DIGIGREEN

IMPROVED WORKFORCE TO SET TRANSITION FROM MANUFACTURING TO DIGITAL GREEN FABRICATION

Methodologies for the digital training and assessment

Co-funded by the European Union

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Revision	Date	Author/Organisation	Description
1st	25-07-2022	Ulisboa IST- Inês Pires	Q1 results
2nd	05-08-2022	Ulisboa IST-Inês Pires	Q1+Q2 results
3rd	06-01-2023	- Ulisboa IST- Inês Pires	All

Contents

1 Objectives

This IO targets at creating the best environment for the development of the new frame of training and assessment to convert personnel from traditional manufacturing to digital manufacturing which produces lower impact to the environment.

This IO is dedicated to the gathering of information (Delphi analysis using specific surveys) that is necessary for the harmonization of the knowledge involved in the transition to the digital and green manufacturing. Also, it is important to understand the needs and expectation of trainer in terms of green and digital education.

2 Introduction

Environmental, and demographic changes, alongside globalisation, are changing the nature of work, the content of jobs, and the demand for training. To adapt to these changes, it is important to ensure that individuals are equipped with the skills to adapt to the present demands and future changes and avoid the risk of job loss.

Education and Training represent the principal means through which individuals acquire skills and competences. And it is through participation in continuous professional development and learning that adults will access, on an ongoing basis, the upskilling and reskilling necessary to adapt to the continuous changes.

Digitalisation (how automation will affect the demand for skills) and greening of the economy (with the emergence of new 'green jobs') are affecting the demand for skills. Evidence suggests that the overall impact of technological change on employment levels continues to be positive and that digitalisation/automation is bringing about an increased demand for highly skilled and qualified workers, that changes in the composition of tasks which comprise a job (often to the benefit of the individual worker where hard physical toil can be undertaken by machines) and that some jobs are disappearing and new ones emerging. Globalisation and the greening of the economy are also seen to favour highly skilled and qualified workers [1].

Digitalization at work refers to the trend of using automation technologies in the workplace, often to replace routine tasks. This development is influenced by (and influences) the changing nature of work and occupations in particular sectors and areas, demanding new sets of knowledge and competencies that cannot be acquired through traditional modes of learning. Such changes call for the reskilling or upgrading of low-skilled workers in occupations with a high risk of job automation. [2].

3 Methodology

First, and in order to gather information concerning the necessary knowledge for the transition to the digital and green manufacturing, all partners have proposed a list of industrial companies to elaborate a database of the entities to be subjected to Delphi analysis (see annex a), then each partner has proposed questions for the first questionnaire which were then selected trough a pool and used in the elaboration of Q1.After the questionnaire being ready they were sent to the industrial companies indicated by each partner.

After analysing the first questionnaires, a second questionnaire was prepared and sent to the previous survey participants to define the interests, goals, availability, and expectations in terms of digital and green manufacturing training methodology.

In order to understand the framework that exist for Webinar and micro-learning research was made and the main findings were summarised. To finalised the most relevant key finding obtained in this project result are presented.

Table 1 – Timetable concerning IO1

TIMETABLE																									
Month no.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	Year	2022												2023												
IO/Activity		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1
O1 - Methodologies for the digital training and assessment																										
1. **Survey** 1 in different industrial sectors having 7P																										
2. **Survey 2** in the same industrial sectors and to the same industrial companies																										
3. **Conclusions** to be taken after the Delphi analysis																										
4. **Analysis of the results** obtained and defining the procedure to adopt in c-VET for upskilling + reskilling, using micro- learning and webinars.																										

3.1 Characterization of the target group

Based on the partners proposed list of industrial companies, questionnaires were sent. From those lists the consortium has received 67 answers. The characterisation of the target group involved in the questionnaires can be seen in Table 2, where the company name, area of activity and position/role of the participants are indicated. It was also noted that in terms of gender 87% of the participants were men and only 13% women and in term of ages, it was verified that the majority of the participants has between 31 and 40 years old, as indicated in Figure 1

Table 2- Information relative to the survey participants

	Area of activity	Position /role
1	Biomaterials	CEO
2	Development and production of technical parts from rubber, plastic, metal (and combinations) for automotive industry	Head of project management office
3	Industrial electric motors and welding transformers	Developing engineer
4	AUTOMOTIVE	Head of technical department
5	Die casting and machinning	technologist
6	Medical, automotive, industrial, smart home	R&D
8	The company's main activity is the design and manufacturing of equipment for clean and cleaning technology. Additional programmes comprise of validation of rooms and production of ALU windows and doors.	Adviser to CEO
9	Casting, Automotive	Team leader R&D
10	HPDC of aluminium and zinc alloys, machining, part assembly for automotive industry.	Development technologist
11	Steel production	Research engineer
12	Medical and surgical instrument sterilization, disinfection, and cleaning products	Managing director
13	Automotive - production	Project manager
14	R&D	R&D Manager

15	Injection Moulding	Production Manager
16	Injection moulding	Production Manager
17	development, design and production of injection moulding tools	Marketing Manager
18	Engineering and Design	Project Leader
19	Moulds for plastics, and injection of plastics	Manager
20	Automotive	Material specialist
21	Automotive	Validation Engineer
22	Trade	Assistant to the Management
23	Automotive	HR Business Partner
24	UPB	Professor
25	Automotive	Production manager
26	Automotive	General Manager
27	Management	Director
28	Welding certification	Mechanical Engineer
29	Electronics Manufacturing Services and HW and SW development	Quality Assurance and ISO Associate
30	mechanical engineering	Lecture
31	Construction	Production assistant
32	Equipment for food, chemical and pharmaceutical industry	Welding engineer
33	Automotive	Digital
34	Mould making	Innovation Manager
35	Welding, heat treatment, metallurgical laboratory	Head of R&D
36	welding and machining	Head of technology
37	Manufacturing and engineering of pressure equipment for pharma, F&B and chemical applications	Head of design and technology department
38	Automotive Transmission Belts	Production Manager
39	Mining	Head of Additive Manufacturing
40	Research - Materials Science	Group leader
41	Education & Research	Lecturer
42	Chemical Industry	Market Development Manager
43	Production of decorated thermoplastic parts for the automotive sector	Project leader in the R&D department

44	Consumer goods	Senior R&D Specialist
45	Temporary job company	Recruiter
46	Engineer project	Engineer mechanic
47	Construction, assembly, and maintenance of industrial installations	Jr. Welding Engineer
48	Construction research	Head of laboratory, scientific researcher grade III
49	Civil and industrial constructions, metal structures.	Director
50	Engineering, Project Management and Maintenance in Oil & Gas Industry.	Welding technologist
51	Middle Ship Vessels	Design Coordinator (Mechanical - Static Equipment)
52	QC RNGINEERING	Engineer
53	Quality control	QC ENGINEER
54	Metallic constructions	Administrator
55	Mechanical and piping installation	QHSE MANAGER
56	pressure equipment	Project Manager
57	Oil and Gas	general manager
58	Oil machinery	Quality Lead
59	Automotive	INGINER QC
60	Metal constructions	Mechanical Engineer
61	Automotive	Technical Director
62	Confidential info	Industrial engineer
63	Welding Technology, Training in Welding, Equipment Reparation	Administrator
64	Shipbuilding	Welding engineer
65	Metal constructions	Administrator
66	shipbuilding	Welding engineer
67	Metal constructions	administrator

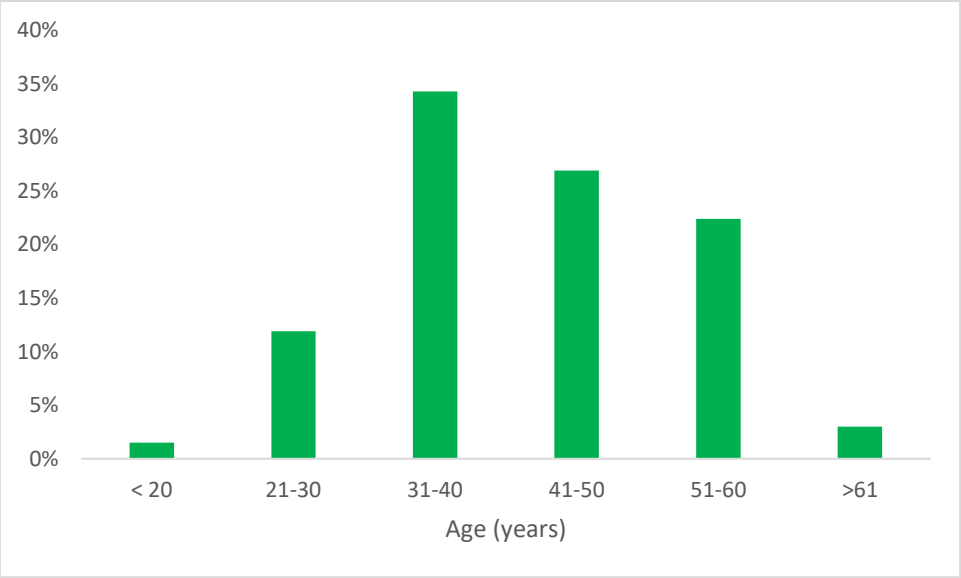

Figure 1- Survey Participants age range

Today digital transformation is impacting every department and function of a business, to the extent that it is no longer the exclusive domain of CIOs and IT departments. Business leaders are challenged to move their enterprises to the next level, by coupling digital technologies with organizational, operational, and business model innovation to create new ways of operating to drive growth.

This report looks at some of today's major challenges, barriers, and opportunities to digital manufacturing success, and how through a new training and education framework these challenges can be overcome to achieve the digital transformation aspirations of companies.

4 Activity 1: Survey 1 in/for different industrial sectors having 7P processes involved

To obtain information and knowledge on the main adopted methods to step from traditional manufacturing to digital manufacturing, and from actual impact on the environment to green manufacturing, a first questionnaire was sent to different companies from different countries and different industrial sectors, as referred previously. The results of this survey are analysed in the following pages.

As referred previously the survey was answered by 67 Industrial Companies and Clusters from DIGIGREEN network. The Companies are representatives of several industrial sectors, which is aligned with DIGIGREEN IO1 objective which is to adopted methods to step from traditional manufacturing to digital manufacturing, and from actual impact on the environment to green manufacturing.

To start with it was important to understand the involvement of the participants in training and more specifically in Digital training. Although the majority (75%) did not receive training in digital and green activities in the past 6 months, 69% have participated in digital training activities and 889 are interested in receiving training in Digital and Green Fabrication (Figure 2). These results are aligned with the purpose of the DIGIGREEN project.

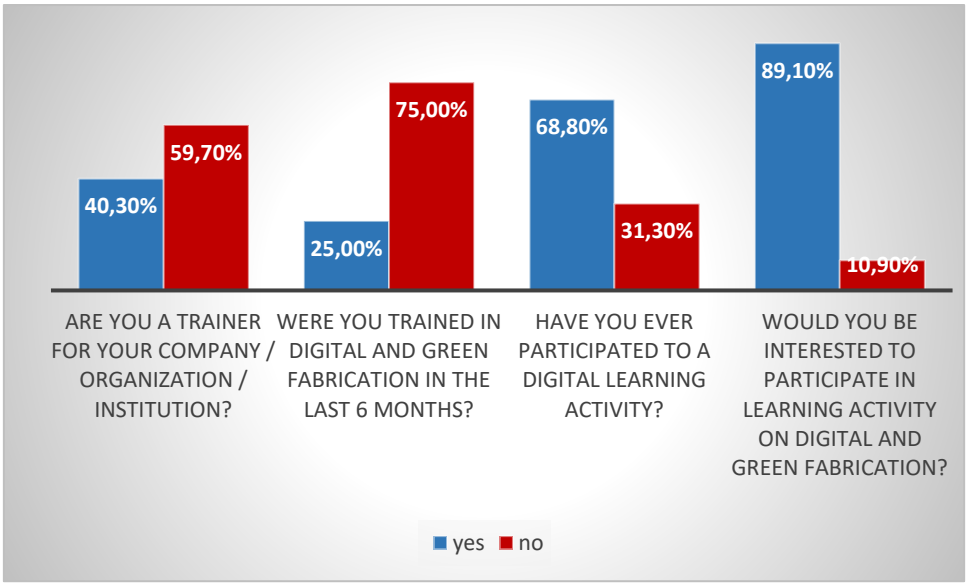

Figure 2 – Results concerning digital training activities

In terms of processes/technologies used in the queried companies an overview of the answers is summarised in Figure 3. Welding and allied processes, as well as machining were the main processes pointed out by the companies.

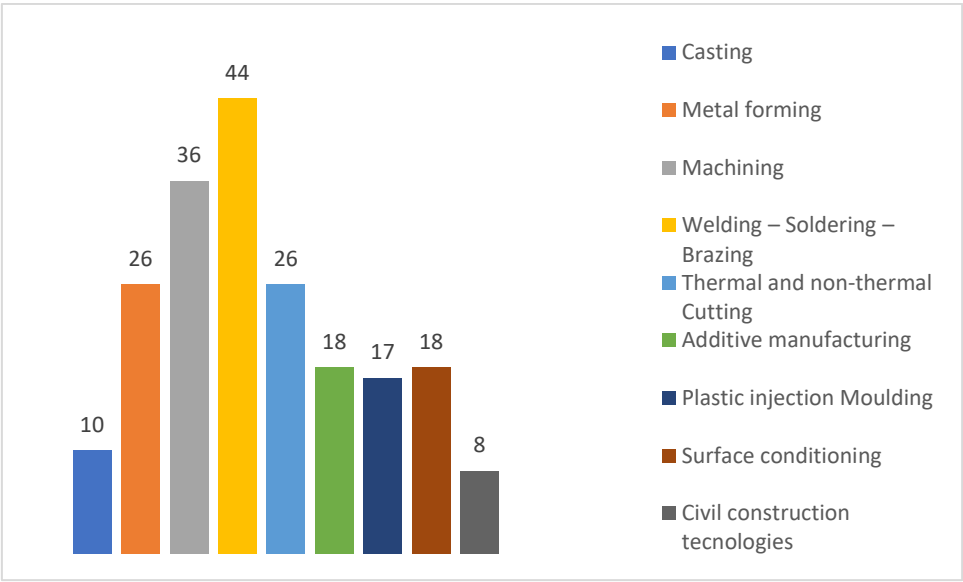

Figure 3 – Question Nº7 "Which processes are used in your company?"

It In terms of use of digital tools in the different manufacturing sector surveyed around 60% use these technologies during the fabrication processes (Figure 4). This means that Digital Manufacturing is rapidly increasing, and Industrial Companies can easily adapt new manufacturing processes in their production process.

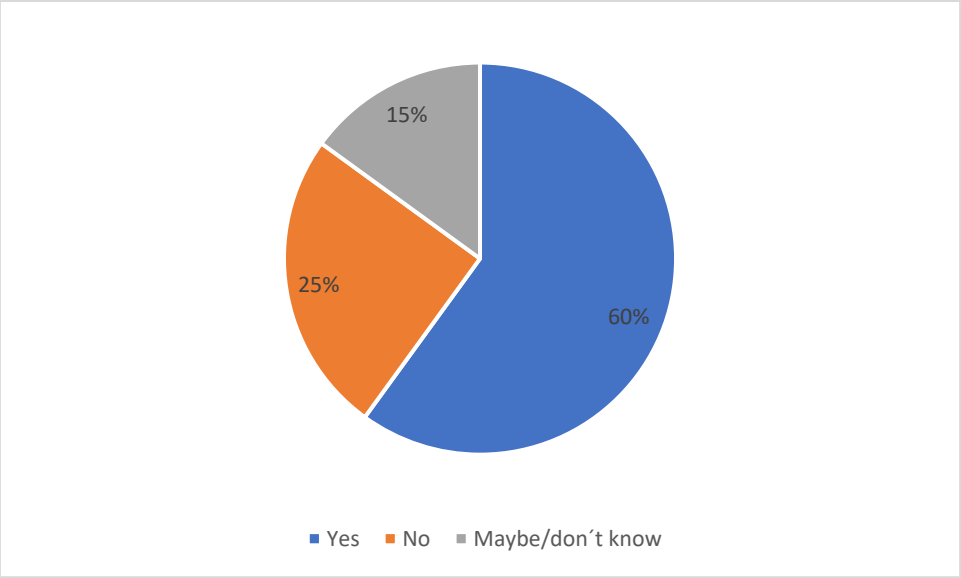

Figure 4 - -Question Nº8 "Does your organization/company use digital tools in the manufacturing sector?"

For those companies that use Digital tools in the manufacturing processes, it was asked what digital tools are used. From the answers obtained most of the survey participants identify CAD-CAM followed by Enterprise resource planning (ERP), Production and Quality Management systems, communications tools and in a minor scale Robotic production technology, simulation tools and virtual programming digital monitoring. These results boost DIGIGREEN project to reach its objectives since it has been validated the industrial needs in terms of the use of Digital Manufacturing Technologies.

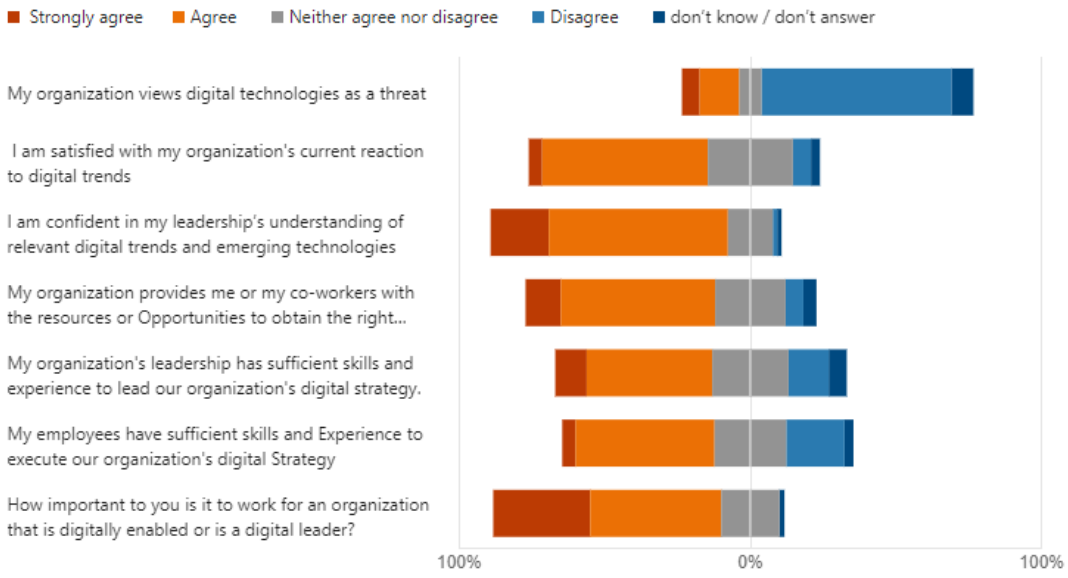

Figure 5 - Question Nº10 "In what extent do you fill satisfied or agree with the following questions according to your organization's digital and green strategy?"

In what concerns the digital tools needed for the different jobs/occupations in the surveyed companies, as expected the results varied according to the type of worker, blue or white. The

Surveyed participants selected most of the areas identified, indicating that training in Digital and green Manufacturing must comprise the selected competencies. Furthermore, the analysis of the results allows to conclude that are the most relevant competences for white workers are online communications, process simulation and digital publishing and managing files tool, while for the blue workers are digital fabrication and digital logistics equipment tools. Nevertheless, the results are quite similar for all competencies which sustains the hypothesis that all competencies are necessary in the Digital Manufacturing industry. These results can be seen in Figure 6

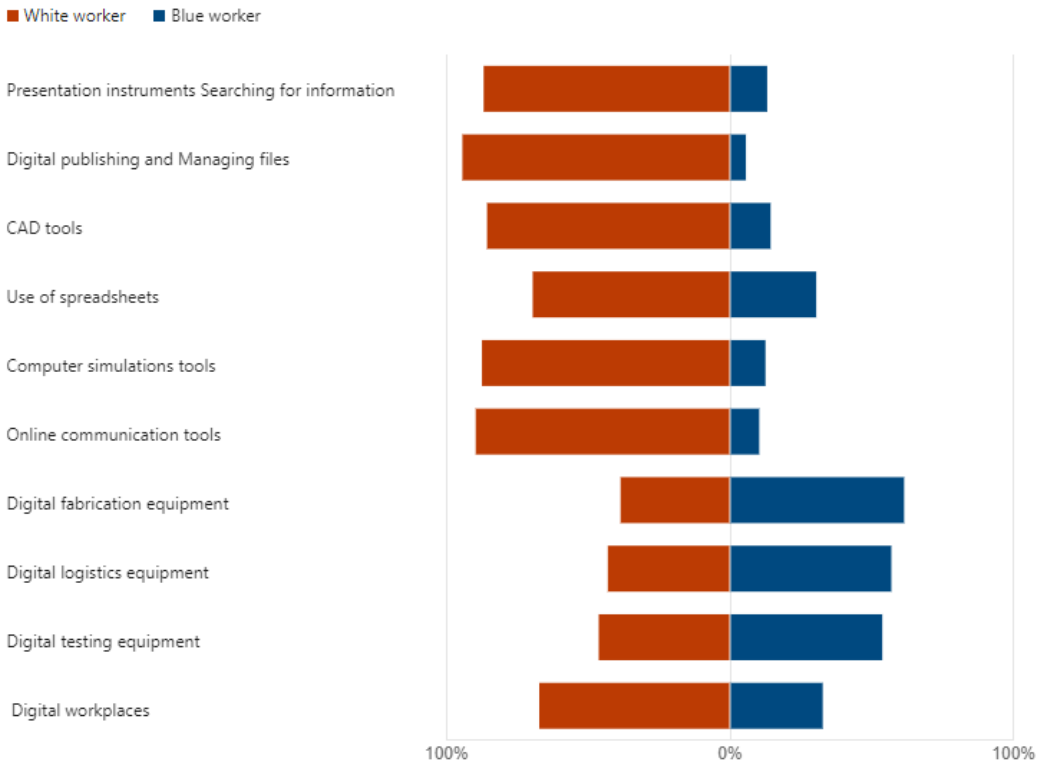

Figure 6 - Question Nº11" What digital tools do you think are the most important for the jobs in your company/organization"

One of the problems identified with this survey was related to lack of digital skills experienced by the surveyed participant (44%) and lack of knowledge in digital training on the part of withe and blue co-workers (almost 80% in total), Figure 7 and Figure 8, respectively.

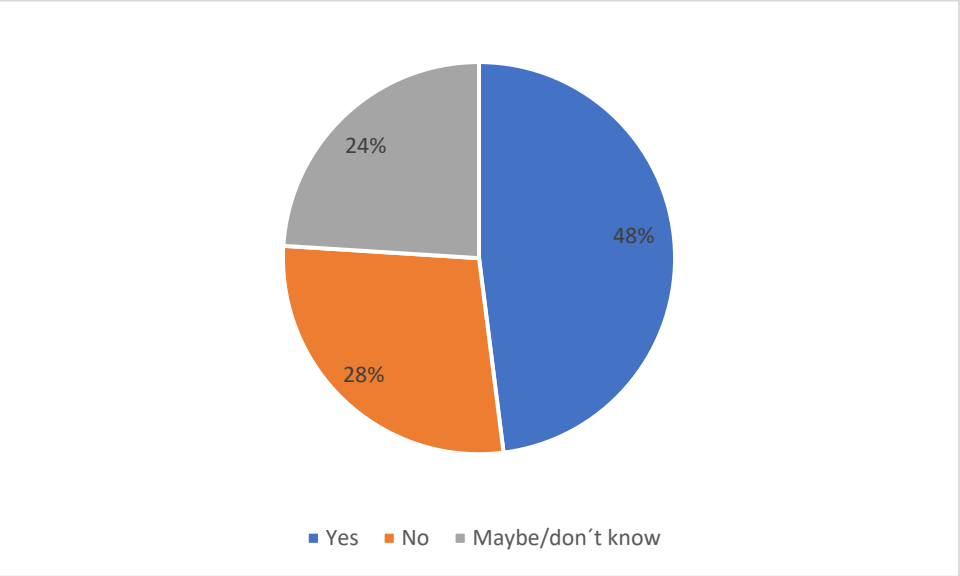

Figure 7 - Question Nº12 " Did you experience professional issues due to lack of digital skills?"

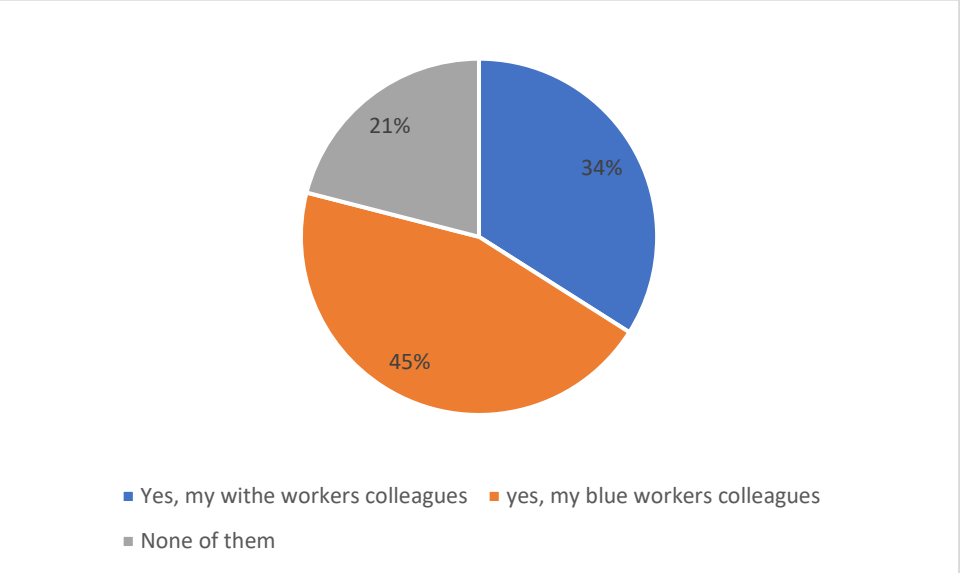

Figure 8 - Question Nº13 "Did your colleagues experience professional issues due to lack of digital skills?"

Based on the previous answers it was asked to the survey participants about the importance of education and training (Figure 9)and 77% of the answer were in favour of supplementary training and that education will help in gaining digital skills.

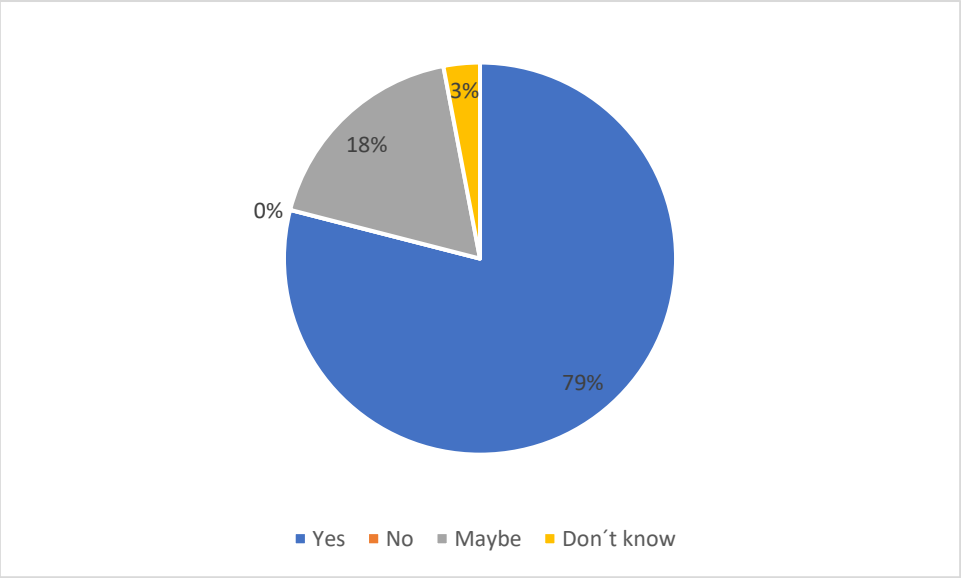

Figure 9 - Question №14 "Do you think that supplementary training or education will help you or your colleagues in gaining digital skills?"

At present, the trend of digitalisation cannot be ignored, and, especially for small and medium-sized enterprises, it creates a barrier to, or, on the contrary, an opportunity for, ensuring their competitiveness and sustainability, not only domestically, but also internationally. The main objectives of digital transformation are to acquire new data and to use the data to reorient old processes

Question № 15 and №16 are related with possible improvements that can be obtain with the implementation of digital transformation and green transformation inside the company, the results of these inquiries are represented in Figure 10 and Figure 11, respectively, and reveal that both green and digital transformation will bring benefits in terms of innovation, cost reduction, simplification of service management, change of working method and improving a green environment.

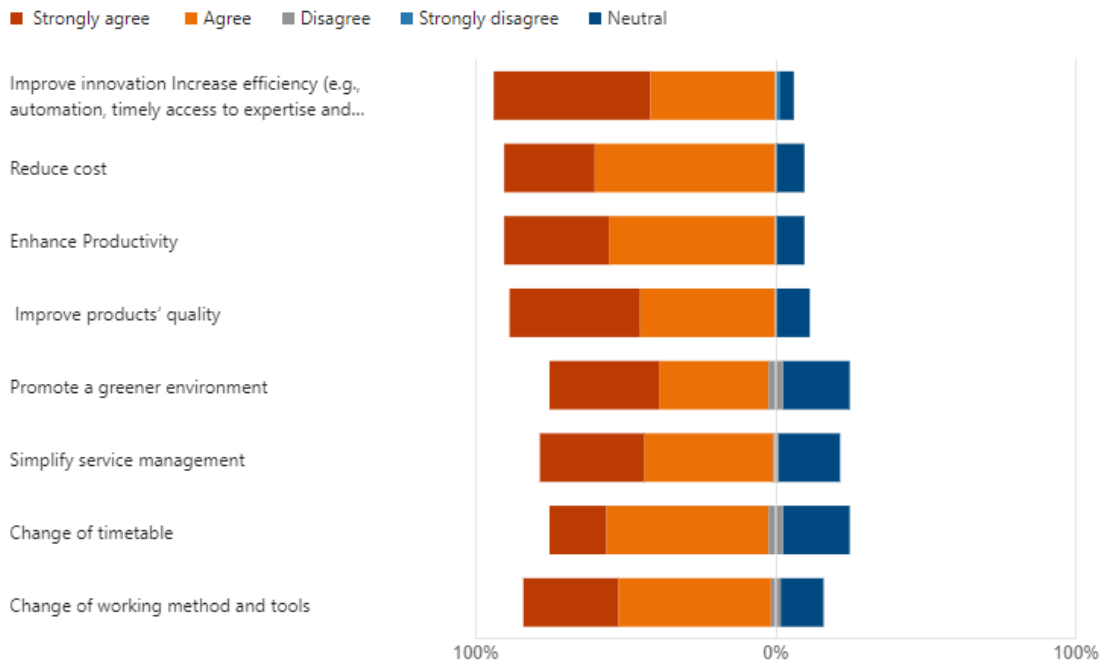

Figure 10 – "Question Nº15 How important are the following benefits of digital transformation to your company? Please tick the box that is relevant. Or in what extent do you agree that the following are objectives of your organization's digital strategy?"

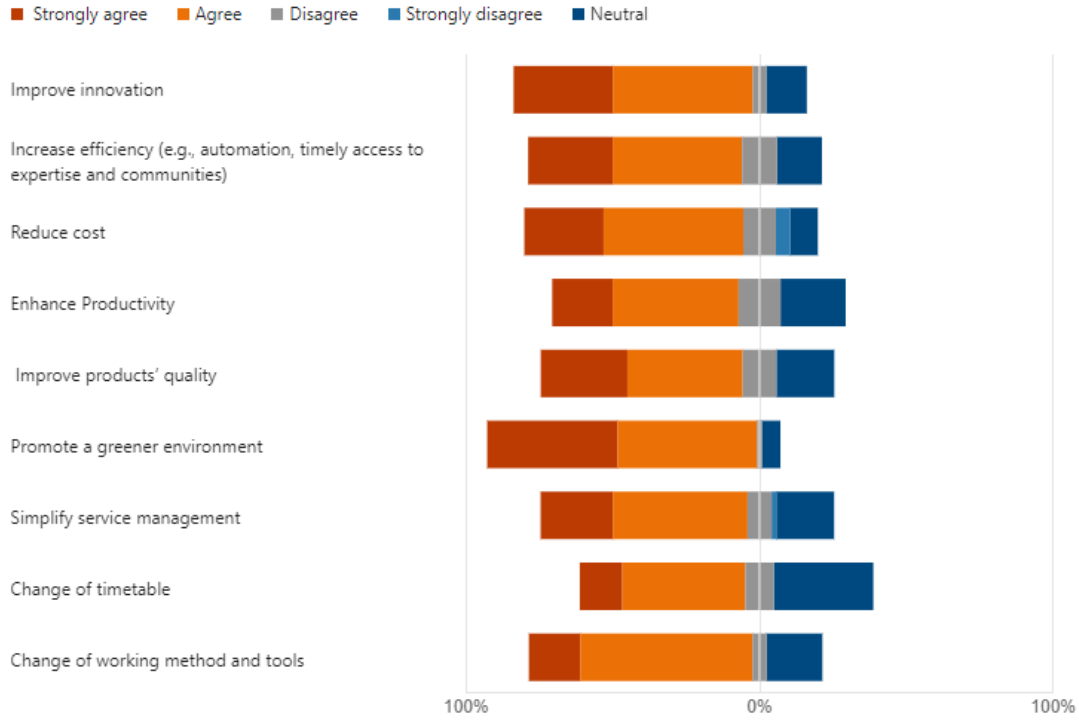

Figure 11 - Question Nº16 "How important are the following benefits of green transformation to your company? Please tick the box that is relevant"

In Figure 12 can be observed the results concerning the disrupting of industry related to the use of digital technologies where it can be seen the dispersion of opinions, although the majority of answers are in agreement (53%) with the disruption.

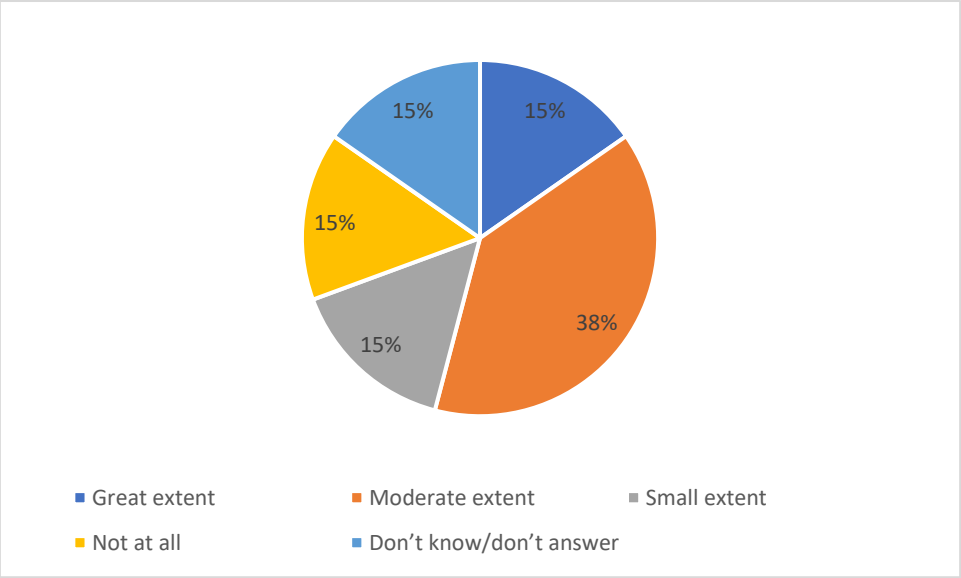

Figure 12 - Question Nº17 "To what extent are digital technologies disrupting your industry?"

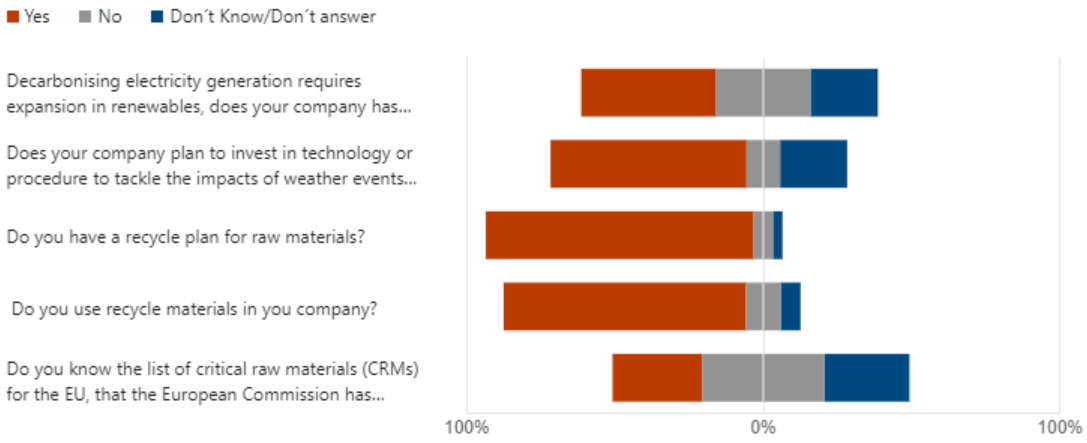

Figure 13 - Question Nº18 "To bring our ambitions to life, Europe needs an industry that becomes greener and more digital while remaining competitive on the global stage. Having this in mind, please answer the following questions"

In Figure 14 it can be seen the main obstacles to green investments in the respective companies. Investment costs was the main factors pointed out follow by the availability of skilled staff. Once again this is aligned with the purpose of Digigreen project, to give the necessary green education tools to empower the workers for the job.

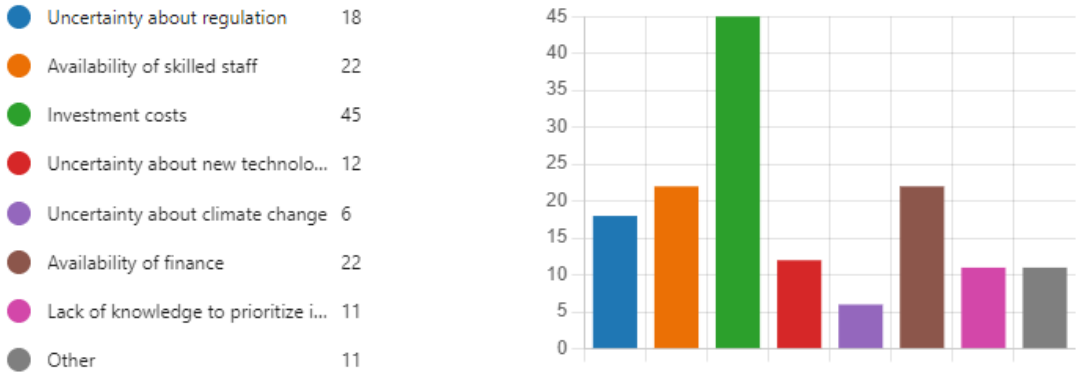

Figure 14 - Question Nº19 "What are the main obstacles to climate/green investment in your company?"

Based on the questionnaire 1 results it was concluded that most survey participants are in agreement of the importance and the benefits that the Digital and Green transformation will bring to the companies and that to take advantage of these transformation education and training is needed.

5 Activity2: Survey 2 in the same industrial sectors and to the same industrial companies

After analysing the first questionnaires, a second questionnaire was prepared and sent to the previous survey participants to define the interests, goals, availability, and expectations in terms of digital and green manufacturing training methodology.

To start with it was necessary to evaluate the capacity in terms of infrastructure of the company to offer technology-enabled and distance learning solutions, and it comes up that around 61% of the inquired company have means to offer those solutions (see Figure 15). Additional 60% of the workers have the necessary digital literacy skills to perform online course (see Figure 16)

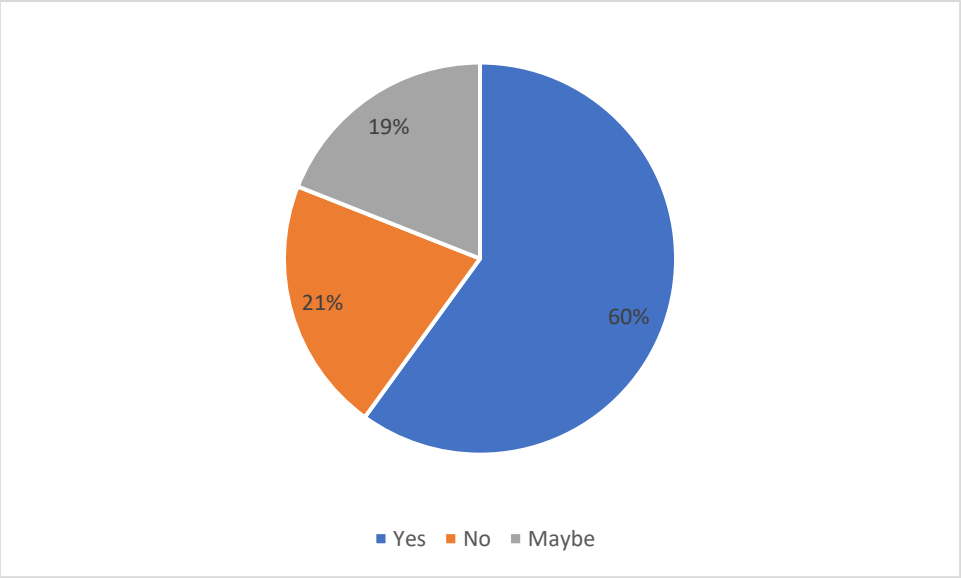

Figure 15 - Question Nº20 "Does your company have the technology infrastructure, pedagogy and organization needed to offer technology-enabled and distance learning solutions?"

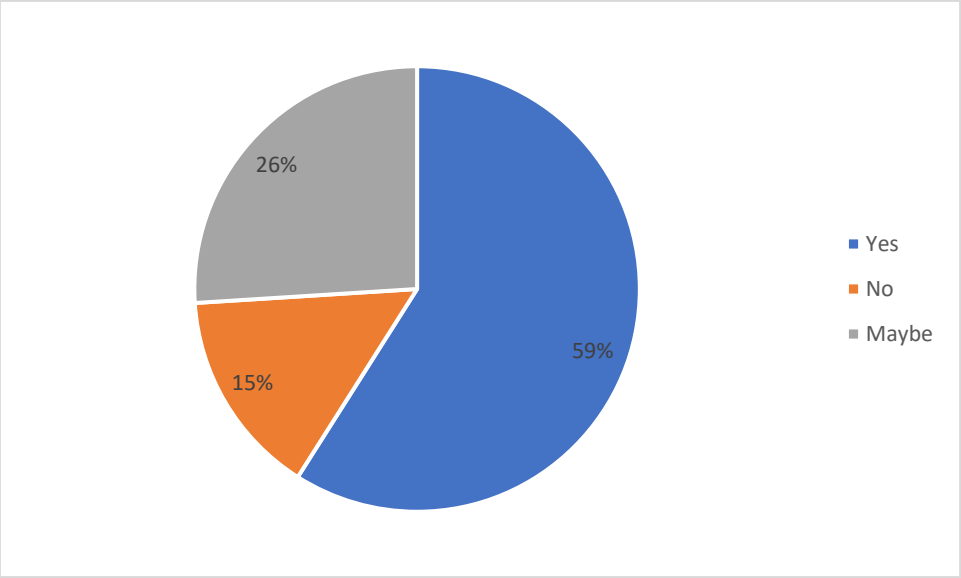

Figure 16 - Question Nº21 "Do the workers have the necessary digital literacy skills to perform online courses?"

It was verified that in terms of the use different digital technologies for the part of the companies it is equilibrated in terms of social media and Collaborative Technologies; Mobile Technologies; Data and Analytics; Cloud Computing Services (see Figure 17)

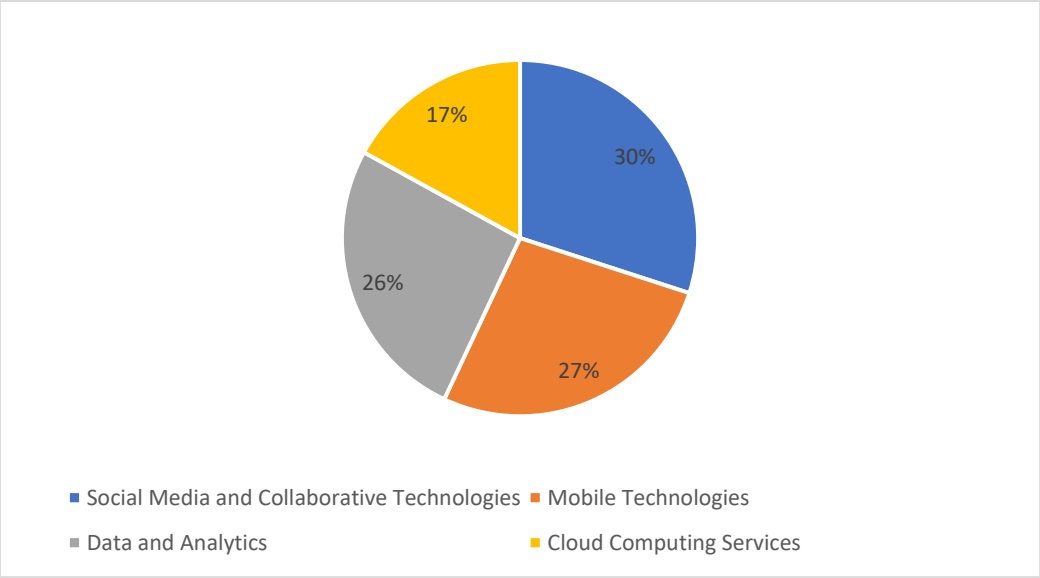

Figure 17 - Question Nº22 "To what extent does your organization use the following digital technologies?"

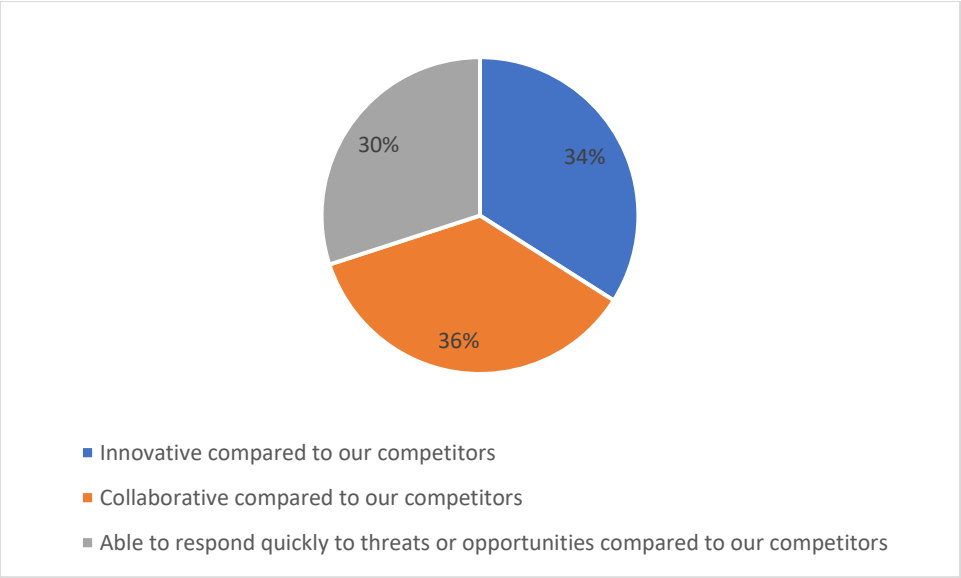

Figure 18 - Question Nº23" How would you characterize your organization?"

The next questions are related on how to engage learners and help them to meet course and programme learning outcomes. Engagement entails includes mindfulness, intrinsic motivation, cognitive effort, and attention. To start with it was important to understand the way teaching/learning should be carried out, and the majority of the participants believed that Hybrid, online and face to face combined lectures are the best learning method (Figure 19), in terms of type of lesson, the short courses between 30-45 min were the most voted option (55%), followed by traditional 45 min lessons (30%), as can be seen in Figure 20.

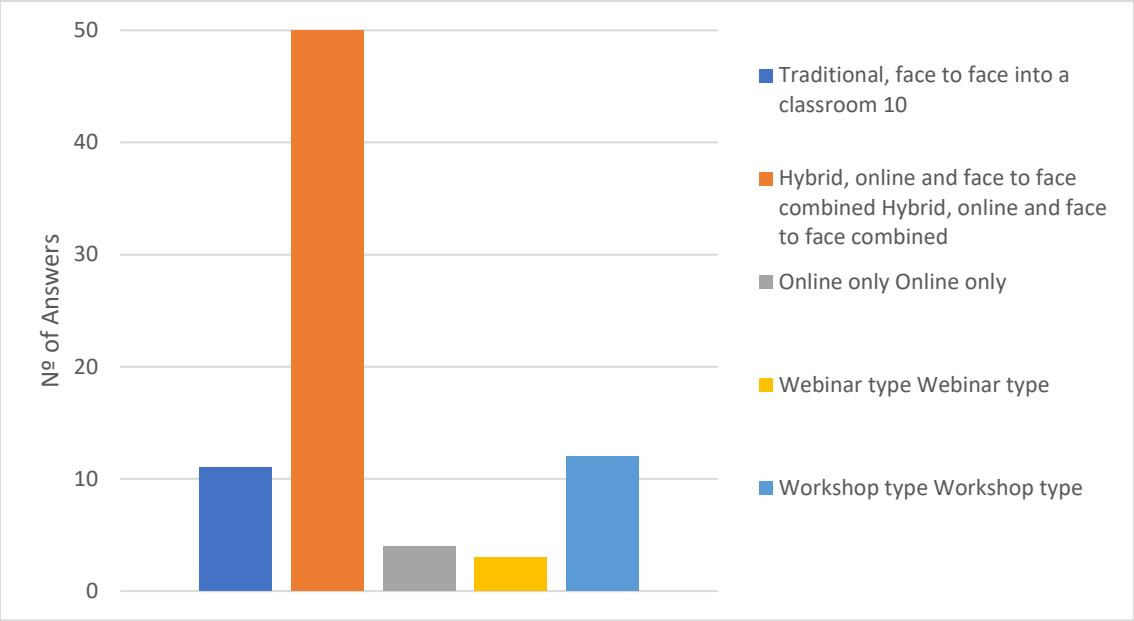

Figure 19 - Question Nº24 "What would you consider optimal for the future in terms of mode of teaching/learning?"

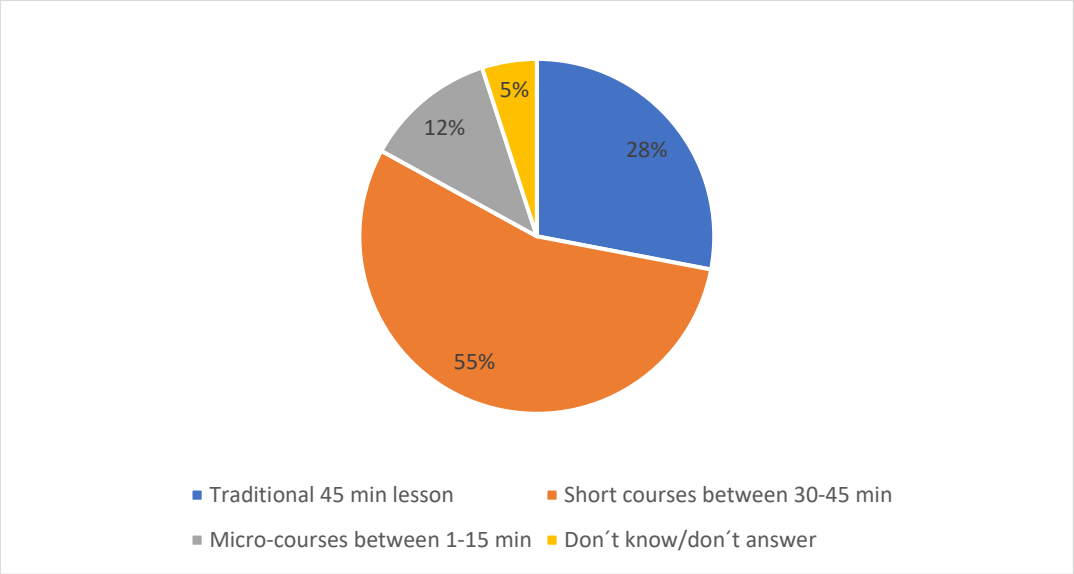

Figure 20 - Question Nº25" What would you consider optimal for the future in terms of Type of lesson?"

For the course duration the majority agrees that the course duration should be below 24h (Figure 21) or 8h.

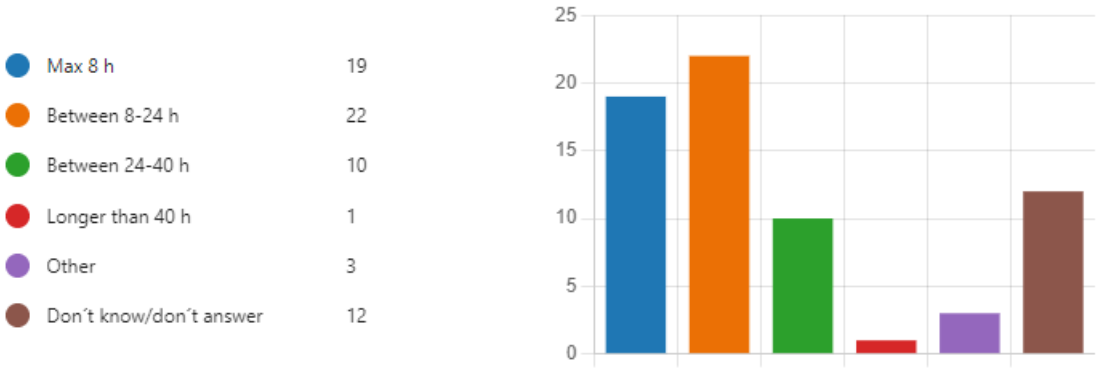

Figure 21 - Question Nº26" What would you consider optimal for the future in terms of course duration?"

As it can be seen in Figure 22 for the location of the course the most voted option was that it should be given in a room in a company, the second most voted place was in the job location. This result indicates that in terms of presential lectures/formation they should be given in the company, most probably due to the lack of time available.

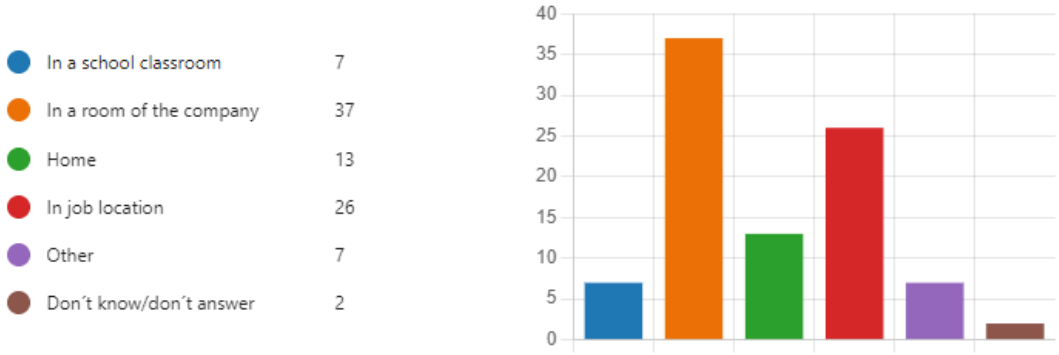

Figure 22 - Question Nº27 "What would you consider optimal for the future in terms of Location of course?"

In Figure 23 it can be seen that in what concern the topic of the training and education there was a consensus that the subject should be proposed by the trainer, to which should be added topics suggested by the trainees. The trainer should come from a trainer provider and more than one trainer should give the courses (Figure 24) .

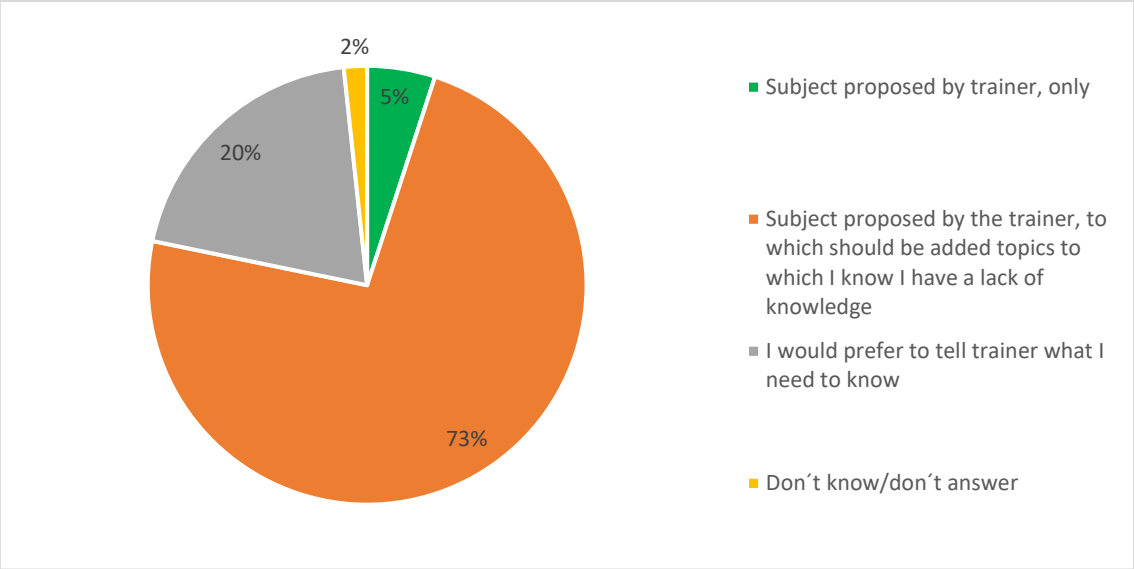

Figure 23 - Question Nº28 "What would you consider optimal for the future in terms of Subject?"

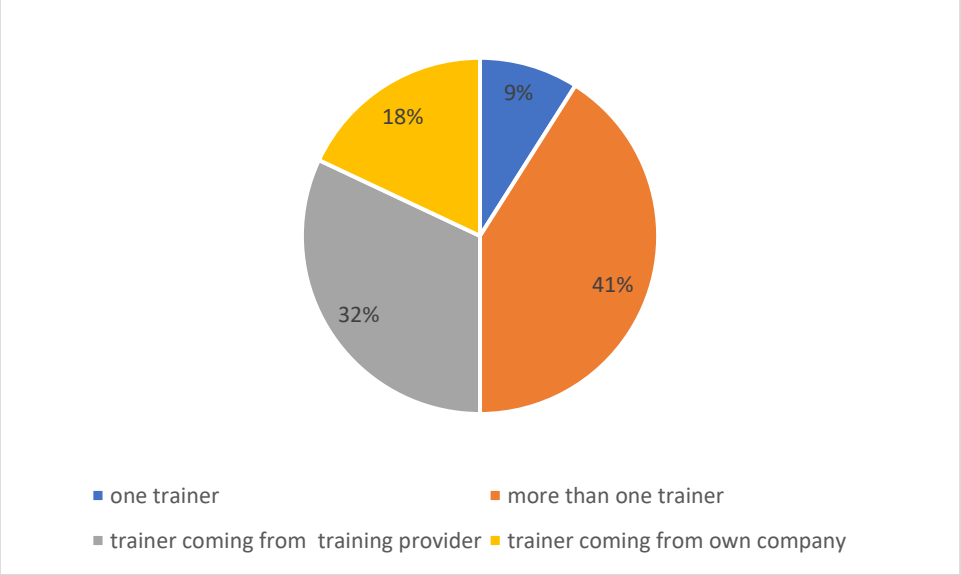

Figure 24 - Question Nº29 "What would you consider optimal for the future in terms of trainers?"

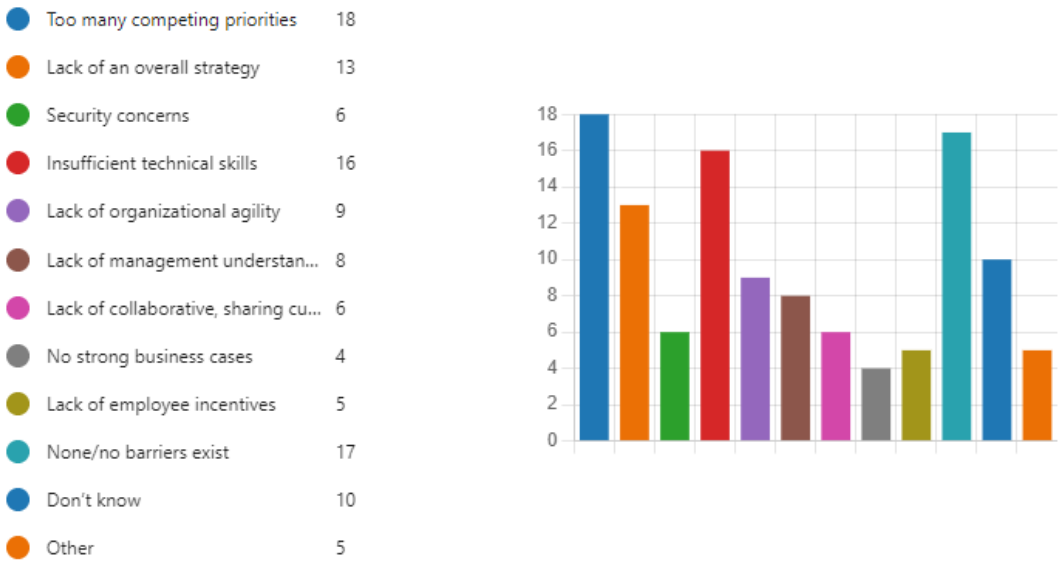

Figure 25 - Question Nº30 "What barriers are impeding your organization from taking advantage of digital trends?", other was referred/indicated as low budget

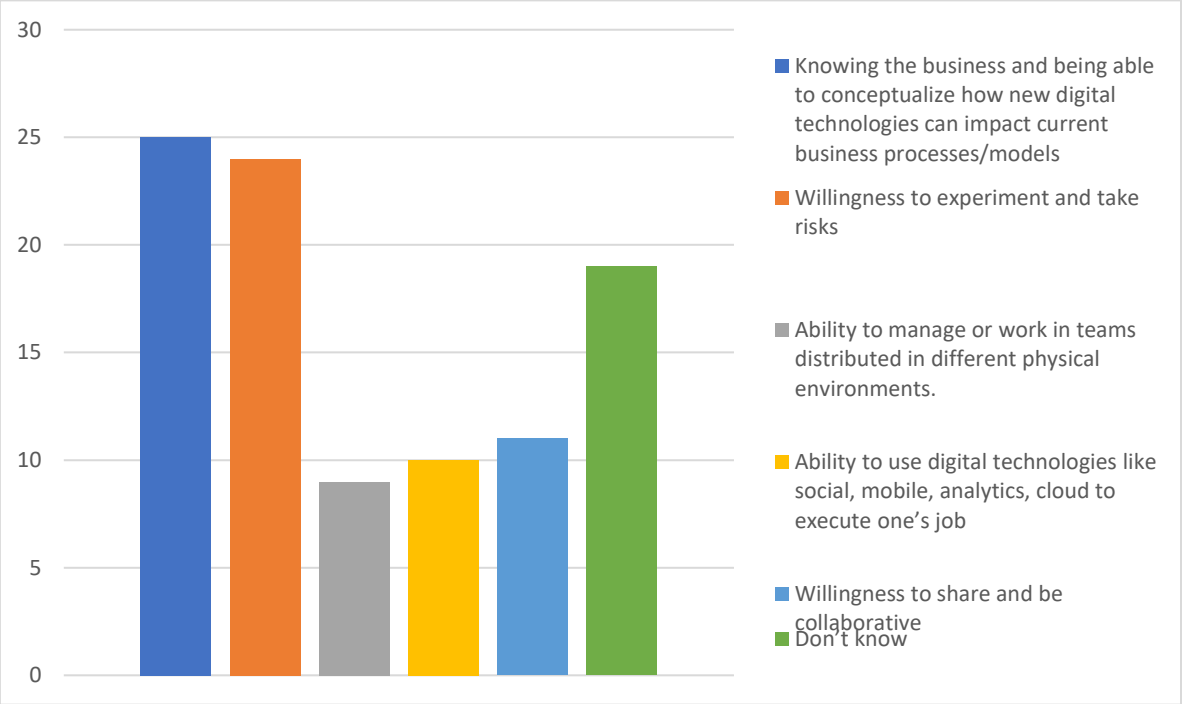

Figure 26 - Question Nº31 "Which of the following skills or abilities are most lacking in your organization? (Select up to three)"

Based on the results analysis(from figure 27 to figure 32) it was noted that learners are more likely to be engaged in a course when they perceive that the teaching and learning activities are close to real-life practice and it is also perceived that the use of Digital tools in these activities allows learners to conduct inquiry-based learning through communication tools, enabled simulation tools and internet resources, to experience real-world practice through a workshop base webinar, to communicate and collaborate with more than one trainer/experts and with different colleagues. It was also observed that there are insufficient digital skills, lack of time for

learning. Most of the participants uses Microsoft teams to communicate, webinars and training purposes. Zoom platform is also used, mostly for training and webinar purposes.

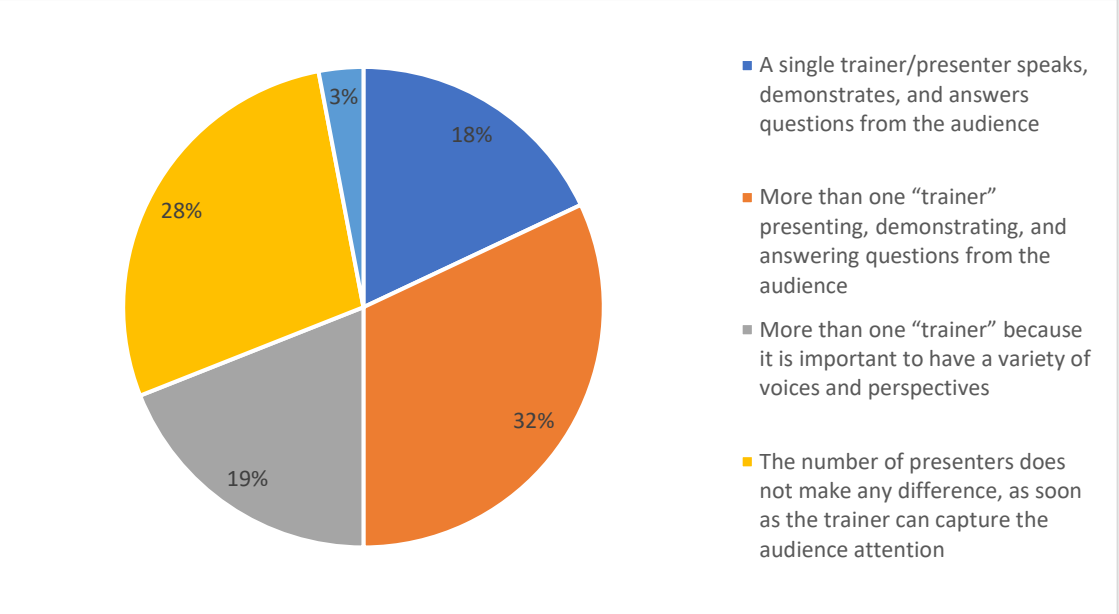

Figure 27 - Question Nº32 ""Which of the following are important to consider in a webinar lecture format in terms of number of Trainer/presenters?"

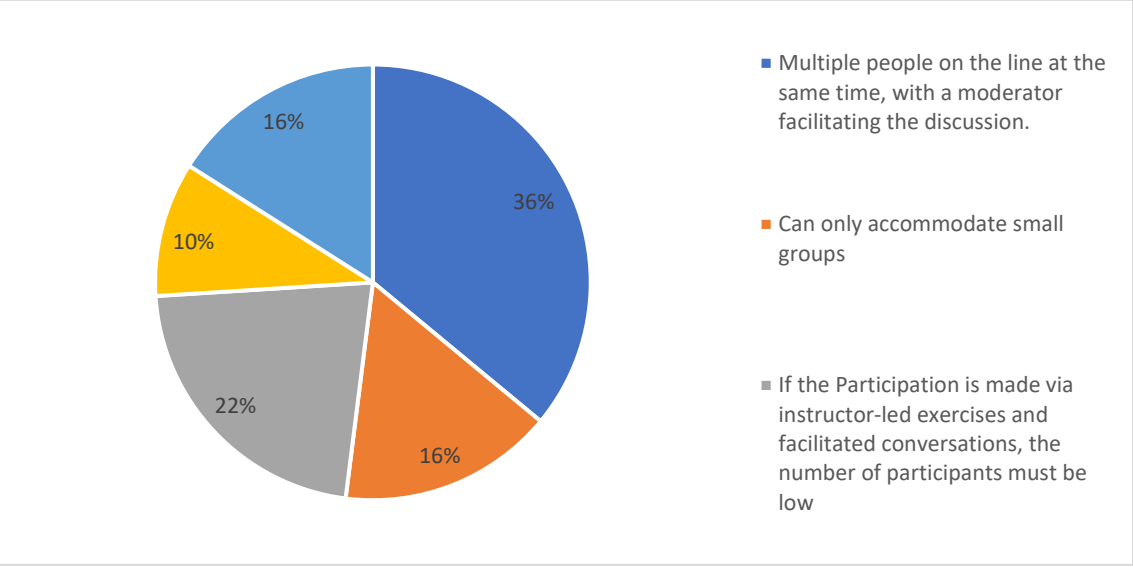

Figure 28 - Question Nº33 "Which of the following are important to consider in a webinar lecture format in terms of number of students/participants?"

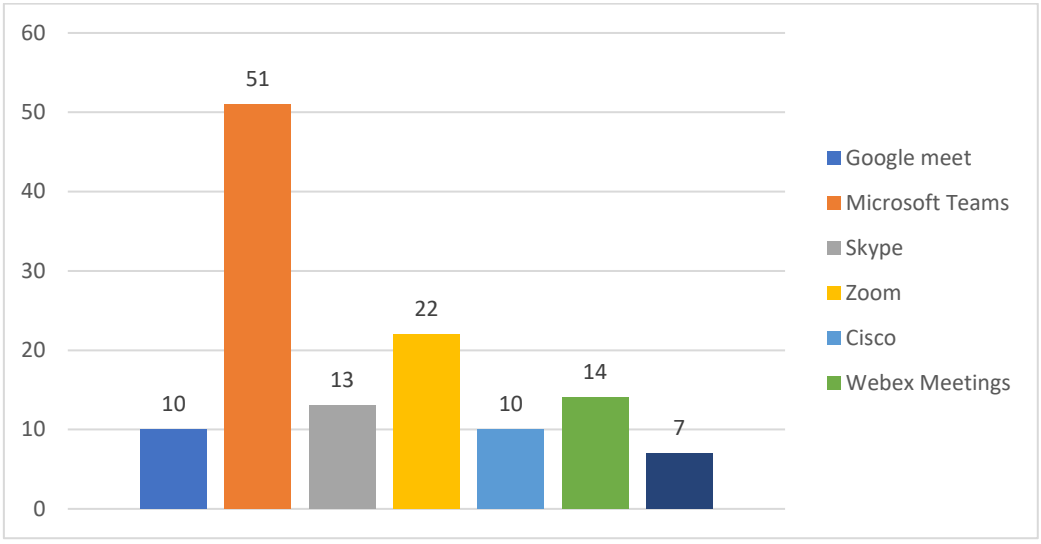

Figure 29 - Question Nº34 "What digital platforms/apps does your institution/company use?"

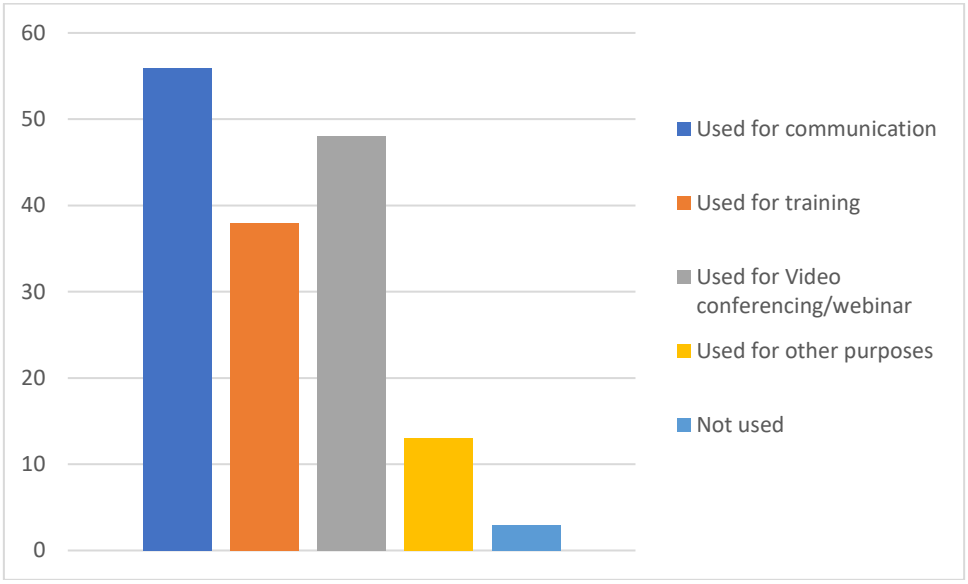

Figure 30 - Question Nº35 "What exactly are those platforms been used for?"

WhatsApp, Facebook, and LinkedIn are the most popular social media used for communication, so advantage should be taken of these means to pass on relevant information, learning content and also to communicate with teachers/trainers, experts and colleagues.

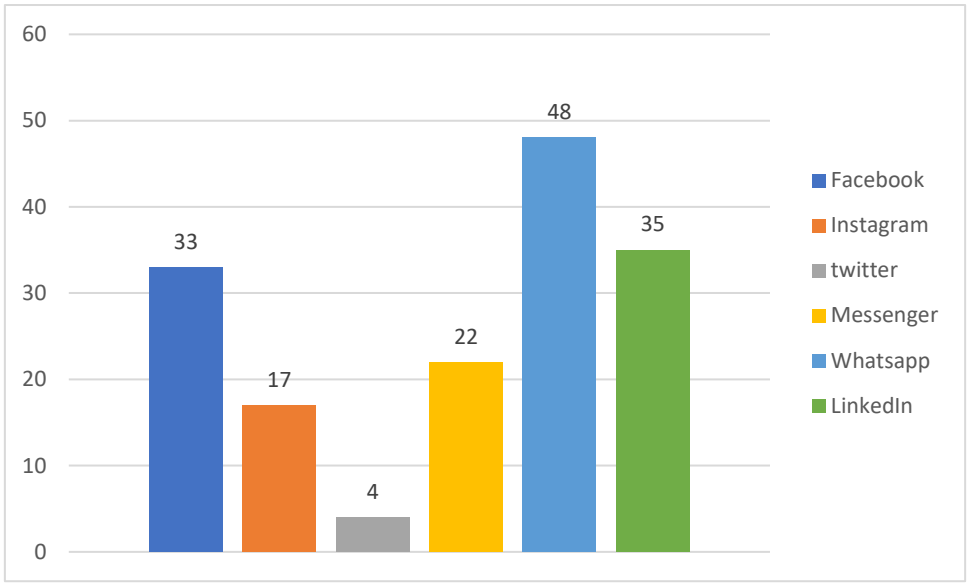

Figure 31 - Question Nº36 "Which social media and messaging apps do you used for communication"

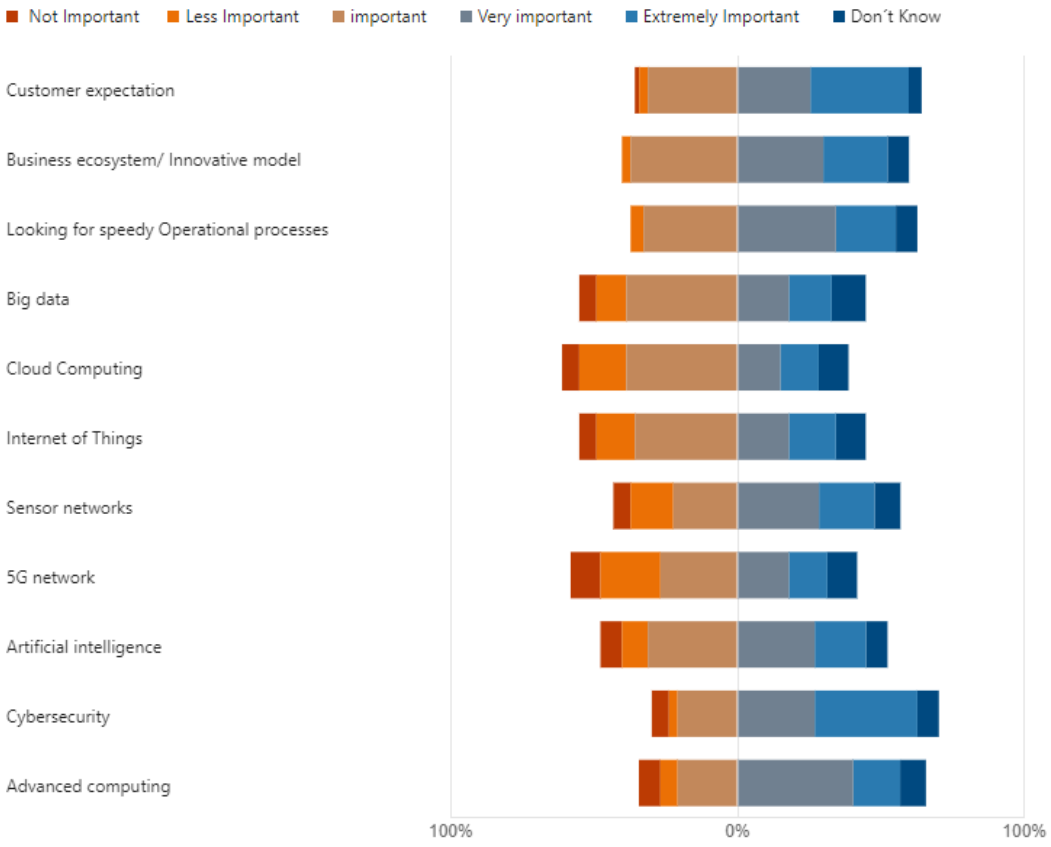

Figure 32 - Question Nº37 "How important are the following factors in your company decision to embark on digital transformation? Please tick the box that is relevant"

6 Conclusion to be taken after the Delphi

From the analysis of the questionnaires, it was found that the training and teaching in digital and green manufacturing is seen as an urgent need, despite involving an effort both personal and financial, on the part of companies. Given the lack of time for reskilling courses should be given in a hybrid way, both online and presential and with short duration. When given physically, most of the "workers" agreed that the training should be given inside the company, that is work-based learning, with the involvement of teachers/trainers coming from training provider centres or other institutions or universities, companies, in its design and delivery. If the courses are given online, they can be given through platforms such as Microsoft teams and zoom, or using social networks, to transmit/spread simple, important, and appealing contents, such as LinkedIn, Facebook and even WhatsApp.

There are various challenges on teaching digital manufacturing through the use of technology in education and training, being required, several skills for effective participation in the digital manufacturing, green manufacturing, society and economy: 1 Basic functional digital skill enable an individual to access and engage with digital technologies (including foundational skills to operate and connect, visual literacy and psychomotor skills). 2 Generic digital skills enable an individual to use digital technologies in meaningful and beneficial ways (including information and data literacy, communication and collaboration, and skills for digital content creation). 3 Higher-level skills enable an individual to use digital technologies to empower and transform (including the advanced skills, namely process simulation, process control.). Of course, that these contents will vary according to the level of the trainees (white or blue worker, graduate, or non-graduate) ranging from simulated. For white workers are online communications, process simulation and digital publishing and managing files tool, while for the blue workers are digital fabrication, simulation tools and digital logistics equipment tools. Nevertheless, the results are quite similar for all competencies which sustains the hypothesis that all competencies are necessary in the Digital Manufacturing industry.

In the area of digital and green manufacturing education, training and upskilling must be focused on both improving the quality and the mode of teaching and allowing a continuous update and share of information and of good practices in an area which is suffering rapid and continuous changes. It is also important to enhance access to qualifications through micro credits, allowing a more flexible and permeable systems and enabling the validation of non-formal (by micro-learning) and informal learning; Micro-Learning system should facilitate the delivery of high-quality teaching and must include as well learning outcomes, contact-time and autonomous work and an assessment where microcredits can be obtained through the completion of each microunit.

Digital transformation is one of the major trends that is affecting the economy and society. This brings the transformation of business activities/functions; processes; models; ecosystems; asset management; organisational culture; ecosystem and partnership models; as well as customer, worker and partner approaches. As for the digital transformation of the EU industry, its importance is highlighted under the digitisation of EU industry strategy and the established digital innovation hubs under the digitising European industry initiative [4, 5].

7 Research of webinar and micro-learning framework

7.1 Framework webinar

A webinar is short for web-based seminar. A webinar is a presentation, lecture, workshop, or seminar that is transmitted over the web, instead of in person. As a result, each member of the webinar, from the presenter to the attendees, can be at a different location providing they have an internet connection.

One of the advantages of webinars is that they can take place at any time and any place, and this way can make learning more accessible. Webinars also enable for practical solutions that are less available in physical meetings, such as swift partitioning into collaboration groups, file sharing and integration of external digital tools.

There are six elements that are essential in the design of educational webinars (figure 33): (i) pedagogical and instructional strategies; (ii) lecture content; (iii) presentation style; (iv) choice of platform; (v) netiquette; and (vi) evaluation (Figure 1). The selection of these elements is aligned with best practices in blended and online learning environments. Taking these elements into consideration could potentially improve the student learning experience [5].

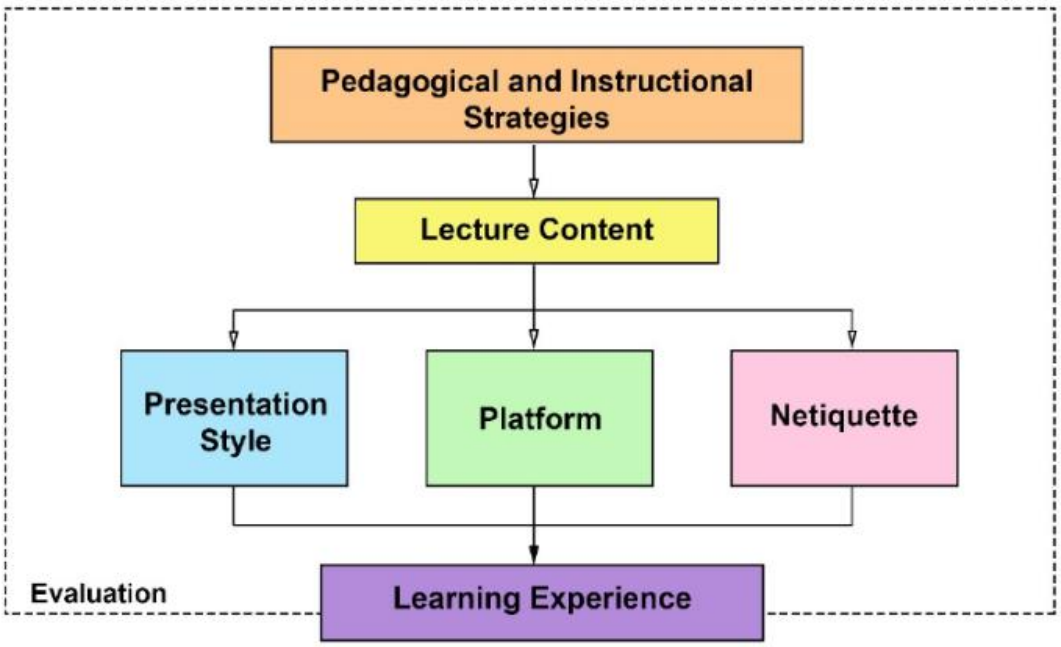

Figure 33 - A practical framework to design educational webinars [5]

7.1.1 Pedagogical and instructional strategies

The first step to design educational webinars should be choosing the pedagogical approaches such as active learning or learning-by-doing. Under the umbrella of active learning, a wide range of pedagogies coexists, such as Problem-Based Learning, Inquiry-Based Learning, Cooperative Learning and Case Studies. The next step is formulating the learning outcomes of the session (of which there should be three to five). It is essential to use learning to guide the development of these outcomes to ensure they are achievable.

From the learning design perspective, using a sequence, such as presenting a concept, a worked example, activity and feedback, could promote student engagement. Interactivity in webinars is recommended due to the short attention span of students in online settings. Using polling systems and quizzes that measure higher-order thinking will engage the students. Ideally, these interactions should be used every ten minutes to break up the monotony.

The use of breakout rooms allows students to work in groups on an activity provided by the educator and reconvene in the main room to summarise their findings, contribute their perspectives, or engage in a debate. Ensuring that groups have four to five students will lead to effective group work and collaboration

7.1.2 Lecture content

Educators should ensure the topic chosen can be covered in the prescribed length of the webinar. It is recommended that webinars should run between 45 to 60 minutes for maximum impact on student learning. This approach will require the development of a lesson plan in which all content and activities are listed, along with their respective time allocation. Having and adhering to a lesson plan will help educators cover the intended content in the timeslot allocated. From a cognitive load perspective, it is essential to present and discuss complex concepts at the beginning when attentional resources are optimal. For instance, research conducted in intensive mode delivery showed that students tend to get tired towards the end of the session. It is a desirable practice to provide the students with a five-minute break every 30minutes.

If the students needed to prepare for the webinar, educators should ensure that students have understood the essential concepts by using a poll at the beginning of the webinar and then addressing misconceptions via direct instruction as used in flipped learning approaches. During the webinar, it is essential to link to preparation material and to other relevant content for the topic with which the students must engage after the webinar. Providing content just for the sake of it could damage student attitude towards preparation if they do not find it to be of value. Towards the end of the webinar, a checklist of concepts covered provides an excellent summary for the students. It is also desirable to include references, both on the slides and at the end of the presentation, that highlight the critical articles for students to review. As previously mentioned, breaking the webinar every ten minutes with an activity, or asking questions is likely to keep students engaged.

In terms of slide design, educators should employ a minimalistic design with minimum text and with diagrams and pictures. Use of images should have a purpose, not used merely as

decorative elements on the slide. The information on the slide should be segmented into user-paced chunks of information.

For legibility, fonts should be selected from sans-serifs (e.g., Arial, Verdana) and the size should be 40pt for titles and 20-24pt for paragraphs.

7.1.3 The platform

There is a wide range of webinar software, but after COVID-19 pandemic, Zoom appears to be the most popular platform, even generating the gerund 'Zooming' to refer to webinar sessions. Other webinar platforms include Adobe Connect, Go-To-Webinar, Skype, Blackboard Collaborate, and Google Hangout.

Most webinar platforms possess the same features, such as chat box, screen sharing, polling systems, and the ability to record the session. As educators, curating technical support documents for the students (PDF, screencast, or videos) is important. During the webinar, advise students to mute their audio, as excessive noise will be distracting and affect student concentration. If the webinar has many students, it will be ideal to ask them to disable their video as the platform can become overloaded and unresponsive. In terms of security, for all except the smallest classes, it is a wise idea to use password-protected meetings where the host needs to approve the participant before going online. This will avoid the problems of "Zoombombing", trolling and hacking that have been frequently reported during the COVID-19 crisis.

7.1.4 Netiquette

Netiquette (the correct or acceptable way of communicating on the internet) is essential when preparing the webinar environment to minimise disruption and ensure a smooth experience. Everyone who logs into the webinar should take steps to ensure that their environment is optimised for the session. For instance, ideally the host and co-hosts will login ten minutes before the event starts and open the meeting five minutes ahead of the starting time. For presenters, it is advisable to use a headset to improve audio quality. Interruptions during the webinar can distract participants, so structuring the environment for productive delivery is crucial. As host, the educator should mute their electronic devices (phone, tablets) to limit extraneous sounds. Sometimes 4G signal can interfere with the Internet connection and putting phones into aeroplane mode may be a good approach. Closing the door and placing a 'do not disturb' sign on it and closing the windows will also reduce outside noise and thereby help students focus. Wearing items of jewellery should be avoided as they may make noise if the speaker moves slightly. Educators can enhance their presence on the webinar by having appropriate lighting in the room. Educators should avoid sitting near a window or with any source of light behind them. In poor lighting conditions, the students may see a silhouette rather than the face of the presenter. When asking questions to the students, educators should allow some take-up time for responses. If running a webinar with a large group, educators could ask participants to type their questions first in the chat box, and the co-host or moderator can read it and address it. A practice that works well is asking the students to number the questions when typing on the chat box. Technical recommendations to help the technology to run smoothly

includes rebooting the computer before the webinar; this will speed up performance. Close all other open programs, including browser tabs, except for the applications needed for the webinar. Having different applications running in the background takes up space in the computer's processor and memory and could make the webinar run slow, noticeable when playing the instructional video. If possible, connect directly to an Internet source. Additionally, consider having a second computer available in case of a technical issue. Finally, educators should not forget a glass of water nearby (but do not use ice, as it can clink in the glass

7.1.5 Evaluation

Evaluation is essential when deploying technological innovations, and it should have a holistic approach. For webinars, students and educators should be part of the evaluation process. A mixed-methods approach to data capture and analysis is desirable. For instance, assessing knowledge construction is possible by incorporating higher-order thinking multiple-choice questions at the end of the webinar on the topic delivered to gauge 'actual knowledge' achieved. The students' attitudes towards webinars can be measured via online surveys and possibly open-ended questions. But to gain an in-depth understanding of the student experience, interviews and focus groups will be a desirable approach. From the educator perspective, reflections and semi-structured interviews will help to gain an understanding of the webinar experience. Data can be put together by methodological triangulation (to find the critical aspects that require improvement. Using the data in the next iteration will enhance the student learning experience [5]

7.2 Microlearning Framework

Workers usually have difficulty combining training and their normal work. In this context, micro-learning emerges as a suitable solution, since it is based on breaking down new concepts into small fragments or pills of content, which can be consumed in short periods of time [6].

Continuous learning has become an increasing need in our society: the constant and rapid evolution of knowledge requires workers to adapt to this new context to maintain their productivity. Micro-learning comes into play to facilitate this process to potential learners by breaking down new concepts into small fragments or pills of content, also called micro-content. These small learning units are given to learners progressively and in a way that is suited to them.

The combination of several factors has stimulated the development and the positive reception of the micro-learning paradigm. First, the human capacity to stay focused on a single item, avoiding distraction and inattention, has decreased. Second, very quick changes in all areas, especially in technology, have resulted in workers needing to update their training constantly. Finally, traditional training is not proving to be a good method to train workers effectively and efficiently.

Offering adequate environments that can be totally integrated into the working processes is not an easy task, which usually results in high drop-out rates. This is clearly reflected in the use of MOOCs (Massive Open Online Courses) as a complement to daily work activity, with more than 90% of drop-outs in this context.

Since each microlearning asset serves a specific objective, the forms they take are diverse and dependent on the intended learning outcome. Common examples of microlearning objects that can be used across multiple devices, such as desktops, laptops, computers, tablets, and mobiles include the following [7]:

- Short chunks of texts Interactive/non-interactive infographics, PDFs, and presentations
- Short interactive/non-interactive videos (graphic animation, whiteboard animation, kinetic text-based animation, explainer videos, mentor-driven videos)
- eBooks, flipbooks, and audiobooks
- Short podcasts and recorded webinars Mobile apps and short HTML pages (interactive parallax-based scrolling) QR codes and learner-generated blog posts
- Gamification and serious games
- Virtual Reality and Augmented Reality
- Step-by-step checklists and quizzes
- Furthermore, many tools and technologies exist that can be used to develop these microlearning objects.

Below is a framework on how to structure each microlearning lesson and example microlearning objects for each structural element

Table 2. Microlearning framework [7]

WHAT STRUCTURAL ELEMENT	HOW INSTRUCTIONAL METHOD	MEDIUM MICROLEARNING OBJECT
WELCOME TO THE LESSON	Structured overview	Video
AWAKEN PRIOR KNOWLEDGE	Inquiry Drill and practice	Survey on Moodle Quiz
REVIEW KEY POINTS	Mental modelling Discovery learning	Infographic
CONTENT	Direct instruction Lecture Drill and practice	Video Animation Infographic Interactive PDFs
DISCUSSION	Reflective discussions Group discussion Debate	Discussion forum Social-media posts
REVIEW KEY POINTS	Question and answer Inquiry	Video Infographic
ASSESSMENT	Quiz Inquiry	Moodle Quiz Google Forms

8 Main conclusions: Key findings

Based on the results obtained applying the Delphi method a table (see table 4) was built which summarises the main finding obtained within the scope of this work.

Based on these results and considering a research and discussion made by all partners, a micro-learning and webinar structure /framework was proposed, as well a general entry requirement (table 3). A more detailed specification of the micro-learning framework, structure, content, and entry requirements will be made in Project result number 2 (PR2) or Intellectual Output number 2 (IO2).

Table 3. Entry requirements

Entry requirements
- To have basic information and communications technology skills

Table 4 – Project results 1 Key findings, obtained from the questionnaires analysis

PR1	Description	Digital Skills		Green Skills	
		White Collars	Blue Collars	White Collars	Blue Collars
Existing know-and skills expressed by Companies	Figure 32 - Question Nº37 "How **important** are the following factors in your company decision **to embark on digital** and green **transformation**? Figure 5 - Question Nº10 "In what extent do you fill satisfied or agree with the following questions according to your organization's digital and green strategy?"	Cybersecurity Business ecosystem/innovative model Advanced computing They are aware of the benefits of digital skills Deficiency in the implementation of digital strategy (different perceptions between W&B)	Looking for speedy operational process They can face lack in Digital trends	Business ecosystem/innovative model Advanced computing	They can face a lack in Green trends
Key processes used by the companies	1.Welding – soldering – brazing 2.Machining				

	3.Metal forming 3.Thermal and non-thermal cutting				
Most important digital tools for companies	Figure 6 - Question Nº11" What digital tools do you think are the most important for the jobs in your company/organization" Figure 30 - Question Nº35 "What exactly are those platforms been used for?"	Digital publishing and managing files Online communication Computer simulation tolls Communication Training Conferences/webinar	Digital fabrication equipment Digital equipment Digital testing equipment	Communication Training Conferences/webinar	1.Digital fabrication equipment 2.Digital equipment 3.Digital testing equipment
Skills Shortage	Figure 25 - Question Nº30 "What barriers are impeding your organization from taking advantage of digital trends?", other was referred/indicated as low budget Figure 26 - Question Nº31 "Which of the following skills or abilities are **most lacking**	Too many competing priories Lack of an overall strategy Lack of organizational agility Knowing the business and being able to conceptualize how new digital technologies can impact current business process/models	Insufficient technical skills Lack of organizational agility	Too many competing priories Lack of an overall strategy Lack of organizational agility	

	in your organization? (Select up to three)" (the gap)	Willingness to experiment and take risks			
Training preferences	Tools	Digital communication tools/ simulation tools and internet resources/ collaborative			
	Structure	Hybrid (remote and on place)			
	Duration	Total duration – 8h to 24h Each session 30 to 45 minutes and no longer than 45minuts			
	Format	Attendance at the company More than 1 trainer or 1 good communicator trainer Demonstration or practical sessions eg. Workshops, webniar			
	Apps	Microsoft teams Zoom Webex meetings			

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