# Innovative Skills for an Old Vocation

## Results of the workshops (WS) in Germany on the influences of the sub-dimensions of the trends globalisation, digitalisation and sustainability on the spheres of activity in the sector

**WP 02 | A2**

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.



**Project data:**
Programme: Erasmus+
Project title: Innovative Skills for an Old Vocation
Acronym: ISOV
Project 2024-1-DE02-KA220-VET-000254492
Duration: 01.11.2024 - 31.10.2027
Website: https://isov-project.eu/

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# Content

# 1 Method

To determine the possible influences of the sub-dimensions of the trends globalisation, digitalisation and sustainability on the fields of activity in the industrial footwear sector, three workshops in Germany were held in spring 2025 with a total of ~30 experts. This product documents the results.

# 2 Sustainability

| Dimension | Green Awareness | | |
|---|---|---|---|
| **Subdimension** | Sustainability education & consumer empowerment | Industry partnerships | Eco-labelling for footwear & digital transparency |
| **Description** | Providing training for employees and consumers about sustainable practices in footwear manufacturing and use. Sustainability education ensures stakeholders understand the environmental impacts of their actions, fostering eco-conscious behaviour Ensuring that consumers have access to clear, accurate, and meaningful information about the environmental, social, and ethical aspects of footwear products. This subdimension aims to empower consumers to make informed purchasing decisions that align with their values and sustainability goals, namely sustainable consumption. | Collaborating with NGOs and green organisations to promote sustainable practices. Partnerships amplify the industry's efforts to raise awareness and enhance sustainability standards. | Clear and certified environmental labels for shoes. Certified eco-labels provide transparency, helping consumers easily identify sustainable options and discouraging deceptive greenwashing practices.<br>Blockchain technology ensures traceability and transparency, providing consumers with verifiable information about product origins and sustainability.<br>Apps showing product lifecycle impact. Interactive digital platforms provide detailed insights into a product's environmental footprint, enabling informed consumer choices. An example is Digital Product Passport (DPP), a digital identity card for products, components, and materials, which will store relevant information to support products' sustainability, promote their circularity and strengthen legal compliance. |
| **Cutting** | Less waste | | Integration |
| **Stitching** | Save machinery | | Integration |
| **Lasting** | Save machinery | | Integration |
| **Assembly** | Save machinery | | Integration |
| **Finish** | | | Integration |
| **Design** | Understanding consumers interests, document activities | | Integration |
| **Production Planning** | Understanding, follow green plant labels, staying updated with the laws, enable blue collar workers | | Might require separate production lines, separate storing to avoid contamination |
| **Technical Development** | Deep understanding; respecting regulations | | Integration, preparation for recycling |
| **Training Management** | Update curricula, prepare for further developments, single module for sustainability for all, independent of SoA, strongly depending on the country/relevance of production | | Include teaching about eco-labels and their use |
| **Maintenance Management** | | | |
| **Quality Management** | | | Integration of eco label requirements |
| **New Materials** | | | Development with respect to eco-labels |
| **Supply Chain Management** | Traceability | Awareness | |
| **Social Responsibility Management** | Include social compliance | | Including |
| **Sustainability Management** | Include this subdimension | Awareness | Including |
| **Environmental Management** | Include this subdimension | | Including |
| **STEM** | | | |
| **Health and Safety at Work Management** | Safety guards | | |

| Dimension | Energy and Process Efficiency | | |
|---|---|---|---|
| **Subdimension** | Green energy integration & smart energy systems | Efficient machinery & Lean manufacturing | Digital manufacturing & automation |
| **Description** | Green energy for factory operations. Incorporating renewable energy sources such as solar, wind, and others reduces carbon emissions and aligns with global climate objectives.<br>Real-time monitoring of energy use. Implementing intelligent energy systems ensures real-time optimisation, reducing waste and enhancing energy efficiency across manufacturing processes. | Upgrading equipment for energy-efficient production. Modernising production equipment minimises energy use, reduces costs, and enhances operational efficiency in high-volume manufacturing.<br>Minimising production waste in shoe assembly and packaging. Streamlining production processes reduces material waste, lowers costs, and improves efficiency while maintaining high-quality standards. | The integration of technologies into the production process to make plant operations more flexible, efficient and resilient in the face of changing market demands. For instance, technologies like 3D printing to create footwear enables precise material use and efficient prototyping.<br>Utilising digital twins and automation improves precision, reduces errors, and minimises waste in footwear manufacturing. |
| **Cutting** | Already included due to cost efficiency | Understanding, basically already included due to costs | See Digitalisation results |
| **Stitching** | Already included due to cost efficiency | Understanding, basically already included due to costs | See Digitalisation results |
| **Lasting** | Already included due to cost efficiency | Understanding, basically already included due to costs | See Digitalisation results |
| **Assembly** | Already included due to cost efficiency | Understanding, basically already included due to costs | See Digitalisation results |
| **Finish** | Already included due to cost efficiency | Understanding, basically already included due to costs | See Digitalisation results |
| **Design** | Other materials/ chemicals | | See Digitalisation results |
| **Production Planning** | Other materials/ chemicals, analyse transports | Reducing energy consumptions via new machinery, update planning accordingly | See Digitalisation results |
| **Technical Development** | | | See Digitalisation results |
| **Training Management** | | | See Digitalisation results |
| **Maintenance Management** | | | See Digitalisation results |
| **Quality Management** | | | See Digitalisation results |
| **New Materials** | | Biggest ecological footprint, reducing energy consumption via new materials | See Digitalisation results |
| **Supply Chain Management** | Energy for transport, determine own energy consumption in production, monitoring based on real data, not estimations | Reducing transport costs, f. e. efficient trucks | See Digitalisation results |
| **Social Responsibility Management** | | | See Digitalisation results |
| **Sustainability Management** | Energy for transport, determine own energy consumption in production, monitoring based on real data, not estimations | | See Digitalisation results |
| **Environmental Management** | Energy for transport, determine own energy consumption in production, monitoring based on real data, not estimations | | See Digitalisation results |
| **STEM** | | | See Digitalisation results |
| **Health and Safety at Work Management** | | | See Digitalisation results |

| Dimension | Resource Efficiency & Sustainable Materials | |
|---|---|---|
| Subdimension | Emission, water & electricity reduction | Sustainable, biodegradable & regional materials selection |
| Description | Implementing measures to decrease greenhouse gas (GHG) emissions throughout the product lifecycle. Examples include adopting low-emission transportation, using energy-efficient technologies, and offsetting carbon footprints through reforestation projects.<br>Streamlining supply chains to reduce carbon emissions. Optimising logistics for raw materials and finished products decreases transportation emissions, contributing to greener supply chains.<br>Strategies to reduce electricity usage, including implementing energy-efficient equipment, using automated systems, and adopting renewable energy solutions like solar and wind power.<br>Strategies to reduce electricity usage, including implementing energy-efficient equipment, using automated systems, and adopting renewable energy solutions like solar and wind power. | Utilising durable materials extends product lifespans, reduces consumption cycles, and conserves resources over time.<br>Using materials that naturally decompose without harming the environment. Examples include plant-based polymers and natural rubbers, which break down into non-toxic by products under natural conditions.<br>Sourcing materials locally to reduce transportation emissions and support regional economies. This approach often results in better traceability and lower environmental impact. |
| Cutting | Understanding, basically already included due to costs | |
| Stitching | | |
| Lasting | | |
| Assembly | | |
| Finish | | |
| Design | | |
| Production Planning | | |
| Technical Development | | |
| Training Management | Integrate the ecological footprint of different materials | |
| Maintenance Management | | |
| Quality Management | | |
| New Materials | | |
| Supply Chain Management | | |
| Social Responsibility Management | | |
| Sustainability Management | | |
| Environmental Management | | |
| STEM | | |
| Health and Safety at Work Management | | |

| Dimension | Sustainable Design & Circular Economy | | |
|---|---|---|---|
| **Subdimension** | Reusability, reparability, disassembly & recycling | Material consumption optimisation | Recycling programs and post-consumer material use |
| **Description** | Designing footwear with replaceable parts encourages repairs, reduces waste, and promotes sustainable consumer behaviour.<br>Designing shoes for easy disassembly facilitates full material recovery and reduces landfill waste. | Designing footwear to minimise material waste during cutting and assembly. Precision design techniques reduce waste, enhance material efficiency, and lower the environmental impact of production processes. | Initiatives for recycling old footwear. Collection and recycling programs enable closed-loop systems, transforming old shoes into raw materials for new products.<br>Incorporating consumer waste into new shoes. Repurposing post-consumer waste supports a circular economy by reducing reliance on virgin materials. |
| **Cutting** | | | |
| **Stitching** | Maybe use of other methods so product is repairable | | |
| **Lasting** | | | |
| **Assembly** | Maybe use of other methods so product is repairable | | |
| **Finish** | Other materials/adhesives for recyclability | | |
| **Design** | Design for recycling | Design with less material consumption | |
| **Production Planning** | | | |
| **Technical Development** | | Integration | |
| **Training Management** | | Life cycle assessment, strengths and weaknesses of different. Materials | Potential recycling methods, added value of different recycling methods |
| **Maintenance Management** | | | |
| **Quality Management** | | | |
| **New Materials** | Developing with respect to this sub-dimension | Developing with respect to this sub-dimension | |
| **Supply Chain Management** | Reverse logistics | | |
| **Social Responsibility Management** | | | |
| **Sustainability Management** | | | |
| **Environmental Management** | | | |
| **STEM** | | | |
| **Health and Safety at Work Management** | | | |

| Dimension | Chemical Safety | |
|---|---|---|
| Subdimension | Restricted substances compliance | Green chemistry innovations |
| Description | Meeting EU REACH regulations. Adhering to strict substance restrictions eliminates harmful chemicals, ensuring safety and regulatory compliance. | Biodegradable and eco-friendly chemical alternatives. Developing and using sustainable chemicals reduces environmental toxicity and enhances the eco-performance of footwear products. |
| Cutting | | |
| Stitching | | |
| Lasting | | |
| Assembly | New glues | New glues |
| Finish | | |
| Design | | |
| Production Planning | Respect regulations | Apply regulations |
| Technical Development | Respect regulations | Apply regulations |
| Training Management | | |
| Maintenance Management | | |
| Quality Management | Respect regulations | Apply regulations |
| New Materials | Respect regulations | Apply regulations |
| Supply Chain Management | Respect regulations | Apply regulations |
| Social Responsibility Management | | |
| Sustainability Management | | |
| Environmental Management | | |
| STEM | | |
| Health and Safety at Work Management | | |

| Dimension | Social Responsibility | | |
|---|---|---|---|
| Subdimension | Fair labour practices | Ethical sourcing | Community engagement & diversity, equity, and inclusion |
| Description | Promoting fair wages and ethical working conditions supports social sustainability and enhances the well-being of workers in global supply chains. | Ensuring raw materials are obtained responsibly, with respect for environmental and social standards. Ethical sourcing includes fair labour practices, biodiversity conservation, and avoiding exploitative suppliers. | Supporting local communities around manufacturing hubs. Investing in community programs fosters goodwill, strengthens business-community relations, and enhances social equity. Diversity, equality and inclusion in labour practices ensures fair opportunities and treatment across gender, age, and orientation in the footwear industry. It promotes diversity in leadership, equitable hiring practices, inclusive workplace policies, and product designs that cater to diverse consumer needs. |
| Cutting | | | |
| Stitching | | | |
| Lasting | | | |
| Assembly | | | |
| Finish | | | |
| Design | Including labour costs | | Respect + include |
| Production Planning | Respect for working time regulations etc. | | |
| Technical Development | Including labour costs | | Respect + include |
| Training Management | Clarification, integration of content for all employees | | |
| Maintenance Management | | | |
| Quality Management | | | Respect + include |
| New Materials | | | |
| Supply Chain Management | Respect for working time regulations etc. | | Respect + include |
| Social Responsibility Management | Respect for working time regulations etc. | | Respect + include |
| Sustainability Management | Respect for working time regulations etc. | | |
| Environmental Management | | | |
| STEM | | | |
| Health and Safety at Work Management | | | |

# 3 Globalisation

| Dimension | Demography | | |
|---|---|---|---|
| **Subdimension** | Birth rate and Population ageing | Mutations in values and cultures | Demographic policies |
| **Description** | The increase in the world's population, the problem of the decline of the European population and the consequent demographic transition imply a more inclusive and flexible labour market, better adapted to the diversity of origins and qualifications of company employees. Aspects to consider also in the analysis of the sector, in the structuring of the training, in qualifications: the increase in life expectancy, the expansion of active life, the demands for better reconciliation between professional and personal life, the valorisation of professional careers and professionals in the final stages of professional exercise. | Emigration and immigration promote greater mobility of populations and changes in social and cultural values, which must be considered in the organization and development of companies, namely in adjusting their reception, training and job satisfaction standards. | Impact of demographic policies on the economic market and the labour market: More diverse and inclusive; Increased productivity through training and qualification; Improved quality of life; Better balance between professional and personal life; Equality of opportunities and gender; Opportunities for the older population; ... |
| **Cutting** | - | - | - |
| **Stitching** | - | - | - |
| **Lasting** | - | - | - |
| **Assembly** | - | - | - |
| **Finish** | - | - | - |
| **Design** | - | - | - |
| **Production Planning** | - | - | - |
| **Technical Development** | - | - | - |
| **Training management** | Apprentice shortage, advertising at schools necessary, show further training options, profession: combination of shoe technology and business people, competition with other industries | Corporate culture, empathy, career plan | (see above, birth rate) |
| **Maintenance Management** | - | - | - |
| **Quality Management** | - | - | - |
| **New Materials** | - | - | - |
| **Supply Chain Management** | - | - | - |
| **Social Responsibility Management** | - | Different corporate culture | - |
| **Sustainability Management** | - | - | - |
| **Environmental Management** | - | - | - |
| **STEM** | - | - | - |
| **Health and Safety at Work Management** | - | Safety awareness is culturally conditioned => integrate. | - |

| Dimension | Economic and Social Factors (part I) | | | |
|---|---|---|---|---|
| **Subdimension** | Migrations | Geopolitical conflicts | Communication and culture | Labour market changes (relocation of production, global competition...) and Innovation and competitiveness of organizations |
| **Description** | Demographic transition processes - changes in population standards and values. And consequently, in the commercial and labour markets, as well as, in the qualification of HR for the sector. | Changes in international relations. Competition, conflicts, increased competitiveness, changing markets, changing trade policies, disruption of supply chains, relocation of production, reduced consumption, ... | The globalization, culture and technological evolution is characterized by an enormous articulation of the face-to-face and the digital, which is why it increasingly implies greater fluidity in communication and ensuring the veracity and effectiveness of information. It requires ongoing improvement in digital literacy and accountability. | Changes in values and cultures - excellence, productivity and competitiveness. Changes in the labour market (relocation of production, global competition, technological innovation, sociocultural diversity, etc.). The Organizations must integrate innovation to remain competitive. The technological innovation is an imperative factor for the evolution of organizations. |
| **Cutting** | - | - | English | - |
| **Stitching** | - | - | English | - |
| **Lasting** | - | - | English | - |
| **Assembly** | - | - | English | - |
| **Finish** | - | - | English | - |
| **Design** | - | - | English | - |
| **Production Planning** | - | Materials from elsewhere if necessary | English | Relocation from China (too expensive), possibly to Cambodia, India, Bangladesh. |
| **Technical Development** | - | - | English | - |
| **Training Management** | Language, companies must make an effort | - | English | - |
| **Maintenance Management** | - | Interruptions possible | English | - |
| **Quality Management** | - | - | English | Relocation from China (too expensive), possibly to Cambodia, India, Bangladesh. |
| **New Materials** | - | - | English | - |
| **Supply Chain Management** | - | Interruptions, relocations | English | Relocation from China |
| **Social Responsibility Management** | Integrate other cultures | What happens to employees during relocations? | English | Relocation from China (too expensive), possibly to Cambodia, India, Bangladesh. |
| **Sustainability Management** | - | New supply chains, sustainability in the background | English | - |
| **Environmental Management** | - | - | English | - |
| **STEM** | - | - | English | - |
| **Health and Safety at Work Management** | Safety awareness is culturally conditioned => integrate. | Where can employees be sent safely? | English | Relocation from China (too expensive), possibly to Cambodia, India, Bangladesh. |

| Dimension | Economic and Social Factors (part II) | | | |
|---|---|---|---|---|
| **Subdimension** | Energy revolution | Consumption mutations | Economic evolution and international competitivity | International agreements |
| **Description** | Transformation in the way energy is produced, consumed and managed. Integration of renewable sources, investments in clean and sustainable technologies. It involves changes in products, production processes, logistics and consumption. | Economic and social changes - globalization of the economy (new political and economic models). It involves the adaptation of models, structures, products and processes in the commercial, industrial and training sectors. International evolution of footwear consumption with emerging markets. According to World Footwear, consumption is expected to grow significantly in Oceania (+25%), followed by Africa (+13.3%), Asia (+9.2%) and North America (+8.3%). More modest increases are projected for South America (+3.2%). Europe (+0.5%) is expected to stagnate. | Political and economic changes - globalization of the economy (new political and economic models). Elements to consider: Macroeconomic vision, impacts on global supply chains, diversity, competitiveness, sustainability.<br>How can Europe compete with Asia, with its technical capacity, productivity, cost advantages and access to raw materials and qualified and available labour? How can Europe compete with Africa as an emerging centre for footwear production? | International agreements (EU and other international trade agreements, agreements on international and national economic activities, ...). |
| **Cutting** | - | - | - | - |
| **Stitching** | - | - | - | - |
| **Lasting** | - | - | - | - |
| **Assembly** | - | - | - | - |
| **Finish** | - | - | - | - |
| **Design** | - | Change of cycles. | Conversions, e.g. Away from the Russian style. | - |
| **Production Planning** | Relocations if necessary, e.g. Due to the energy crisis in Moldova. | Change of cycles. | Conversions, e.g. Away from the Russian style. | - |
| **Technical Development** | - | - | - | - |
| **Training Management** | - | - | - | - |
| **Maintenance Management** | - | - | - | - |
| **Quality Management** | - | - | - | - |
| **New Materials** | - | New products | - | - |
| **Supply Chain Management** | Adaptation to new regulations. | | The hope that parts of production would be relocated back to Europe as a result of corona was misplaced. | Customs duties |
| **Social Responsibility Management** | - | - | - | - |
| **Sustainability Management** | Solar plants, wind turbines. Economic sustainability through diversification. | - | - | Pollutant management |
| **Environmental Management** | - | - | - | - |
| **STEM** | - | - | - | - |
| **Health and Safety at Work Management** | Crisis management | - | - | - |

| Dimension | Qualification / Training / Knowledge | | | |
|---|---|---|---|---|
| **Subdimension** | Educational systems | Qualifications' evolution and employability | Technological evolution | Ethical challenges and Integration of values |
| **Description** | Political, social and structural changes in educational systems. New dynamics and activities within a broader framework of values, objectives and needs. Values to promote: equity, quality, efficiency. Consider methodologies that promote self-training. Validation and certification of knowledge and skills. | Impact on all areas of work and also on training management - technology transfer and innovation. Integrate knowledge of the use of digital environments, collaborative learning, the development of soft skills, upskilling and reskilling actions. Reindustrialization of the cluster (from tradition to sustainable engineering): market study and consumer behaviour, design, materials, processes/industrialization (Kaizen, Lean methodologies, new technologies), competitiveness, digital marketing, purchasing and export logistics, product BI, end of life. The constant and rapid socioeconomics and technological changes require increasingly qualified, adaptable, entrepreneurial and autonomous people. Thus, training involves the development of dynamics in this register. | The technological evolution requires people to constantly develop skills, otherwise, it is a factor of social, cultural and professional exclusion - digital education. It requires ongoing improvement in digital literacy and accountability. Technological evolution must be considered in the models and resources applicable in education/training: Online training; Didactic and management applications; | Guarantee privacy and digital security rights; Permanent reinforcement of digital literacy; HR requalification; Responsible digital culture; Accountability in information and platform management; Equal access to technology (inclusion and equal opportunities); ethical standards and regulation of AI; Integrate the following values into training/qualifications: universality, quality, equity and inclusion. |
| **Cutting** | - | - | See digitalisation. | - |
| **Stitching** | - | - | See digitalisation. | - |
| **Lasting** | - | - | See digitalisation. | - |
| **Assembly** | - | - | See digitalisation. | - |
| **Finish** | - | - | See digitalisation. | - |
| **Design** | - | - | See digitalisation. | - |
| **Production Planning** | - | - | See digitalisation. | - |
| **Technical Development** | - | - | See digitalisation. | - |
| **Training Management** | - | Master craftsmen hardly in demand. Consideration of adding commercial content to industrial shoe manufacturers. Shoe manufacturers and technicians Stagnation at a low level. | See digitalisation. | - |
| **Maintenance Management** | - | - | See digitalisation. | - |
| **Quality Management** | - | - | See digitalisation. | - |
| **New Materials** | - | - | See digitalisation. | - |
| **Supply Chain Management** | - | - | See digitalisation. | Countries are becoming more nationalistic, less influence from companies. |
| **Social Responsibility Management** | - | - | See digitalisation. | Increased commitment against forced labour etc. |
| **Sustainability Management** | - | - | See digitalisation. | Increased commitment against forced labour etc. |
| **Environmental Management** | - | - | See digitalisation. | - |
| **STEM** | - | - | See digitalisation. | - |
| **Health and Safety at Work Management** | - | - | See digitalisation. | Increased commitment against forced labour etc. |

| Dimension | Markets and Consumers | | | |
|---|---|---|---|---|
| **Subdimension** | Technological evolution in commercial and industrial processes and New business models | Emergent markets in the value chain | Product diversification | Change in consumption standards |
| **Description** | The technological evolution has caused changes in the global economy, as well as in commercial and industrial processes. From digital marketing, commercial transactions, e-commerce, Artificial Intelligence, digitalization, automation and robotics, ... to changes in financial transactions.<br>New business models based on creating value through cost, differentiation, experience and through digital platforms - e-commerce. Strong focus on communication and digital marketing to internationalize more quickly, overcome competition and be globally competitive. | New markets, transfer of production activities; increasing internal fragmentation of production. | In the sector, the product diversification is essential due to changes in consumption patterns, short fashion cycles, ... Consider elements that foster diversity, creativity and innovation in HR qualifications and training. | Evolution of options: people buy less, buy better and buy in different ways. Consumers are prioritizing digital experiences and products over physical goods. Greater visibility of product information. Consider elements that promote sustainability, transparency, reuse, ... |
| **Cutting** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Stitching** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Lasting** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Assembly** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Finish** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Design** | See digitalisation. | See digitalisation. | Individualisation | See digitalisation. |
| **Production Planning** | See digitalisation. | See digitalisation. | Individualisation | See digitalisation. |
| **Technical Development** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Training Management** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Maintenance Management** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Quality Management** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **New Materials** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Supply Chain Management** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Social Responsibility Management** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Sustainability Management** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Environmental Management** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **STEM** | See digitalisation. | See digitalisation. | - | See digitalisation. |
| **Health and Safety at Work Management** | See digitalisation. | See digitalisation. | - | See digitalisation. |

| Dimension | Compliance | |
|---|---|---|
| Subdimension | Applicable regulations and legislation | Corporate Social Responsibility |
| Description | Policies, initiatives, instruments and measures for regulating people, organizations and products. Certification, audits, commercial and sustainable policies, ... human rights, labour rights, ... | Policies, initiatives, instruments and measures for the social responsibility of people, organizations and products. Certification, audits, commercial and sustainable policy, Quality, Environment, Safety, ... human rights, labour rights, ... |
| Cutting | - | - |
| Stitching | - | - |
| Lasting | - | - |
| Assembly | - | - |
| Finish | - | - |
| Design | Restrictions in design f. e. Circularity | Restrictions in design f. e. Circularity |
| Production Planning | - | - |
| Technical Development | - | - |
| Training Management | - | - |
| Maintenance Management | - | - |
| Quality Management | - | - |
| New Materials | Development of new materials with regard to crescent management | Development of new materials with regard to crescent management |
| Supply Chain Management | Implementation | Implementation |
| Social Responsibility Management | Implementation | Implementation |
| Sustainability Management | Implementation/co-design | Implementation |
| Environmental Management | Implementation | Implementation |
| STEM | - | - |
| Health and Safety at Work Management | Implementation/co-design | Implementation |

# 4 Digitalisation

| Dimension | New Era of Robots | | |
|---|---|---|---|
| Subdimension | 2 Arm robots | Adaptive robots | Lightweight robots |
| Description | Dual arm robots are unique in their design because instead of a single robotic arm, they have two. Their arms extend outward from either side of their robotic base. Since these robots have two arms, they tend to have more axes than single six axis robots. The number of axes for a dual arm robot can range from four up to fifteen, for an enhanced range of motion. | Adaptive robotics is a field that goes one step further than collaborative robotics. It involves the development and manufacturing of robots capable of adapting to and learning from their environment, interacting with humans. In other words, adaptive robots are those with cognitive, sensing and decision-making capabilities to modify their behaviour and function in response to contextual changes. | In contrast to their bulky counterparts, lightweight robots are more compact, space-saving and - as the name suggests - lighter. They are used in laboratories, electronics production, packaging and precision mechanics, among other areas. |
| Cutting | - | - | Further development of pick and place - costs and speed could be problematic |
| Stitching | - | - | Further development of pick and place - costs and speed could be problematic |
| Lasting | - | - | - |
| Assembly | - | - | Further development of assembly robots - https://www.desma.de/de/automation/robotik/ |
| Finish | - | - | Further development of pick and place - costs and speed could be problematic |
| Design | - | - | - |
| Production Planning | - | - | - |
| Technical Development | - | - | - |
| Training Management | - | - | - |
| Maintenance Management | - | - | - |
| Quality Management | - | - | - |
| New Materials | - | - | - |
| Supply Chain Management | - | - | - |
| Social Responsibility Management | - | - | - |
| Sustainability Management | - | - | - |
| Environmental Management | - | - | - |
| STEM | - | - | Further development of assembly robots - https://www.desma.de/de/automation/robotik/ |
| Health and Safety at Work Management | - | - | - |

| Dimension | Artificial Intelligence (AI) | | | |
|---|---|---|---|---|
| **Subdimension** | Image generation tools | Text generating and translating systems | Text-to-speech and speech-to-text systems | Data mining |
| **Description** | AI image generation tools allow you to quickly produce high-quality visuals by describing desired images in text prompts. With thoughtful use, these tools can enhance the creation of diagrams, illustrations, and graphics to engage students and enrich lectures and assignments. | Text generation is the process of automatically producing coherent and meaningful text, which can be in the form of sentences, paragraphs or even entire documents. It involves various techniques, which can be found under the field such as natural language processing (NLP), machine learning and deep learning algorithms, to analyse input data and generate human-like text. | Text to speech is a noble technology that reads text aloud. You may also know this tool as "Read Aloud" on products like eBooks and e-readers. Speech to text is a computational linguistics technology that uses speech recognition or an audio file to convert spoken language into text. | Data mining is the use of machine learning and statistical analysis to uncover patterns and other valuable information from large data sets. |
| **Cutting** | - | - | - | - |
| **Stitching** | - | - | - | - |
| **Lasting** | - | - | - | - |
| **Assembly** | - | - | - | - |
| **Finish** | - | - | - | - |
| **Design** | High, draft, sketch, proposals, sketches for drafts | Support with naming and design briefs | - | Market analysis |
| **Production Planning** | - | Draft, summaries | Communication in various languages, summaries | - |
| **Technical Development** | Low, draft, sketch, proposals, sketches for drafts | - | | - |
| **Training Management** | AI integration | AI integration | AI integration | AI integration |
| **Maintenance Management** | - | - | - | Error detection |
| **Quality Management** | Fault detection | - | | Predictive maintenance |
| **New Materials** | - | - | - | - |
| **Supply Chain Management** | - | Document creation | Transnational communication | Monitoring, traceability |
| **Social Responsibility Management** | - | Document creation | - | - |
| **Sustainability Management** | - | Document creation | - | - |
| **Environmental Management** | - | Document creation | - | - |
| **STEM** | - | - | - | - |
| **Health and Safety at Work Management** | - | - | - | - |

| Dimension | Big Data | | | | |
|---|---|---|---|---|---|
| **Subdimension** | Digital marketing and branding | Personalisation and mass customisation | Data-driven decision-making | Traceability | Internet of Things (IoT) |
| **Description** | Digital branding is the process of using digital assets to create an online brand identity that can be expressed on virtually any digital channel, like your website, social media profiles, digital ads, and content marketing. Done right, digital branding enables you to create richer digital marketing campaigns and build a powerful presence in the digital sphere. | The most common form of customization comes in the form of product customization and is typically found online. Product customization is particularly popular for clothing outlets. Mass customization is all about customer experience, sometimes referred to as CX, which marks an enormous shift from shopping habits that were once almost entirely about the product. One type of personalization is the recommendation engine, although it should be noted that personalization is not a type of recommendation. | Data-driven decision-making (DDDM) is defined as using facts, metrics, and data to guide strategic business decisions that align with your goals, objectives, and initiatives. When organizations realize the full value of their data, that means everyone—whether you're a business analyst, sales manager, or human resource specialist—is empowered to make better decisions with data, every day. | Traceability and supply chain mapping are essential for companies to be able to understand and address supply chain risks related to deforestation, ecosystem conversion, and human rights abuses. To support these processes, the Accountability Framework provides guidance on the appropriate level of traceability and how companies may achieve it. | The Internet of Things (IoT) refers to a network of physical devices, vehicles, appliances, and other physical objects that are embedded with sensors, software, and network connectivity, allowing them to collect and share data. |
| **Cutting** | - | - | - | - | - |
| **Stitching** | - | - | - | - | - |
| **Lasting** | - | - | - | - | - |
| **Assembly** | - | - | - | - | - |
| **Finish** | - | - | - | - | - |
| **Design** | - | Design by customers possible on the Internet | - | - | - |
| **Production Planning** | - | Design by customers possible on the Internet | - | - | - |
| **Technical Development** | - | - | - | - | - |
| **Training Management** | - | - | - | - | - |
| **Maintenance Management** | - | - | - | - | - |
| **Quality Management** | - | - | - | - | - |
| **New Materials** | - | - | - | - | - |
| **Supply Chain Management** | - | Agile supply chains required | Shoe interior | Tracing materials | - |
| **Social Responsibility Management** | - | - | - | - | - |
| **Sustainability Management** | - | - | - | - | - |
| **Environmental Management** | - | - | - | - | - |
| **STEM** | - | Foot health, customized insoles | - | - | - |
| **Health and Safety at Work Management** | - | - | - | - | - |

| Dimension | 3D Printing | |
|---|---|---|
| Subdimension | Plastics | Metals |
| Description | Material extrusion, also known as Fused Deposition Modelling (FDM), is the most common consumer 3D printing technology. It's used by affordable home 3D printers. The nozzle heats up the filament above its melting point and extrudes it onto the build platform (or the latest printed layer) where it hardens. The object is built up layer by layer, where each layer solidifies and adheres to the layer below.<br>Supports structures are built-up during overhangs and bridging. After the print finishes, the support structure can be removed. | 3D printing with metal (also known as metal 3D printing or metal additive manufacturing) is a process for manufacturing metal parts by applying and fusing metal powder or wire in layers. This method makes it possible to create complex geometries and customised components that would be difficult or impossible to produce using conventional methods. |
| Cutting | - | - |
| Stitching | - | - |
| Lasting | - | - |
| Assembly | Printed elements | Printed elements |
| Finish | - | - |
| Design | Patterns | |
| Production Planning | Fits | |
| Technical Development | Patterns | |
| Training Management | Integration | Integration |
| Maintenance Management | - | - |
| Quality Management | - | - |
| New Materials | - | - |
| Supply Chain Management | - | - |
| Social Responsibility Management | - | - |
| Sustainability Management | - | - |
| Environmental Management | - | - |
| STEM | - | - |
| Health and Safety at Work Management | - | - |

| Dimension | Combination of Digitalisation and Sciences | |
|---|---|---|
| Subdimension | Wearables | Cyber physical systems (CPS) |
| Description | Wearable technology is any kind of electronic device designed to be worn on the user's body. Such devices can take many different forms, including jewellery, accessories, medical devices, and clothing or elements of clothing. The term wearable computing implies processing or communications capabilities, but in reality, the sophistication among wearables can vary. | Cyber-physical systems (CPS) are networked information-processing systems that interact directly with their surrounding physical environment. CPSs record environmental information via sensors, process this information with computer support, and in turn influence their environment via actuators. CPS are therefore in a continuous control loop and in many application areas must perform time-critical and safety-relevant calculations and communicate with other technical systems or humans across domains. |
| Cutting | - | - |
| Stitching | - | - |
| Lasting | - | - |
| Assembly | - | - |
| Finish | - | - |
| Design | - | - |
| Production Planning | - | - |
| Technical Development | - | - |
| Training Management | - | |
| Maintenance Management | - | - |
| Quality Management | - | Potentially |
| New Materials | - | - |
| Supply Chain Management | - | - |
| Social Responsibility Management | - | - |
| Sustainability Management | - | - |
| Environmental Management | - | - |
| STEM | - | - |
| Health and Safety at Work Management | - | - |

| Dimension | Virtual and Augmented Reality | |
|---|---|---|
| Subdimension | Virtual reality | Augmented reality |
| Description | Virtual reality (VR) is a technology that simulates a computer-generated environment and makes it possible to interact with it in a very realistic way. It has become increasingly popular in recent years, with applications in fields such as gaming, education, healthcare, and entertainment. | Augmented reality refers to a computer-based extension of our perceptible reality. Generally, all human senses are addressed, but often it is only about the visual or auditory depiction of information, i.e., in the form of an overlay. A commonly known example is the arrows and rings used in the analysis of soccer matches. |
| Cutting | - | - |
| Stitching | - | Glasses if necessary |
| Lasting | - | - |
| Assembly | - | Glasses, if necessary |
| Finish | - | - |
| Design | Design, collaboration | Design, collaboration |
| Production Planning | Design, collaboration | Design, collaboration |
| Technical Development | Design, collaboration, gravity sketch | Design, collaboration |
| Training Management | - | - |
| Maintenance Management | Remote diagnostics | Complex/rare repairs |
| Quality Management | - | - |
| New Materials | - | - |
| Supply Chain Management | - | - |
| Social Responsibility Management | - | - |
| Sustainability Management | - | - |
| Environmental Management | - | - |
| STEM | - | - |
| Health and Safety at Work Management | - | - |