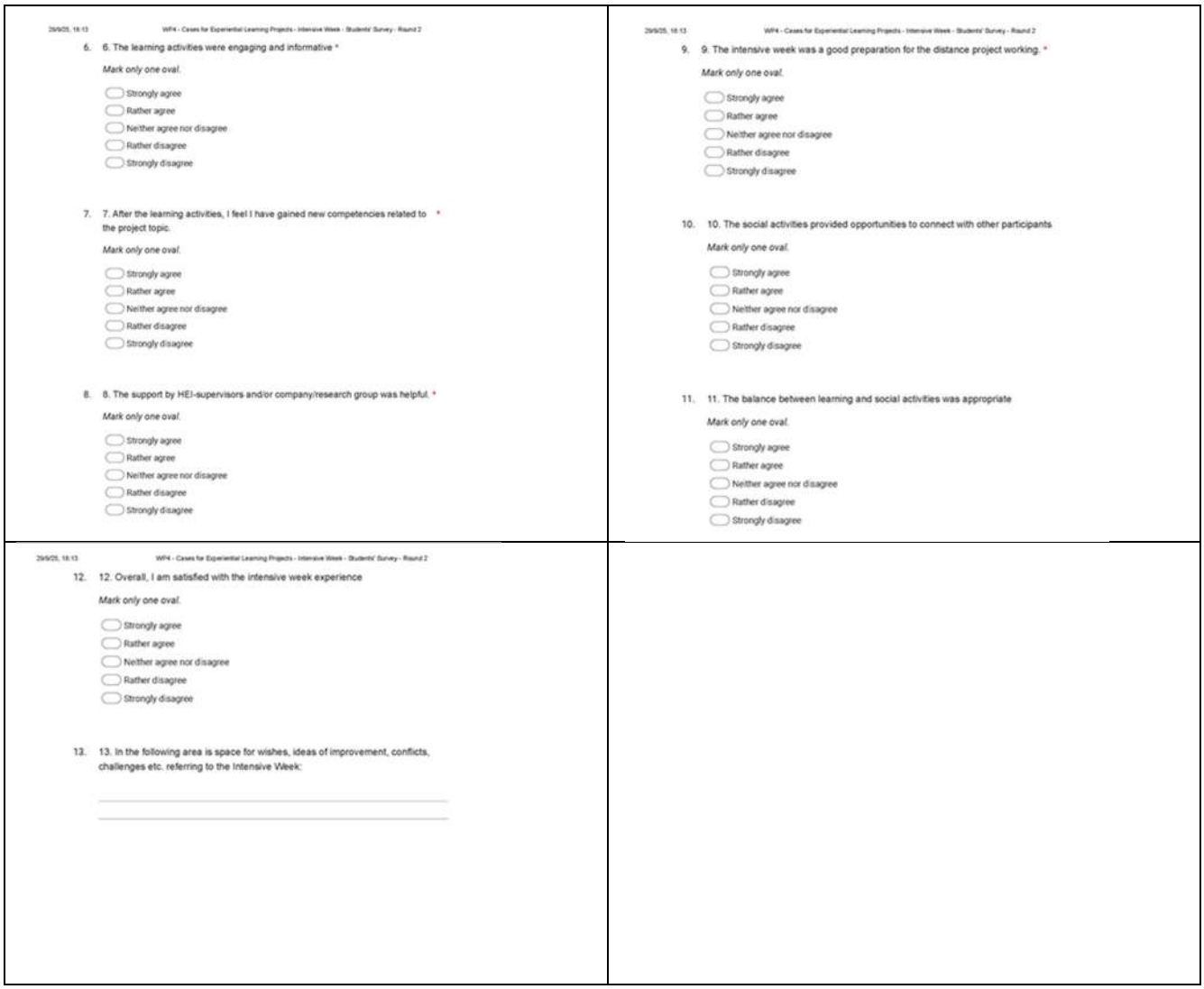
4. 4. Which study program are you taking? *

B. Intensive week

5. 5. The proposed agenda was well-structured and effective *

Mark only one oval.

- ◯ Strongly agree
- ◯ Rather agree
- ◯ Neither agree nor disagree
- ◯ Rather disagree
- ◯ Strongly disagree



29/9/25, 18:13 WP4 - Cases for Experiential Learning Projects - Intensive Week - Students' Survey - Round 2

6. 6. The learning activities were engaging and informative *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

7. 7. After the learning activities, I feel I have gained new competencies related to the project topic. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

8. 8. The support by HEI-supervisors and/or company/research group was helpful. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

29/9/25, 18:13 WP4 - Cases for Experiential Learning Projects - Intensive Week - Students' Survey - Round 2

9. 9. The intensive week was a good preparation for the distance project working. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

10. 10. The social activities provided opportunities to connect with other participants

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

11. 11. The balance between learning and social activities was appropriate

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

29/9/25, 18:13 WP4 - Cases for Experiential Learning Projects - Intensive Week - Students' Survey - Round 2

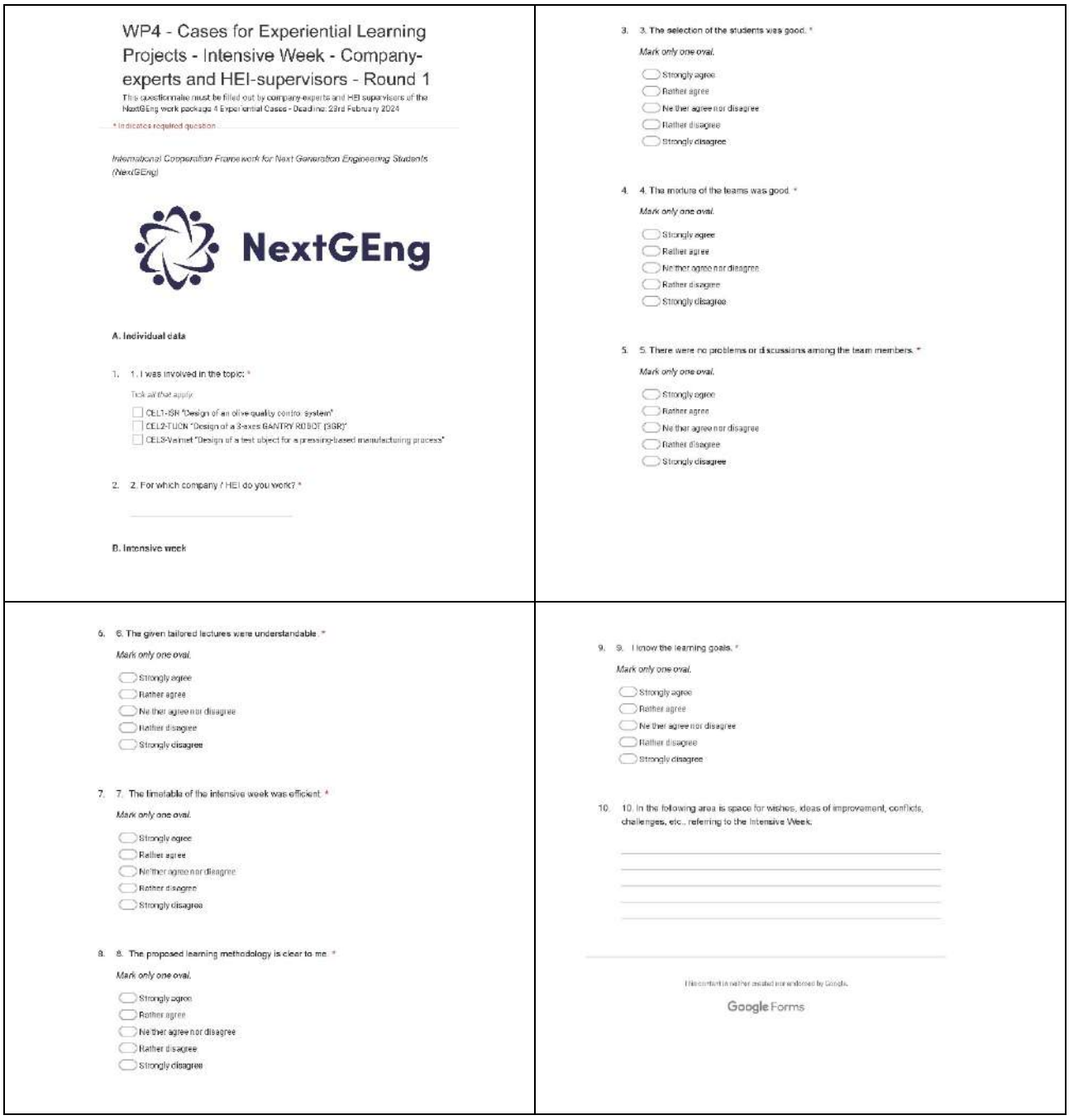
12. 12. Overall, I am satisfied with the intensive week experience

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

13. 13. In the following area is space for wishes, ideas of improvement, conflicts, challenges etc. referring to the Intensive Week:

Table 4. Survey for the students in the intensive week



WP4 - Cases for Experiential Learning Projects - Intensive Week - Company-experts and HEI-supervisors - Round 1

This questionnaire must be filled out by company-experts and HEI supervisors of the NextGEng work package 4 Experiential Cases - Deadline: 23rd February 2024

* Indicates required question

International Cooperation Framework for Next Generation Engineering Students (NextGEng)

NextGEng

A. Individual data

1. 1. I was involved in the topic: *

Tick all that apply.

- CEL1-ISR "Design of an olive quality control system"
- CEL2-TUCN "Design of a 3-axes GANTRY ROBOT (3GR)"
- CEL3-Valmet "Design of a test object for a pressing-based manufacturing process"

2. 2. For which company / HEI do you work? *

B. Intensive week

3. 3. The selection of the students was good. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

4. 4. The mixture of the teams was good. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

5. 5. There were no problems or discussions among the team members. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

6. 6. The given tailored lectures were understandable. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

7. 7. The timetable of the intensive week was efficient. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

8. 8. The proposed learning methodology is clear to me. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

9. 9. I know the learning goals. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

10. 10. In the following area is space for wishes, ideas of improvement, conflicts, challenges, etc., referring to the Intensive Week.

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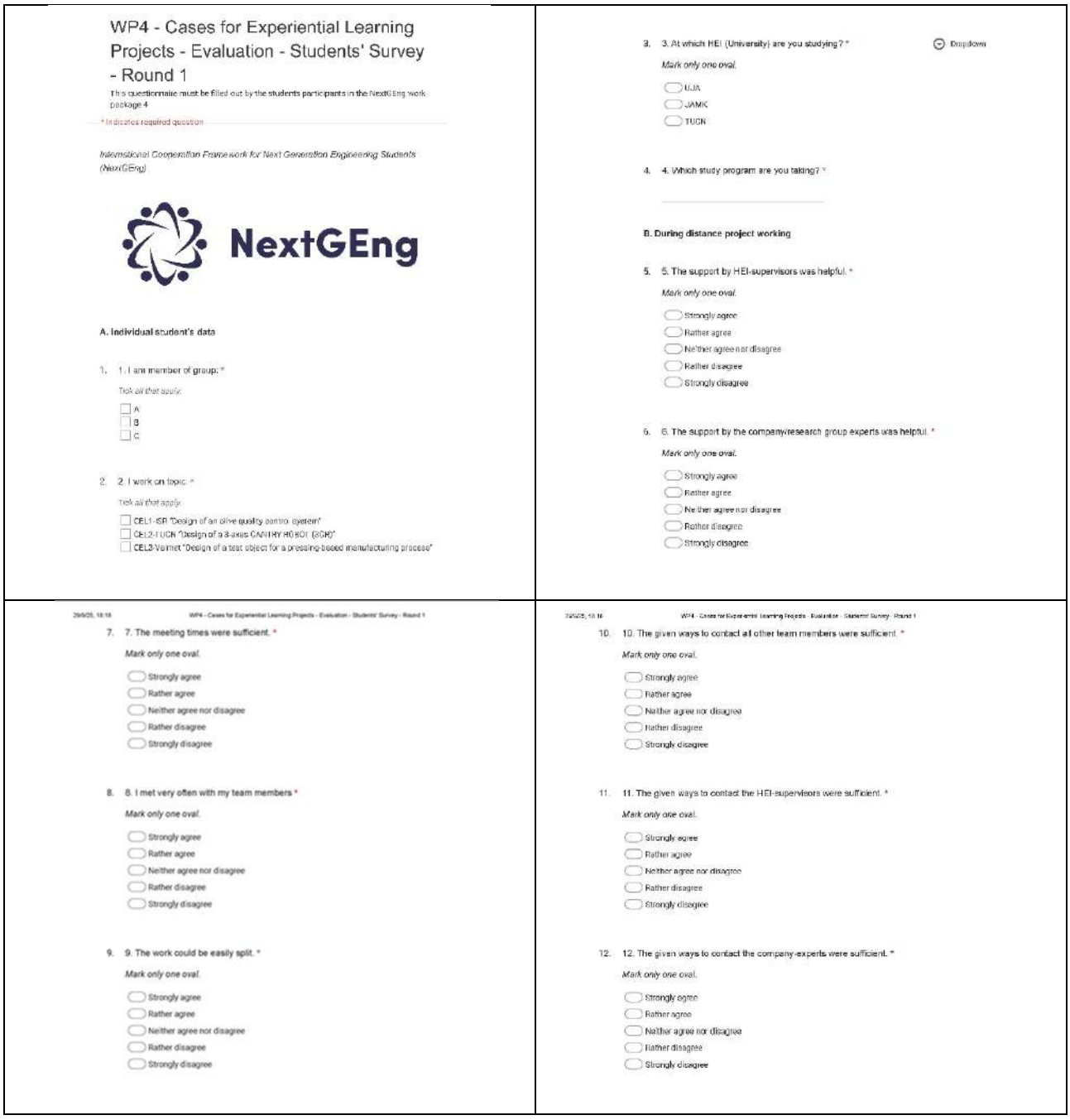
Table 5. Survey for expert & HEI supervisors in the intensive week



WP4 - Cases for Experiential Learning Projects - Evaluation - Students' Survey - Round 1

This questionnaire must be filled out by the students participants in the NextGEng work package 4

* Indicates required question

International Cooperation Framework for Next Generation Engineering Students (NextGEng)

NextGEng

A. Individual student's data

1. 1. I am member of group: *

Tick all that apply.

- A
- B
- C

2. 2. I work on topic: *

Tick all that apply.

- CEL1-ISR "Design of an olive quality control system"
- CEL2-TUCN "Design of a 3-axes CARTHY HOBOT (3CR)"
- CEL3-Valmet "Design of a test object for a pressing-based manufacturing process"

3. 3. At which HEI (University) are you studying? * Dropdown

Mark only one oval.

- UJA
- JAMK
- TUCN

4. 4. Which study program are you taking? *

B. During distance project working

5. 5. The support by HEI-supervisors was helpful. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

6. 6. The support by the company/research group experts was helpful. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

29/5/25, 18:18 WP4 - Cases for Experiential Learning Projects - Evaluation - Students' Survey - Round 1

7. 7. The meeting times were sufficient. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

8. 8. I met very often with my team members *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

9. 9. The work could be easily split. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

29/5/25, 18:18 WP4 - Cases for Experiential Learning Projects - Evaluation - Students' Survey - Round 1

10. 10. The given ways to contact all other team members were sufficient. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

11. 11. The given ways to contact the HEI-supervisors were sufficient. *

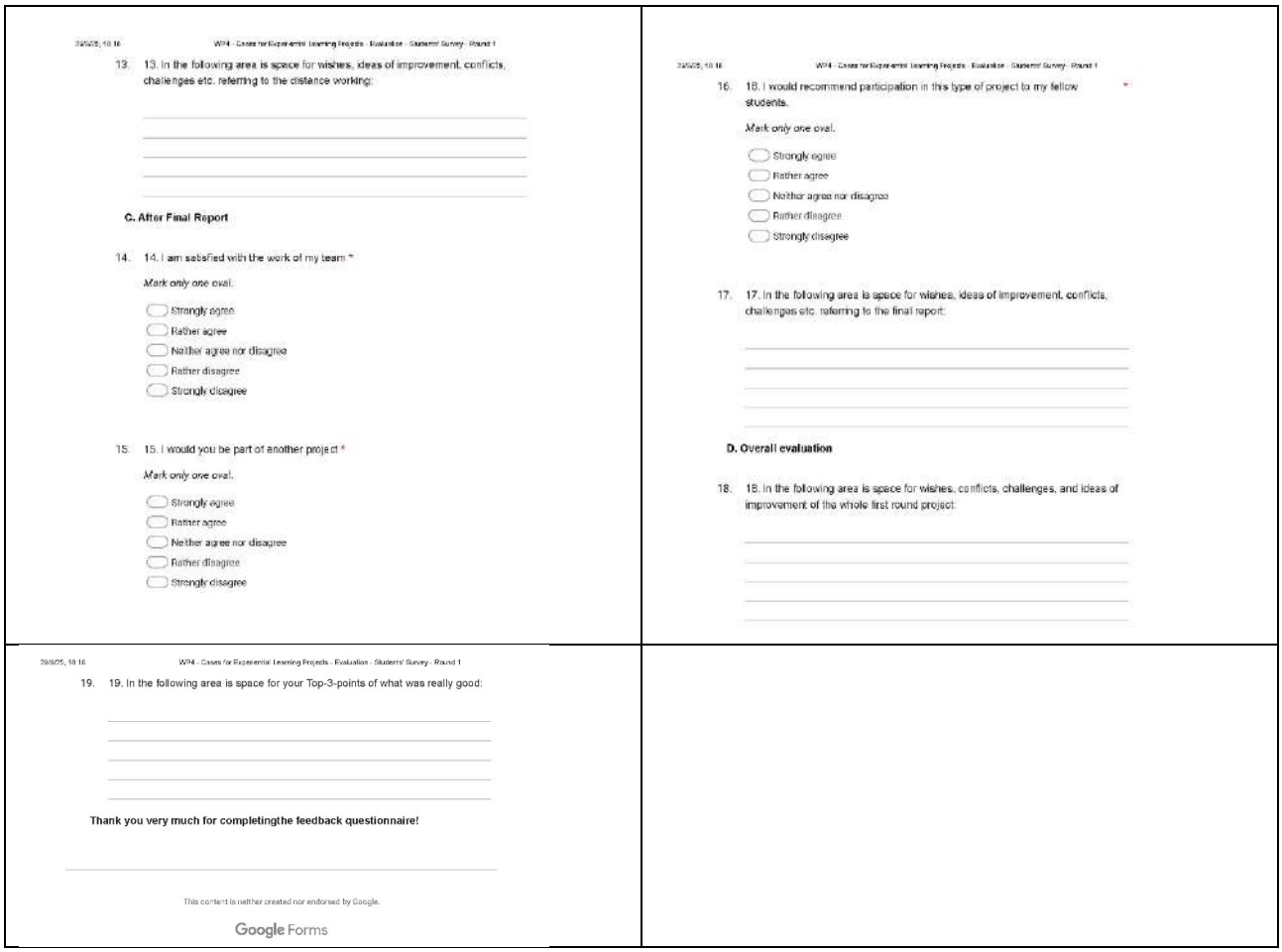
Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

12. 12. The given ways to contact the company-experts were sufficient. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree



13. 13. In the following area is space for wishes, ideas of improvement, conflicts, challenges etc. referring to the distance working:

C. After Final Report

14. 14. I am satisfied with the work of my team *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

15. 15. I would you be part of another project *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

16. 18. I would recommend participation in this type of project to my fellow students. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

17. 17. In the following area is space for wishes, ideas of improvement, conflicts, challenges etc. referring to the final report:

D. Overall evaluation

18. 18. In the following area is space for wishes, conflicts, challenges, and ideas of improvement of the whole first round project:

19. 19. In the following area is space for your Top-3-points of what was really good:

Thank you very much for completingthe feedback questionnaire!

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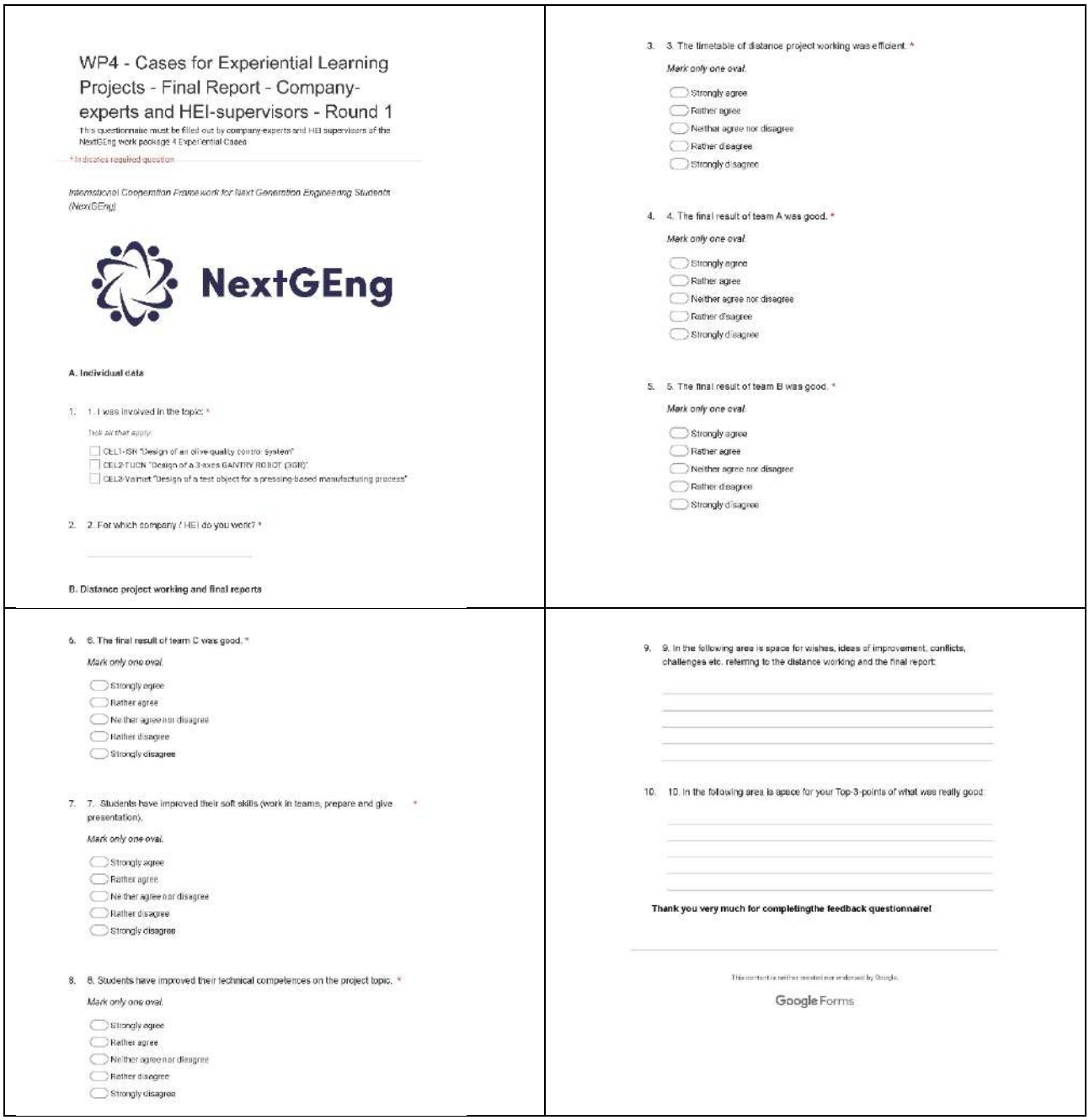
Table 6. Survey for students after the virtual seminar



WP4 - Cases for Experiential Learning Projects - Final Report - Company-experts and HEI-supervisors - Round 1

This questionnaire must be filled out by company-experts and HEI supervisors of the NextGEng work package 4 Experiential Cases

* Indicates required question

International Cooperation Framework for Next Generation Engineering Students (NextGEng)

NextGEng

A. Individual data

1. 1. I was involved in the topic: *

Tick all that apply.

- CEL1-ISR "Design of an olive quality control system"
- CEL2-TUCN "Design of a 3-axes GANTRY ROBOT (3GR)"
- CEL2-Valmet "Design of a test object for a pressing-based manufacturing process"

2. 2. For which company / HEI do you work? *

B. Distance project working and final reports

3. 3. The timetable of distance project working was efficient. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

4. 4. The final result of team A was good. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

5. 5. The final result of team B was good. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

6. 6. The final result of team C was good. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

7. 7. Students have improved their soft skills (work in teams, prepare and give presentation). *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

8. 8. Students have improved their technical competences on the project topic. *

Mark only one oval.

- Strongly agree
- Rather agree
- Neither agree nor disagree
- Rather disagree
- Strongly disagree

9. 9. In the following area is space for wishes, ideas of improvement, conflicts, challenges etc. referring to the distance working and the final report:

10. 10. In the following area is space for your Top-3-points of what was really good:

Thank you very much for completingthe feedback questionnaire!

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Table 7. Survey for experts and HEI supervisors after the virtual seminar

Annex 3

The following annex presents the results of students from the winning solution of project CEL2-TUCN RG and CEL6-UJA RG. For confidentiality reasons, only the CEL projects whose topics were proposed by research groups from the university partners are shown.

CEL2- TUCN RG

As mentioned in subsection 4.2, this project was focused on the design and development of a three-axis gantry robot (3GR) under strict limitations: the use of no more than three fixed motors and a single transmission. The main innovation of the winner group was the implementation of a ball-chain transmission system, which enabled smooth vertical movement of the gripper using only one transmission. This solution emphasized efficiency and simplicity, achieving functionality while minimizing the number of components. The robot integrated a standard H-bot configuration with this novel transmission approach.

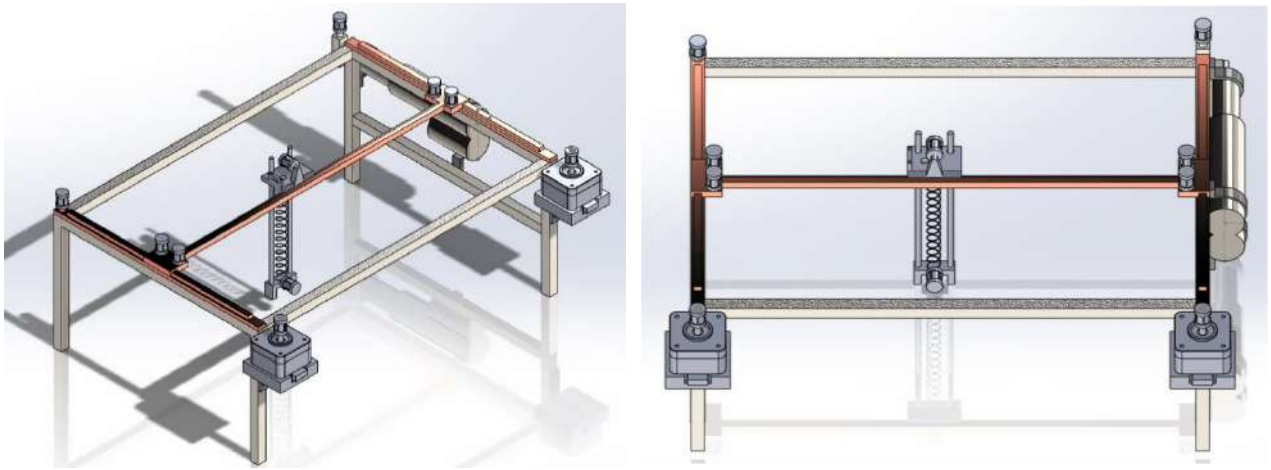

Figure 12. CAD model for the three-axis gantry robot (3GR)

To ensure feasibility, the team B carried out digital modeling and simulations with SolidWorks and SimScape. These tools were used to design, analyze, and validate the kinematics and overall performance of the robot. Figure 12 shows the CAD model of the robot. Key advantages were: reduced mechanical wear and heat generation, improved smoothness of movement, and the ability to test and refine the design virtually prior to building. However, some limitations were identified:

the robot's load capacity is restricted to a maximum of 20 kilograms, and no real-world experiments with heavy loads were conducted within the project's timeframe.

CEL6-UJA RG

The project developed a transparent combustion chamber mockup for wind tunnel testing, aimed at enabling airflow visualization through tracers and Particle Image Velocimetry (PIV). The winner team designed and manufactured a 3D prototype using SolidWorks and combined plexiglass with 3D-printed parts to create a modular and low-cost solution. The iterative design process addressed issues such as misaligned or incorrectly shaped holes and turbulence management. The CAD model (Figure 13) illustrates the final mockup design and enclosure, showing its modular construction and integration of plexiglass panels.

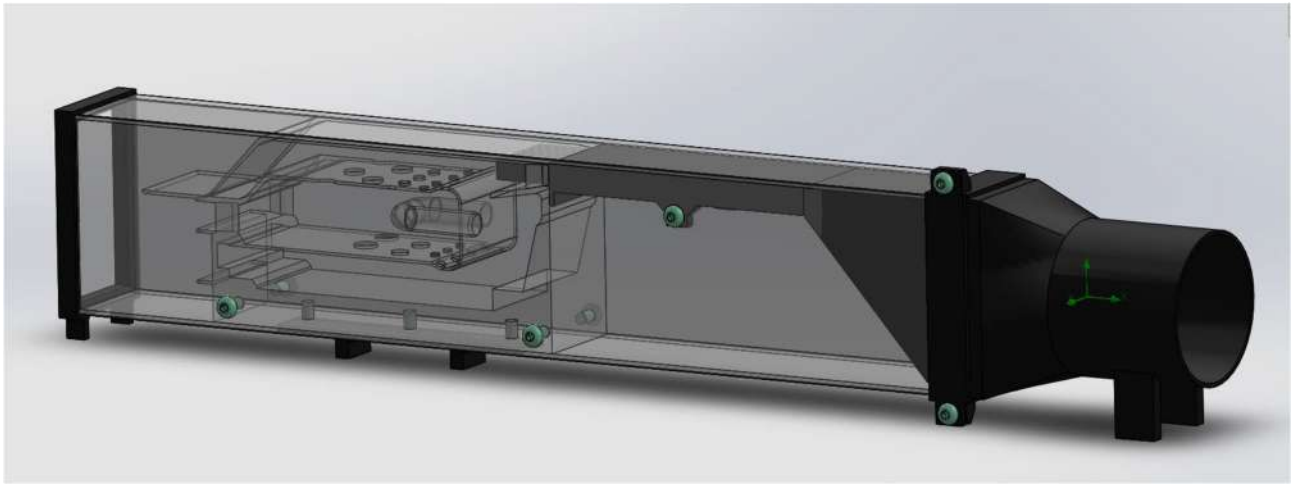

Figure 13. CAD model for the transparent combustion chamber

Airflow simulations were central to the validation process and Figure 14 shows one of the final simulations.

Materials and manufacturing methods were also studied in depth. It were compared ABS, PLA, PETG, Smart Glace, and resin as candidate materials. The transparency results and post-processing techniques are presented in Figure 15.

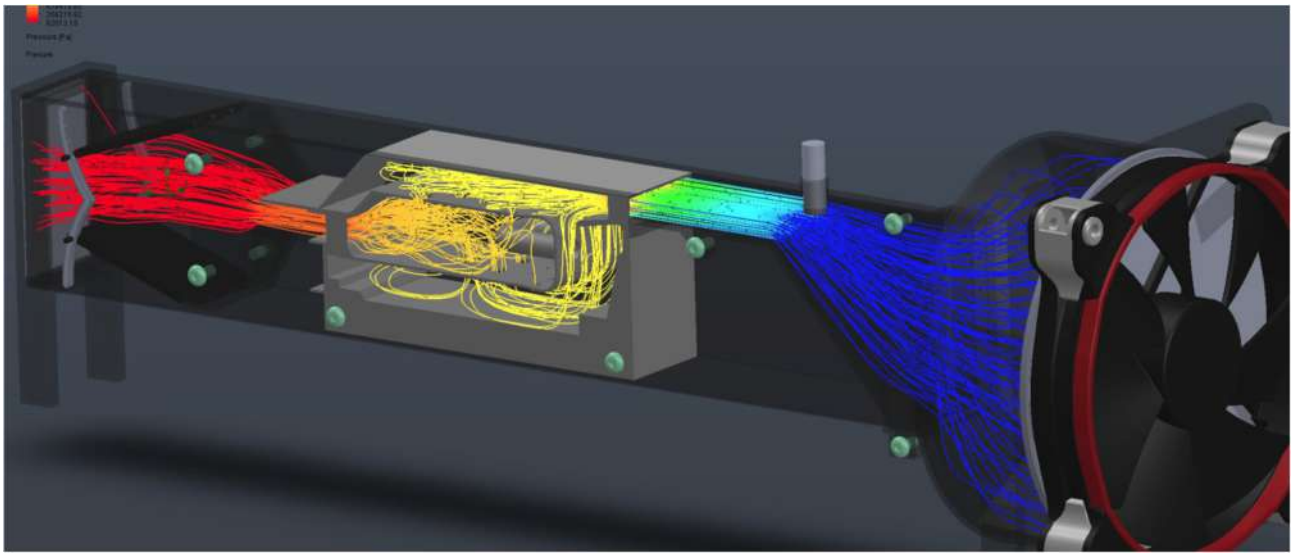

Figure 14. Airflow simulation

Figure 15. Prototypes to assess transparency

The team successfully produced a functional and low-cost combustion chamber mockup, spending under 15 euros on materials while overcoming issues like printing defects, structural inaccuracies, and simulation limits. Although the prototype still needs improvements in transparency and experimental validation through PIV testing, the project met its core goals. It showcased effective teamwork, creative use of CAD and CFD tools, and innovative manufacturing methods, marking an important step toward practical educational prototypes in aerospace engineering.