

Evaluation of the self-study modules developed in ExCurS project

Nikola Gjeldum¹, Boženko Bilić¹, Marko Mladineo¹, Marina Crnjac Žižić¹ and Amanda Aljinović Meštrović¹

1) University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, R. Boskovicica 32, 21000 Split, Croatia

Corresponding author: ngjeldum@fesb.hr

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Abstract: The Industry 4.0/5.0 era implies acquirement of new knowledge on digital, process improvement based on lean methodology technologies and digital transformation, sustainability and green approaches in the business. It represents significant effort for the enterprises to acquire all this knowledge, especially for small and medium-sized enterprises. Therefore, ExCurS project was initiated to bridge this knowledge gap by developing On-line platform with Self Assessment Tool, Concept of blended learning and Complementary resources. One of the most important aspects of this platform is more than 50 self-study modules that have been developed in the project. This paper uses scientific methodology of questionnaire to evaluate a dozen of self-study modules in a kind of validation process. Large sample of participants has been interviewed on the success rate of acquiring the knowledge of the self-study modules they've been learning. The results of analysis of 12 self-study modules are presented in this paper.

Keywords: *ExCurS project; Lean-green; SMEs; Digital transformation; Sustainability*

1. Introduction

Small and medium-sized enterprises (SMEs) are a key segment for economic growth and stability in most economies. This is underpinned by the fact that SMEs account for around 90% of global economic activity and 50-60% of total employment in the world [1]. In the modern business environment, these enterprises face two major challenges: firstly, the ever-increasing pressure to adapt to rapid digital transformation and secondly, the requirements to achieve the triple bottom line of sustainability, i.e. environmental, economic and social sustainability. In this context, with the European Green Deal and the EU Industrial Strategy, the European Union has set clear targets for environmental protection and the reduction of harmful gas emissions, as well as an accelerated transition to a circular economy with a focus on resource efficiency and digital resilience. These objectives have a direct impact on the activity of SMEs, which must adapt their processes to remain competitive and comply with the new environmental regulations that will be imposed on them in the future, considering that SMEs are responsible for 60-70% of hazardous emissions in the world [2], [3]. Although the COVID-19 pandemic has accelerated the transition to digital solutions and remote working [4], many companies are still only using information and communication technologies to support existing processes and are not taking full advantage of the digital environment.

The digital transformation of SMEs must be gradually integrated into the company and be multidimensional. This means that it requires a complete transformation of business processes, which should be based on the continuous improvement of technical, organizational and individual aspects and not only on the integration of suitable technologies or automation [5], [6], [7]. By combining advanced technologies and sustainability strategies, SMEs have the opportunity to increase their resilience, reduce waste and move towards circular and regenerative business models. In this sense, the digital and sustainable transformation of companies is no longer just an advantage, but also a strategic necessity for SMEs that want to grow and survive in a dynamic global environment [8], [9]. However, this transition is slowed down by numerous obstacles. Among the most common are limited financial resources leading to difficulties in investing in the infrastructure and technology required for

digital transformation, lack of strategic planning, shortage of skilled labour and lack of management willingness to innovate [10], [11]. One of the possible solutions that SMEs can use to respond to the above challenges is to adopt lean and green practices. Lean and green practices represent an operational strategy that enables companies to simultaneously achieve the desired economic goals and improve their sustainability performance [12], [13]. Lean tools focus on process optimization, waste reduction and value creation for the customer, while the green economy emphasizes the importance of efficient resource use, waste reduction and environmental responsibility. Together, these tools form a strategic platform through which digital tools are selected and implemented to achieve the desired goals, Figure 1. Digital transformation without lean-green compliance often leads to fragmented or short-term changes [14].

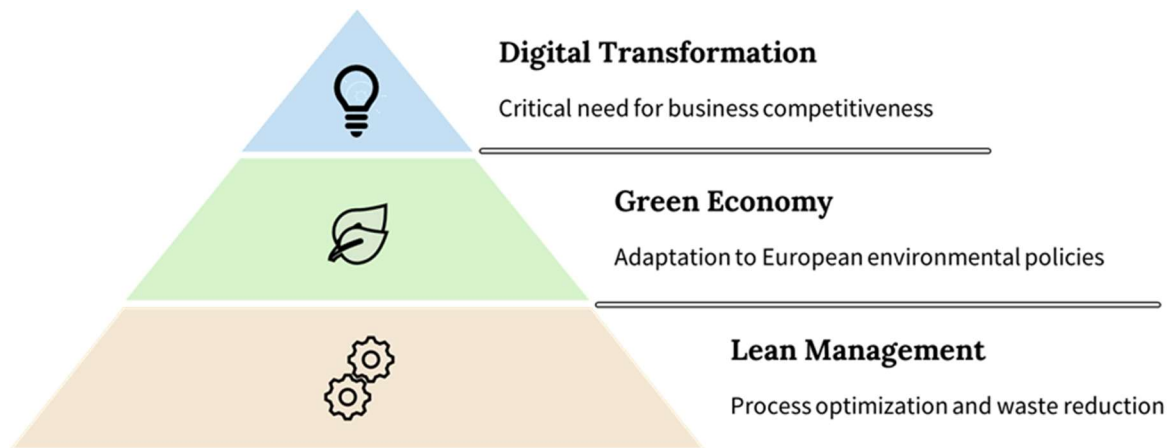


Figure 1. Lean-green management skills as the basis for long-term digital transformation

Due to the great diversity of SMEs and the specific challenges faced by each individual company, the need for a tailored approach to their digital transformation that is adapted to their unique characteristics, resources and individual needs has been recognised [9], [14]. Considering all these challenges and needs, it becomes clear that targeted tools and methodological approaches are crucial for a successful digital and sustainable transformation of SMEs. In response to these needs, An excellence-based curriculum to improve LEAN & GREEN management skills in SMEs, the ExCurS project, was launched in 2022.

The ExCurS project is oriented to the European SMEs and aimed to support companies through the development of an integrated digital platform based on self-assessment and flexible self-study modules. This platform will enable SMEs to identify transformation needs at an individual level and explore the opportunities of the green economy and digitalization.

2. ExCurS Project – short description

The ExCurS project [15] is an initiative funded by the Erasmus+ programme that aims to create a vocational training programme focusing on lean and green management skills for European SMEs. The expected duration of the project is 36 months and the implementation period is from 2022 to 2025. Six organisations from five different European countries and sectors are involved in the project. The project is coordinated by Gaia (Spain), the Knowledge and Technology Industries Association, which represents more than 304 companies from the ICT sector. The five partners come from the academic community: University of Reutlingen (Germany) and University of Split (Croatia) and from the business community: IBK Management Solutions (Germany), Irish Work Study Institute (Ireland) and Mindpedia (Romania). The diversity of the partners, including different work cultures, economic sectors, professional and scientific knowledge, and their international cooperation contribute to the creation of a comprehensive educational programme and open up the possibility of networking numerous companies in different European regions.

In order to achieve the project objectives, the project focuses on the development of a comprehensive digital and green transition tool, which includes three key intellectual outputs that will be developed sequentially during the project lifetime (Figure 2):

- Self-assessment tool,
- Concept of blended learning,
- Online platform.

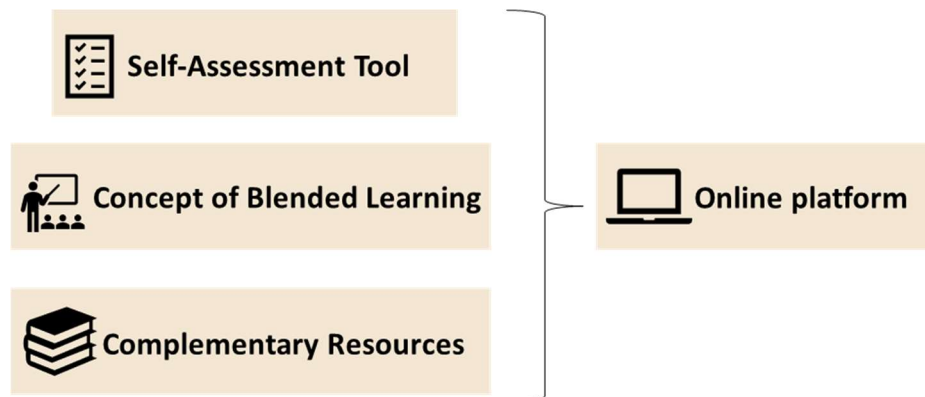


Figure 2. Expected outcomes of the ExCurS project

The Self Assessment Tool is a series of self-assessment tools developed on the basis of the EFQM 4.0 Excellence Model (European Foundation for Quality Management, EFQM). This tool was developed with the aim of enabling SMEs to recognise their own weaknesses and encourage them to independently identify opportunities for improvement in order to achieve digital transformation and environmental sustainability.

The Online platform is a validated digital environment that combines self-assessment tools, best practice examples and training content. It is available at regional, European, organisational and individual level. The platform is multilingual, easy to use, interactive and designed to support users in learning, analysing and implementing lean and green strategies in organisations.

The Concept of blended learning is a training concept aimed at managers and employees. It is based on the principles of learning through work, which develops professional, cognitive and digital skills. These three intellectual outputs complement each other and form a logical and integrated system to promote the digital and green transformation of SMEs. The self-assessment tool serves as a starting point to lay the foundations, i.e. companies can identify their needs and weaknesses and determine which resources and modules are important to them. The online platform brings everything together and guides users to training courses that enable concrete skills development.

In addition to these main intellectual components, the project will also produce a number of Complementary resources that will further facilitate the application and customisation of the developed tools in real business and educational contexts. These resources include a library, a glossary, guidelines for trainers and other important documents.

In the long term, the ExCurS project makes a multidimensional contribution to the development of small and medium-sized enterprises, the improvement of education systems and the achievement of the objectives of the European Green Deal through four key levels of impact: organizational, educational, environmental and collaborative, Figure 3.

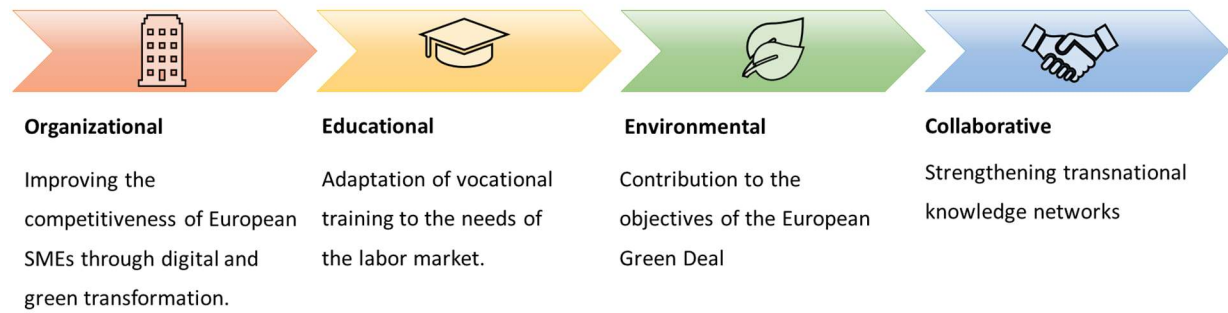


Figure 3. Expected long-term results of the ExCurS project

To ensure the effectiveness of these tools and their relevance to the real business environment, they have been developing and disseminating throughout the project, which consists of five work packages. However, one of the important aspects is the evaluation of the tools, especially the evaluation of the developed self-study modules (Figure 4). It is a kind of validation process for the self-study modules that can help further improvement of the modules.

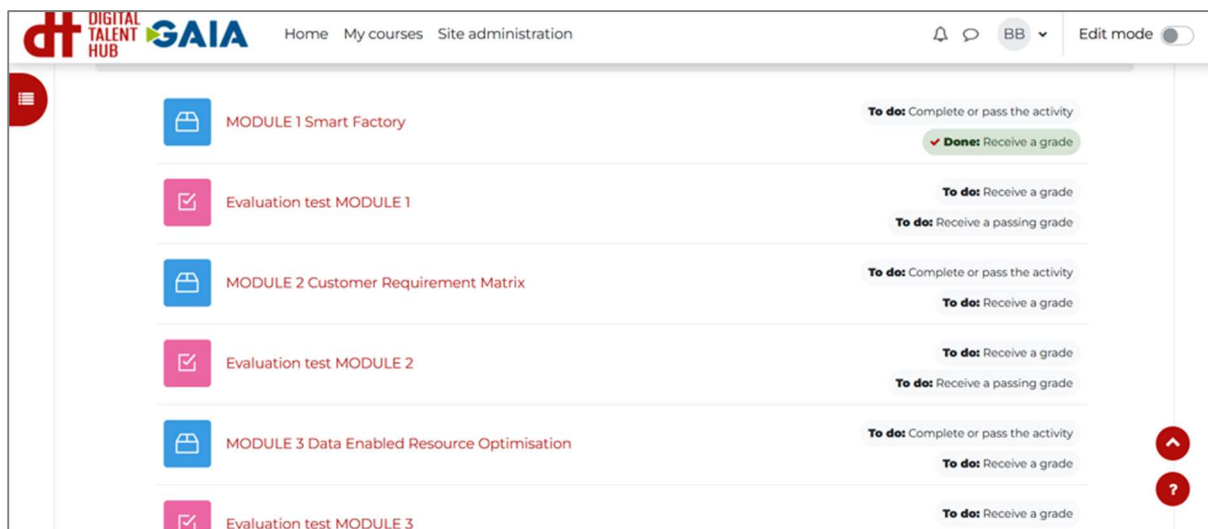


Figure 4. On-line platform with self-study modules of ExCurS project

3. Methodology

A dozen of ExCurS project's self-study modules have been selected for evaluation (Table 1). In total, 65 participants took part in evaluation process based on a questionnaire, so the large sample of answers was collected. The participants evaluated modules from the perspective of usage and relevance, and from perspective of the competence development.

The usage and relevance of self-study module was assessed through the following questions:

- How did you use the module?
- How helpful was the module for your understanding of the topic?
- How would you rate the module's practical relevance?
- How do you evaluate the learning format used?

On the other hand, the competence development was assessing how the self-study module helped participant to expand his/her knowledge on:

- Sustainability,
- Digitalization,
- Lean management.

Table 1. ExCurS project's self-study modules evaluated in this analysis

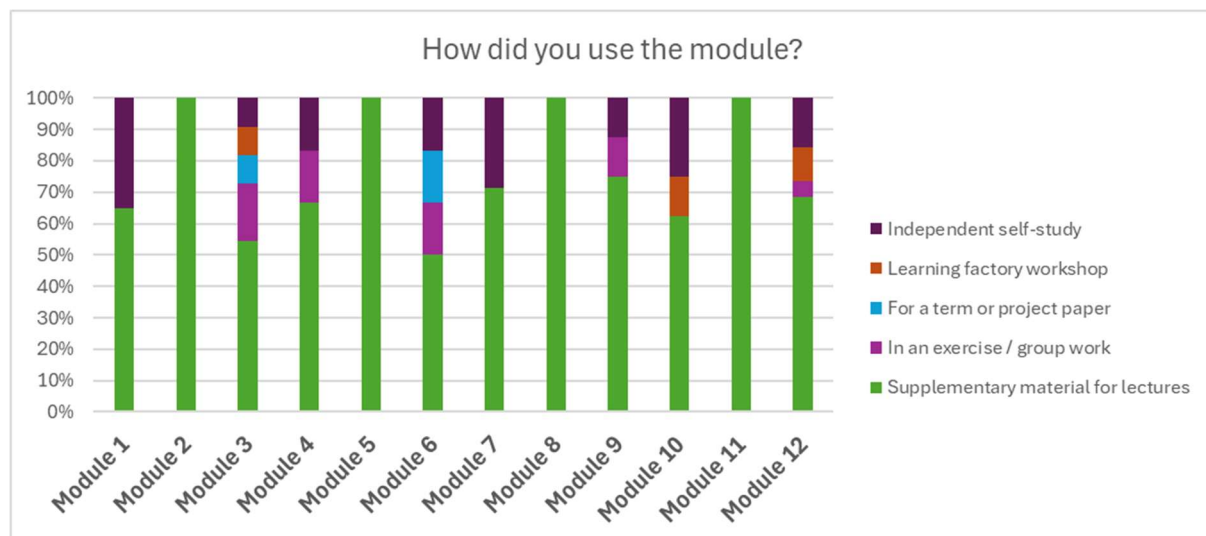
Module No.	Module name
Module 1	Connected Company / Smart Factory
Module 2	Customer Requirement Matrix (QFD)
Module 3	Data-enabled Resource Optimisation
Module 4	Digital Assistant Systems
Module 5	Digital Twin of the Facility
Module 6	KPI Analysis)
Module 7	Predictive Maintenance
Module 8	Process Identification and Mapping
Module 9	Benchmarking / Continuous Improvement
Module 10	Digital Human Resource Management
Module 11	EU-UN-ILO Policies
Module 12	Brainstorming

The participants were learning and using self-study modules in period from April to July 2025. After the period of self-study module learning, each participant answered the questionnaire to evaluate the modules that has been learning.

4. Results

As mentioned, 65 participants were evaluating 12 self-study modules (Table 1). The questionnaire consisted of four questions regarding the usage and relevance of self-study module, and three questions where participant needed to rate how much the module helped in their personal competence development.

The results show that most of the participants have been using self-study modules as "Supplementary material for lectures" (Figure 5), because the self-study modules were integrated into the curriculum of several courses in different studies at Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture.

**Figure 5.** Chart representing the usage of self-study module

Regarding the understanding of the specific topic, the modules were mostly "Rather helpful" or "Very helpful" to better understand some specific topic, except Module 2 which was rated "Neutral" (Figure 6). And similar observation is regarding the module's practical relevance (Figure 7).

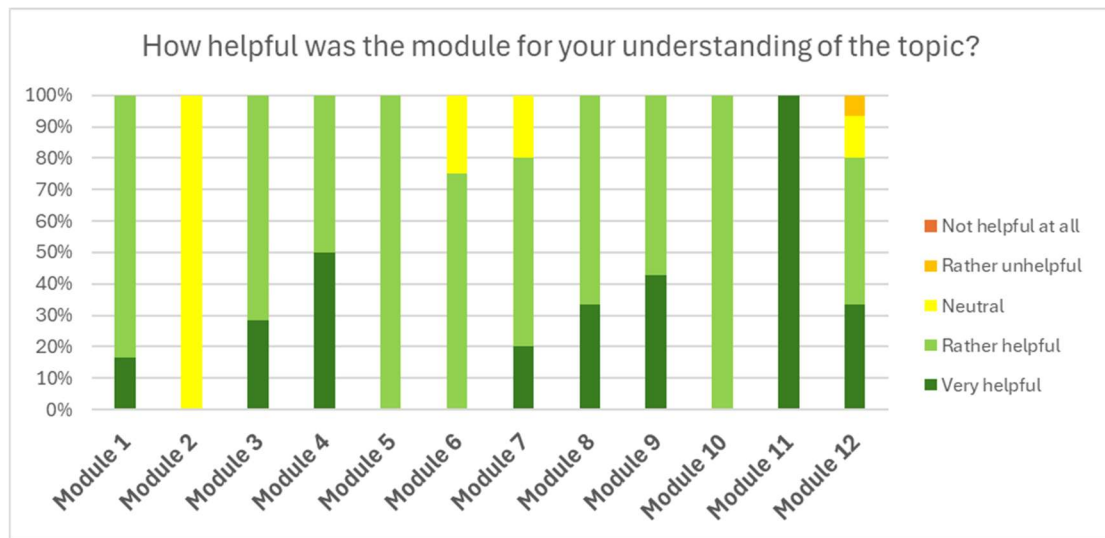


Figure 6. Chart representing the understanding of self-study module

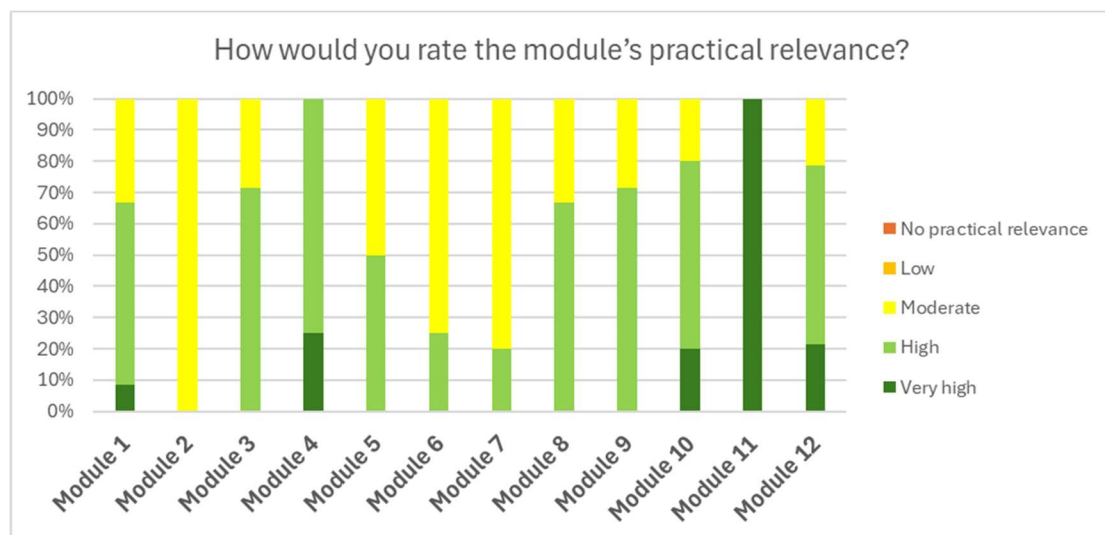


Figure 7. Chart representing the practical relevance of self-study module

Regarding the learning format used for the module, most of the participants rated module formats as "Rather suitable" or "Very suitable" (Figure 8).

The next, and the more important, part of the questionnaire was competence development, i.e. how the module helped participant to expand his/her knowledge on sustainability, digitalization and lean management. The participant rated each aspect (sustainability, digitalization and lean management) with a rate from 1 to 5, i.e. a scale from "1 = not at all" (module wasn't helpful) to "5 = very much" (module was very helpful). The rating of each aspect for each module is presented in Table 2.

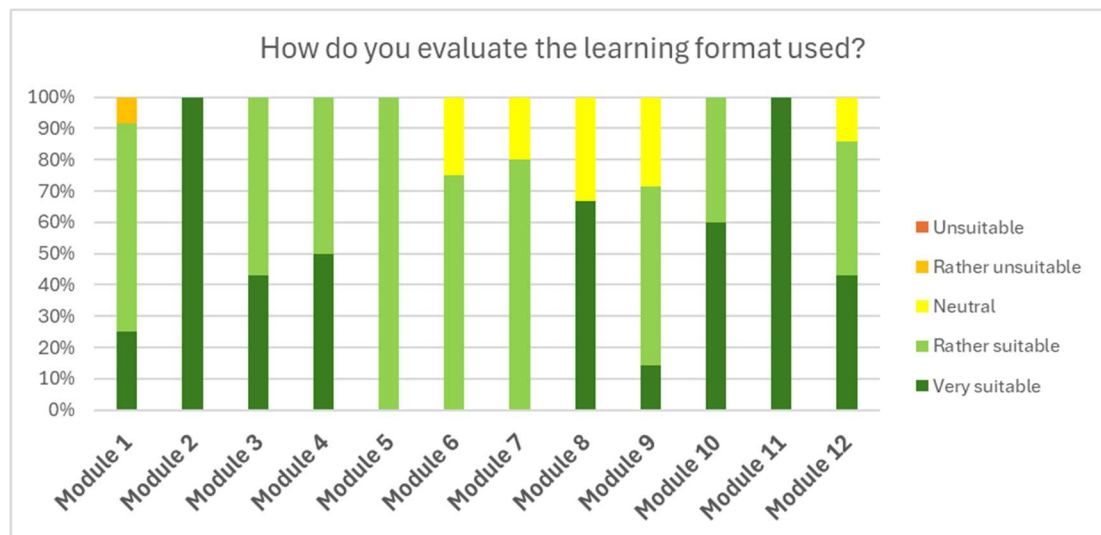


Figure 8. Chart representing the evaluation of the learning format of self-study module

Table 2. Evaluation of the acquirement of knowledge through learning a self-study module (scale from 1 to 5; 1 = not at all; 5 = very much)

Module No.	1	2	3	4	5	6	7	8	9	10	11	12
Sustainability	3.50	3.00	3.86	3.50	4.50	3.75	4.00	3.67	3.86	3.40	5.00	3.71
Digitalization	4.17	4.00	3.71	4.50	3.50	3.00	4.00	4.00	2.57	4.00	2.00	3.50
Lean management	3.08	3.00	3.57	3.25	4.00	3.00	3.40	4.00	3.57	3.40	3.00	3.93
Min	3.08	3.00	3.57	3.25	3.50	3.00	3.40	3.67	2.57	3.40	2.00	3.50
Average	3.58	3.33	3.71	3.75	4.00	3.25	3.80	3.89	3.33	3.60	3.33	3.71
Max	4.17	4.00	3.86	4.50	4.50	3.75	4.00	4.00	3.86	4.00	5.00	3.93

Table 2 shows the quite different ratings of modules regarding the extension of a knowledge sustainability, digitalization and lean management. In some cases, the module gained very low rating for one aspect, for example Module 11 "EU-UN-ILO Policies" was scored 2.00 for the digitalization. But it is a logical score, since it is a module about policies, and these policies really doesn't address digitalization issue, but mostly the sustainability issue which was rated 5.00.

From this and other examples, it can be concluded that ratings are quite realistic. However, it is important to look at some statistics, as well. Because it would be a strange thing that average rating of all three aspects for one module is below 3.00. It could be a signal that the module wasn't designed well, so it didn't transfer proper knowledge. But there is no such a module, all modules have average rating above 3.00 (Table 2). That fact is kind of validation of self-study modules, and the conclusion is that all 12 modules have been successfully validated.

Table 2 has been visualized in Figure 9 (Modules from 1 to 6) and Figure 10 (Modules from 7 to 12) by using radar chart with three axes: sustainability, digitalization and lean management. These charts demonstrate the difference between the self-study modules regarding sustainability, digitalization and lean management.

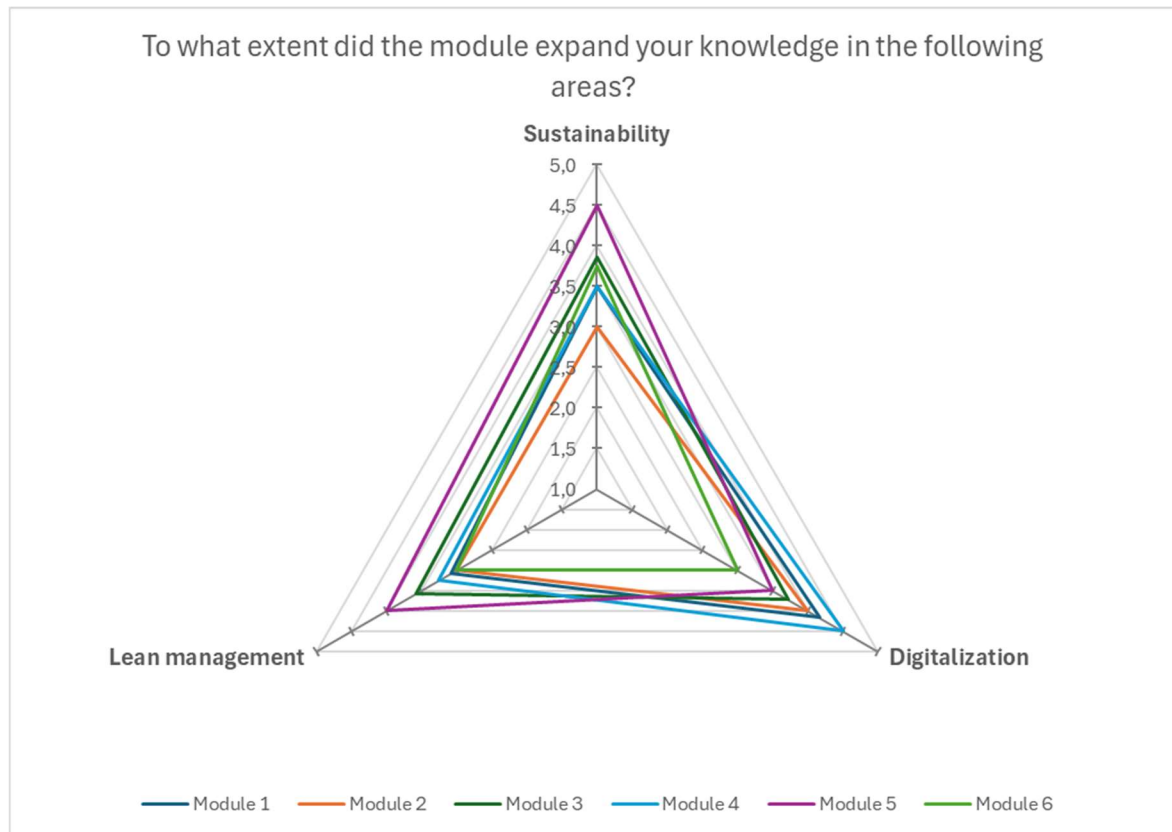


Figure 9. Radar chart representing the acquiring of knowledge on sustainability, digitalization and lean management for each self-study modules 1-6

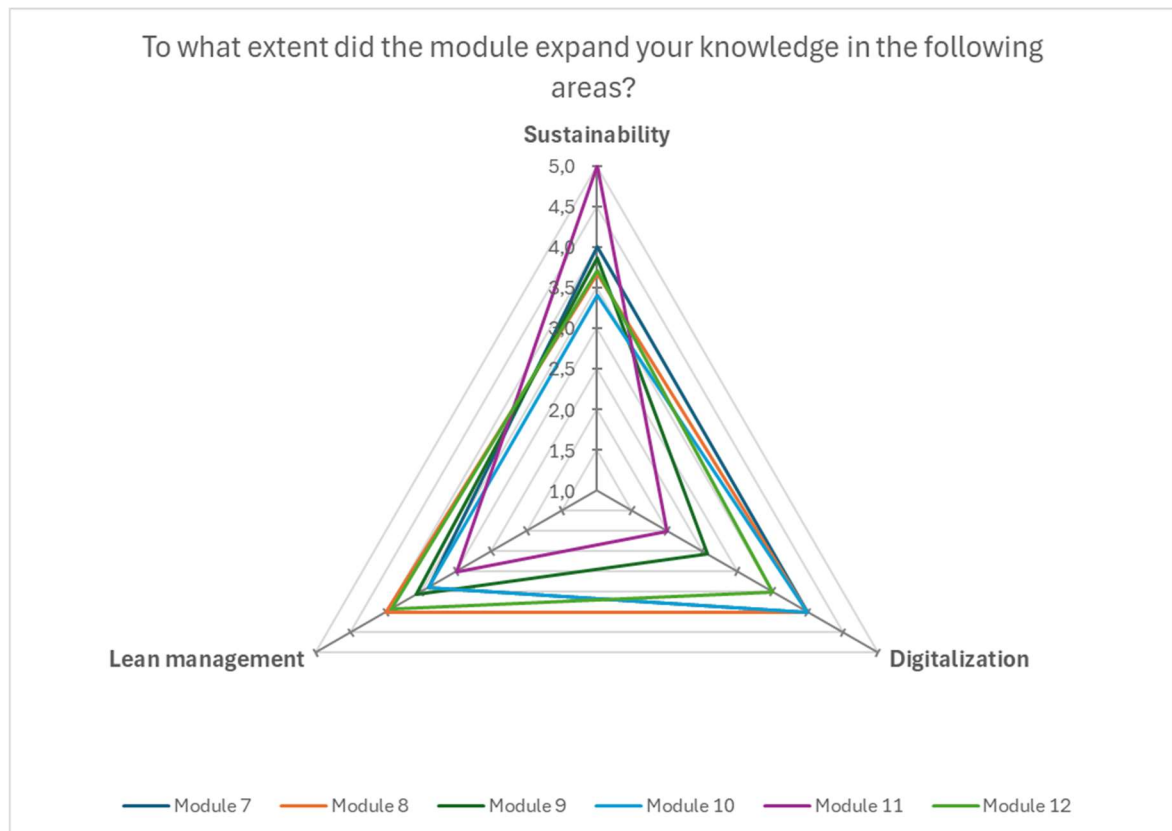


Figure 10. Radar chart representing the acquiring of knowledge on sustainability, digitalization and lean management for each self-study modules 7-12

5. Conclusions

The evaluation of 12 self-study modules developed in ExCurS project has been presented in this research. The evaluation was based on answers of 65 participants collected by using the questionnaire. Each participant was learning and using self-study modules for some period, after which he/she answered the questionnaire. The results gave insight into usage and relevance of each model, which can help further improvement of the module. The competence development evaluation was a kind of module validation, which showed that every module helped participant acquire above average knowledge on at least one out of three components: sustainability, digitalization, and lean management. So, it can be concluded that ExCurS project self-study modules have been successfully validated. The further research could be made with larger number of participants, and with some additional modules included.

Acknowledgments

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