SHOEPRO Modular Curriculum on Footwear Manufacturing: Digital Skills and Eco-Design/Waste Management – WP2

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Document Description	
Document name	**SHOEPRO Modular Curriculum on Footwear Manufacturing: Digital Skills and Eco-Design/Waste Management**
Abstract	
Version	1
Authors	Faculty of Textile Technology (TTF)
Creation Date	29/07/2025
Version Date	**20/03/2026**
Status	Completed
Destination	
Work Package /Activity number	Work Package: 2
Related Documents	

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DEFINITIONS OF MICRO-CREDENTIAL AND ITS STANDARD ELEMENTS

According to the Council Recommendation of 16 June 2022 on a European approach to micro-credentials for lifelong learning and employability 2022/C 243/02 (ttps://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022H0627(02)), the definition of a micro-credential is as follows:

'Micro-credential' means a record of the learning outcomes that a learner has acquired following a small volume of learning. These learning outcomes are assessed against transparent and clearly defined criteria. Learning experiences leading to micro-credentials are designed to provide the learner with specific knowledge, skills and competences that respond to societal, personal, cultural or labour market needs. Micro-credentials are owned by the learner, can be shared and are portable. They may be stand-alone or combined into larger credentials. They are underpinned by quality assurance following agreed standards in the relevant sector or area of activity.

In addition, in the same document, the Council recommended the following definition of providers of micro-credentials:

'Providers of micro-credentials' means education and training institutions and organisations, social partners (i.e. organisations representing workers and employers), employers and industry, civil society organisations, public employment services (PES), regional and national authorities, and other types of actors designing, delivering and issuing micro-credentials for formal, non-formal and informal learning. This is without prejudice to regional and national legislation and circumstances.

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The European standard elements to describe a micro-credential include the following mandatory elements:

- identification of the learner
- title of the micro-credential
- country(ies)/region(s) of the issuer
- awarding body(ies)
- date of issue
- learning outcomes
- notional workload needed to achieve the learning outcomes (in European Credit Transfer and Accumulation System – ECTS, wherever possible)
- level (and cycle, if applicable) of the learning experience leading to the micro-credential (European Qualifications Framework, Qualifications Frameworks in the European Higher Education Area), if applicable
- type of assessment
- form of participation in the learning activity
- type of quality assurance used to underpin the micro-credential.

Additionally, a micro-credential can be defined as a short, certified record of specific skills or competences gained from targeted learning, offering a flexible alternative to traditional degrees for upskilling, reskilling or career advancement, validated by quality assurance and shareable with employers and educational providers.

The following text will describe some mandatory standard elements of a micro-credential.

Title of the micro-credential

The title of the micro-credential should be a concise description reflecting the content and focus of the learning experience. It must communicate the specific skill or knowledge area the credential represents. A well-crafted title provides immediate insight into the nature of the learning outcomes described.

Learning outcomes

Learning outcomes have many definitions. Kennedy D. et al., in Writing and Using Learning Outcomes: A Practical Guide (https://ehea.info/media.ehea.info/file/Qualifications_frameworks/05/0/Kennedy_Writing_and_Using_

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Learning_Outcomes_597050.pdf), provided several definitions of learning outcomes.

> *Learning outcomes are statements of what is expected that the student will be able to do as a result of learning the activity. (Jenkins and Unwin, 2001)*
>
> *Learning outcomes are statements that specify what learners will know or be able to do as a result of a learning activity. Outcomes are usually expressed as knowledge, skills or attitudes. (American Association of Law Libraries)*
>
> *Learning outcomes are an explicit description of what a learner should know, understand and be able to do as a result of learning. (Bingham, 1999)*
>
> *Learning outcomes are statements of what a learner is expected to know, understand and/or be able to demonstrate after completion of a process of learning. (ECTS Users' Guide, 2005)*
>
> *Learning outcomes are explicit statements of what we want our students to know, understand or be able to do as a result of completing our courses. (University of New South Wales, Australia)*
>
> *Learning outcome: a statement of what a learner is expected to know, understand and/or be able to demonstrate at the end of a period of learning". (Gosling and Moon, 2001)*
>
> *A learning outcome is a statement of what the learner is expected to know, understand and/or be able to do at the end of a period of learning. (Donnelly and Fitzmaurice, 2005)*
>
> *A learning outcome is a statement of what a learner is expected to know, understand and be able to do at the end of a period of learning and of how that learning is to be demonstrated". (Moon, 2002)*
>
> *Learning outcomes describe what students are able to demonstrate in terms of knowledge, skills and attitudes upon completion of a programme. (Quality Enhancement Committee, Texas University)*
>
> *A learning outcome is a written statement of what the successful student/learner is expected to be able to do at the end of the module/course unit or qualification. (Adam, 2004)*

Learning outcomes state what a learner is expected to know, be able to do, and understand at the end of a learning process or sequence. How these outcomes are defined and written guides teaching and learning, and influences the quality and relevance of education and training. The way learning outcomes are defined and written is important for individual learners, the labour market, and society in general.

Cedefop (2014) offers two interrelated definitions of this concept:

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a) learning outcomes are 'statements of what a learner knows, understands and is able to do on completion of a learning process, defined in terms of knowledge, skills and competence' (Cedefop, 2014)

b) learning outcomes are 'sets of knowledge, skills and/or competences an individual has acquired and/or is able to demonstrate after completion of a learning process, whether formal, non-formal or informal' (Cedefop, 2014).

Notional workload needed to achieve the learning outcomes

The notional workload, often expressed in European Credit Transfer and Accumulation System (ECTS) credits, quantifies the time and effort required to achieve the learning outcomes.

The European Credit Transfer and Accumulation System (ECTS) is used by 48 countries within the European Higher Education Area. From the perspective of higher education, the ECTS is a recognised mechanism to make the learning outcomes and the estimated workload of a course visible and part of the Bologna Process (Commission, n.d.).

Workload is an estimation of the time the individual typically needs to complete all learning activities such as lectures, seminars, projects, practical work, work placements and individual study required to achieve the defined learning outcomes in formal learning environments.

Generally, a micro-credential can have several assigned/estimated ECTS that vary in different countries, and the number of ECTS credits varies from 1 to more than 100 (European Commission, 2021). One micro-credential, designed to enhance specific skills or competencies, is designated for a comprehensive training program spanning 25 hours, ensuring focused and efficient learning outcomes tailored to meet learners' needs (Cedefop, 2023; European Commission, 2020). In Croatia 1 ECTS credit is 30 hours of individual activities (lectures, seminars, practical work, individual study, projects etc.).

Level and cycle of the learning experience leading to the micro-credential

The level and cycle of a micro-credential refer to the complexity and depth of learning, often aligned with frameworks such as the European Qualifications Framework (EQF), Qualifications Framework (QF), and the European Higher Education Area (EHEA). These frameworks provide a reference point for comparing qualifications across different education systems in different countries. Also, aligning

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with these frameworks helps learners and employers understand micro-credentials complexity and their educational context, facilitating recognition and transferability across borders.

Micro-credentials are not offered as a replacement for full qualifications but as addons or supplementary credentials/qualifications that complement existing competencies with updated ones. In addition, a micro-credential may not be part of a qualification and does not necessarily lead to one. Still, it aligns with a set of learning outcomes covered by a full qualification, such as training units of short duration.

Type of assessment

When assessing micro-credentials, the goal is to ensure that learners have achieved the necessary competencies in the intended area of study. Various types of assessment can be used for micro-credentials, depending on course quality, each serving different purposes based on the learning outcomes and skills being measured. Most assessments are conducted by the organisation awarding the micro-credentials; however, it is not uncommon for independent assessors to be involved.

Common forms of assessment include quizzes and short tests, which are administered throughout the course to evaluate real-time understanding and provide immediate feedback to learners. Practical activities allow learners to apply new knowledge in controlled environments, helping them monitor their own progress. Peer reviews, where participants assess each other's work, promote collaborative learning and reflective practice. Summative assessments, such as final exams, measure learners' overall mastery at the conclusion of the programme. Similarly, projects and portfolios offer a comprehensive synthesis of the knowledge and skills developed during the course.

Competency-based assessments often require learners to demonstrate specific skills or complete tasks in simulated or real-world environments by the end of the micro-credential programme. Practical assessments, including hands-on activities such as lab work or simulations, test learners' ability to perform job-related tasks. Self-assessments and reflections can also be valuable, as learners critically evaluate their own progress and understanding.

Other notable assessment methods include peer and collaborative evaluations, where learners complete group projects and their contributions are assessed by both peers and instructors according to established criteria. Digital assessments and badging are increasingly popular, particularly for remote learning, allowing assessments to be conducted online. Digital badges are verifiable credentials that can be displayed on digital platforms and social networks, indicating the successful completion of a micro-credential.

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Form of participation in the learning activity

Participation in learning activities for a micro-credential can take various forms, reflecting the flexibility and accessibility of these programmes. Common forms of participation in micro-credential learning activities across Europe include online learning, blended (hybrid) learning, in-person learning, workplace-based learning, peer-to-peer learning and collaboration, competency-based participation, interactive and gamified learning, assessment- and feedback-oriented participation, recognition of prior learning (RPL), and open learning.

Type of quality assurance used to underpin the micro-credential

The Quality Assurance (QA) process is essential for ensuring the integrity and value of micro-credentials, which are concise, targeted certifications. This process involves rigorous assessment to confirm that these micro-credentials meet high educational and professional standards, maintaining their credibility and achieving broad acceptance. A key aspect of QA is the accreditation of micro-credentials by academic institutions or professional bodies, aligning these credentials with recognised standards. Additionally, integrating micro-credentials into national and international qualification frameworks, such as the European Qualifications Framework (EQF) and the European Credit Transfer and Accumulation System (ECTS), is necessary to meet established educational benchmarks.

Endorsements from industry and employers are also crucial in confirming that the skills provided by micro-credentials are relevant to current market needs. Quality assurance processes include external validation, such as peer reviews and independent national or international quality agency evaluations. Providers often use learner feedback, continuous improvement cycles, and digital credentialing standards (such as verifiable digital badges) to maintain and improve the quality of their programmes. These mechanisms ensure that micro-credentials are transparent, transferable, and valuable to learners, employers, and educational institutions.

METHODOLOGY FOR DEVELOPING CURRICULA FOR COURSES

According to the TCLF Skills Alliance (https://pact-for-skills.ec.europa.eu/about/industrial-ecosystems-and-partnerships/textiles_en), the TCLF sector – comprising textiles, clothing, leather and footwear – is

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part of complex and interlinked value chains in fashion, high-end industries and relevant innovative technologies. However, despite innovation and creativity, the TCLF industry faces increasing skills gaps and shortages, primarily due to its ageing workforce, a mismatch between education and industry needs, technological change, and low levels of worker mobility. In addition, the sector suffers from an image problem, making it difficult to attract recruits, especially younger workers, and creating significant skills gaps along the entire supply value chain.

Key trends and challenges in the TCLF sector include digital skills, green skills, and an ageing workforce.

Digital Skills

Historically, the TCLF industries have been leaders in industrial revolutions and innovation. However, in the context of today's fourth industrial revolution and rapid technological transformation, they must continually adapt by digitalising their supply chains and adopting additive manufacturing, the Internet of Things, augmented reality, e-commerce solutions, and more. The COVID-19 pandemic and the temporary closure of shops made e-commerce solutions and marketing essential. According to Eurostat, 64% of online shoppers in the EU purchased clothes, shoes, or accessories online in 2020. Enterprises have the opportunity to operate online business-to-customer (B2C) models but may lack the necessary skills to adapt their business strategies and engage consumers. As a result, the demand for digital skills and solutions exceeds the current supply. Older and more experienced TCLF employees often struggle to adapt and acquire new skills, while the digitally-savvy generation entering the job market is less interested in manufacturing roles.

Green Skills

According to a survey of 225 European TCLF enterprises conducted in October 2018, environmental drivers of change – such as customers' perceptions of sustainability, supply chain transparency, the circular economy, and increased costs of energy and raw materials due to climate change – are the most important factors influencing employment and production processes. These factors remain relevant today. Such changes have a significant impact on enterprises' occupational needs and the types of skills required, for example, those related to sustainable production processes and products (eco-design), or to the analysis of environmental impact within the context of current standards and legislation.

Ageing Workforce

The TCLF industries are also facing the challenge of an ageing workforce. According to 2020 data, 36% of

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the workforce is over the age of 50, while young workers up to the age of 25 represent only 4% of all employees.

For these reasons, the project partners decided to develop one modular curriculum composed of two independent but complementary modules: one focused on improving digital skills and the other focused on green skills, eco-design and waste management.

To specify the needs and requirements of the business, we created a questionnaire, which we conducted among Croatian and Portuguese companies. Based on the analysis of the results, we developed a curriculum that meets the current and future demands and needs of the footwear and leather industry (Appendix 1).

A template for the curriculum was developed to collect the elements described in the chapter "Definitions of Micro-credential and Its Standard Elements," as agreed by the partners. The template includes the following elements (Appendix 2):

- Aim / Purpose and short description of the course
- Target group of participants / users
- Prerequisites for users to start the course
- Level Croatian Qualifications Framework (HKO) / European Qualifications Framework (EQF)
- Learning outcomes
- Competences
- Syllabus (content distribute by chapters)
- Material conditions required for acquiring learning outcomes
- Learning / teaching delivery formats
- Type of final assessment / evaluation
- Workload and individual study necessary. The microcredits were calculated based on the rule of 30 hours per 1 ECTS. The workload was distributed among Lectures, Exercises, Laboratory practice, Project work and Final assessment.

Based on the analysis of the questionnaire, the final result is the modular curriculum “Digital Skills and Waste Management in the Footwear Sector”, composed of two modules.

MODULE 1: Digital Skills for Footwear Design and Modelling (Appendix 3)

MODULE 2: Eco-Design and Waste Management in the Footwear Sector (Appendix 4)

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Appendix 1

SHOEPRO Survey: Questionnaire

„Integrated Action for Building VET Curricula and Training Opportunities in Croatia & Portugal for Digital and Green Transformation in the Footwear Sector - SHOEPRO“ is a project co-funded by the European Commission under the Erasmus+ program (code 2024-1-HR01-KA210-VET-000251356).

The main goal of the project is to develop an innovative and agile “ready to use” short-term curricula, enable to be customized to the different target-groups’ training needs to cover all the EQF levels encountered in footwear companies, envisaging the upskilling and reskilling of workers and youngsters in footwear, complying with companies’ needs, toward the green and digital transformation in footwear sector.

In order to specify the needs and requirements of the business, we elaborated a questionnaire and kindly ask you to participate in the survey we conduct among the Croatian and Portuguese companies.

The analysis of the results obtained will help us to build a training program /course responding to the current and future qualification requirements in order to unlock the potentials of the shoe / leather industry.

For more information about SHOEPRO you can visit the project website https://shoepro.eu/?lang=en

Thanks in advance for your contribution!

Disclaimer

The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

1. Country (Croatia, Portugal, other, please specify)
   _____
2. Your position in the company
   - Owner
   - General Manager
   - Human Resources Specialist
   - Administration/Management
   - Production Manager
   - Marketing Manager

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- Sales manager
- Other: _____

3. How would you classify your company according to the number of its employees?
   - Micro (from 1 to 9 employees)
   - Small (form 10 to 49 employees)
   - Medium (from 50 to 249 employees)
   - Large (more than 250 employees)
4. If you want please provide your company name
   _____
5. What product range does your company produce?
   - Leather
   - Men's shoes
   - Women's shoes
   - Children's shoes
   - Sneaker
   - Soles
   - Components for cars
   - Seats for car
   - Other: _____
6. Does your company have an ESG department?
   - Yes
   - No
   - We are in the process to create it
   - No, but we need it
   - No and we don't need it
7. Does your company have a department dedicated to research & innovation?
   - Yes
   - No
   - We are in the process to create it
   - No, but we need it
   - No and we don't need it
8. Does your company develop products under its own brand or does it mainly produce for other brands (private label)?
   - We develop and produce under our own brand.
   - We mainly produce for other brands (private label).
   - We combine production under our own brand and for other brands.
   - Other (please specify)_____
9. Are development and innovation based on the principles of green chemistry and the selection of ecologically and economically more favourable production processes?
   - Yes
   - Partially
   - No

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10. What materials do you use most often in production? (Check all that apply to your company)
- Leather
- Textiles
- Nonwovens
- Biomaterials
- Synthetic materials (e.g. polyurethane, PVC)
- Rubber
- Plastics
- Recycled materials (please specify):
- Other (please specify): _____

11. Are the materials you use sustainable?
- Yes
- Partially
- No

If you have answered to use recycled materials, please specify which ones.

12. Is the entire life cycle assessment of the product monitored during production?
- Yes
- Partially
- No

13. Are your products accompanied by digital passports?
- Yes
- No

14. During the last 5 years, has your company adopted / developed one or more of the following typologies of innovations?
- Material Innovation
- Technological innovation
- New machines/equipment
- Process innovation
- Product innovation
- New ICT solutions (marketing, design, logistic, supply chain)
- Adoption of Circular Economy principles/solutions
- Other:_____

15. Did you in last 5 years:
- introduced new materials into production (e.g. biomaterials, recycled materials)
- implemented new technologies in production process (e.g. 3D printing, automation)
- introduced new ICT solutions (e.g. for marketing, design, logistics, supply chain)

16. Is your company implementing sustainable production circular model (closing a loop) in accordance with your production type?
- Yes
- No

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17. If applied, please specify in which production processes has your company implemented sustainable production principles
    - Eco-design
    - BAT technique
    - Chemicals
    - Quality of raw material
    - Transport
    - Energy
    - Waste disposal
    - Other: _____
18. What challenges do you face in implementing sustainable production?
    _____
19. In your opinion, which ones of the following drivers of changes have major impacts on your company business model?
    - Norms and rules
    - Environmental changes
    - Economy and globalization
    - Technological changes
    - Demographic changes
    - Values and identities
    - New consumer patterns
    - Other: _____
20. What are the biggest obstacles to digital and green transformation in your industry?
    - Lack of necessary digital skills
    - Insufficient use of innovative technologies
    - Need to adapt to sustainable production
    - Complexity of processes
    - Other:_____
21. Which of the following cutting technologies is your company equipped with
    - Semi-automated mechanical equipment for cutting
    - Automatic cutting system
    - Plotter digitizer
    - Other: _____
22. For which kind of processes, automatic industrial sewing machines are used in your company
    - For small details
    - For long seams
    - for sewing uppers,
    - linings,
    - decorative seams,
    - Other (specify): _____
23. Does your company use CAD systems in production process?
    - Yes

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- No

If you don't use CAD systems, what are the reasons for that? _____

24. For what purposes do you use CAD systems?
- design
- modelling
- pattern production
- pattern adaptation
- creation of technical documentation
- other: _____

25. Which functions of the CAD system do you use most frequently?
- 2D drawing
- 3D modelling
- creation of technical documentation
- visualisation
- Other: _____

26. What kind of computer-aided techniques are implemented in your company?
- CAD (Computer-Aided Design)
- CAE (Computer-Aided Engineering)
- CAM (Computer-Aided Manufacturing)
- CAPP (Computer-Aided Process Planning)
- CAQ (Computer-Aided Quality Assurance)
- PPC (Production Planning and Control)
- ERP (Enterprise Resource Planning)
- PLM (Product Lifecycle Management)
- no computer-aided techniques
- Other: _____

27. Is the dedicated staff regularly trained on using CAD/CAM software by the company owner of the software/machines used in your company?
- Yes
- No

28. Can you provide your opinion about how your company production process can be turned more digital and more digitally manageable?

_____

29. Which parts of your production process do you consider the most important for digitalization?

_____

30. What of the following challenges do you face in the digitalization of the production process?
- Design and modelling
- Prototyping
- Production planning

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- Creation of technical documentation
- Production monitoring
- Quality control
- Distribution
- Other: _____

31. What is your opinion about 2D/3D visualization of your newly programmed models/patterns?

- Very useful
- Useless at all
- Partially helpful

32. Does 2D/3D visualization contribute to the efficiency of the product development process?

- Yes
- No

33. What kind of skills has your company management staff?

- Scheduling and planning of workflow
- Developing policies and procedures
- Solving problems
- Staying abreast of trends in the field
- Collaborating with other staff and departments
- Organization and efficiency
- Strong understanding of the industry
- Other: _____

34. What skills should pattern makers have in your company?

- To fully develop the shoes
- Just to grade the details
- Only to control and make small pattern changes
- For making pattern design
- For preparing cutting process
- For automatic cutting process
- Other:_____

35. Can you identify specific topics according which your pattern makers need to be trained for?

- Pattern making of shoes
- Grading details
- Making pattern design
- Automatic cutting process
- Other: _____

36. What kind of skills has your company technical staff?

- To drive our production lines
- To drive our production lines and to develop new products on request
- To manage our production lines and to improve it
- Barely can handle our production lines
- Other: _____

37. What kind of skills does your company technical staff need to improve in your opinion?

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- Machine maintenance
- Machine programming
- Ability to manage and optimize production processes
- Ability to use newest CAD/CAM software
- Ability to effectively operate with the machines and to use all their latest features
- Other: _____

38. Specify which kind of training the employees need most in order to improve their skills in innovative or conventional shoe production and technologies.

_____

39. In which specific areas do they need additional training?

_____

40. What type of training is most effective for your employees?

_____

41. In your opinion, which ones of the topic should be the content of the curricula?

- digital skills and uses of software for shoe design / pattern making / shoe construction / grading
- digital skills and uses of software for cutting leather and other materials
- digital skills and uses of software for 3D printing
- knowledge for disposal of waste in production processes
- knowledge for disposal of waste after used of leather / shoe / accessories made from leather
- sustainable shoe design / production / use and circular economy
- other _____

42. This project will develop several courses. Would you like to be involved in the assessment and promotion of them?

- Yes
- No

43. If your answer to the above question is "yes" , please, leave your e-mail address here:

_____

44. Comments / Observations / Proposals:

_____

45. I give my consent to process my personal data for the survey purposes

- Yes
- No

Thank for your support - SHOEPRO Team!

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SHOEPRO Survey: Results

GENERAL INFORMATION

The first graph illustrates the product range of the 29 companies that participated in this survey: 18 from Croatia and 11 from Portugal. Most responses were from companies producing men's shoes (8 from Croatia, 5 from Portugal), women's shoes (8 from Croatia, 7 from Portugal), and sneakers (7 from Croatia, 6 from Portugal) (Figure 1 and 2).

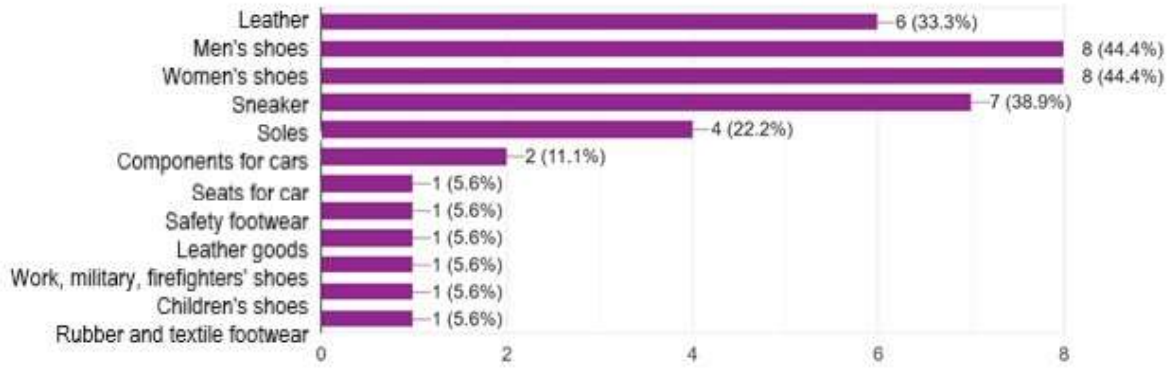

Figure 1: *Product range of Croatian companies*

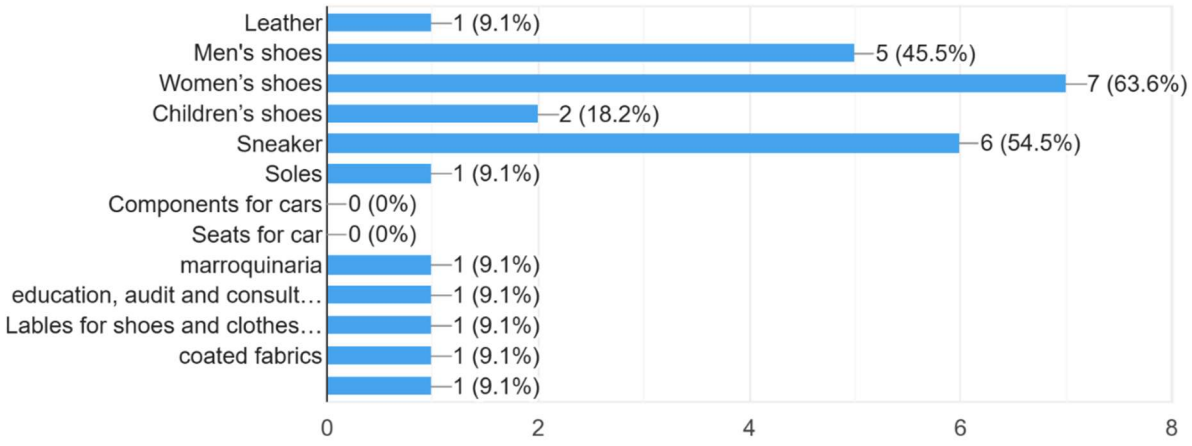

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Figure 2: *Product range of Portuguese companies*

For the question, *"Does your company have an ESG department?"* a pie chart was created (Figure 3). Three different responses were given: yes, in the process of creating it, and no. 72.2% of participants from Croatia gave a negative response, while 45.5% of those from Portugal stated they were in the process of creating one.

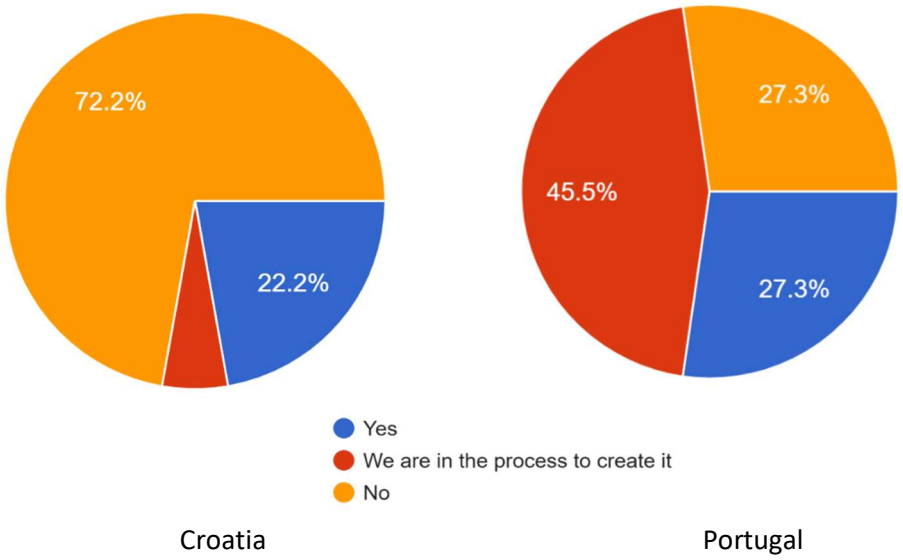

Figure 3: *Pie chart for the question "Does your company have an ESG department?"*

Additionally, for the question, *"Do you have a department dedicated to research and innovation?"* another pie chart was created. In Croatia, the situation is clear: 83.3% of participants have this department, while in Portugal only 36.4% do. However, 27.3% are in the process of creating one (Figure 4).

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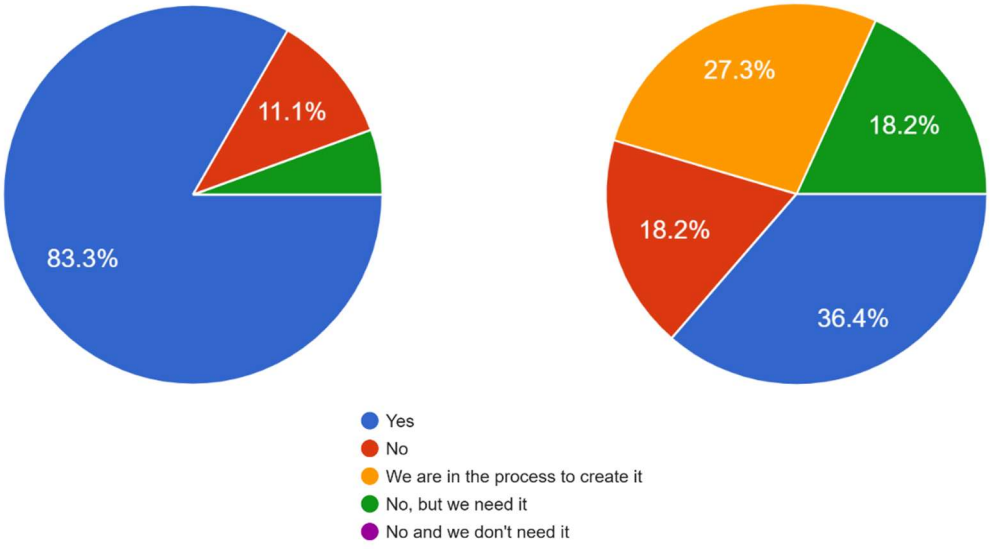
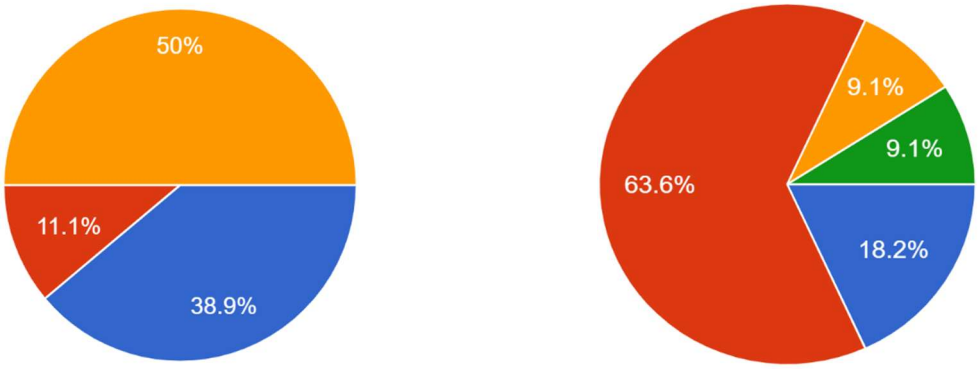


Figure 4: *Pie chart for the question "Do you have a department dedicated to research and innovation?"*

In Croatia, half of the companies that participated in the survey combine production under their own brand and for other brands, and partially base their production on the principles of green chemistry and ecologically and economically more favourable processes. Meanwhile, in Portugal, most companies (63.6%) produce for other brands (private label) and also partially base their production on the aforementioned principles (Figure 5).



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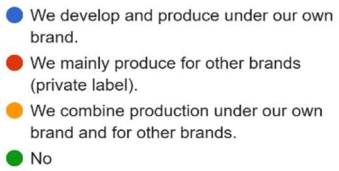


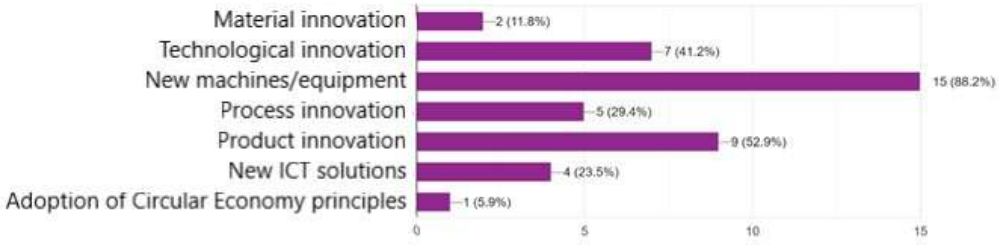
Croatia Portugal

Figure 5: *Pie chart for the question "Does your company develop products under its own brand or does it mainly produce for other brands (private label)?"*

SUSTAINABILITY

The majority of companies from both countries use leather and textiles in their production. Most of them monitor or partially monitor the entire life cycle assessment of their products, and their products do not have a digital passport.

The survey included a bar chart based on the following question: *"During the last 5 years, has your company adopted or developed one or more of the following types of innovation?"* Five possible answers were given: material innovation, technological innovation, process innovation, product innovation, machine/equipment ICD solutions, circular economy adoption, or none. The majority of companies have developed or adopted innovations in the machines/equipment field, while the smallest number have included material innovations in production (Figure 6). However, they have introduced new materials in production (e.g. biomaterials, recycled materials), implemented new technologies in the production process (e.g. 3D printing, automation), and introduced new ICT solutions for marketing, design, etc. (Figure 7).



Croatia

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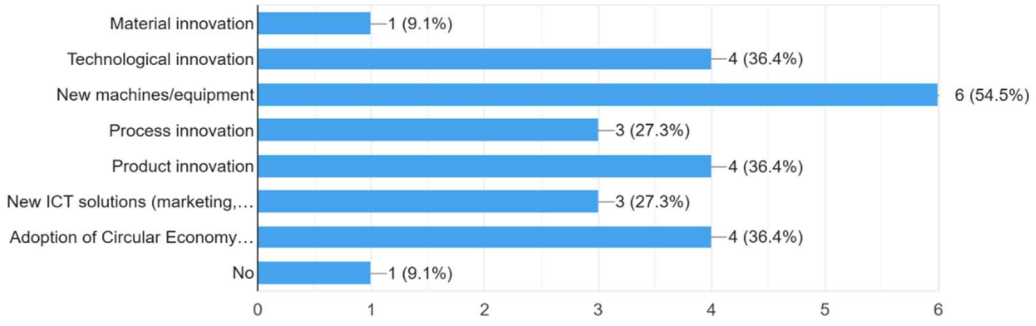
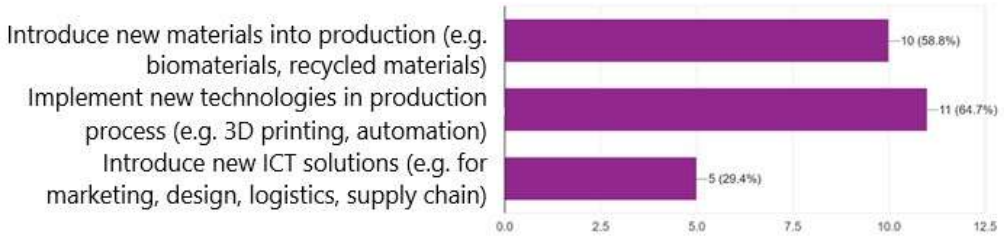
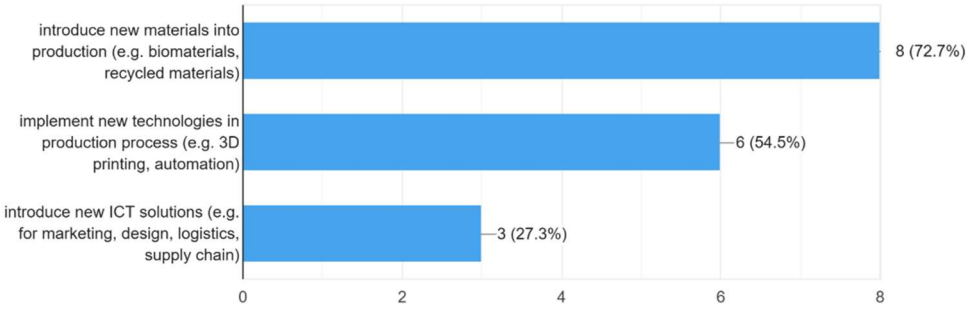


Portugal

Figure 6: *Bar chart for the question "During the last 5 years, has your company adopted or developed one or more of the following types of innovation?"*



Croatia



Portugal

Figure 7: *Bar chart for the question "Did you in last 5 years: introduced new materials, implemented new technologies and introduced new ICT solutions? "*

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Most companies have not implemented a sustainable production circular model (closing the loop) (Figure 8). However, those that have applied such models have done so in areas such as chemicals, raw material quality, and waste disposal.

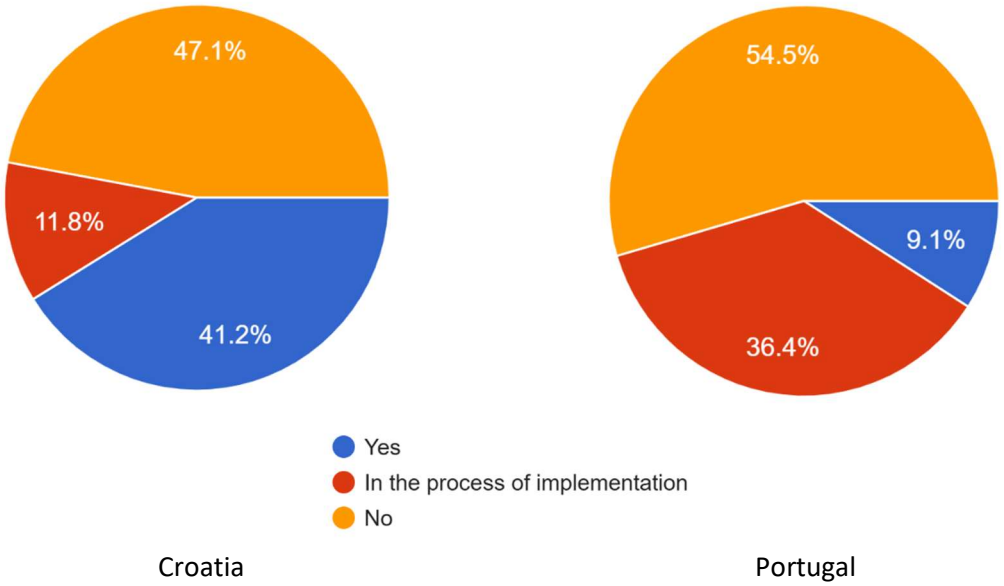
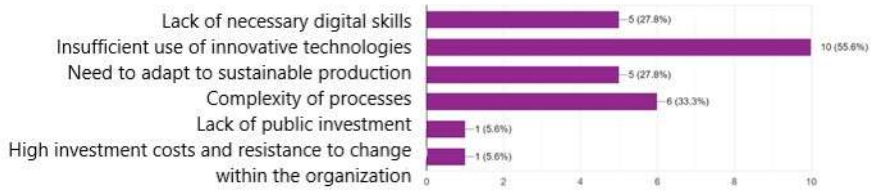


Figure 8: *Pie chart for the question "Is your company implementing sustainable production circular model (closing a loop) in accordance with your production type? "*

The bar chart was created to show the obstacles to digital and green transformation in the industry where participants work. Ten responses from Croatia and five from Portugal cited the need to adapt to sustainable production; six from Croatia and five from Portugal cited the complexity of the process; five from Croatia and two from Portugal cited a lack of necessary digital skills; and ten from Croatia and two from Portugal cited insufficient use of innovative technologies (Figure 9).



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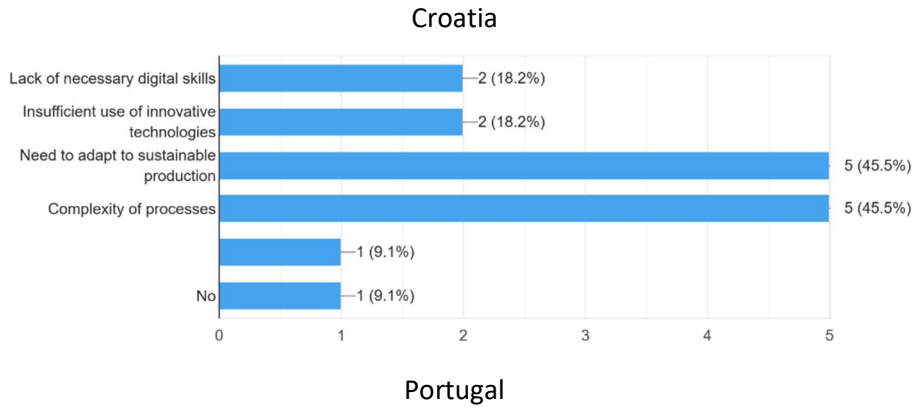

Figure 9: *Bar chart for the question "What are the biggest obstacles to digital and green transformation in your industry?"*

PRODUCTION PROCESS

93.8% of companies in Croatia and 81.8% of companies in Portugal use CAD systems in the production process (Figure 10). In both countries, CAD systems are mainly used for modelling and pattern production (Figure 11). Moreover, Croatian companies use CAD systems more for the creation of technical documentation than Portuguese companies. Nevertheless, Portuguese companies have a higher number of responses in the design field than Croatian companies. According to the survey, 2D drawing functions are most frequently used.

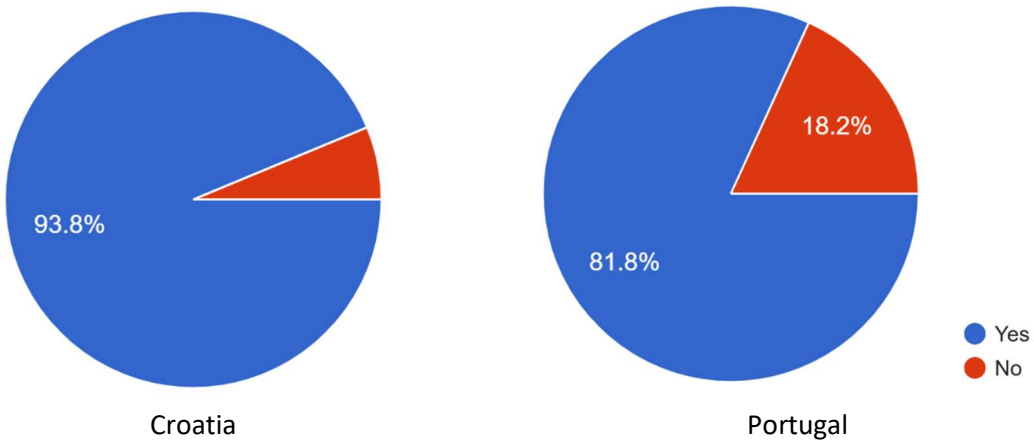

Figure 10: *Pie chart for the question "Does your company use CAD systems in production process?"*

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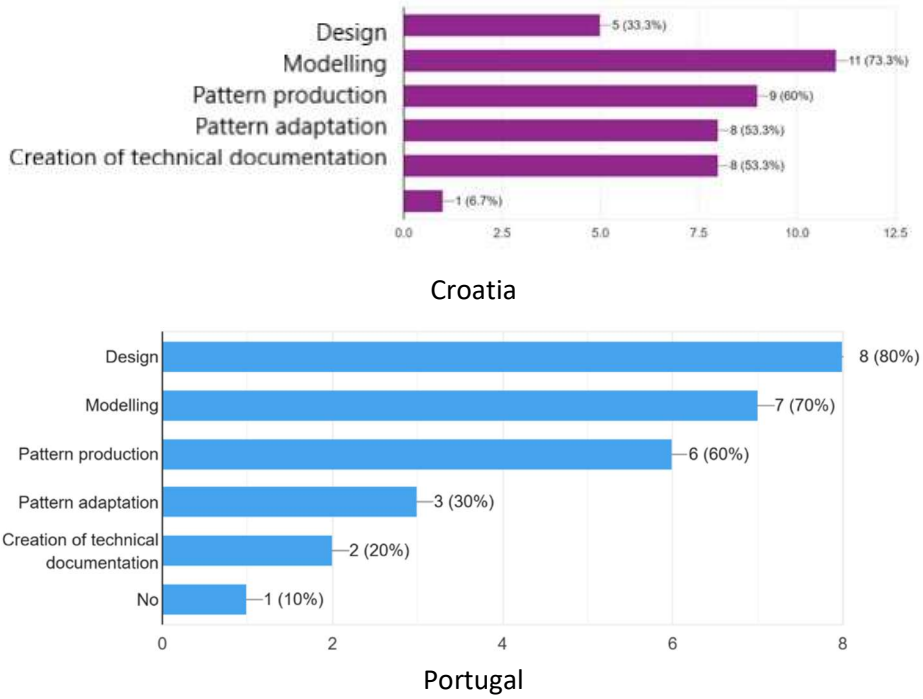

Figure 11: *Bar chart for the question "For what purposes do you use CAD systems? "*

Furthermore, participants were asked to respond to the question, *"What kind of computer-aided techniques are implemented in your company?"* Eight different CAD techniques were proposed: CAD, CAE, CAM, CAPP, CAQ, PPC, ERP, PLM, and no computer-aided techniques. Most participants in Croatia and Portugal use CAD, CAM, and ERP techniques, while none use CAQ or PLM techniques (Figure 12). According to created bar chart, the most important processes for digitalisation are design and modelling, as well as prototyping. Nevertheless, participants do not ignore the importance of digitalising other production processes, such as production planning, creation of technical documentation, production monitoring, quality control, and distribution (Figure 13). Educated human resources and financial support for digitalisation are the main challenges that companies face in the digitalisation of the production process.

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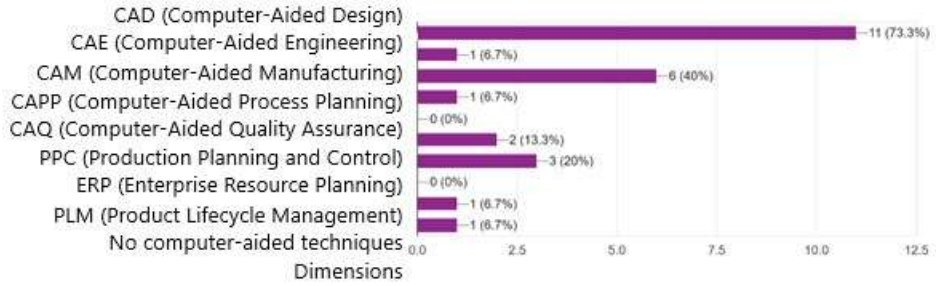
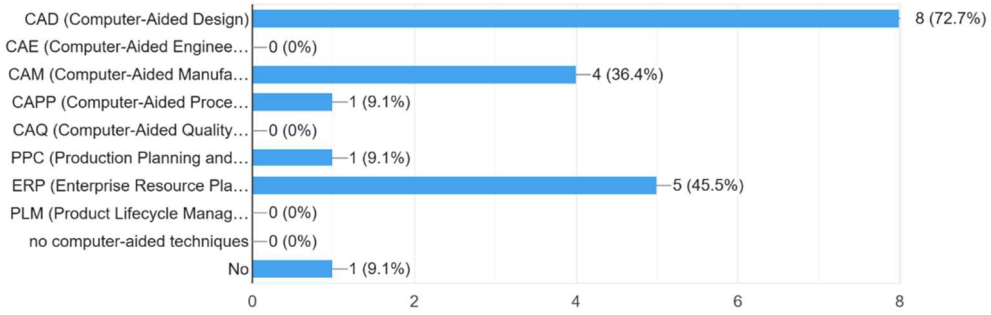
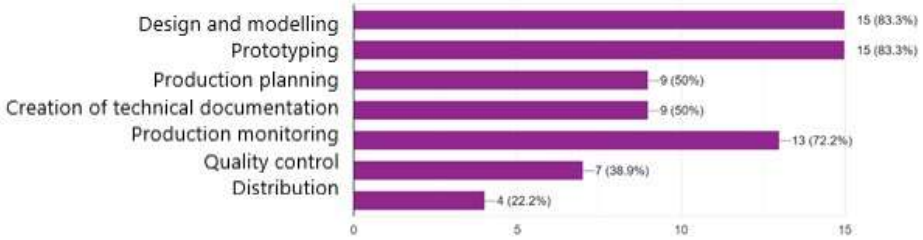


Croatia



Portugal

Figure 12: *Bar chart for the question "What kind of computer-aided techniques are implemented in your company? "*



Croatia

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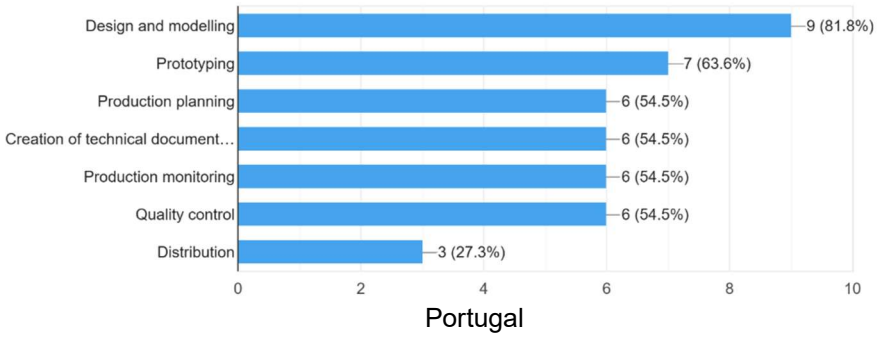

Figure 13: *Bar chart for the question "Which parts of following production process do you consider the most important for digitalization? "*

SKILLS

Survey participants believe that technical staff primarily need to improve their ability to manage and optimise production processes. Nevertheless, machine maintenance, machine programming, the ability to use the latest CAD/CAM software, and effective machine operation are also important skills to develop, according to the survey responses (Figure 14).

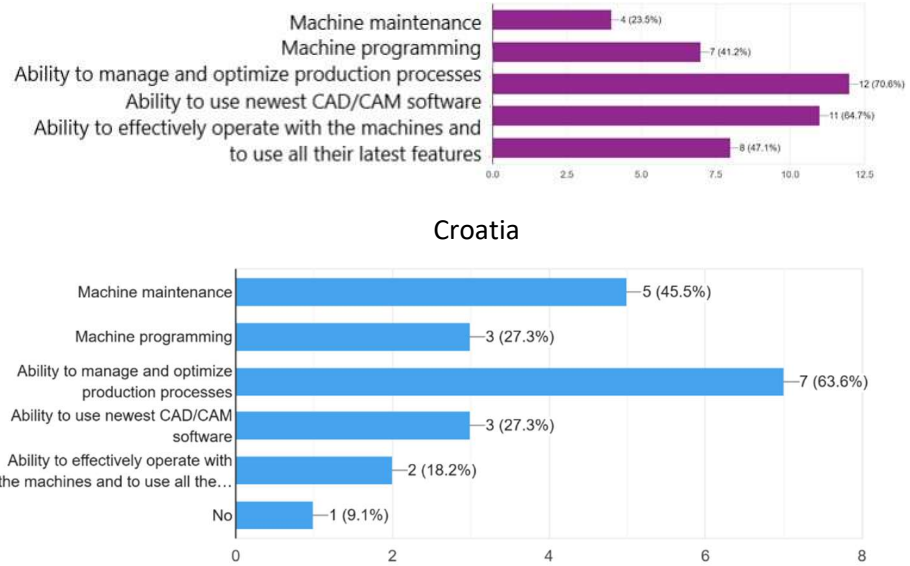

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Figure 14: *Bar chart for the question "What kind of skills does your company technical staff need to improve in your opinion? "*

Croatian companies have specified that employees require the most training in the following areas: digitalisation and automation, existing methods of continuous improvement, effective machine operation, managerial skills, 3D techniques, and pattern making. In contrast, Portuguese companies are mainly focused on work quality, communication, and openness to new ideas.

Croatian companies need additional training in digitalisation and automation, product knowledge, production process optimisation, production planning, implementation of new technologies, and reduction of material consumption. Portuguese companies indicated that training in innovation and 3D design is required. All participants consider training to be very important for their employees.

FINAL

Croatian participants in the survey believe that almost all the topics covered should be included in the curricula:

- digital skills and use of software for shoe design, pattern making, shoe construction, and grading
- digital skills and use of software for cutting leather and other materials
- knowledge about waste disposal in production processes
- knowledge about waste disposal after the use of leather, shoes, or accessories made from leather
- sustainable shoe design, production, use, and the circular economy.

In Portugal, digital skills and use of software for shoe design, pattern making, shoe construction, and grading, as well as sustainable shoe design, production, use, and the circular economy, are the topics highlighted in the responses.

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Appendix 2

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HUP
CROATIAN EMPLOYERS' ASSOCIATION

UNIVERSITY OF ZAGREB
FACULTY OF TEXTILE TECHNOLOGY

CENTRO TECNOLÓGICO DO CALÇADO DE PORTUGAL

SHOEPRO

Title of the Curricula:

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Aim / Purpose and short description of the course	Text (up to 500 words)
Target group of participants / users	Text (up to 100 words)
Prerequisites for users to start the course	Text (up to 200 words)
Level Croatian Qualifications Framework (HKO) / European Qualifications Framework (EQF)	Level 5, 6 or 7.1 (choose level)
Learning outcomes	**Learning outcomes:** List of specific learning outcomes (max 8)
Competences	**Competences:** List of competences (max 10)
Syllabus	(Topics – – limit between min 5- max 10 chapters, each chapter having

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	2-4 sub-chapters maximum)
Material conditions required for acquiring learning outcomes	
Learning / teaching delivery formats	
Type of final assessment / evaluation	

Workload	**Lectures**	**Seminars**	**Exercises**	**Laboratory practice**	**Final assessments**	**Total**
Teaching hours						
Individual work						
Number of Credits = Total hours						

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UNIVERSITY OF ZAGREB FACULTY OF TEXTILE TECHNOLOGY

CENTRO TECNOLÓGICO DO CALÇADO DE PORTUGAL

SHOEPRO

Title of the Curriculum:

Digital skills and waste management in the footwear sector

MODULE 1: Digital skills for footwear design and modelling

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Aim / Purpose and short description of the course	The curriculum aims to improve the digital skills of students and employees in the footwear industry by acquiring knowledge in 2D and 3D footwear design and 3D printing. The programme enables faster, more accurate and flexible development of footwear models and promotes the digital transformation of traditional footwear model/pattern design and development processes. This creates the conditions for innovation and modernisation. The curriculum includes theoretical and practical knowledge in digital footwear design with a focus on the application of 2D and 3D footwear modelling systems. Students are trained in the use of digital tools to create and customise shoe models in a virtual environment, model patterns in 3D software, prepare files for 3D printing and use 3D printers to create prototypes. The programme is designed to allow students to apply the acquired knowledge in real working conditions, with a focus on practicality, efficiency and sustainability. Through active participation, students develop the technical and creative competences required for modern footwear development based on digital technologies.
Target group of participants / users	- Experts, students and teachers from the fields of design, fashion industry and footwear production. - Technicians/modellers/engineers and designers who want to expand their skills in 2D/3D design and modelling. - Innovative entrepreneurs and professionals involved in the application of modern and sustainable methods in footwear production. - Individuals with basic design skills who wish to develop additional competences in the field of 3D design and printing for application in production processes.
Prerequisites for users to start the course	- Basic digital skills: working with files, using the operating system, the internet and familiarity with basic software (e.g. Microsoft Office, web browser) - Basic technical knowledge or experience in shoemaking.
Level Croatian Qualifications Framework (HKO) / European Qualifications Framework (EQF)	Level 5 or 6
Learning outcomes	- Apply of digital 2D/3D tool systems for the design and modelling of

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	footwear models - Apply of basic tools for the 3D modelling of footwear - Design/model the sole according to the shape - Create aesthetic and structural elements of the upper - Apply textures, materials and colours for a realistic representation of the model - Develop the model for presentation/virtual catalogue - Apply basic tools for 2D modelling (construction of lines and shapes, marking of functional elements for production) - Explain the principles of additive technologies, prepare CAD models for 3D printing and select appropriate 3D printing parameters
Competences	- Independent application of 2D and 3D CAD tools specialised in the design and modelling of footwear - Modelling of functional and aesthetic parts of shoes according to technical and design requirements - Creation and presentation of digital prototypes for the purpose of presentation or further development - Creating and editing pattern pieces in 2D CAD programmes - Defining parameters of lines and pattern pieces - Practical application of digital technologies for the development of shoes - from concept to prototype - Independent design of shoes according to aesthetic, functional and technical requirements. - Application of basic knowledge of additive manufacturing processes - Preparation of CAD models for 3D printing on a desktop 3D printer
Syllabus	1. Introduction to CAD tools for 3D footwear modelling 2. Basics of 3D modelling (interface, tools and basic operations in the program) 3. 3D modelling of basic footwear components 4. 3D design/modelling of shoe soles (creating soles according to the shape of lasts) 5. 3D design/modelling of shoe uppers (drawing on the surface of lasts)

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	6. Visualization of 3D models (textures, colours, materials) 7. Preparation and presentation of virtual shoe sample designs 8. Introduction to CAD tools for 2D footwear modelling 9. Basics of 2D modelling (interface, tools and basic operations in the program) 10. Line creation tool system 11. Production of cut parts 12. Basics of additive manufacturing (procedures, principles of 3D printing, 3D printers, materials, environmental aspects) 13. Preparation of CAD models for 3D printing 14. Basics of FDM desktop 3D Printer 15. 3D Printing Parameters (fill density, print speed, bed temperature and 3D printer nozzle)
Material conditions required for acquiring learning outcomes	Specialized lecture hall/classroom equipped with computers and digital programs/CAD systems for 2D/3D design for each student. 3D printing laboratory equipped with desktop 3D printers and available polymers for 3D printing.
Learning / teaching delivery formats	- Lectures - Demonstrations - Workshops and practical exercises - Project learning - Individual work and mentoring - Simulations - Presentations
Type of final assessment / evaluation	- Project-related: Final project for students in which they apply the knowledge gained in this course to solve assigned problems - Presentations and demonstrations: Students will prepare and give presentations to demonstrate their understanding of theoretical concepts and their ability to communicate innovative ideas - Lab/Practical reports

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Workload	Lectures	Exercises	Laboratory practice	Project work	Final assessments	Total
Teaching hours	25 h	15 h	10 h	5 h	4 h	59 h
Individual work	-	30 h	10 h	20 h	1 h	61 h
Number of Credits = Total hours						**4 ECTS = 120 h**

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UNIVERSITY OF ZAGREB
FACULTY OF TEXTILE TECHNOLOGY

CENTRO TECNOLÓGICO DO CALÇADO DE PORTUGAL

SHOEPRO

Title of the Curriculum:

Digital skills and waste management in the footwear sector

MODULE 2: Eco-Design and Waste Management in the Footwear Sector

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Aim / Purpose and short description of the course	The curriculum aims to equip participants, through lectures and laboratory exercises, with the skills necessary to apply sustainable and environmentally friendly solutions throughout the entire production process related to leather processing and the footwear industry. Participants will be trained to select more environmentally favourable materials during the production process and to evaluate opportunities for adapting specific production operations in accordance with the principles of economy and sustainability. Furthermore, they will be capable of managing waste materials following the cradle-to-cradle principles, which include selecting options for recycling, repurposing, and disposal, as well as assessing their environmental impact. The curriculum also incorporates the use of software tools for detailed development and monitoring of case studies, enabling a comprehensive understanding of the methodology, processes, and techniques/technologies critical for effective life cycle analysis (LCA). This will contribute to the development and application of participants' own LCA projects. Graduates will gain competencies in evaluating and optimizing existing production processes guided by the principles of sustainable development and the circular economy.
Target group of participants / users	➢ Specialists, technicians, and production managers in the leather and footwear industry, as well as footwear designers ➢ Educators in the field of leather and footwear ➢ Innovative entrepreneurs focused on the application of environmentally friendly materials and sustainable technological processes and methods in leather processing and footwear manufacturing
Prerequisites for users to start the course	➢ Basic technical knowledge and experience in leather and footwear production ➢ Fundamental chemical knowledge and principles related to the application of various substances ➢ Basic computer skills (Microsoft Office, web browsers)
Level Croatian Qualifications Framework (HKO) / European Qualifications Framework (EQF)	Level 5 or 6

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Learning outcomes	➢ Select environmentally favourable agents in leather processing and footwear manufacturing procedures ➢ Propose the principles of circular economy in leather and footwear production ➢ Explain the environmental impact of products ➢ Select standardised methods and procedures for the evaluation of leather and footwear with regard to added properties ➢ Determine the conformity of production processes and product eco-design according to cradle-to-cradle principles ➢ Evaluate a part of the footwear life cycle (LCA) in accordance with one's own production ➢ Select methods for recycling, repurposing, reuse, and disposal of waste raw materials
Competences	➢ Independently select environmentally friendly agents based on technical datasheets and pictograms in leather processing and footwear manufacturing ➢ Independently apply methods and procedures for analysing leather and footwear ➢ Independently assess environmental impact based on conducted analyses ➢ Propose improvements to existing products aimed at optimizing their economic and environmental efficiency ➢ Determine the compliance of the selected product with sustainable development principles through the application of analytical procedures and professional criteria ➢ Apply expert knowledge of waste types and waste materials to select appropriate recycling and disposal methods ➢ Independently identify and evaluate methods for the reuse and repurposing of waste materials in accordance with circular economy principles
Syllabus	1. Introduction to sustainable design

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	2. Introduction to the circular economy 3. Ecological and economic principles in production 4. Green chemistry and the REACH regulation 5. LCA methodology: application of tools for detailed development and monitoring of case studies, enabling full understanding of the methodology, processes, and techniques/technologies essential for effective Life Cycle Assessment (LCA Tools: SimaPro, GaBi) 6. Testing mechanical properties of finished leather (Dynamometer, Color Fastness, Flexometer, KOOH Test) 7. Analysis of obtained test results (Dynamometer, Color Fastness, Flexometer, KOOH Test) 8. Environmental impact testing (Formaldehyde, TG-IR) 9. Analysis of results and environmental impact assessment 10. Testing leather flammability before and after finishing using a Limiting Oxygen Index (LOI) device 11. Testing leather heat resistance before and after finishing using thermogravimetric analysis (TGA) 12. Analysis of obtained LOI and TGA test results 13. Material classification based on physicochemical properties (FTIR-ATR) 14. Preparation and analysis of obtained spectral curves 15. Waste management in footwear production (waste classification, hazardous substance identification, waste reduction strategies)
Material conditions required for acquiring learning outcomes	➢ LCA Software (e.g., OpenLCA, SimaPro, GaBi...) ➢ Samples of footwear materials and waste ➢ Access to Legislative Databases (EUR-Lex, Official Gazette)
Learning / teaching delivery formats	➢ Lectures ➢ Demonstrations

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	➢ Workshops and practical exercises ➢ Project learning ➢ Individual work and mentoring ➢ Simulations ➢ Presentations
Type of final assessment / evaluation	➢ Project-related: Final project for students in which they apply the knowledge gained in this course to solve assigned problems ➢ Presentations and demonstrations: Students will prepare and give presentations to demonstrate their understanding of theoretical concepts and their ability to communicate innovative ideas ➢ Lab/Practical reports

Workload	**Lectures**	**Exercises**	**Laboratory practice**	**Project work**	**Final assessments**	**Total**
Teaching hours	25 h	10 h	35 h	5 h	4 h	79 h
Individual work	-	10 h	20 h	10 h	1 h	41 h
Number of Credits = Total hours						**4 ECTS = 120 h**

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