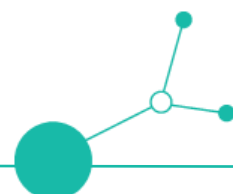


Pilot Run Report LP1

D 2.2.1





PILOT RUN REPORT - LP1

Table of Content

Introduction

- Purpose and scope - (SumUP of RE/UP programs and workshops formats of partner)

Methodology

- Data collection and evaluation approach

Pilot Run Data

- Overview of pilot runs in relation to RE/UP programmes

Evaluation

- Assessments (pre/post)
- Participant feedback
- Instructor observations
- Tandem observations
- Impact on skills development

Best Practices and Challenges

- What worked well
- Identified challenges
- Effective assessment tools

Stakeholders Report

- Key insights for policymakers
- Residency visits
- Relevance for regional and EU level

Conclusion and Next Steps

- Improvements for re/upskilling programs
- Inputs for further implementation (A3.3)



1. Introduction

This deliverable summarises the Pilot Runs implemented by Lead Partner 1, Brno University of Technology (BUT), through strojLAB. The activities were developed within two complementary RE/UPskilling programmes defined in Deliverable D2.1.1: Maker Engineering (ME) and Digital Manufacturing Engineering (DME). Together, the programmes address digital-fabrication skill gaps while strengthening the connection between education, practical experimentation and current industrial needs.

The **Maker Engineering (ME)** programme primarily targets university students and selected secondary-school learners. It focuses on upskilling through project-based, interdisciplinary and hands-on learning. Its Pilot Runs covered different educational formats and topics. In addition to technical competences, the programme develops problem-solving, teamwork, communication, iterative prototyping and the ability to translate an idea into a tangible and technically feasible outcome.

The **Digital Manufacturing Engineering (DME)** programme is oriented mainly towards company employees, independent professionals and lifelong learners who need to update or redirect their existing expertise. It combines theoretical preparation, guided self-study, laboratory activities and consultations, with advanced practical applications.

ME offers a broad and flexible portfolio of formats, ranging from short hands-on workshops and competitions to mentored projects and longer thematic studios. It is primarily designed for students and focuses on upskilling, experimentation, teamwork and the development of maker-engineering competences.

DME provides more specialised and professionally oriented training for company employees, independent professionals and lifelong learners. Its formats place greater emphasis on advanced technical competence, industrial applicability and structured recognition of learning outcomes.

The formats are modular and adaptable. Their duration, technical topic, level of difficulty and assessment method can be adjusted to the target group and regional or industrial skill gaps.

Assessment extends beyond knowledge testing and combines pre- and post-training self-assessment (on the skillNest.app), practical outputs, formative feedback and, where appropriate, evaluation by educators, mentors or industrial experts.

Overview of piloted workshop formats

Programme	Workshop format	Typical structure	Main characteristics
ME - Maker Engineering	Project Sprint + Mentoring	A 1-3-day intensive workshop followed by regular consultations and a final presentation or demonstration	Real-world assignment, teamwork, rapid prototyping, industrial mentoring and iterative development



ME - Maker Engineering	Challenge-Based Learning + Competition	Teams address a defined engineering challenge within a one-day or multi-week programme and present their solutions at a competitive demo event	Experiential and game-based learning, interdisciplinary cooperation, time pressure, motivation through competition and jury feedback
ME - Maker Engineering	Short-Term Workshop	A focused theoretical introduction followed by practical laboratory or FabLab activities, typically delivered within one day or one week	Rapid acquisition of a clearly defined technical skill, direct equipment use and an immediately applicable practical outcome
ME - Maker Engineering	Weekly Thematic Studio	A sequence of lectures, laboratory exercises and consultations delivered over several weeks, concluding with a prototype or presentation	Deeper exploration of a technical topic, continuous project development, regular feedback and individual or team-based assignments
DME - Digital Manufacturing Engineering	Professional Thematic Studio	Approximately 26 learning hours delivered intensively (3 days intensive) or over several weeks through lectures, self-study, laboratory work and consultations	Specialised training for employees and professionals, industry-relevant content, integration of theory and advanced practice, and potential recognition through micro-certification



2. Methodology - Data collection and eval. approach

The LP1 evaluation followed a mixed-method and practice-oriented approach designed to assess both participant development and the quality and relevance of the Pilot Runs. Data were collected at three complementary levels: participant learning, workshop implementation and alignment with stakeholder and labour-market needs.

Participant development was evaluated mainly through pre- and post-workshop self-assessment questionnaires. The questionnaires typically included three to six core questions linked directly to the skill gaps addressed by the respective Pilot Run, supplemented by workshop-specific questions prepared by the lecturer. Participants assessed their knowledge, practical ability or confidence using numerical scales, most commonly five-point Likert scales. Where participant identification allowed it, individual pre- and post-responses were paired. Otherwise, results were compared at an aggregated group level. The analysis included changes in mean scores, response distributions and the proportion of participants reporting increased confidence. Open-ended questions were also used to capture expectations, perceived benefits and recommendations for improvement. Data collection was centralised through SkillNest.app where possible and complemented by online forms or event-specific questionnaires.

Self-assessment was supplemented by evidence from practical activities. Depending on the workshop format, this included digital models, fabricated components, prototypes, measurement reports, animations, presentations or final pitches. Outputs were evaluated through facilitator observations, formative feedback, peer discussion and, in selected challenge-based or industry-oriented activities, feedback from juries, mentors and external experts. Accredited university activities could additionally apply established academic or ECTS-based assessment.

Workshop-level monitoring covered the number and type of participants, target groups, duration, delivery mode, workshop format and cumulative participant-hours. Pilot reports also documented implementation challenges, participant engagement, suitability of the schedule and equipment, effectiveness of teaching materials, and recommendations for subsequent iterations.

Finally, stakeholder feedback from companies, external experts, project partners and university representatives was used to assess industrial relevance, transferability and correspondence with identified regional skill gaps. The evaluation therefore combined quantitative pre/post comparisons with qualitative feedback and assessment of tangible outcomes. Since most measurements were self-reported and some pre- and post-samples could not be individually matched, the results were interpreted primarily as evidence of perceived development and programme effectiveness rather than as strictly controlled impact measurements.



3. Pilot RUN Data

Planned Targets and Achieved Results

The approved project proposal envisaged that LP1 BUT would implement five Pilot Runs comprising approximately 400 programme hours and involving 100 participants. In practice, LP1 delivered 23 completed Pilot Runs under the Maker Engineering (ME) and Digital Manufacturing Engineering (DME) programmes, providing 339 workshop hours to 353 participant places and generating 5,510 cumulative participant-hours. LP1 therefore implemented 4.6 times more Pilot Runs and reached more than 3.5 times the originally expected number of participant places, while delivering 84.8% of the anticipated workshop hours. This difference reflects a shift from a small number of long programmes towards a broader and more modular portfolio of short workshops, thematic studios, challenge-based competitions, a mentored project sprint and professional micro-credential pilots. All activities were delivered in person, predominantly at BUT/strojLAB, with selected workshops organised at FAB25 Czechia and Maker Faire Brno 2025. The results substantially exceeded the expected reach while maintaining a high overall training intensity.

Overview table of LP1 BUT Pilot Runs

Prgm	Workshop format	Pilot Run title	Particip. places	Target group	Worksh. hours	Particip. hours
ME	Weekly Thematic Studio	3D Digitization and Inspection of a Functional Part - Introduction to 3D Scanning	24	University students	7	168
ME	Short-Term Workshop	From Reality to 3D Model	12	High-school students	4.5	54
ME	Weekly Thematic Studio	Stop-Motion Animation with Digital Fabrication Aid	15	University students	28	420



ME	Weekly Thematic Studio	3D Printing of a Digital Sculpture / Modelling and Fabrication of a Dice Tower	8	University students and makers	18	144
ME	Weekly Thematic Studio	Metal Powder Additive Manufacturing Skills for Engineering Applications - introductory run	15	University students	4	60
ME	Weekly Thematic Studio	Introduction to Large-Scale Robotic 3D Printing of Metal Parts	15	University students	3	45
ME	Short-Term Workshop	3D Printing for Final Thesis Projects	15	University students	8	120
ME	Short-Term Workshop	Algorithmic Modelling with Grasshopper - Not Just for Clay 3D Printing	19	General public	4	76
ME	Short-Term Workshop	Advanced Strategies for Clay 3D Printing	30	General public	4	120
ME	Short-Term Workshop	Generative Design in Practice	10	General public and engineering students	2	20



ME	Challenge-Based Learning + Competition	strojLAB Challenge - Maker Hackathon 2025	24	High-school students	8	192
ME	Challenge-Based Learning + Competition	strojLAB Challenge - Maker Hackathon 2026	24	High-school students	8	192
ME	Project Sprint + Mentoring	Design Thinking with an Industrial Partner	8	University students	32	256
ME	Weekly Thematic Studio	Algorithmic Modelling and Its Application in Wall Panel/Object Design	24	University students	20	480
ME	Weekly Thematic Studio	Metal Powder Additive Manufacturing Skills for Engineering Applications - extended run	37	University students	22	814
ME	Weekly Thematic Studio	ZPC - How to Make Almost Anything	25	University students	72	1,800
ME	Short-Term Workshop	Vinyl Cutting	8	High-school students	1.5	12
ME	Short-Term Workshop	Clay 3D Printing	7	University students	3	21



ME	Short-Term Workshop	CNC Milling from CAD to Machine	13	University students	8	104
ME	Short-Term Workshop	PLC and Arduino microcontrollers programming for electrical drives machinery	5	University students	4	20
ME subtotal		20 Pilot Runs	338		261	5,120
DME	Thematic Studio	Industrial Robotic 3D Printing with Polymers - Micro-credential Pilot	7	Industrial participants and students	26	182
DME	Thematic Studio	Metal 3D Printing for Engineering Applications - Micro-credential Pilot	5	Industrial participants and students	26	130
DME	Thematic Studio	Metrological Inspection Using 3D Scan Data - Micro-credential Pilot	3	Industrial participants and students	26	78
DME subtotal		3 Pilot Runs	15		78	390
LP1 BUT total		23 Pilot Runs	353 participant places		339 total ws hours	5,510 person hours



Communication, Outreach Materials, Promotion of Workshops

Communication and recruitment activities were adapted to the different target groups and formats of the LP1 Pilot Runs. University students were primarily reached through existing BUT teaching structures, strojLAB communication channels, university event pages and direct links to relevant study courses. High-school-oriented activities were promoted through contacts with schools and by presenting the workshops as accessible, practical and team-based experiences. Workshops for the general public benefited from being embedded in established events such as FAB25 Czechia and Maker Faire Brno 2025. Industry-oriented activities were communicated through university and stakeholder networks, professional events, guest lectures and direct engagement with industrial experts.

This combination of established institutional channels, targeted communication and event-based outreach proved effective. LP1 reached 353 participant places compared with the 100 participants originally anticipated in the project proposal. Particularly successful were messages that clearly described the practical outcome of the activity, the technologies available to participants and the relevance of the acquired skills to engineering practice.

Templates for Promoting Training Programmes

The promotional-template requirement was implemented through a reusable and standardised structure for presenting Pilot Runs. Workshop descriptions consistently communicated the programme title, target group, learning objectives, duration, delivery mode, prerequisites, technologies used and expected practical outcomes. This structure was applied across BUT event announcements, SkillNest workshop pages, institutional website articles and event-specific publicity materials.

The common DiSTT visual identity, document and presentation templates, project branding and standardised workshop format ensured consistent communication across different Pilot Runs. Individual materials could nevertheless be adapted to the needs of a particular audience. For example, promotional content for high-school students emphasised accessibility, teamwork and hands-on experimentation, while announcements for advanced additive-manufacturing workshops focused on industrial technologies, engineering applications and specialist equipment. The central Pilot Run overview also included dedicated fields for recording pre-event publicity materials, website articles, photographs and folders containing workshop outcomes.

Messaging Strategies for Schools and Companies

Communication followed a target-specific messaging strategy. For schools and young participants, the core message was that digital fabrication can be learned through practical experimentation without requiring extensive prior experience. Challenge-based workshops promoted teamwork, creativity, competition and the opportunity to produce a tangible result within a limited time. These messages were especially suitable for the strojLAB Challenge and introductory workshops in 3D scanning, vinyl cutting and digital fabrication.

For companies, employees and technical professionals, communication emphasised the industrial relevance of the training. Messages focused on complete digital-manufacturing workflows, access to advanced BUT facilities, practical application of technologies and opportunities to update professional competences. The DME micro-credential pilots added the prospect of structured recognition of acquired learning outcomes. Industrial partners and external experts were also involved as mentors, lecturers, challenge providers or evaluators, strengthening the credibility of the communication.



Registration forms were used not only to recruit participants but also to collect information about their backgrounds, existing competences and expected learning outcomes. This allowed lecturers to adjust the content and provided participants with a sense that their specific needs were reflected in the workshop.

Tools for Community Building and Sharing Results

SkillNest.app became the principal digital tool for presenting Pilot Runs, connecting workshops with relevant skill gaps and making their structure and outcomes accessible to a wider educational community. Individual Pilot Run reports include direct links to workshop pages, while the platform also supports participant assessment and provides a basis for sharing programmes with potential educators and uptakers.

Community building was further supported through the strojTALK lecture series, where guest speakers presented digital-fabrication skills through examples from professional practice. Recorded lectures were made available through the FME BUT YouTube channel. Teaching materials for accredited courses were shared through the BUT e-learning environment.

At workshop level, final presentations, prototype demonstrations, screenings, competitions, peer discussions and jury evaluations created opportunities for participants, educators and external experts to exchange experience. Public events such as FAB25 Czechia and Maker Faire extended this exchange beyond the university community. Website articles, workshop galleries, photographs and shared outcome folders were used to document and disseminate results. The available overview nevertheless indicates that links to photographs and outcome repositories were not recorded consistently for every Pilot Run; completing this evidence archive should therefore form part of the final reporting process.

Materials for participants

The materials and equipment provided varied according to the workshop format, duration, target group and technologies involved. A short public workshop required a different support package from a multi-week thematic studio, challenge-based competition or professional micro-credential course. Nevertheless, participants generally received access to the following:

- Presentation materials explaining the workshop objectives, theoretical background, schedule, technical workflows, safety requirements and practical assignments.
- Instructions and manuals, including step-by-step procedures, laboratory-equipment guidance, fabrication rules and task-specific worksheets.
- Digital data, such as sample models, software files, Grasshopper definitions, scan data, production files, datasets and templates required for practical exercises.
- Writing materials and notepads for recording observations, developing concepts, sketching and documenting project decisions.
- Tools and technical equipment required for the respective activity, including access to computers, specialised software and strojLAB fabrication or measurement technologies.
- Personal protective equipment, such as safety glasses, gloves or other workshop-specific protection, whenever required by the technology or laboratory environment.
- Basic refreshments, which were provided during a number of the longer or more intensive workshops.

Before the workshops, participants commonly received a programme description, schedule, prerequisites, learning objectives and access to registration or pre-assessment forms. During delivery, PowerPoint presentations were the main instructional resource and were complemented by demonstrations, videos, printed materials, digital files and hands-on assignments. After the workshops, materials from accredited



BUT courses remained available through the university e-learning environment, while selected recorded strojTALK lectures were accessible through the FME BUT YouTube channel. Participants also retained their own outputs, including digital models, scan data, reports, presentations, animations and fabricated prototypes.

Pedagogical approach of LP1

The pedagogical approach applied by LP1 BUT combined academic engineering education with the hands-on, experimental character of the strojLAB makerspace. The objective was not only to transfer knowledge about digital manufacturing technologies, but also to enable participants to apply that knowledge to realistic tasks, create tangible outputs and understand the relationship between design decisions, manufacturing constraints and practical results. The approach can be characterised by the following principles:

- **Project- and problem-based learning:** Participants worked on defined engineering or design problems rather than completing isolated technical exercises. Activities typically progressed from problem identification and concept development to digital design, fabrication, testing and presentation. Projects included functional prototypes, digitally fabricated components, scan-based inspection reports, animations and algorithmically generated designs.
- **Learning by doing:** Theoretical introductions were directly connected to demonstrations and practical work with software, machines and measurement equipment. Participants used digital-fabrication technologies themselves under the supervision of lecturers and technical mentors. This helped them understand not only how a technology operates, but also what it can realistically produce and how data must be prepared for manufacturing.
- **Iterative and reflective learning:** Failure was treated as a natural part of the learning process. Participants were encouraged to test solutions, identify problems and improve their designs or manufacturing strategies. Reflection was supported through discussions, self-assessment, peer feedback and comparison of initial intentions with the final outcome.
- **Design Thinking and user-centred problem solving:** Selected Pilot Runs used Design Thinking methods to structure problem identification, ideation, prototyping and validation. The emphasis was placed on understanding the actual need behind a task, communicating ideas effectively and developing feasible solutions through successive iterations.
- **Interdisciplinary collaboration:** Team-based activities connected participants with different technical, design and educational backgrounds. Challenge-based workshops required teams to distribute roles, combine individual competences, communicate under time constraints and jointly deliver a functional result. This reflected the interdisciplinary nature of contemporary engineering practice.
- **Industry relevance and external involvement:** Real-world applicability was strengthened through cooperation with industrial partners, external experts and guest lecturers. These stakeholders contributed as challenge providers, mentors, lecturers, evaluators or members of final juries. The strojTALK format further connected workshop content with examples from professional practice.

The intensity and level of facilitation were adapted to the workshop format and target group. Short-term workshops used concise theoretical explanations followed by guided exercises. Thematic studios enabled deeper and more autonomous project development over several sessions. Challenge-based competitions introduced motivation through time limits, teamwork and public evaluation, while project sprints combined intensive work with subsequent mentoring. DME micro-credential pilots applied a more structured professional-learning format combining lectures, self-study, laboratory activities and consultations.



Assessment was integrated into the learning process rather than treated only as a final grading activity. Pre- and post-workshop self-assessment supported participant reflection, while lecturers provided continuous formative feedback. Learning was also demonstrated through practical outputs, presentations, pitches, prototype testing and peer or expert evaluation. In accredited university courses, these methods were complemented by formal academic and ECTS-based assessment.

Overall, LP1 applied a learner-centred and constructivist approach that combined “Learn-it” theoretical preparation with “Make-it” practical experimentation. The central pedagogical outcome was the development of applied technical competence, problem-oriented thinking, teamwork, autonomy and confidence in using digital-manufacturing technologies in realistic contexts.

4. Evaluation

Self-Assessments and feedback tools

LP1 combined pre- and post-workshop self-assessment with formative feedback and evaluation of practical outputs. The purpose was to identify participants’ initial competence, adapt workshop delivery where possible, measure perceived development and collect evidence for improving subsequent runs.

Pre- and post-workshop self-assessment

The common approach used the same or closely corresponding questions before and after a workshop. Participants usually assessed their knowledge, ability or confidence on a five-point Likert scale. A limited number of pilots used different scales, such as 1-3 or 1-10, reflecting their earlier development or specific format.

SkillNest.app was progressively adopted as the common platform for workshop presentation and assessment. The Design Thinking datasets, for example, were collected through forms integrated into SkillNest and linked by a common workshop identifier. Earlier Pilot Runs also used other online forms or paper questionnaires. The intended common structure consisted of three to six core questions linked to the skill gaps addressed by the workshop, supplemented by questions selected by the lecturer.

The pre-assessment served several purposes:

- establishing participants’ initial level and previous experience;
- identifying specific knowledge gaps and expectations;
- supporting adaptation of the workshop content and teaching pace;
- providing a baseline for comparison with the post-assessment.

The post-assessment repeated the principal competence questions and could additionally collect feedback on content, organisation, practical activities and suggested improvements.

Examples of assessed competences

Questions were formulated around the actual learning outcomes of each Pilot Run. Examples included:

- understanding the principles, energy sources and applications of L-PBF or DED metal additive manufacturing;
- understanding technology-specific design rules and limitations;



- ability to use Grasshopper, work with data structures and apply algorithmic modelling;
- ability to prepare models, use slicing software, generate G-code and operate a 3D printer;
- ability to calibrate and operate a 3D scanner, process mesh data and perform dimensional inspection;
- ability to identify user needs, define a problem, generate ideas and manufacture a prototype;
- confidence in teamwork, communication, Design Thinking and presentation of results.

These questions were selected to cover not only theoretical knowledge, but also process understanding, practical competence, application-oriented decision-making and transferable soft skills.

Representative self-assessment results

The results should not be pooled into a single impact indicator because the workshops addressed different skills, used different respondent samples and were not always individually paired. Nevertheless, the representative five-point-scale results consistently indicate positive perceived development.

Pilot Run	Pre-workshop mean	Post-workshop mean	Change
Metal Powder Additive Manufacturing	1.56	3.54	+1.98
FDM for Final Thesis Projects - Run 1	2.37	3.88	+1.51
Introduction to 3D Scanning	2.47	3.83	+1.36
Algorithmic Modelling	1.36	2.64	+1.28
FDM for Final Thesis Projects - Run 2	2.10	3.10	+1.00
Design Thinking Workshop	2.86	3.74	+0.89

Values represent the arithmetic mean across the competency means reported for each Pilot Run



Figure 1. Design Thinking Workshop: paired pre/post self-assessment

Design Thinking Workshop: self-assessed competences

Mean scores for seven participants with paired pre- and post-workshop responses. Five-point scale; all seven paired participants improved their overall average.

The paired Design Thinking evaluation was methodologically the strongest example. The overall average increased from 2.86 to 3.74, and every paired participant improved. The largest gains were recorded in teamwork (+1.43), confidence in using Design Thinking tools (+1.29) and defining a problem statement (+1.00).

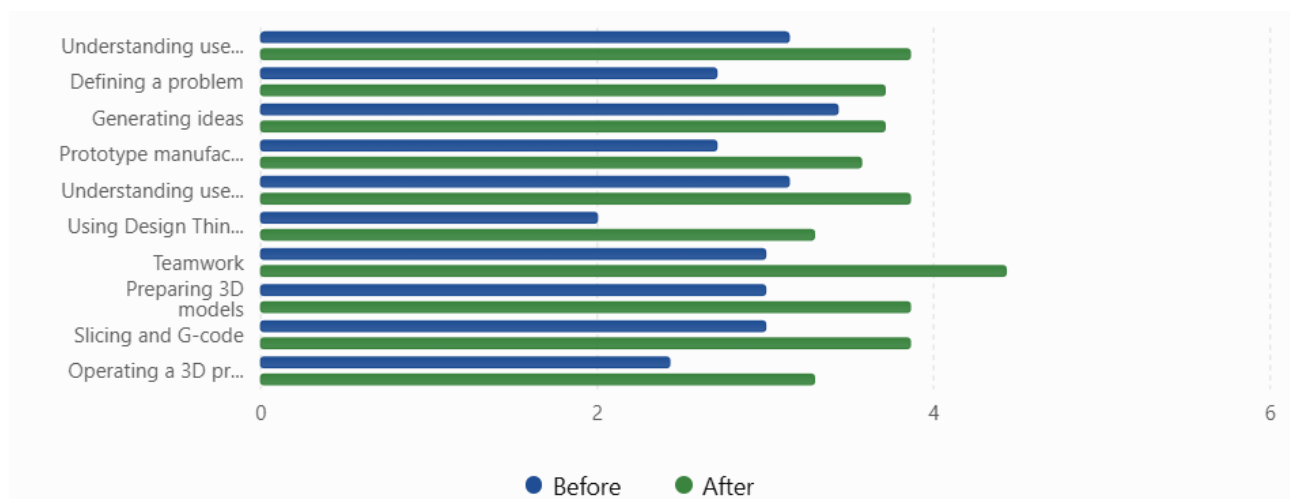


Figure 2. Introduction to 3D Scanning

Introduction to 3D Scanning: self-assessed competences

Comparison of reported group means before and after the Pilot Run. Five-point scale; pre- and post-workshop samples were not individually paired. The greatest relative improvement concerned dimensional and tolerance inspection (+73%), followed by scanner operation and accessories (+67%). Mesh optimisation improved more moderately and remained the most challenging competence, indicating a need for additional time for data processing.

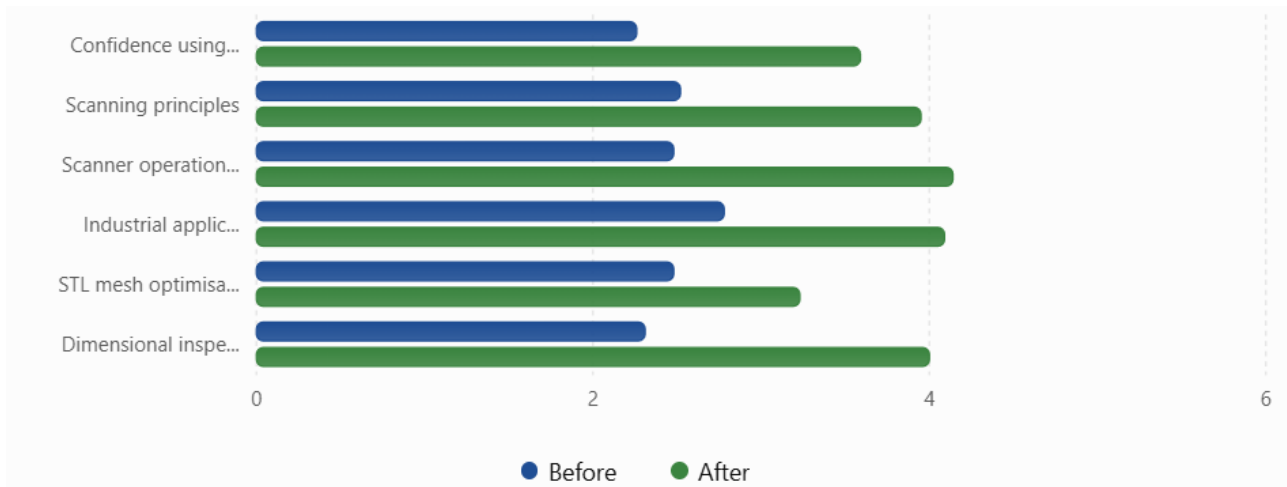
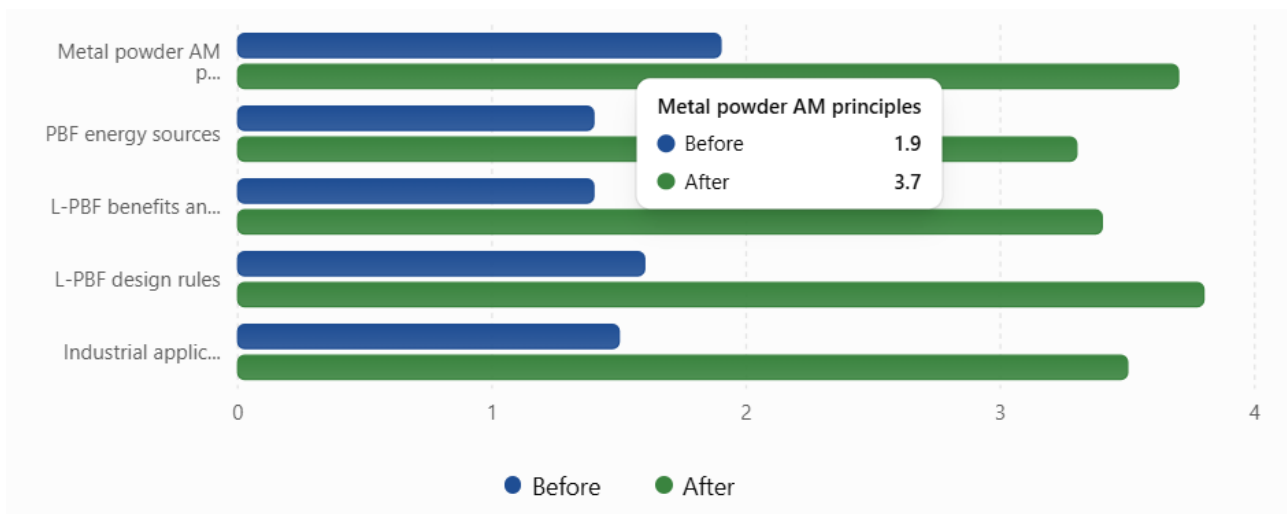


Figure 3. Metal Powder Additive Manufacturing

Metal Powder Additive Manufacturing: self-assessed knowledge. Mean pre- and post-workshop scores across five L-PBF competence areas. Five-point scale; the largest gain concerned L-PBF design limitations and rules.



Formative evaluation and practical outputs

Self-assessment was complemented by continuous formative evaluation. Facilitators observed participants during practical work, provided feedback at intermediate milestones and adjusted explanations according to the difficulties encountered. Longer studios and mentored projects included consultations, while team-based activities incorporated peer feedback and guided reflection.

Practical outputs were assessed according to criteria appropriate to each format:

- technical correctness, functionality and fabrication quality;
- appropriate application of design and manufacturing rules;
- completeness of the digital workflow and quality of prepared data;
- innovation, feasibility and relevance of the proposed solution;
- prototype iteration and response to feedback;
- teamwork, communication and quality of the final presentation.



Challenge-based events added jury or mentor evaluation, while accredited courses could combine these practice-oriented criteria with formal ECTS assessment.

Skill recognition

LP1 tested different levels of learning recognition. For shorter ME workshops, recognition was primarily informal and based on completed practical outputs, facilitator feedback, final presentations and documented participation. The three 26-hour DME thematic studios were designed as micro-credential pilots, providing a more structured route towards recognition of professional learning outcomes.

What worked and what was challenging

The most effective element was the direct alignment between assessment questions and workshop learning outcomes. Simple self-assessment scales were easy to administer, and pre-assessment questions also provided useful information about participant expectations. Pairing responses through a stable identifier, as achieved in the Design Thinking workshop, produced particularly credible evidence of individual development.

The main challenge was incomplete or unmatched data. In several workshops, fewer participants completed the post-assessment because they left before the final activity or because completion was not mandatory. Some early forms lacked a stable anonymised identifier, preventing individual pairing. Differences in scales and workshop-specific questions also limited comparison across Pilot Runs. Finally, self-assessment captures perceived competence and confidence rather than independently verified mastery.

Future assessments should therefore use a consistent SkillNest-based core questionnaire, participant registration or an anonymised identifier, and a mandatory post-assessment completed before departure. Self-assessment should continue to be combined with facilitator observations and clearly defined criteria for evaluating practical outputs.

Participant feedback

Participant feedback was collected through post-workshop self-assessments, open-ended questions, event-specific surveys and facilitated discussions. The available evidence is heterogeneous: some Pilot Runs used SkillNest.app or structured questionnaires, while others relied on peer discussion, prototype reviews or facilitator records. The findings should therefore be interpreted as complementary indications of participant experience rather than directly comparable satisfaction scores.

Feedback relating to the **ZPC - How to Make Almost Anything** course was obtained from six external stakeholders who reviewed the workshop approach and student outcomes. All respondents rated the workshop as *Excellent*, the project-based approach as *Very effective*, and the balance between theory and practice as *Excellent*. Five of six believed that the course prepared students *Very well* for real-world engineering challenges, while all considered the acquired skills relevant to the labour market. Five respondents would definitely regard graduates as attractive candidates for internships, projects or employment, and all expressed interest in future collaboration. The main strengths identified were hands-on and challenge-based learning, freedom in project selection, strong mentoring, access to laboratory facilities, multidisciplinary problem-solving and the integration of technical and soft skills. Suggested



improvements included stronger teamwork, clearer links to industry, greater attention to customer needs and business value, and more guidance on bringing prototypes towards market application.

Further participant-level feedback was identified in several Pilot Run reports. In the Design Thinking workshop, eight respondents rated their enjoyment at an average of **4.0 out of 5**, while all seven participants with paired assessments reported an overall increase in confidence. Participants in the 3D scanning workshop generally described the activity positively, appreciated the combination of theoretical explanation and practical work, and indicated that it met their expectations. Their main recurring request was more time for scanning, mesh processing and preparation of inspection reports. Feedback from the CNC milling workshop similarly supported a longer, preferably two-day format with more individual machine time and preparatory e-learning. In the strojLAB Challenge 2026 survey, 90% of respondents selected general prototyping as an area of increased confidence, 70% selected presentation of results, and 70% reported learning a new practical use of laser cutting.

Across the reviewed sources, participants responded most positively to tangible outputs, direct equipment use, realistic challenges and close facilitator support. The most consistent recommendations were to provide more hands-on time, accommodate different starting levels and strengthen the links between technical solutions, teamwork, users and industrial application. Activities evaluated through peer review, such as the Dice Tower and stop-motion workshops, also confirmed the value of collective presentation and constructive discussion, although these formats did not generate standardised satisfaction data.

Instructor observations

Instructor observations were consolidated through a joint feedback meeting involving the management of the Institute of Machine and Industrial Design of FME BUT, the teaching team and ZPC students, and were complemented by an anonymous survey completed by seven lecturers. The results show a clear distinction between the educational concept and its implementation. The core concept of **ZPC - How to Make (Almost) Anything** was considered relevant and worth retaining: project-based learning, practical work, prototyping and portfolio development gave students an opportunity to address complex tasks and demonstrate tangible results.

The lecturers were positively surprised by the students' determination, the time and energy invested, their ability to acquire missing knowledge independently, and the quality of the final projects. The independent project based on *learning by doing* was ranked as the most valuable part of the course, followed by consultations with supervisors and other experts. Consultations with peers, mini-projects and lectures were perceived as progressively less important. The final project and presentation nevertheless worked well as a shared objective and provided evidence that students could integrate technical knowledge, fabrication skills and problem-solving into functional outcomes.

At the same time, the first run was regarded as organisationally and academically overloaded. They were negatively surprised by the dissatisfaction expressed by some students. This was probably caused by the effect of the course's complexity on practical teaching. Students were able to begin meaningful work on their main projects only relatively late because too much time had been allocated to introductory lectures and mini-projects. Some activities lacked a clear relationship to the semester project, while assessment criteria, project financing and the expected division of responsibility between students and supervisors were insufficiently transparent.

The lecturer feedback therefore recommends a substantial restructuring of the course. More time should be allocated primarily to the independent project and to consultations with supervisors and specialists. The



main project should start near the beginning of the semester, while introductory training should be shorter, more applied and limited to technologies that students are likely to use. Mini-projects should either be directly connected to exercises and the semester project or be removed. Additional self-study materials, clearly defined backup topics and a better relationship with preceding courses would reduce duplication and support participants with different starting levels. The complexity of assignments should also be controlled so that ambitious projects remain feasible within the available time.

The observations indicate that the most effective teaching model combines an early project start with focused technical instruction, repeated consultation, practical experimentation and continuous formative feedback. Clear assessment criteria should distinguish minimum, good and excellent performance, while checkpoints and examples of previous projects should help students calibrate the expected scope and quality.

Students did acquire relevant practical skills and demonstrated them through their final projects. However, the instructors' feedback shows that learning was achieved at an unnecessarily high organisational and personal cost. The principal lesson is therefore to preserve the project-based, *learning-by-doing* approach while simplifying the course structure, improving coordination and ensuring that every lecture, exercise and mini-project directly supports the main learning task.

Tandem observations

As tandem partners, LP1 BUT and PP2 FabLab Brno exchanged experience in the delivery and evaluation of challenge-based education. Martina Michlovská (PP2) acted as an external evaluator during both LP1 strojLAB Challenge hackathons for secondary-school students and participated in assessing the teams' final outputs. The partners discussed the use of Mentimeter (Menti.com) to collect immediate participant feedback and the use of pre-assessment results to form balanced teams according to participants' prior skills and experience. The observations confirmed the suitability of the hands-on workshop concept, and no substantial changes were considered necessary. The collaboration also included reciprocal evaluation: David Škaroupka (LP1) participated in the final evaluation of PP2's *Competition with FabLab for High-School Students*, while Tomáš Mejzlík, representing FabLab Brno, served on the ZPC evaluation committee and contributed to its stakeholder survey. He rated the course highly, identifying challenge-based learning, just-in-time training and the combined development of technical and soft skills as its principal strengths. He recommended placing greater emphasis on explaining why and for whom solutions are developed, thereby reinforcing customer-centred thinking. He also expressed interest in further collaboration through internships and part-time employment opportunities for students.

Impact on skills development

The LP1 Pilot Runs developed an interconnected set of technical, methodological and interpersonal competencies. Technical training focused primarily on digital modelling, additive manufacturing, digital fabrication, 3D scanning and engineering inspection. These hard skills were combined with design thinking, problem-solving, teamwork, creativity and communication. Skills were not assessed through a single standardised examination; depending on the workshop format, evidence was collected through pre- and post-workshop self-assessments, practical exercises, instructor observation, completed prototypes or digital outputs, peer review and final presentations. The available results indicate improvements across all major competence areas. Particularly strong progress was recorded in L-PBF design knowledge, FDM printer maintenance and multi-material printing, generative-design workflows, 3D-scanner operation and



dimensional inspection. Among soft skills, the Design Thinking pilot produced the largest increase in teamwork, followed by confidence in applying Design Thinking tools and defining a problem statement.

Skill type	Main skills taught and assessed	Examples of application and assessment
Hard skills - CAD and computational design	2D/3D modelling, parametric and algorithmic modelling, Grasshopper data structures, Fusion 360 and generative-design workflows	Creation and modification of digital models; parametric wall-panel designs; pre/post self-assessment and instructor observation
Hard skills - Additive manufacturing	FDM and metal additive manufacturing, design-for-additive-manufacturing rules, slicing and G-code preparation, printer operation and troubleshooting	Preparation and fabrication of prototypes and final-project components; practical demonstrations and pre/post assessment
Hard skills - Advanced 3D printing	Multi-material and multicolour printing, print-quality optimisation, basic printer maintenance and servicing	Practical exercises and self-assessed competence gains; review of prepared print data and physical outputs
Hard skills - Metal L-PBF	Metallic powders, PBF energy sources, process advantages and limitations, design constraints, industrial applications and post-processing	Knowledge assessed before and after training; the reported improvements ranged from +1.8 to +2.2 points on a five-point scale
Hard skills - 3D digitisation and inspection	Laser scanning, photogrammetry, scanner calibration and operation, point-cloud and mesh processing, model alignment, dimensional and GD&T inspection	Practical scanning tasks, processing in GOM Inspect, comparison of STL and OBJ models and preparation of inspection reports
Hard skills - Digital fabrication and prototyping	Laser cutting, 3D printing, fabrication planning, material and technology selection, prototype production and evaluation	Dice towers, animation assets, wall panels, challenge outputs and other physical prototypes assessed through functional and design review



Methodological skills	Design Thinking, understanding user needs, problem definition, ideation, iterative prototyping, testing and responding to feedback	Challenge-based assignments, user-centred projects and pre/post self-assessment; teamwork improved by +1.43 points in the evaluated Design Thinking pilot
Soft skills	Teamwork, peer learning, creativity, critical reflection, independent learning and constructive feedback	Team challenges, group consultations, peer review, collective screening and continuous facilitator observation
Communication and project skills	Presentation, storytelling, explanation of design decisions, project planning and time management	Final presentations, portfolio outputs, prototype demonstrations and evaluation by instructors, peers or external committees

Effective assessment tools

The Pilot Runs confirmed that no single assessment method was sufficient for evaluating both technical and soft-skill development. The most reliable approach combined participants' self-assessment with direct evidence from practical work, facilitator observation and structured feedback. Pre- and post-assessment questionnaires were particularly effective when they used identical competence-related questions and the same Likert scale, allowing changes in participants' perceived knowledge and confidence to be compared. However, self-assessment results were interpreted as evidence of perceived progress rather than as an objective skills test and were therefore complemented by the evaluation of prototypes, digital outputs and practical tasks.

The main methodological lesson was that assessment data were most useful when pre- and post-responses could be paired at participant level. Unequal response numbers—such as a substantially lower post-assessment response rate—could distort group averages. Future assessments should therefore retain consistent questions, scales and anonymous identifiers while keeping questionnaires short enough to achieve a high completion rate.

Assessment tool	What proved effective	Why it was useful
Pre-workshop self-assessment	Mapping prior knowledge, experience, expectations and skill gaps	It allowed facilitators to adjust the level and pace of training. In challenge-based activities, the results could also be used to create balanced teams with complementary skills.



Matched pre/post questionnaires	Repeating the same competence-related questions before and after training	This provided a simple and transparent indication of perceived learning progress across technical, methodological and teamwork-related skills.
Practical tasks and prototype evaluation	Assessing digital models, fabricated components, inspection reports, animations and functional prototypes	Tangible outputs demonstrated whether participants could apply the acquired knowledge, not merely describe it.
Continuous facilitator observation	Observing tool use, problem-solving, independence and cooperation during exercises	Facilitators could identify difficulties immediately, provide formative feedback and adapt explanations to participants' needs.
Peer review and final presentations	Group discussions, prototype demonstrations, collective screenings and peer-to-peer feedback	These formats revealed communication, reflection and teamwork skills while helping participants learn from different solutions.
External committee or evaluation	Involving instructors, stakeholders and tandem partners in reviewing final results	External perspectives increased the relevance and credibility of the evaluation and connected technical quality with user and industry expectations.
Mentimeter feedback	Collecting immediate responses and short qualitative comments during or directly after activities	Mentimeter provided a quick, accessible and engaging way to identify participant reactions, organisational issues and topics requiring further explanation.
Open-ended questions	Asking what participants expected, valued or would improve	The comments explained the quantitative results and produced actionable recommendations, such as allocating more time to data processing or practical work.



5. Best Practices and Challenges

Best practice	Evidence from sources	How to use it
Challenge-based hands-on learning	All ZPC respondents assessed project-based learning as very effective and the theory-practice balance as excellent.	Keep challenge-based learning as a core design principle across programs.
Visible prototypes and portfolio outputs	ZPC comments valued visible results and suggested using outputs for interviews/portfolios.	Require final demonstrators, documentation and portfolio-ready outputs.
Low-threshold company entry formats	Company Day: guest lectures/workshops were selected by 26 companies.	Create a standard package for lectures, feedback sessions and short company inputs.
Talent pipeline framing	Company Day: recruitment/employer branding was selected by 35 companies.	Use recruitment as an entry argument while gradually introducing upskilling and innovation benefits.
FabLab/strojLAB as neutral interface	ZPC comments valued the lab environment; Company Day included interest in strojLAB and materials/excursions.	Position FabLabs as practical brokers between education, companies and regional policy.

Table: Best practices (stakeholder section result)

Challenge / risk	Evidence	Mitigation recommendation
Weak immediate employee upskilling demand	Only 3 companies declared direct upskilling interest; 14 are considering it.	Start with short workshops and student cooperation, then convert engaged companies into upskilling users through demonstrated value.
Unclear industry cooperation model	ZPC comments state that collaboration with industry was not clearly explained.	Prepare a one-page cooperation menu with roles, expected time, benefits, deliverables, IP/data handling and contact point.
Need for business/customer framing	Stakeholders requested focus on the problem, customer, business value and market pathway.	Integrate customer discovery, value proposition, cost/BOM and business constraints into program modules.
Limited teamwork in some pilot design	ZPC comments recommend teamwork and interdisciplinary cooperation.	Use team-based challenges and assign roles such as engineering, design, business/user perspective and documentation.
Risk of low technical ambition	ZPC comments note that some students choose easier technical paths and that CNC/material decisions could be more visible.	Offer baseline and advanced challenge tracks with required technical criteria and mentor checkpoints.
Uncertain sponsorship readiness	Company Day: 13 companies selected uncertainty; financial support is lower than in-kind support.	Prioritise in-kind materials, mentoring, excursions and challenge briefs before financial sponsorship.

Table 13. Main challenges and mitigation logic.



6. Stakeholders Report

The two analysed sources (Company Day at FME BUT, and ZPC Pilot Run Evaluation by stakeholder's committee) confirm strong stakeholder support for DiSTT-style, FabLab-based re/upskilling when the offer is framed around practical, challenge-based learning, visible prototypes and direct relevance to labour-market transitions. The strongest evidence comes from the ZPC stakeholder feedback, where all six respondents rated the workshop as excellent, all assessed the project-based learning approach as very effective, all rated the theory-practice balance as excellent, and all expressed interest in future collaboration. ZPC Pilot Run was selected as a representative workshop for the purpose of evaluation by stakeholders, because of the wide scope of taught skills and high time dotation.

The Company Day questionnaire adds a broader employer perspective. Out of 44 company records, 33 companies (75%) indicated that they are willing or rather willing to cooperate actively with students, while another 8 (18%) would at least like to present their company. This indicates a strong stakeholder base for student-oriented pilots, challenge sourcing, guest inputs and follow-up engagement.

At the same time, the evidence shows that companies currently respond more strongly to student cooperation, recruitment and employer branding than to employee upskilling. Only 3 companies (7%) declared immediate interest in employee upskilling and 14 (32%) are considering it. This should not be interpreted as a rejection of upskilling. Rather, it suggests that the upskilling offer needs clearer business framing, more concrete modular formats and a low-threshold entry point.

The key draft recommendation is to position DiSTT pilots and the Digital Skills Transformation Toolkit as a stakeholder bridge: companies can start with light-touch engagement such as guest lectures, short workshops, excursions and feedback sessions, then progress towards mentoring, internships, challenge-based student projects, material sponsorship and eventually co-designed upskilling modules. This graduated engagement pathway is aligned with the project proposal requirement for the stakeholder report to provide data, best practices, challenges and recommendations that support adoption and policy integration of the Toolkit.

Key insights for policymakers and regional innovation stakeholders

Key policy message. Regional policymakers and innovation stakeholders should support FabLabs and university labs as practical brokers between company skill needs, student talent pipelines and modular re/upskilling delivery. The evidence points to demand for hands-on, short, industry-connected formats rather than long generic training courses.

List of Recommendations

1. Recognise FabLabs and university labs as practical infrastructure for digital-skills transformation, not only as technology-access spaces.
2. Support brokerage functions. The evidence shows that companies need help translating broad interest into concrete lectures, challenges, internships, sponsorship and upskilling modules.
3. Integrate the Toolkit into smart specialisation and labour-market policies as a modular, place-based instrument that can adapt to different company and target-group needs.
4. Fund short, low-threshold pilot formats and follow-up pathways. Short workshops can act as gateways to deeper training and company commitment.



5. Encourage non-financial company contributions such as materials, mentors, excursions and challenge briefs, because these appear more immediately feasible than direct financial support.
6. Use the final D.2.3.1 report as evidence for adoption of the Digital Skills Transformation Toolkit by training-oriented organisations and regional stakeholders.

Company motivations

The dominant motivation is recruitment and employer branding. This is highly relevant for DiSTT because it confirms that companies see student-facing cooperation as a talent pipeline. However, only a small share selected testing ideas, which means that the partnership should better communicate how company challenges can be transformed into low-risk student projects, prototypes and innovation experiments.

Motivation	Companies selecting	Share of company records
recruitment and employer branding	35	80%
marketing/visibility	19	43%
CSR/social responsibility	9	20%
testing ideas	4	9%

Table: Company Day - declared motivations for cooperation.

Technology and skill interests (by companies)

Technology demand is distributed rather than concentrated in one topic. The strongest interest areas were Design Thinking, polymer 3D printing and Arduino/PLC, followed by metal 3D printing and Fusion/CAD-CAM. This supports a modular program architecture where organisations can select relevant modules and combine them around real problems.

Technology / skill topic	Companies selecting	Share of company records
Design Thinking	11	25%
polymer 3D printing	10	23%
Arduino/PLC	9	20%
metal 3D printing	7	16%
Fusion/CAD-CAM	7	16%
optical scanning	6	14%
robotic 3D printing	4	9%
2D laser cutting	4	9%
algorithmic modelling	2	5%

Table: Company Day - technology and skill interests.

Preferred training formats and strategic priorities

Short workshops are the preferred training format. Individual or coaching formats also appear relevant. Longer multi-day or one-week formats received limited demand in this sample, which indicates that the



entry offer for companies should be compact and low-threshold. The strategic priority data also shows that many companies are still mapping options (50% of respondents), meaning that stakeholder onboarding and interpretation of possibilities are necessary before asking for firm commitments.

Preferred format	Companies selecting	Share of company records
short workshops	16	36%
individual/coaching format	7	16%
multi-day format	4	9%
online/practice format	3	7%
one-week format	1	2%

Table: Company Day - preferred training formats.

Company willingness to cooperate with students

The Company Day results show a broad base for student-oriented stakeholder engagement. Out of 44 company records, 33 companies declared active or rather active willingness to cooperate with students, and 8 additional companies selected a presentation-only mode. This means that the majority of the sample can be engaged through some form of company-student interface.

Cooperation attitude	Count	Share of company records	Implication
Yes / rather yes to active student cooperation	33	75%	Strong base for company-student interaction.
Presentation-only interest	8	18%	Useful entry point, but needs conversion into deeper engagement.
Rather no / no active interest	1	2%	Low direct resistance in the sample.
Missing / not answered	2	5%	Follow-up needed.

Table 4. Company Day - willingness to cooperate with students.

Preferred cooperation formats

Guest lectures and workshops are the strongest entry format, followed by internships and traineeships. Deeper formats such as projects integrated into teaching, hackathons and final theses were selected less often, which suggests that stakeholders first need a clear cooperation pathway before committing to more demanding formats.

Cooperation format	Companies selecting	Share of company records
guest lectures/workshops	26	59%
internships/traineeships	16	36%
theses/final projects	8	18%
projects integrated into teaching	5	11%
hackathons	3	7%
joint prototyping	0	0%
student projects	0	0%

Table 5. Company Day - preferred cooperation formats.



Strengths identified by stakeholders

Stakeholders consistently described the workshop as practical, challenge-based and close to real engineering work. The strengths cluster around five themes:

- Hands-on learning and visible outcomes. Stakeholders valued practical work, prototypes and visible results.
- Challenge-based learning. The workshop was seen as combining hard skills with soft skills and just-in-time learning.
- Real-life engineering tasks. Respondents highlighted complex problem solving and the use of practical constraints.
- Multi-technology integration. The workshop forced students to combine tools, technologies and knowledge sources rather than relying on a single isolated skill.
- FabLab/strojLAB environment. Stakeholders recognised the lab background, supervisor support, design thinking and prototyping as important enabling factors.

Improvement needs from stakeholders

The positive assessment was accompanied by clear recommendations for further development. These should be treated as inputs for program refinement before final Toolkit compilation.

- Strengthen the problem definition phase. Stakeholders asked for stronger focus on why the problem matters, for whom it is being solved, and what value it creates.
- Add business and commercial thinking. Several comments pointed to market relevance, business values, customer needs, cost constraints, productisation and route-to-market.
- Make teamwork more explicit. Respondents recommended more teamwork and, where possible, interdisciplinary cooperation such as designer-engineer teams.
- Clarify the industry cooperation model. Stakeholders noted that cooperation with industry was not always sufficiently explained, which may reduce company engagement.
- Increase technical ambition where appropriate. Comments mentioned that students sometimes choose easier paths and that areas such as material choice, CNC and advanced technical constraints could be made more visible.
- Create portfolio value. Stakeholders suggested using outcomes in interviews and public portfolios, which would increase both employability and program visibility.

Cross-source synthesis: what the two sources jointly show

- The pilot/workshop format is credible to stakeholders. ZPC feedback confirms that hands-on project-based learning is perceived as effective and relevant.
- Companies are open to cooperation, especially when it strengthens talent pipelines. The strongest Company Day motivation is recruitment and employer branding, and the strongest cooperation format is guest lectures/workshops.



- Stakeholders need clear cooperation pathways. Many companies are still mapping options or are unsure about sponsorship; therefore, DiSTT should offer concrete engagement packages with defined effort, benefits and outputs.
- The offer should be modular. Technology interests are diverse and no single topic dominates enough to justify a single fixed course for all companies.
- Business, customer and market thinking should be added to technical learning. Stakeholder comments repeatedly asked for a stronger link between engineering prototypes and value creation.
- Teamwork and interdisciplinary collaboration should be strengthened. This is both a labour-market skill and a practical way to make industry cooperation more realistic.
- The transition from student cooperation to employee upskilling needs deliberate design. Companies may first engage through students, lectures and mentoring, then later adopt upskilling modules once value is proven.

Residency Visit and External Evaluation

For LP1 BUT, the residency visitor and external evaluator was Tanguy Prevot, a Belgian industrial designer with international experience in both professional practice and higher education. This combination made him particularly suitable for providing an independent outside perspective on the reference pilot workshop *ZPC - How to Make Almost Anything*. His evaluation considered the project-based learning approach, the balance between theory and practice, the relevance of the technologies used, students' employability and the applicability of the course to real engineering challenges.

Prevot rated the workshop as excellent overall and considered its project-based methodology very effective. He highlighted its “pragmatic mix of technologies and tools” and observed that students “cannot ignore any aspect of the project”, as the comprehensive assignment requires them to address technical, design and implementation issues beyond their initial expertise. He also assessed the course as highly relevant to employability and considered its graduates attractive candidates for internships, projects or employment.

His principal recommendation was to add a “small dose of business and commercial thinking”. In particular, students should be guided to consider customer value, user experience and commercial criteria when defining their problem statements and evaluating alternative solutions. He also noted that the open project format allowed students to choose either relatively simple or highly ambitious solutions, making the level of complexity difficult to control. Future iterations should therefore include clearer criteria for project scope and structured feedback sessions addressing problem definition, prioritisation of requirements and user experience. These recommendations confirmed the overall validity of the ZPC concept while identifying opportunities to strengthen its connection to market-oriented innovation.

Relevance for regional and EU level

At the regional level, the LP1 Pilot Runs responded to the needs of the South Moravian manufacturing and innovation ecosystem by connecting university education, digital-fabrication facilities, secondary schools and industrial employers. The company survey, completed by 51 organisations, confirmed substantial interest in cooperation with students: 36 respondents expressed a positive or generally positive interest, including affirmative free-text responses. The most frequently selected cooperation formats were company lectures and workshops (27), internships or trainee programmes (18), industry-linked final theses (8), projects integrated into teaching (6) and hackathons (4). Recruitment was the strongest motivation for cooperation, selected by 38 respondents.



The requested competence areas also corresponded closely with the LP1 portfolio. Companies showed the greatest interest in Design Thinking, teamwork and soft skills (12 responses), followed by plastic 3D printing and Arduino/PLC programming (10 each), metal additive manufacturing and Fusion CAD/CAM (8 each), and optical scanning and component inspection (7). Short workshops were preferred more frequently than multi-day formats, supporting the relevance of modular and accessible training. Interest in direct employee upskilling was more cautious—three companies confirmed interest and sixteen were considering it—indicating that professional training offers must be clearly connected to specific operational needs.

At the EU level, the tested ME and DME formats contribute to wider priorities concerning digital transformation, advanced manufacturing, interdisciplinary skills and lifelong learning. Their modular structure allows workshops to be adapted to different learner groups, technological facilities and regional industrial profiles. The combination of technical training with teamwork, problem-solving and user-centred innovation is particularly transferable. Cooperation between universities, FabLabs, schools and companies therefore provides a replicable model for strengthening skills ecosystems and reducing the gap between education and rapidly changing industrial practice.

Conclusion and Next steps

Improvements for Re/UPskilling Programmes

The Pilot Runs confirmed the relevance of the modular ME and DME programme concepts while identifying several opportunities for improvement. Future training should begin with a short pre-assessment of participants' experience, expectations and learning needs. The results can be used to adjust the level of instruction, create balanced teams and distinguish between introductory and advanced learning pathways. In longer formats, essential technical training should be concentrated at the beginning, allowing participants to start their main projects earlier and retain sufficient time for experimentation, iteration and consultation. Time-intensive activities, including 3D printing, scanning and data processing, should be divided into multiple sessions where appropriate.

Learning objectives and assessment criteria should also be communicated more clearly, including the distinction between minimum, good and excellent performance. Self-assessment should be combined with facilitator observation, practical tasks, prototype evaluation, peer feedback and final presentations. Pre- and post-assessments should use identical questions, scales and anonymous identifiers to enable reliable paired comparisons. Short Mentimeter evaluations can complement these tools by capturing immediate participant reactions. Supporting materials—step-by-step guides, templates, example projects and video tutorials—should be expanded, while project assignments should include stronger consideration of user needs, customer value and potential industrial application.



Inputs for Further Implementation (A3.3)

The results of the Pilot Runs implemented under A3.2 provide direct input for A3.3 and the preparation of deliverable D3.3.1, the *Digital Skills Transformation Toolkit*. Embedded in the SkillNest platform, the Toolkit is intended as a ready-made solution enabling FabLabs and other training-oriented organisations across Central Europe to address digital-fabrication skills gaps. It will consolidate all six re/upskilling programmes developed and tested through the collaborative activities A1.3, A2.1, A2.3, A3.2 and A3.3.

The LP1 Pilot Runs contribute validated examples of how the ME and DME programmes can be implemented in practice. Their course descriptions, learning outcomes, target groups, duration, required facilities, educational materials, assessment questions, participant results and lessons learned will help future users select and adapt suitable workshop formats. The Pilot Run reports also identify practical implementation requirements, including recommended group sizes, prerequisite knowledge, equipment, facilitator support and adjustments needed for participants with different experience levels. The pilots therefore transform the programme concepts into tested and reusable implementation models.

A substantial proportion of the piloted workshops is already available online through SkillNest. Registered educators can access workshop descriptions and download available teaching materials, guides, presentations, templates and digital data required for implementation. The consortium is continuing to consolidate, complete and harmonise these resources so that the Toolkit provides consistent support for preparation, delivery and evaluation while remaining adaptable to local facilities and target groups.

SkillNest also supports the assessment approach tested during the DiSTT Pilot Runs. Organisations taking up the Toolkit can use the platform to conduct pre- and post-training assessments, collect participant feedback and compare perceived competence development. Any FabLab, school or other training provider can therefore adopt the Toolkit by registering in SkillNest, selecting or adapting the relevant programme and using the available resources and assessment functions. In this way, the Pilot Runs provide both the evidence base and the practical content required to transfer, replicate and further improve the six re/upskilling programmes throughout the Central European region.

The Pilot Runs confirmed the value of modular programmes that can be adapted to different audiences, competence levels and timeframes. A particularly important lesson is that technical knowledge becomes more meaningful when it is linked to a real task, access to fabrication equipment, the production of a physical or digital outcome, and direct feedback from educators, mentors or industrial experts. The pilots also demonstrated the importance of combining pre- and post-activity self-assessment with the evaluation of practical outputs and formative feedback. These findings provide the basis for further refinement, transfer and wider uptake of the programmes through SkillNest.app and other DiSTT educational channels.