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SAWYER
SKILLS AND SAFETY NEEDS IN A CIRCULAR FURNITURE SECTOR
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Impacts of the twin transition on the EU furniture industry

Forecast of the sector by 2030 due to its circular economy transition and digital transformation

CENFIM Furnishings Cluster
European Federation of Building and Woodworkers
EFBWW
EFIC European Furniture Industries Confederation
FLA FEDERLEGNOARREDO
UEA

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Av. Generalitat, 66 - 43560
La Senia (Tarragona) SPAIN
Tel. +34 977 57 01 22
www.cenfim.org

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This report was prepared by CENFIM SAWYER project technical team, composed by:
Massimiliano Rumignani
Julio Rodrigo Fuentes
Joaquim Solana Monleón
With the collaboration of the following external experts:
Juan Carlos Alonso
Jeroen Doom
Ellen Schmitz-Felten

Design: srbeardman.com

Lead partner:

CENFIM Furnishings Cluster

Partners:

European Federation of Building and Woodworkers

EFBWW

EFIC European Furniture Industries Confederation

FLA FEDERLEGNOARREDO

Associate organization:

UEA

Collaborating national associations:

apmr

BRANCH CHAMBER OF WOODWORKING AND FURNITURE INDUSTRY

CBM

FCBA INSTITUT TECHNOLOGIQUE

FACKET FÖR SKOGS-, TRÄ- OCH GRAFISK BRANSCH

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- APMR - Romanian Furniture Manufacturers Association / Romania
- BBCWFI - Bulgarian Branch Chamber of Woodworking and Furniture Industry / Bulgaria
- CBM - Trade association for interior construction and Furniture industry / The Netherlands
- FCBA - Institute of Technology for Forest-based and Furniture Sectors / France
- GS - The Swedish Union of Forestry, Wood and Graphical Workers / Sweden

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Summary

The **Twin Transition (green & digital)** will have a huge impact on the EU furniture sector during next years and decades. The new European Industrial Strategy, the European Green Deal and the new Circular Economy Action Plan will play an important role for the EU industry transition. The SAWYER project, building up its analysis on the previous outcomes of the DIGIT-FUR project focusing on the impact of the sector digitalization in 2025, aimed to **analyse the key instruments/drivers of change of the transition** toward a more **circular economy** within the **EU furniture sector by 2030** and **anticipate the understanding of these changes**. This will provide useful insights to **all sector social partners and stakeholders** on how the sector, its business models and its workers will be affected by this transition along its whole value chain by 2030.

The project has been implemented involving **different partners (CENFIM, EFBWW, EFIC, FLA,** and **UEA)** and other national entities (APMR, BBCWFI, CBM, FCBA and GS) with a long and sound expertise in the furniture sector. Moreover, other **individual experts** in circular economy, EU VET system, OHS risks and the furniture sector itself provided their expertise and inputs along the whole project implementation.

The SAWYER was implemented following a **progressive research methodology**. Initially, the main legislative and voluntary instruments and other policies and strategies impacting the EU furniture sector transition toward a more circular economy were identified. Based on this, 49 evolutions of these instruments and policies were forecasted and their level of probability and impact were evaluated through an **on-line survey** by 51 experts coming from 15 countries. The forecasted evolutions were analysed and fine-tuned in a **workshop** by 20 experts. The outcomes were used to forecast the 2030 scenario of the EU furniture sector due to circular economy.

This scenario, building on the previous DIGIT-FUR project results and adapting to the furniture sector the **ReSOLVE framework**, allowed to identify the **expected changes in key eleven occupational profiles tasks** due to the transition of the sector toward a more circular economy and the sector digitalization. From there the new **occupational and health safety risks** and the changes in **skills, knowledge and competencies needs** were identified.

All reports are available at: circularfurniture-sawyer.eu/downloads

The main research outcomes are summarised hereafter, starting with the SAWYER project vision, which states:

By 2030, with a broadly **digitalised furniture sector**, the wood-based furniture manufacturing industry will offer **products and services** with **environmentally conscientious design** based on **low impact and traceable raw materials, sustainable manufacturing processes**, and promotion of the **best usage and recovery scenarios** for materials and discarded products. Customers (B2B or B2C) will demand more detailed information about products and their **sustainable characteristics**, including life-cycle indicators, and consumer empowerment will be key in the success of circularity objectives. Authorities (at local, national and European level) will facilitate circularity by boosting **sustainable end-of-life scenarios** for materials and wood-based products, expanding **green public and private procurement schemes** and promoting **material efficiency policies**.

In this scenario, **Digital tools** will be massively used in the sector by both SMEs' and large enterprises, along their whole value chain. These digital tools will promote a more circular economy, making the **manufacturing processes more efficient** and facilitating the **traceability** of substances, materials and products. Customers will be better informed about products' **sustainable characteristics** and the furniture products **e-commerce will increase**, provoking changes in marketing activities and the relationship with customers, in the sales and the related logistic aspects. This framework will facilitate that a growing number of furniture manufacturers will implement along their **whole value chain** different circular economy practices making their management and production systems more sustainable. There will be a growing social and legislative demand to companies to reduce their **environmental footprint** and contribute to tackle the current climate change. Circularity in the sector is in its early stages and results will be seen in the medium-long term.

The furniture industry Twin Transition poses **new challenges for occupational health and safety. New types of workplaces, new processes, new technologies** and **new materials/products** can affect the safety and health of workers, but if properly planned and deployed **workers' health and safety can clearly be improved**. For this reason, we need to ensure that this transition and its new technologies or working processes do not lead to new hazards. **Circular economy in the sector**, giving equal consideration to OSH and to environmental issues, should be **deployed through safer and efficient machinery, working processes and materials** able to decrease workers' chemical and physical risks. The application of **ecodesign** concepts to products should facilitate recovery and repair operations, reducing ergonomic risks, and should reduce the content of hazardous substances, decreasing chemical risks in the entire value chain. Workers' safety and health could increase by integrating the OSH management into companies' quality management systems.

For some job profiles, **new green skillsets** will be required, as there will be some new, specific tasks related to disassembling and re-using, remanufacturing, recycling and upcycling. These new skillsets are especially (more) important for the tasks of the "practical" profiles. These new green skillsets will also have an impact, though not so significant, on those profiles that are managing and taking strategic decisions within the company. Additionally, **generic green skills, knowledge and competences** were defined as necessary for social, economic and environmental developments within the wood furniture sector. These generic green skills are aligned with key competencies or soft skills, which have been contextualized within the perspective of environmental awareness and the understanding of sustainable development and circular economy.

The project outcomes will facilitate and support the social dialogue among sector key actors and stakeholders and allow them to properly support the furniture sector Twin transition and to cope with next years challenges and **secure workers employability and safety, and companies' competitiveness**.

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Introduction

Objectives

The overall SAWYER objective was to **understand and forecast** how the EU furniture sector will be affected by its **circular economy transition** and provide useful insights to **all sector social partners and stakeholders** on how the sector, its business models and its workers will be affected by this transition along its **whole value chain by 2030**. Along the project implementation, partners saw that this circularity transition was closely related to sector digitalization and decided to build the analysis on the existing results of the previous DIGIT-FUR project, which forecasted the impact of the digitalization of the sector in 2025. In conclusion, the key result of the SAWYER project is a forecast of the **impact of the Twin Transition (green & digital) on the EU Furniture Sector**, in general in relation to the sector business models, VET provision and OHS risks and specifically on eleven key occupational profiles.

This Twin Transition forecast will facilitate sector stakeholders **anticipating the changes** required to improve and update the workers competencies and their safety at work in order to secure EU furniture companies' competitiveness during next years or even decades.

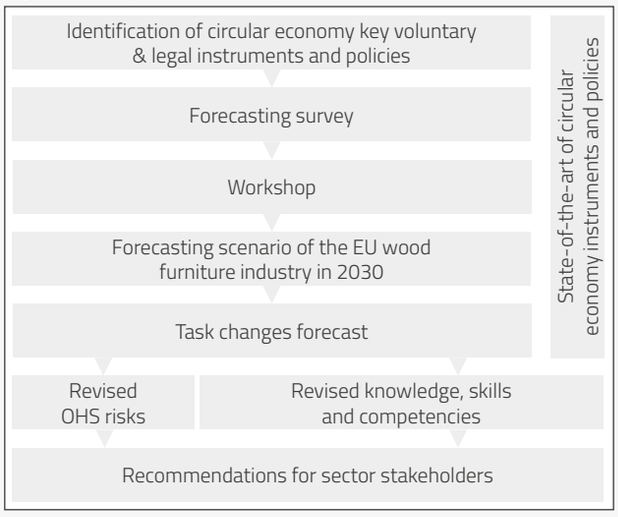
SAWYER specific objectives were:

- Understanding the **current status and trends** in the EU Furniture sector of circular economy legislative & voluntary instruments.
- Defining the future **possible sector scenario in 2030** due to its circular economy transition.
- Identify the **impacts** of this scenario **on sector key occupational profiles tasks, OHS risks and skills & knowledge needs.**
- Forecast **what sector stakeholders can expect** because of these changes and how to deal with them.
- Support the work of the **European Social Dialogue** and improve European industrial relations.
- **Map successful initiatives** to support stakeholders in circular economy implementation processes.

Methodology

The research methodology adopted by the partnership (Figure 1) was designed by the CENFIM SAWYER team (M. Rumignani, J. Rodrigo, J. Solana) and the project external expert in circular economy, Juan Carlos Alonso and it was implemented with the support of the other SAWYER partners (FLA, EFBWW, EFIC and UEA) and the other two external experts of the project, Jeroen Doom (VET system) and Ellen Schmitz-Felten (OHS risks). The study started with the identification of the **main legislative and voluntary instruments and other policies and strategies** that can impact the EU furniture sector transition toward a more circular economy.

Figure 1.- Project methodology scheme



In order to support this analysis, a specific report on **the state-of-the-art of these instruments and policies** at European level and in seven EU countries (Spain, Italy, France, The Netherlands, Romania, Bulgaria and Sweden) was prepared. Based on this, 49 evolutions of these instruments and policies were forecasted and their level of probability and impact were evaluated through an **on-line survey**, which involved 50 European professionals from 15 EU countries, experts in circular economy and/or in the furniture sector.

Once the survey results were collected, elaborated and summarized, the 49 forecasted evolutions were analysed and fine-tuned in a **workshop** by 20 professionals coming from 9 EU countries with different expertise ranging from the furniture sector, ecodesign and specific circular economy legislative and voluntary instruments. As final result of this process, the **report "Furniture Sector Forecasted Scenario in relation to Circular Economy in 2030"** was produced. It forecasts the status of the EU furniture sector in 2030 built on the forecasted scenario for 2025 of the previous DIGIT-FUR project, which analysed the impact of digitalization on the sector. The result has been a forecast and analysis of the impact of the **Twin Transition (green & digital)** on the EU furniture sector for the next years and decades.

Based on these results, project circular economy expert, in collaboration with the CENFIM SAWYER project team and building on the previous DIGIT-FUR project results, identified the **expected changes in key eleven occupational profiles tasks** due to the transition of the sector toward a more circular economy and the sector digitalization. The analysis was implemented adapting to the furniture sector the **ReSOLVE framework**, developed by McKinsey Center and Ellen MacArthur Foundation. So, the new forecasting tables include the expected results of the Twin Transition (green & digital) of the furniture sector, providing a clear picture of the expected future tasks for all eleven occupational profiles.

The following step was the analysis of the current and forecasted **OHS hazards and risks changes**, due to sector digitalization and circular economy transition, considering the reformulation of the tasks done in the previous analysis for the different occupational profiles. In this analysis, the different kinds of hazards that can be faced by workers of wood furniture manufacturing plants have been characterised in different categories of risks.

The last step was the analysis of how the current workers and companies **knowledge, skills and competences (KSCs) needs** can change due to sector digitalization (by 2025) and circular economy (by 2030) for the key eleven occupational profiles, considering the "main causes/reasons of change" for digitalisation and for circular economy and analysing if they will continue to be needed or not. This analysis allows to identify which KSCs needs will suffer changes, and which new competencies will be required for the circular economy by the sector companies willing to adapt to and properly exploit the opportunities offered by sector growing circularity.

Building on a further analysis and elaboration of all these results and outputs experts and SAWYER partnership produced a set of **recommendations** for furniture sector stakeholders in general and specifically for policymakers, VET providers and regulatory entities.

A mapping exercise of **European initiatives** facilitating and supporting the transition of EU industries toward a more circular economy provided information about different relevant national and regional initiatives.

The key 11 occupational profiles selected and analysed from the ESCO classification (European classification of Skills/Competences, qualifications and Occupations) with the related ISCO identification code:

1221 Sales and marketing managers
1321s Industrial production manager
1324s Supply Chain manager (Supply, distribution and related managers)
2141s Maintenance & repair engineer (machinery maintenance and repair workers)
2163s Furniture designers (Product and garment designers)
7522 Cabinet-makers and related workers
7523 Woodworking-machine tool setters and operators
7534 Upholsterers and related workers
8172 Wood processing plant operators
8219s Furniture assembler
9329 Factory hand

Results

State of the art of the circular economy in the EU furniture sector

The area of analysis covered by the SAWYER project was the furniture sector that according to the NACE Rev. 2 classification refers to code 31.0 (Manufacture of furniture). It has a turnover of 110,4 € billions and an added value of 32% (according to latest 2018 EUROSTAT data), making it a very relevant sector for the EU economy also because of its 1.043.806 sector workers (EUROSTAT, 2018). The EU28 furniture sector is largely composed by micro, small and medium size companies, as shown by the following table.

The following table shows sector workers data in relation to the main jobs functions categories and the profiles analysed by the SAWYER project.

Table 1.- Volume of workers for the main categories of the EU Furniture Sector in 2018.

Job function categories[1]	Approx. volume in 2018, 1.043.806 workers[2]	Professional profiles targeted by SAWYER project (ISCO occupational profiles)
Managers	80.395	No covered by this study
ICT Professional	11.485	No covered by this study
Designers	10.818	2163s Furniture designer
Production manager	22.970	1321s Industrial production manager
Sales and marketing staff	22.970	1221 Sales and marketing managers + additional profiles not covered by this study
Supply chain managers	10.818	1324s Supply chain manager
Administrative support staff	114.851	No covered by this study
Plant and machinery maintenance and repair workers	68.910	2141s Maintenance & repair engineer+ additional profiles not covered by this study
Skilled handicraft workers (Cabinet makers and upholsterers)	574.255	7522 Cabinet-makers and related workers
		7534 Upholsterers and related workers
		8219s Furniture assembler
Machine operators	45.941	7523 Woodworking-machine tool setters and operators
		8172 Wood processing plant operators
Labourers	80.395	9329 Factory hand

[1]Jobs functions categories from the study TNO, ZSI, SEOR (2009), EC.
[2]Based on elaboration of EUROSTAT data of the total number of workers for EU 28 Furniture Sector.

Following the identification of the set of **main legislative and voluntary instruments** and other **policies** and strategies impacting the EU furniture sector **transition toward a more circular economy**, a detailed analysis of their level of deployment was implemented.

In the first project report "State of the art of circular economy in the furniture sector", prepared by November 2019, the partnership has implemented a detailed analysis of all these elements and of their level of deployment, both at EU level and then specifically at some EU countries level (France, Italy, Spain, Romania, Netherlands, Sweden, Bulgaria). This related knowledge is considered necessary by the partnership in order to properly understand and forecast the evolution of the circular economy in the sector.

The selected instruments were grouped in three different groups: legislative and voluntary instruments and other policies and strategies. Their detailed description and the results of their analysis have been collected in three different documents:

- The State-of-the-art of circular economy in the furniture sector at EU level
- The State-of-the-art of circular economy in the furniture sector in 7 EU countries
- Summary Table: Update of the State-of-the-art of circular economy at EU level

All these documents can be downloaded in the SAWYER project website: circularfurniture-sawyer.eu/downloads

The following table presents the list of the selected instruments and policies and their estimated level of deployment at EU level, on a scale between 1 and 5 (1 = minimum value and 5 = maximum value).

Table 2- List of selected instruments and policies and their level of deployment at EU level

Instrument	Description	Level of deployment
Legislative Instruments		
Circular Economy Package of the EC	Circular Economy Action Plan (COM (2015) 614) aims to boost the implementation of Circular Economy in Europe. It includes revision of some regulations (e.g. framework on waste) and other actions to promote circularity (e.g. plastic strategy).	**5** All the 54 proposed actions have been completed or they are in the implementation phase {SWD(2019) 90 final}.
The European Green Deal	The European Green Deal (COM(2019) 640 final and Annex) is the EU roadmap for making the EU's economy more sustainable, with actions to: • boost the efficient use of resources by moving to a clean, circular economy • restore biodiversity and cut pollution • The objective is that EU will be climate neutral in 2050, making the transition just and inclusive for all. This will require action by all sectors of EU economy, including: • investing in environmentally-friendly technologies • supporting industry to innovate • rolling out cleaner, cheaper and healthier forms of private and public transport • decarbonising the energy sector • ensuring buildings are more energy efficient • working with international partners to improve global environmental standards	**2** In its point 2.1.3. Mobilising industry for a clean and circular economy, it announces that the Commission will adopt an EU industrial strategy and publish a new Circular Economy Action Plan as pillars of this EU Green Deal (done in March 2020). The Annex of the Communication on the European Green Deal defines the Roadmap and Key action, from 2019 until 2021. These key actions are classified in the following aspects: • Climate ambition • Clean, affordable and secure energy • Industrial strategy for a clean and circular economy • Sustainable and smart mobility • Greening the Common Agricultural Policy / 'Farm to Fork' Strategy • Preserving and protecting biodiversity • Towards a zero-pollution ambition for a toxic free environment • Mainstreaming sustainability in all EU policies • The EU as a global leader • Working together –a European Climate Pact
New Circular Economy Action Plan for a Cleaner and More Competitive Europe	The New Circular Economy Action Plan (COM(2020) 98 final and Annex) announces initiatives along the entire life cycle of products, targeting for example their design, promoting circular economy processes, fostering sustainable consumption, and aiming to ensure that the resources used are kept in the EU economy for as long as possible.	**1** The Plan indicates in its Annex the timing for the proposed initiatives, from 2020 until 2023. The key actions are classified in the following aspects: • A sustainable product policy framework • Key product value chains • Less waste, more value • Making circularity work for people, regions and cities • Crosscutting actions • Leading efforts at global level • Monitoring progress
Waste Electrical and Electronic Equipment Directive (WEEE)	The Directive 2012/19/EU enquires the establishment of collection schemes (free of charge for consumers) in order to increase the WEEEs re-use and/or recycling.	**5** The former WEEE Directive entered into force in 2003. In 2017 the Commission adopted the "WEEE package", and in 2018 a final report on WEEE compliance promotion exercise, examining the implementation in each EU country.
Restriction of use of hazardous substances in Electrical and Electronic Equipment (ROHS)	Directive 2011/65/EU was amended by the Directive (EU) 2017/2102, reviewing the scope for some group of products and facilitating to encourage a more circular economy in the Union by promoting the secondary market operations for EEE, which involve repair, replacement of spare parts, refurbishment and reuse, and retrofitting.	**5** The former ROHS Directive entered into force in 2003. It was reviewed several times to modify the exceptions and their deadlines.

Instrument	Description	Level of deployment
Energy related Products Directive (ErP or eco design)	The Directive 2009/125/EC is the framework to define Ecodesign requirements for products that use energy or which are energy related (i.e. they do not consume energy directly, but can provoke the use of additional energy, such as windows).	**4** EC publishes Working Plans to identify priority family products and future strategies. The latest working plan covers the period 2016-2019 and gets more attention to resource efficiency, analysing the possible application of additional "product-specific" requirements on matters such as durability, etc.
Extended Producers Responsibility (EPR)	The Extended Producer Responsibility (EPR) is "an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle".	**4** Existing directives at EU level for some specific products (WEEE, batteries, end-of-life vehicles, packaging, etc.).At national level, EPR schemes for other products.
Hazardous substances / REACH Regulation	REACH Regulation (EC 1907/2006) has the objective of improving human health and environment protection by identifying the hazardous properties of chemical substances used in EU. Both manufacturers and importers have the responsibility to collect information on the specific and critical properties of chemical substances they use.	**3** REACH is fully operational but it is lagging behind initial expectations. Some identified problems are among others the lack of compliant information in the registration dossiers or the need of simplification of the authorisation process.
Formaldehyde emissions	The formaldehyde produced and imported at European level is used mainly for manufacturing resins used for manufacturing of wood-based panels. The exposure to formaldehyde emissions is an important issue for consumers (emissions from articles) and for workers (occupational exposure).	**2** At European level, there is not a common legislative requirement, but there is a voluntary industry agreement of the members of the European Panel Federation (EPF), which produce only class E1 wood-based panels. Some EU Member States have adopted national legislations.
EU's rules on end of life waste criteria	The Waste Framework Directive 2008/98/EC indicates that some specific waste shall stop to be considered normal waste if it has undergone through a recovery process (including recycling) and if it complies with specific criteria developed in line with certain legal conditions. The objective is to remove the administrative burdens of waste legislation for safe and high-quality waste materials, in order to facilitate their recycling.	**3** At European level, the criteria have been defined for 8 types of waste, but there are specific regulations for iron, steel, copper and aluminium scrap and for glass cullet.
Flame retardants	Some furniture products use flame retardants to fulfil the variety of flammability standards for furniture. Some of these standards require compliance with open flame tests, forcing the use of flame retardants. Some type of substances used for flame retardants are regulated under the Regulation (EU) 2019/1021, which recast the Regulation (EC) 850/2004 on persistent organic pollutants (POPs).	**3** The use of flame retardants are not directly regulated at European level. Indirectly, it is regulated if the used substances are considered as hazardous (e.g. via REACH or POPs Regulation). The mentioned regulations are well deployed, and new substances are under study.
Renewable energy Directive (RED II)	In December 2018, the revised renewable energy directive 2018/2001/EU entered into force, as part of the Clean energy for all Europeans package. It establishes a new binding renewable energy target for the EU for 2030 of at least 32%, with a clause for a possible upwards revision by 2023. The Renewable Energy Directive sets out biofuels sustainability criteria for all biofuels produced or consumed in the EU.	**4** The Directive is deployed and more ambitious targets for renewable energy are under consideration. Regarding biofuels sustainability, companies can show they comply with the sustainability criteria through national systems or so-called voluntary schemes recognised by the European Commission.

Instrument	Description	Level of deployment
Illegal logging and illegal timber trade	The Regulation (EU) No 995/2010 defines the obligations of operators selling or distributing timber and timber products. It is known as the EU Timber Regulation or EUTR, as part of the EU Forest, Law, Enforcement, Governance and Trade (FLEGT) Action Plan. Another scheme is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).	**5** These regulations and Action Plans are deployed at EU and international level. New action plans to protect forest are published, for example COM(2019) 352 final about "Stepping up EU Action to Protect and Restore the World's Forests", proposing the creation of an EU Observatory on Deforestation and Forest Degradation.
Voluntary Instruments		
Green Public Procurement (GPP)	Green public procurement incorporates environmental criteria in the specifications of a public tender, involving the integration of the environmental components into public procurement decisions. These environmental criteria could cover different aspects of the products during their life cycle. GPP can foster the creation of a critical demand mass of more sustainable goods and services, which otherwise would not be easy to get in the market	**3** The level of real implementation is different in each EU country. The European Commission and several EU countries have prepared different guidelines for GPP processes, in the form of national GPP criteria. The main challenges are to ensure compatible GPP requirements between different EU countries and to foster more public sector bodies to adopt these criteria.
Environmental management in organizations	An environmental management system (EMS) can help organizations in the identification, management, monitoring and control of their environmental aspects in a "holistic" manner. At European level there are two main certified Environmental Management Systems, which are EMAS and the ISO-14001:2015.	**4** Different revisions of the ISO and EMAS schemes have been published. They are consolidated schemes, but partially implemented in the business sector. At EU level, 3,728 organizations have EMAS certification (April 2019) and 111,133 ISO-14001 certifications (2017).
Eco-design methodology	Eco-design is defined as "the integration of environmental aspects into product design and development with the aim of reducing adverse environmental impacts throughout a product's entire life cycle" The UNE-EN ISO 14006:2020 provides guidelines to assist organizations in establishing, documenting, implementing, maintaining and continually improving their management of eco-design as part of an EMS. There are other standards related to eco-design, such as UNE-ISO/TR 14062:2007 or IEC 62430:2019	**3** The last revision of the ISO 14006 was in 2020. The standard indicates that it is not intended for certification purposes, which make difficult to know the real level of implementation in the market. In any case, it is assumed that this implementation is much lower than ISO-14001.
Eco labels (Type I, II, and III)	The ecolabels try to give information to the customers, about the environmental characteristics of a product. There is a huge amount of different ecolabels, but all of them could be included in three main types of ecolabels (i.e. I, II and III) and they are regulated under the ISO 14020.	**4** The different ecolabel systems are well developed, and are broadly used in some type of products (e.g. consumer products). However, some additional work is needed to better inform the consumer about the real meaning of these ecolabels to avoid misunderstanding.

Instrument	Description	Level of deployment
Chain of custody certification (FSC / PEFC)	Timber supply Chain of Custody certification provides evidence that the certified product originates from certified, well managed forests. It verifies and ensures that these products are not mixed with other products from no-certified forests at any point along the supply chain, except under strict controls when percentage (%) labelling is being used. There are currently two independently accredited chains of custody programmes operating in the Timber Industry: The FSC (Forest Stewardship Council) and the PEFC (Programme for the Endorsement of Forest Certification) schemes.	**5** These two schemes are well developed and demand for chain of custody certification has grown dramatically in the last three years, to the extent that, for many companies, the ability to prove that a timber product has been derived from a well-managed source is now a key factor in the specification of timber and paper products.
Green building certification (BREEAM / LEED)	There are two main green building certification schemes: The Building Research Establishment's Environmental Assessment Method (BREEAM), which was the first green building rating system developed in the UK, and the Leadership in Energy and Environmental Design (LEED) developed lately in the U.S. by the Green Building Council (USGBC).	**4** These two schemes are well deployed at EU level. For example, 19,542 BREEAM assessments are certified in EU Countries (most of them in UK) and 3,766 LEED certified projects. There is an increasing demand of this type of certification, but it is still a small part of all buildings sector.
Other Instruments and Policies		
Cascading use of wood	Cascading use of biomass resources, such as wood and agricultural products, means an efficient use of these resources from the point of view of natural resources, materials and land consumption. It gives priority to higher value uses that allow the reuse and recycling of products and raw materials, promoting energy use only when other options are not feasible.	**2** The European Commission has published two relevant publications on this issue, including Guidance on cascading use of biomass.Until the date, there are no other requirements associated to this topic.
EU industry policy for Forestry	The EU Commission adopted the EU Forest Strategy in 2013 (COM(2013) 659 final), which aims to help forests and the related sector to tackle current challenges. The Strategy provides a framework to respond to the increasing demands put on forests and to deal with societal and political changes. The EU forest strategy 2014-2020 was developed to provide a coherent framework for both EU forest-related policies and the national forestry policies of the individual EU countries.	**4** In 2018 the Commission delivered the report "Progress in the implementation of EU forest strategy" (COM(2018) 811 final) reviewing this strategy. The review highlights that the EU forest strategy is achieving its objective to foster a more sustainable forest management at EU and global level.
Forest Based Industries Blueprint	In 2013, the European Commission published the Blueprint for the EU forest-based industries (SWD(2013) 343 final). This document accompanied the EU Forest strategy and it highlights the challenges that the forest-based industry has to address to remain competitive.	**3** Some actions have been identified to address these challenges for the timeframe 2014-2020. A group of organisations have presented their shared strategic vision and agenda towards 2050 for the Forest-Based Industries.
Bioeconomy	The goal of Bioeconomy is a more innovative and low-emissions economy, integrating demands for sustainable agriculture and fisheries, food security, and the sustainable use of renewable biological resources for industrial purposes, while ensuring biodiversity and environmental protection.	**3** The European Commission has set a Bioeconomy Strategy and action plan, published in 2012 and revised in 2018. This update designed an action plan including 14 concrete actions to be launched in 2019. Moreover, the Commission works on ensuring a coherent approach to bioeconomy through different programmes and instruments (e.g. Horizon 2020, BBI, etc.).

Forecasting: survey and workshop results

Project following steps were the organization of a **forecasting online survey and an experts workshop**. The survey was implemented among 50 professionals from 15 EU countries and supported by the state-of-the-art report previously prepared. Experts in Circular Economy and/or in the furniture sector were required to evaluate the level of probability and impact of 49 forecasted evolutions expected by 2030 and related to the previously identified impacting instruments and policies.

The **survey objectives** were:

- Identifying **which evolutions are more probable** to happen by **2030**.
- Create a f**irst draft list of the most impacting situations that the sector will face by 2030**.

The survey results allowed to rank the list of these 49 forecasted evolutions in relation to their **probability** of happening and the relevance of their **impact** on the sector transition toward a more circular economy, showing to sector stakeholders to which of these instruments they should pay more attention in order to properly cope with the challenges posed by the circular economy transition.

Once the survey results were collected, elaborated and summarized, they were analysed and discussed in December 2019 in a specific workshop by 20 professionals coming from 9 EU countries with different expertise ranging from the furniture sector, ecodesign and circular economy specific legislations. Experts joint brainstorming and inputs helped us to update and fine-tune the 49 forecasted evolutions and improve the forecast on how the sector will evolve by 2030.

As final result of these processes, the report the **"Furniture Sector Forecasted Scenario in relation to Circular Economy in 2030"** was produced. It contains the forecasted scenario in relation to the impact of the sector transition toward a more circular economy, built on the previous forecasted scenario of the DIGIT-FUR project focusing on the sector digital transformation by 2025. This new forecasting can stimulate a more comprehensive thinking about future strategic activities and investments. The vision statement is:

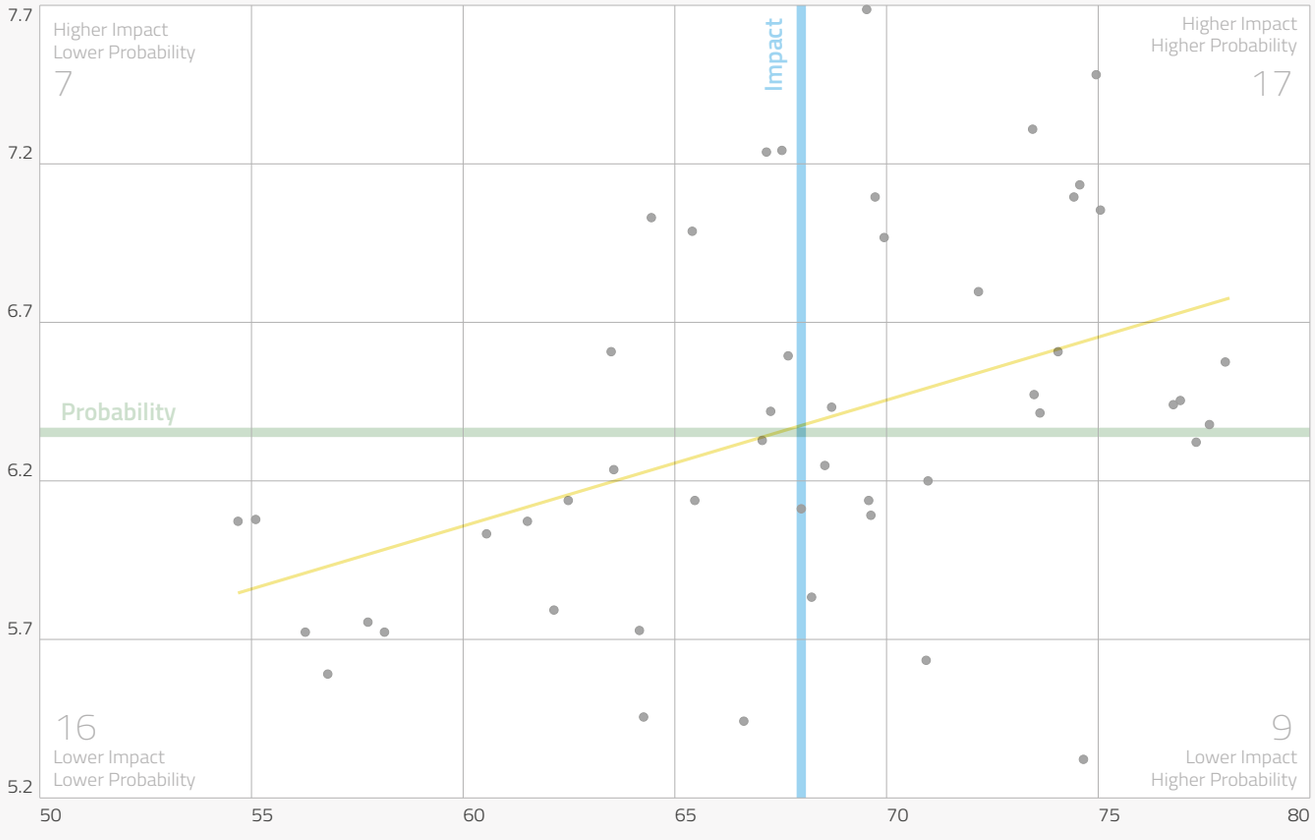
*By 2030, with a broadly **digitalised furniture sector**, the wood-based furniture manufacturing industry will offer **products and services** with **environmentally conscientious design** based on **low impact and traceable raw materials, sustainable manufacturing processes**, and promotion of the **best usage and recovery scenarios** for materials and discarded products. Customers (B2B or B2C) will demand more detailed information about products and their **sustainable characteristics**, including life-cycle indicators, and consumer empowerment will be key in the success of circularity objectives. Authorities (at local, national and European level) will facilitate circularity by boosting **sustainable end-of-life scenarios** for materials and wood-based products, expanding **green public and private procurement schemes** and promoting **material efficiency policies.***

This vision clearly shows the **close interrelationship between the sector transition toward a more circular economy and its digital transformation**. These two evolutions have combined, strong and long-term impacts on each other and only a **joint analysis** of their impacts can provide a realistic and useful forecast of how the furniture sector will be during next years and decades and thus properly **support the strategic decisions of the sector stakeholders**.

The full reports can be found at: circularfurniture-sawyer.eu/downloads/

The graphic shows that there is not a clear correlation between evolutions impact and probability and that we lack evolutions with impacts values lower than 5 and higher than 8 on the 0-10 used scale.

Figure 2.- Distribution of the 49 forecasted evolutions in relation to their probability and impact values.



In the following table, we present the 49 forecasted evolutions ranked according to their level of importance (impact x probability) as outcome of the survey results.

Table 3 - Classification of forecasted evolutions 2030 - workshop results.

Class	Instrument	**Forecasted Evolution** Importance = Probability x Impact. Probability: scale 1 - 100. Impact: scale 1 - 10	**Importance**	Probability Mean Value	Probability Standard devation	Impact Mean Value	Impact Standard devation
1	ECD	The furniture is designed to reduce the impact of used raw materials (use of recycled materials, reduction of hazardous substances content, use of wood with lower environmental impact, use of proximity wood, etc.), provoking changes in the supply chains of companies and in the managing of old furniture collected when the new one is delivered, generating new business models.	561	75	15	7,48	1,61
2	ECD	Low, medium and high quality furniture is designed to optimize its recovery at the end of its life cycle (to facilitate materials disassembly and separation, modularity for reuse of certain parts, reuse and remanufacturing enhancement, etc.).	537	73	18	7,30	1,61
3	EPR	Some national authorities define an Extended Producer Responsibility scheme or take-back scheme for some furniture products, forcing to define a system for the collection and treatment of these products at the end of their life cycle, being the organisation that put the product on the market the one responsible for covering the associated costs.	534	70	23	7,68	1,79
4	CE	The implementation of the actions proposed in the Circular Economy Package of the EC (COM (2015) 614) will generate changes in the productive models of the furniture sector, developing processes and machinery that are more efficient and generating less waste, based on lean manufacturing principles and new ICT technologies (Industry 4.0).	531	75	16	7,13	1,91
5	CUS	New technologies (e.g. Internet of Things, blockchain, BIM, RFID tags, etc.) are used to improve the traceability of wood products to ensure the chain of custody along the whole value chain and to create Material Passports to facilitate their reusing and recycling.	529	75	14	7,04	1,54
6	GPP	In Europe, it has been achieved the objective that 50% of public procurement tenders for furniture include all environmental criteria of green public procurement set by the European Union or all the ones set by each country. This percentage will be higher than 70%, if we include also those public procurement tenders for furniture that include only some of these environmental criteria.	528	74	17	7,09	1,69
7	CUS	Customers, final customers (B2C) and especially intermediate customers (B2B), demand that the furniture product has a chain of custody certification, according to existing schemes (FSC, PEFC, etc.), which have become a standard.	512	78	16	6,57	1,96
8	FEM	The European Commission decides to regulate the emission of formaldehyde of products at European level, fixing a value lower than category E1 (<0.124 mg/m3) currently fixed in several European countries and in the voluntary agreement of EPF (European Panel Federation) members, bringing harmonization to a fragmented single market.	496	77	17	6,44	1,92
9	ECD	The majority of furniture is designed to extend its life cycle (more resistant materials/joints, facilitate its repair and maintenance, etc.), increasing its quality. The furniture that is not meant to last, will be designed in such a way that is easy to re/upcycle.	494	70	19	7,09	1,84
10	CUS	Customers, final customers (B2C) and especially intermediate customers (B2B), demand that the furniture products use wood from forests with certified management according to certificates such as FSC, PEFC, or others equivalent, which have become a standard.	494	78	16	6,36	1,95
11	REA	The proposal presented within the REACH Regulation framework is approved to restrict the placing on the market or the use of items that emit formaldehyde at concentration levels equal or lower to 0.124 mg/m3 (equivalent to category E1), bringing harmonization to a fragmented single market	494	77	17	6,43	2,06
12	GPP	All European countries have developed Green Public Procurement criteria for furniture, either by adopting the EU recommendations or by developing their own. Only some of them will approve a law based on these criteria, the others will just consider them as recommendations. A European directive to implement green public procurement will be adopted and countries will follow it, but some of them probably won't have it fully transposed by 2030.	490	72	18	6,79	1,56
13	GBC	The criteria associated with the use of furniture that uses sustainable materials acquires greater relevance in the systems of Green building certification (e.g. LEED or BREEAM), encouraging their use in those buildings that aim to obtain this type of certification. This will act as a driver that will encourage the use of these more sustainable materials, also for buildings that don't have these certifications.	489	74	17	6,60	1,77

Class	Instrument	**Forecasted Evolution** Importance = Probability x Impact. Probability: scale 1 - 100. Impact: scale 1 - 10	**Importance**	Probability Mean Value	Probability Standard devation	Impact Mean Value	Impact Standard devation
14	ErP	Ecological design requirements are defined for products not-related with energy, such in the case of furniture sector products, under the eco-design (ErP) directive framework (2009/125/EC). These criteria include aspects of materials efficiency such as durability requirements, reparability, spare parts availability, disassembling easiness, use of materials, source of materials (from previous products, raw material, reused materials), etc. Private sector could exploit this to create new services and opportunities.	489	68	24	7,23	1,63
15	CE	The implementation of the actions proposed in the Circular Economy Package of the EC (COM (2015) 614) will produce changes in the customer service models, increasing the information to be provided to customers (for example: content of hazardous substances, product durability, manuals for repair and maintenance, instructions for the end of life management, etc.).	488	77	19	6,31	2,05
16	CUW	The European Commission reinforces its circular economy strategy by promoting the strategy of cascading use in the wood sector, facilitating the recovery of wood in the different stages of the product, optimising its use according to the wood quality (less contaminated, etc.)	487	70	19	6,96	1,71
17	CE	The furniture sector will be an established priority in the Circular Economy Package of the EC (COM (2015) 614)[1], with specific legislation to increase the reuse and recycling of its products, setting specific objectives of recovery similar to existing EPR schemes.	486	67	17	7,23	1,53
18	REA	The REACH Regulation (EC 1907/2006) classifies some of the substances used in the furniture products manufacturing, such as toxic flame retardants, formaldehyde or VOCs, as restricted substances (Annex XVII), in the list of candidates or as extremely worrying substances (substances of very high concern –SVHC-) that require authorization (Annex XIV).	475	74	20	6,47	1,93
19	EWC	There is a growing market and demand for wood waste that will be used as secondary raw materials in different sectors, ensuring their quality and traceability.	472	74	19	6,40	1,83
20	CE	Wood and wood-based derivatives will be considered a priority raw material in future reviews of the Action Plan in Circular Economy of the European Commission (COM (2015) 614), developing specific legislation in this regard to promote how and where wood is grown, how wood is maintained, as well as its efficient use and recovery in wood and wood-based derivatives.	457	65	15	6,98	1,63
21	CE	Business models of the furniture sector based on servitization are common in certain sectors (e.g. office, student rental, co-workers, young professionals, etc.), where the manufacturer owns the product and offers the use of furniture as a service to consumers for a certain fee, which covers its maintenance, replacement, etc.	453	64	24	7,02	2,24
22	EWC	End-of-life waste criteria are defined for wood waste from the industry (Directive 2008/98/EC), which will produce quality standards for secondary raw materials. This scenario is not foreseen for post-consumer wood waste (contamination, quality guarantees, etc.)	446	68	17	6,59	1,98
23	CUS	More than 70% of the furniture sector products will be made out of CoC certified resources. Big and medium companies and companies with high export rates will have this certification as a standard. Small companies will have difficulties to obtain this certification due to high costs of certification and high administrative efforts for developing, documenting and implementing the system.	441	69	18	6,42	1,77
24	FOR	The activities of greenhouse gas emissions compensation generate a reactivation of forest resources and plantations, making necessary their better management, traceability and monitoring, which will also supply the furniture industry.	440	71	18	6,20	2,05
25	BE	Based on the European Bioeconomy strategy, the European Commission will encourage significant synergies with other sectors of primary production that use and produce biological resources arise, optimizing raw materials consumption and minimizing generation of waste.	431	67	16	6,41	1,73
26	FEM	Consumers would not have the sufficient knowledge to appreciate that a particular product does not emit formaldehyde, thus a specific label of "formaldehyde-free" to inform consumers will not be needed/effective.	428	69	23	6,24	2,27
27	WEE	Some specific products that contain electrical and electronic components are affected by the requirements of the WEEE Directive (2012/19/EU), and therefore, at the end of their life cycle, they require a specific disassembly and treatment.	427	70	22	6,13	2,20
28	FLA	The use of the most toxic and dangerous flame retardants in furniture products is forbidden. Compliance with the flammability requirements set by current legislation will be secured by alternatives, such as material combinations that in themselves are fire safe, new materials, product design, including the use of interliners, with lower risk for people and the environment, and in addition smart fire prevention and education for consumers will be encouraged.	424	70	18	6,09	1,67
29	BE	The European Bioeconomy strategy has identified the furniture sector as a relevant sector to achieve its objectives, setting concrete actions that bind sector companies.	424	67	15	6,32	1,63

Class	Instrument	**Forecasted Evolution** Importance = Probability x Impact. Probability: scale 1 - 100. Impact: scale 1 - 10	**Importance**	Probability Mean Value	Probability Standard devation	Impact Mean Value	Impact Standard devation
30	FBP	The EU furniture sector adopts concrete and binding commitments aligned with the "Forest-based Industries 2050: a vision for sustainable choices in a climate-friendly future" and in particular aligned with the following goals of the vision: i) eradicate waste in circular economy by closing materials loops with a sector target of at least 90% material collection and 70% recycling rate; ii) drive resource-efficiency in the industrial value chain by enhancing productivity in all areas (materials, manufacturing, logistics); iii) meet the increasing demand for raw materials by maximizing new secondary streams and ensuring primary raw materials supply from sustainably managed forests and iv) satisfy the growing demand for climate-friendly products by increasing the use of wood and wood-based products in our daily lives.	419	64	18	6,60	1,40
31	WEE	Some specific furniture sector products that contain electrical and electronic components are affected by the requirements of the WEEE Directive (2012/19 / EU), and guidelines are set for specific disassembly of the electrical and electronic components inside the normal recovery circuit of furniture waste.	415	68	21	6,11	2,05
32	CE	The implementation of the actions proposed in the Circular Economy Package of the EC (COM (2015) 614) will produce changes in the customer service models, increasing the minimum guarantee period and the time of spare parts availability.	401	66	21	6,13	2,07
33	FEM	The European Commission does not propose to reduce the formaldehyde occupational exposure limit below the current value of 0.3 ppm.	399	71	18	5,62	1,73
34	ILL	The type of products covered by the Regulation (EU) No. 995/2010 or EUTR is extended, reducing the number of exclusions and extending the scope to medical furniture and seating furniture (e.g. sofas, chairs, etc.). Market surveillance will be stronger and the traceability of wood from forests to furniture companies will be ensured (through sustainable and traceable chains).	397	68	17	5,82	1,92
35	ROH	Furniture sector products that contain electrical and electronic components are affected by the requirements of the RoHS Directive (EU 2017/2102), and therefore their components cannot contain substances such as brominated flame retardants (PBDE, PBB) or heavy metals such as lead, mercury, cadmium or hexavalent chromium, including components purchased and finished outside the EU.	396	75	20	5,31	2,15
36	FOR	The EU Forest Strategy extends beyond forests and deals with aspects of its value chain, such as how forest resources are used to produce products or services, taking into account regional/local conditions but without specifying requirements that imply compliance.	396	64	21	6,22	1,48
37	ECL	50% of the furniture sector products have at least one type of environmental ecolabel. Ecolabel Type II will be the most common one, but Type I and III will also grow.	383	63	20	6,13	1,55
38	ECL	Customers (final or intermediate customers) will not value ecolabels Type I (according to ISO 14024) in a massive way. Just some of these ecolabels will be widely recognized and clients will consider them important, especially in specific markets and for specific products.	373	62	22	6,07	1,78
39	EMS	Some intermediate customers (B2B), value positively that the furniture products supplier in the sector has a certified environmental management system, either EMAS or ISO-14001, which has become a competitive advantage.	367	64	20	5,72	2,14
40	ECL	Intermediate customers (B2B) positively value that the furniture products have a Type III ecolabel (according to ISO 14025), which has become a competitive advantage. Final customers (B2C) will still have many difficulties to appreciate/understand the value of Type III ecolabel for products.	365	61	21	6,02	2,02
41	FLA	Consumers do not have sufficient knowledge on fire safety to determine whether it would be appreciated that a product does not contain dangerous flame retardants (and a label could have the opposite desired effect, leading the consumer to think that fire safety decreases if no flame retardants are used), thus a specific label of "flame retardant-free" would not be effective/desired.	362	67	23	5,43	2,00
42	EMS	In Europe, 15% of companies of the furniture sector have a certified environmental management system, either EMAS or ISO-14001. The impact on certified companies will be high along the whole value chain.	360	62	24	5,78	2,00
43	ILL	The signature of an agreement, under the umbrella of the FLEGT Regulation (Regulation (EC) No 2173/2005), will be compulsory between countries that want to sell wood / wood products in the EU. A stronger market surveillance will prevent the importation and sale of illegal timber products in the EU.	350	64	18	5,44	1,83
44	ECD	20% of the European furniture sector companies will adopt criteria defined by Ecodesign ISO-14006 management system, but only 5% will reach the certification.	334	55	23	6,07	1,90
45	ECD	Few final customers (B2C) and some intermediate customers (B2B), positively value that the furniture products supplier in the sector has an Eco-design ISO-14006 management system, which has become a competitive advantage in niche markets and public procurement.	333	58	24	5,72	1,82
46	END	In some pilot cases and specific regions, wood furniture and panels waste are used to produce second generation biofuels, which meet the sustainability requirements set out in Directive 2018/2001/EU.	332	58	22	5,74	1,98

Class	Instrument	**Forecasted Evolution** Importance = Probability x Impact. Probability: scale 1 - 100. Impact: scale 1 - 10	**Importance**	Probability Mean Value	Probability Standard devation	Impact Mean Value	Impact Standard devation
47	EPR	Some major manufacturers and distributors of the furniture sector and some municipalities at local level agree to define an Extended Producer Responsibility scheme or take-back scheme, which allows the products collection, return and treatment at the end of their life cycle.	332	55	26	6,06	2,39
48	ECL	The different Type I ecolabels criteria that affect the furniture sector are not unified yet, this is hindering their understanding by customers (for example European label, Blue Angel, Nordic Swan, etc.).	322	56	25	5,71	2,18
49	ECL	The amount of companies with a Type II ecolabel (according to ISO 14021) will increase a lot until 2030. This is a positive first step for this trend, but educated consumers will not give much value to self-declarations.	317	57	21	5,58	1,93

Topics Acronyms Code/ Instrument

CUW	*Cascading use of wood*
CUS	*Chain of Custody FSC/PEFC*
CE	*Circular Economy Package of the EC*
ECD	*Ecodesign ISO14006*
ECL	*Ecolabels (Type I, II, III)*
EWC	*End-of-waste criteria*
END	*Energy Directive*
EMS	*Environmental Management Systems ISO14001/EMAS*
EPR	*EPR schemes*
ErP	*ErP Directive*
FOR	*EU industry policy for Forestry*
FLA	*Flame retardants*
FBP	*Forest Based Industries Blueprint*
FEM	*Formaldehyde emissions*
GBC	*Green building certification BREEAM/LEED*
GPP	*Green Public Procurement*
ILL	*Illegal logging and illegal timber trade*
REA	*REACH Regulation*
ROH	*RoHS Directive*
WEE	*WEEE Directive*

We can see the following ones in the graphic first quadrant with higher probability and higher impact (probability > 68; impact > 6,35):

- Chain of custody
- Green Public Procurement
- REACH Regulation
- Cascading use of wood
- Green building certification BREEAM/LEED
- Ecodesign
- End-of-waste criteria
- EPR – Extended Producer Responsibility schemes

We can see the following ones in the graphic second quadrant with lower probability and higher impact (probability < 68; impact > 6,35)

- ErP Directive
- Forest Based Industries Blueprint
- Bioeconomy
- Circular Economy Package of the EC

Concepts and framework taken into account for the occupational profiles changes analysis

In this section we present the framework and concepts we used to implement the analysis of the impact of the circular economy transition on the EU furniture sector within the perspective of the sector Twin Transition. As basis for the analysis, we used the framework of the ReSOLVE levers developed by the McKinsey Center and Ellen MacArthur Foundation (Growth Within: A Circular Economy Vision for a Competitive Europe, 2015 bit.ly/2MreFWM) and we analysed how the different levers impacted the occupational profiles existing tasks and eventually created new ones.

Based on the changes in the occupational profiles tasks, we identified the evolution of the OHS risks and of the skills needs due to the furniture sector transition toward a more circular economy. In the following section, we present these changes for each of the eleven profiles through different tables later on presented.

The full reports can be found at: circularfurniture-sawyer.eu/downloads/

ReSOLVE levers explanation

This first table shortly describes the levers identified by the McKinsey Center and Ellen MacArthur Foundation as key accelerators of the transition toward a more circular economy. These levers have been slightly adapted by us to the furniture sector.

Table 4 - ReSOLVE levers explanation, considering furniture sector

	Levers	Short description
Regenerate	Shift to renewable energies	Using mainly renewable energies, for example solar, wind, including biomass (e.g. possible use of wood residues as energy source).
	Shift to renewable materials	Using wood-based materials from more sustainable sources or change other materials (e.g. plastic, metals or textiles parts) for renewable alternatives.
	Reclaim, retain, and regenerate health of ecosystems	Facilitating the regeneration of ecosystems damaged by their activities, for example promote sustainable management of forests and plantations, land regeneration, biodiversity preservation, etc.
	Return recovered biological resources to the biosphere	Facilitating the return of wood waste to the biosphere (e.g. return of wood incineration ashes as nutrients to forest, etc.).
Share	Reduce product replacement speed and increase product utilisation by sharing it among different users	Promoting the products sharing, for example through the sharing of privately owned products or through public sharing of a pool of products.
	Reuse products throughout their technical lifetime	Supporting products reuse, for example facilitating refurbishment or remanufacturing processes (e.g. cleaning, disassembly, etc.) and providing information about the product characteristics (e.g. disassembly process, used materials and components, etc.).
	Prolong products lifetime through maintenance	Facilitating the maintenance of the products by providing maintenance instructions to users or specialised services (e.g. coating maintenance requirements, recommended maintenance products, etc.).
	Prolong products lifetime through repair	Facilitating product repair (by the user or by specialised services), for example making available repair information, spare parts and their quick delivery at reasonable price, facilitating products disassembly/assembly, increasing warranty period or providing information about the product characteristics (e.g. disassembly process, used materials and components, etc.).
	Prolong products lifetime through design for durability	Extending product durability through design, for example using more durable materials and fittings, avoiding aesthetic obsolescence, applying modular/adaptable design, etc.
Optimise	Increase performance/ efficiency of products	Rising the performance of their products, for example through modular design, using a lower number of parts and materials, offering more functionalities, etc.
	Customisation/made to order	Customising products according to consumers' needs and requirements or producing on demand (e.g. batch size 1, massive customisation).
	Reproductible and adaptable manufacturing	Upgrading manufacturing processes to be more reproducible, adaptable, flexible and autonomous to demand changes and production needs (Industry 4.0).
	Minimize waste in production and supply chain	Reducing the generation of waste along the whole life cycle of products, for example of the packaging (from suppliers and product distribution), production scraps, etc.
	Increase efficiency of production processes	Rising the efficiency of their production process, for example by applying new 4.0 technologies (e.g. robots, big data, etc.), more efficient equipment or new methods (e.g. lean manufacturing).
Loop	Remanufacturing products and/or components	Directly remanufacturing products or parts, for example defining collection systems, implementing remanufacturing processes (e.g. sorting and cleaning, replacement of components/materials, etc.) and defining testing and quality validation mechanisms.
	Implement take-back programs	Starting take-back programmes for company's products (e.g. collection points, reverse logistics, treatment processes, end-of-life scenario for the recovered materials, etc.).
	Recycling materials	Increasing the use of recycled materials (e.g. wood-based recycled material), defining quality and supply requirements for recycled material, testing procedures, quality validation mechanism, etc.
	Promote the cascade use of wood	Supporting the cascade use of wood, for example facilitating the recycling (material compatibility, etc.), avoiding the use of hazardous substances, providing information about the used materials and substances, etc.
	Promote extraction of biochemicals from organic waste	Promoting the anaerobic digestion or extraction of biochemicals from wood waste, for example avoid the use of possible contaminants facilitating the recovery process.
Virtualise	Virtualise direct aspects of the product	Dematerialising (virtualising) the product itself, for example through the virtual design for the customer, product performance simulation, etc.
	Virtualise indirect aspects of the product	Dematerialising (virtualising) indirect aspects of the product, for example on-line shopping, virtual assistance services, digital information about the product for the consumer, etc.
Exchange	Replace old materials with advanced renewable ones	Changing the old materials by other advanced renewable materials, for example new types of laminates, new coatings, new additives, etc.
	Apply new technologies	Implement and adopting new 4.0 technologies in the product and production processes (e.g. additive manufacturing, IoT, augmented reality, etc.)
	Choose new products and services	Developing new products, services and business models, for example servitization (product as a service), multi-functional product, etc.

Level of impact of the legislative, voluntary and policy instruments on the ReSOLVE levers

The following table presents the foreseen level of impact of the identified legislative, voluntary and policy instruments, on the proposed levers of the ReSOLVE framework on circular economy, in 2030.

0.- No impact foreseen in 2030 on wood-based furniture manufacturers
1.- Small impact foreseen in 2030 on wood-based furniture manufacturers
3.- Medium impact foreseen in 2030 on wood-based furniture manufacturers
5.- Large impact foreseen in 2030 on wood-based furniture manufacturer

The higher values highlight those instruments that could have a greater impact on the levers and which lever could be more affected by those instruments. This information can be used by the company to properly define its own circularity strategy and its alignment with these instruments.

Table 5 - Level of impact of the legislative, voluntary and policy instruments on the ReSOLVE levers.

		Regenerate			
		Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere
Legislative instruments	Circular Economy Package of the EC	3	5	3	3
	Waste Electrical and Electronic Equipment Directive (WEEE)	0	0	0	0
	Restriction of hazardous substances in Electrical and Electronic Equipment (ROHS)	0	0	0	0
	Energy related Products Directive (ErP or eco-design directive)	0	3	1	0
	Extended Producers Responsibility (EPR schemes)	3	3	1	3
	Hazardous substances / REACH Regulation	0	3	1	1
	Formaldehyde emissions/ VOCs	0	1	0	0
	EU's rules on "end-of-waste" criteria	3	3	1	3
	Flame retardants	1	1	0	0
	Renewable energy Directive (RED II)	5	0	0	3
	Illegal logging and illegal timber trade	0	3	3	0
Voluntary Instruments	Green Public Procurement	1	5	1	0
	Environmental management in organizations	3	1	3	3
	Ecodesign methodology	3	5	0	1
	Ecolabels (Type I, II, and III)	1	3	1	0
	Chain of custody certification	0	5	5	1
	Green building certification	1	3	1	0
Policies	Cascading use of wood	3	5	1	3
	EU industry policy for Forestry	1	3	3	1
	Forest-based Industries Blueprint	1	3	1	1
	Bioeconomy	1	3	3	1
	Total	30	58	29	24

	Share					Optimise					Loop					Virtualise		Exchange			
	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	Remanufacturing products and/or components	Implement take-back programs	Recycling materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	Total
	3	5	3	3	5	3	3	3	5	3	3	5	5	3	1	3	3	3	3	5	84
	0	1	0	1	1	1	1	1	3	1	1	3	3	1	0	0	1	1	3	1	24
	0	0	0	0	0	0	1	1	0	0	0	0	3	3	1	0	1	1	1	0	12
	1	3	1	1	3	3	1	1	1	1	3	1	3	3	0	1	3	1	1	1	37
	3	5	3	5	5	3	1	3	5	3	5	5	3	3	1	1	3	3	3	5	78
	0	3	1	1	1	1	3	3	1	3	1	1	3	5	1	1	1	3	3	1	42
	0	1	1	1	1	1	3	3	0	1	0	0	1	3	0	0	1	5	3	0	26
	0	0	0	0	0	1	0	0	5	3	1	1	5	3	3	0	0	1	0	1	34
	1	3	0	1	3	1	3	3	0	1	1	1	3	3	1	1	1	3	3	0	35
	0	0	0	0	0	0	0	0	3	3	0	1	0	1	3	0	0	0	1	1	21
	0	0	0	0	0	0	1	3	1	1	1	1	3	1	0	0	1	1	3	3	26
	3	3	5	5	5	5	3	3	1	3	3	3	5	3	0	3	3	3	3	5	74
	0	0	0	0	1	0	1	3	3	5	1	3	3	1	0	0	3	1	1	1	37
	3	5	3	5	5	3	1	0	1	1	3	1	5	3	1	3	1	3	3	5	64
	1	3	1	3	3	3	3	1	1	3	3	1	5	3	0	1	5	3	3	3	54
	0	0	0	1	0	1	1	3	1	3	1	1	3	3	1	1	3	3	3	3	43
	1	1	1	1	3	3	3	1	1	1	1	1	3	1	0	1	1	1	1	3	34
	3	3	1	1	3	1	1	1	3	3	3	3	5	5	3	1	1	1	3	3	60
	0	0	0	0	0	0	0	1	1	3	1	1	1	1	1	0	0	0	1	1	20
	1	3	1	3	3	1	3	5	1	5	3	1	3	3	0	3	3	3	3	5	59
	1	1	0	0	1	0	0	1	1	1	1	3	3	3	1	0	1	3	3	3	35
	21	40	21	32	43	31	33	40	38	48	36	37	68	55	18	20	36	43	48	50	

Ranking of impacting ReSOLVE levers and legislative, voluntary and policy instruments

The following two tables are built on the outcomes of the previous analysis.

The first table presents the ranking of the ReSOLVE levers most impacted by the previously identified legislative, voluntary and policy instruments playing a key role in accelerating the furniture sector transition toward a more circular economy.

The second table presents ranking of the most impacting instruments and policies on the ReSOLVE levers.

Table 6 - Ranking of ReSOLVE levers impact

ReSOLVE levers	Score
Recycling materials	68
Shift to renewable materials	58
Promote the cascade use of wood	55
Choose new products and services	50
Apply new technologies	48
Increase efficiency of production processes	48
Prolong products lifetime through design for durability	43
Replace old materials with advanced renewable ones	43
Reuse products throughout their technical lifetime	40
Reproductible and adaptable manufacturing	40
Minimize waste in production and supply chain	38
Implement take-back programs	37
Remanufacturing products and/or components	36
Virtualise indirect aspects of the product	36
Customisation/made to order	33
Prolong products lifetime through repair	32
Increase performance/efficiency of products	31
Shift to renewable energies	30
Reclaim, retain, and regenerate health of ecosystems	29
Return recovered biological resources to the biosphere	24
Reduce product replacement speed and increase product utilisation by sharing it among different users	21
Prolong products lifetime through maintenance	21
Virtualise direct aspects of the product	20
Promote extraction of biochemicals from organic waste	18

Table 7 - Ranking of circular economy instruments and policies impact

Instruments	Score
Circular Economy Package of the EC	84
Extended Producers Responsibility (EPR schemes)	78
Green Public Procurement	74
Ecodesign methodology	64
Cascading use of wood	60
Forest-based Industries Blueprint	59
Ecolabels (Type I, II, and III)	54
Chain of custody certification	43
Hazardous substances / REACH Regulation	42
Environmental management in organizations	37
Energy related Products Directive (ErP or eco-design directive)	37
Flame retardants	35
Bioeconomy	35
Green building certification	34
EU's rules on "end-of-waste" criteria	34
Illegal logging and illegal timber trade	26
Formaldehyde emissions/ VOCs	26
Waste Electrical and Electronic Equipment Directive (WEEE)	24
Renewable energy Directive (RED II)	21
EU industry policy for Forestry	20
Restriction of hazardous substances in Electrical and Electronic Equipment (ROHS)	12

Risks and hazards in the wood furniture industry

Woodworking in the furniture industry can be hazardous for workers. From the use of machinery and tools, handling heavy materials to exposure to dust, noise and chemicals - potentially harmful events can happen at any time. These events can affect the health of workers, for example causing them to suffer skin and respiratory diseases. They can cause injuries such as a loss of fingers or even death.

In Table 8 you will find an overview about the different kinds of hazards that workers of wood furniture manufacturing plants can face. It is the product of our OHS external expert, based on different sources of information and their analysis. In BLUE you will find the hazards due to the sector digitalization in 2025. In addition, we highlighted in GREEN the new hazards due to the circular economy transition in 2030.

The hazards mentioned in the table are related to the furniture industry - furniture manufacturing plants - and the potential new activities that could be carried out in these plants due to new production processes and bussiness models emerged thanks to a more circular economy (e.g. remanufacture, repair, etc.).

Provided that occupational health and safety are part of the management and included when designing eco-friendly products (e.g. easier dissassembly, less hazardous substances content, etc.), the health and safety of workers in the woodworking sector will benefit from circular economy strategies.

Changes and hazards due to activities and tasks of the recycling industry or related to new sources of energy are not in the scope of this analysis and have not been included. Field services like maintenance and repair at customer site are also not in the scope of this report.

Table 8 - Common and new risks and hazards in the furniture sector.

Different categories of hazards	Hazards details for each category and short description
Mechanical hazards	
• Unprotected moving parts (cobotics), (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping). • Parts with hazardous shapes (cutting, pointed, rough). • Moving means of transport and tools (run over, roll over, falls from height). • Uncontrolled moving parts (flying objects, wood chips).	Hand and power tools: Risk of stabs, cuts, amputations of fingers from hand and power tools. Remanufacturing and selective disassembling could require new types of tools. Unprotected moving parts: Risk of entanglement of body parts into rotating parts or machinery. Parts with hazardous shapes (cutting, pointed, rough).
• Slip and trips	Slips and trips and falls from heights.
• Falls from height	Risks of slips, trips and from slippery surfaces, stairs, obstacles on walkways, poor lighting, unsuitable footwear, unsafe use of ladders.
• Ergonomic hazards	Risks from ergonomic hazards may decrease, depending on takeover of specific task by cobots/ robots. On the other hand, workers are increasingly exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous machines and cobots from computer workstations. Risk may decrease for workers due to a better design of products (ecodesign), considering aspects such as easier assembly and disassembly, better selection of joining systems, etc. and if safe maintenance of the machinery is taken into consideration from the beginning.
• Heavy loads/heavy dynamic work	Risk of pain from heavy loads and heavy dynamic work. Risk may decrease for workers due to use of robots/cobots and digital machinery. The dismantling of manufactured goods might cause Musculoskeletal Disorders (MSDs) (e.g. awkward positions, heavy lifting and carrying).
• Awkward position/unbalanced strain	Risk of pain or injury from working in awkward positions. Risk may decrease for workers due to use of robots/cobots and digital machinery. Disassembly operations for material recovery (destructive methods) might cause additional Musculoskeletal Disorders (MSDs).
• Repetitive movements	Risk of pain or injury from performing repetitive tasks.
• Lack of exercise; inactivity	Risk of chronic neck and back pain, obesity and cardiovascular diseases resulting from inactivity, prolonged sitting and from poor ergonomic practices with mobile devices.
Electrical hazards	
• Electric shock	Risk of electrocution from poorly maintained or broken machinery and electrical cables.
• Hazards due to physical effects/physical agents	
Hazards due to physical effects/physical agents	
• Noise	Exposure to loud noise from machinery and tools. Possible more use of loud machinery in dismantling and repairing activities. However, noise maybe reduced due to ecodesign of machinery operating quieterly and more efficiently.
• Vibration	Risk of hand-arm vibration from vibrating tools or workpieces. Possible additional use of vibrating tools during product remanufacturing or repair (polisher, etc.). However, vibration maybe reduced due to ecodesign of machinery operating with less vibrations and more efficiently.
• Laserlight	Exposure to laserlight from laser cutting machines.

Different categories of hazards	Hazards details for each category and short description
Fire and explosion hazards	
• Flammable substances	Explosion: Explosion risks from materials, including wood dust and chemicals. Recycling of wood products produces high levels of wood dust and fine particles during the crushing. Without efficient dust extraction the risk of explosion may increase. Solvents, cleaning products and lubricants used in the woodworking sector may be based on less hazardous substances (e.g. solvents) and prevent therefore fire hazards.
	Fire: Risk of fire from chemicals and wood dust. Recycling of wood products produces high levels of wood dust and fine particles during the crushing. Without efficient dust extraction the risk of fire may increase. Solvents, cleaning products and lubricants used in the woodworking sector may be based on less hazardous substances (e.g. solvents) and prevent therefore fire hazards.
Work environmental hazards	
Poor lighting conditions	Risk of glare or insufficient light as well as flickering light.
Climate	Risk of being exposed to hot or cold work environment combined with humidity or draughts.
Poor ventilation	Risk of being exposed to a working environment with poor ventilation or fresh air.
Hazards through dangerous substances	Risk may decrease for workers due to use of robots/cobots and digital machinery when handling dangerous substances. Manufacturing: Hazards may be reduced, if OSH will be included in the design of the products/materials. The need of solvents may decrease, less hazardous solvents might be used, as the use of hazardous flame retardants if any new related legislation is approved or good practices implemented. Recycling/using recycled material: Hazards might be increased by the lack of information on chemicals contained in recycled products and on ways how to deal appropriately with them.
• Dust	Cancer risk from wood dust. Risk of allergic respiratory symptoms from wood dust. Recycling - Increased exposure to dust: exposure to fibres or dust when disassembling, remanufacturing and repairing furniture; dust from recycled material of unknown origin might cause occupational asthma (cases of occupational asthma have been reported in association with wood and paper recycling).
• Solvents (neurotoxic, allergens)	Risks from hazardous chemicals, solvents and other materials - dermatitis, allergic reactions or respiratory problems, organ damage. Manufacturing: the need of solvents may decrease, less hazardous solvents may be used. Repairing and remanufacturing activities may increase the need of solvents (varnish cleaning, cleaning of used parts).
• Carcinogens	Cancer risks from chemicals (hazardous flame retardants mainly in upholstery products; adhesives and coating agents are used in finishing wood products, such as solvents in paints, glues, varnishes and lacquers, and paint stripping chemicals). Manufacturing: the need of solvents may decrease, less hazardous solvents may be used. Recycling and using recycled material: Recycled material may contain dangerous substances, to the latest findings carcinogen or repro-toxic (nowadays restricted by law (REACH)).
• New materials (e.g. Nanomaterials)	Risk of exposure to nanomaterials: there are large gaps in the knowledge about health hazards associated to nanomaterials. On the other hand, new materials may be safer substitutes for hazardous substances.
• Recycled materials	Recycled materials may concentrate hazardous substances (impurities and hazardous flame retardants mainly in upholstery products) during successive recycling or may change the composition due to different factors such as light, heat and aging of material →unknown content and kind of hazardous substances.
Biological hazards	
• Handling microorganism: Risks from non-targeted activities with microorganism.	New Companies using their own wood waste as an energy source. Remanufacturing activities and take-back systems of old furniture may put workers at risk of being exposed to microorganisms such as mould.
Psychosocial hazards	The working environment and the nature of work itself are both important influences on the health and well-being of working people.
• Excessive workloads	Excessive workload put workers at risk of high levels of time pressure, and working at the limit.
• Low job satisfaction	Low job satisfaction leads to psychological distress in workers and may result in sleep disorders, headaches and gastro-intestinal problems.
• Work tasks not clearly defined	Poor organisation of work, tasks that are not clearly defined may put workers at risk of work overload or under load, and result in discontent and stress.

Different categories of hazards	Hazards details for each category and short description
• Poor organisation of work	Poor organisation of work may put workers at risk of work overload or under load, machine pacing, high levels of time pressure.
• Poorly designed workplace environment (incl. software)	Inadequate equipment availability, suitability or maintenance; poor environmental conditions such as lack of space, poor lighting, excessive noise put workers under stress.
• Repetitive, monotonous work	
• Cognitive strain	Cognitive interactions with autonomous equipment and virtual reality put workers under stress. Increased demand for competences and up-to-date knowledge on developments in circular economy and recycling industry.
• Stress due to long period concentration and awareness	Long period of concentration working with computer and new software and performing multitasks.
• Increased demands on flexibility	Increased demand on flexibility: workers may perform some tasks from everywhere with mobile devices. Workers are at risk of being permanent available outside working hours. Remanufacturing and repair activities, working with recycled material, deciding on circular economic and sustainable oriented strategies/products/marketing projects, and use of renewable energy sources require an increased demand for flexibility.
• Lack of work experience	New software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Working with materials, which have previously been manufactured: new skills need to be acquired throughout the production cycle and supply chain. Repairing, remanufacturing and selective disassemblying require new methods and procedures. Deciding on circular economic and sustainable oriented strategies/products/marketing projects.
• Lack of involvement in making decisions that affect the worker	Workers that do not see themselves respected and appreciated feel vulnerable and helpless.
• Ineffective communication, lack of support from management or colleagues	Ineffective communication due to bad working atmosphere or lack of colleagues put workers under stress.
• Working alone/isolation	Working alone without colleagues or only with robots put workers under stress and isolation.
• Unbalanced workload: overload/underload	Unbalanced workload put workers under stress.

Poole C.J.M., Basu S., 'Systematic Review: Occupational illness in the waste and recycling sector', Occup Med (Lond), 67(8), p: 626–636, 2017.

Short description of skills, knowledge and competences and the green generic competencies

The definitions of the following concepts are the same in ESCO (European classification of Skills/Competences, qualifications and Occupations) and in the European Qualifications Framework.

Knowledge

"Knowledge means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study."

Both skills and competences rely on factual and theoretical knowledge, the difference lies in the way this knowledge is applied and being put into use.

Skills

"Skill means the ability to apply knowledge and use know-how to complete tasks and solve problems". They can be described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

Competences

"Competence means the proven ability and individual capacity to use knowledge (theoretical and practical), skills and personal, social and/or methodological abilities, in real work or study situations and in professional and personal development." They are described in terms of responsibility and autonomy. Competences are therefore by definition individual, process-oriented (action and development-oriented) and contextual.

While sometimes used as synonyms, the terms skill and competence can be distinguished according to their scope. The term skill refers typically to the use of methods or instruments in a particular setting and in relation to defined tasks. The term competence is broader and refers typically to the ability of a person - facing new situations and unforeseen challenges - to use and apply knowledge and skills in an independent and self-directed way.

Thus:
- **Knowledge = theoretical, practical, occupational, industrial ...**
- **Skills = cognitive, practical, social ... Skills = know how to ...**
- **Competence = task-based, occupational, procedural, social, personal ... Competence = social and self-competence**

Generic green skills

Generic green skills include knowledge, skills and competences (KSC) that are necessary for social, economic and environmental developments in our wood furniture sector. Thanks to these generic green skills we can contribute to the greening of the sector, supporting the transformation from a linear to a circular economy. Therefore, it is necessary to develop a green mindset for minimizing the environmental impacts during the entire life-cycle of the products.

Dr Margarita Pavlova has classified **generic green skills in four categories**, which are required for every occupation regardless of its skills level and align with key competencies or soft skills that are crucial for the modern workforce. These soft skills are here contextualized within the perspective of environmental awareness and the understanding of sustainable development and circular economy.

- **cognitive competencies** (1 to 3)
- **interpersonal competencies** (4 tot 9)
- **intrapersonal competencies** (10 and 11)
- **technological competencies** (12 to 14)

In this SAWYER study, we use these generic green skills in the following context:

- **Environmental awareness and willingness to learn**: about sustainable development and circular economy.
- **Systems and risk analysis skills** to assess, interpret and understand both the need for change from a linear to a circular economy and the specific measures required for this transformation.
- **Innovation skills** to identify opportunities and create new strategies to respond to green challenges associated to circular economy.
- **Coordination, management and business skills** to facilitate holistic and interdisciplinary approaches incorporating economic, social and ecological objectives in the organisation, but also in the product value chain.
- **Communication and negotiation skills** to discuss conflicting interests in complex contexts associated to the product value chain.
- **Marketing skills** to promote greener products and services and communicating the benefits of circular economy strategies.
- **Strategic and leadership skills** to enable policy-makers and business executives to set the right incentives and create conditions enabling cleaner production, cleaner transport, etc. and promote circular economy in general.
- **Consulting skills** to advise consumers about green solutions and to spread the use of green technologies and circular economy strategies.
- **Networking, information technology and language skills** to enable performance in global markets and in the product value chain.
- **Adaptability and transferability skills** to enable workers to learn and apply the new technologies and processes required to green their jobs and apply circular economy strategies.
- **Entrepreneurial skills** to seize the opportunities relating to low-carbon technologies and circular business models for products and services.
- Waste, energy and water **quantification and monitoring** to follow the evolution of circular economy performance indicators.
- **Material use and impact** quantification and monitoring in green procurement and selection,
- Material use and impact **minimization** (impact assessment), considering the complete life cycle of the material

We have indicated whether these generic green skills have an impact (or not) on the targeted ESCO profiles and in which measure.

Technical green skillsets

For some occupational profiles, new green skillsets will be required as there will be some new, specific tasks, related to disassembling and re-using, remanufacturing, recycling and upcycling. These new skillsets are especially (more) important for the "practical" profiles, such as the Cabinet Maker, the Upholsterer or the Woodworking Machine Tool Setter, but also for the Factory Hand, the Furniture Assembler and the Wood Processing Plant Operator. For these profiles, some of the Generic Green Competences related to management, marketing and communication will be less pronounced.

The **new specific, technical green skillsets** are:

- Disassemble wood-based furniture products.
- Examine disassembled pieces for further steps (re-use, remanufacturing, recycle, upcycle).
- Repair wood-based furniture pieces, where needed.

These skills come as a "topping up" on the existing, necessary KSCs for the above-mentioned occupational profiles.

The new green skillsets will also have an impact, though not so significant, on those profiles that are managing and taking strategic decisions in the company. In the case of the analysed ESCO profiles, we think about the sales and marketing managers, the industrial production managers, the supply chain managers and of course, the furniture designers.

Occupational profiles: current and forecasted changes in 2030

The following section includes the details of the changes forecasted within the **furniture sector** due to its circular economy transition (in green for 2030) and digitalization (in blue for 2025): the **updated tasks** of the targeted occupational profiles, the **existing and new OHS risks** and the **updated skills, knowledge and competencies needs**. They are presented through specific tables focusing on each of these aspects.

In all the following tables, we used the blue colour text to identify any changes of the current situation due to the sector digitalization and the green colour text for the changes due to the sector circular economy transition.

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition and digitalization for each occupational profile.
In these green tables, the **first column** on the left includes a detailed description for each profile of the **current/updated tasks** (in 2020). The columns and cells in the middle identify which tasks are affected by the different ReSOLVE levers. The **last column** on the right presents the **tasks changes forecast** due to the sector digitalization in blue for 2025 and due to sector circular economy transition in green by 2030.

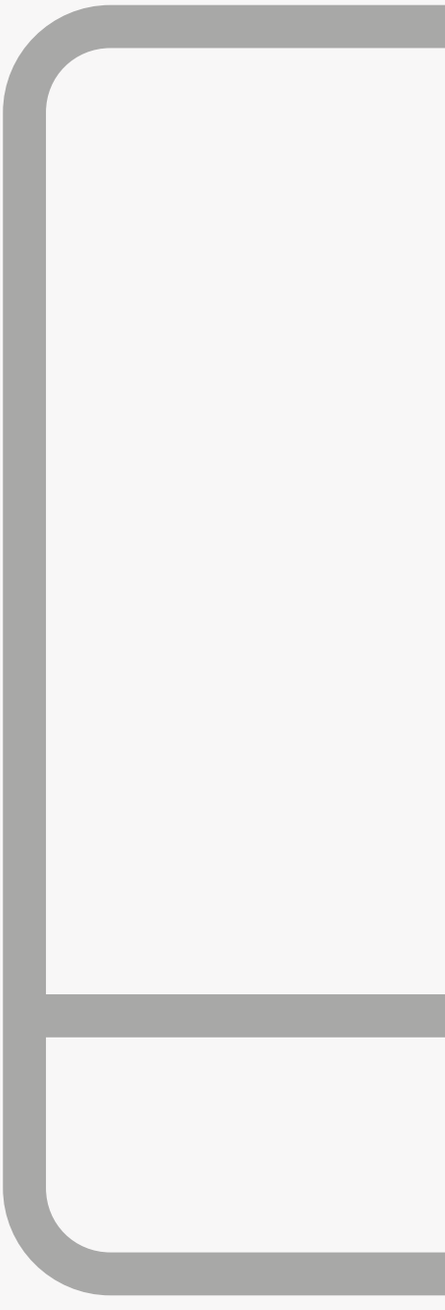
Hazards and risks changes

Current and forecasted risk changes due to sector digitalization for each occupational profile.
In these yellow tables, the first and the last columns are the same than in previous tasks changes tables. The central cells represent the forecast of the **new categorization of hazards**, identifying in grey the ones that should not change, in green the ones reduced due to the circular economy, in red the new or increased ones due to circular economy, in blue the ones reduced due to digitalization and in yellow the ones increased due to digitalization. Following this table, another section contains the **details of current and forecasted hazards and risks** changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025).

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and sector digitalization (in blue for 2025) for each occupational profile.

In these tables, on the left column you will find the list of **current and new skills, knowledge and competences needs** including the generic green ones. The second column will tell you for each profile if the SKC will be updated (YES, changed), still needed (YES or NO), new ones (NEW) or not applicable (NA). In the last columns on the right, which number and content differ for each profile, identify the **reasons of change** for each of the skills, knowledge and competences: the green points indicate that the change is due to the sector circular economy transition and the blue points if it is due to the sector digitalization.



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You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.

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Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

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Sales and marketing manager ISCO 1221

2020
Occupational profile

Current profile description
Sales and marketing managers plan, direct and coordinate the sales and marketing activities of an enterprise or organization, or of enterprises that provide sales and marketing services to other enterprises and organizations.

Current profiles tasks		ReSOLVE levers*																							
		Regenerate	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	**Share**	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	**Optimise**	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	**Loop**	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste	
A	Planning and organizing special sales and marketing programmes based on sales records and market assessments.		●	●	●	●		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●	
B	Determining price lists, discount and delivery terms, sales promotion budgets, sales methods, special incentives and campaigns.		●	●					●	●	●	●		●	●	●				●	●	●			
C	Establishing and directing operational and administrative procedures related to sales and marketing activities.																								
D	Leading and managing the activities of sales and marketing staff.													●	●	●				●	●				
E	Planning and directing daily (sales and marketing) operations.																								
F	Establishing and managing budgets and controlling expenditure to ensure the efficient use of resources.																								
G	Overseeing the selection, training and performance of staff.			●				●	●	●	●	●					●				●	●	●		
H	Representing the enterprise or organization at sales and marketing conventions, trade exhibitions and other forums.		●	●	●				●	●	●	●		●	●	●	●	●		●	●	●	●		

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Sales and marketing manager - ISCO 1221

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Sales and marketing managers plan, direct and coordinate the sales and marketing activities of highly digitized and circular economy-oriented enterprises or organizations, or of enterprises that provide sales and marketing services to other digitized and circular economy-oriented enterprises and organizations. Use digitization tools and circular economy-oriented strategies to work in a customer-oriented manner.

Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	**Profile tasks forecast**
	●	●		●	●	●	A Planning and organizing special sales and marketing programmes based on connected customers ecosystem, sales records, and global digitized market assessments and considering the circular economy-oriented strategies of the organisation and its customers.
	●	●				●	B Determining price lists, discount and delivery terms, sales promotion budgets, sales methods, special incentives and campaigns using digitized inputs from customer ecosystems, including customers' sustainability needs and requirements on products and services, and a globally connected distribution and marketing network.
	●	●				●	C Establishing and directing digitized operational and administrative procedures related to sales and marketing activities, aligned with the organisation's strategies and customers demands on sustainability.
	●	●				●	D Leading and managing the activities of sales and marketing staff in highly digitized and circular economy-oriented organizations, motivating and engaging the staff on organisation sustainability strategies.
	●	●				●	E Planning and directing daily (sales and marketing) operations within a highly digitized entreprise-customer ecosystem and alligned with the circular economy-oriented strategies of the customers and the organisation.
	●	●				●	F Establishing and managing budgets and controlling expenditure to ensure the efficient use of resources in a fully connected and digitized system, meeting the customers' expectations on sustainability (and other issues).
	●	●			●	●	G Overseeing the selection, training and performance of staff exploiting tools and instruments of an highly connected and digitized company, promoting circular economy competences and skills.
	●	●		●	●	●	H Representing the enterprise or organization at sales and marketing conventions, trade exhibitions, in online platforms and other face-to-face or virtual forums, communicating the circular economy-oriented strategies of the organisation and other sustainability aspects of the products and services.

Sales and marketing manager ISCO 1221

2020
Occupational profile

Current profile description
Sales and marketing managers plan, direct and coordinate the sales and marketing activities of an enterprise or organization, or of enterprises that provide sales and marketing services to other enterprises and organizations.

New categorization of hazards

Current profiles tasks		**Mechanical hazards**	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	**Ergonomic hazards**	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	**Electrical hazards**	Electric shock	**Hazards due to physical effects/physical agents**	Noise	Vibration	Laserlight	**Fire and explosion hazards**	Flammable substances	**Work environment hazards**	Poor lighting conditions	Climate	Poor ventilation	**Hazards through dangerous substances**	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	**Biological Hazards**	Non-targeted activities with microorganism	**Psychosocial hazards**	Excessive workloads	
A	Planning and organizing special sales and marketing programmes based on sales records and market assessments.												●		○								○	○											○	
B	Determining price lists, discount and delivery terms, sales promotion budgets, sales methods, special incentives and campaigns.												●		○								○	○											○	
C	Establishing and directing operational and administrative procedures related to sales and marketing activities.												●		○								○	○											○	
D	Leading and managing the activities of sales and marketing staff.												●		○								○	○											○	
E	Planning and directing daily (sales and marketing) operations.												●		○								○	○											○	
F	Establishing and managing budgets and controlling expenditure to ensure the efficient use of resources.												●		○								○	○											○	
G	Overseeing the selection, training and performance of staff.												●		○								○	○											○	
H	Representing the enterprise or organization at sales and marketing conventions, trade exhibitions and other forums.						●						●										○	○											○	

○ No changes ● Reduced due to Circular Economy ● New or increased due to Circular Economy ● Reduced due to digitalization ● New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Sales and marketing manager - ISCO 1221

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Sales and marketing managers plan, direct and coordinate the sales and marketing activities of highly digitized and circular economy-oriented enterprises or organizations, or of enterprises that provide sales and marketing services to other digitized and circular economy-oriented enterprises and organizations. Use digitization tools and circular economy-oriented strategies to work in a customer-oriented manner.

	Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload	Profile tasks forecast
A		●	●	●		●	●	●	●		●	●	●	Planning and organizing special sales and marketing programmes based on connected customers ecosystem, sales records, and global digitized market assessments and considering the circular economy-oriented strategies of the organisation and its customers.
B		●	●	●		●	●	●	●		●	●	●	Determining price lists, discount and delivery terms, sales promotion budgets, sales methods, special incentives and campaigns using digitized inputs from customer ecosystems, including customers' sustainability needs and requirements on products and services, and a globally connected distribution and marketing network.
C		●	●	●		●	●	●	●		●	●	●	Establishing and directing digitized operational and administrative procedures related to sales and marketing activities, aligned with the organisation's strategies and customers demands on sustainability.
D		●	●	●		●	●	●	●		●		●	Leading and managing the activities of sales and marketing staff in highly digitized and circular economy-oriented organizations, motivating and engaging the staff on organisation sustainability strategies.
E		●	●	●		●	●	●	●		●	●	●	Planning and directing daily (sales and marketing) operations within a highly digitized entreprise-customer ecosystem and alligned with the circular economy-oriented strategies of the customers and the organisation.
F		●	●	●		●	●	●	●		●	●	●	Establishing and managing budgets and controlling expenditure to ensure the efficient use of resources in a fully connected and digitized system, meeting the customers' expectations on sustainability (and other issues).
G		●	●	●		●	●	●	●		●		●	Overseeing the selection, training and performance of staff exploiting tools and instruments of an highly connected and digitized company, promoting circular economy competences and skills.
H		●	●	●		●	●	●	●		●		●	Representing the enterprise or organization at sales and marketing conventions, trade exhibitions, in online platforms and other face-to-face or virtual forums, communicating the circular economy-oriented strategies of the organisation and other sustainability aspects of the products and services.

1 Cobotics (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping).
2 Run over, roll over, falls from height.

Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Sales and marketing manager - ISCO 1221

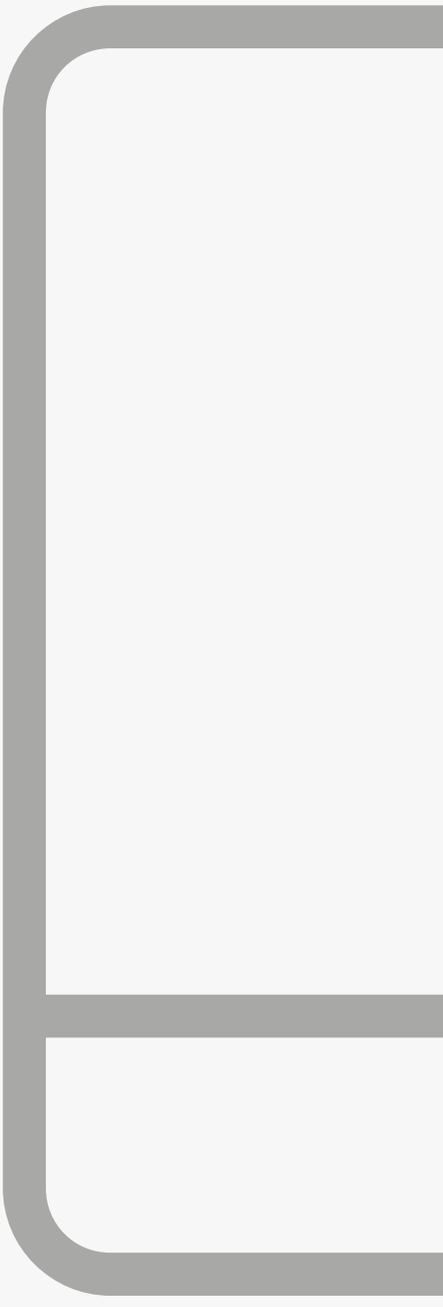
2020 Current situation	2025-30 Situation forecast
Work system/work area: office work, business trips, visits to trade fairs, contact with business partners and clients.	Work system/work area: office work, business trips, visits to trade fairs, contact with business partners and clients. Use of innovative software and tools. Taking into account sustainable products and production lines, circular-economy and renewable energy.
Mechanical hazards	
• Slips and trips, obstacles, table edges, moving vehicles, machines. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	• Slips and trips, obstacles, table edges, moving vehicles, machines. **Effects**: squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: from poor ergonomic conditions and inactivity. **Effects**: musculoskeletal diseases, overweight, cardiovascular problems.	• Ergonomic hazards: from poor ergonomic conditions and inactivity. Digitalization will put workers more at risk of being exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous equipment from their office, participating in virtual conferences and online platforms. **Effects**: musculoskeletal diseases, overweight, cardiovascular problems.
Electrical hazards	
• Electrical hazards: contacts with live parts, defective cables (Computer and other electric devices). **Effect**: fatal accident.	• Electrical hazards: contacts with live parts, defective cables (Computer and other electric devices). **Effect**: fatal accident.
Work environmental hazards	
• Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effects**: eyestrain, headache, colds, cardiovascular problems.	• Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effects**: eyestrain, headache, colds, cardiovascular problems.
Psychosocial hazards	
• Organisation of work/content of work: tight deadlines, performance pressure, high responsibility, overload, lack of training and information.	• Organisation of work/content of work: tight deadlines, performance pressure, high responsibility, overload, lack of training and information, increased demand on flexibility. Excessive workload: involved in the implementation/transition of industrial production towards circular economy. • Lack of work experience: new software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Deciding on circular economic and sustainable oriented strategies/products/marketing projects: increased demand on skills and knowledge/keeping up-to-date regarding the current development in circular economy and sustainable oriented strategies/products/marketing projects (staying up-to-date; further training for new technologies and processes).
• Social relationship: difficult clients, difficult colleagues.	• Social relationship: difficult clients, difficult colleagues, lack of social contacts.
• Working method: Frequent contacts with customers, cooperation with other departments. Use of simple software and CRM. **Effects**: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.	• Working method: Frequent contacts with customers, growing cooperation with other departments. Use of innovative software, digital equipment, cognitive interactions with autonomous machines and virtual reality, virtual conferences. Long period of concentration to work with computer and new software and performing multitasking. Increased demand on flexibility as workers/managers may work from everywhere with mobile devices. Managers/workers are also at risk of being permanent available outside working hours, this will increase with digitalization. Increased demand on flexibility: need of knowledge concerning recycling, sustainable materials and products. **Effects**: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders, cognitive strain, stress due to long period of concentration and information overload.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Sales and marketing manager - ISCO 1221

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Virtualise direct aspects of the product	Virtualise indirect aspects of the product	Choose new products and services	Use digitization tools to work in a customer-oriented manner	Using digitalized input from customer ecosystems and a globally connected distribution and marketing network	Working within a highly digitalized enterprise-customer ecosystem	Working in a fully connected and digitalized system
Essential skills and competences								
Align efforts towards business development	YES, changed	●	●	●		●	●	●
Build business relationships	YES, changed	●	●		●	●	●	
Develop professional network	YES, changed			●		●		●
Implement marketing strategies	YES, changed	●	●	●	●	●	●	●
Integrate new products in manufacturing	YES, changed			●		●	●	
Manage contracts	YES							
Manage sales channels	YES, changed	●	●			●		●
Manage sales teams	YES							
Use analytics for commercial purposes	YES, changed				●	●		●
Essential knowledge								
Commercial law	YES							
Customer relationship management	YES, changed	●	●	●	●	●	●	
Product comprehension	YES, changed	●	●					
Project management	YES							
Risk management	YES, changed			●		●		●
Generic green skills, knowledge and competences (*)								
Environmental awareness and willingness to learn	NEW			●				
Systems and risk analysis skills	NEW			●				
Innovation skills	NEW			●				
Coordination, management and business skills	NEW			●				
Communication and negotiation skills	NEW	●	●	●				
Marketing skills	NEW	●	●	●				
Strategic and leadership skills	NA							
Consulting skills	NEW	●	●	●				
Networking, information technology and language skills	NEW	●	●	●				
Adaptability and transferability skills	NEW	●	●	●				
Entrepreneurial skills	NEW			●				
Waste, energy and water quantification and monitoring	NA							
Material use and impact quantification and monitoring	NEW		●					
Material use and impact minimisation	NA							

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova



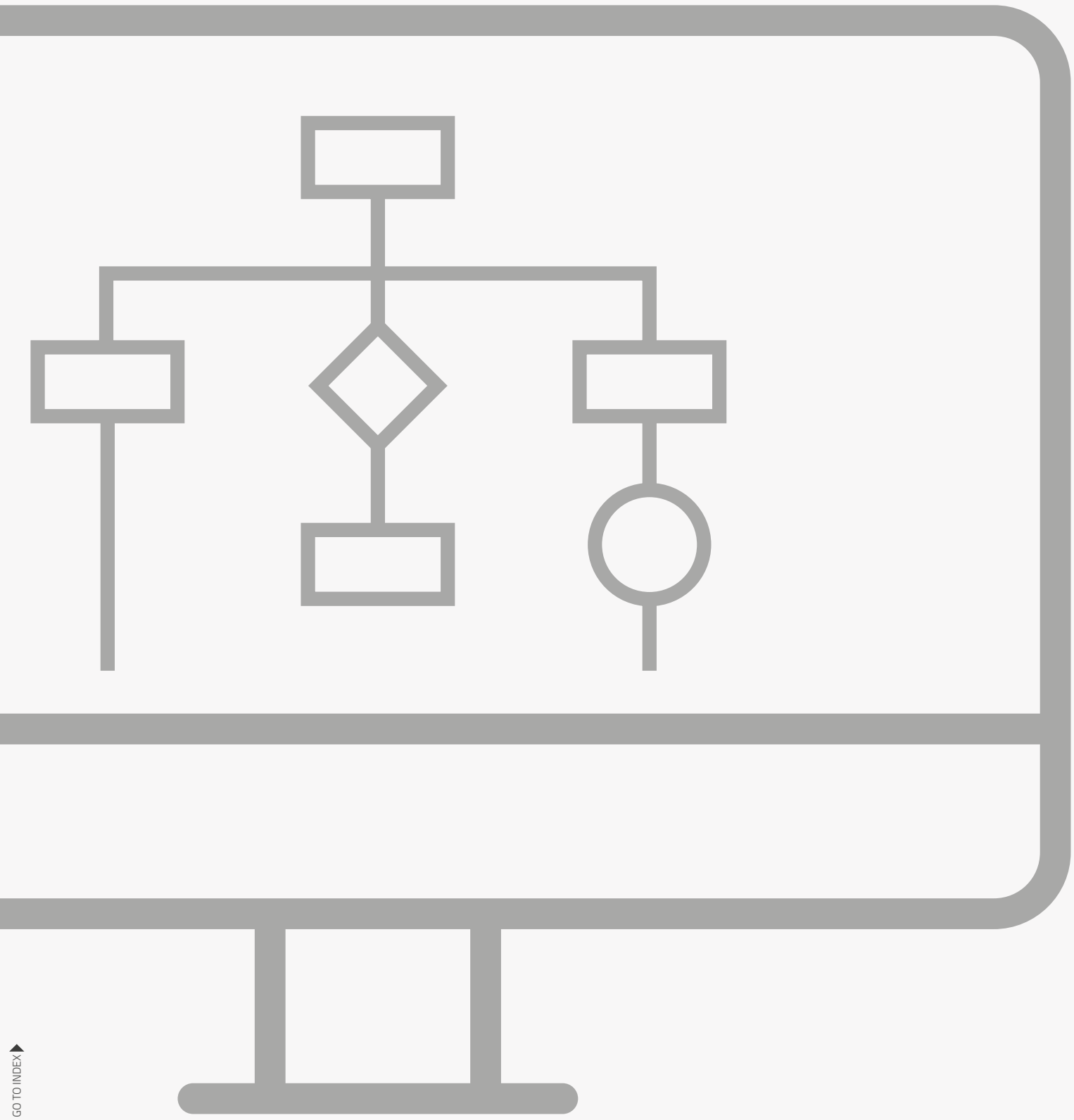
Industrial production manager ISCO 1321s

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.



Industrial production manager ISCO 1321s

Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

GO TO INDEX

Industrial production manager ISCO 1321s

2020
Occupational profile

Current profile description
Industrial production managers oversee the operations and the resources needed in industrial plants and manufacturing sites for a smooth running of the operations. They prepare the production schedule by combining the requirements of clients with the resources of the production plant. They organise the journey of incoming raw materials or semi finished products in the plant until a final product is delivered by coordinating inventories, warehouses, distribution, and support activities.

Current profiles tasks		ReSOLVE levers*																						
		Regenerate	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	**Share**	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	**Optimise**	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	**Loop**	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste	
A	Determining, implementing and monitoring production strategies, policies and plans.		●	●		●		●	●	●	●	●		●	●	●	●	●		●	●	●	●	
B	Planning details of production activities in terms of output quality and quantity, cost, time available and labour requirements.		●	●										●	●	●	●	●		●		●	●	
C	Controlling the operation of production plant and quality procedures through planning of maintenance, designation of operating hours and supply of parts and tools.		●	●										●	●	●	●	●		●		●		
D	Establishing and managing budgets, monitoring production output and costs, and adjusting processes and resources to minimize costs.		●	●										●	●	●	●	●				●		
E	Consulting with and informing other managers about production matters.		●	●										●	●	●	●	●		●	●	●	●	
F	Overseeing the acquisition and installation of new plant and equipment.		●	●		●					●			●	●	●	●	●		●	●	●	●	
G	Controlling the preparation of production records and reports.		●	●										●	●	●	●	●		●		●		
H	Coordinating the implementation of occupational health and safety requirements.		●	●										●	●	●	●	●		●	●			
I	Identifying business opportunities and determining products to be manufactured.		●	●		●			●		●	●		●	●	●	●	●		●	●	●	●	
J	Researching and implementing regulatory and statutory requirements affecting manufacturing operations and the environment.		●	●		●			●	●	●	●		●	●	●	●	●		●		●		
K	Overseeing the provision of quotations for the manufacture of specialized goods and establishing contracts with customers and suppliers.		●	●		●			●			●		●	●	●	●	●		●	●	●	●	
L	Overseeing the selection, training and performance of staff.		●	●				●	●	●	●	●		●	●	●	●	●		●	●	●	●	

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Industrial production manager - ISCO 1321s

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Industrial production managers oversee the operations and the resources needed in highly digitised and ecoefficient industrial plants and manufacturing sites for a smooth running of the operations. Supported by data and instruments of highly digitized systems and following circular economy-oriented strategies, they prepare the production schedule by combining the technical & sustainability requirements of clients with the resources of the production plant. They organise the journey of incoming raw materials or semi finished products in the plant until a final product is delivered by coordinating inventories, warehouses, distribution, and support activities. Use digitization tools and circular economy-oriented strategies to work in a customer-oriented manner.

Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	**Profile tasks forecast**
	●	●		●	●	●	A Determining, implementing and monitoring production strategies, policies and plans exploiting the possibilities of a highly digitised manufacturing plant and considering the circular economy-oriented strategies of the organisation.
	●			●	●		B Planning details of a highly digitized and connected set of production activities in terms of output, quality and quantity, cost, time available and labour requirements and in terms of reducing their environmental impact and the application of circular economy opportunities, such as waste reduction.
	●				●		C Controlling the operation of a highly digitised, lean and ecoefficient production plant including handling of quality procedures and sustainability work practices & policies through planning of maintenance, designation of operating hours and supply of parts and tools.
					●		D Establishing and managing budgets, monitoring production output and costs, and adjusting processes and resources to minimize costs and environmental impacts in a highly connected digital manufacturing chain which applies sustainable technologies and practices.
	●	●		●	●	●	E Securing distribution of information of all production matters to other managers as part of digital performance and sustainability-oriented management as well as consultations with other managers in general and the sustainability manager in specific.
	●	●		●	●	●	F Overseeing the acquisition and installation of highly digitised and ecoefficient new plants and equipment, following the sustainability strategies of the organisation and green procurement criteria.
	●			●	●		G Securing the preparation of fully integrated and digitised production records and reports, including sustainability performance indicators associated to the manufacturing plant.
	●			●	●	●	H Coordinating the implementation of occupational health and safety requirements and other environmental requirements such as hazardous substances use, as part of the highly integrated digital enterprise ecosystem.
	●	●		●	●	●	I Identifying business opportunities and circular economy business models and determining smart (digital) and eco-designed products to be manufactured in an extremely digitised and low environmental impact manufacturing ecosystem.
				●	●		J Researching and implementing regulatory and statutory requirements affecting highly digitised manufacturing operations, the environment and the general company ecosystem, including environmental regulations on products and processes.
	●	●		●	●	●	K Exploiting data and instruments of a highly digitized system, overseeing the provision of quotations for the digitized manufacture of specialized goods and establishing contracts with customers and suppliers, taking into account green procurement criteria and boosting the traction of the supply chain on sustainability.
	●	●		●	●	●	L Overseeing the selection, training and performance of staff exploiting tools and instruments of an highly connected and digitized company, promoting circular economy-oriented competences and skills.

Industrial production manager ISCO 1321s

2020
Occupational profile

Current profile description
Industrial production managers oversee the operations and the resources needed in industrial plants and manufacturing sites for a smooth running of the operations. They prepare the production schedule by combining the requirements of clients with the resources of the production plant. They organise the journey of incoming raw materials or semi finished products in the plant until a final product is delivered by coordinating inventories, warehouses, distribution, and support activities.

New categorization of hazards

Current profiles tasks	**Mechanical hazards**	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	**Ergonomic hazards**	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	**Electrical hazards**	Electric shock	**Hazards due to physical effects/physical agents**	Noise	Vibration	Laserlight	**Fire and explosion hazards**	Flammable substances	**Work environment hazards**	Poor lighting conditions	Climate	Poor ventilation	**Hazards through dangerous substances**	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	**Biological Hazards**	Non-targeted activities with microorganism	**Psychosocial hazards**	Excessive workloads
A Determining, implementing and monitoring production strategies, policies and plans.												●		●								●	●											●
B Planning details of production activities in terms of output quality and quantity, cost, time available and labour requirements.												●		●								●	●											●
C Controlling the operation of production plant and quality procedures through planning of maintenance, designation of operating hours and supply of parts and tools.												●		●								●	●											●
D Establishing and managing budgets, monitoring production output and costs, and adjusting processes and resources to minimize costs.												●		●								●	●											●
E Consulting with and informing other managers about production matters.												●										●	●											●
F Overseeing the acquisition and installation of new plant and equipment.														●								●	●											●
G Controlling the preparation of production records and reports.												●		●								●	●											●
H Coordinating the implementation of occupational health and safety requirements.												●		●								●	●											●
I Identifying business opportunities and determining products to be manufactured.												●		●								●	●											●
J Researching and implementing regulatory and statutory requirements affecting manufacturing operations and the environment.												●		●								●	●											●
K Overseeing the provision of quotations for the manufacture of specialized goods and establishing contracts with customers and suppliers.												●		●								●	●											●
L Overseeing the selection, training and performance of staff.												●		●								●	●											●

● No changes ● Reduced due to Circular Economy ● New or increased due to Circular Economy ● Reduced due to digitalization ● New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Industrial production manager - ISCO 1321s

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Industrial production managers oversee the operations and the resources needed in highly digitised and ecoefficient industrial plants and manufacturing sites for a smooth running of the operations. Supported by data and instruments of highly digitized systems and following circular economy-oriented strategies, they prepare the production schedule by combining the technical & sustainability requirements of clients with the resources of the production plant. They organise the journey of incoming raw materials or semi finished products in the plant until a final product is delivered by coordinating inventories, warehouses, distribution, and support activities. Use digitization tools and circular economy-oriented strategies to work in a customer-oriented manner.

	Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload	Profile tasks forecast
A		●	●	●		●	●	●	●		●	●	●	Determining, implementing and monitoring production strategies, policies and plans exploiting the possibilities of a highly digitised manufacturing plant and considering the circular economy-oriented strategies of the organisation.
B		●	●	●		●	●	●	●		●	●	●	Planning details of a highly digitized and connected set of production activities in terms of output, quality and quantity, cost, time available and labour requirements and in terms of reducing their environmental impact and the application of circular economy opportunities, such as waste reduction.
C		●	●	●		●	●	●	●		●	●	●	Controlling the operation of a highly digitised, lean and ecoefficient production plant including handling of quality procedures and sustainability work practices & policies through planning of maintenance, designation of operating hours and supply of parts and tools.
D		●	●	●		●	●	●	●		●	●	●	Establishing and managing budgets, monitoring production output and costs, and adjusting processes and resources to minimize costs and environmental impacts in a highly connected digital manufacturing chain which applies sustainable technologies and practices.
E		●	●	●		●	●	●	●		●		●	Securing distribution of information of all production matters to other managers as part of digital performance and sustainability-oriented management as well as consultations with other managers in general and the sustainability manager in specific.
F		●	●	●		●	●	●	●		●		●	Overseeing the acquisition and installation of highly digitised and ecoefficient new plants and equipment, following the sustainability strategies of the organisation and green procurement criteria.
G		●	●	●		●	●	●	●		●	●	●	Securing the preparation of fully integrated and digitised production records and reports, including sustainability performance indicators associated to the manufacturing plant.
H		●	●	●		●	●	●	●		●	●	●	Coordinating the implementation of occupational health and safety requirements and other environmental requirements such as hazardous substances use, as part of the highly integrated digital enterprise ecosystem.
I		●	●	●		●	●	●	●		●	●	●	Identifying business opportunities and circular economy business models and determining smart (digital) and eco-designed products to be manufactured in an extremely digitised and low environmental impact manufacturing ecosystem.
J		●	●	●		●	●	●	●		●	●	●	Researching and implementing regulatory and statutory requirements affecting highly digitised manufacturing operations, the environment and the general company ecosystem, including environmental regulations on products and processes.
K		●	●	●		●	●	●	●		●		●	Exploiting data and instruments of a highly digitized system, overseeing the provision of quotations for the digitized manufacture of specialized goods and establishing contracts with customers and suppliers, taking into account green procurement criteria and boosting the traction of the supply chain on sustainability.
L		●	●	●		●	●	●	●		●	●	●	Overseeing the selection, training and performance of staff exploiting tools and instruments of an highly connected and digitized company, promoting circular economy-oriented competences and skills.

1 Cobotics (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping).
2 Run over, roll over, falls from height.

Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Industrial production manager - ISCO 1321s

2020 Current situation	2025-30 Situation forecast
Work system/work area: office work, use of software, inspection of production facilities and machines, contact with clients.	Work system/work area: office work, use of software, inspection of production facilities and machines, contact with clients, use of digitalized equipment and systems; implementation of industrial production towards circular-economy and use of renewable energy; being in charge of new production lines such as recycling, disassembling, and repair of furniture.
Mechanical hazards	
• Slips and trips, obstacles, table edge, Safety hazards/accidents due to unknown workplaces, travelling and setting up stands. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	• Slips and trips, obstacles, table edge, Safety hazards/accidents due to unknown workplaces, travelling and setting up stands. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: from poor ergonomic conditions and inactivity. **Effects**: musculoskeletal diseases, overweight, cardiovascular problems.	• Ergonomic hazards: from poor ergonomic conditions and inactivity. Digitalization put workers at risk of being exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous machines from their office, participating in virtual conferences and online platforms. **Effects**: musculoskeletal diseases, overweight, cardiovascular problems.
Electrical hazards	
• Electrical hazards: contacts with live parts, defective cables (computer and other electric devices). **Effect**: fatal accident.	• Electrical hazards: contacts with live parts, defective cables (computer and other electric devices). **Effect**: fatal accident.
Work environmental hazards	
• Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effects**: eyestrain, headache, colds, cardiovascular problems**.**	• Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effects**: eyestrain, headache, colds, cardiovascular problems.
Psychosocial hazards	
• Organisation of work/content of work: tight deadlines, performance pressure, high responsibility, overload, lack of training and information, increased demand on flexibility.	• Organisation of work/content of work: tight deadlines, performance pressure, high responsibility, overload, lack of training and information, increased demand on flexibility. Excessive workload: involved in the implementation/transition of industrial production towards circular economy. • Lack of work experiences: New software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Deciding on circular economic and sustainable oriented strategies/products/marketing projects: increased demand on skills and knowledge/keeping up-to-date regarding the current development in circular economy and sustainable oriented strategies/products/marketing projects (staying up-to-date; further training for new technologies and processes).
• Social relationship: difficult clients, difficult colleagues.	• Social relationship: difficult clients, difficult colleagues, lack of social contacts.
• Working method: Digital equipment, software. Long period of concentration working with computer and new software and performing multitasking. Managers/workers are also at risk of being permanent available outside working hours. **Effects**: stress: burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.	• Working method: digital equipment, cognitive interactions between autonomous techniques and virtual reality, virtual conferences. Use of innovative software, digital equipment, cognitive interactions with autonomous machines and virtual reality, virtual conferences. Long period of concentration to work with computer and new software and performing multitasking. Increased demand on flexibility as workers/managers may work from everywhere with mobile devices. Managers/workers are also at risk of being permanent available outside working hours, this will increase with digitalization. Increased demand on flexibility: need of knowledge and skills concerning recycling, disassembly and remanufacture operations as well as in use of renewable energy. **Effects**: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders, cognitive strain, stress due to long period of concentration and information overload.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Industrial production manager - ISCO 1321s

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Shift to renewable energies	Shift to renewable materials	Increase performance/ efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	Remanufacture products and/or components	Recycle materials	Apply new technologies	Support by data and instruments of highly digitized systems	Use digitization tools to work in a customer-oriented manner	Exploiting the possibilities, tools and instruments of a highly connected and digitized manufacturing plant/chain	Securing distribution of information	Working in a fully connected and digitized system
Essential skills and competences																
Adhere to organisational guidelines	YES, changed	●	●	●	●	●	●	●	●	●	●					
Adjust production schedule	YES, changed											●	●	●		
Assess impact of industrial activities	YES, changed	●	●	●			●	●		●	●	●	●	●		
Check material resources	YES, changed	●	●	●			●	●	●	●	●	●	●	●		
Control financial resources	YES, changed	●	●	●			●	●		●						
Create manufacturing guidelines	YES, changed	●	●	●			●	●	●	●	●	●	●	●	●	
Define quality standards	YES, changed		●	●				●	●	●	●	●		●	●	
Liaise with industrial professionals	YES, changed	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Manage budgets	YES															
Manage resources	YES, changed	●	●	●	●		●	●		●	●	●		●		
Manage staff	YES, changed											●		●		
Manage supplies	YES, changed	●	●	●	●		●	●		●	●	●	●	●		
Meet deadlines	YES															
Oversee assembly operations	YES, changed		●		●	●		●	●	●	●	●	●	●		
Oversee production requirements	YES, changed	●	●		●	●		●	●		●	●	●	●		
Plan health and safety procedures	YES, changed	●	●	●			●	●	●	●						
Essential knowledge																
Industrial health and safety measures	YES, changed	●	●	●			●	●	●	●						
Industrial engineering	YES, changed	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Manufacturing processes	YES, changed	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Generic green skills, knowledge and competences (*)																
Environmental awareness and willingness to learn	NEW	●	●	●			●	●	●	●	●					
Systems and risk analysis skills	NEW	●	●	●			●	●	●	●						
Innovation skills	NEW	●	●	●	●	●	●	●	●	●	●					
Coordination, management and business skills	NEW	●	●	●	●	●	●	●	●	●	●					
Communication and negotiation skills	NEW	●	●	●	●		●	●		●	●					
Marketing skills	NA															
Strategic and leadership skills	NEW	●	●	●	●	●	●	●	●	●	●					
Consulting skills	NA															
Networking, information technology and language skills	NEW	●	●	●	●	●		●	●		●					
Adaptability and transferability skills	NEW	●	●	●	●	●	●	●	●	●	●					
Entrepreneurial skills	NEW			●			●	●	●	●	●					
Waste, energy and water quantification and monitoring	NEW	●		●		●	●	●			●					
Material use and impact quantification and monitoring	NEW		●	●	●	●	●	●	●	●	●					
Material use and impact minimisation	NEW		●	●	●	●	●	●	●	●	●					

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova

Supply chain manager ISCO 1324s

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.

Supply chain manager ISCO 1324s

Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

GO TO INDEX

Supply chain manager
ISCO 1324s

2020
Occupational profile

Current profile description
Supply chain managers plan, manage and coordinate all activities related to the sourcing and procurement of supplies needed to run manufacturing operations from the acquisition of raw materials to the distribution of finished products. The supplies can be raw materials or finished products, and it can be for internal or external use. Moreover, they plan and commission all the activities needed to be performed in manufacturing plants and adjust operations to changing levels of demand for a company's products.

Current profiles tasks		ReSOLVE levers*																						
		Regenerate	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	**Share**	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	**Optimise**	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	**Loop**	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste	
A	Determining, implementing and monitoring purchasing, storage and distribution strategies, policies and plans.		●	●	●	●						●		●	●	●	●	●		●	●	●	●		
B	Preparing and implementing plans to maintain required stock levels at minimum cost.		●	●											●	●		●		●	●	●	●		
C	Negotiating contracts with suppliers to meet quality, cost and delivery requirements.		●	●	●	●								●	●	●	●	●		●	●	●	●		
D	Monitoring and reviewing storage and inventory systems to meet supply requirements, and control stock levels.		●	●											●	●		●			●	●			
E	Overseeing the dispatch of road vehicles, trains, vessels or aircraft.		●	●											●	●		●		●	●				
F	Operating recording systems to track all movements of goods, and ensuring reordering and restocking at optimal times.		●	●											●	●		●		●	●	●			
G	Liaising with other departments and customers concerning requirements for outward goods and associated forwarding transportation.		●	●											●	●		●		●	●	●	●		
H	Overseeing the recording of purchase, storage and distribution transactions.		●	●											●	●				●	●	●			
I	Establishing and managing budgets, controlling expenditure and ensuring the efficient use of resources.		●	●										●	●	●		●		●	●	●			
J	Establishing and directing operational and administrative procedures.		●	●											●	●		●		●	●	●			
K	Planning and directing daily operations.		●	●											●	●		●		●	●	●			
L	Overseeing the selection, training and performance of staff.		●	●				●	●	●	●	●			●	●	●	●		●	●	●	●	●	

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Supply chain manager - ISCO 1324s

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Supply chain managers plan, manage and coordinate all activities related to the sourcing and procurement of supplies needed to run manufacturing operations from the preferable acquisition of sustainable raw materials to the distribution of ecodesigned finished products with the support of updated and continuous data collected in an highly connected, circular economy-oriented and digitized company system. The supplies can be sustainable raw materials or finished products (including reused/recovered or remanufactured products), and it can be for internal or external use. Moreover, they plan and commission all the activities needed to be performed in ecoefficient manufacturing plants and adjust operations to changing levels of demand for a company's sustainable product. Use digitization tools and circular economy-oriented strategies to work in a customer-oriented manner.

Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	**Profile tasks forecast**	
	●	●		●	●	●	A	Determining, implementing and monitoring environmentally friendly purchasing, storage and distribution strategies, policies and plans of the digitised ecosystem, aligned with the circular economy-oriented strategies of the organisation.
	●	●		●	●	●	B	Preparing and implementing plans to maintain required stock levels of the highly digitised enterprise ecosystem at minimum cost and with minimal environmental impact.
	●	●		●	●	●	C	Negotiating fair contracts with suppliers to meet quality, environmental, cost and delivery requirements of the highly digitised enterprise ecosystem, applying green purchasing criteria and boosting a sustainable supply chain.
	●	●		●	●	●	D	Monitoring and reviewing storage and inventory systems to meet supply requirements, and control stock levels through the data and instruments of an highly interconnected and digitised enterprise ecosystem, and alligned with the sustainability strategies of the organisation.
	●	●		●	●	●	E	Overseeing the dispatch of road vehicles, trains, vessels or aircraft, selecting preferably the most environmentaly friendly alternative and promoting a sustainable supply chain, through digitised updated and continuous data collected in an highly connected, and digitized enterprise ecosystem.
	●	●		●	●	●	F	Operating recording systems to track all movements of goods, and ensuring reordering and restocking at optimal times of the highly digitised enterprise ecosystem, analysing the environmental impact associated to the logistics of the raw materials and products.
	●	●		●	●	●	G	Liaising with other departments and customers concerning requirements for outward goods and associated forwarding transportation, aligned with the circular economy-oriented strategies of the organisation (for example sustainable source of materials) and using the highly digitised ecosystem inside and outside the company.
	●	●		●	●	●	H	Overseeing the recording of purchase, storage and distribution transactions as an integrated part of the digitised work process of the digital and ecoefficient factory ecosystem.
	●	●		●	●	●	I	Establishing and managing budgets, controlling expenditure and ensuring the efficient use of resources as integrated part of the highly interconnected, circular economy-oriented and digitised company ecosystem, meeting the customers' needs and expectations on sustainability (and other issues) and boosting the traction of the supply chain on sustainability.
	●	●		●	●	●	J	Establishing and directing operational and administrative procedures in the highly digitised company ecosystem, aligned with the organisation strategies and customers' demands on sustainability.
	●	●		●	●	●	K	Planning and directing daily operations both physically and digitally using the connected cloud and considering the environmental impact of these operations.
	●	●		●	●	●	L	Overseeing the selection, training and performance of staff exploting tools and instruments of a highly connected and digitized company, promoting circular-economy-oriented competences and skills.

Supply chain manager
ISCO 1324s

2020
Occupational profile

Current profile description
Supply chain managers plan, manage and coordinate all activities related to the sourcing and procurement of supplies needed to run manufacturing operations from the acquisition of raw materials to the distribution of finished products. The supplies can be raw materials or finished products, and it can be for internal or external use. Moreover, they plan and commission all the activities needed to be performed in manufacturing plants and adjust operations to changing levels of demand for a company's products.

New categorization of hazards

Current profiles tasks		**Mechanical hazards**	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	**Ergonomic hazards**	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	**Electrical hazards**	Electric shock	**Hazards due to physical effects/physical agents**	Noise	Vibration	Laserlight	**Fire and explosion hazards**	Flammable substances	**Work environment hazards**	Poor lighting conditions	Climate	Poor ventilation	**Hazards through dangerous substances**	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	**Biological Hazards**	Non-targeted activities with microorganism	**Psychosocial hazards**	Excessive workloads
A	Determining, implementing and monitoring purchasing, storage and distribution strategies, policies and plans.												●										●	●											●
B	Preparing and implementing plans to maintain required stock levels at minimum cost.												●										●	●											●
C	Negotiating contracts with suppliers to meet quality, cost and delivery requirements.												●										●	●											●
D	Monitoring and reviewing storage and inventory systems to meet supply requirements, and control stock levels.												●										●	●											●
E	Overseeing the dispatch of road vehicles, trains, vessels or aircraft.												●										●	●											●
F	Operating recording systems to track all movements of goods, and ensuring reordering and restocking at optimal times.												●										●	●											●
G	Liaising with other departments and customers concerning requirements for outward goods and associated forwarding transportation.												●										●	●											●
H	Overseeing the recording of purchase, storage and distribution transactions.												●										●	●											●
I	Establishing and managing budgets, controlling expenditure and ensuring the efficient use of resources.												●										●	●											●
J	Establishing and directing operational and administrative procedures.												●										●	●											●
K	Planning and directing daily operations.												●										●	●											●
L	Overseeing the selection, training and performance of staff.												●										●	●											●

● No changes ● Reduced due to Circular Economy ● New or increased due to Circular Economy ● Reduced due to digitalization ● New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Supply chain manager - ISCO 1324s

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Supply chain managers plan, manage and coordinate all activities related to the sourcing and procurement of supplies needed to run manufacturing operations from the preferable acquisition of sustainable raw materials to the distribution of ecodesigned finished products with the support of updated and continuous data collected in an highly connected, circular economy-oriented and digitized company system. The supplies can be sustainable raw materials or finished products (including reused/recovered or remanufactured products), and it can be for internal or external use. Moreover, they plan and commission all the activities needed to be performed in ecoefficient manufacturing plants and adjust operations to changing levels of demand for a company's sustainable product. Use digitization tools and circular economy-oriented strategies to work in a customer-oriented manner.

Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload		**Profile tasks forecast**
	●	●	●		●	●	●	●		●		●	A	Determining, implementing and monitoring environmentally friendly purchasing, storage and distribution strategies, policies and plans of the digitised ecosystem, aligned with the circular economy-oriented strategies of the organisation.
	●	●	●		●	●	●	●		●	●	●	B	Preparing and implementing plans to maintain required stock levels of the highly digitised enterprise ecosystem at minimum cost and with minimal environmental impact.
	●	●	●		●	●	●	●		●		●	C	Negotiating fair contracts with suppliers to meet quality, environmental, cost and delivery requirements of the highly digitised enterprise ecosystem, applying green purchasing criteria and boosting a sustainable supply chain.
	●	●	●		●	●	●	●		●		●	D	Monitoring and reviewing storage and inventory systems to meet supply requirements, and control stock levels through the data and instruments of an highly interconnected and digitised enterprise ecosystem, and alligned with the sustainability strategies of the organisation.
	●	●	●		●	●	●	●		●	●	●	E	Overseeing the dispatch of road vehicles, trains, vessels or aircraft, selecting preferably the most environmentaly friendly alternative and promoting a sustainable supply chain, through digitised updated and continuous data collected in an highly connected, and digitized enterprise ecosystem.
	●	●	●		●	●	●	●		●	●	●	F	Operating recording systems to track all movements of goods, and ensuring reordering and restocking at optimal times of the highly digitised enterprise ecosystem, analysing the environmental impact associated to the logistics of the raw materials and products.
	●	●	●		●	●	●	●		●		●	G	Liaising with other departments and customers concerning requirements for outward goods and associated forwarding transportation, aligned with the circular economy-oriented strategies of the organisation (for example sustainable source of materials) and using the highly digitised ecosystem inside and outside the company.
	●	●	●		●	●	●	●		●	●	●	H	Overseeing the recording of purchase, storage and distribution transactions as an integrated part of the digitised work process of the digital and ecoefficient factory ecosystem.
	●	●	●		●	●	●	●		●	●	●	I	Establishing and managing budgets, controlling expenditure and ensuring the efficient use of resources as integrated part of the highly interconnected, circular economy-oriented and digitised company ecosystem, meeting the customers' needs and expectations on sustainability (and other issues) and boosting the traction of the supply chain on sustainability.
	●	●	●		●	●	●	●		●	●	●	J	Establishing and directing operational and administrative procedures in the highly digitised company ecosystem, aligned with the organisation strategies and customers' demands on sustainability.
	●	●	●		●	●	●	●		●		●	K	Planning and directing daily operations both physically and digitally using the connected cloud and considering the environmental impact of these operations.
	●	●	●		●	●	●	●		●		●	L	Overseeing the selection, training and performance of staff exploting tools and instruments of a highly connected and digitized company, promoting circular-economy-oriented competences and skills.

1 Cobotics (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping).
2 Run over, roll over, falls from height.

Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Supply chain manager - ISCO 1324s

2020 Current situation	2025-30 Situation forecast
Work system/work area: office work, business trips, contact with clients and business partners, use of complex software.	Work system/work area: office work, business trips, contact with clients and business partners, use of complex software, use of digitalized tools and circular economy-oriented strategies.
Mechanical hazards	
• Slips and trips, obstacles, table edges. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	• Slips and trips, obstacles, table edges. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: from poor ergonomic conditions and inactivity. **Effects:** musculoskeletal diseases, overweight, cardiovascular problems.	• Ergonomic hazards: from poor ergonomic conditions and inactivity. Digitalization put workers at risk of being exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous equipment from their office, participating in virtual conferences and online platforms. Effects: musculoskeletal diseases, overweight, cardiovascular problems.
Electrical hazards	
• Electrical hazards: contacts with live parts, defective cables (Computer and other electric devices). **Effect:** fatal accident.	• Electrical hazards: contacts with live parts, defective cables (Computer and other electric devices). **Effect:** fatal accident.
Work environmental hazards	
• Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effects:** eyestrain, headache, colds, cardiovascular problems.	• Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effects:** eyestrain, headache, colds, cardiovascular problems.
Psychosocial hazards	
• Organisation of work/content of work: tight deadlines, performance pressure, high responsibility, overload, lack of training and information.	• Organisation of work/content of work: tight deadlines, performance pressure, high responsibility, overload, lack of training and information, increased demand on flexibility. Increased demand on competences and up-to-date knowledge on the current development in circular economy and recycling industry.
• Social relationship: difficult clients, difficult colleagues.	• Social relationship: difficult clients, lack of social contacts.
• Working method: digital equipment, software. Long period of concentration working with computer and new software and performing multitasking. Managers/workers are also at risk of being permanent available outside working hours.	• Working method: digital equipment, cognitive interactions with autonomous technologies and virtual reality, virtual conferences. Digitalization may put workers more at risk of long period of concentration working with computer and new software and performing multitasking. Increased demand on flexibility as workers/managers may work from everywhere with mobile devices. Managers/ workers are also at risk of being permanent available outside working hours. • Lack of work experience: new software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Deciding on circular economic and sustainable oriented strategies/products/ marketing projects: increased demand on skills and knowledge/keeping up-to-date regarding the current development in circular economy and sustainable oriented strategies/products/marketing projects (staying up-to-date; further training for new technologies and processes).
Effects: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.	**Effects**: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders, cognitive strain, stress due to long period of concentration.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Supply chain manager - ISCO 1324s

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Shift to renewable energies	Shift to renewable materials	Customisation/made to order	Reproductible and adaptable manufacturing	Implement Take Back programs	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	Using the updated and continuous data and instruments, collected in an highly connected and digitized company systems	Use digitization tools to work in a customer-oriented manner	Working in a highly digitized enterprise ecosystem	Using the highly digitized ecosystem inside and outside the company	Using resources as an integrated part of the highly interconnected and digitized company ecosystem
Essential skills and competences																
Analyse logistic changes	YES, changed	●	●	●	●	●			●	●	●	●	●		●	●
Analyse supply chain strategies	YES, changed	●	●	●		●				●	●	●	●		●	●
Analyse supply chain trends	YES, changed	●	●	●	●	●	●	●	●	●	●		●		●	
Assess supplier risks	YES, changed	●	●	●		●			●	●	●	●			●	
Estimate costs of required supplies	YES, changed											●				●
Follow company standards	YES, changed	●	●	●	●	●	●	●	●	●	●	●	●			
Liaise with managers	YES, changed														●	●
Maintain relationship with customers	YES, changed		●	●		●	●	●	●	●	●		●		●	
Maintain relationship with suppliers	YES, changed	●	●	●	●	●			●	●	●		●		●	
Manage inventory	YES, changed		●	●		●				●	●					
Manage supplies	YES, changed	●	●	●		●	●	●	●	●	●	●	●		●	●
Order supplies	YES, changed	●	●	●		●			●	●	●					
Strive for company growth	YES, changed	●	●	●	●	●	●	●	●	●	●	●	●		●	●
Essential knowledge																
Corporate social responsibility	YES, changed	●	●	●	●	●	●	●	●	●	●					
Supplier management	YES, changed	●	●	●		●			●	●	●	●	●			
Supply chain management	YES, changed	●	●	●		●			●	●	●				●	●
Supply chain principles	YES, changed	●	●	●		●			●	●	●					
Generic green skills, knowledge and competences (*)																
Environmental awareness and willingness to learn	NEW	●	●	●	●	●	●	●	●	●	●					
Systems and risk analysis skills	NEW	●	●	●		●			●	●	●					
Innovation skills	NEW	●	●	●					●	●	●					
Coordination, management and business skills	NEW	●	●	●	●	●			●	●	●					
Communication and negotiation skills	NEW	●	●	●	●	●			●	●	●					
Marketing skills	NEW	●	●	●		●	●	●	●	●	●					
Strategic and leadership skills	NEW	●	●	●						●	●					
Consulting skills	NA															
Networking, information technology and language skills	NEW	●	●	●		●			●	●	●					
Adaptability and transferability skills	NEW	●	●	●	●	●	●	●	●	●	●					
Entrepreneurial skills	NEW					●			●	●	●					
Waste, energy and water quantification and monitoring	NEW	●	●		●	●			●	●	●					
Material use and impact quantification and monitoring	NEW	●	●		●	●			●	●	●					
Material use and impact minimisation	NEW	●	●	●	●	●	●	●	●	●	●					

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova

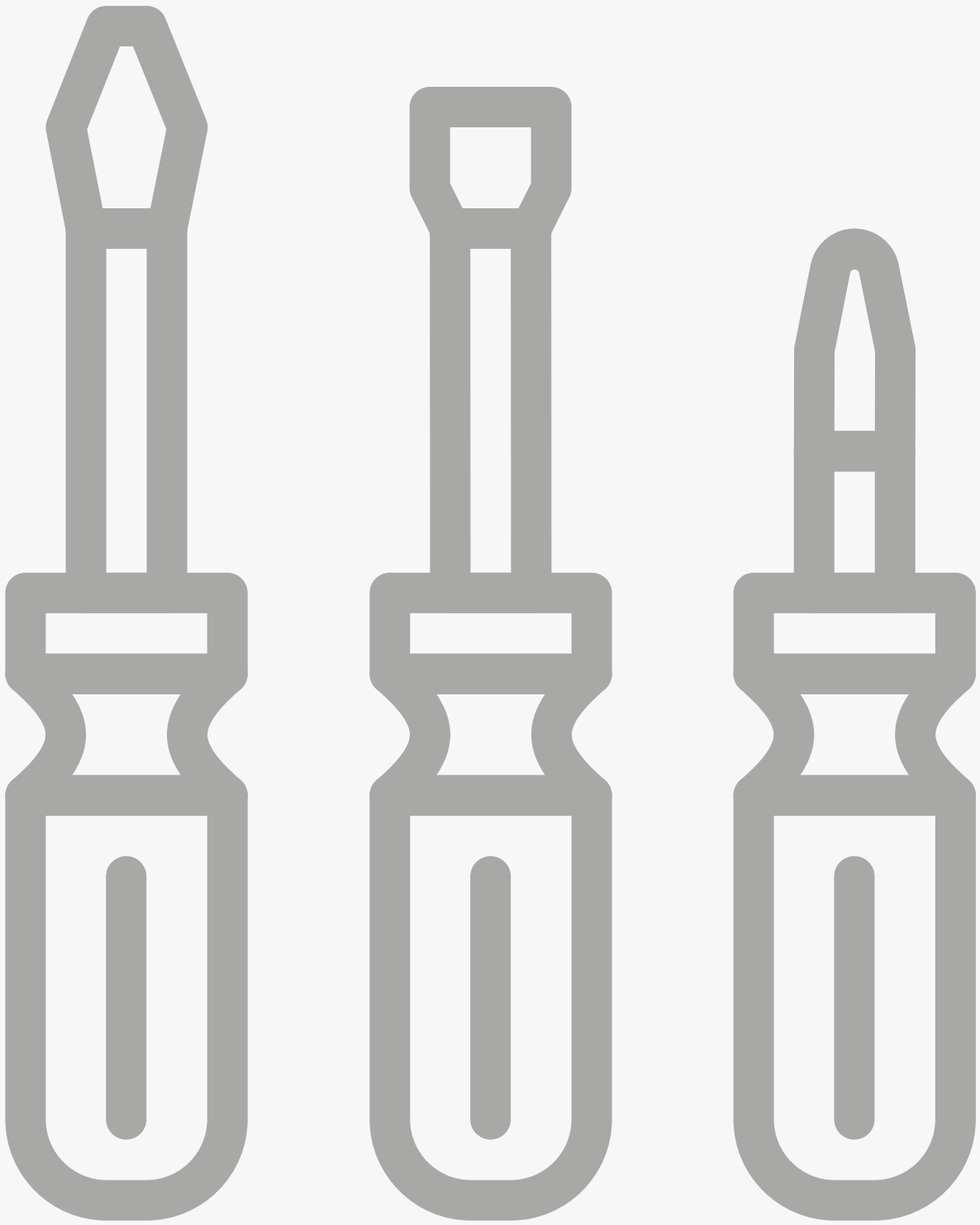
Maintenance & repair engineer ISCO 2141s

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.



Maintenance & repair engineer ISCO 2141s

Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

GO TO INDEX

Maintenance & repair engineer ISCO 2141s

2020
Occupational profile

Current profile description
Maintenance and repair engineers focus on the optimization of equipment, procedures, machineries and infrastructure. They ensure their maximum availability at minimum costs.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

Current profiles tasks		ReSOLVE levers*																							
		Regenerate	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	**Share**	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	**Optimise**	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	**Loop**	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste	
A	Establishing standards and policies for installation, modification, quality control, testing, inspection and maintenance according to engineering principles and safety regulations.		●	●										●	●	●	●	●				●	●		
B	Inspecting plant to improve and maintain performance.		●	●											●	●	●	●				●			
C	Directing the maintenance of plant buildings and equipment, and coordinating the requirements for new designs, surveys and maintenance schedules. **Preventive maintenance:** • Checks the operation of the machines, instruments (for measuring pressure, flow, temperature...) and the critical wear points, lubrication points, ... • Maintains the machine or installation preventively. **Predictive maintenance:** • Analyses the working condition of installation or machines, to predict faults on the basis of indications (via measurements and data collection). • Formulates recommendations for possible interventions. **Corrective maintenance:** • Locates and diagnoses a defect or malfunction. • Replaces, repairs and tests the defective parts and adjusts them. • Performs preparatory tests before releasing the machine or installation. **Adaptive maintenance: modifications, changes:** • Provides technical support to other departments (production, quality...). • Plans, develops, executes approved modifications to the installation(s).		●	●											●	●	●	●				●			
D	Advising management on new production methods, techniques and equipment.		●	●										●	●	●	●	●			●	●	●		
E	Liaising with materials buying, storing and controlling departments to ensure a steady flow of supplies.		●	●											●	●	●	●				●			

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Maintenance & repair engineer - ISCO 2141s

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Maintenance and repair engineers focus on the optimization of equipment, procedures, machineries and infrastructure in a highly integrated digital ecosystem of the digital and ecoefficient manufacturing plant. They ensure their maximum availability at minimum costs and environmental impact.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Use digitization tools to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, technical and ICT services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction, recycling programs, green energy use, etc.).

Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services		**Profile tasks forecast**
		●		●	●	●	A	Establishing standards and policies for installation, modification, quality control, testing, inspection and maintenance according to engineering principles, sustainability-oriented strategies and safety regulations in a highly digitised and ecoefficient manufacturing plant ecosystem.
		●		●	●	●	B	Monitoring, inspection and digital registration of the plant to improve and maintain its technical and environmental performance (e.g. energy use, waste generation, air & water emissions, etc.).
		●		●	●	●	C	Directing the digital handling of the maintenance of plant buildings and equipment, and coordinating the requirements for new designs, surveys and maintenance schedules, aligned with the sustainability strategies of the organisation. **Preventive maintenance:** • Checks the operation of the machines, instruments (for measuring pressure, flow, temperature...) and the critical wear points, lubrication points, ... • Maintains the machine or installation preventively. **Predictive maintenance:** • Analyses the working condition of installation or machines, to predict faults on the basis of indications (via measurements and data collection). • Formulates recommendations for possible interventions. **Corrective maintenance:** • Locates and diagnoses a defect or malfunction. • Replaces, repairs and tests the defective parts and adjusts them. • Performs preparatory tests before releasing the machine or installation. **Adaptive maintenance: modifications, changes:** • Provides technical support to other departments (production, quality, ICT...). • Plans, develops, executes approved modifications to the installation(s). • Analyses how to reduce the environmental impact of the plant and proposes modifications.
	●	●		●	●	●	D	Advising management on new smarter and ecoefficient production methods, and best-available and digital techniques and equipment; considering the reduction of the environmental impact of the plant (e.g. reduction of raw materials, energy, waste, etc.).
		●		●	●	●	E	Liaising with materials purchasing, storing and controlling departments to ensure a steady flow of sustainable supplies within and around the entire digital ecosystem and following green purchasing criteria.

Maintenance & repair engineer ISCO 2141s

2020
Occupational profile

Current profile description
Maintenance and repair engineers focus on the optimization of equipment, procedures, machineries and infrastructure. They ensure their maximum availability at minimum costs.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

Current profiles tasks		New categorization of hazards: Mechanical hazards	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	Ergonomic hazards	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	Electrical hazards	Electric shock	Hazards due to physical effects/physical agents	Noise	Vibration	Laserlight	Fire and explosion hazards	Flammable substances	Work environment hazards	Poor lighting conditions	Climate	Poor ventilation	Hazards through dangerous substances	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	Biological Hazards	Non-targeted activities with microorganism	Psychosocial hazards	Excessive workloads
A	Establishing standards and policies for installation, modification, quality control, testing, inspection and maintenance according to engineering principles and safety regulations.										●		●										●	●										●	
B	Inspecting plant to improve and maintain performance.		●		●		●								●		●	●					●	●	●		●	●	●	●			●		●
C	Directing the maintenance of plant buildings and equipment, and coordinating the requirements for new designs, surveys and maintenance schedules. **Preventive maintenance:** • Checks the operation of the machines, instruments (for measuring pressure, flow, temperature...) and the critical wear points, lubrication points, ... • Maintains the machine or installation preventively. **Predictive maintenance:** • Analyses the working condition of installation or machines, to predict faults on the basis of indications (via measurements and data collection). • Formulates recommendations for possible interventions. **Corrective maintenance:** • Locates and diagnoses a defect or malfunction. • Replaces, repairs and tests the defective parts and adjusts them. • Performs preparatory tests before releasing the machine or installation. **Adaptive maintenance: modifications, changes:** • Provides technical support to other departments (production, quality...). • Plans, develops, executes approved modifications to the installation(s).		●	●	●	●	●			●	●			●		●	● ●	●	●		●			●	●	●		●	●	●	●			●		●
D	Advising management on new production methods, techniques and equipment.																						●	●										●	
E	Liaising with materials buying, storing and controlling departments to ensure a steady flow of supplies.																						●	●										●	

● No changes ● Reduced due to Circular Economy ● New or increased due to Circular Economy ● Reduced due to digitalization ● New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Maintenance & repair engineer - ISCO 2141s

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Maintenance and repair engineers focus on the optimization of equipment, procedures, machineries and infrastructure in a highly integrated digital ecosystem of the digital and ecoefficient manufacturing plant. They ensure their maximum availability at minimum costs and environmental impact.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Use digitization tools to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, technical and ICT services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction, recycling programs, green energy use, etc.).

Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload		**Profile tasks forecast**
	●	●	●		●	●	●	●		●	●	●	A	Establishing standards and policies for installation, modification, quality control, testing, inspection and maintenance according to engineering principles, sustainability-oriented strategies and safety regulations in a highly digitised and ecoefficient manufacturing plant ecosystem.
	●	●	●		●	●	●	●		●	●	●	B	Monitoring, inspection and digital registration of the plant to improve and maintain its technical and environmental performance (e.g. energy use, waste generation, air & water emissions, etc.).
	●	●	●		●	●	●	●		●	●	●	C	Directing the digital handling of the maintenance of plant buildings and equipment, and coordinating the requirements for new designs, surveys and maintenance schedules, aligned with the sustainability strategies of the organisation. **Preventive maintenance:** • Checks the operation of the machines, instruments (for measuring pressure, flow, temperature...) and the critical wear points, lubrication points, ... • Maintains the machine or installation preventively. **Predictive maintenance:** • Analyses the working condition of installation or machines, to predict faults on the basis of indications (via measurements and data collection). • Formulates recommendations for possible interventions. **Corrective maintenance:** • Locates and diagnoses a defect or malfunction. • Replaces, repairs and tests the defective parts and adjusts them. • Performs preparatory tests before releasing the machine or installation. **Adaptive maintenance: modifications, changes:** • Provides technical support to other departments (production, quality, ICT...). • Plans, develops, executes approved modifications to the installation(s). • Analyses how to reduce the environmental impact of the plant and proposes modifications.
	●	●	●		●	●	●	●		●		●	D	Advising management on new smarter and ecoefficient production methods, and best-available and digital techniques and equipment; considering the reduction of the environmental impact of the plant (e.g. reduction of raw materials, energy, waste, etc.).
	●	●	●		●	●	●	●		●		●	E	Liaising with materials purchasing, storing and controlling departments to ensure a steady flow of sustainable supplies within and around the entire digital ecosystem and following green purchasing criteria.

1 Cobotics (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping).
2 Run over, roll over, falls from height.

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Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Maintenance & repair engineer - ISCO 2141s

2020 Current situation	2025-30 Situation forecast
Work system/work area: working on a wide variety of machines and workplaces, use of complex test devices and software. Working in the maintenance sector often means working during stop, start-up, shut-down, or disrupted operating phases, giving rise to potential risks in terms of accidents or exposure to many hazards. The work often requires maintenance workers to remove or dismantle collective protective equipment; as such equipment is not effective for their type of work. Maintenance workers have more serious and more frequent accidents than production workers. More so than for any other activity, maintenance-related accidents are characterised by their many different causes.	Work system/work area: working on a wide variety of machines and workplaces, use of complex test devices and software, use of digitalized instruments. Working in the maintenance sector often means working during stop, start-up, shut-down, or disrupted operating phases, giving rise to potential risks in terms of accidents or exposure to many hazards. The work often requires maintenance workers to remove or dismantle collective protective equipment; as such equipment is not effective for their type of work. Maintenance workers have more serious and more frequent accidents than production workers. More so than for any other activity, maintenance-related accidents are characterised by their many different causes. Maintenance of power plant stations (own green energy production), wastewater and waste treatment systems and recycling programs.
Mechanical hazard	
• Mechanical hazards from moving machines and tools.	• Mechanical hazards from moving machines and tools and from moving cobots and robots. Risks from mechanical hazards may decrease, depending on takeover of specific task by cobots/robots. Better design of products (ecodesign) could reduce hazards associated to maintenance operations.
Effects: severe bruises, amputations, cuts and sharp injuries, crushing.	**Effects**: severe bruises, amputations, cuts and sharp injuries, crushing.
• Slips and trips, obstacles, table edges, moving vehicles, machines.	• Slips and trips, obstacles, table edges, moving vehicles, machines.
Effects: squeezing, cutting, twisting, spraining, bumps and bruises.	**Effects**: squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: from poor ergonomic conditions, awkward position, confined spaces, heavy physical workload.	• Ergonomic hazards: from poor ergonomic conditions, awkward position, confined spaces, heavy physical workload. In spite of this, risks from ergonomic hazards may decrease, depending on take over of specific task by cobots/robots. On the other hand, workers are increasingly exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous machines and cobots from computer workstations. Ecodesign may help to reduce exposure to awkward positions of maintenance workers if safe maintenance of the machinery is taken into consideration from the beginning.
Effect: musculoskeletal diseases.	**Effects**: musculoskeletal diseases.
Electrical hazards	
• Electrical hazards: contacts with live parts or connections or exposure to arc flash.	• Electrical hazards: contacts with live parts or connections or exposure to arc flash. Electrical hazards from woodworking machines (maybe broken) during maintenance and repair as well as from autonomous or highly autonomous equipment.
Effect: fatal accident.	**Effect**: fatal accident.
Hazards due to physical effects/physical agents	
• Noise	• Noise: exposure to noise and vibration may decrease, depending on takeover of specific tasks by cobots/robots. Noise maybe reduced due to ecodesign of machinery operating quieter and more environmental-friendly.
Effects: hearing loss, headache, nervousness, poor concentration.	**Effects**: hearing loss, headache, nervousness, poor concentration.
• Vibrations	• Vibrations: exposure to vibration risks may decrease, depending on takeover of specific task by cobots/robots. Vibration maybe reduced due to ecodesign of machinery operating with less vibration energy and more environmental-friendly.
Effects: hand-arm-vibration syndrome (e.g. white finger disease).	**Effects**: hand-arm-vibration syndrome (e.g. white finger disease).
Explosion and fire hazards	
• Explosion and fire hazards from materials, including wood dust, solvents and chemicals.	Explosion and fire hazards from materials, including wood dust, solvents and chemicals. Risks from explosion and fire may decrease, depending on takeover of specific task by cobots/robots. Solvents and cleaning products used for maintenance tasks may be based on less hazardous substances (e.g. solvents) and prevent fire hazards.
Effects: burns, fatal accidents.	**Effects**: burns, fatal accidents.

2020 Current situation	2025-30 Situation forecast
Work environmental hazards	
Work environmental hazards: excessive heat and cold, poor lighting.	Work environmental hazards: poor lighting, climate and temperature.
Effects: cardiovascular diseases, negative effects on muscles, tendons and joints, cold, eye strain, poor concentration.	**Effects**: cardiovascular diseases, negative effects on muscles, tendons and joints, cold, eye strain, headache, poor concentration.
Hazards through dangerous substances	
• Chemical hazards/ dangerous substances: asbestos, glass fibre, vapours, fumes, dust, solvents. Injury of the eyes caused by splashing lubricants, allergies due to contact with solvents, oils, hydraulic fluids and lubricants, exposure to dust. Contact with substances that are generated as by-products during maintenance activities and by the equipment used, such as welding fumes, diesel exhaust (e.g. from generators), and sanding dust.	• Chemical hazards/ dangerous substances: asbestos, glass fibre, vapours, fumes, dust, solvents, new materials. Injury of the eyes caused by splashing lubricants, allergies due to contact with solvents, oils, hydraulic fluids and lubricants, exposure to dust. Contact with substances that are generated as by-products during maintenance activities and by the equipment used, such as welding fumes, diesel exhaust (e.g. from generators), and sanding dust. The risk of being exposed to chemicals may decrease, depending on takeover of specific tasks by cobots/robots. Risks may decrease with use of cobots/robots. Maybe reduced, if the use of hazardous chemicals in products used for maintenance will be reduced/substituted due to circular economy.
Effects: contamination/intoxication, skin diseases, respiratory diseases, cancer.	**Effects**: contamination/intoxication, skin diseases, respiratory diseases, cancer. New materials (e.g. nanomaterials): Nanotechnology and nanomaterials may be used in woods as well as wood-composite materials in order to improve some of their properties, e.g. to improve the water resistance or thermal conductivity. **Effects**: not yet well known, included are among others inflammation and tissue damage, fibrosis and tumour generation. Recycling programs: Recycled material may contain dangerous substances, to the latest findings carcinogen or repro-toxic. (nowadays restricted by law (REACH)). **Effects**: contamination/intoxication, skin diseases, respiratory diseases, cancer.
• Biological hazards: bacteria, mould and fungi (e.g. lubricants may contain biological hazards).	• Biological hazards: bacteria, mould and fungi (e.g. lubricants may contain biological hazards). Risk from non-targeted activities with microorganism. Risks may decrease with use of cobots/robots. Maintenance of machinery and systems such as: waste treatment, waste water treatment systems and power plant stations. New Companies using their own waste as an energy source (Shifting to renewable energies – e.g. from biomass), operate their own waste water treatment system.
Effects: contamination/intoxication, skin diseases, respiratory diseases, infections.	**Effects**: contamination/intoxication, allergies, skin diseases, respiratory diseases, infections.
Psychosocial hazards	
• Organisation of work: time pressure, shift work, stress, often related to poor work organisation and lack of training.	Organisation of work: time pressure, shift work, stress, often related to poor work organisation lack of training and increased demand on flexibility and digital know how. Lack of experience: New software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Increased demand on competences and up-to-date knowledge on the current development in circular economy and recycling industry. Working with materials which have previously been manufactured: new skills need to be acquired throughout the production cycle. Repair, remanufacture and selective disassembly require new methods and procedures.
• Social relationship: difficult discussion with the management, difficult partners, lack of information.	• Social relationship: difficult discussion with the management, difficult partners, lack of information, lack of social contacts.
• Working method: teamwork, working outside of "core working hours".	Working method: working outside of "core working hours", digital equipment, cognitive interactions between autonomous techniques. The use of cobots and other digital techniques may increase the risk of working alone and feeling isolated. Cognitive interactions between a robot and a human worker can lead to mental stress. Long period of concentration working with computer and new software and performing multitasking, increased demand on flexibility as workers may work from everywhere with mobile devices. Workers are also at risk of being permanent available outside working hours. Maintenance of machines and plants emerged from circular economic and sustainable oriented strategies/products/marketing projects.
Effects: stress, burnout.	**Effects**: stress, burnout.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Maintenance & repair engineer - ISCO 2141s

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Shift to renewable energies	Shift to renewable materials	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	Recycle materials	Virtualise indirect aspects of the product	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	Working in a highly integrated digital ecosystem of the digital manufacturing plant	Use digitization tools to work in a customer-oriented manner	Monitoring and inspection using big data	Digital handling and registration	Using new smarter production methods, digital techniques and equipment
Essential skills and competences																	
Advise on efficiency improvements	YES, changed	●	●	●	●	●	●	●	●	●	●	●		●	●		●
Conduct quality control analysis	YES, changed			●	●			●	●	●	●			●	●		
Conduct routine machinery checks	YES, changed	●			●		●				●						
Create solutions to problems	YES, changed	●	●	●	●	●	●	●	●	●	●	●		●			●
Inspect industrial equipment	YES, changed	●			●		●				●						
Inspect machinery	YES, changed	●			●		●				●						
Maintain equipment	YES, changed	●			●		●				●			●	●		●
Maintain machinery	YES, changed	●			●		●				●			●	●		●
Manage budgets	YES, changed	●	●	●	●	●	●	●		●	●	●		●	●	●	
Perform machine maintenance	YES, changed														●		●
Perform test run	YES, changed														●		●
Resolve equipment malfunctions	YES, changed														●		●
Troubleshoot	YES, changed														●		●
Use testing equipment	YES, changed														●		●
Work safely with machines	YES, changed	●	●	●	●		●		●	●	●	●	●				●
Write technical reports	YES, changed	●	●	●	●		●			●	●				●	●	
Essential knowledge																	
Engineering principles	YES																
Engineering processes	YES																
Maintenance and repair	YES, changed													●	●		●
Mechanics	YES																
Quality assurance procedures	YES, changed	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Generic green skills, knowledge and competences (*)																	
Environmental awareness and willingness to learn	NEW	●	●	●	●	●	●	●	●	●	●	●					
Systems and risk analysis skills	NEW	●	●				●	●		●	●	●					
Innovation skills	NEW	●	●	●	●	●	●	●	●	●	●	●					
Coordination, management and business skills	NA																
Communication and negotiation skills	NEW	●	●	●	●	●		●		●	●	●					
Marketing skills	NA																
Strategic and leadership skills	NA																
Consulting skills	NA																
Networking, information technology and language skills	NEW	●	●	●	●					●	●	●					
Adaptability and transferability skills	NEW	●	●	●	●					●	●	●					
Entrepreneurial skills	NA																
Waste, energy and water quantification and monitoring	NEW	●				●	●	●	●	●	●	●					
Material use and impact quantification and monitoring	NEW		●			●	●	●	●	●	●						
Material use and impact minimisation	NEW		●					●	●	●	●						

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova

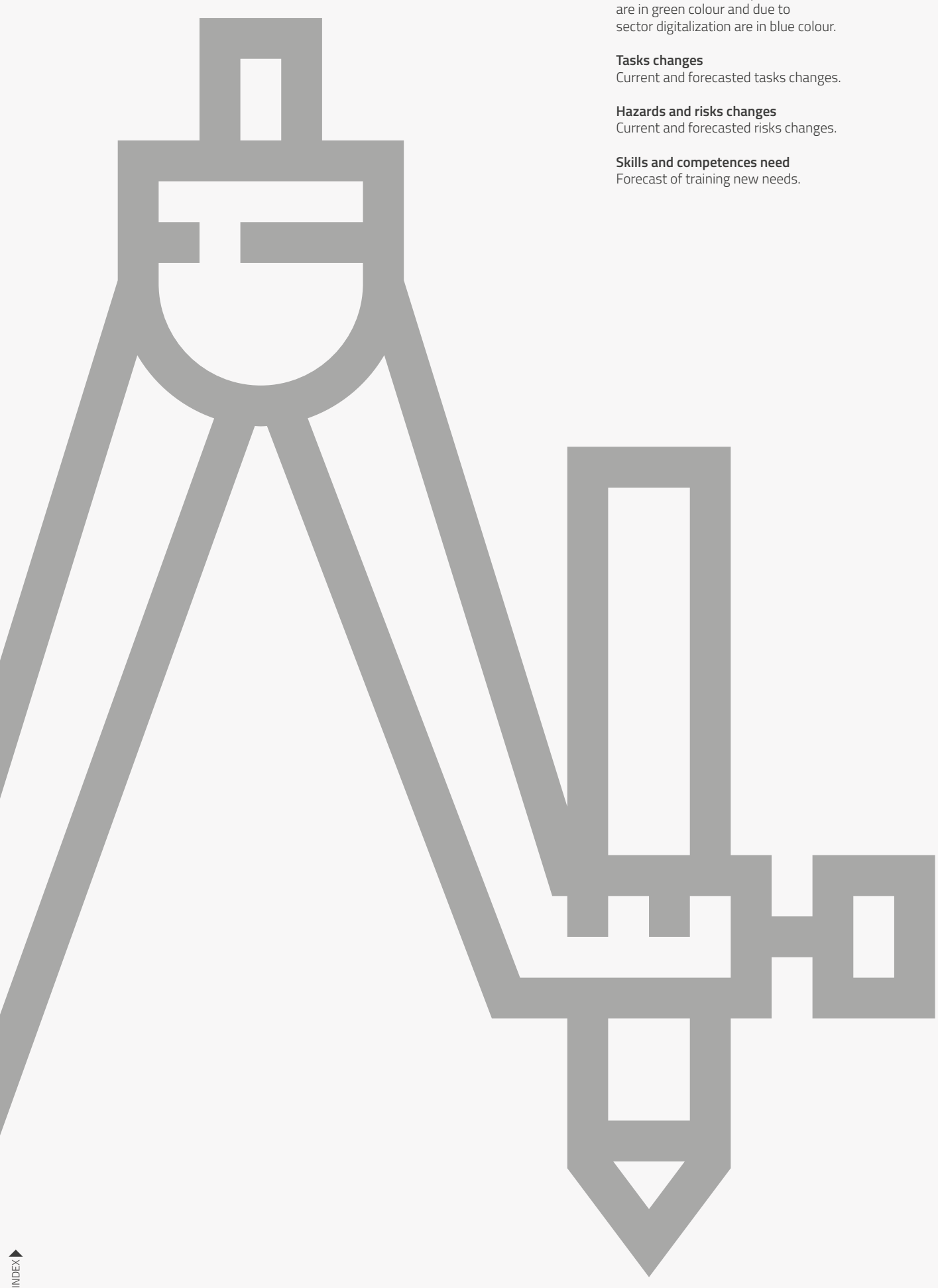
Furniture designer
ISCO 2163s

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.



Furniture designer
ISCO 2163s

Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

GO TO INDEX

Furniture designer
ISCO 2163s

2020
Occupational profile

Current profile description
Furniture designers work on items of furniture and related products. They design the product and are involved in its production as craftsmen and designers or makers. The conception of furniture combines innovative design, functional requirements and aesthetic appeal.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness.
- Contributes to continuous improvement of work processes in the company.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

	Current profiles tasks	**Regenerate**	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	**Share**	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	**Optimise**	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	**Loop**	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste	
		ReSOLVE levers*																							
A	Determining the objectives and constraints of the design brief by consulting with clients and stakeholders.			●				●	●	●	●	●		●	●		●			●	●	●	●		
B	Formulating design concepts for industrial, commercial and consumer products.			●				●	●	●	●	●		●	●		●			●	●	●	●		
C	Harmonizing aesthetic considerations with technical, functional, ecological and production requirements.			●				●	●	●	●	●		●	●		●			●	●	●	●		
D	Preparing sketches, diagrams, illustrations, plans, samples and models to communicate design concepts.			●				●	●	●	●	●		●	●		●			●	●	●	●		
E	Negotiating design solutions with clients, management, and sales and manufacturing staff.			●				●	●	●	●	●		●	●					●	●	●	●		
F	Selecting, specifying and recommending functional and aesthetic materials, production methods and finishes for manufacture.			●				●	●	●	●	●		●	●		●	●		●	●	●	●		
G	Detailing and documenting the selected design for production.			●				●	●	●	●	●		●	●	●	●			●	●	●	●		
H	Preparing and commissioning prototypes and samples.			●						●	●	●		●	●	●	●			●	●	●	●		
I	Supervising the preparation of patterns, programmes and tooling, and of the manufacturing process.			●				●	●	●	●	●		●	●	●	●	●		●	●	●	●		

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Furniture designer - ISCO 2163s

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Furniture designers work on items of future furniture and related products exploiting the newest eco-design methods, software and tools and the data and information collected through the highly connected and digitised company ecosystem. They design the product and are involved in its production as craftsmen and designers or makers. The conception of furniture combines innovative design, functional and environmental requirements and aesthetic appeal.

- Uses digitization tools to work in a customer-oriented manner
- Considers cost, environmental impact and time-effectiveness.
- Contributes to continuous improvement of work processes in the company.
- Cooperates with other departments (administrative, commercial, ICT and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Applies a life-cycle thinking approach and the ecodesign methodology.
- Uses tools to assess the environmental profile of the designed product (e.g. impact of the materials used in the product, etc.).

Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	**Profile tasks forecast**	
	●	●		●	●	●	A	Determining the objectives and constraints of the design (including environmental performance) using real life computational simulation models and integrating environmental protection criteria over product's lifecycle, by consulting with clients and stakeholders and aligned with the circular economy-oriented strategies of the organisation.
	●	●		●	●	●	B	Formulating design concepts, based on a life-cycle thinking and circularity approach and using rapid experimentation and digital models, for industrial, commercial and consumer products and services.
	●	●		●	●	●	C	Use virtual models to help harmonizing aesthetic considerations with technical, functional, ecological and production requirements, considering the complete life-cylce of the product, from raw materials selection to end-of-life scenario.
	●	●		●	●	●	D	Make digital (virtual) models and physical samples and models through rapid prototyping to communicate design concepts and the environmental performance of the product, considereing its complete life-cycle.
	●	●		●	●	●	E	Negotiating digital design solutions with clients, management, and sales and manufacturing staff based on the sustainability strategies of the customers and the organisation.
	●	●		●	●	●	F	Selecting, specifying and recommending functional, environmental-friendly and aesthetic materials, ecoefficient production methods and finishes for manufacturing using the highly digitised set of tools and considering the complete life-cycle of the products (e.g. end-of-life scenario).
	●	●		●	●		G	Detailing and documenting the selected circular economy-oriented and digital design for production.
	●	●		●	●		H	Preparing and commissioning physical and digital prototypes, models and samples to assess the technical & environmental performance of the product, prior its launch.
	●	●		●	●		I	Supervising the preparation of patterns, programmes and tooling, and of the digital manufacturing process, to reduce its environmental impact, for example energy consumption or waste generation.

Furniture designer
ISCO 2163s

2020
Occupational profile

Current profile description
Furniture designers work on items of furniture and related products. They design the product and are involved in its production as craftsmen and designers or makers. The conception of furniture combines innovative design, functional requirements and aesthetic appeal.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness.
- Contributes to continuous improvement of work processes in the company.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

New categorization of hazards

Current profiles tasks		**Mechanical hazards**	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	**Ergonomic hazards**	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	**Electrical hazards**	Electric shock	**Hazards due to physical effects/physical agents**	Noise	Vibration	Laserlight	**Fire and explosion hazards**	Flammable substances	**Work environment hazards**	Poor lighting conditions	Climate	Poor ventilation	**Hazards through dangerous substances**	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	**Biological Hazards**	Non-targeted activities with microorganism	**Psychosocial hazards**	Excessive workloads
A	Determining the objectives and constraints of the design brief by consulting with clients and stakeholders.																																		●
B	Formulating design concepts for industrial, commercial and consumer products.												●										●	●											●
C	Harmonizing aesthetic considerations with technical, functional, ecological and production requirements.												●										●	●											●
D	Preparing sketches, diagrams, illustrations, plans, samples and models to communicate design concepts.												●										●	●											●
E	Negotiating design solutions with clients, management, and sales and manufacturing staff.						●																●	●											●
F	Selecting, specifying and recommending functional and aesthetic materials, production methods and finishes for manufacture.						●																●	●											●
G	Detailing and documenting the selected design for production.												●										●	●											●
H	Preparing and commissioning prototypes and samples.		●	●			●								●								●	●	●					●	●				●
I	Supervising the preparation of patterns, programmes and tooling, and of the manufacturing process.																						●	●											●

● No changes ● Reduced due to Circular Economy ● New or increased due to Circular Economy ● Reduced due to digitalization ● New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Furniture designer - ISCO 2163s

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Furniture designers work on items of future furniture and related products exploiting the newest eco-design methods, software and tools and the data and information collected through the highly connected and digitised company ecosystem. They design the product and are involved in its production as craftsmen and designers or makers. The conception of furniture combines innovative design, functional and environmental requirements and aesthetic appeal.

- Uses digitization tools to work in a customer-oriented manner
- Considers cost, environmental impact and time-effectiveness.
- Contributes to continuous improvement of work processes in the company.
- Cooperates with other departments (administrative, commercial, ICT and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Applies a life-cycle thinking approach and the ecodesign methodology.
- Uses tools to assess the environmental profile of the designed product (e.g. impact of the materials used in the product, etc.).

Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload		**Profile tasks forecast**
	●	●	●		●	●	●	●		●		●	A	Determining the objectives and constraints of the design (including environmental performance) using real life computational simulation models and integrating environmental protection criteria over product's lifecycle, by consulting with clients and stakeholders and aligned with the circular economy-oriented strategies of the organisation.
	●	●	●		●	●	●	●		●	●	●	B	Formulating design concepts, based on a life-cycle thinking and circularity approach and using rapid experimentation and digital models, for industrial, commercial and consumer products and services.
	●	●	●		●	●	●	●		●	●	●	C	Use virtual models to help harmonizing aesthetic considerations with technical, functional, ecological and production requirements, considering the complete life-cylce of the product, from raw materials selection to end-of-life scenario.
	●	●	●		●	●	●	●		●		●	D	Make digital (virtual) models and physical samples and models through rapid prototyping to communicate design concepts and the environmental performance of the product, considereing its complete life-cycle.
	●	●	●		●	●	●	●		●		●	E	Negotiating digital design solutions with clients, management, and sales and manufacturing staff based on the sustainability strategies of the customers and the organisation.
	●	●	●		●	●	●	●		●		●	F	Selecting, specifying and recommending functional, environmental-friendly and aesthetic materials, ecoefficient production methods and finishes for manufacturing using the highly digitised set of tools and considering the complete life-cycle of the products (e.g. end-of-life scenario).
	●	●	●		●	●	●	●		●	●	●	G	Detailing and documenting the selected circular economy-oriented and digital design for production.
	●	●	●		●	●	●	●		●		●	H	Preparing and commissioning physical and digital prototypes, models and samples to assess the technical & environmental performance of the product, prior its launch.
	●	●	●		●	●	●	●		●		●	I	Supervising the preparation of patterns, programmes and tooling, and of the digital manufacturing process, to reduce its environmental impact, for example energy consumption or waste generation.

1 Cobotics (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping).
2 Run over, roll over, falls from height.

Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Furniture designer – ISCO 2163s

2020 Current situation	2025-30 Situation forecast
Work area: office workplace, computer workplace, meeting room, sales rooms, discussion with difficult clients, managers and manufacturing staff, workshop for preparing prototypes and patterns.	Work area: office workplace, computer workplace, meeting room, sales rooms, discussion with difficult clients, managers and manufacturing staff, workshop for preparing prototypes and patterns, use of complex software, use of digitalized tools. Taking into consideration design of sustainable products made from e.g. recycled materials with energy saving processes.
Mechanical hazards	
• Mechanical hazards: (when working in workshops to prepare prototypes): from moving machines and tools. **Effects**: bruises, cuts and sharp injuries, crushing. • Slips and trips, obstacles, table edges, moving vehicles, machines. **Effects**: squeezing, cutting, twisting, spraining, bumps and bruises.	• Mechanical hazards: (when working in workshops to prepare prototypes): from moving machines and tools. **Effects**: bruises, cuts and sharp injuries, crushing. • Slips and trips, obstacles, table edges, moving vehicles, machines. **Effects**: squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: from poor ergonomic conditions and inactivity, prolonged sitting and from poor ergonomic practices with mobile devices. **Effects**: chronic neck and back pain, obesity and cardiovascular diseases.	• Ergonomic hazards: from poor ergonomic conditions and inactivity, prolonged sitting and from poor ergonomic practices with mobile devices. Digitalization put workers at risk of being exposed to ergonomic hazards such as lack of exercise/ inactivity because of operating autonomous or semi-autonomous machines from office workstations. Inactivity may increase with further digitalization. **Effects**: chronic neck and back pain, obesity and cardiovascular diseases.
Electrical hazards	
• Electrical hazards: contacts with live parts or connections or exposure to arc flash. **Effect**: fatal accident.	• Electrical hazards: contacts with live parts or connections or exposure to arc flash. **Effect**: fatal accident.
Work environmental hazards	
• Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effects**: eyestrain, headache, colds, cardiovascular problems.	• Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effects**: eyestrain, headache, colds, cardiovascular problems.
Hazards through dangerous substances	
	• Experiments and work with new materials and with recycled materials. **Effects**: not yet well known, included are among others skin diseases, respiratory diseases, cancer.
Psychosocial hazards	
• Organisation of work/content of work: tight deadlines, performance pressure, high expectations regarding creativity, difficult negotiations, no clear distinction between private life and work life, overload, lack of training and information. • Social relationship: difficult clients, difficult colleagues. • Working method: working alone frequently, cooperation with other departments. **Effects**: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.	• Organisation of work/content of work: tight deadlines, performance pressure, high expectations regarding creativity, difficult negotiations, no clear distinction between private life and work life, overload, lack of training and information. Increased demand on competences and up-to-date knowledge on the current development in circular economy and recycling industry. • Social relationship: difficult clients, difficult colleagues. • Working method: working alone frequently, cooperation with other departments; digitalization may increase long period of concentration working with computer and new software and performing multitasking, increased demand on flexibility as workers may work from everywhere with mobile devices. Increased demand on knowledge regarding the design of sustainable products respecting circular economy. Workers are also at risk of being permanent available outside working hours. • Lack of work experience: new software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Deciding on circular economic and sustainable oriented strategies/products: increased demand on skills and knowledge/keeping up-to-date regarding the current development in circular economy and sustainable oriented strategies/products (staying up-to-date; further training for new technologies and processes). • Workers are at risk of cognitive strain due to interactions between digitalized instruments and autonomous technologies. The use of cobots and other digital techniques may increase the risk of working alone and feeling isolated. Working in a customer-oriented manner requires an increased flexibility. **Effects**: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Furniture designer – ISCO 2163s

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Shift to renewable materials	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	Increase performance/efficiency of products	Customisation/made to order	Remanufacture products and/or components	Implement Take Back programs	Recycle materials	Promote the cascade use of wood	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	Replace old materials with advanced renewable ones	Apply new technologies	Exploiting the newest design methods, software and tools and the data and information collected through the highly connected and digitized company ecosystem	Use digitization tools to work in a customer-oriented manner	Using real life computational simulation models	Using rapid experimentation / rapid prototyping and digital/virtual models	Digital design
Essential skills and competences																				
Adapt to new design materials	YES																			
Attend design meetings	YES, changed															●	●	●	●	●
Consult with design team	YES, changed															●		●	●	
Design original furniture	YES, changed															●	●	●	●	●
Develop design concept	YES, changed	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●			●
Gather reference materials for artwork	NO																			
Monitor art scene developments	YES																			
Monitor exhibition designs	YES																			
Monitor sociological trends	YES, changed	●	●	●	●	●	●	●	●	●	●	●	●	●	●					
Monitor textile manufacturing developments	YES																			
Present detailed design proposals	YES, changed						●				●	●	●		●			●	●	
Transfer designs	YES, changed	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	
Essential knowledge																				
Art history	YES																			
Aesthetics	YES																			
Copyright legislation	YES																			
Design principles	YES, changed	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Engineering principles	YES, changed		●	●	●	●		●				●	●		●	●		●	●	
Engineering processes	YES, changed	●						●	●	●				●	●					
Ergonomics	YES																			
Industrial design	YES, changed	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●
Manufacturing processes	YES, changed	●						●	●	●				●	●			●	●	
Mathematics	NO																			
Generic green skills, knowledge and competences (*)																				
Environmental awareness and willingness to learn	NEW	●	●	●	●	●	●		●	●	●	●								
Systems and risk analysis skills	NA																			
Innovation skills	NEW	●	●	●	●	●		●		●		●	●	●	●					
Coordination, management and business skills	NEW	●				●	●		●	●	●			●	●					
Communication and negotiation skills	NEW	●				●	●		●	●	●	●	●	●	●					
Marketing skills	NEW	●					●		●		●	●	●		●					
Strategic and leadership skills	NA																			
Consulting skills	NEW	●				●	●		●	●	●	●	●	●	●					
Networking, information technology and language skills	NEW	●	●	●	●	●		●		●		●	●	●	●					
Adaptability and transferability skills	NEW	●	●	●	●	●	●	●	●		●			●	●					
Entrepreneurial skills	NEW	●	●	●	●	●		●		●		●	●	●	●					
Waste, energy and water quantification and monitoring	NEW	●				●		●	●	●	●		●	●	●					
Material use and impact quantification and monitoring	NEW	●				●		●	●	●	●		●	●	●					
Material use and impact minimisation	NEW	●	●	●	●	●		●	●	●	●		●	●	●					

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova

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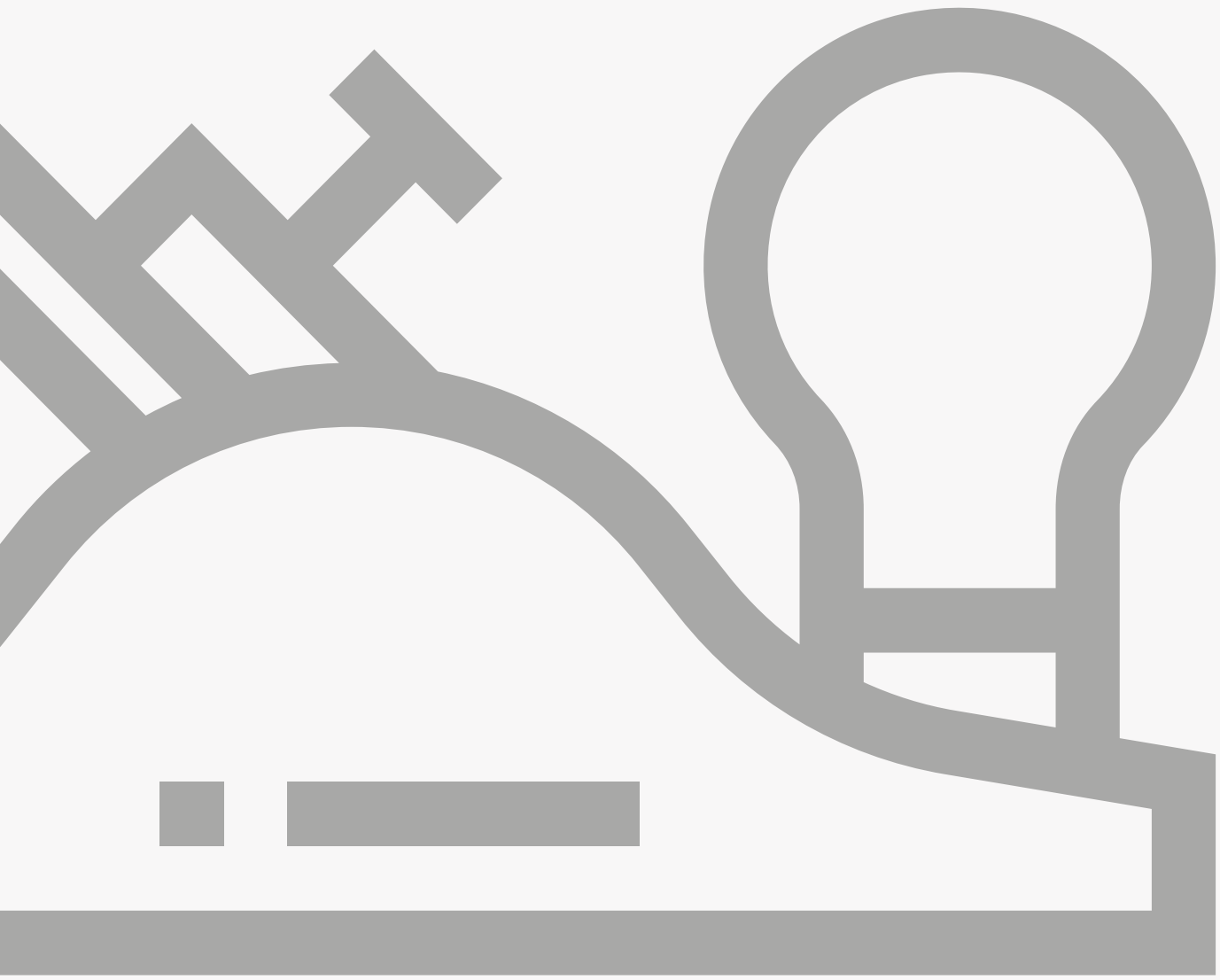
Cabinet-maker and related workers
ISCO 7522

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.



Cabinet-maker and related workers
ISCO 7522

Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

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Cabinet-maker and related workers ISCO 7522

2020
Occupational profile

Current profile description
Cabinet-makers and related workers make, decorate and repair wooden furniture, carts and other vehicles, wheels, parts, fittings, patterns, models and other wooden products using woodworking machines, machine tools and specialized hand tools.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

Current profiles tasks		ReSOLVE levers*																								
		Regenerate	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	**Share**	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	**Optimise**	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	**Loop**	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste		
A	Operating woodworking machines such as power saws, jointers, mortisers and shapers, and using hand tools to cut, shape and form parts and components. - Selecting, controlling, mounting and replacement of cutting tools on the woodworking machines. - Operating woodworking machines.			●						●	●	●		●	●	●	●	●		●		●	●			
B	Studying plans, verifying dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to specifications.			●					●	●	●	●		●	●	●	●	●		●		●	●			
C	Trimming joints and fitting parts and subassemblies together to form complete units using glue and clamps, and reinforcing joints using nails, screws or other fasteners.			●					●	●	●	●		●	●	●	●	●		●		●	●			
D	Making, restyling and repairing various wooden articles such as cabinets, furniture, vehicles, scale models, sports equipment and other parts or products.			●					●	●	●	●		●	●	●	●	●		●	●	●	●			
E	Decorating furniture and fixtures by inlaying wood or applying veneer and carving designs.			●					●		●	●		●	●	●	●	●		●	●	●				
F	Finishing surfaces of wooden articles or furniture.			●						●	●	●		●	●	●	●	●				●				
G				●				●						●		●	●				●	●	●	●		
H				●				●	●	●	●	●		●	●	●	●	●		●	●	●	●			

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Cabinet-maker and related workers - ISCO 7522

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Cabinet-makers and related workers make, decorate and repair wooden furniture, carts and other vehicles, wheels, parts, fittings, patterns, models and other wooden products using highly digitized, connected, ecoefficient and automated woodworking machines and machine tools as well as specialized hand tools.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Uses digitization tools to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction, etc.).
- Applies a life-cycle thinking and favour the future disassembly of the product for maintenance, repair, reuse or recycling.

	Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	**Profile tasks forecast**
A					●	●		Operating connected, digitized, ecoefficient and highly automated, even autonomous woodworking machines, such as power saws, jointers, mortisers and shapers, and using hand tools to cut, shape and form parts and components. • Selecting, controlling, mounting and replacement of cutting tools on the woodworking machines. • Operating connected, digitized, ecoefficient and highly automated woodworking machines. • Optimising the use of resources and energy and reducing to maximum the generated waste (e.g. wood scrap).
B			●		●	●		Simulating, using digital twins, to study and optimise plans, verifying dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to technical & environmental specifications, including product durability, reparability, etc.
C			●			●		With the help of cobots trim joints and fit parts and subassemblies together to autonomously form complete units using glue and clamps, and reinforcing joints using nails, screws or other fasteners, considering the future disassembly needs and potential reparability of the product (e.g. reducing glued components, etc.).
D		●	●		●	●	●	Through human-robot collaboration make, restyle and repair various wooden articles such as cabinets, furniture, vehicles, scale models, sports equipment and other parts or products, in line with the circular economy-oriented strategies of the organisation (e.g. increase product durability).
E		●	●		●	●	●	Create environmental-friendly designs, using digital simulation tools like digital twins and augmented reality, and decorate furniture and fixtures by inlaying wood or applying veneer and carving designs with the use of automated and ecoefficient machines such as laser-cutting cobots and other human-robot collaboration, using sustainable materials and taking into account future disassembling and whole product life cycle.
F					●	●		Finishing surfaces of wooden articles or furniture using non-hazardous substances (e.g. low-VOCs chemicals) through highly automated, even autonomous machines, cobots and robots, that can be remotely operated (with the help of Augmented Reality) using big data.
G					●			Selective and/or destructive disassembling of out of use or defective wood-based furniture products for separation of materials and elements for further recovery or recycling.
H					●	●	●	Operating tools and highly digitized, connected and automated woodworking machines for the maintenance, reparation and/or re-manufacturing of wood-based furniture products, including cleaning, polishing and/or additional finishing treatments.

Cabinet-maker and related workers ISCO 7522

2020
Occupational profile

Current profile description
Cabinet-makers and related workers make, decorate and repair wooden furniture, carts and other vehicles, wheels, parts, fittings, patterns, models and other wooden products using woodworking machines, machine tools and specialized hand tools.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

Current profiles tasks

New categorization of hazards

		Mechanical hazards	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	Ergonomic hazards	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	Electrical hazards	Electric shock	Hazards due to physical effects/physical agents	Noise	Vibration	Laserlight	Fire and explosion hazards	Flammable substances	Work environment hazards	Poor lighting conditions	Climate	Poor ventilation	Hazards through dangerous substances	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	Biological Hazards	Non-targeted activities with microorganism	Psychosocial hazards	Excessive workloads
A	Operating woodworking machines such as power saws, jointers, mortisers and shapers, and using hand tools to cut, shape and form parts and components. - Selecting, controlling, mounting and replacement of cutting tools on the woodworking machines. - Operating woodworking machines.		●	●	●	●	●			● ●	● ●				●		●	●	●				●	●	●	●				●	●				●
B	Studying plans, verifying dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to specifications.																						●	●	●										●
C	Trimming joints and fitting parts and subassemblies together to form complete units using glue and clamps, and reinforcing joints using nails, screws or other fasteners.		●	●	●	●	●			● ●	● ●						● ●	● ●	●			●		●	●	●				●	●	●	●		●
D	Making, restyling and repairing various wooden articles such as cabinets, furniture, vehicles, scale models, sports equipment and other parts or products.		●	●	●	●	●			● ●	● ●				●		● ●	● ●	●			●		●	●	●				●	●	●	●		●
E	Decorating furniture and fixtures by inlaying wood or applying veneer and carving designs.		●		●		●			● ●	● ●						● ●	● ●	●			●		●	●	●				●	●	●	●		●
F	Finishing surfaces of wooden articles or furniture.			●	●		●			● ●	● ●						● ●	● ●	●			●		●	●	●				●	●	●	●		●
G			●	●		●	●			●	●						●	●				●	●	●	●	●				●	●	●	●	●	
H			●	●		●	●			●	●						●	●				●	●	●	●	●				●	●	●	●	●	

● No changes ● Reduced due to Circular Economy ● New or increased due to Circular Economy ● Reduced due to digitalization ● New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Cabinet-maker and related workers - ISCO 7522

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Cabinet-makers and related workers make, decorate and repair wooden furniture, carts and other vehicles, wheels, parts, fittings, patterns, models and other wooden products using highly digitized, connected, ecoefficient and automated woodworking machines and machine tools as well as specialized hand tools.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Uses digitization tools to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction, etc.).
- Applies a life-cycle thinking and favour the future disassembly of the product for maintenance, repair, reuse or recycling.

Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload		**Profile tasks forecast**
	●	●	●		●	●	●	●	●	●	●	●	A	Operating connected, digitized, ecoefficient and highly automated, even autonomous woodworking machines, such as power saws, jointers, mortisers and shapers, and using hand tools to cut, shape and form parts and components. • Selecting, controlling, mounting and replacement of cutting tools on the woodworking machines. • Operating connected, digitized, ecoefficient and highly automated woodworking machines. • Optimising the use of resources and energy and reducing to maximum the generated waste (e.g. wood scrap).
	●	●	●		●	●	●	●	●	●	●	●	B	Simulating, using digital twins, to study and optimise plans, verifying dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to technical & environmental specifications, including product durability, reparability, etc.
	●	●	●	●	●	●	●	●	●	●	●	●	C	With the help of cobots trim joints and fit parts and subassemblies together to autonomously form complete units using glue and clamps, and reinforcing joints using nails, screws or other fasteners, considering the future disassembly needs and potential reparability of the product (e.g. reducing glued components, etc.).
	●	●	●		●	●	●	●	●	●	●	●	D	Through human-robot collaboration make, restyle and repair various wooden articles such as cabinets, furniture, vehicles, scale models, sports equipment and other parts or products, in line with the circular economy-oriented strategies of the organisation (e.g. increase product durability).
	●	●	●		●	●	●	●	●	●	●	●	E	Create environmental-friendly designs, using digital simulation tools like digital twins and augmented reality, and decorate furniture and fixtures by inlaying wood or applying veneer and carving designs with the use of automated and ecoefficient machines such as laser-cutting cobots and other human-robot collaboration, using sustainable materials and taking into account future disassembling and whole product life cycle.
	●	●	●		●	●	●	●	●	●	●	●	F	Finishing surfaces of wooden articles or furniture using non-hazardous substances (e.g. low-VOCs chemicals) through highly automated, even autonomous machines, cobots and robots, that can be remotely operated (with the help of Augmented Reality) using big data.
	●	●	●				●	●	●	●		●	G	Selective and/or destructive disassembling of out of use or defective wood-based furniture products for separation of materials and elements for further recovery or recycling.
	●	●	●				●	●	●	●		●	H	Operating tools and highly digitized, connected and automated woodworking machines for the maintenance, reparation and/or re-manufacturing of wood-based furniture products, including cleaning, polishing and/or additional finishing treatments.

1 Cobotics (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping).
2 Run over, roll over, falls from height.

Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Cabinet-maker and related workers - ISCO 7522

2020 Current situation	2025-30 Situation forecast
Work area: workshops with wood processing machines, hand and power tools such as (sanders, circular/crosscut/ripsaws), wood storage, finishing of wood products.	Work area: workshops with wood processing machines, hand and power tools such as (sanders, circular/crosscut/ripsaws), wood storage, storage of new and recycled materials, finishing of wood products, use of digitalized tools, disassembly, dismantling, repair, reuse, maintenance and remanufacturing of furniture.
Mechanical hazards	
• Mechanical hazards from moving machines and tools. Woodworking machinery exposes workers to risks of being injured by unprotected moving parts, contact with moving blades (saw blade, drill, kick back etc), uncontrolled moving parts (flying objects, wood chips) and parts with hazardous shapes (cutting, pointed, rough).	• Mechanical hazards from moving machines and tools and from cobots and robots. Woodworking machinery exposes workers to risks of being injured by unprotected moving parts, contact with moving blades (saw blade, drill, kick back etc), uncontrolled moving parts (flying objects, wood chips) and parts with hazardous shapes (cutting, pointed, rough). Some risks from mechanical hazards may decrease, depending on takeover of specific tasks by cobots/robots. Most of industrial cobots and robots are unaware of their surroundings therefore they can be dangerous to workers. Industrial robots can pose several types of hazards based on their origin: Mechanical hazards such as those arising from unintended and unexpected movements or release of tools. Remanufacturing and selective disassembling could require new type of tools not available. Better design of products (ecodesign) could reduce hazards associated to assembly/disassembly operations, using optimised joining systems, etc.
Effects: severe bruises, amputations, cuts and sharp injuries, crushing.	**Effects**: severe bruises, amputations, cuts and sharp injuries, crushing.
• Slips and trips, obstacles, table edges, moving vehicles, machines.	• Slips and trips, obstacles, table edges, moving vehicles, machines.
Effects: squeezing, cutting, twisting, spraining, bumps and bruises.	**Effects**: squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: poor ergonomic conditions, heavy physical workload.	• Ergonomic hazards: poor ergonomic conditions, heavy physical workload. Risks from ergonomic hazards may decrease, depending on take over of specific tasks by cobots/robots. On the other hand, workers are increasingly exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous machines and cobots from computer workstations. Maintenance, remanufacturing and repair services as well as dismantling of manufactured goods may be related to Musculoskeletal Disorders (MSDs) (e.g. awkward positions, heavy lifting and carrying). This risk could be reduced with ecodesign strategies to facilitate assembly/disassembly (e.g. type of fasteners, etc.) if occupational safety and health is taken into account when designing the product.
Effect: musculoskeletal diseases.	**Effect**: musculoskeletal diseases.
Electrical hazards	
• Electrical hazards: contacts with live parts or connections or exposure to arc flash. Electrical hazards from woodworking machines.	• Electrical hazards: contacts with live parts or connections or exposure to arc flash. Electrical hazards from woodworking machines and from autonomous or highly autonomous equipment.
Effect: fatal accident.	**Effect**: fatal accident.
Hazards due to physical effects/physical agents	
• Noise	• Noise: exposure to noise may decrease, depending on takeover of specific tasks by cobots/robots. Noise maybe reduced due to ecodesign of machinery operating quieter and more environmental-friendly. However, dismantling activities may expose workers still to noise.
Effects: hearing loss, headache, nervousness, poor concentration.	**Effects**: hearing loss, headache, nervousness, poor concentration.
• Vibrations	• Vibrations: exposure to vibration may decrease, depending on takeover of specific tasks by cobots/robots. Possible more use of vibrating tools during dismantling, product remanufacturing or repair (polisher, etc.). Vibration maybe reduced due to ecodesign of machinery operating with less vibration energy and more environmental-friendly.
Effects: hand-arm-vibration syndrome (e.g. white finger disease).	**Effects**: hand-arm-vibration syndrome (e.g. white finger disease).
• Laserlight	• Laserlight: cabinet makers may be exposed to laserlight.
Effects: eye damage, negative effects similar to sunburn.	**Effects**: eye damage, negative effects similar to sunburn.
Fire and explosion hazards	
• Fire and explosion hazards from materials, including wood dust, solvents and chemicals.	• Fire and explosion hazards from materials, including wood dust, solvents and chemicals. Exposure to fire and explosion hazards may decrease, depending on takeover of specific tasks by cobots/robots. Dust maybe emitted during dismantling, remanufacturing or repair activities– inappropriate dust extraction system increases risk of dust explosion. Risk from explosion and fire may decrease, depending on the substitution of flammable solvents in glues.
Effects: burns, fatal accidents.	**Effects**: burns, fatal accidents.

2020 Current situation	2025-30 Situation forecast
Work environmental hazards	
• Work environmental hazards: poor lighting, climate and temperature. **Effects**: negative effects on muscles, tendons and joints, cold, poor concentration, eye strain, headache.	• Work environmental hazards: poor lighting, inadequate temperature and climate, poor ventilation. **Effects**: negative effects on muscles, tendons and joints, cold, poor concentration, eye strain, headache.
Hazards through dangerous substances	
• Chemical hazards/ dangerous substances: asbestos, glass fibre, vapours, fumes, dust, solvents, new materials (nanomaterials). **Effects**: contamination/intoxication, skin diseases, respiratory diseases, cancer.	• Chemical hazards/dangerous substances: asbestos, glass fibre, vapours, fumes, dust, solvents, new materials (nanomaterials). The risk of being exposed to chemicals may decrease, depending on takeover of specific tasks by cobots/robots. Chemical hazards may be reduced, if OSH will be included in the design of the products/ materials (use of less dangerous substances) and if dangerous substances will be substituted by less dangerous substances (solvents, glues, formaldehyde). Disassembling, dismantling: Exposure to fibres or dust when disassembling, dismantling products. **Effects**: contamination/intoxication, skin diseases, respiratory diseases, cancer. • New materials (e.g. nanomaterials): Nanotechnology and nanomaterials may be used in woods as well as wood-composite materials in order to improve some of their properties, e.g. to improve the water resistance or thermal conductivity. Effects: not yet well known, included are among others inflammation and tissue damage, fibrosis and tumour generation. • Recycled material: Risk of exposure to dangerous substances may be increased through lack of information on chemicals contained in recycled products and on ways how to deal with them appropriately. Recycled material may contain dangerous substances, to the latest findings carcinogen or repro-toxic. (nowadays restricted by law (REACH)). **Effects**: contamination/intoxication, skin diseases, respiratory diseases, cancer.
Biological hazards	
• Biological hazards: bacteria, mould and fungi. **Effects**: contamination/intoxication, skin diseases, respiratory diseases, infections.	• Non-targeted activities with microorganism: selective and/or destructive disassembling for separation of materials and elements for further recovery or recycling may expose workers to microorganism such as mould (Recycled, old and used material may contain mould). **Effects**: contamination/intoxication, skin diseases, respiratory diseases, infections.
Psychosocial hazards	
• Organisation of work: time pressure, shift work, stress, often related to poor work organisation lack of training.	• Organisation of work: time pressure, shift work, stress, often related to poor work organisation lack of training, increased demand on flexibility and digital know how, repetitive and monotonous work. Lack of experience: New software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Increased demand on competences and up-to-date knowledge on the current development in circular economy and recycling industry. Working with materials which have previously been manufactured: new skills need to be acquired throughout the production cycle. Repair, remanufacture and selective disassembly require new methods and procedures.
• Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues.	• Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues, lack of social contacts.
• Working method: operating woodworking machines, working with colleagues. **Effects**: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.	• Working method: working with colleagues, operating digital equipment, cognitive interactions with autonomous technologies. The use of cobots and other digital technologies may increase the risk of working alone and feeling isolated. Cognitive interactions between a robot and a human worker can lead to mental stress. Long period of concentration working with computer and new software and performing multitasking, increased demand on flexibility as workers may work from everywhere with mobile devices. Workers are also at risk of being permanent available outside working hours. **Effects**: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Cabinet-maker and related workers - ISCO 7522

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Shift to renewable materials	Increase performance/efficiency of products	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Remanufacture products and/or components	Recycle materials	Promote the cascade use of wood	Apply new technologies	Use digitization tools to work in a customer-oriented manner	Using highly digitized, connected and automated (autonomous) woodworking machines	Simulation and use of digital twins to study and optimize	Human-robot collaboration, use of cobots, that can be remotely operated (with the help of Augmented Reality) using big data	Create designs, using digital simulation tools like digital twins and augmented reality
Essential skills and competences														
Apply a protective layer	YES, changed	●	●		●	●			●		●		●	
Apply wood finishes	YES, changed	●	●		●	●			●		●		●	
Clean wood surface	YES, changed					●	●	●	●		●		●	
Create furniture frames	YES, changed		●	●		●	●	●	●		●		●	
Create smooth wood surface	YES, changed										●		●	
Design objects to be crafted	YES, changed	●			●	●	●	●	●			●		●
Design original furniture	YES, changed	●				●	●	●	●			●		●
Join wood elements	YES, changed	●	●	●		●	●	●	●		●		●	
Operate drilling equipment	YES, changed		●	●		●			●		●		●	
Operate wood sawing equipment	YES, changed		●	●		●			●		●		●	
Repair furniture frames	YES, changed	●	●	●	●	●	●	●	●		●		●	
Sand wood	YES, changed					●	●	●	●		●		●	
Tend boring machine	YES, changed		●	●		●			●		●		●	
Disassemble wood-based furniture products	NEW	●	●	●	●	●	●	●	●		●		●	
Examine disassembled pieces for further steps (reuse, recylce, upcycle)	NEW	●	●	●	●	●	●	●	●		●		●	
Repair wood-based furniture pieces, where needed	NEW	●	●	●	●	●	●	●	●		●		●	
Essential knowledge														
Construction products	YES, changed	●	●	●	●	●	●	●	●	●		●		●
Furniture trends	YES, changed	●	●	●		●	●	●	●	●		●		
Sanding techniques	YES, changed					●	●		●		●		●	
Technical drawings	YES, changed	●	●	●		●	●		●	●		●		●
Types of wood	YES, changed	●	●		●	●	●	●	●					
Wood products	YES, changed	●	●		●	●	●	●	●					
Woodturning	YES, changed		●	●		●			●		●		●	
Generic green skills, knowledge and competences (*)														
Environmental awareness and willingness to learn	NEW		●	●		●	●	●	●					
Systems and risk analysis skills	NA													
Innovation skills	NEW	●	●	●		●		●	●					
Coordination, management and business skills	NA													
Communication and negotiation skills	NEW	●						●						
Marketing skills	NA													
Strategic and leadership skills	NA													
Consulting skills	NEW	●	●	●	●			●						
Networking, information technology and language skills	NA													
Adaptability and transferability skills	NEW	●	●	●		●	●	●	●					
Entrepreneurial skills	NA													
Waste, energy and water quantification and monitoring	NEW	●	●	●	●	●	●	●	●					
Material use and impact quantification and monitoring	NEW	●	●	●	●	●	●	●	●					
Material use and impact minimisation	NEW	●	●		●	●	●	●	●					

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova

Woodworking-machine tool setter and operator
ISCO 7523

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.

Woodworking-machine tool setter and operator
ISCO 7523

Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

GO TO INDEX

Woodworking-machine tool setter and operator
ISCO 7523

2020
Occupational profile

Current profile description
Woodworking machine tool setters and operators set-up, operate and monitor automatic or semi-automatic woodworking machines such as precision sawing, shaping, planing, boring, turning and woodcarving machines to fabricate or repair wooden parts for furniture, fixtures and other wooden products.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

	Current profiles tasks	ReSOLVE levers*																								
		Regenerate	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	**Share**	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	**Optimise**	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	**Loop**	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste		
A	Verifying dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to specifications.			●					●		●	●		●	●	●	●	●		●		●	●			
B	Setting up, programming, operating and monitoring several types of woodworking machines for sawing, shaping, boring, drilling, planing, pressing, turning, sanding or carving to fabricate or repair wooden parts for furniture, fixtures and other wooden products.														●	●	●	●		●			●			
C	Operating preset special-purpose wood-working machines to fabricate wooden products such as coat hangers, mop hand-les, clothespins and other products.			●					●		●	●		●	●	●	●	●		●		●	●			
D	Selecting knives, saws, blades, cutter heads, cams, bits or belts according to work piece, machine functions and product specifications.			●											●	●	●	●		●		●	●			
E	Installing and adjusting blades, cut-ter heads, boring-bits and sanding-belts, and using hand tools and rules.			●											●	●	●	●		●		●	●			
F	Selects, controls, mounts and replaces cut-ting tools on the woodworking machines.			●											●	●	●	●		●		●	●			
G	Setting and adjusting various kinds of woodworking machines for operation by others; reading and interpreting specifica-tions or following verbal instructions.			●										●	●	●	●	●		●		●	●			
H				●				●	●	●	●	●		●	●	●	●	●		●	●	●	●			

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Woodworking-machine tool setter and operator - ISCO 7523

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Woodworking machine tool setters and operators set-up, operate and monitor ecoefficient, semi-automatic or fully automated, even autonomous woodworking machines, such as precision sawing, shaping, planing, boring, turning and woodcarving machines to fabricate, remanufacture or repair wooden parts for furniture, fixtures and other wooden products.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Uses digitization software tools to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT- and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction, etc.).

Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	**Profile tasks forecast**	
		●		●	●		A	Using digital quality management to verify dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to technical & environmental specifications, including product durability.
		●			●		B	Setting up, programming, operating and monitoring several types of connected and ecoefficient woodworking machines for sawing, shaping, boring, drilling, planing, pressing, turning, sanding or carving to fabricate or repair wooden parts for furniture, fixtures and other wooden products, trying to minimise the generated waste and the use of resources.
		●		●	●		C	Operating special-purpose ecoefficient, automated and real-time optimized woodworking machines to fabricate wooden products such as coat hangers, mop handles, clothespins and other products, optimising the use of resources and the generation of waste.
		●		●	●		D	Setting up flexible connected machines/cobots for selecting knives, saws, blades, cutter heads, cams, bits or belts according to work piece, machine functions and product specifications, optimising the use of resources, consumables and the generation of waste.
		●		●	●		E	Installing and adjusting blades, cutter heads, boring-bits and sanding-belts using cobots and semi-autonomous robots, reducing the use of resources, consumables and the generation of waste.
		●		●	●		F	Use cobots for the autonomous selection, control, mounting and replacing of cutting tools on the woodworking machines, reducing the use of resources, consumables and the generation of waste.
		●		●	●		G	Setting and adjusting through digitized and remote controls various kinds of connected and ecoefficient woodworking machines for operation by others; studying and interpreting technical & environmental specifications using simulation models and mixed/augmented reality.
				●	●		H	Operating tools and semi-automatic or fully automated, even autonomous woodworking machines for the maintenance, reparation and/or re-manufacturing of wood-based products, including cutting, polishing and/or additional finishing treatments.

Woodworking-machine tool setter and operator

ISCO 7523

2020

Occupational profile

Current profile description

Woodworking machine tool setters and operators set-up, operate and monitor automatic or semi-automatic woodworking machines such as precision sawing, shaping, planing, boring, turning and woodcarving machines to fabricate or repair wooden parts for furniture, fixtures and other wooden products.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

Current profiles tasks		New categorization of hazards	Mechanical hazards	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	Ergonomic hazards	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	Electrical hazards	Electric shock	Hazards due to physical effects/physical agents	Noise	Vibration	Laserlight	Fire and explosion hazards	Flammable substances	Work environment hazards	Poor lighting conditions	Climate	Poor ventilation	Hazards through dangerous substances	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	Biological Hazards	Non-targeted activities with microorganism	Psychosocial hazards	Excessive workloads
A	Verifying dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to specifications.													🟡										⚪	⚪										⚪
B	Setting up, programming, operating and monitoring several types of woodworking machines for sawing, shaping, boring, drilling, planing, pressing, turning, sanding or carving to fabricate or repair wooden parts for furniture, fixtures and other wooden products.			🟡	🔵		⚪	⚪						🟡		⚪		🔵 🟢	🔵 🟢			🟢		⚪	⚪			🔵	🟢		🟡	🔴			⚪
C	Operating preset special-purpose wood-working machines to fabricate wooden products such as coat hangers, mop hand-les, clothespins and other products.			🟡	🔵		⚪	⚪						🟡		⚪		🔵 🟢	🔵 🟢			🟢		⚪	⚪			🔵	🟢		🟡	🔴			⚪
D	Selecting knives, saws, blades, cutter heads, cams, bits or belts according to work piece, machine functions and product specifications.			🟡	🔵	⚪	⚪	⚪						🟡		⚪		🔵 🟢	🔵 🟢					⚪	⚪				🟢						⚪
E	Installing and adjusting blades, cut-ter heads, boring-bits and sanding-belts, and using hand tools and rules.			🟡	🔵	⚪	⚪	⚪				🔵 🟢		🟡		⚪		🔵 🟢	🔵 🟢			🟢		⚪	⚪				🟢						⚪
F	Selects, controls, mounts and replaces cut-ting tools on the woodworking machines.			🟡	🔵	⚪		⚪				🔵 🟢		🟡		⚪		🔵 🟢	🔵 🟢			🟢		⚪	⚪				🟢						⚪
G	Setting and adjusting various kinds of woodworking machines for operation by others; reading and interpreting specifica-tions or following verbal instructions.													🟡										⚪	⚪										⚪
H				🔴	🔴		🔴	🔴								🔴		🔴	🔴					🔴	🔴				🔴	🔴		🔴				🔴

⚪ No changes 🟢 Reduced due to Circular Economy 🔴 New or increased due to Circular Economy 🔵 Reduced due to digitalization 🟡 New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Woodworking-machine tool setter and operator - ISCO 7523

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Woodworking machine tool setters and operators set-up, operate and monitor ecoefficient, semi-automatic or fully automated, even autonomous woodworking machines, such as precision sawing, shaping, planing, boring, turning and woodcarving machines to fabricate, remanufacture or repair wooden parts for furniture, fixtures and other wooden products.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Uses digitization software tools to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT- and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction, etc.).

Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload		**Profile tasks forecast**
	●	●	●		●	●	●	●		●	●	●	A	Using digital quality management to verify dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to technical & environmental specifications, including product durability.
	●	●	●		●	●	●	●		●		●	B	Setting up, programming, operating and monitoring several types of connected and ecoefficient woodworking machines for sawing, shaping, boring, drilling, planing, pressing, turning, sanding or carving to fabricate or repair wooden parts for furniture, fixtures and other wooden products, trying to minimise the generated waste and the use of resources.
	●	●	●		●	●	●	●		●		●	C	Operating special-purpose ecoefficient, automated and real-time optimized woodworking machines to fabricate wooden products such as coat hangers, mop handles, clothespins and other products, optimising the use of resources and the generation of waste.
	●	●	●		●	●	●	●		●		●	D	Setting up flexible connected machines/cobots for selecting knives, saws, blades, cutter heads, cams, bits or belts according to work piece, machine functions and product specifications, optimising the use of resources, consumables and the generation of waste.
	●	●	●		●	●	●	●		●		●	E	Installing and adjusting blades, cutter heads, boring-bits and sanding-belts using cobots and semi-autonomous robots, reducing the use of resources, consumables and the generation of waste.
	●	●	●		●	●	●	●		●		●	F	Use cobots for the autonomous selection, control, mounting and replacing of cutting tools on the woodworking machines, reducing the use of resources, consumables and the generation of waste.
	●	●	●		●	●	●	●		●		●	G	Setting and adjusting through digitized and remote controls various kinds of connected and ecoefficient woodworking machines for operation by others; studying and interpreting technical & environmental specifications using simulation models and mixed/augmented reality.
	●	●	●		●	●	●	●		●		●	H	Operating tools and semi-automatic or fully automated, even autonomous woodworking machines for the maintenance, reparation and/or re-manufacturing of wood-based products, including cutting, polishing and/or additional finishing treatments.

1 Cobotics (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping).
2 Run over, roll over, falls from height.

Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Woodworking-machine tool setter and operator - ISCO 7523

2020 Current situation	2025-30 Situation forecast
Work area: workshops with wood processing machines, hand and power tools such as (sanders, circular/crosscut/ripsaws), wood storage, finishing of wood products.	Work area: workshops with wood processing machines, hand and power tools such as (sanders, circular/crosscut/ripsaws), wood storage, finishing of wood products, use of digitalized tools, work, programming of semi- or fully automated, even autonomous machines, use of digitalized software tools. Working with new and recycled material, remanufacture and repair of products. Reparation and remanufacture of wood-based products.
Mechanical hazards	
• Mechanical hazards from moving machines and tools. Woodworking machinery exposes workers to risks of being injured by unprotected moving parts, contact with moving blades (saw blade, drill, kick back etc), uncontrolled moving parts (flying objects, wood chips) and parts with hazardous shapes (cutting, pointed, rough).	• Mechanical hazards from moving machines and tools. Woodworking machinery exposes workers to risks of being injured by unprotected moving parts, contact with moving blades (saw blade, drill, kick back etc), uncontrolled moving parts (flying objects, wood chips) and parts with hazardous shapes (cutting, pointed, rough), and from cobots and robots. Some risks from mechanical hazards may decrease, depending on takeover of specific tasks by cobots/robots. Most of industrial cobots and robots are unaware of their surroundings therefore they can be dangerous to workers. Industrial robots can pose several types of hazards based on their origin: Mechanical hazards such as those arising from unintended and unexpected movements or release of tools. Better design of machinery and tools (ecodesign) could reduce hazards associated to working with woodworking machinery and hand power tools.
Effects: severe bruises, amputations, cuts and sharp injuries, crushing.	**Effects**: severe bruises, amputations, cuts and sharp injuries, crushing.
• Slips and trips, obstacles, table edges, moving vehicles, machines.	• Slips and trips, obstacles, table edges, moving vehicles, machines.
Effects: squeezing, cutting, twisting, spraining, bumps and bruises.	**Effects**: squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: from poor ergonomic conditions, awkward positions, heavy physical workload.	• Ergonomic hazards: from poor ergonomic conditions, awkward positions, heavy physical workload. Risks from ergonomic hazards may decrease, depending on take over of specific tasks by cobots/robots. On the other hand, workers are increasingly exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous machines and cobots from computer workstations. The risk could be reduced with ecodesign strategies if occupational safety and health is taken into account when designing the product and machines.
Effect: musculoskeletal diseases.	**Effect**: musculoskeletal diseases.
Electrical hazards	
• Electrical hazards: contacts with live parts or connections or exposure to arc flash.	• Electrical hazards: contacts with live parts or connections or exposure to arc flash. Electrical hazards from woodworking machines and from autonomous or highly autonomous equipment.
Effect: fatal accident.	**Effect**: fatal accident.
Hazards due to physical effects/physical agents	
• Noise	• Noise: exposure to noise may decrease, depending on takeover of specific tasks by cobots/robots. The risk could be reduced with ecodesign strategies if occupational safety and health is taken into account when designing the product and machines.
Effects: hearing loss, headache, nervousness, poor concentration.	**Effects**: hearing loss, headache, nervousness, poor concentration.
• Vibrations	• Vibrations: exposure to vibrations may decrease, depending on takeover of specific tasks by cobots/robots. The risk could be reduced with ecodesign strategies if occupational safety and health is taken into account when designing the product and machines.
Effect: hand-arm-vibration syndrome (e.g. white finger disease).	**Effect**: hand-arm-vibration syndrome (e.g. white finger disease).
• Laserlight	• Laserlight: woodworking machine tool setters and operators may be exposed to laserlight.
Effects: eye damage, negative effects similar to sunburn.	**Effects**: eye damage, negative effects similar to sunburn.
Fire and explosion hazards	
• Fire and explosion hazardsfrom materials, including wood dust, solvents and chemicals.	• Fire and explosion hazards from materials, including wood dust, solvents and chemicals. Exposure to fire and explosion hazards may decrease, depending on takeover of specific tasks by cobots/robots. Solvents and cleaning products used for maintenance tasks may be based on less hazardous substances (e.g. solvents) and prevent fire hazards.

2020 Current situation	2025-30 Situation forecast
Work environmental hazards	
• Work environmental hazards: poor lighting, inadequate temperature and climate, poor ventilation.	• Work environmental hazards: poor lighting, inadequate temperature and climate, poor ventilation.
Effects: negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.	**Effects**: negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.
Hazards through dangerous substances	
• Chemical hazards/dangerous substances: wood dust.	• Chemical hazards/dangerous substances: wood dust, dust of recycled material. The risk of being exposed to wood dust may decrease, depending on takeover of specific tasks by cobots/robots. Maybe reduced, if OSH will be included in the design of the products/ materials, less dangerous solvents and lubricants.
Effects: contamination/intoxication, respiratory diseases, wood dusts (carcinogens, allergens) may cause nasal or lung cancer.	**Effects**: contamination/intoxication, respiratory diseases, wood dusts (carcinogens, allergens) may cause nasal or lung cancer.
	• New materials (e.g. nanomaterials): Nanotechnology and nanomaterials may be used in woods as well as wood-composite materials in order to improve some of their properties, e.g. to improve the water resistance or thermal conductivity. **Effects**: not yet well known, included are among others inflammation and tissue damage, fibrosis and tumour generation.
	• Recycled material: Risk of exposure to dangerous substances may be increased through lack of information on chemicals contained in recycled products and on ways how to deal with them appropriately. Recycled material may contain dangerous substances, to the latest findings carcinogen or repro-toxic. (nowadays restricted by law (REACH)). **Effects**: contamination/intoxication, skin diseases, respiratory diseases, cancer.
Psychosocial hazards	
• Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility, repetitive, monotonous work.	• Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility and digital know how, repetitive, monotonous work. Lack of experience: New software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Increased demand on competences and up-to-date knowledge on the current development in circular economy and recycling industry. Working with materials which have previously been manufactured: new skills need to be acquired throughout the production cycle.
• Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues.	• Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues, lack of social contacts.
• Working method: working with colleagues.	• Working method: working with colleagues, digital equipment, cognitive interactions with autonomous equipment. The use of cobots and other digital techniques may increase the risk of working alone and feeling isolated. Cognitive interactions between a robot and a human worker can lead to mental stress. Long period of concentration working with computer and new software and performing multitasking. Increased demand on flexibility as workers may perform some tasks from everywhere with mobile devices. Workers are also at risk of being permanent available outside working hours.
Effects: stress, burnout.	**Effects**: stress, burnout.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Woodworking-machine tool setter and operator - ISCO 7523

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	Remanufacture products and/or components	Promote the cascade use of wood	Apply new technologies	Use digitization tools to work in a customer-oriented manner	Setting up flexible connected machines/cobots	Using highly digitized, connected and automated (autonomous) woodworking machines	Human-robot collaboration, use of cobots, that can be remotely operated (with help of AR) using big data, simulation models and mixed/augmented reality	Using digital quality management
Essential skills and competences													
Consult technical resources	YES, changed	●		●		●	●						
Dispose of cutting waste material	YES, changed		●	●		●	●	●					
Maintain furniture machinery	YES												
Monitor automated machines	YES, changed	●	●	●	●	●	●	●	●			●	●
Operate furniture machinery	YES, changed		●	●		●		●		●	●	●	
Remove inadequate workpieces	YES, changed												●
Remove processed workpiece	YES												
Set up the controller of a machine	YES, changed									●			
Supply machine	YES												
Supply machine with appropriate tools	YES, changed									●	●	●	
Disassemble wood-based furniture products	NEW	●	●	●		●	●			●		●	
Examine disassembled pieces for further steps (reuse, recylce, upcycle)	NEW	●	●	●	●	●	●	●		●		●	●
Repair wood-based furniture pieces, where needed	NEW	●	●	●	●	●	●	●		●		●	●
Essential knowledge													
Machine tools	YES												
Quality standards	YES, changed	●	●	●	●	●	●	●					●
Types of wood	NO												
Generic green skills, knowledge and competences (*)													
Environmental awareness and willingness to learn	NEW	●	●	●	●	●	●	●					
Systems and risk analysis skills	NA												
Innovation skills	NA												
Coordination, management and business skills	NA												
Communication and negotiation skills	NA												
Marketing skills	NA												
Strategic and leadership skills	NA												
Consulting skills	NA												
Networking, information technology and language skills	NA												
Adaptability and transferability skills	NEW	●	●	●	●	●	●	●					
Entrepreneurial skills	NA												
Waste, energy and water quantification and monitoring	NEW	●	●	●	●			●					
Material use and impact quantification and monitoring	NEW	●	●		●	●	●	●					
Material use and impact minimisation	NEW	●	●		●	●	●	●					

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova

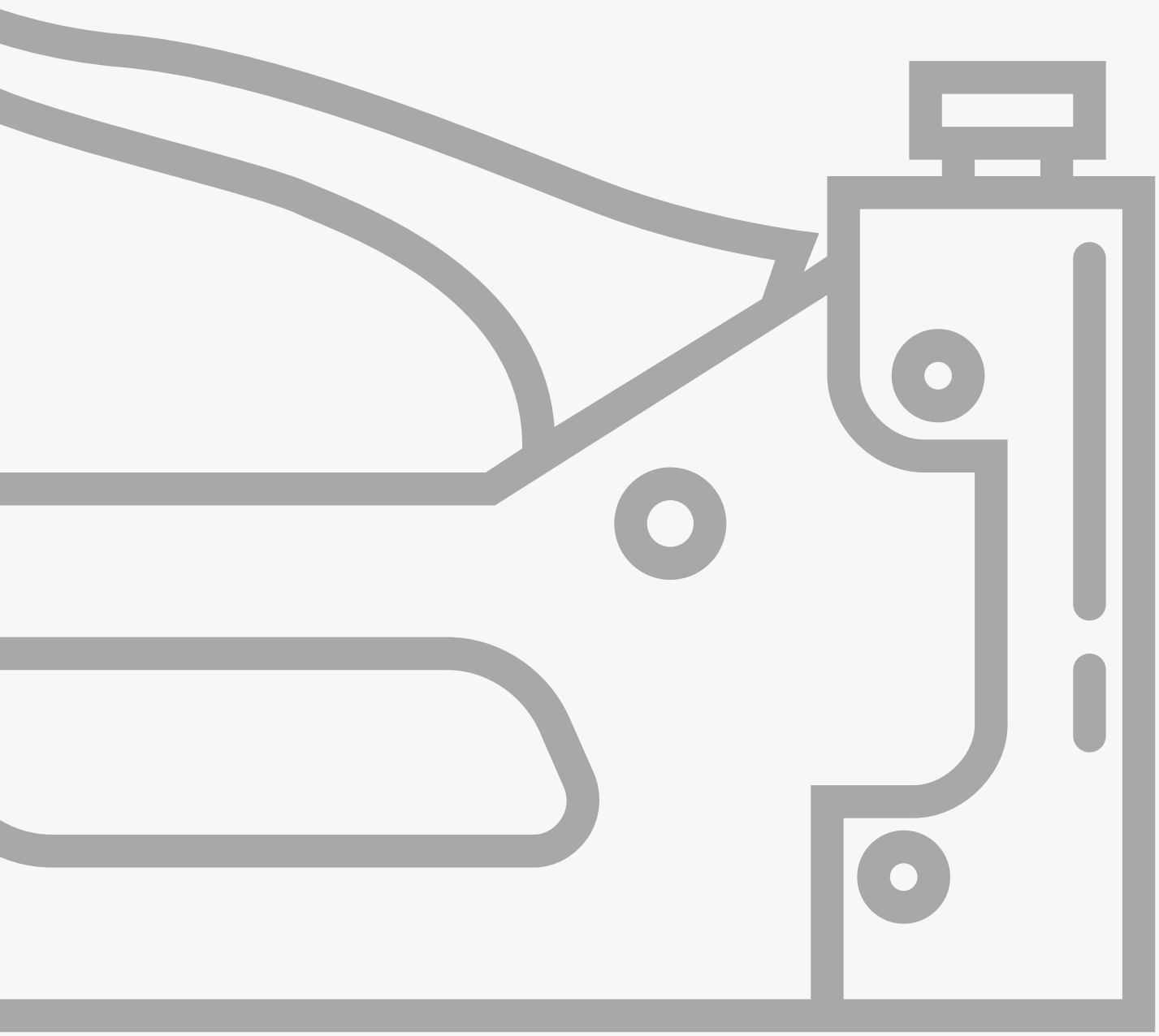
Upholsterer and related workers
ISCO 7534

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.



Upholsterer and related workers
ISCO 7534

Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

GO TO INDEX

Upholsterer and related workers ISCO 7534

2020
Occupational profile

Current profile description
Upholsterers and related workers install, repair and replace upholstery of furniture, fixtures, seats, panels, convertible and vinyl tops and other furnishings of automobiles, railway coaches, aircraft, ships and similar items with fabric, leather, rexine or other upholstery material. They also make and repair cushions, quilts and mattresses.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

Current profiles tasks		ReSOLVE levers*																						
		Regenerate	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	**Share**	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	**Optimise**	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	**Loop**	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste	
A	Discussing upholstery fabric, colour and style with customers and providing cost estimates for upholstering furniture or other items.			●					●	●	●	●		●	●	●	●	●		●	●	●	●		
B	Verifying dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to specifications.			●					●		●	●		●	●	●	●	●		●	●	●	●		
C	Making upholstery patterns from sketches, customer descriptions or blueprints.			●				●	●	●	●	●		●	●	●	●	●				●	●		
D	Laying out, measuring and cutting upholstery materials following patterns, templates, sketches or design specifications.			●					●		●				●	●	●	●				●			
E	Installing, arranging and securing springs, padding and covering material to furniture frames.			●					●	●	●	●			●	●	●	●		●	●	●	●		
F	Sewing upholstery materials by hand to seam cushions and joining sections of covering materials.			●					●	●	●	●			●	●	●	●		●	●	●	●		
G	Sewing rips or tears in material, or creating tufting, using needle and thread or hand operated machines for sewing-/locking.								●	●	●	●			●	●	●	●		●	●				
H	Tacking, gluing or sewing ornamental trims, buckles, braids, buttons and other accessories to covers or frames on upholstered items.			●					●	●	●	●		●	●	●	●	●		●	●	●	●		
I	Laying out, cutting, fabricating and installing upholstery. • Installing upholstery on the structure. • Finishing of the upholstery.			●					●	●	●	●		●	●	●	●	●		●	●	●	●		
J	Renovating antique furniture using a variety of tools including ripping chisels, magnetic hammers and long needles • Ripping off the seats and sofas. • Demounting of the (structural) parts. • Renovating of the upholstery.			●				●	●	●	●	●		●	●	●	●	●		●	●	●	●		
K	Collaborating with interior designers to decorate rooms and coordinate furnishing fabrics.			●				●	●	●	●	●			●	●	●	●			●	●	●		
L	Making quilts, cushions and mattresses. • Filling up cushions. • Filling up mattresses.			●					●	●	●	●		●	●	●	●	●			●	●	●		
M				●				●						●		●	●				●	●	●	●	
N				●				●	●	●	●	●		●	●	●	●	●		●	●	●	●		

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Upholsterer and related workers - ISCO 7534

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Upholsterers and related workers install, repair, remanufacture and replace upholstery of furniture, fixtures, seats, panels, convertible and vinyl tops and other furnishings of automobiles, railway coaches, aircraft, ships and similar items with fabric, leather, rexine or other upholstery material using ecoefficient semi-automatic or fully automated machines. They also make and repair cushions, quilts and mattresses.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Uses digitization tools to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT- and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. materials used, waste generation or energy use reduction, etc.).
- Uses a life-cycle thinking approach when takes decissions on the materials to be used and favours the future disassembly of the product for maintenance, repair, reuse or recycling.

Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	**Profile tasks forecast**
	●	●		●	●	●	A Using digital simulation models, discussing preferable eco-friendly upholstery fabric, colour and style with customers and providing cost estimates for upholstering furniture or other items, proposing sustainable materials and considering the future circularity of the product.
	●	●		●	●	●	B Using computer vision and digital twin simulation models, verifying dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to technical & environmental specifications, including product durability, reparability, etc.
	●	●		●	●		C Making upholstery patterns from digital models, sketches, customer descriptions, trying to favour sustainable raw materials and reducing as much as possible the generation of waste and the quantity of used materials.
		●			●		D Laying out, measuring and cutting eco-friendly upholstery materials using advanced digital process control following patterns, templates, sketches or design specifications, reducing as much as possible the scrap generated in the process.
				●	●		E Highly automated installing, arranging and securing springs, padding and eco-friendly covering material to furniture frames, thinking on the future needs for maintenance, repair, reuse or substitution of the product.
					●		F Sewing eco-friendly upholstery materials to seam cushions and joining sections of covering materials using semi-automated processes and connected cobots thinking on the future needs or disassembly for maintenance, repair or recycling of the product.
		●			●		G Using computer vision and big data analytics to automate the process of sewing rips or tears in material, or creating tufting, using fully automated cobots with needle and thread or semi-autonomous and ecoefficient machines for sewing-/locking; and considering the future need for maintenance, repair or recycling of the product.
				●	●		H Semi-autonomously tacking, gluing or sewing ornamental trims, buckles, braids, buttons and other accessories to covers or frames on upholstered items using cobots and considering aspects such as materials' compatibility for recycling, future disassembly needs, etc. (e.g. reducing glued components).
	●	●		●	●	●	I Highly automated laying out, cutting, fabricating and installing upholstery using ecoefficient and autonomous robots connected to the big data cloud. • Selecting sustainable materials and circular economy-oriented strategies (e.g. repairability). • Installing upholstery on the structure. • Finishing of the upholstery.
		●		●	●	●	J Renovating antique furniture with highly automated machines and cobots using a variety of tools including ripping chisels, magnetic hammers and long needles. • Ripping off the seats and sofas. • Demounting of the (structural) parts. • Checking what parts can be reused, repaired or need to be replaced. • Renovating of the upholstery. • Facilitating future maintenance, repair, reuse or recycling.
	●	●		●	●	●	K Using digital models and augmented reality to collaborate with interior designers to decorate rooms and coordinate furnishing fabrics, selecting sustainable materials and applying circular economy-oriented strategies.
	●	●		●	●	●	L Fully automated and ecoefficient manufacturing of eco-friendly quilts, cushions and mattresses, optimising the use of resources and reducing the generation of waste. • Filling up cushions. • Filling up mattresses.
				●			M Operating the adequate tools for selective and/or destructive disassembling of out of use or defective upholstery articles for separation of materials and elements for further recovery or recycling.
		●		●	●	●	N Operating highly automated machines and cobots for the maintenance, reparation and/or re-manufacturing of upholstery or upholstered parts of furniture, including cleaning, cutting, etc.

Upholsterer and related workers ISCO 7534

2020
Occupational profile

Current profile description
Upholsterers and related workers install, repair and replace upholstery of furniture, fixtures, seats, panels, convertible and vinyl tops and other furnishings of automobiles, railway coaches, aircraft, ships and similar items with fabric, leather, rexine or other upholstery material. They also make and repair cushions, quilts and mattresses.

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- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

New categorization of hazards

Current profiles tasks		**Mechanical hazards**	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	**Ergonomic hazards**	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	**Electrical hazards**	Electric shock	**Hazards due to physical effects/physical agents**	Noise	Vibration	Laserlight	**Fire and explosion hazards**	Flammable substances	**Work environment hazards**	Poor lighting conditions	Climate	Poor ventilation	**Hazards through dangerous substances**	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	**Biological Hazards**	Non-targeted activities with microorganism	**Psychosocial hazards**	Excessive workloads
A	Discussing upholstery fabric, colour and style with customers and providing cost estimates for upholstering furniture or other items.												●										●	●											●
B	Verifying dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to specifications.												●										●	●											●
C	Making upholstery patterns from sketches, customer descriptions or blueprints.												●										●	●											●
D	Laying out, measuring and cutting upholstery materials following patterns, templates, sketches or design specifications.		●	●			●				● ●		●		●		● ●	● ●	●				●	●	●				●	●					●
E	Installing, arranging and securing springs, padding and covering material to furniture frames.		●	●		●	●				● ●		●		●		● ●	● ●					●	●	●	●			●	●					●
F	Sewing upholstery materials by hand to seam cushions and joining sections of covering materials.		●	●			●				● ●		●		●		● ●	● ●					●	●	●	●			●	●					●
G	Sewing rips or tears in material, or creating tufting, using needle and thread or hand operated machines for sewing-/locking.		●	●			●				● ●		●		●		● ●	● ●					●	●	●	●			●	●					●
H	Tacking, gluing or sewing ornamental trims, buckles, braids, buttons and other accessories to covers or frames on upholstered items.		●	●			●				● ●		●		●		●	● ●			●		●	●	●			●	●	●	●	●			●
I	Laying out, cutting, fabricating and installing upholstery. • Installing upholstery on the structure. • Finishing of the upholstery.		●	●			●				● ●		●		●		● ●	● ●					●	●	●			●	●	●	●	●			●
J	Renovating antique furniture using a variety of tools including ripping chisels, magnetic hammers and long needles • Ripping off the seats and sofas. • Demounting of the (structural) parts. • Renovating of the upholstery.		●	●			●				● ●		●		●		● ●	● ●					●	●	●			●	●	●	●	●		●	●
K	Collaborating with interior designers to decorate rooms and coordinate furnishing fabrics.												●										●	●											●
L	Making quilts, cushions and mattresses. • Filling up cushions. • Filling up mattresses.										● ●		●				● ●	● ●					●	●				●			●				●
M			●	●		●	●				●				●		●	●			●		●	●	●			●			●			●	●
N			●	●		●	●				●				●		●	●			●		●	●	●			●			●			●	●

● No changes ● Reduced due to Circular Economy ● New or increased due to Circular Economy ● Reduced due to digitalization ● New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Upholsterer and related workers - ISCO 7534

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Upholsterers and related workers install, repair, remanufacture and replace upholstery of furniture, fixtures, seats, panels, convertible and vinyl tops and other furnishings of automobiles, railway coaches, aircraft, ships and similar items with fabric, leather, rexine or other upholstery material using ecoefficient semi-automatic or fully automated machines. They also make and repair cushions, quilts and mattresses.

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- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT- and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. materials used, waste generation or energy use reduction, etc.).
- Uses a life-cycle thinking approach when takes decissions on the materials to be used and favours the future disassembly of the product for maintenance, repair, reuse or recycling.

Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload	**Profile tasks forecast**	
	●	●	●		●	●	●	●		●		●	A	Using digital simulation models, discussing preferable eco-friendly upholstery fabric, colour and style with customers and providing cost estimates for upholstering furniture or other items, proposing sustainable materials and considering the future circularity of the product.
	●	●	●		●	●	●	●		●	●	●	B	Using computer vision and digital twin simulation models, verifying dimensions of articles to be made, or preparing specifications and checking the quality and fit of pieces in order to ensure adherence to technical & environmental specifications, including product durability, reparability, etc.
	●	●	●		●	●	●	●		●	●	●	C	Making upholstery patterns from digital models, sketches, customer descriptions, trying to favour sustainable raw materials and reducing as much as possible the generation of waste and the quantity of used materials.
	●	●	●		●	●	●	●		●	●	●	D	Laying out, measuring and cutting eco-friendly upholstery materials using advanced digital process control following patterns, templates, sketches or design specifications, reducing as much as possible the scrap generated in the process.
	●	●	●		●	●	●	●		●	●	●	E	Highly automated installing, arranging and securing springs, padding and eco-friendly covering material to furniture frames, thinking on the future needs for maintenance, repair, reuse or substitution of the product.
	●	●	●		●	●	●	●		●	●	●	F	Sewing eco-friendly upholstery materials to seam cushions and joining sections of covering materials using semi-automated processes and connected cobots thinking on the future needs or disassembly for maintenance, repair or recycling of the product.
	●	●	●		●	●	●	●		●	●	●	G	Using computer vision and big data analytics to automate the process of sewing rips or tears in material, or creating tufting, using fully automated cobots with needle and thread or semi-autonomous and ecoefficient machines for sewing-/locking; and considering the future need for maintenance, repair or recycling of the product.
	●	●	●		●	●	●	●		●	●	●	H	Semi-autonomously tacking, gluing or sewing ornamental trims, buckles, braids, buttons and other accessories to covers or frames on upholstered items using cobots and considering aspects such as materials' compatibility for recycling, future disassembly needs, etc. (e.g. reducing glued components).
	●	●	●		●	●	●	●		●	●	●	I	Highly automated laying out, cutting, fabricating and installing upholstery using ecoefficient and autonomous robots connected to the big data cloud. • Selecting sustainable materials and circular economy-oriented strategies (e.g. repairability). • Installing upholstery on the structure. • Finishing of the upholstery.
	●	●	●		●	●	●	●		●	●	●	J	Renovating antique furniture with highly automated machines and cobots using a variety of tools including ripping chisels, magnetic hammers and long needles. • Ripping off the seats and sofas. • Demounting of the (structural) parts. • Checking what parts can be reused, repaired or need to be replaced. • Renovating of the upholstery. • Facilitating future maintenance, repair, reuse or recycling.
	●	●	●		●	●	●	●		●		●	K	Using digital models and augmented reality to collaborate with interior designers to decorate rooms and coordinate furnishing fabrics, selecting sustainable materials and applying circular economy-oriented strategies.
●	●	●	●		●	●	●	●		●	●	●	L	Fully automated and ecoefficient manufacturing of eco-friendly quilts, cushions and mattresses, optimising the use of resources and reducing the generation of waste. • Filling up cushions. • Filling up mattresses.
		●					●	●				●	M	Operating the adequate tools for selective and/or destructive disassembling of out of use or defective upholstery articles for separation of materials and elements for further recovery or recycling.
		●				●	●	●			●	●	N	Operating highly automated machines and cobots for the maintenance, reparation and/or re-manufacturing of upholstery or upholstered parts of furniture, including cleaning, cutting, etc.

Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Upholsterer and related workers – ISCO 7534

2020 Current situation	2025-30 Situation forecast
Work area: workshops with upholsterer machines (sewing machine), hand and power tools such as (steam iron, pneumatic staple gun, tack hammer, scissors, hammer, knife, pliers, screwdrivers, hand brushes. hot melt glue guns), on-site workplaces (cars, airplanes, ships and others), discussion with clients and textile salesmen.	Work area: workshops with upholsterer machines (sewing machine), hand and power tools such as (steam iron, pneumatic staple gun, tack hammer, scissors, hammer, knife, pliers, screwdrivers, hand brushes. hot melt glue guns), on-site workplaces (cars, airplanes, ships and others), discussion with clients and textile salesmen, use of digitalized instruments, use of eco-friendly materials, life-cycle thinking approach when taking decisions on the materials and design of the product (taking into account disassembly of the product for maintenance, repair, reuse or recycling).
Mechanical hazards	
• Mechanical hazards from moving machines and tools. Machinery used in upholstery exposes workers to risks of being injured by unprotected moving parts, uncontrolled moving parts (air tools/electric staplers, springs) and parts with hazardous shapes (cutting, pointed, rough).	• Mechanical hazards from moving machines and tools. Machinery used in upholstery exposes workers to risks of being injured by unprotected moving parts, uncontrolled moving parts (air tools/electric staplers, springs) and parts with hazardous shapes (cutting, pointed, rough), and from cobots and robots. Risks from mechanical hazards may decrease, depending on takeover of specific task by cobots/robots. Remanufacturing and selective disassembling could require new types of tools. Risks of being injured by unprotected moving parts, uncontrolled moving parts (air tools/electric staplers, springs) and parts with hazardous shapes (cutting, pointed, rough). Better design of products (ecodesign) could reduce hazards associated to assembly/disassembly operations, using optimised joining systems, etc.
Effects: severe bruises, cuts and sharp injuries.	**Effects**: severe bruises, cuts and sharp injuries.
Slips and trips, obstacles, table edges, moving vehicles, machines.	Slips and trips, obstacles, table edges, moving vehicles, machines.
Effects: squeezing, cutting, twisting, spraining, bumps and bruises.	**Effects**: squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: from poor ergonomic conditions, awkward positions.	• Ergonomic hazards: from poor ergonomic conditions, awkward positions. Risks from ergonomic hazards may decrease, depending on take over of specific task by cobots/robots. On the other hand, workers are increasingly exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous machines and cobots from computer workstations. Remanufacturing and selective disassembling may be performed in unsuitable positions. This risk could be reduced with ecodesign strategies to facilitate assembly/disassembly (e.g. type of fasteners, etc.) if occupational safety and health is taken into account when designing the product.
Effect: musculoskeletal diseases.	**Effect**: musculoskeletal diseases.
Electrical hazards	
Electric hazards: contacts with live parts or connections or exposure to arc flash.	Electric hazards: contacts with live parts or connections or exposure to arc flash. Electrical hazards from upholstery machines and from autonomous or highly autonomous equipment.
Effect: fatal accident.	**Effect**: fatal accident.
Hazards due to physical effects/physical agents	
• Noise	• Noise: exposure to noise may decrease, depending on takeover of specific task by cobots/robots. Noise maybe reduced due to ecodesign of machinery operating quieter and more environmental-friendly. However, dismantling or remanufacturing upholstered furniture may pose workers at risk of noise.
Effects: hearing loss, headache, nervousness, poor concentration.	**Effects**: hearing loss, headache, nervousness, poor concentration.
• Vibrations	• Vibrations: exposure to noise and vibration risks may decrease, depending on takeover of specific task by cobots/robots. Vibration maybe reduced due to ecodesign of machinery operating with less vibration energy and more environmental-friendly. However, dismantling or remanufacturing upholstered furniture may pose workers still at risk of vibration.
Effects: hand-arm-vibration syndrome (e.g. white finger disease).	**Effects**: hand-arm-vibration syndrome (e.g. white finger disease).
• Laserlight	• Laserlight: exposure to laserlight from laser cutting machines used to cut leather and other fabrics.
Effects: eye and skin injuries resulting from a direct laser beam or a reflection of the beam.	Effects: eye and skin injuries resulting from a direct laser beam or a reflection of the beam.
Fire and explosion hazards	
• Fire and explosion hazards from materials, including glue, solvents and other chemicals. High risk of fire and explosion due to the presence of flammable solvents/glues and other flammable material and the accumulation of solvent vapours, particularly in small, unventilated areas.	• Fire and explosion hazards from materials, including glue, solvents and other chemicals. High risk of fire and explosion due to the presence of flammable solvents/glues and other flammable material and the accumulation of solvent vapours, particularly in small, unventilated areas. Risks from explosion and fire may decrease, depending on takeover of specific task by cobots/robots. Risk from explosion and fire may decrease, depending on the substitution of flammable solvents in glues. In recycling, dismantling or disassembling activities the risk of dust explosion may increase, because of dust formation (emission) and not suitable dust extraction systems.
Effects: burns, fatal accidents.	**Effects**: burns, fatal accidents.

2020 Current situation	2025-30 Situation forecast
Work environmental hazards	
• Work environmental hazards: poor lighting, inadequate temperature and climate, poor ventilation.	• Work environmental hazards: poor lighting, inadequate temperature and climate, poor ventilation.
Effect: negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.	**Effect**: negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.
Hazards through dangerous substances	
• Chemical hazards/ dangerous substances: toxic flame retardants, wood dust, solvents, preservatives, formaldehyde, glues.	• Chemical hazards/ dangerous substances: toxic flame retardants, wood dust, solvents, preservatives, formaldehyde, glues, new substances/materials. Chemical hazards may decrease depending on the substitution of dangerous substances (no toxic flame retardants in the material). Chemical hazards may increase depending on the quality of recycled materials (during successive recycling of unknown raw materials).
• Upholsterers usually require an extensive use of solvents. Glues and solvents for assembling parts and finishing products. Injury of the eyes caused by splashing glue, cleaners, etc., burns caused by contact with hot glue/glue guns, allergies due to contact with formaldehyde and allergenic substances, exposure to dust.	• Upholsterers usually require an extensive use of solvents. Glues and solvents for assembling parts and finishing products. Injury of the eyes caused by splashing glue, cleaners, etc., burns caused by contact with hot glue/glue guns, allergies due to contact with formaldehyde and allergenic substances, exposure to dust. Exposure to chemicals may decrease, depending on takeover of specific task by cobots/robots. Exposure to chemicals may decrease depending on the integration of OSH into the design of new processes, techniques (prevention through design), substitution of dangerous substances (no toxic flame retardants in the material).
Effects: contamination/intoxication, skin diseases, respiratory diseases, allergies, cancer.	**Effects**: contamination/intoxication, skin diseases, respiratory diseases, allergies, cancer.
	• New materials (e.g. nanomaterials): Nanotechnology and nanomaterials may be used in woods as well as wood-composite materials in order to improve some of their properties, e.g. to improve the water resistance or thermal conductivity. **Effects**: not yet well known, included are among others inflammation and tissue damage, fibrosis and tumour generation.
	• Recycled material may concentrate hazardous substances (impurities and hazardous flame retardants mainly in upholstery products) during successive recycling or may change the composition due to different factors such as light, heat and aging of material ~~-~~unknown content and kind of hazardous substances. Exposure may increase when working with recycled material or performing disassembling/ dismantling activities. Workers may be exposed to dangerous substances used in former times, now restricted by law. Disassembling may also be related to an increased risk of inhaled dust. **Effects**: contamination/intoxication, skin diseases, respiratory diseases, allergies, cancer.
Biological hazards	
• Biological hazards: bacteria, mould and fungi.	• Non-targeted activities with microorganism: Remanufacturing activities: selective and/ or destructive disassembling of out of use or defective upholstery articles for separation of materials and elements for further recovery or recycling may expose workers to microorganism such as mould (Recycled, old and used material may contain mould).
Effects: contamination/intoxication, skin diseases, respiratory diseases, infections.	**Effects**: contamination/intoxication, skin diseases, respiratory diseases, infections.
Psychosocial hazards	
• Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility, repetitive work.	• Organisation of work: time pressure, shift work, stress, often related to poor work organisation lack of training, increased demand on flexibility and digital know how, repetitive and monotonous work.
	• Lack of experience: New software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Working with materials which have previously been manufactured: new skills need to be acquired throughout the production cycle. Repair, remanufacture and selective disassembly require new methods and procedures. Deciding on circular economic and sustainable oriented strategies/products/ marketing projects.
• Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues.	• Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues, lack of social contacts.
• Working method: working with colleagues.	• Working method: working with colleagues, digital equipment, cognitive interactions with autonomous technologies. The use of cobots and other digital techniques may increase the risk of working alone and feeling isolated. Cognitive interactions between a robot and a human worker can lead to mental stress. Long period of concentration working with computer and new software and performing multitasking. Increased demand on flexibility as workers may perform some tasks from everywhere with mobile devices. Workers are also at risk of being permanent available outside working hours.
Effects: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.	**Effects**: stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Upholsterer and related workers – ISCO 7534

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Shift to renewable materials	Reuse products throughout their technical lifetime	Prolong products lifetime through repair	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	Remanufacture products and/or components	Recycle materials	Promote the cascade use of wood	Apply new technologies	Using semi-automatic or fully automated operating machines and connected cobots	Use digitization tools to work in a customer-oriented manner	Using digital simulation models, computer vision and digital twin simulation models	Using advanced digital process control
Essential skills and competences																
Clean furniture	YES															
Create patterns for textile products	YES, changed	●			●	●	●		●	●				●	●	●
Cut textiles	YES, changed	●			●	●	●		●	●			●	●	●	●
Decorate furniture	YES															
Fasten components	YES, changed												●		●	
Install spring suspension	YES, changed												●			
Perform upholstery repair	YES, changed	●	●	●	●		●		●	●	●		●			
Provide customized upholstery	YES, changed	●			●				●	●			●	●	●	
Sew pieces of fabric	YES, changed	●			●	●	●		●	●			●		●	●
Sew textile-based articles	YES, changed	●			●	●	●		●	●			●	●	●	●
Use manual sewing techniques	YES, changed		●	●	●		●		●	●						
Disassemble wood-based furniture products	NEW		●	●		●	●		●	●	●		●			●
Examine disassembled pieces for further steps (reuse, recylce, upcycle)	NEW		●	●			●		●	●	●			●	●	
Repair wood-based furniture pieces, where needed	NEW		●	●			●		●	●	●		●			●
Essential knowledge																
Furniture industry	YES															
Furniture trends	YES, changed	●	●	●	●		●	●	●	●	●	●				
Textile materials	YES, changed	●					●		●	●			●		●	
Upholstery fillings	YES, changed	●					●		●	●	●		●		●	
Upholstery tools	YES, changed	●	●	●		●	●	●	●			●	●			
Generic green skills, knowledge and competences (*)																
Environmental awareness and willingness to learn	NEW	●	●	●				●	●	●	●					
Systems and risk analysis skills	NEW										●					
Innovation skills	NEW	●			●	●			●		●	●				
Coordination, management and business skills	NA															
Communication and negotiation skills	NEW	●	●	●	●		●			●	●					
Marketing skills	NA															
Strategic and leadership skills	NA															
Consulting skills	NEW	●	●	●	●		●			●	●					
Networking, information technology and language skills	NA															
Adaptability and transferability skills	NEW	●				●	●	●	●	●	●	●				
Entrepreneurial skills	NA															
Waste, energy and water quantification and monitoring	NEW		●	●		●	●	●	●		●	●				
Material use and impact quantification and monitoring	NEW	●	●	●		●	●	●	●		●	●				
Material use and impact minimisation	NEW	●	●	●	●		●		●	●	●	●				

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova

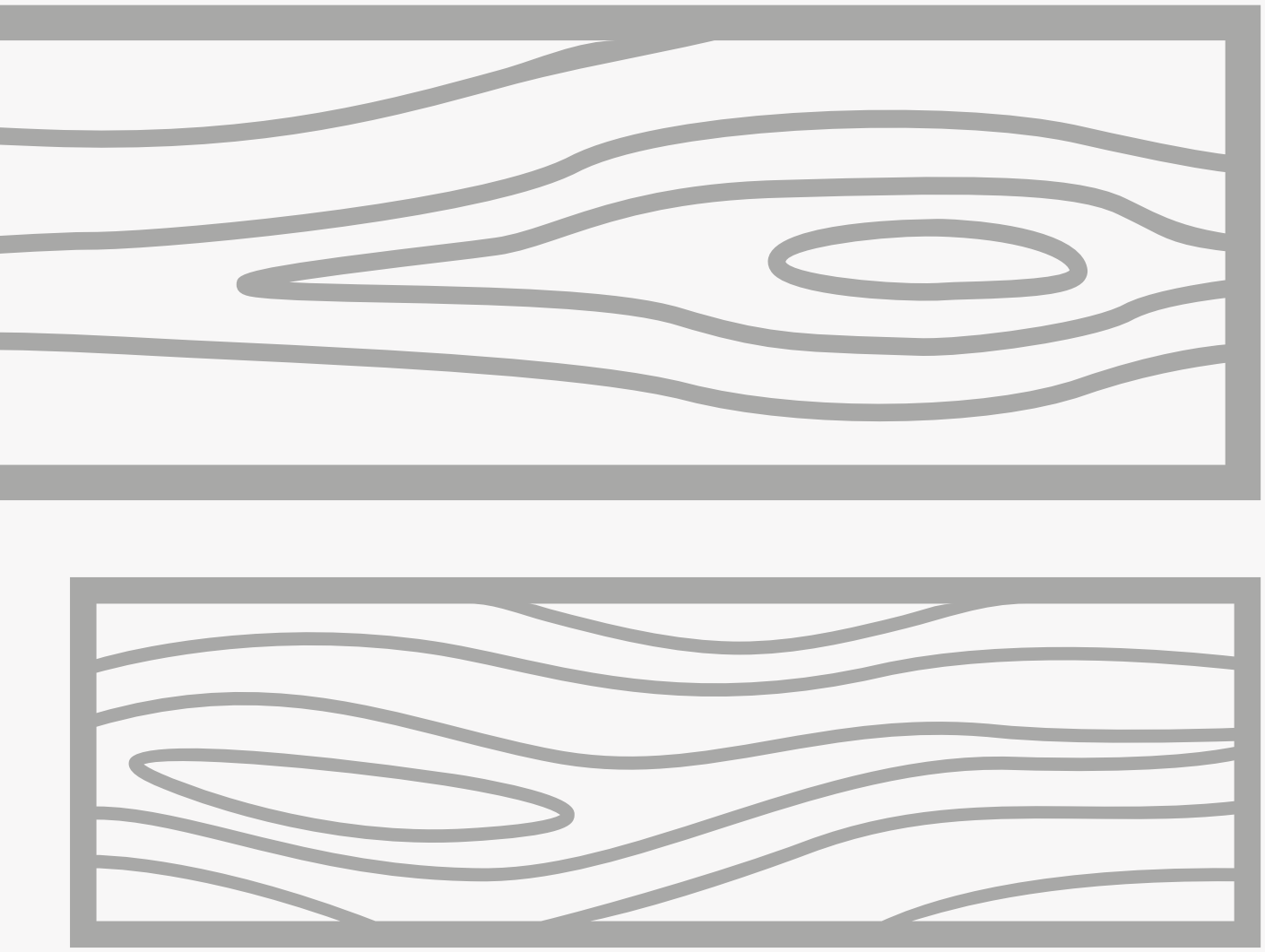
Wood processing plant operator
ISCO 8172

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.



Wood processing plant operator
ISCO 8172

Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

GO TO INDEX

Wood processing plant operator ISCO 8172

2020
Occupational profile

Current profile description
Wood processing plant operators monitor, operate and control lumber mill equipment for sawing timber logs into rough lumber, cutting veneer, making plywood and particle board, and otherwise preparing wood for further use.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

Current profiles tasks		ReSOLVE levers*																								
		Regenerate	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	**Share**	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	**Optimise**	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	**Loop**	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste		
A	Examining logs and rough lumber to determine size, condition, quality and other characteristics to decide best lumber cuts to carry out, or operating automated equipment to convey logs through laser scanners which determine the most productive and profitable cutting patterns.			●							●	●		●	●	●	●	●		●		●	●			
B	Operating and monitoring log in-feed and conveyor systems.			●							●	●			●	●	●	●				●				
C	Preparation of the work, by removing strange elements (in metal, stone…), removing bark, etc.			●								●			●	●	●	●				●	●			
D	Operating and monitoring head saws, resaws and multiblade saws to saw logs, cants, flitches, slabs or wings and remove rough edges from sawn timber into dressed lumber of various sizes, and to saw or split shingles and shakes.			●								●		●	●	●	●	●				●	●			
E	Selecting, controlling, mounting and replacement of cutting tools on the woodworking machines.			●											●	●	●	●				●	●			
F	Operating and monitoring plywood core-laying machines and hot-plate plywood presses and machines which cut veneer.			●										●	●	●	●	●		●		●	●			
G	Cleaning and lubricating sawmill equipment.			●												●	●	●				●	●			
H				●				●	●	●	●	●		●	●	●	●	●		●	●	●	●			

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Wood processing plant operator - ISCO 8172

2025/30
Occupational profile

Description forecast of the occupational profile in 2030

Wood processing plant operators monitor, operate and control ecoefficient, digitized, connected and automated lumber mill equipment for sawing timber logs, coming preferably from certified sustainable sources, into rough lumber, cutting veneer, making plywood and particle board, and otherwise preparing wood for further use.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Uses digitization tool to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT- and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair or remanufacturing processes (e.g. waste generation or energy use reduction, etc.).

Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services		**Profile tasks forecast**
		●		●	●	●	A	Examining logs and rough lumber, using fulled automated, computer vision, big data and cloud connectivity to determine size, condition, quality, source and other characteristics to decide best lumber cuts to carry out, or operate automated and ecoefficient equipment to convey logs through different sensors, like laser scanners, to determine the most productive and profitable cutting patterns, optimising the use of resources and energy and reducing to maximum the generated waste (e.g. wood scrap).
		●		●	●		B	Operating and monitoring log autonomous, ecoefficient and highly automated in-feed and conveyor systems.
		●		●	●		C	Automated, semi-automated preparation of the work, by removing strange elements (in metal, stone…), removing bark, etc., using sustainable techniques and reducing as much as possible the use of hazardous substances.
		●		●	●		D	Ecoefficient, fully automated operating and monitoring head saws, resaws and multiblade saws to saw logs, cants, flitches, slabs or wings and remove rough edges from sawn timber into dressed lumber of various sizes, and to saw or split shingles and shakes, optimising the use of wood and the generation of waste.
		●		●	●		E	Autonomous selection, controlling, mounting and replacement of cutting tools on the highly digitized connected and ecoefficient woodworking machines, optimising the use of consumables prolonging their useful life.
		●		●	●	●	F	Automated operating and remote monitoring of digitized and ecoefficient plywood core-laying machines and hot-plate plywood presses and machines which cut veneer, optimising the use of raw materials and the generation of waste.
		●		●	●		G	Data driven predictive maintenance and quality assurance through cleaning and lubricating of sawmill equipment, using substances with low environmental impact and optimising their consumption.
				●	●		H	Operating tools and digitized, connected and automated equipment for preparing wood for the maintenance, reparation and/or re-manufacturing of wood-based products, including sawing, etc.

Wood processing plant operator ISCO 8172

2020
Occupational profile

Current profile description
Wood processing plant operators monitor, operate and control lumber mill equipment for sawing timber logs into rough lumber, cutting veneer, making plywood and particle board, and otherwise preparing wood for further use.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

New categorization of hazards

Current profiles tasks		Mechanical hazards	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	Ergonomic hazards	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	Electrical hazards	Electric shock	Hazards due to physical effects/physical agents	Noise	Vibration	Laserlight	Fire and explosion hazards	Flammable substances	Work environment hazards	Poor lighting conditions	Climate	Poor ventilation	Hazards through dangerous substances	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	Biological Hazards	Non-targeted activities with microorganism	Psychosocial hazards	Excessive workloads
A	Examining logs and rough lumber to determine size, condition, quality and other characteristics to decide best lumber cuts to carry out, or operating automated equipment to convey logs through laser scanners which determine the most productive and profitable cutting patterns.		●		●		●						●		●		● ●						●	●					●	●				●	
B	Operating and monitoring log in-feed and conveyor systems.				●		●						●		●		● ●	● ●					●	●			●	●			●				●	
C	Preparation of the work, by removing strange elements (in metal, stone…), removing bark, etc.		●	●	●	●	●			● ●	● ●				●		● ●						●	●	●		●	●						●	
D	Operating and monitoring head saws, resaws and multiblade saws to saw logs, cants, flitches, slabs or wings and remove rough edges from sawn timber into dressed lumber of various sizes, and to saw or split shingles and shakes.		●	●		●	●			● ●	● ●			●			● ●	● ●					●	●			●				●				●	
E	Selecting, controlling, mounting and replacement of cutting tools on the woodworking machines.			●			●			● ●	● ●			●			● ●	● ●					●	●											●	
F	Operating and monitoring plywood core-laying machines and hot-plate plywood presses and machines which cut veneer.		●	●										●			● ●	● ●					●	●			●			●	●				●	
G	Cleaning and lubricating sawmill equipment.		●				●				●			●			● ●				●		●	●			●	●	●	●	●				●	
H			●	●			●				●			●									●	●	●				●		●				●	

● No changes ● Reduced due to Circular Economy ● New or increased due to Circular Economy ● Reduced due to digitalization ● New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Wood processing plant operator - ISCO 8172

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Wood processing plant operators monitor, operate and control ecoefficient, digitized, connected and automated lumber mill equipment for sawing timber logs, coming preferably from certified sustainable sources, into rough lumber, cutting veneer, making plywood and particle board, and otherwise preparing wood for further use.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Uses digitization tool to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT- and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair or remanufacturing processes (e.g. waste generation or energy use reduction, etc.).

	Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload	Profile tasks forecast
A		●	●	●		●	●	●	●		●	●	●	Examining logs and rough lumber, using fulled automated, computer vision, big data and cloud connectivity to determine size, condition, quality, source and other characteristics to decide best lumber cuts to carry out, or operate automated and ecoefficient equipment to convey logs through different sensors, like laser scanners, to determine the most productive and profitable cutting patterns, optimising the use of resources and energy and reducing to maximum the generated waste (e.g. wood scrap).
B		●	●	●		●	●	●	●		●	●	●	Operating and monitoring log autonomous, ecoefficient and highly automated in-feed and conveyor systems.
C		●	●	●		●	●	●	●		●	●	●	Automated, semi-automated preparation of the work, by removing strange elements (in metal, stone…), removing bark, etc., using sustainable techniques and reducing as much as possible the use of hazardous substances.
D		●	●	●		●	●	●	●		●	●	●	Ecoefficient, fully automated operating and monitoring head saws, resaws and multiblade saws to saw logs, cants, flitches, slabs or wings and remove rough edges from sawn timber into dressed lumber of various sizes, and to saw or split shingles and shakes, optimising the use of wood and the generation of waste.
E		●	●	●		●	●	●	●		●	●	●	Autonomous selection, controlling, mounting and replacement of cutting tools on the highly digitized connected and ecoefficient woodworking machines, optimising the use of consumables prolonging their useful life.
F		●	●	●		●	●	●	●		●	●	●	Automated operating and remote monitoring of digitized and ecoefficient plywood core-laying machines and hot-plate plywood presses and machines which cut veneer, optimising the use of raw materials and the generation of waste.
G		●	●	●		●	●	●	●		●	●	●	Data driven predictive maintenance and quality assurance through cleaning and lubricating of sawmill equipment, using substances with low environmental impact and optimising their consumption.
H		●	●	●		●		●	●		●	●	●	Operating tools and digitized, connected and automated equipment for preparing wood for the maintenance, reparation and/or re-manufacturing of wood-based products, including sawing, etc.

1 Cobotics (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping).
2 Run over, roll over, falls from height.

Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Wood processing plant operator - ISCO 8172

2020 Current situation	2025-30 Situation forecast
Work system/work area: working on a timber yard, saw/lumber mill, operate and control lumber mill equipment, operate machines to prepare plywood and particle wood, programming of machines, storing and transporting raw timber, handling heavy timber.	Work system/work area: working on a timber yard, saw/lumber mill, operate and control digitised and automated lumber mill equipment, operate machines to prepare plywood and particle wood, new and recycled material, programming of machines, storing and transporting raw timber, handling heavy timber, prepare wood for reuse/re-manufacture, work with ecoefficient woodworking machines.
Mechanical hazards	
• Mechanical hazards from moving machines and tools. Wood processing machinery exposes workers to risks of being injured by unprotected moving parts, contact with moving blades (saw blade, drill, kick back etc.), uncontrolled moving parts (flying objects, wood chips) and parts with hazardous shapes (cutting, pointed, rough).	• Mechanical hazards from moving machines and tools. Wood processing machinery exposes workers to risks of being injured by unprotected moving parts, contact with moving blades (saw blade, drill, kick back etc.), uncontrolled moving parts (flying objects, wood chips) and parts with hazardous shapes (cutting, pointed, rough), and from moving cobots and robots. Some risks from mechanical hazards may decrease, depending on takeover of specific tasks by cobots/robots. Most of industrial cobots and robots are unaware of their surroundings therefore they can be dangerous to workers. Industrial robots can pose several types of hazards based on their origin: Mechanical hazards such as those arising from unintended and unexpected movements or release of tools. Preparing wood for reuse/remanufacturing may require new type of tools not available. Better design of products (ecodesign) could reduce hazards associated to activities on a timber yard, saw/lumber mill – using wood processing machines.
Effects: severe bruises, amputations, cuts and sharp injuries, crushing.	**Effects**: severe bruises, amputations, cuts and sharp injuries, crushing.
• Slips and trips, obstacles, table edges, moving vehicles, machines.	• Slips and trips, obstacles, table edges, moving vehicles, machines.
Effects: squeezing, cutting, twisting, spraining, bumps and bruises.	**Effects**: squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: from poor ergonomic conditions, awkward positions, heavy physical workload.	• Ergonomic hazards: from poor ergonomic conditions, awkward positions, heavy physical workload, digitalization put workers at risk of inactivity because of operating autonomous techniques from office workstations. Risks from ergonomic hazards may decrease, depending on take over of specific task by cobots/robots. On the other hand, workers are increasingly exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous machines and cobots from computer workstations. Inactivity may increase with digitalization. Preparing wood for reuse and reassembling may be related to Musculoskeletal Disorders (MSDs) (e.g. awkward positions, heavy lifting and carrying). This risk could be reduced with ecodesign strategies if occupational safety and health is taken into account when designing the product.
Effect: musculoskeletal diseases.	**Effect**: musculoskeletal diseases.
Electrical hazards	
• Electrical hazards: caused by contact with defective or unearthed electrical equipment.	• Electrical hazards: caused by contact with defective or unearthed electrical equipment and from autonomous or highly autonomous equipment.
Effect: fatal accident.	**Effect**: fatal accident.
Hazards due to physical effects/physical agents	
• Noise	• Noise: exposure to noise may decrease, depending on takeover of specific tasks by cobots/robots. The risk could be reduced with ecodesign strategies if occupational safety and health is taken into account when designing the product and machines.
Effects: hearing loss, headache, nervousness, poor concentration.	**Effects**: hearing loss, headache, nervousness, poor concentration.
• Vibrations	• Vibrations: exposure to vibration may decrease, depending on takeover of specific tasks by cobots/robots. The risk could be reduced with ecodesign strategies if occupational safety and health is taken into account when designing the product and machines.
Effects: hand-arm-vibration syndrome (e.g. white finger disease).	**Effects**: hand-arm-vibration syndrome (e.g. white finger disease).
• Laserlight	• Laserlight: wood processing plant operators may be exposed to laserlight.
Effect: eye damage, effects similar to sunburn.	**Effect**: eye damage, effects similar to sunburn.

2020 Current situation	2025-30 Situation forecast
Fire and explosion hazards	
• Fire and explosion hazards from materials, including wood dust and chemicals.	• Fire and explosion hazards from materials, including wood dust and chemicals. Exposure to fire and explosion hazards may decrease, depending on takeover of specific tasks by cobots/robots. Solvents and cleaning products used for maintenance tasks may be based on less hazardous substances (e.g. solvents) and prevent fire hazards.
Effects: burns, fatal accidents.	**Effects**: burns, fatal accidents.
Work environmental hazards	
• Work environmental hazards: poor lighting, inadequate temperature and climate.	• Work environmental hazards: poor lighting, inadequate temperature and climate.
Effect: negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.	**Effect**: negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.
Hazards through dangerous substances	
• Chemical hazards/dangerous substances: wood dust, preservatives, formaldehyde.	• Chemical hazards/dangerous substances: wood dust, preservatives, formaldehyde. The risk of being exposed to chemicals may decrease, depending on takeover of specific tasks by cobots/robots. Maybe reduced, if OSH will be included in the design of the products/ materials, less dangerous solvents and lubricants.
Effects: contamination/intoxication, skin diseases, respiratory diseases, wood dusts (carcinogens, allergens) may cause nasal or lung cancer.	**Effects**: contamination/intoxication, skin diseases, respiratory diseases, wood dusts (carcinogens, allergens) may cause nasal or lung cancer.
	• New materials (e.g. nanomaterials): Nanotechnology and nanomaterials may be used in woods as well as wood-composite materials in order to improve some of their properties, e.g. to improve the water resistance or thermal conductivity. **Effects**: not yet well known, included are among others inflammation and tissue damage, fibrosis and tumour generation.
	• Recycled material may concentrate hazardous substances (impurities) during successive recycling or may change the composition due to different factors such as light, heat and aging of material ~~u~~nknown content and kind of hazardous substances. Recycled material may contain dangerous substances, to the latest findings carcinogen or repro-toxic. (nowadays restricted by law (REACH)). **Effects**: contamination/intoxication, skin diseases, respiratory diseases, allergies, cancer.
Psychosocial hazards	
• Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility, repetitive, monotonous work.	• Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility and digital know how, repetitive, monotonous work. Lack of experience: New software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Increased demand on competences and up-to-date knowledge on the current development in circular economy and recycling industry. Working with materials which have previously been manufactured: new skills need to be acquired throughout the production cycle.
• Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues.	• Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues, lack of social contacts.
• Working method: working with colleagues.	• Working method: working with colleagues, autonomous machines/equipment, cognitive interactions with autonomous technologies. The use of cobots and other digital techniques may increase the risk of working alone and feeling isolated. Cognitive interactions between a robot and a human worker can lead to mental stress. Long period of concentration working with computer and new software and performing multitasking. Increased demand on flexibility as workers may perform some tasks from everywhere with mobile devices. Workers are also at risk of being permanent available outside working hours.
Effects: stress, burnout.	**Effects**: stress, burnout.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Wood processing plant operator - ISCO 8172

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Shift to renewable materials	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	Recycle materials	Replace old materials with advanced renewable ones	Apply new technologies	Operating digitized, connected and fully automated/autonomous machines	Use of computer vision, big data and cloud connectivity	Using remote monitoring and data driven predictive maintenance and quality assurance
Essential skills and competences											
Adjust properties of cut	YES, changed	●				●	●	●	●		
Create cutting plan	YES, changed	●	●	●	●	●	●	●	●		
Dispose of cutting waste material	YES, changed	●		●		●		●			
Ensure conformity to specifications	YES, changed	●				●	●			●	●
Ensure equipment availability	YES										
Handle timber	YES, changed			●		●		●			
Handle timber-based products	YES, changed			●		●		●			
Keep sawing equipment in good condition	YES, changed									●	●
Manipulate wood	YES, changed			●		●		●	●	●	
Monitor automated machines	YES										
Operate wood sawing equipment	YES, changed			●		●		●	●	●	
Perform test run	NO										
Remove inadequate workpieces	YES, changed			●		●					
Remove processed workpiece	NO										
Supply machine	YES										
Troubleshoot	YES, changed									●	●
Wear appropriate protective gear	YES										
Work safely with machines	YES										
Disassemble wood-based furniture products	NEW	●	●	●		●	●		●		
Examine disassembled pieces for further steps (reuse, recylce, upcycle)	NEW	●	●	●	●	●	●	●	●	●	●
Repair wood-based furniture pieces, where needed	NEW	●	●	●	●	●	●	●	●		●
Essential knowledge											
Cutting technologies	YES										
Types of wood	YES, changed	●		●		●	●				
Wood cuts	YES										
Woodworking processes	YES, changed	●	●	●	●		●	●	●	●	
Generic green skills, knowledge and competences (*)											
Environmental awareness and willingness to learn	NEW	●	●	●	●	●	●	●			
Systems and risk analysis skills	NA										
Innovation skills	NA										
Coordination, management and business skills	NA										
Communication and negotiation skills	NA										
Marketing skills	NA										
Strategic and leadership skills	NA										
Consulting skills	NA										
Networking, information technology and language skills	NA										
Adaptability and transferability skills	NEW	●	●	●	●	●	●	●			
Entrepreneurial skills	NA										
Waste, energy and water quantification and monitoring	NEW		●	●	●			●			
Material use and impact quantification and monitoring	NEW	●	●	●	●	●	●	●			
Material use and impact minimisation	NEW	●	●	●	●	●	●				

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova

Furniture assembler
ISCO 8219s

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.

Furniture assembler
ISCO 8219s

Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

GO TO INDEX

Furniture assembler
ISCO 8219s

2020
Occupational profile

Current profile description
Furniture assemblers place together all parts of furniture and auxiliary items such as furniture legs and cushions. They may also fit springs or special mechanisms. Furniture assemblers follow instructions or blueprints to assemble the furniture, and use hand tools and power tools.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

Current profiles tasks	ReSOLVE levers*	Regenerate	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	Share	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	Optimise	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	Loop	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste
A	Reviewing work orders, specifications, diagrams and drawings to determine materials needed and assembly instructions. • Fixed assembling with glue, screws, nails, fasteners and demountable assembling. • Finishing of the surfaces (filling up nail holes…). • Small corrections and reparations. • Mounting and adjusting fasteners and special hinges, rails…			●				●	●	●	●	●		●	●	●	●	●		●		●	●	
B	Reviewing work orders, specifications, diagrams and drawings to determine materials needed and assembly instructions.			●				●	●	●	●	●		●	●	●	●	●		●	●	●	●	
C	Recording production and operatio-nal data on specified forms.													●	●	●	●							
D	Inspecting and testing components and completed assemblies.			●				●	●	●	●	●		●	●	●	●	●		●	●	●	●	
E	Rejecting faulty products.			●										●	●	●	●	●		●	●	●	●	
F				●				●						●		●	●				●	●	●	●
G				●				●	●	●	●	●		●	●	●	●	●		●	●	●	●	

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Furniture assembler - ISCO 8219s

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Furniture assemblers place together all parts of furniture and auxiliary items such as furniture legs and cushions. They may also fit springs or special mechanisms. Furniture assembling is done by joint cooperation between robots and humans using cobots and sometimes it is significantly automated eventually into a fully autonomous process using cobots, big data and industrial IoT.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Uses digitization tools to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT- and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction, etc.).
- Applies a life-cycle thinking and favours the future disassembly of the product for maintenance, repair, reuse or recycling.

	Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	**Profile tasks forecast**
A			•		•	•	•	Semi-autonomous review of work orders jointly between humans and advanced artificial intelligence, based on computer vision, specifications, diagrams and drawings to determine materials needed and assembly instructions. • Fixed assembling with glue, screws, nails, fasteners and demountable assembling. • Finishing of the surfaces (filling up nail holes…). • Small corrections and reparations. • Mounting and adjusting fasteners and special hinges, rails… • Considering the future disassembly of the product for maintenance, repair, refurbishment or recycling (e.g. reducing glued components).
B			•		•	•	•	Reviewing work orders, specifications, diagrams and drawings to determine materials needed and assembly instructions of the highly digitised enterprise ecosystem, optimising also the future disassembly of the product for repair, refurbishment or recycling.
C			•			•		Recording production and operational data of the highly digitised and ecoefficient manufacturing plant on specified digitilized forms, including environmental performance indicators.
D			•			•		Inspecting and testing components and completed assemblies to fulfill quality and circular economy-oriented requirements (e.g. disassembly sequence for maintenance, repair, etc.) as integrated part of the fully digitised smart manufacturing ecosystem of the company.
E			•			•		Supervising the highly autonomous rejection system of faulty products, reducing as much as possible the scrap generated and promoting the internal reuse of part or components.
F					•			Defining and following disassembly instructions for selective disassembling of out of use or defective wood-based products for separation of materials and elements for further recovery or recycling.
G					•	•	•	Defining and following intructions for the maintenance, reparation and/or re-manufacturing of wood-based products, including re-assembly and final quality inspection and testing.

Furniture assembler
ISCO 8219s

2020
Occupational profile

Current profile description
Furniture assemblers place together all parts of furniture and auxiliary items such as furniture legs and cushions. They may also fit springs or special mechanisms. Furniture assemblers follow instructions or blueprints to assemble the furniture, and use hand tools and power tools.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

New categorization of hazards

Current profiles tasks		**Mechanical hazards**	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	**Ergonomic hazards**	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	**Electrical hazards**	Electric shock	**Hazards due to physical effects/physical agents**	Noise	Vibration	Laserlight	**Fire and explosion hazards**	Flammable substances	**Work environment hazards**	Poor lighting conditions	Climate	Poor ventilation	**Hazards through dangerous substances**	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	**Biological Hazards**	Non-targeted activities with microorganism	**Psychosocial hazards**	Excessive workloads
A	Reviewing work orders, specifications, diagrams and drawings to determine materials needed and assembly instructions. • Fixed assembling with glue, screws, nails, fasteners and demountable assembling. • Finishing of the surfaces (filling up nail holes…). • Small corrections and reparations. • Mounting and adjusting fasteners and special hinges, rails…		●	●		●	●			●	●	●	●				● ●	● ●	●		● ●		●	●	●			●	●	●	●					●
B	Reviewing work orders, specifications, diagrams and drawings to determine materials needed and assembly instructions.						●						●										●	●												●
C	Recording production and operatio-nal data on specified forms.												●										●	●												●
D	Inspecting and testing components and completed assemblies.		●				●						●				● ●						●	●						●	●					●
E	Rejecting faulty products.		●				●						●				● ●						●	●												●
F			●	●	●		●				●				●		●	●					●	●	●		●			●	●		●			●
G			●	●	●		●				●				●		●	●					●	●	●		●			●	●		●			●

● No changes ● Reduced due to Circular Economy ● New or increased due to Circular Economy ● Reduced due to digitalization ● New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Furniture assembler - ISCO 8219s

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Furniture assemblers place together all parts of furniture and auxiliary items such as furniture legs and cushions. They may also fit springs or special mechanisms. Furniture assembling is done by joint cooperation between robots and humans using cobots and sometimes it is significantly automated eventually into a fully autonomous process using cobots, big data and industrial IoT.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Uses digitization tools to work in a customer-oriented manner.
- Considers cost, environmental impact and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT- and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction, etc.).
- Applies a life-cycle thinking and favours the future disassembly of the product for maintenance, repair, reuse or recycling.

	Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload	Profile tasks forecast
A		●	●	●		●	●	●	●					Semi-autonomous review of work orders jointly between humans and advanced artificial intelligence, based on computer vision, specifications, diagrams and drawings to determine materials needed and assembly instructions. • Fixed assembling with glue, screws, nails, fasteners and demountable assembling. • Finishing of the surfaces (filling up nail holes…). • Small corrections and reparations. • Mounting and adjusting fasteners and special hinges, rails… • Considering the future disassembly of the product for maintenance, repair, refurbishment or recycling (e.g. reducing glued components).
B		●	●	●		●	●	●	●					Reviewing work orders, specifications, diagrams and drawings to determine materials needed and assembly instructions of the highly digitised enterprise ecosystem, optimising also the future disassembly of the product for repair, refurbishment or recycling.
C		●	●	●		●	●	●	●					Recording production and operational data of the highly digitised and ecoefficient manufacturing plant on specified digitilized forms, including environmental performance indicators.
D		●	●	●		●	●	●	●					Inspecting and testing components and completed assemblies to fulfill quality and circular economy-oriented requirements (e.g. disassembly sequence for maintenance, repair, etc.) as integrated part of the fully digitised smart manufacturing ecosystem of the company.
E		●	●	●		●	●	●	●					Supervising the highly autonomous rejection system of faulty products, reducing as much as possible the scrap generated and promoting the internal reuse of part or components.
F		●	●	●				●	●					Defining and following disassembly instructions for selective disassembling of out of use or defective wood-based products for separation of materials and elements for further recovery or recycling.
G		●	●	●				●	●					Defining and following intructions for the maintenance, reparation and/or re-manufacturing of wood-based products, including re-assembly and final quality inspection and testing.

1 Cobotics (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping).
2 Run over, roll over, falls from height.

Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Furniture assembler - ISCO 8219s

2020 Current situation	2025-30 Situation forecast
Work system/work area: working on site, operate wood processing machines, use of hand and power tools to place together furniture and auxiliary items.	Work system/work area: working on site, operate wood processing machines, use of hand and power tools, cobots and other digital machines to place together furniture and auxiliary items, following instructions circular and economic oriented requirements, using less dangerous substances (glue, solvents, coatings), using new and recycled material. Disassemble, dismantle, repair and maintenance of products.
Mechanical hazards	
• Mechanical hazards from moving machines and tools. Machinery used to assemble furniture exposes workers to risks of being injured by unprotected moving parts, uncontrolled moving parts (air tools/electric staplers, springs) and parts with hazardous shapes (cutting, pointed, rough).	• Mechanical hazards from moving machines and tools. Machinery used to assemble furniture exposes workers to risks of being injured by unprotected moving parts, uncontrolled moving parts (air tools/electric staplers, springs) and parts with hazardous shapes (cutting, pointed, rough), and from cobots and robots. Some risks from mechanical hazards may decrease, depending on takeover of specific tasks by cobots/robots. However, most of industrial cobots and robots are unaware of their surroundings therefore they can be dangerous to workers. Industrial robots can pose several types of hazards based on their origin: Mechanical hazards such as those arising from unintended and unexpected movements or release of tools. Remanufacturing and selective disassembling could require new type of tools not available. Better design of products (ecodesign) could reduce hazards associated to assembly/disassembly operations, using optimised joining systems, etc.
Effects: severe bruises, cuts and sharp injuries.	**Effects**: severe bruises, cuts and sharp injuries.
• Slips and trips, obstacles, table edges.	• Slips and trips, obstacles, table edges.
Effects: squeezing, cutting, twisting, spraining, bumps and bruises.	**Effects**: squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: from poor ergonomic conditions, awkward positions, heavy physical workload.	• Ergonomic hazards: from poor ergonomic conditions, awkward positions, heavy physical workload. Risks from ergonomics hazards such as heavy load may decrease, depending on takeover of specific task by cobots/robots. On the other hand, workers may be increasingly exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous machines and cobots from computer workstations. The disassembling and dismantling of manufactured goods may be related to Musculoskeletal Disorders (MSDs) (e.g. awkward positions, heavy lifting and carrying). This risk could be reduced with ecodesign strategies to facilitate assembly/disassembly (e.g. type of fasteners, etc.) if occupational safety and health is taken into account when designing the product.
Effect: musculoskeletal diseases.	**Effect**: musculoskeletal diseases.
Electrical hazards	
• Electrical hazards: contacts with live parts or connections or exposure to arc flash. Electrical hazards from woodworking machines.	• Electrical hazards: contacts with live parts or connections or exposure to arc flash. Electrical hazards from woodworking machines and from autonomous or highly autonomous equipment.
Effect: fatal accident.	**Effect**: fatal accident.
Hazards due to physical effects/physical agents	
• Noise	• Noise: exposure to noise may decrease, depending on takeover of specific tasks by cobots/robots. Noise maybe reduced due to ecodesign of machinery operating quieter and more environmental-friendly. However, dismantling activities may expose workers still to noise.
Effects: hearing loss, headache, nervousness, poor concentration.	**Effects**: hearing loss, headache, nervousness, poor concentration.
• Vibrations	• Vibrations: exposure to vibration may decrease, depending on takeover of specific tasks by cobots/robots. Possible more use of vibrating tools during product remanufacturing or repair (polisher, etc.). Vibration maybe reduced due to ecodesign of machinery operating with less vibration energy and more environmental-friendly.
Effect: hand-arm-vibration syndrome (e.g. white finger disease).	**Effect**: hand-arm-vibration syndrome (e.g. white finger disease).
• Laserlight	• Laserlight: furniture assembler may be exposed to laserlight.
Effects: eye damage, negative effects similar to sunburn.	**Effects**: eye damage, negative effects similar to sunburn.
Fire and explosion hazards	
• Fire and explosion hazards from materials, including wood dust, solvents and chemicals.	• Fire and explosion hazards from materials, including wood dust, solvents and chemicals. Exposure to fire and explosion hazards may decrease, depending on takeover of specific tasks by cobots/robots. Dust maybe emitted during dismantling, remanufacturing or repair activities– inappropriate dust extraction system increases risk of dust explosion. Risk from explosion and fire may decrease, depending on the substitution of flammable solvents in glues.
Effects: burns, fatal accidents.	**Effects**: burns, fatal accidents.

2020 Current situation	2025-30 Situation forecast
Work environmental hazards	
• Work environmental hazards: poor lighting, inadequate temperature and climate, poor ventilation. **Effect**: negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.	• Work environmental hazards: poor lighting, inadequate temperature and climate, poor ventilation. **Effect**: negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.
Hazards through dangerous substances	
• Chemical hazards/dangerous substances: wood dust, solvents, preservatives, formaldehyde, glues, new substances/materials. **Effects**: contamination/intoxication, skin diseases, respiratory diseases, allergies, cancer.	• Chemical hazards/dangerous substances: wood dust, solvents, preservatives, formaldehyde, glues, new substances/materials. Chemical risks may decrease, depending on takeover of specific task by cobots/robots. Chemical hazards may be reduced, if OSH will be included in the design of the products/ materials (use of less dangerous substances) and if dangerous substances will be substituted by less dangerous substances (solvents, glues, formaldehyde). Chemical hazards may increase depending on the quality of recycled materials (during successive recycling of unknown raw materials). Disassembling, dismantling: Exposure to fibres or dust when disassembling, dismantling products. **Effects**: contamination/intoxication, skin diseases, respiratory diseases, allergies, cancer. • New materials (e.g. nanomaterials): Nanotechnology and nanomaterials may be used in woods as well as wood-composite materials in order to improve some of their properties, e.g. to improve the water resistance or thermal conductivity. **Effects**: not yet well known, included are among others inflammation and tissue damage, fibrosis and tumour generation. • Recycled material: Risk of exposure to dangerous substances may be increased through lack of information on chemicals contained in recycled products and on ways how to deal with them appropriately. Recycled material may contain dangerous substances, to the latest findings carcinogen or repro-toxic. (nowadays restricted by law (REACH)). **Effects**: contamination/intoxication, skin diseases, respiratory diseases, cancer.
Biological hazards	
• Biological hazards: bacteria, mould and fungi. **Effects**: contamination/intoxication, skin diseases, respiratory diseases, infections.	• Non-targeted activities with microorganism: selective and/or destructive disassembling for separation of materials and elements for further recovery or recycling may expose workers to microorganism such as mould (Recycled , old and used material may contain mould). **Effects**: contamination/intoxication, skin diseases, respiratory diseases, infections.
Psychosocial hazards	
• Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility, repetitive and monotonous work.	• Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility and digital know how, repetitive and monotonous work. • Lack of experience: New software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Increased demand on competences and up-to-date knowledge on the current development in circular economy and recycling industry. Working with materials which have previously been manufactured: new skills need to be acquired throughout the production cycle. Repair, remanufacture and selective disassembly require new methods and procedures.
• Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues.	• Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues, lack of social contacts.
• Working method: working with colleagues. **Effects**: stress, burnout	• Working method: working with colleagues, digital equipment, cognitive interactions with autonomous equipment. The use of cobots and other digital techniques may increase the risk of working alone and feeling isolated. Cognitive interactions between a robot and a human worker can lead to mental stress. Long period of concentration working with computer and new software and performing multitasking. Increased demand on flexibility as workers may perform some tasks from everywhere with mobile devices. Workers are also at risk of being permanent available outside working hours. **Effects**: stress, burnout, and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Furniture assembler - ISCO 8219s

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Shift to renewable materials	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	Recycle materials	Promote the cascade use of wood	Apply new technologies	Furniture assembling is done by joint cooperation between robots and humans using cobots, big data and industrial IoT	Working in a highly digitized smart manufacturing ecosystem, with digitilized forms	Working as an integrated part of the fully digitized ecosystem of the company
Essential skills and competences												
Align components	YES, changed									●		
Apply a protective layer	YES, changed	●	●						●			
Assemble prefabricated furniture	YES, changed	●	●				●	●	●	●		
Clean wood surface	YES, changed	●			●		●		●			
Create furniture frames	YES, changed	●	●	●	●		●	●	●			
Create smooth wood surface	YES, changed	●	●						●			
Ensure conformity to specifications	YES, changed	●				●	●	●	●		●	
Follow written instructions	YES, changed									●	●	
Join wood elements	YES, changed	●	●	●	●		●	●	●	●		
Memorise assembly instructions	NO											
Operate drilling equipment	YES, changed									●		
Tend boring machine	YES, changed									●		
Use power tools	YES, changed									●		
Disassemble wood-based furniture products	NEW				●		●	●	●	●		
Examine disassembled pieces for further steps (reuse, recylce, upcycle)	NEW				●		●	●			●	
Repair wood-based furniture pieces, where needed	NEW			●	●		●	●	●	●		
Essential knowledge												
Technical drawings	YES, changed										●	
Generic green skills, knowledge and competences (*)												
Environmental awareness and willingness to learn	NEW	●	●	●	●	●	●	●	●			
Systems and risk analysis skills	NA											
Innovation skills	NA											
Coordination, management and business skills	NA											
Communication and negotiation skills	NA											
Marketing skills	NA											
Strategic and leadership skills	NA											
Consulting skills	NA											
Networking, information technology and language skills	NA											
Adaptability and transferability skills	NEW	●	●	●	●	●	●	●	●			
Entrepreneurial skills	NA											
Waste, energy and water quantification and monitoring	NEW	●		●	●	●		●	●			
Material use and impact quantification and monitoring	NEW	●		●	●	●	●	●	●			
Material use and impact minimisation	NEW	●	●		●	●	●	●	●			

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova

Factory hand
ISCO 9329

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector circular economy transition are in green colour and due to sector digitalization are in blue colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences need
Forecast of training new needs.

Factory hand
ISCO 9329

Unfold this to see the current occupational profile description and its tasks and to relate them to the following green table and first yellow table.

Tasks changes

Hazards and risks changes

Hazards and risks comments

Skills and competences needs

GO TO INDEX

Factory hand ISCO 9329

2020
Occupational profile

Current profile description
Factory hands assist machine operators and product assemblers. They clean the machines and the working areas. Factory hands make sure supplies and materials are replenished.

- Works in accordance with basic health and safety regulations, including environmental protection and efficient energy use.
- Works in a customer-oriented manner.
- Considers cost- and time-effectiveness when planning and organizing his/her work in his/her area of influence.
- Contributes to continuous improvement of work processes in the company.
- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

Current profiles tasks		ReSOLVE levers*																								
		Regenerate	Shift to renewable energies	Shift to renewable materials	Reclaim, retain, and regenerate health of ecosystems	Return recovered biological resources to the biosphere	**Share**	Reduce product replacement speed and increase product utilisation by sharing it among different users	Reuse products throughout their technical lifetime	Prolong products lifetime through maintenance	Prolong products lifetime through repair	Prolong products lifetime through design for durability	**Optimise**	Increase performance/efficiency of products	Customisation/made to order	Reproductible and adaptable manufacturing	Minimize waste in production and supply chain	Increase efficiency of production processes	**Loop**	Remanufacture products and/or components	Implement take-back programs	Recycle materials	Promote the cascade use of wood	Promote extraction of biochemicals from organic waste	
A	Conveying goods, material, equipment and other items to work areas, and removing finished pieces.														●	●	●	●		●	●				
B	Verifying specifications of goods, material, equipment and other items and checking the quality in order to ensure adherence to specifications.			●										●	●	●	●	●		●	●	●	●		
C	Loading and unloading vehicles, trucks and trolleys.														●	●		●							
D	Clearing machine blockages, and cleaning machinery, equipment and tools.														●	●	●	●							
E	Carrying out manual sorting of products or components.														●	●		●		●	●	●			
F	Recording operational data on specified forms.			●										●	●	●	●	●				●	●		
G				●				●						●		●	●				●	●	●	●	

*McKinsey center and Ellen MacArthur Foundation

Tasks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Factory hand - ISCO 9329

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

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- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction, etc.).

Virtualise	Virtualise direct aspects of the product	Virtualise indirect aspects of the product	**Exchange**	Replace old materials with advanced renewable ones	Apply new technologies	Choose new products and services	**Profile tasks forecast**	
		●			●		A	Conveying goods, material, equipment and other items to highly digitized, connected and automated work areas, and removing finished pieces, applying sustainable working practices (e.g. waste management, etc.).
		●		●	●		B	Digitally verifying technical & environmental specifications of goods, material, equipment and other items and checking the quality in order to ensure adherence to these specifications.
		●			●		C	Loading and unloading vehicles, trucks and trolleys in a digital and ecoefficient manufacturing plant, reducing the impact of logistics (e.g. load optimisation, etc.).
		●			●	●	D	Clearing machine blockages, and cleaning machinery, equipment and tools when predictive maintenance and online realtime monitoring could not prevent this; using non-hazardous substances, reducing their consumption and making a proper management of the generated waste.
		●			●		E	Carrying out semi-automated sorting of products or components when necessary in highly digitized and ecoefficient factory.
		●		●	●		F	Recording operational data of the digital and ecoefficient factory on specified forms, including environmental performance indicators.
				●			G	Following disassembly instructions and using adequate tools for destructive disassembling of out of use or defective wood-based products for separation of materials and elements to future recovery or recycling.

Factory hand ISCO 9329

2020
Occupational profile

Current profile description
Factory hands assist machine operators and product assemblers. They clean the machines and the working areas. Factory hands make sure supplies and materials are replenished.

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- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial and technical services).
- Assists in the implementation of quality assurance activities.

New categorization of hazards

Current profiles tasks		**Mechanical hazards**	Unprotected moving parts[1]	Parts with hazardous shapes (cutting, pointed, rough)	Moving means of transport and tools[2]	Uncontrolled moving parts (flying objects, wood chips)	Slip and trips	Falls from height	**Ergonomic hazards**	Heavy loads/heavy dynamic work	Awkward position/unbalanced strain	Repetitive movements	Lack of exercise, inactivity	**Electrical hazards**	Electric shock	**Hazards due to physical effects/physical agents**	Noise	Vibration	Laserlight	**Fire and explosion hazards**	Flammable substances	**Work environment hazards**	Poor lighting conditions	Climate	Poor ventilation	**Hazards through dangerous substances**	Dust	Solvents (neurotoxic, allergens)	Carcinogens	New materials (e.g. Nanomaterials)	Recycled material	**Biological Hazards**	Non-targeted activities with microorganism	**Psychosocial hazards**	Excessive workloads
A	Conveying goods, material, equipment and other items to work areas, and removing finished pieces.		●	●	●		●			● ●	● ●	●			●		● ●	● ●				●	●	●		●			●	●				●
B	Verifying specifications of goods, material, equipment and other items and checking the quality in order to ensure adherence to specifications.		●		●		●			● ●	● ●	●					● ●					●	●	●		●			●	●				●
C	Loading and unloading vehicles, trucks and trolleys.		●	●	●		●			● ●	● ●	●					● ●	● ●				●	●	●		●			●	●				●
D	Clearing machine blockages, and cleaning machinery, equipment and tools.		●	●	●		●			● ●	●	●			●		● ●	● ●		●		●	●	●		●	●	●	●	●				●
E	Carrying out manual sorting of products or components.		●	●			●			● ●	● ●	●	●				● ●					●	●	●		●			●	●				●
F	Recording operational data on specified forms.									● ●							● ●					●	●												●
G			●	●	●	●	●			●	●	●			●		●	●				●	●	●		●	●	●	●	●		●	●	●

● No changes ● Reduced due to Circular Economy ● New or increased due to Circular Economy ● Reduced due to digitalization ● New or increased due to digitalization

Hazards and risks changes

Current and forecasted tasks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Factory hand - ISCO 9329

2025/30

Occupational profile

Description forecast of the occupational profile in 2030

Factory hands assist machine operators and product assemblers. They clean the machines and the working areas. Factory hands make sure supplies and materials are replenished.

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- Coordinates work with the rest of the team, report to his/her team leader.
- Cooperates with other departments (administrative, commercial, ICT and technical services).
- Assists in the implementation of quality assurance and sustainability activities.
- Assists in the reduction of the environmental impact of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction, etc.).

	Low job satisfaction	Work tasks not clearly defined	Poor organisation of work	Poorly designed workplace environment (incl. software)	Repetitive, monotonous work	Cognitive strain	Stress due to long period concentration and awareness	Increased demands on flexibility	Lack of work experience	Lack of involvement in making decisions that affect the worker	Ineffective communication, lack of support from management or colleagues	Working alone/isolation	Workload: overload/underload	Profile tasks forecast
A	●	●	●	●	●			●	●	●	●		●	Conveying goods, material, equipment and other items to highly digitized, connected and automated work areas, and removing finished pieces, applying sustainable working practices (e.g. waste management, etc.).
B		●	●	●		●		●	●		●	●	●	Digitally verifying technical & environmental specifications of goods, material, equipment and other items and checking the quality in order to ensure adherence to these specifications.
C	●	●	●	●	●			●	●	●	●		●	Loading and unloading vehicles, trucks and trolleys in a digital and ecoefficient manufacturing plant, reducing the impact of logistics (e.g. load optimisation, etc.).
D	●	●	●	●				●	●	●	●		●	Clearing machine blockages, and cleaning machinery, equipment and tools when predictive maintenance and online realtime monitoring could not prevent this; using non-hazardous substances, reducing their consumption and making a proper management of the generated waste.
E	●	●	●	●	●		●	●	●	●	●	●	●	Carrying out semi-automated sorting of products or components when necessary in highly digitized and ecoefficient factory.
F	●	●	●	●			●	●	●		●	●	●	Recording operational data of the digital and ecoefficient factory on specified forms, including environmental performance indicators.
G	●	●	●	●	●	●		●	●					Following disassembly instructions and using adequate tools for destructive disassembling of out of use or defective wood-based products for separation of materials and elements to future recovery or recycling.

1 Cobotics (Squeezing, bumping, crushing, cutting, amputation, drawing-in/trapping).
2 Run over, roll over, falls from height.

Hazards and risks changes

Current and forecasted risks changes due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Factory hand – ISCO 9329

2020 Current situation	2025-30 Situation forecast
Work system/work area: working on site, cleaning and tidying up the workshop and machines, passing tools and materials, storage activities, supporting machine operators.	Work system/work area: working on site, cleaning and tidying up the workshop and machines, passing tools and materials, storage activities, supporting machine operators, loading and unloading activities, using digitalized instruments, collecting and sorting generates waste following sustainable and ecological requirements, using less hazardous materials , support in disassembling, repair and dismantling of furniture.
Mechanical hazards	
• Mechanical hazards from moving machines and tools and means of transportation, uncontrolled moving parts and parts with dangerous shapes.	• Mechanical hazards from moving machines and tools and means of transportation, uncontrolled moving parts and parts with dangerous shapes. Hazards from moving cobots/robots. Some risks from mechanical hazards may decrease, depending on takeover of specific tasks by cobots/robots. Most of industrial cobots and robots are unaware of their surroundings therefore they can be dangerous to workers. Industrial robots can pose several types of hazards based on their origin: Mechanical hazards such as those arising from unintended and unexpected movements or release of tools. Support in remanufacturing and selective disassembling of furniture could require new type of tools not available. Better design of products (ecodesign) could reduce hazards associated to assembly/disassembly operations, using optimised joining systems, etc.
Effects: severe bruises, amputations, cuts and sharp injuries, crushing, roll over or being crushed by means of transportation, forklift trucks etc.	**Effects**: severe bruises, amputations, cuts and sharp injuries, crushing, roll over or being crushed by means of transportation, forklift trucks etc.
• Slips and trips, obstacles, table edges, moving vehicles, machines.	• Slips and trips, obstacles, table edges, moving vehicles, machines.
Effects: squeezing, cutting, twisting, spraining, bumps and bruises.	**Effects**: squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
• Ergonomic hazards: from poor ergonomic conditions, awkward position, confined spaces, handling heavy loads.	• Ergonomic hazards: from poor ergonomic conditions, awkward position, confined spaces, handling heavy loads. Risks from ergonomic hazards may decrease, depending on take over of specific tasks by cobots/robots. On the other hand, workers are increasingly exposed to ergonomic hazards such as lack of exercise/inactivity because of operating autonomous machines and cobots from computer workstations as well as repetitive movements due to operating digitized machinery. Support in remanufacturing and repair services as well as dismantling of manufactured goods may be related to Musculoskeletal Disorders (MSDs) (e.g. awkward positions, heavy lifting and carrying). The risk of heavy loads may be reduced for factory hands due to use of lighter materials. Exposure to awkward positions may be reduced for workers if occupational safety and health is taken into account from the beginning, when the machinery is designed.
Effect: musculoskeletal diseases.	**Effect**: musculoskeletal diseases.
Electrical hazards	
• Electrical hazards: caused by contact with defective or unearthed electrical equipment.	• Electrical hazards: caused by contact with defective or unearthed electrical equipment. Electrical hazards from woodworking machines and from autonomous or highly autonomous equipment.
Effect: fatal accident.	**Effect**: fatal accident.
Hazards due to physical effects/physical agents	
• Noise: sawmill, other wood processing machines.	• Noise: sawmill, other wood processing machines. Exposure to noise and vibration may decrease, depending on takeover of specific tasks by cobots/robots. Noise maybe reduced due to ecodesign of machinery operating quieter and more environmental-friendly. However, noise during support of repair, dismantling or remanufacturing furniture may still be a risk.
Effects: hearing loss, headache, nervousness, poor concentration.	**Effects**: hearing loss, headache, nervousness, poor concentration.
• Vibrations	• Vibrations: exposure to vibration may decrease, depending on takeover of specific tasks by cobots/robots. Vibration maybe reduced due to ecodesign of machinery operating with less vibration energy and more environmental-friendly. However, vibrations during support of repair, dismantling or remanufacturing furniture may still be a risk.
Effect: hand-arm-vibration syndrome (e.g. white finger disease).	**Effect**: hand-arm-vibration syndrome (e.g. white finger disease).

2020 Current situation	2025-30 Situation forecast
Fire and explosion hazards	
• Fire and explosion hazards from materials, including wood dust and chemicals.	• Fire and explosion from materials, including wood dust and chemicals. Exposure to fire and explosion hazards may decrease, depending on takeover of specific tasks by cobots/robots. Dust maybe emitted during support of dismantling activities – inappropriate dust extraction system increases risk of dust explosion. Fire hazards of solvents when cleaning machinery, equipment and tools may be reduced due to new cleaning products based on less flammable substances such as water.
Effect: burns, fatal accidents.	**Effect**: burns, fatal accidents.
Work environmental hazards	
• Work environmental hazards: excessive heat and cold, poor lighting.	• Work environmental hazards: excessive heat and cold, poor lighting.
Effects: cardiovascular diseases, negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.	**Effects**: cardiovascular diseases, negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.
Hazards through dangerous substances	
• Chemical hazards/dangerous substances: asbestos, glass fibre, vapours, fumes, dust, solvents.	• Chemical hazards/dangerous substances: asbestos, glass fibre, vapours, fumes, dust, solvents. The risk of being exposed to chemicals may decrease, depending on takeover of specific tasks by cobots/robots Maybe reduced, due to products/materials used for cleaning machinery, equipment and tools based on less dangerous substances.
Effects: contamination/intoxication, skin diseases, respiratory diseases, cancer.	**Effects**: contamination/intoxication, skin diseases, respiratory diseases, cancer.
	• New materials (e.g. nanomaterials): ranotechnology and nanomaterials may be used in woods as well as wood-composite materials in order to improve some of their properties, e.g. to improve the water resistance or thermal conductivity. **Effects**: not yet well known, included are among others inflammation and tissue damage, fibrosis and tumour generation.
	• Recycled material: risk of exposure to dangerous substances may be increased through lack of information on chemicals contained in recycled products and on ways how to deal with them appropriately. Recycled material may contain dangerous substances, to the latest findings carcinogen or repro-toxic. (nowadays restricted by law (REACH)). **Effects**: contamination/intoxication, skin diseases, respiratory diseases, cancer.
Biological hazards	
• Biological hazards: bacteria, mould and fungi.	• Non-targeted activities with microorganism: support of selective and/or destructive disassembling for separation of materials and elements for further recovery or recycling may expose workers to microorganism such as mould (recycled, old and used material may contain mould).
Effects: contamination/intoxication, skin diseases, respiratory diseases, infections.	**Effects**: contamination/intoxication, skin diseases, respiratory diseases, infections.
Psychosocial hazards	
• Organisation of work: time pressure, shift work, stress, often related to poor work organisation, lack of experience and training, overload, low job satisfaction, repetitive, monotonous work.	• Organisation of work: time pressure, shift work, stress, often related to poor work organisation, lack of experience and training, overload, low job satisfaction, repetitive, monotonous work, interactions between a robot and a human worker can lead to mental health risks.
	• Lack of experience: new software and digital devices require training, some workers may not have enough competences and may feel overloaded, not experienced enough. Increased demand on competences and up-to-date knowledge on the current development in circular economy and recycling industry: Repair, remanufacture and selective disassembly require new methods and procedures.
• Social relationship: Lack of involvement in making decisions that affect the worker.	• Social relationship: Lack of involvement in making decisions that affect the worker. Cobots/robots that replace colleagues may increase the risk of working alone and feeling isolated.
• Working method: unskilled work, working with colleagues.	• Working method: unskilled work will change to digital know how. Long period of concentration working with computer and new software and performing multitasking. Increased demand on flexibility as workers may perform some tasks from everywhere with mobile devices. Workers are also at risk of being permanent available outside working hours. Robots/cobots may take over many tasks originally intended for factory hands, this may increase the feeling of being useless. On the other hand, operating more and more digitalized tools may change the task for factory hand totally and require new training and competences.
Effects: stress, burnout.	**Effects**: stress, burnout.

Skills and competences needs

Forecast of training new needs due to sector circular economy transition (in green for 2030) and digitalization (in blue for 2025) for the occupational profile: Factory hand – ISCO 9329

Skills, knowledge and competences	Will it continue to be needed?	Main causes/reasons of change: Customisation/made to order	Reproductible and adaptable manufacturing	Increase efficiency of production processes	Apply new technologies	Working in highly digitized, connected and automated work areas	Step in in situations where machines and automated processes block or temporarily fail
Essential skills and competences							
Clean building floors	NO						
Clean equipment	YES, changed				●	●	●
Clean surfaces	YES, changed				●		
Maintain work area cleanliness	YES, changed					●	●
Supply machine	YES, changed	●	●	●		●	●
Supply machine with appropriate tools	YES, changed					●	
Wear appropriate protective gear	YES						
Disassemble wood-based furniture products	NEW		●		●	●	●
Examine disassembled pieces for further steps (reuse, recylce, upcycle)	NEW		●	●	●	●	●
Essential knowledge							
Cleaning products	YES, changed			●	●		
Cleaning techniques	YES, changed			●	●	●	
Industrial tools	YES, changed					●	●
Generic green skills, knowledge and competences (*)							
Environmental awareness and willingness to learn	NEW		●	●	●		
Systems and risk analysis skills	NA						
Innovation skills	NA						
Coordination, management and business skills	NA						
Communication and negotiation skills	NA						
Marketing skills	NA						
Strategic and leadership skills	NA						
Consulting skills	NA						
Networking, information technology and language skills	NA						
Adaptability and transferability skills	NEW		●	●	●		
Entrepreneurial skills	NA						
Waste, energy and water quantification and monitoring	NA						
Material use and impact quantification and monitoring	NA						
Material use and impact minimisation	NEW		●		●		

(*) Source: Strietskallina et al. and Dr. Margarita Pavlova

Finland
bit.ly/39qFe6o

Sweden
bit.ly/2Xywndm

Norway
bit.ly/3i91XI1

UK
bit.ly/2XzY1XB

Denmark
bit.ly/38CyqmW

Ireland
bit.ly/39I6duz

Netherlands
bit.ly/3qj5Woy

Belgium
bit.ly/3i8MRlW

Switzerland
bit.ly/3i8eoE5

Liechtenstein
bit.ly/3qgl8T7

France
bit.ly/2Lw2Ezp

Portugal
bit.ly/3bGGsNP

Spain
bit.ly/2XBbGxn

Italy
bit.ly/2LI5nvD

Bosnia and Herzegovina
bit.ly/35DH42J

Montenegro
bit.ly/3ibgy64

Albania
bit.ly/35CGimv

Mapping of EU circular economy initiatives

Circular economy strategies have been under development in European cities, regions, and countries in the last few years. Since 2014, 33 strategies have been adopted and at least 29 more are under development.

We have produced a specific report "Collection of relevant initiatives supporting circular economy in the EU", which does not pretend to be an exhaustive list, but it contains examples of different approaches to promote circular economy in several EU countries. Most of them are focused on resource efficiency and waste reduction, but other topics such as sustainable development goals or climate change are also covered by some initiatives. You can find the full report at: bit.ly/2KqAu8l

The links on this map allows you to access specific reports produced by EIONET containing an overview of policies, approaches and targets of 32 European countries related to their resource efficiency and circular economy and their level of development.

Other relevant sources of information used for the report about initiatives, strategies and analysis related to circular economy are:

- Circular economy strategies and roadmaps in Europe: Identifying synergies and the potential for cooperation and alliance building – Study by the European Economic and Social Committee: bit.ly/2NchxqZ
- European Circular Economy Stakeholder Platform: bit.ly/3bRv8hM

Estonia
bit.ly/3oJJrsc

Latvia
bit.ly/3ibevP2

Lithuania
bit.ly/3svHRN8

Poland
bit.ly/3qglh97

Germany
bit.ly/3qhY6vi

Czech Republic
bit.ly/2N2m67h

Slovakia
bit.ly/2LspqrS

Austria
bit.ly/2LHqt74

Hungary
bit.ly/3nDPhtV

Slovenian
bit.ly/2LwEMeO

Croatia
bit.ly/39wj2b9

Serbia
bit.ly/35BPwQd

Turkey
bit.ly/3nF8A6b

Bulgaria
bit.ly/2LwMjKF

North Macedonia
bit.ly/2LqUfgs

Conclusions

Furniture manufacturers embracing circularity and circular practices will become more and more common, as circular economy is key to tackle climate and environmental challenges and the demands for contributions from the sector will constantly increase. Circularity is in its early stages and results will be seen in the medium-long term.

Two recent EU initiatives will facilitate this transition to a circular economy. On the one hand the European Green Deal (COM(2019) 640 final), which will support and accelerate the EU's industry transition to a sustainable model of inclusive growth and on the other hand the new Action Plan on Circular Economy (COM(2020) 98 final), in which the furniture sector is specifically mentioned as one of the priority products groups in the context of the value chains targeted by the Plan.

The SAWYER project vision statement by 2030 has been stated as follow:

*By 2030, with a broadly **digitalised furniture sector**, the wood-based furniture manufacturing industry will offer **products and services** with **environmentally conscientious design** based on **low impact and traceable raw materials, sustainable manufacturing processes**, and promotion of the **best usage and recovery scenarios** for materials and discarded products. Customers (B2B or B2C) will demand more detailed information about products and their **sustainable characteristics**, including life-cycle indicators, and consumer empowerment will be key in the success of circularity objectives. Authorities (at local, national and European level) will facilitate circularity by boosting **sustainable end-of-life scenarios** for materials and wood-based products, expanding **green public and private procurement schemes** and promoting **material efficiency policies**.*

In the analysis implemented in SAWYER, specific factors/actions showed a higher impact on most of the assessed occupational profiles, such as:

- Shift to renewable materials;
- Reuse products throughout their technical lifetime;
- Prolong products lifetime through maintenance and repair;
- Prolong products lifetime through design for durability;
- Increase performance/efficiency of products;
- Increase efficiency of production processes;
- Remanufacture products and/or components;
- Recycle materials;
- Promote the cascade use of wood;
- Virtualise indirect aspects of the product;
- Replace old materials with advanced renewable ones and
- Apply new technologies.

In order to cope with the challenges posed by the circularity transition and to exploit the opportunities offered by it, EU furniture sector stakeholders will have to look at this transition as part of the sector **Twin Transition** (green & digital), as they are closely related. As DIGIT-FUR project results forecasted, the wood furniture manufacturing industry will offer personalised smart products and services based on digital manufacturing systems supplied by resource-efficient and sustainable industries. A number of different technologies (e.g. cheap advanced sensors, IoT/IIoT, next generation Internet, data analytics, artificial intelligence, VR/AR, collaborative robots, etc...) will offer transformative business potentials, both in terms of products, which can be developed and produced, and of the manufacturing processes itself, for those able to utilise them. Another demanding challenge for the wood furniture industry will be the provision to the workers' necessary skills to effectively deal with this digital transformation. Overall, Industry 4.0 technologies will greatly impact the sector production processes during next years and will benefit as well the sector transition toward a more circular economy.

Looking at this from an overall perspective, the sector Twin Transition should represent the framework of reference for all future sector analysis, companies' innovation for products and production processes, innovative business models, sector policies and consequently the sector social dialogue.

From a digitalization perspective, the furniture industry is rapidly transforming from a traditional industry into a computerized, industrial sector. Based upon the expected changes in the analysed job profiles - using the McKinsey levers and taking into account the Industry 4.0 technologies - DIGIT-FUR forecasted the **changes in the demand for skills, knowledge and competences**. Future employees in the furniture industry not only have to be able to efficiently perform tasks, but they have to possess as well the skills and ability to recognize and adopt continuous changes. The demanded qualification level will become higher and more specialized, as the core of the skills becomes more abstract, due to digitization/computerization.

There is no increased need for hard skills, but the hard skills or technical skills need a complete integration of (all the relevant) digital skills. Technical knowledge remains essential and forms the foundation; cognitive, social and behavioural skills will become a priority. People will no longer be selected on the basis of their diploma, but in function of their mindset. Each individual will become responsible for his or her own proficiency in learning and self-improvement.

For some job profiles, **new green skillsets** will be required, as there will be some new, specific tasks related to disassembling and re-using, remanufacturing, recycling and upcycling. These new skillsets are especially (more) important for the tasks of the "practical" profiles. We name the following:

- disassembling wood-based furniture products
- examining disassembled pieces for further steps (reuse, remanufacturing, recycle, upcycle)
- repairing wood-based furniture pieces, where needed

These new green skillsets will also have an impact, though not so significant, on those profiles that are managing and taking strategic decisions within the company. These skills come as a "topping up" on the existing, necessary skillsets for the examined profiles.

Additionally, **generic green skills, knowledge and competences** were defined as necessary for social, economic and environmental developments within the wood furniture sector. These generic green skills are aligned with key competencies or soft skills, which have been contextualized within the perspective of environmental awareness and the understanding of sustainable development and circular economy.

The furniture industry Twin Transition poses **new challenges for occupational health and safety**. The furniture industry can be **truly sustainable** (environmentally, socially and economically) only when ensuring the safety, health, and welfare of its **most crucial resource: its workers** – or at least, it cannot be sustainable without protecting in the most effective way their safety and health.

New types of workplaces, new processes, new technologies and new materials/products can affect the safety and health of workers, but if properly planned and deployed **workers' health and safety can clearly be improved**. From the digitalization perspective, robots and digital technologies can make work that is

physically demanding or monotonous, easier, more efficient and safer. Workers may be removed from hazardous environments, and sensors may automatically indicate whether a machine needs maintenance and thus reduce the risks of machinery failure and incidents. Typical hazards in the furniture industry such as dangerous substances, dust, dangerous machines and tools will still remain, but the risk of being exposed to those risks will be reduced.

The analysis shows that the transition toward a more circular economy will **improve the global environment**, but under no circumstances it should reduce workers' health and safety. For this reason, we, furniture sector stakeholders, need to ensure that this transition and its new technologies or working processes do not lead to new hazards. And we need to ensure that new and recycled materials cannot put workers at risks of "new" or hidden dangerous substances**. Circular economy in the sector**, giving equal consideration to Occupational Health and Safety and to environmental issues, should be **deployed through safe and efficient machinery, working processes and materials** able to control workers' chemical and physical risks. The application of **ecodesign** concepts to products should facilitate recovery and repair operations, reducing ergonomic risks, and should reduce the content of hazardous substances, decreasing chemical risks in the entire value chain. Workers' safety and health could increase by integrating the OSH management into companies' quality management systems.

The Furniture sector Twin Transition, if not properly guided and deployed, could lead to new challenges and stress problems for workers. Increasing workloads and task complexity, excessive working hours and constant reachability give rise to tension and suffering at work, leading to psychosocial risks (EUOSHA, 2015). In order to avoid these new risks the **acquisition of new knowledge, capacities and flexibility** to properly deal with increasing automation, new processes and the development of new products become a real and key need for sector all workers.

The results of these analyses of the SAWYER project are useful to:

- properly understand how sector workers' jobs and their safety will evolve due to the impact of the circular economy transition;
- to prepare companies and workers to face and exploit the upcoming challenges and opportunities; and
- to have a stronger basis for future European Social Dialogue discussions and collaborations.

Also, these combined analyses on digitalisation and circularity – Twin Transition - have shown relevant synergies between them. For example related to:

- ~~h~~ow environmental information about products (e.g. hazardous substances content, reusable parts, recyclable materials, etc…) has to be collected and communicated along the supply chain, until the customer or recycler is reached;
- ~~h~~ow to shift from products to services (virtualisation, dematerialisation, servitization, etc…);
- ~~h~~ow to reduce the environmental impact of the manufacturing processes by using new technologies (e.g., energy efficiency, waste reduction, raw material optimisation, etc.).

This synergic analysis reinforces the vision that the future EU furniture sector will be greatly impacted by the Twin Transition and that all stakeholders will have to carefully cope with digital and circular challenges to exploit at the best all the opportunities offered by them.

Recommendations

The path to a circular economy **requires the collaboration of different actors**, ranging from policymakers, industry, experts, academia and consumers. To activate and speedup the transition toward a more circular economy, the **industry offer of more circular products** should expand together with the **market and consumers demand** for such products. In order to achieve this, **Vocational Education and Training providers and policymakers play a key role** in pushing these two key trends, and for this reason, in the following parts of this document you can find different specific recommendations for policymakers and the VET system able to support them in achieving these relevant goals.

Despite the above and the fact that several of the following recommendations focus on coping with the challenges posed by the sector transition toward a more circular furniture sector, it is important to always keep in mind that at practical level, the sector will be simultaneously and jointly impacted by its Twin Transition (digital & green). This is necessary not only to enable sector stakeholders to tackle sector challenges, but especially to allow them to successfully exploit the opportunities offered by their specific and joint impact.

Policymakers

Ensuring the success of the transition toward a more circular economy in the framework of the sector Twin Transition requires that **harmonized rules are put in place at EU/international level** and that EU initiatives are implemented **in a consistent way by the Member States**, reducing the risk of fragmentation of the internal market and **avoiding barriers** to free movement of (more) sustainable and circular goods.

To ensure a smooth implementation of EU initiatives, **simple and smart circular economy rules, clear definitions** at EU level and a **common language** are needed, especially when it comes to parameters measuring circularity, such as 'long lifetime', 'reuse', 'recyclability', among others. This is key to **provide harmonized information to consumers**. The EU Sustainable Product Policy Initiative should provide clarification and rules on these issues. One of its cornerstones will be widening the scope of the Ecodesign Directive to cover non energy-related products, such as furniture. The wide range of products that are considered 'furniture' and the diverse materials used in their production makes this a **complex sector to address**. Ecodesign/circular design criteria will not work for all products in the same way. In this context, it will be important to take into account the complexity of furniture, the need for a **step-by-step** approach, for **harmonisation** at European l**egislative level** and **across policies** and a **dialogue** should take place with the industry. (bit.ly/3a0Gihs)

When it comes to barriers to circular design, **key aspects to overcome** are the availability of **substitution materials and parts**, as well as the **lack of information from suppliers** on substances of concern and stringent national regulations leading to the use of unwanted chemicals (such as the case of toxic flame retardants which are often needed to comply with flammability requirements). In this framework, the EU Chemical Strategy for Sustainability and the Sustainable Products Initiative should promote the **reduction of substances of concern** in furniture products, reducing workers' exposure to chemicals. As documented by the Alliance for Flame Retardant Free Furniture (safefurniture.eu), flame retardants migrate out of products and accumulate in the environment and their use counteracts the objectives of a circular economy. These chemicals have no proven fire safety benefit and there is a large base of evidence of their harmful effects on **human and workers' health**, increased **fire toxicity** and the environment (bit.ly/2Y6beHN // bit.ly/2KLXjni). They represent an **avoidable risk** for workers during production, sale and end-of-life processing. This is a common risk for upholsterers and it is expected to **decrease or disappear** with the industry **transition** toward a more circular economy and if the upcoming policy tools will address the unneeded **use of toxic flame retardants** in furniture.

As part of the sector Twin Transition, the sector transition to the circular economy will depend on other parameters too, such as the **increased digitalization, innovative tools** and **ongoing innovation and research efforts**. These efforts and investments on circularity and development of more environmentally friendly technologies should be supported by **financing programs** such as Horizon Europe, etc. Appropriate investments should facilitate this transition and guarantee that it reaches all players involved, especially SMEs, and promote the collaboration among companies and stakeholders. The new EU Industrial Strategy should promote and facilitate the Twin Transition looking simultaneously at the potentialities of the industry digitalization and circularity.

The policy initiatives, such as the European Green Deal or the Circular Economy Action Plan should **stimulate market demand and offer of circular products**, promote the **development of new business models**, for example product-as-a-service, promoting reuse, refurbishment, remanufacturing, recycling, disownership models, models based on enabling care, repair, and refurbishment, repurchases or B2B procurement.

Due to the enormous impact of the COVID19 pandemic, the EU institutions and Member States efforts should be focused on the recovery from the social and economic crisis, using the stimulus package (e.g. Next Generation EU, the Recovery and Resilience Facility and the European Social Fund Plus) also for fighting climate change, for the promotion of digitalization and circular economy and to **facilitate workers' training on new technologies and green skills**, especially for the lower skilled workers, women, migrants, youngsters as well as older workers.

Vocational Education and Training (VET)

Education is the force for the future because it is one of the most powerful instruments of change. One of the greatest problems we face, is how to adjust our way of thinking to meet the challenge of an increasingly complex world. We must rethink our way of organizing knowledge. This means breaking down the traditional barriers among disciplines. We must **redesign our educational policies and programs**. And as we put these reforms into effect, we must keep our **sights on the long term** and honour our tremendous responsibility for future generations.

The Twin Transition of the furniture industry creates a **demand for new specific competences and skills** of the workforce. Anticipating and building skills for the future is essential in this rapidly changing and greening labour market. This applies to all changes in the types and levels of skills needed, as well as in occupational and technical areas.

The current supply of skills often does not match this demand for new and adapted skills. There is a **clear gap among the skills needed** by the Twin Transition of the furniture sector **and the current education offer and provision**.

UNESCO described **Five Dimensions of Greening TVET (Technical and Vocational Education and Training)** as a translation of the **three dimensions of sustainability** that need to be addressed - **environmental, economic, and social** - into a key framework for understanding the approach to Education for Sustainable Development.

In relation to the Twin Transition, we also added the digital aspect.

Based upon these five dimensions of greening TVET, we can recommend the following:

Green and digital campus

Managing campus with regards to energy, water, waste and pollution management.

- For schools and training centres, it is almost **impossible to keep up with all the investments needed** by the Twin Transition, as the new technologies are evolving increasingly rapid.

Therefore, a green and digital campus should also focus on **hybrid learning environments**, including in their formal training, an offer of work-based learning, dual learning, and apprenticeships. A green and digital campus invests in digital learning methods, in e-learning through MOOCS (Massive Open Online Courses), in green curricula.

The green and digital campus is an **open campus**, where start-ups have their place, where companies are welcomed to invest as a partner in new technologies, in green research and in new, flexible curricula.

Green and digital curriculum

Integrating Education for Sustainable Development (ESD). Green technology, clean technology, green jobs and greening existing jobs. Therefore, there is a need of green programs and courses, green practices in classes and workshops and a better interaction between industries and educational institutes.

VET systems need to be **adaptive and continuously evolving** (in a smart way).

As inspiration, we present the following examples on how to achieve green(er) skills.

- Adapting labour market information on the greening and digital economy in the development of new curricula and reviewing existing curricula with green and digital aspects. This can be done by sector councils, advising organism with captains of (green) industry, digital champions, or advisory committees with local businesses (for regional adaptation, context of local labour market, etc.).

- In order to introduce circular economy in the curricula of VET schools, businesses could come to the school and talk about how they manufacture products. Then they hand over their products to pupils/students to be redesigned in a circular economy perspective (circlevet.eu - Steve Parkinson).

- The design and adaptation or modification of the curricula should respond or even anticipate the changing skill needs for the Twin Transition. The design of programs and modification of courses and learning outcomes in curricula that are set up in a **modular** way or **based upon workplace-based training** makes it very flexible to integrate the new skills demand. Many courses and programs are already being modified to integrate (some) aspects of circular economy, of sustainability and/or of digitalization. But this is too often only 'sideways' and too limited. For example, using wood from sustainable sources is often only taught in theoretical lessons, but not included in the procurement of the used resources in the workshops. Digitalization is taught as a concept, as a theory, but often not integrated in the machine-workshops, where the computers are outdated and unsuited for demanding VR/AR applications.

- Besides the adaptation of the curricula for students, we also need adapted training paths for retraining and workplace-based training for the 'upskilling' and 'reskilling' of the workforce.

- The continuous learning (CVET) is also an important level to address the above-mentioned recommendations for the curricula. The above-mentioned **new delivery methods** (modular, workplace-based, web-based distance learning, hybrid learning methods, off-campus training, etc.) can be used to offer **on-demand and personalized training pathways** for everyone who is interested. It is important to adapt the method to the specific target groups and to focus on the changing of the mindset, rather than addressing purely technical issues.

- The Twin Transition must be spread out through all departments, integrated in all branches and within all course programs and curricula.

Such an integrated, sustainable approach can consist of:

- Developing skills, necessary to **implement** sustainable and digitized solutions;
- Making connections between the chosen program/curriculum and the Twin Transition;
- Being part of inter-connected worldwide systems;
- Integrated understanding of social, economic and environmental systems and discussing practical solutions to the Twin Transition;
- Sustainable thinking and decision-making as contribution to the process of solution-building for social, environmental and economic crises;
- Engaging students in learning 'for', not just 'about', the Twin Transition.

Green and digital community

Adapting the community by capacity building, renewable technology and resource support.

Effective methods to anticipate future skill needs include sustained dialogue between employers and employees, companies and trainers, coordination across governmental institutions,

labour market information systems, employment services and performance reviews of training institutions. Collaboration and co-operation at all stages (decision makers, policy makers, practical, organizational, etc.) is needed. There is an enormous need for the **involvement of all stakeholders**, training providers, social partners (firms, employers' and employees' organizations and federations), universities and academic world, sectoral organizations, public employment services and all the relevant governmental partners (ministries of education, work, environment, digitalization…). For example, for the recognition of skills, to develop **skills alliances within the sector, but also cross-sectoral.**

Green and digital research

Fostering research in the areas of renewable energy, green innovations and waste recycling.

In relation to the Twin Transition, we recommend more joint actions concerning the **research on the recognition of skills, developed outside the normal learning pathways**. This recognition - which becomes more and more important - must be transparent and supported by all stakeholders, including governmental partners. After only a few years away from the (high-)school/university, the acquired knowledge and skills become somehow obsolete, due to the rapid changing environment in the light of the Twin Transition. Only Continuous VET, be it in a formal, an informal or a non-formal way, guarantees the lasting validation of a degree/diploma.

Green and digital culture

Promoting a culture of green values, green attitude, green ethics and green practices.

In relation to the Twin Transition, we would like to add **a digital culture** (digital attitude, digital ethics and digital practices).

Besides this green and digital culture, we recommend adapting a **learning culture in the company**, integrating informal and non-formal learning. Workers need to be given time or freed up to properly learn and benefit their companies. Thanks to flexible and modular learning paths, on-site or off-site, work-based, just in time, where needed (in the right place and with the right format), when needed (at the right time), workers can learn throughout their working life and working situation. The challenge is to ensure that learners **access qualitative information** (see digital literacy). There must be given sufficient attention to the highly educated workforce. These employees will also become responsible to train the lower-skilled workforce. The **learning expectancy is increasing** and the **learning opportunities** as well.

Green skills

Studies on future skills demand endorse the importance of soft skills, collaboration and digital competences. The defined generic green skills also refer under these soft skills.

The needed digital competences and the generic green skills do not defer much. Often, it is the context and situation, objective or goal that starts from a different viewpoint. The following table shows the defined (new) generic green skills (on the left) and the needed digital skills (on the right), as they were defined in the Digit-Fur project. Because the digital skills were defined in a more general way than the generic green skills (which are more detailed), we can relate the digital skills more than once with the green skills (in italic).

Besides these generic 'soft' skills, we also need to integrate and embed the technical green and/or digital skills.

Table 9.- New green skills and their link with digital skills.

Environmental awareness and willingness to learn	Digital literacy
Systems and risk analysis skills	Critical thinking and problem solving
Innovation skills	Curiosity and innovation
Coordination, management and business skills	*Initiative and entrepreneurship*
Communication and negotiation skills	Effective communication
Marketing skills	*Effective communication*
Strategic and leadership skills	*Initiative and entrepreneurship*
Consulting skills	*Effective communication*
Networking, information technology and language skills	Collaboration across networks
Adaptability and transferability skills	Agility and adaptability
Entrepreneurial skills	Initiative and entrepreneurship
Waste, energy and water quantification and monitoring	Information retrieval
Material use and impact quantification and monitoring in procurement and selection	*Information retrieval*
Material use and impact minimization (impact assessment)	*Information retrieval*

Formal VET

Formal VET-training and education is broader than just labour market oriented and remains important. The new increased **demand for the right soft skills needs to be supported** in a stronger manner. Despite the importance of these soft skills, the system may not lose sight of **basic technical competencies** and the need for an up-to-date technical education remains. One can only be successfully creative in his/her job if one has also the basic skills.

- A **better cooperation** between education and sector is needed, especially for technical programs. The future sector employees must be able to efficiently perform tasks, but they also need the **skills and capacities to recognize the upcoming changes and to adapt to them**. The role of multidisciplinary skills and abilities is increasing significant, and **companies will demand higher and more specialized qualification levels**.
- This shift in competences also points out the importance of **professional qualification profiles** (set up by the sector), **as a base of the learning pathways** in education.

Initial-VET vs Continuous-VET

- There is an increasing importance of **demand driven systems** as apprenticeships, dual learning or workplace-based learning. These systems need to be implemented in both VET-systems.
- Existing initial VET systems and continuous VET systems need to **adopt the new green and digital technologies**. Educational partners and training providers must work closely together with companies. Not only technical skills and specialized domain-specific knowledge on the Twin Transition is needed. The defined generic soft skills are equally crucial.

Finally, we can conclude that for an up-to-date **learning provision system**, we need **collaboration** of all stakeholders and partners to successfully implement and integrate the new skills needs for this Twin Transition. Collaboration that requires that all the stakeholders' attention and actions focus in a complementary and collaborative manner.

Collaboration between **VET regulatory and educational governmental entities** is needed to integrate the new skills sets for a green and digital world, already in an early stage, such as in primary education and these skills must be further developed during secondary education.

Collaboration between **training providers and companies** is needed to provide flexible and adaptive learning paths, on-site or off-site, work-based, just in time, where needed (in the right place and with the right format), when needed (at the right time).

Collaboration between the **workers' social partners and associations** is needed to support and facilitate the conditions enabling the workers to obtain the needed proficiency and skills to face the Twin Transition in the sector. Sector **workforce** will need to adopt a new mindset of continuous learning (lifelong learning). They will have to continuously update their knowledge about the new OHS risks and act accordingly. Overall, each individual will become responsible for his or her own future skills and proficiency.

Together, in partnerships between employers, government and educational institutes, we can work on the development of demanded skills for the Twin Transition, to anticipate, build and enhance the skills of all stakeholders (teachers, students, parents, employers, co-workers, administrations, etc…). In this way, a bright future awaits us in the furniture sector.

Because in the future, every job will be a green and digital job!

Bibliography

From the SAWYER project results/publications

- Collection of relevant initiatives supporting circular economy in the EU (2020). bit.ly/3iMxGzb
- The State-of-the-art of circular economy in the furniture sector in 7 EU countries (2020). bit.ly/3a28bGd
- Summary Table: Update of the State-of-the-art of circular economy at EU level (2020). bit.ly/3cd0ShC
- The SAWYER forecasting survey results (2020). bit.ly/3cgDY8X
- The State-of-the-art of circular economy in the furniture sector at EU level (2020). bit.ly/3qPSRTK
- Furniture Sector Forecasted Scenario in relation to Circular Economy in 2030 (2020). bit.ly/3a70w9s

General sources

- Bauer B. et al, Nordic Council of Ministers. Potential Ecodesign Requirements for Textiles and Furniture, 2018. bit.ly/2M6pPAr
- Ellen MacArthur Foundation, Growth Within: a circular economy vision for a competitive Europe, 2015. bit.ly/2MreFWM
- Leka S., Jain A., Impact of Psychosocial Hazards at Work: An Overview, Institute of Work, Health & Organisations, University of Nottingham Health, 2010. Source: apps.who.int Available at: bit.ly/2LOdw7i
- Malenfer M., Héry M, Montagnon C. – INRS A circular economy in 2040. What impact on occupational safety and health? What prevention?, 2019. bit.ly/2M4QNIS
- Montgomery D. L. Safe and healthy life, Health and Safety in the Woodworking Industry, 2017. Source: safeandhealthylife.com Available at: bit.ly/2AvHuJ0
- Pavlova M. - Fostering inclusive, sustainable economic growth and 'green' skills development in learning cities through partnerships. International Review of Education: Journal of Lifelong learning, 2018. bit.ly/2YgCun2
- Storesund K. et al. BRANDFORSK - RISE Research Institutes of Sweden, Fire safe furniture in a sustainable perspective, 2019. bit.ly/3a4d3KW

European Union funded projects

- Bolster-Up II - Core profiles for wood and furniture professions. bolster-up2.eu
- DIGIT-FUR - Impacts of the Digital Transformation in the Wood Furniture Industry. digit-fur.eu
- CircleVET - circlevet.eu
- DITRAMA – Digital Transformation Manager, leading companies in Furniture value chain to implement their digital transformation strategy. ditrama.eu
- EQ-WOOD - The innovation manager for the wood and furniture industry. eqwood.org
- FUNES – Furniture New European Skills 2020. funesproject.eu
- FURN360 – Circular business training for the furniture and woodworking sectors. furn360.eu
- GPP 2020 procurement for a low-carbon economy. gpp2020.eu/home
- GPP Furniture An innovative and open learning resource for professionals of the furniture industry to expand their knowledge and provide added value for the Green Public Procurement. gpp-furniture.eu/
- SPP Regions – Regional networks for sustainable procurement sppregions.eu/home
- WOODUAL - Wood Sector and Dual Learning for Youth Employment and Skills adapt.it/WOODual

European Union sources

- CASCADES. Study on the optimised cascading use of wood – Final report. European Commission. July 2016. bit.ly/36o8bPx
- CEDEFOP (2015) Spotlight on VET, Anniversary Edition, Vocational education and training systems in Europe. Source: cedefop.europa.eu. Available at: bit.ly/1JWFIAj
- CEDEFOP Spotlight on VET country reports. cedefop.europa.eu
- CEN European Committee for Standardization. cen.eu
- Circular Economy Action plan. European Commission COM (2015) 614. bit.ly/36e16B6
- Circular economy strategies and roadmaps in Europe: Identifying synergies and the potential for cooperation and alliance building – Study by the European Economic and Social Committee. bit.ly/3sWYiSC
- Communication Closing the loop - An EU action plan for the Circular Economy COM/2015/0614 final. bit.ly/3plg0gC
- Circular Economy Opportunities in the Furniture Sector - European Environmental Bureau (EEB), September 2017. bit.ly/3iO3iEr
- Commission General Report on the operation of REACH and review of certain elements Conclusions and Actions Conclusions and Actions. European Commission Communication (COM(2018) 116 final). bit.ly/3oqwT8s
- Communication A New Industrial Strategy for Europe COM/2020/102 final. bit.ly/3pmK8YR
- Communication The European Green Deal COM/2019/640 final. bit.ly/3qMxa70
- Communication on Public procurement for a better environment (COM (2008) 400). bit.ly/3oqx8jS
- Country factsheets on resource efficiency and circular economy in Europe (2019). bit.ly/3c9aCJL
- Development of Guidance on Extended Producer Responsibility (EPR), developed by BIO Intelligence Service for theEuropeanCommission, 2014. bit.ly/3a7wltd
- DG Energy - Renewable Energy Directive. bit.ly/3t5MSfJ
- DG Environment - Circular Economy. bit.ly/36e16B6
- DG Environment - EMAS. bit.ly/3iNvhUN

- DG Environment - End of Waste Directive. bit.ly/39iNHK4
- DG Environment - EU Ecolabel. bit.ly/3qRbref
- DG Environment - Green public procurement. bit.ly/2MqZBIZ
- DG Environment - Timber regulation. bit.ly/36eQUZ5
- Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work bit.ly/36d7kRT
- Directive 2008/98/EC on waste (Waste Framework Directive). bit.ly/3iZ3ykp
- Directive (EU) 2019/904 on the reduction of the impact of certain plastic products on the environment. bit.ly/3a9amHQ
- ECHA European Chemicals Agency. echa.europa.eu
- Ecodesign Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products. bit.ly/2Yeg8CL
- Ecodesign Directive (2009/125/EC) European Implementation Assessment. EPRS - European Parliamentary Research Service. PE 611.015, November 2017. bit.ly/36eRmXh
- Ecodesign Working Plan 2016-2019 (European Commission). bit.ly/2LXjWpu
- Ecolabel Facts and Figures. bit.ly/3cbM1DX
- EEA Report No 26/2019 - Resource efficiency and the circular economy in Europe 2019 – even more from less – EIONET. bit.ly/3c9bkGV
- EMAS EU Eco-Management and Audit Scheme. bit.ly/3iNvhUN
- Environmental Implementation Review 2019 of the European Commission (COM(2019) 149 final). bit.ly/2L2MDAG
- ESCO, European Skills, Competences, Qualifications and Occupations website. Source: ec.europa.eu Available at: bit.ly/2GWtpdb
- ESCOpedia. bit.ly/3pf2ScN
- EU-OSHA (European Agency for Safety and Health at Work) (2009). The human machine interface as an emerging risk. Source: osha.europa.eu Available at: bit.ly/2CQQ4Ul
- EU Forest Strategy. European Commission Communication. COM(2013) 659 final. bit.ly/3qRc07R
- EU-OSHA (European Agency for Safety and Health at Work) (2013a). Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Source: osha.europa.eu Available at: bit.ly/2F7ZrjV
- EU-OSHA (European Agency for Safety and Health at Work) (2013a). Priorities for occupational safety and health research in Europe: 2013-2020. bit.ly/2LW1mht
- EU-OSHA (European Agency for Safety and Health at Work) (2017). Key trends and drivers of change in information and communication technologies and work location. Source: osha.europa.eu Available at: bit.ly/2qVC6Ys
- European Agency for safety and health at work (EU OSHA), OSH Wiki, Psychosocial risks and workers health, 2013. Source: oshwiki.eu Available at: bit.ly/2F83Nrc
- European Commission. Bioeconomy. bit.ly/3iKarWw
- European Commission. EU Forestry. bit.ly/2M8dbkD
- European Green Deal. bit.ly/3sRkLk2
- EUROSTAT. ec.europa.eu/eurostat
- Forest Information System for Europe (FISE). bit.ly/39jBUuV
- GPP National Action Plans. bit.ly/3iO5sUz
- Guidance on cascading use of biomass with selected good practice examples on woody biomass. European Commission, August 2019. bit.ly/2YgMeO8
- Monitoring Framework for the Circular Economy. bit.ly/36h0dIe
- National renewable energy action plans and progress reports data portal. bit.ly/3qSrBE3
- New Skills Agenda for Europe. bit.ly/3sZgBH2
- Occupational Safety and Health Administration - OSHA, Guide for Protecting Workers from Woodworking Hazards (1999). Source: osha.gov Available at: bit.ly/2CO0GD7
- Opinion of the EESC - A new Circular Economy Action Plan For a cleaner and more competitive Europe COM(2020) 98 final. bit.ly/2YhWipW
- Organisation and Product Environmental Footprint. bit.ly/2YdvCqj
- REACH Regulation (EC 1907/2006). bit.ly/3onXC5k
- Regulation (EU) 2017/1369 setting a framework for energy labelling and repealing Directive 2010/30/EU. bit.ly/2Yiyy54
- Regulation (EU) No 2019/1021 on persistent organic pollutants (POPs Regulation). bit.ly/3cbdPZ4
- Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of the Circular Economy Action Plan {SWD(2019) 90 final}. bit.ly/3pmhAyy
- Revision of the EU Green Public Procurement (GPP) criteria for Furniture. Joint Research Center. August 2017. bit.ly/2YiEyeh
- RoHS Directive. bit.ly/3t0UDTR
- Stepping up EU Action to Protect and Restore the World's Forests. European Commission Communication COM(2019) 352 final. bit.ly/2MnxytY
- Sustainable Products in a Circular Economy - Towards an EU Product Policy. Framework contributing to the Circular Economy.- Commission Staff Working Document SWD(2019) 91 final. bit.ly/36eDufQ
- The uptake of green public procurement in the EU27. Centre for European Policy Studies (CEPS) for the European Commission, February 2012. bit.ly/2MnQZTt

- TNO, ZSI, SEOR, Investing in the Future of Jobs and Skills - Scenarios, implications and options in anticipation of future skills and knowledge needs, Furniture (2009), EC. Source: ec.europa.eu Available at: bit.ly/2F95DrU
- WEEE Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment. bit.ly/3pkJpYg
- WEEE compliance promotion exercise. Final Report (developed by Bipro for the European Commission), December 2017. bit.ly/3sX9JK1

Other documents

- Digit-fur forecasting scenario of the EU wood furniture industry in 2025 (2018). bit.ly/2LW2YI3
- EFIC - Sustainable Products Initiative - European furniture industry insights in view of upcoming proposal for a Directive, 2020 bit.ly/3aamvfB
- Furniturelink, Occupational Health and Safety (2016). Source: furniturelinkca.com Available at: bit.ly/2Au2zmS
- German statutory accident insurance for the wood and metal industry (Berufsgenossenschaft Holz und Metall BGHM), Gefahrstoffe im Schreiner-/Tischlerhandwerk und der Möbelfertigung-Handhabung und sicheres Arbeiten, DGUV 209-040, 2010. Source: bghm.de Available at: bit.ly/2F5d8kt
- Health and Safety Executive (HSE), Manual handling solutions in woodworking, 2013. Source: hse.gov.uk Available at: bit.ly/2QmPSPT
- Health and Safety Executive (HSE), Wood dust Controlling the risks, Woodworking Sheet No 23 (Revision 1), 2012. Source: hse.gov.uk Available at: bit.ly/2s8r9VQ
- HSE, Wood furniture and windows - Managing occupational health risks. Source: hse.gov.uk Available at: bit.ly/2Vw6sRw
- Impacts of the digital transformation in the wood furniture industry – final results (2019). bit.ly/3a7b4W6
- LIGNUM.- Spanish Information System on Wood Trade. bit.ly/3cdCJqY
- Plan Estatal Marco de Gestión de Residuos (PEMAR) 2016-2022. BOE number 297, 12/12/2015. bit.ly/2MsOtLn
- Spanish Circular Economy Strategy. Circular Spain 2030. Spanish Ministry for Ecological Transition, February 2018. bit.ly/3oegy6w
- Work Safe Western Australia, Safe use of Chemicals in the Woodworking Industry Guidance note (2001). Source: commerce.wa.gov.au Available at: bit.ly/2RCWQFv
- WorkSafe, A guide to safety in the wood products manufacturing industry, First edition, 2007. Source: worksafe.vic.gov.au Available at: bit.ly/2nz0NuJ

Other sources/websites

- AENOR. aenor.com
- Alliance for Flame Retardant Free Furniture in Europe. safefurniture.eu
- Basque Ecodesign Center. basqueecodesigncenter.net
- BREEAM (The Building Research Establishment's Environmental Assessment Method). breeam.com
- Blue Angel Ecolabel. blauer-engel.de
- CEN/CENELEC.- CEN/CLC/JTC 10. cencenelec.eu
- Ecolabel Index. ecolabelindex.com
- écoMobilier. ecomobilier.fr
- Ellen MacArthur Foundation. ellenmacarthurfoundation.org
- EPD System. environdec.com
- European Circular Economy Stakeholder Platform circulareconomy.europa.eu/platform
- Forest Law Enforcement, Governance and Trade. flegt.org
- FSC (Forest Stewardship Council). ic.fsc.org
- Generalitat de Catalunya. web.gencat.cat
- I4R Platform. i4r-platform.eu
- IHOBE. ihobe.eus
- ISO - International Organization for Standardization. iso.org
- LEED (Leadership in Energy and Environmental Design). new.usgbc.org/leed
- McKinsey & Company. mckinsey.com
- NF Environment Ecolabel. marque-nf.com/nf-environnement
- Nordic Swan Ecolabel. nordic-ecolabel.org
- PEFC (Programme for the Endorsement of Forest Certification). pefc.org
- PROCURA+ European Sustainable Procurement Network. procuraplus.org
- Spanish Ministry for Ecological Transition. miteco.gob.es
- Valdelia. valdelia.org
- WRAP. wrap.org.uk

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