Final External Quality Report (15/01/2020 – 14/01/2024)

WP4. Quality Plan

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1 Project Information

HEIn4.0 is a Capacity Building for Higher Education project, co-funded by the Erasmus+ programme. It started as a 3-year project, that started in January 2020 and eventually ended in January 2024, after being given a 1-year extension.

It involves 13 partners, 5 from Ukraine, 4 from Georgia and 4 from the European Union (2 from Belgium, 1 from Portugal and 1 from Sweden):

- **EU**: Katholieke Universiteit Leuven (Belgium), Instituto Politécnico do Porto (Portugal), KTH Royal Institute of Technology (Sweden), Volvo Cars Gent (Belgium)
- **Ukraine**: National Metallurgical Academy of Ukraine (merged later with Ukrainian State University of Science and Technologies), Donetsk National Technical University, Lutsk National Technical University, Odessa National University, Company “Festo”
- **Georgia**: Akaki Tsereteli State University, Batumi Shota Rustavelli State University, Business and Technology University, Georgia's Innovation & Technology Agency

HEIn4 project aims at solving the identified problem of disproportion between the availability of technologies relevant to Industry 4.0 and the lack of experience in Georgia and Ukraine in re-setting the business model of an enterprise in order to enable comprehensive utilisation of the opportunities arising under emerging paradigm of the new Industrial Revolution. The wider project objective is to reinforce the role of HEIs in assisting the industrial transformation in Ukraine and Georgia under the Industry 4.0 paradigm.

HEIn4.0 addresses the identified NEED in Ukraine and Georgia through:

- building capacities in HEIs (human resource and institutional units);
- delivery of tailored business management courses for industrial personnel;
- launching consultancy services for the industrial companies (large and SME);
- setting new taught modules for Master students (Management).

Hence, aims at achieving the following specific objectives:

1. To reinforce capacities in HEIs (human resource, material base and institutional units) in response to emerging Industry 4.0 paradigm;
2. To reinforce collaboration of HEIs with industry by delivery tailored courses and consultancy services for the companies (large and SME) towards exploring the opportunities of new Industrial Revolution through reconfiguration of business models;
3. To set new taught module "Industry 4.0 Business Management" for the MSc students for enhancing graduates' employability under emerging market conditions;
4. To develop recommendations for updating the Engineering curriculum towards competencies required for operating the factories of the future.

The tasks are distributed in 7 Work Packages:

PREPARATION	WP1. Study of EU HEI’s experience
DEVELOPMENT	WP2. Curriculum for Industry 4.0

DEVELOPMENT	WP3. Capacity building
QUALITY PLAN	WP4. Quality Plan
DISSEMINATION & EXPLOITATION	WP5. Dissemination
DISSEMINATION & EXPLOITATION	WP6. Exploitation
MANAGEMENT	WP7. Management

2 Introduction

The External Quality Expert was selected by the partnership to deliver 1 final evaluation report at the end of the project.

The responsibility of the external evaluation in HEIn4.0 is to evaluate, verify and report on the quality of the project, the achievement of milestones and objectives, and the quality of the results of each Work Package of the project, based on the information provided by the Project Coordinator, and the partnership, according to the framework defined in the approved project.

The activities of building the External Evaluation Report were conducted between October 2023 and January 2024. The Report contains the evaluation of the different aspects (outputs, activities, among others) of the project that were undertaken from the beginning of the project, on January 14, 2020 (M1) until January 14, 2024 (M48).

In addition to this introduction, the Report includes the following chapters:

Chapter 3. Methodology: this chapter provides an explanation about the methodology used for conducting the external evaluation process.

Chapter 4. Analysis: this chapter presents the analysis of the information gathered through the data collection process as part of the external evaluation, using a set of criteria.

Chapter 5. Conclusions: this chapter provides the conclusions from the analysis of findings during the evaluation, which aim to provide important considerations for the HEIn4.0 partners and contribute to the improvement of the project's performance.

3 Methodology

The overall evaluation methodology has been designed in accordance with the Project proposal, focusing on the following areas:

- How well the partnership functioned as a multinational collaboration (Intercultural understanding, activity sharing, communication effectiveness, managing deadlines, etc.)
- The amount of progress made towards the anticipated objectives and more specifically, deliverables and project outcomes and adherence to the workplan
- The success and results of outreach initiatives, as well as the degree to which best practices from comparable projects have been incorporated into the project
- The degree to which the target audiences (teachers, students, and stakeholders from the public) have been included in project planning and activities as part of a strategy for maintaining the project activities.

3.1 Tools of evaluation

The methodology starts with project overview and analysis of planned and achieved deliverables, and cross-matching with logical framework matrix in order to define to which extent the quality of results meet the plan according to the available indicators:

- Analysis of end results of the project
- Evaluation of whether stated objectives have been met

Therefore, the External Evaluation execution and process included:

- Observation and analysis of project documents via the shared document space and HEIn4.0 website (https://hein4.net/). The author was given full access to all relevant external and internal documents and on the contents of the project's shared file space in the dedicated project sharing platform.
- Starting from the original documentation e.g. project proposal, the Logical Framework Matrix - LFM, available documentation included reports & deliverables, internal quality control and monitoring reports for work packages, etc.
- Direct communication with project partner institutions was established. The author participated in meetings with the Project Coordinator, as well as via e-mail communications, beginning in October 2023, in order to collect and summarize the important information for reporting and evaluation findings and to clarify important issues regarding the project.
- Analysis of responses to a questionnaire addressed to the project partners, received in January 2024.

3.2 Criteria of Evaluation

The External Evaluation was based on agreed success criteria looking at the following evaluation criteria in Table 1.

Table 1. Key external evaluation criteria

Criteria	Focus of evaluation
Relevance	The consistency and validity of the project activities and outputs against the initially proposed objectives.

Efficiency	Measuring the resource used both from economic and time perspectives in the project activities to achieve the project objectives. How economically resources/inputs (funds, expertise, time, etc.) are converted to results.
Effectiveness	Measuring the success rate of project results and outputs against the initially proposed objectives. The extent to which the project's objectives were achieved, or are expected to be achieved, taking into account their relative importance.
Impact	Examination of the changes produced by the project. The changes could be positive or negative, direct or indirect, intended or unintended. Positive and negative, primary and secondary long-term effects produced by a development intervention, directly or indirectly, intended or unintended

Especially for the deliverables, the evaluation is done on the basis of:

Relevance	The consistency and validity of the deliverable against the initially proposed objectives.
Scientific/Educational soundness	The characteristics of soundness of scientific and educational work to produce the deliverable, as expressed through reliability, validity, and objectivity.
Impact potential	How possible it is that the deliverable will benefit the target group(s)
Sustainability potential	How possible it is that the deliverable will continue to be used after the project has ended

4 Analysis

4.1 Management and Collaboration in the Partnership

The success of internal communication is crucial to any project's success since the work of the transnational partnership is essential to achieving the objectives. Most of the time, collaboration on the project went as planned.

Management and coordination of the project are covered by Work Package 7 (Management).

Main points to highlight concerning the management and collaboration between partners are:

- The project Coordinator (KU) has been responsible for the overall financial and administrative management and operation of the project, which included the preparation of reports, and time monitoring, in addition to being a liaison between the consortium and EACEA. The coordinator took all the essential actions from the start and throughout the entire project's lifetime to ensure that it was consistently organized and implemented at all levels.

- Due to coronavirus restrictions the beginning of the project delayed by a few months, resulting in having the 1st (kickoff) meeting online in June 2020. According to the meeting minutes decisions focused on the implementation of first activities, and financial issues.
- The kickoff presentation contained a detailed schedule of the project activities with specific targets and timelines.
- No management structures were formed during the kickoff meeting, making the partnership the decisive mechanism for any strategic decisions of the project.
- Frequent management meetings were held. 7 face-to-face partnership meetings were scheduled to be held at the beginning of the project. Due to the 2 main problems faced by the project (Covid-19 and the war in Ukraine), physical mobility was difficult, especially at the beginning of the project. For this reason, it was decided to do frequent online meetings instead of the transnational meetings originally planned.
- By the end of the project, 32 monthly partnership meetings were held (online and hybrid); 2 more are planned to be held by the end of February 2024, well after the end of the project period. This is commendable and indicative of the commitment of the partnership to the sustainability of the project results.
- Due to coronavirus restrictions as well as the war in Ukraine, travelling for partnership meetings has been severely limited; when it was finally feasible to hold partnership meetings, these have been combined with training and study visits or conferences. Due to these situations, 6 partnership meetings have been held in hybrid form (physical and online) within 2022 and 2023. This combined with the extremely regular hosting of monthly online meetings is convincing of a robust monitoring and coordination of the project progress.
- In each meeting, the partnership received and discussed reports from the partners' representatives. Minutes of meetings are posted in a designated area in the shared space, as well as the project website, complete with decisions taken, results, pending issues, and deadlines. The available documents show that the full sets of documents were prepared and published. Meetings and published presentations prove the active work that was done during the project first year as well as the availability and quality of corresponding deliverables.
- Within the meeting minutes, as well as the document repository (private for partners and public on the website), there is limited use of the original designation and numeration of tasks and deliverables, making monitoring the tasks and deliverables and their relevant due dates a very difficult task, which seems only balanced by the frequency of the online meetings for keeping the schedule.
- As to facilitating partner participation and commitment, all partners are participants in the management structure as members in the partnership. Partners from Ukraine and Georgia are also members of the Reference Groups (more in the Quality section). Moreover, each partner is a leader of at least one work package, which enhances participation levels of partners and the sense of ownership of project processes.
- According to the meetings' minutes, the partnership agreements among the partners were signed and sent to EACEA before July 2020.
- A shared document drive exists, rather complementary to the project website, which has all the public information available. Indeed, the website has plenty of information, almost everything needed for the project. However, for the collaboration purposes it aims to support, the shared space is less than convenient, and does not contain all the necessary information, organized in a manner that would facilitate a partner or an external evaluator to have a full view of the project and a quick search for the needed document. Also, it seems rather addressed to the partner countries, as European partners do not seem to have any files of their own.
- From the communication with the partners and the evaluation of the questionnaires, it can be concluded that there is great partner cooperation and coordination, and the project advanced successfully toward

its goals, however not smoothly and not without obstacles, but mostly due to external factors (covid-19 and the war in Ukraine), which the partnership handled quite well under the circumstances.

- It must be born in mind that the project was affected by two major factors in its lifetime: It started in the midst of the spread of Covid-19 and the enforcement of mobility restrictions and afterwards it saw the start of the war in Ukraine. The former affected the start and the progress of the project (delayed by almost 6 months) and the latter has affected the way the Ukrainian partners progressed with their tasks, as some are very close to the war front, staff from the Universities have changed, businesses have closed, to mention only a few of the implications the war brought. The fact that the project ended successfully as it has is highly commendable.

4.2 Quality Management of the Project

The Quality Management of the project was covered by WP4. Quality Plan.

The tasks included the formation of a Reference Group in each university in Ukraine and Georgia, with members the entire hierarchy of the university, as well as representation from the industry, tasked with the internal Quality Control of the tasks and activities of the university.

Regarding the Quality management of the project, the following aspects have been evaluated:

- The proposal sees that a Reference Group (RG), responsible for the Quality Control of the project would be formed. Reference Groups were indeed formed in each University in Georgia and Ukraine. Names of members of the Groups, as well as a timeplan for their meetings was found in the Quality Assurance Plan.
- However, a horizontal instrument throughout the partnership regarding quality could have utilized prior knowledge and experience in quality assurance techniques and instruments as well as the topics themselves from other partners, resembling an internal peer-review process for the project results.
- No European partner was involved in the QA process.
- Each RG produced Activity Evaluation Reports (AER) referring to the work done for the project inside the university and referred them to the partnership meetings for approval. The topic of reports from the RGs is mentioned in various meetings' minutes. Not all AERs were located in the shared space, however most partners from Georgia and Ukraine have kept the schedule of 6 month-meetings for this purpose.
- A Quality Plan was not foreseen in the approved proposal, (as was also noted in the Technical Implementation Report evaluation by EACEA) but a Quality Assurance Plan was developed. The Quality Assurance Plan is rather minimal, is based on the main axes described in the tasks of the relevant WP but does elaborate on key factors of the Quality strategy outlined: the persons that staff the Quality control instruments/committees, a timeplan for their quality assurance tasks, as well as a broad description of the evaluation of the courses methodology.
- The strategy concerning quality had room for improvement from the beginning of the project. The main concept of Quality Assurance was concentrated on the self-evaluation of certain deliverables by the partners themselves; as a tool this is an important part of the toolbox, however there are many more tools to be used for project quality assurance.
- The evaluation of the deliverables was done by the RGs of each university in Ukraine and Georgia; the Evaluation Reports, named "Course Feeback" were found for all UA and GE partners on the website. Evaluation was done using Google forms, using a standard questionnaire for the evaluation of the courses offered to students.

- Hiring an External Auditor is a significant step in the right direction, even at the end of the project, although many suggestions would be much more effective if they were done after the 1st interim report from EACEA.
- Nonetheless, the project has also included certain important quality control activities, piloting and validation of key deliverables, such as for the short courses, the students' modules and the Labs' activities, although they were part of the "Exploitation" work package. This misallocation of tasks is however inconsequential, the performance of the quality control activities themselves is considered to be effective for the enforcement of quality measures within the project.

4.3 Assessment of the Quality of Deliverables

In the following chapter we will examine all key deliverables of the project, i.e. from Work Packages 1 to 4.

4.3.1 PREPARATION - WP1. Study of EU HEI's experience

The main objective of the first Work Package was to acquaint the participating academics from Ukraine and Georgia with new teaching methods and contents of the curriculum relevant to business management under conditions of the new Industrial Revolution. The experience would help them create the contents of the new curriculum for the next activities of the project, namely in WP2.

All tasks and outputs of this WP have been fully completed and delivered, however their start, as with the whole project, was initially delayed by 6 months due the onset of the COVID-19 pandemic and the restrictions it carried. As a result of the same obstacle, changes to the workplan were also introduced: instead of a set of short visits to the EU partners, a large number of webinars (17) were performed as a substitute. For all accounts and purposes, the substitution has been effective, given the range and the variety of the topics presented through the webinars.

The results of the Work Package are all available on the project website. With the exception of the list of webinars offered in the context of Tasks 1.1 and 1.3, the other deliverables (Case Studies, task 1.4) are not available in English (Case Study "Best experiences and Practices of Georgian and European Universities"; and Case Study "Higher education towards fourth industrial revolution: European and Ukrainian cases"), therefore it was not possible to assess their contents against project objectives, relevance, etc. Nevertheless, the documents present a large quantity of work dedicated to the task and the deliverable.

4.3.2 DEVELOPMENT - WP2. Curriculum for Industry 4.0

The aim of this work package was to deliver:

- Short courses for industrial staff upgrade based on the EU experience and in close contact with the industrial partners (3 ECTS each).
- New educational modules (5 ECTS each) for educating future professionals yet on the Master level enhance graduates' employability and strategically prevent skills shortage in a longer term perspective.

All of the tasks and outputs of the WP have been concluded.

The outputs and deliverables for Tasks 2.1 and 2.2 are presented below in 4.3.2.1 and 4.3.2.2.

For the implementation of Task 2.3 "Development of recommendations for updating Engineering curriculum", two Case Studies were developed: "Case_study Methodology Concept Higher Education 4.0 in Georgia" and Case Study "Higher education towards fourth industrial revolution: European and Ukrainian cases", which,

unfortunately are not available in English, so they cannot be evaluated as to their contents. Additional to these, however, the UA partners have published a separate document titled "Joint recommendations for updating engineering curriculum" (in English) which includes recommendations for updating curricula for educational programs of the engineering profile, taking into account the best practices of the European partners of the project. The result is a very useful guide towards the modernization of curricula utilizing European experience.

4.3.2.1 Development of short courses for upgrading industrial staff (Task 2.1)

For this task, Each HEI developed a set of training modules to be offered to industrial staff (professional training). See list of training modules below in the table, as found on the website of the project.

Table 2. Training modules prepared (Task 2.1)

Country	University	Training modules prepared
Ukraine	Donetsk National Technical University	Training modules on Industry 4.0 – Industry 4.0: the Future of Production – Industry 4.0: the world of connected "SMART" enterprises and production ecosystems – Industry 4.0 and sustainable development: modern chemical technologies – Modern computer packages of programs for simulation of chemical-technological processes – New types of realities in technological processes of smart enterprises and production ecosystems – Smart manufacturing and digital ecosystems – Industrial Internet of Things – Management in Industry 4.0. New knowledge and skills for Industry 4.0
	Lutsk National Technical University	– Digitalization of production, – Management Industry 4.0, – Additive technologie and materials, – Digital leadership training for civil servants at LNTU, – Study and training materials
	Ukrainian State University of Science and Technologies	– "Industry 4.0. Technologies in metallurgy" , – "Integration of Industry 4.0 to Manufacturing Operations"
	Odessa I.I.Mechnikov National University	Integration of Industry 4.0 in industrial and management systems
Georgia	Akaki Tsereteli State University	Short Descriptions of the Courses offered by ATSU – “Smart House”

Country	University	Training modules prepared
	Batumi Shota Rustavelli State University	Short Descriptions of the Courses offered by BSU – 3D modelling and animation, – Graphic Design and Visualization, – Video Editing Installation - Adobe Premier Pro, – UI & UX Design Course
	Business and Technology University	Short Descriptions of the Courses offered by BTU – Amazon Web Services – SEO/Google Ads/ Google Analytics – Microsoft Power Bi – Mastering the Google Suite: Empowering Productivity and Collaboration – EmpowHER: Mastering Cybersecurity for Women – Internet Governance and Cyber Diplomacy – Data Visualization in MS Excel – Data Visualization in Power BI

Overall, the course materials as they are presented in the created syllabi provide an extensive array of learning opportunities and knowledge. The course objectives are achieved via the use of internationally recognized materials. Every course has suitable content, and there are enough time slots available. Overall, each of the suggested courses satisfies quality requirements.

According to WP6, the piloting of these activities was prescribed, by organizing short courses for people from local businesses including both large and SME. At least one course developed within Activity 2.1 will be launched in each HEI and delivered at least 4 times throughout the project. These piloting activities took place through Task 6.1. Each university has provided a report of piloting activities performed within WP6.

4.3.2.2 Development of taught module "Industry 4.0 Business Management" for Master students

New disciplines each partner country HEI were launched since the 2021/2022 academic year. The aim of the task was to introduce new educational modules on the Masters' Level, however more courses were introduced on the Bachelors' level too, to the commendation of the relevant partners.

The courses prepared for the purposes of this task are outlined as follows:

Table 3. New taught modules in UA and GE universities (Task 2.2)

Country	HEI	Cours	Level	Elective/ Mandatory
Ukraine	Donetsk National Technical University:	Industry 4.0: Business Management// Chemical and bioengineering	Master	Elective

Country	HEI	Cours	Level	Elective/ Mandatory
	Lutsk National Technical University	Basic of Mechatronics	Bachelor	
		Management Industry 4.0	Master	Basic
		Additive Technologies and Materials	Bachelor	
	Ukrainian State University of Science and Technologies	Industry 4.0 in metallurgy	Master	Elective
		Integration of Industry 4.0 to Manufacturing Operations	Master	Elective
	Odessa I.I.Mechnikov National University	Integration of Industry 4.0 to Manufacturing Operations//Management	Bachelor	Elective
		Integration of Industry 4.0 to Manufacturing Operations//Management	Master	Elective
Georgia	Akaki Tsereteli State University	Integration of Industry 4.0 in a Renewable Energy	Master	Elective
	Batumi Shota Rustavelli State University	Data Safety and Security	Master	Mandatory
		Intellectual systems	Master	Basic
		Computer Graphics and Visualization	Bachelor	Elective
	Business and Technology University	Industrial Transformation and Technical Changes	Master	Elective

The course materials, as outlined in the prepared syllabi, offer rich educational opportunities and content. In general, the curriculum provides opportunities for the future professional in the field and offers an array of educational options for the student. The course objectives are achieved through the use of internationally recognized materials. Every course has suitable content, and there are enough time slots available. Overall, each of the suggested courses satisfies strict quality requirements.

The curriculum is modified to meet the demands of the developing science and technology of the Industry 4.0 field and includes internationally recognized content courses to achieve its stated goals. Stakeholder participation in the planning process instills trust in the program's viability.

According to WP6, the piloting of these activities was prescribed. Taught module "Industry 4.0 Business Management", was scheduled to be piloted from September 2021 onwards and delivered to groups of students on Master level. These piloting activities took place based on Task 6.2.

The piloting activities, according to the relevant report Introduction of new academic disciplines for bachelors and masters in Georgia and Ukraine (overall information) were implemented for 3 academic years (2021-2022, 2022-2023 and 2023-2024); for the 1st academic year, 72 students enrolled in 5 modernised courses in the Georgian HEIs and 167 students to 18 courses in the Ukrainian HEIs. The numbers of students' enrollments increased by each next year, giving clear indications for the success of the venture.

4.3.3 DEVELOPMENT - WP3. Capacity building

The aim of this WP was to:

- Create Virtual Factory Learning Labs at 3 HEIs in Georgia and 4 HEIs in Ukraine, as a training platform for simulating real business processes in virtual environment
- Upgrade the knowledge of the Labs' staff members through visits to EU
- Develop content and capacity for consultancy services offered by the Labs.

The progress of the implementation of these tasks were severely affected by the war in Ukraine. The equipment was purchased, relatively early in the progress of the project and there is evidence of the facilities opening for the students. However, the conflict has made it difficult to exploit the full potential of these Labs in Ukraine.

Table 4. Virtual Factory Learning Labs establishment per HEI

Country	HEI	Status
Ukraine	Donetsk National Technical University	MiniFactory Learning Lab Official opening December 2021 Location of the Lab – Room 304, 3rd floor, building 3 2, Shybankova square, Pokrovsk 85300 Ukraine
	Lutsk National Technical University	Smart Factory Labs Official Opening June 2021 Located in the main campus of the university Lutsk
	Ukrainian State University of Science and Technologies	Virtual Factory Learning Lab Opening information n/a Located in the main campus of the university
	Odessa I.I.Mechnikov National University	Virtual Factory Learning Lab Opening June 2021 Located in the main campus of the university
Georgia	Akaki Tsereteli State University	Focused on Smart Solar Systems simulation

Country	HEI	Status
		Opening information n/a Located in the main campus of the university
	Batumi Shota Rustavelli State University	Innovation Laboratory Opening: Aprli 2021 Located in the main campus of the university
	Business and Technology University	Opening March 2021 Located in the main campus of the university (Tbilisi, Georgia)

According to WP6, the review of the Labs' operation was prescribed by each reference Group. Issues related to staffing, subordination, working methods and responsibilities were to be reviewed.

These reviews by the RGs took place through Task 6.4. All partners have created reports about the activities through WP6.

4.4 Dissemination & Communication

The dissemination and exploitation of the project was distributed in two work packages, WP5 (Dissemination), which includes the dissemination and promotion activities of the project, and WP6 (Exploitation) which includes the activities for the follow-up to the results of the project, in order to prepare them for the final users.

4.4.1 DISSEMINATION & EXPLOITATION - WP5 Dissemination

The Work package includes some of the usual dissemination activities in a project, such as the creation of a project website, development of newsletters ("semi-annual leaflets") and holding of Seminars, Workshops and a Conference for the purposes of promotion of the project etc.

The proposal does not describe the development of a Dissemination plan, although it describes the project's dissemination strategy in some detail. Based on that, a Dissemination Strategy is available on the website, which identifies target groups, main tools to be utilized and tasks.

The plan has identified the main target groups and stakeholders of the project to be:

1. Students
2. Academics
3. University administrators
4. Industrial stakeholders
5. Ministries and National Teams of HE Reform Experts in GE and UA
6. Business
7. Authorities

Other than that, the Dissemination Strategy does not deviate or add to the initial dissemination WP description; it would be preferable to make reference to tools, instruments, channels of communication and even indicators of success.

4.4.2 DISSEMINATION & EXPLOITATION - WP6 Exploitation

The main focus of this WP is to "initiate exploitation of the deliverables (e.g. courses for industry, modules for students, Labs with their services and day-to-day business, stakeholders' Round Table as a method to facilitate collaboration with industry, staff coaching in order to maintain and upgrade human resource etc) in order to detect possible drawbacks and to bring in place the mechanisms needed to ensure lasting sustainability of the results achieved and activities initiated."

Both the aim as well as many of the activities and tasks contained and described in this Work Package seem more oriented towards quality control of some key project results (6.1, piloting and validating short courses, 6.2, modules for students, 6.3, Labs' activities), whereas some others are, more appropriately, focused on the engagement of stakeholders (organisation of roundtables, 6.5) and sustainability (6.6, Staff coaching, 6.7, Sustainability Business Plans, 6.8, Network of Labs).

Similarly to WP5, the proposal does not describe the development of an Exploitation plan. However, an Exploitation Strategy is available on the website, which identifies the relevant activities and tasks, as they are presented in the proposal, without much deviation or additions, as to tools, instruments, channels, or indicators of success.

The first 4 tasks of the WP are evaluated along with the relevant deliverables, in par. 4.3. Tasks 6.5-6.8 are all activities focused on the engagement of stakeholders (roundtables), the propagation and use of results by people outside the consortium (staff coaching, network of Labs) and the sustainability of the Labs (Sustainability Business Plans). All of these activities will be evaluated collectively with the activities from WP5 in the following paragraphs.

4.4.3 Communication

The project looks active in the communication of project results to the external stakeholders and the public in general. There is a relevant section on the website dedicated to the external dissemination activities by the partners.

4.4.3.1 Website and social media

The website developed for the project (https://hein4.net/) seems to be updated regularly, with information about the project as well as news and updates about the various dissemination activities performed by the partners. There is a plethora of information about the many dissemination activities performed by the partners, i.e. leaflets, workshops, videos, information posted on partners' websites, and more.

Furthermore, each partner in Ukraine and Georgia had a dedicated page on their own websites to present the progress of the project for the University, news and relevant information.

There is a social media account of the project (Facebook: https://www.facebook.com/hein4point0 , 200 followers). The Facebook activity was very frequent until October 2023, with posts of the project activities and more news from the partners.

4.4.3.2 Newsletters-Project leaflets

Two different versions of newsletters were developed for the project, one for Ukraine and one for Georgia. The publication was semi-annual, with 6 issues published on the website for each country. Each country had their own version of the newsletter. It cannot be ascertained if the content is the same because the Newsletters are not in English, and it is not clear whether the newsletter has been distributed via any other means than the university pages and how many people were reached.

4.4.4 Stakeholder engagement/involvement

Stakeholder networking is an important part of the dissemination activities.

The work package WP 5 includes the organization of workshops in Ukraine and Georgia to raise the level of awareness and action among stakeholders, guaranteeing sustainability of outcome. Many dissemination events (workshops) were organized by the partners in Ukraine and Georgia with the participation of representatives from the industry.

WP6, more particularly, describes the organization of roundtables that will bring together representatives from academia, industry and authorities. The schedule in the kickoff meeting presentation dictated that Round Tables would be organized at each PC HEI by Labs and held 2 times at each HEI during the project lifetime for collegiate discussion of the project implementation with stakeholders (predominantly - industry) outside the project team (D6.5. Round Table meetings).

Round tables were organized by the Universities in combination with the trainings for the industry, done with the purpose to have representatives from different industrial companies and universities in discussions about the future of technical higher education, and cooperation between businesses. Based on the KPIs provided, the outreach to the industry achieved through the sum of all of these training workshops is considered positive, since partners managed to present to and engage a high number of stakeholders the project activities, courses, and Labs.

4.4.5 Events

The work packages include the organization of several workshops/events to publicize the new programs to the public in order to attract students and the awareness of stakeholders. It should be noted that the first year of the project Covid-19 restrictions were in place in most of the countries involved, reasonably there was some delay in the implementation of most face-to-face dissemination and networking activities. Based on this, it is commendable how the project has organised many of these events after the 1st half of 2021.

According to the project public records on the website (News & Activities):

- 22 online and hybrid Seminars/webinars have been conducted in Georgia and Ukraine.
- The workshop “University leadership in the transition towards Industry 4.0” was held as a 2 days online event (17-18.02.21).
- 2 onsite conferences were organized in Georgia in 2022 and 2023 (none in Ukraine because of the war)

The detailed information regarding the conferences is available on the HEIn4 project website in News & Activities section.

During the analysis of information for the evaluation of the dissemination activities of the project, we found that it would greatly facilitate the evaluation of outreach, engagement and impact the existence of dedicated dissemination reports with information about attendance, composition regarding target groups. This information was located in the document repository (not on the website), but it was fragmented, not organised in a way that would facilitate evaluation. Some reports are updated but not all.

Also, as is evident in the news section of the website of the project, many partners have participated in multiple relevant events in Ukraine and Georgia and presented the progress of the project to the mass media, local academia and industry representatives.

4.5 Sustainability & Impact

4.5.1 Sustainability

According to Task 6.7, each Lab has produced a Sustainability Plan to outline the strategy and the plans to ensure their sustainability.

The developed sustainability plans are all available on the project Website:

Ukraine:

Donetsk National Technical University

Lutsk National Technical University

Ukrainian State University of Science and Technologies

Odessa I.I.Mechnikov National University

Georgia:

Akaki Tsereteli State University

Batumi Shota Rustavelli State University

Business and Technology University

Many of the Sustainability Business Plans delivered are complete with SWOT analysis, Strategy, Action Plans for the near future, as well as allocation of funds and resources for the operation of the Labs, and Risks; overall very good efforts to plan for the sustainability of the Labs. However, the SBPs from Donetsk and the partners from Georgia contain only basic information about sustainability of the Labs, such as the kind of services to be offered and an estimation of the Labs' capacity. At this point of the project's implementation more information and date should be available for analysis and designing a more elaborate sustainability strategy.

Since the Sustainability Business Plans are a very important part of the tools available for the viability of the Labs in the long run, it is advisable that the plans will be updated so as to include a more robust strategy towards sustainability, to point out concrete ways of achieving specific future goals and to ensure long term viability of the programs against changing environments and requirements.

As part of the sustainability work for the project, it is important to note, that partners in Ukraine and Georgia made great efforts towards this, by signing agreements with academic and non-academic partners, such as the agreement for the International Network of Labs among participating HEIs from Ukraine and Georgia, as described in Task 6.8 (which was signed in December 2023), and the agreement with FESTO, which are both important steps towards the sustainability of the Labs.

Also, another part of sustainability that should be part of the analysis is the regular staff coaching that was part of the Task 6.6. Due to the known physical mobility problems with covid-19 and the war, these were mostly merged with the capacity building activities in the EU and the multiple webinars that took place between 2020-2021.

4.5.2 Impact

One of the most important aims of this report is to provide, not only an evaluation of the achievements of the project, but also an assessment of the impact of the outcomes of the project has had on the stakeholders, the partner institutions as well as the society as a whole, based on the information available to the Evaluator.

Projects typically have a greater impact as they progress, as the results become more obvious, and as the major deliverables are completed and made public. This typically happens near the end of a project and during the time after the end of its funding.

At this point of the project, which is at its end, we can make assumptions about the impact it has had on a personal and on an institutional level.

According to the representatives of the partners, the project has already shown its impact:

- The Universities have included Industry 4.0 themes into numerous specialization-specific educational programs and included relevant issues into the curriculum creation for both undergraduate and graduate students.
- Several of university staff have received specific training on Industry 4.0 techniques, allowing them to inject relevant themes into their own educational paths.
- According to teachers in the Universities, the amount of Industry 4.0 research has significantly grown since the beginning of the project, and overall student understanding of this technological method has also increased.
- The establishment of a virtual laboratory allows students access to specialist software, enabling them to learn Industry 4.0 tools. The labs themselves are expected to improve cooperation with the industry even more and will give the opportunity to perform joint research on real-world problems and needs.
- Strong connections and collaboration with both academic and non-academic partners to further Industry 4.0 concepts.

However, the new Virtual Factory Learning Labs in Ukraine will have a significant impact on the industry only after the end of the war in Ukraine, since many industrial enterprises in Ukraine have either been destroyed, or closed, or moved to safe locations.

The networking efforts with the stakeholders and the involvement of students during various phases of the preparation and development of the programs are promising, as the collaborations are expected to maximise the impact the new programs will have among the target groups and stakeholders.

Finally, we can have a good overview of the impact obtained through the networking activities and in general activities involving the stakeholder from the KPI report of the project. According to this, the project has:

- Reached 281 companies and HEIs,
- Had in total 894 external participants (not unique)
- Facilitated about 2700 FTE days of training & workshops:
    - Georgia about 800 FTE days, large range of companies reached (BTU + GITA influence): 126.
    - Ukraine about 1900 FTE days including the company Festo, without Festo about 800 FTE days, spread (over the project partners) range of companies: 155.
- Organised 116 training events.

Overall, these activities show a successful campaign of industry involvement which in turn provide for a high impact of the project activities.

4.6 Evaluation of the partners' level of satisfaction (based on feedback information)

A survey was conducted among the representatives of the partners of the project, using a questionnaire that aimed to collect the participants' views on various aspects of the project, such as management, communication, monitoring and implementation. The responses were collected at the beginning of 2024. 31 responses were collected from all partners.

The questionnaire, after the first 3 questions which cover the project as a whole, is divided into 4 groups of statements, for which the respondents are to assign a number between 1-5 depending on their degree of agreement (ranging from fully disagreeing to fully agreeing). For the questions that asked for answers on a scale, the analysis was done by calculating the weighted average for each question.

At the end of each section, there are 2 open questions which aim to collect the post-fact experiences, positive or negative.

The analysis of the survey responses follows in the next few chapters.

4.6.1 Country of origin

Given that the project involved 13 partners, 5 from Ukraine, 4 from Georgia and 4 from the European Union (2 from Belgium, 1 from Portugal and 1 from Sweden), the distribution of the participants per country is not balanced:

- 18 responses from 4 partners in Ukraine: 4,2 responses per partner
- 10 responses from 3 partners in Georgia: 3,3 responses per partner
- 3 responses from 4 partners in Europe: <1 response per partner

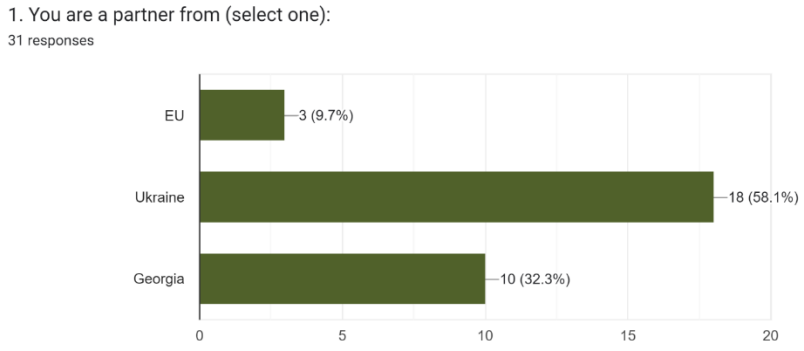

Figure 1. Country of origin of participants of survey

Since the survey is anonymous, it is not possible to know how many of which partners eventually responded.

4.6.2 Overall, how successful was the project?

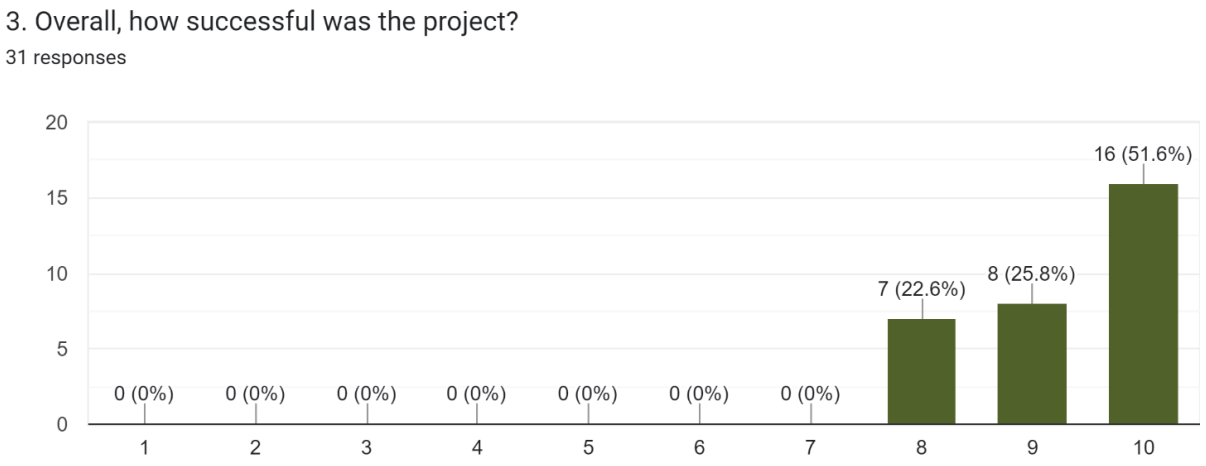

Figure 2. Overall success of the project

Respondents were called to answer how successful the project was, in their opinion, on a scale of 1-10. All of the responses lie on the upper 1/3 of the scale (8-10) with the predominant response to be 10 (51.6%), showing an overall approval of the project implementation as a whole.

4.6.3 Brief description of why the project was / was not successful.

The next question was an open question, asking what made the project successful or not, in the respondents' opinions. The following is a consolidation of the responses, as many overlap and there are common themes.

According to the responses in this question, the overarching theme of the responses is that the project was overall successful, despite the many challenges and obstacles it had to face since its beginning, the most important of which is the COVID-19 pandemic hitting right at the beginning of the project and the war in Ukraine in 2022. These of course had their impact on the implementation of the tasks, but the project showed flexibility and its main objectives were reached.

The second dominating theme among the responses was that the project has already made an impact in the participating universities in the main fields of interest: the extensive training of teaching staff for Industry 4.0 methodology; the curriculum development with intensive application of Industry 4.0 principles throughout the different courses; the establishment of the laboratories for virtual technologies with modern equipment; and the development of partnerships with industrial and innovation stakeholder on national and international levels.

4.6.4 Evaluation of the Organisation/Management aspects of the project

In terms of Organisation and Management, the representatives of the partners gave a very good assessment to the project, with all questions being very high in the calculated average scale (most >90%). This is an indication that

partners are very happy with the coordination of the project and the proceedings and decisions of the partnership regarding management of the project.

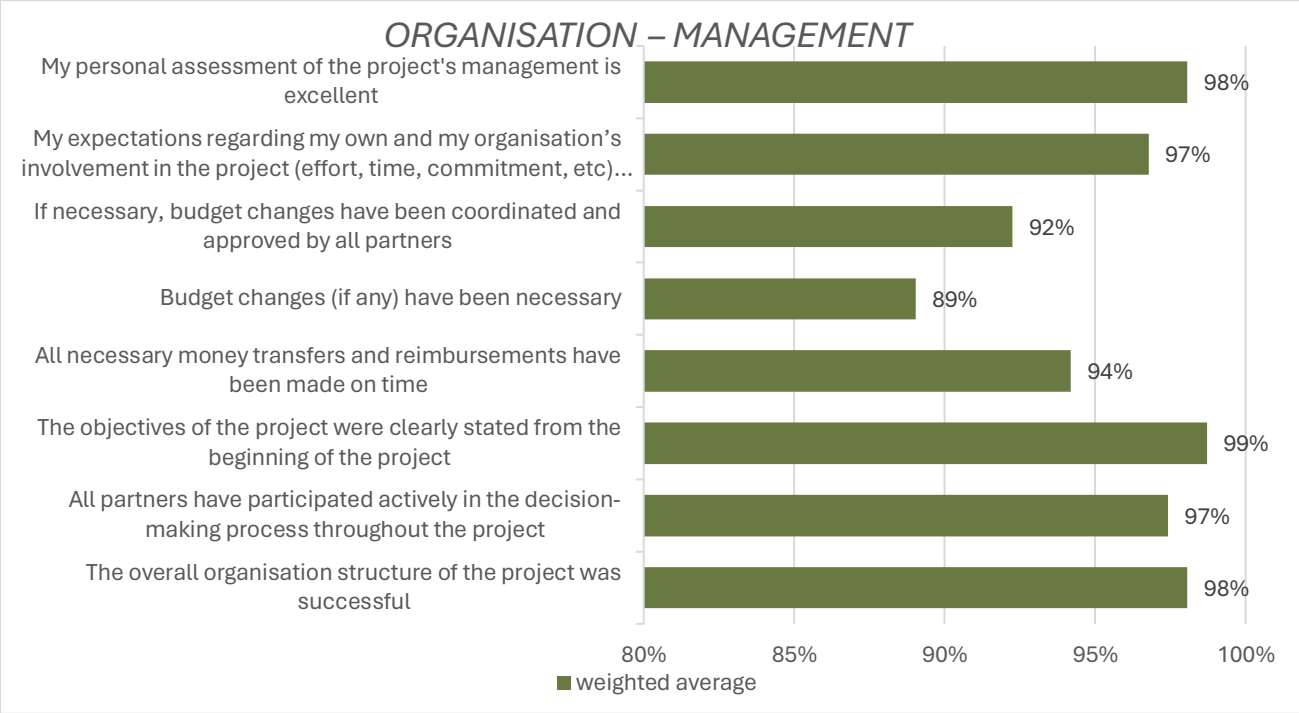

Figure 3. Organisation & Management

On a more careful analysis of the responses, we see that almost all responses were given to agree or fully agree. There are some answers "neither agree nor disagree" indicating some sporadic doubts.

A.2 What was done well (regarding organization and management)?

At the end of the section, there are 2 open questions which aim to collect the post-fact experiences, positive or negative.

The following is a consolidation of the responses, as many overlap and there are common themes.

According to the responses in this question, participants overwhelmingly agree that the overall management, coordination, communication of the project was successful under difficult circumstances (pandemic and war). There was clear communication of the progress of the project, of any changes to the workplan.

The active participation and involvement of all partners was mentioned also by many responses. It was also mentioned that all partners have participated actively in the decision-making process throughout the project.

A.3 What could have been done better, regarding organization and management?

Many of the "problems" cited here by many of the participants are related to factors outside the control of the partnership or the coordination, such as decisions by the EACEA regarding the extension of the project, the known obstacles posed by the pandemic and the war in Ukraine, difficulties in the transfer of funds due to European Banks' regulations, or the Erasmus+ programme financial regulations.

Some of the other notes for improvement include the improvement of certain project management aspects, such as the management of certain work packages, the instructions given regarding project deliverables, as well as more coordinated provision of templates for the implementation of tasks. Better publication activity has also been mentioned and a suggested improvement in the knowledge-sharing among the new Labs.

4.6.5 Evaluation of the Teamwork & Communication aspects of the project

In this section, the representatives of the partners who responded gave a very good assessment to the project in terms of teamwork and communication, with all questions being very high in the calculated average scale (almost all >90%). This is an indication that partners are very happy with the internal communication of the project and the flow of information. However, there have been some frustration regarding the difficulty to engage stakeholders.

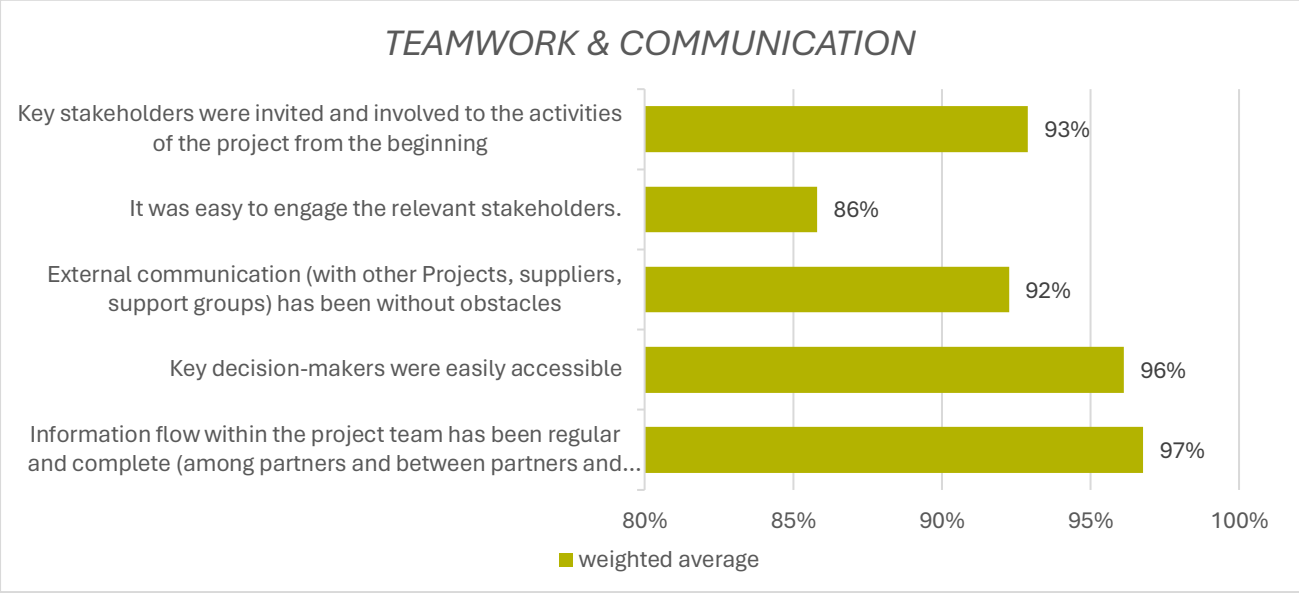

Figure 4. Teamwork & Communication

On a more careful analysis of the responses, we see that almost all responses were given to agree or fully agree. There are some answers “neither agree nor disagree” indicating some sporadic doubts, especially to the lowest average rated question of stakeholder engagement, where 19% of the respondents answered “neither agree nor disagree” and only 48% answered “fully agree”.

B.2 What was done well (regarding teamwork and communication)?

Regarding this topic, participants almost unanimously agree that the communication within the partnership was clear, unhindered and uninterrupted. To this contributed the large number and frequent coordination meetings, which resulted in great teamwork, with frequent interactions and updates among partners. Internally the partners claimed that they had communication withing their own project management teams and they had support from their institutions.

B.3 What could have been done better (regarding teamwork and communication)?

The topic of communication also had some problematic areas, naturally due to external reasons, such as the war, which made physical interactions among partners but also with important stakeholders, difficult or even impossible. These are causes for reflection on how to overcome such issues with alternative methods of approach and communication and possibly with more knowledge-sharing among partners. Overall, the biggest trouble in terms of communication partners faced was attracting and engaging stakeholders.

Some less noted issues were that improvements could be made to the exchange of good practices and information among partners regarding stakeholder engagement, and also more active participation in communication from some less active in communications partners.

4.6.6 Evaluation of the Planning, Monitoring and Tracking aspects of the project

In terms of Planning, Monitoring & Tracking, the representatives of the partners who responded gave an excellent assessment to the project, with all questions being very high in the calculated average scale (all >95%). This is an indication that partners are extremely happy with the manner in which the project was monitored as to is progress and its results.

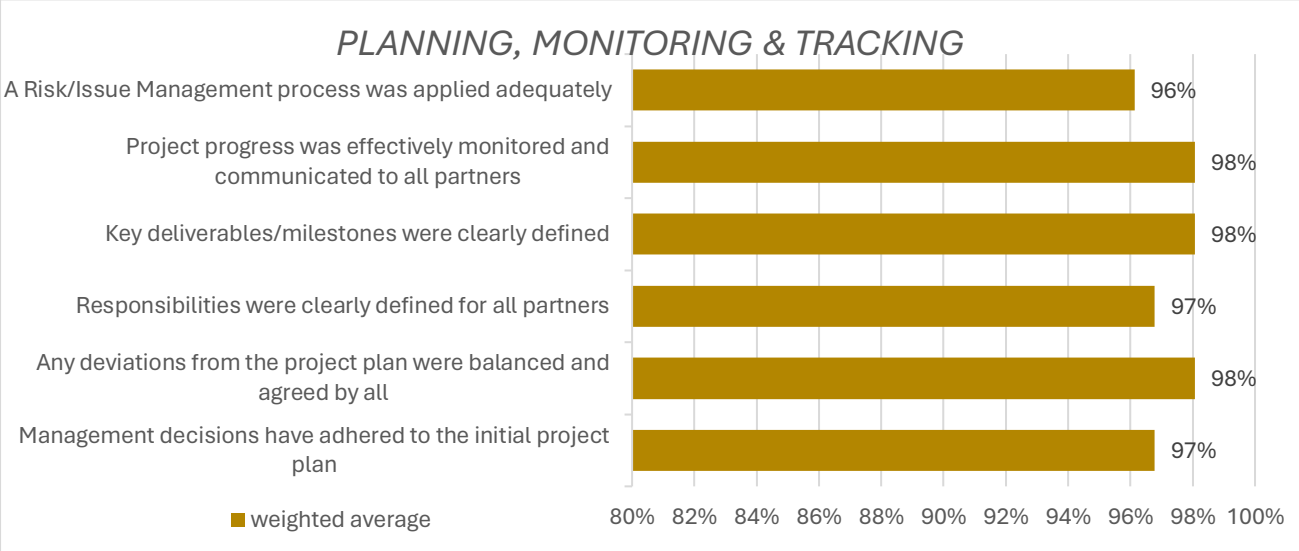

Figure 5. Planning, Monitoring & Tracking

C.2 What was done well regarding Planning, Monitoring & Tracking?

In this section, participants agree that good coordination and communication with the partners resulted in effective monitoring of goals and results, also owing to the frequency of the coordination meetings, which also followed an effective follow-up protocol. It was also noted that regular assessment of the implementation of project work packages helped to find bottlenecks and find solutions to issues.

C.3 What could have been done better regarding planning, monitoring & tracking?

Improvements in this area of the project, include, according to the responses, easier to use templates, evaluation of the status of each task according to the action plan, organizing more informative meetings on Industry 4.0 best

practices in European Union, better functionality of the project website to allow broader use for the project purposes, more feedback templates and total publication of all project results.

It should be noted that in this question, the responses were scattered without repetition, showing there were no "obvious" answers for improvements.

4.6.7 Evaluation of the Implementation aspects of the project

In this section, the responses of the representatives of the partners are mixed in terms of their assessment of the project implementation. It is not surprising, given that it is probably the most important and most populated section of the questionnaire.

Here, again, as with previous sections, all questions are ranked quite high in the calculated average scale (almost all >90%). This is an indication that partners are very happy with the implementation of the project and the delivery of results. However, partners (not unsurprisingly) show some discontent regarding the opportunity of the Virtual Labs and their missed opportunity to impact the industry.

Overall, the partners seem satisfied with the results developed during the project, even with the obvious obstacles of war.

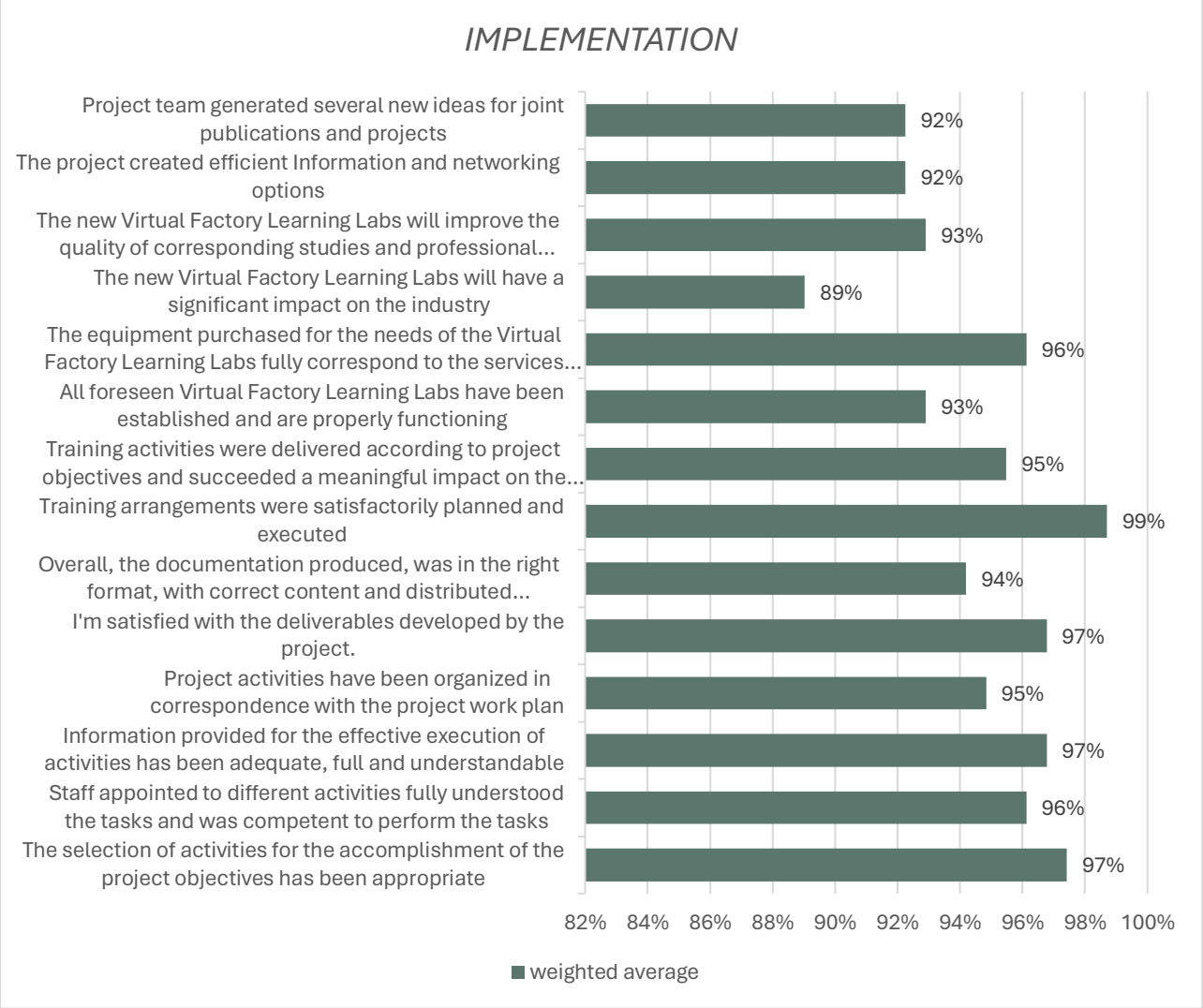

Figure 6. Implementation

D.2 What was done well regarding implementation?

In this section, participants agree that the implementation of the project produced some results that they are very satisfied with. First of all, the Virtual Factory Learning Labs which are considered a great asset for the Universities after the project, have a great impact on education, research and relations with industry; connections and new networks were established, such as the MoUs among academic partners and synergies with non-academic partners, as well as the participation in new joint projects with the partners of the HEIn4 project. Training activities were delivered according to project objectives and succeeded a meaningful impact on the research and teaching capacity of the staff involved. Implementation of the project improved international cooperation (joint publications, and new ideas for projects).

D.3 What could have been done better regarding implementation?

Improvements in this area of the project, include, according to the responses: More detailed recommendations, standards, requirements and usage recommendations for the labs' equipment before purchasing; enhanced presentation of thee virtual labs and specifically international presentation; closer cooperation when elaborating deliverables; more new ideas for joint publications and projects; better support in situations of conflict; and finally, better publications.

4.6.8 Conclusions from the survey

The partnership seems to have an almost unanimous opinion on the quality of the project: despite the problems the project and, more particularly, the partners that implement the project, have faced from the beginning of the project and, unfortunately, continue to face, have created a series of outputs and results for which they are proud of. Namely the injection of new material on Industry 4.0 to the curricula of HEIs in Ukraine and Georgia for students and for professional training, the creation of the Virtual Labs, which are considered to make a great impact institutionally but also to external stakeholders – to the degree that this is possible due to the ongoing war that drives away businesses and people and destroys infrastructure. Problems and areas for improvement were present, however, the consensus is that a robust coordination and management has led the partnership through some difficult circumstances to a successful end.

5 Lessons Learned-Conclusions

The project has concluded its activities through a work plan that included many obstacles, such as the covid-19 pandemic in 2020 and later on, in 2022, the war on one of the partner countries of the project, Ukraine.

It has largely reached its objective, thanks to good partner cooperation and an effective coordination. Each partner worked well together, both with the coordinator and inside the group. The project's tasks were defined with adequate clarity and effectively monitored through a series of regular monthly online partnership meetings.

The management system was somewhat un-conventional, in terms of structure and monitoring. There are elements missing from a usual project management system (documented management and quality plans, predefined tools, instruments, work schedule and indicators), however, these seem to be counterbalanced effectively by a strict framework of meetings, which were complete with action plans and follow-up activities. Similarly, quality management is focused on the internal control of results, deliverables and outputs.

The schedule was impossible to be followed exactly, due to the initial delay of 6 months due to the coronavirus pandemic, the following restrictions in mobility due to the same cause, and later on the effects of the erupting war in Ukraine in 2022.

The deliverables demonstrate however, a strong focus on high quality, and coherence with the project's goals. To the extent that it could be verified, due to the absence of English versions in some of the deliverables, and the complicated file organization system in the 2 document repositories (private and public), the deliverables seem to be the result of rigorous work and collaboration among partners. In particular, new courses and modules appear to be of high caliber, provide students and professionals with a wide scope of opportunities (educational, professional) and substance on the topic of Industry 4.0 and cater to the demands of society, education, and industry. The newly created Virtual Factory Learning Labs, equipped with high-end equipment and software suitable for Industry 4.0 learning, provide the suitable ground for better understanding of the topics for students and professionals and for joint cooperations with businesses.

Despite the challenges presented by the pandemic and the war constraints, the partnership made a great effort to reach out to and include stakeholders through all accessible avenues of communication. A more effective system for tracking dissemination efforts and the impact and audience goals reached in each HEI would be very helpful for the evaluation purposes.

The involvement of the target groups and stakeholders and efforts to combine the knowledge from both academia and industry are creating a promising environment for the sustainability of the project. However, regarding sustainability, at this stage in the project, a more detailed sustainability could be established for the Labs. The Sustainability Business Plans are crucial for long-term Labs' viability, so updating them with a robust strategy and concrete goals is recommended.

The project has shown a significant impact to the universities by incorporating Industry 4.0 themes into specialization-specific educational programs, training staff on Industry 4.0 techniques, increasing research and student understanding, establishing a virtual laboratory for students and businesses, and fostering strong connections with academic and non-academic partners to further develop Industry 4.0 concepts.