DIGIT -FUR
IMPACTS OF THE DIGITAL TRANSFORMATION IN THE WOOD FURNITURE INDUSTRY

Digit-Fur

Impacts of the digital transformation in the wood furniture industry

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With financial support from the European Union.

CENFIM
Home & Contract furnishings cluster and innovation hub

European Federation of Building and Woodworkers

UEA

EFIC
European Furniture Industries Confederation

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EFBWW

UEA

EFIC
European Furniture Industries Confederation

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Executive summary

The **DIGIT-FUR** project - Impacts of the digital transformation on the wood furniture industry has focused its research on the changes caused by the **Industrial Digitization (or Industry 4.0)** on the **European wood furniture sector in 2025 (NACE 31.0)**. It has been funded by the European Commission call: Support for Social Dialogue VP/2016/001. Grant Agreement Reference VS/2017/0027.

Project partners were: **CENFIM** – Home & Contract Furnishings Cluster and Innovation Hub (Lead Partner); **EFBWW** - European Federation of Building and Woodworkers; **UEA** - European Furniture Manufacturers Federation and **EFIC** - European Furniture Industries Confederation.

The project has provided a better understanding of the possible **scenario of the furniture sector due to digitization impact in 2025** and it forecasted which will be the effects of this transformation on 11 ESCO occupational profiles (ESCO – European classification of Skills/Competences, qualifications and Occupations) in relation to the **changes in their tasks, occupational health and safety (OHS) risks** and the related new **skills, knowledge and competencies (VET)** needed. This forecast exercise and the forecasted scenario in 2025 are the key part of the study and it is presented in the central part of this report through specific tables for each of these aspects and profiles.

Profiles selection was implemented looking at those **occupations specific** to the furniture sector and their **relevance** for the functioning of companies. The 11 occupational profiles analysed are:

- Cabinet-makers and related workers
- Woodworking-machine tool setters and operators
- Upholsterers and related workers
- Wood processing plant operators
- Sales and marketing manager
- Factory hand
- Industrial production manager
- Supply chain manager (Supply, distribution and related managers)
- Maintenance & repair engineer (machinery maintenance and repair workers)
- Furniture designers
- Furniture assembler

The main research outcomes are the following:

The adoption of **Industry 4.0 new technologies** is believed being one of **the key drivers of change** during this and next decades for the European industries, together with the Circular Economy. This research **aimed to anticipate the understanding of these changes** in order to facilitate and thus support the social dialogue among sector key actors and stakeholders and to properly face next years challenges and **secure workers employability and safety, and companies' competitiveness**.

With a massively connected and globalised economy, the wood furniture manufacturing industry will offer personalised smart products and services based on **digital manufacturing systems** supplied by resource-efficient and sustainable industries with an immense need for enough digitization talents and skills securing a competitive transformation of the industry. A number of **new technologies offer transformative business potentials**, both in terms of the products and manufacturing processes, for those companies able to properly use and adopt them. An even greater transformation can come from the **accumulated effect** of the combination of several of these new technologies. Most of these technologies can be utilised by SMEs' and large enterprises, making them suitable for a large part of the European wood furniture industry.

Digitization poses **new challenges for occupational health and safety**, but new types of workplaces, processes and technologies **can increase the safety and health of workers**. Workers may be removed from hazardous environments, and sensors may facilitate machineries maintenance. However, digitalization gives also rise to many **new challenges and stresses for workers**. Increasing automation can lead to a lack of sufficient understanding of the new processes and technologies. Workers may also be exposed to time pressure, an increased pace of work and workloads, tasks complexity, excessive working hours and constant reachability. The use of and cognitive interactions with robots/cobots can lead to mental stress or the risk of working alone and feeling isolated. Long working hours on computer screens and poor ergonomic design of non-office visual display unit workplaces may lead to musculoskeletal disorders.

In order to **reduce the above mentioned possible negative impacts** while properly **exploit the digitization opportunities**, companies, workers and all sector stakeholders and associations will have to join efforts and **increase collaborations. Formal, Informal, Initial and Continuous VET** will play a key role in supporting workers and managers and provide the new demanded skills, knowledge and competencies such as the seven survival skills of the future and the ones related with digital literacy, data security, engineering, science, technology and ICT.

Changes in jobs tasks will create new needs for **skills, knowledge and competences**. Future employees of 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, adopt and adapt to continuous changes**. There is no increased need for hard skills, but the hard skills or technical skills need a **complete integration of all relevant digital skills**. Technical knowledge remains essential and forms the foundation; cognitive, social and behavioral skills will become a priority. People will no longer being 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.

A **key follow-up step** of this project is the approval of the project proposal DITRAMA in the 2017 Sector Skills Alliances call of the ERASMUS+ program. Furniture sector companies, challenged by the 4th Industrial revolution, need professionals able to properly lead their digital transformation. **DITRAMA project** aims to provide an innovative **Massive Online Open Course** for a new key occupational profile for the Furniture sector: the **Digital Transformation Manager**. This MOOC will train managers to **successfully lead the digital transformation** along the whole value chain.

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Introduction

Objectives

The overall DIGIT-FUR objective was to present a **clear forecast** useful to **all EU Furniture sector social partners and stakeholders** of how the sector and its workers will be affected by the **impact of the digital transformation** along its **whole value chain in 2025**. This better understanding will facilitate **anticipating the changes** required to keep and improve the workers competencies and safety at work, and secure companies' competitiveness during next years or even decades. The specific objectives were:

- Understanding which was the **existing structural situation** of the European Furniture sector.
- Defining the **future possible sector scenario in 2025** due to its **digitization.**
- Identify the **impact on sector occupations tasks, OHS risks and skills & knowledge needs.**
- **What to expect** because of these changes and how to deal with them.
- Support the work of the European social dialogue and improve EU industrial relations.
- **Map successful EU initiatives** supporting the industry digitization.

Methodology

The research methodology adopted by the consortium to properly achieve the targeted results can be named as a simplified Delphi research methodology. The first step of the DIGIT-FUR project consortium and external experts (T.S. Toftegaard, J. Doom, E. Schmitz-Felten and N. Sangalli) had been to **take a picture of the European Furniture Sector situation** (2017). The first report provides updated information about the furniture sector structural situation, value chain, processes and technologies, occupations and employment, the related OHS risks, VET provision systems, market trends and main drivers of change with a special attention to the digitalization impact.

The second step was the implementation of a **prospective forecasting survey** among 56 multidisciplinary experts from 15 European countries, supported by the Furniture sector report. The aim was to identify which factors / situations / impacts are more probable to happen in 2025 and the ones with a greater impact, and thus create a **first draft list of drivers of change and factors** supposed to be the most relevant for the wood furniture sector. The results were presented and discussed in a Workshop (third step) in Brussels among 21 experts and professionals from 13 European countries and specialized in different fields such as the Furniture Sector, Digitization, VET systems, OHS risks and Economy.

The results were analysed and reported (forth step) by the project Digitalization expert (T.S. Toftegaard) in the document **Forecasting Scenario of the EU Wood Furniture Industry in 2025**. Based on these results, this expert, in collaboration with the CENFIM DIGIT-FUR project team (J. Solana, J. Rodrigo, M. Rumignani) and the project expert in furniture VET System (J. Doom), identified the expected changes in eleven occupational profiles tasks due to the impact of the digitalization (fifth step).

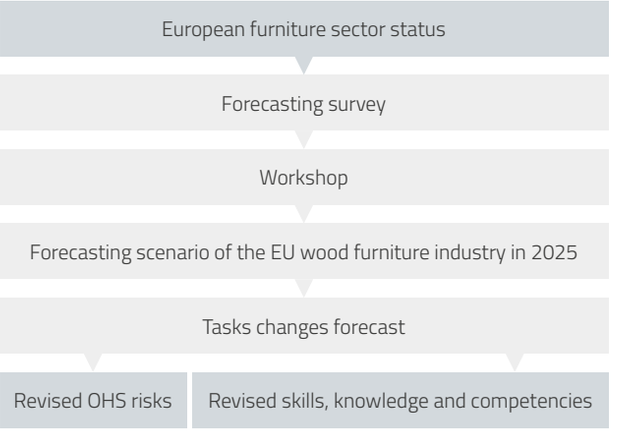
The final sixth steps were the **detailed forecasting** of the consequences of these tasks changes on the **OHS risks** for workers (by E. Schmitz-Felten, project expert in OHS risks) and the **new skills, knowledge and competencies** (by J. Doom) required to employees by the sector companies willing to adopt and exploit all the opportunities offered by the Industry digitalization.

A **mapping of initiatives** supporting the digitization of European Industries provided information about some relevant national and regional initiatives.

The 11 occupational profiles selected from the ESCO classification (European classification of Skills/Competences, qualifications and Occupations) and analysed are:

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

Figure 1.- Project methodology scheme



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Results

EU furniture sector: state of the art

The "Report on the Furniture Sector Status" of the DIGIT-FUR project was prepared during 2017 and it provides basic information and data to understand the current situation and trends of the EU wood furniture industry and it was designed as reference material for the survey "Forecasting the Furniture sector in 2025" respondents.

The DIGIT-FUR consortium decided to focus the research on the manufacture sector of wood furniture which is part of NACE Rev. 2 classification: 31.0, which value was around 85 € billions in 2016, accounting for 1.9% of the EU manufacturing added value.

The EU28 furniture sector is largely composed by **micro, small and medium size companies**, as shown by the following table.

Table 1.- Number of furniture enterprises by size in EU28 (Source: EUROSTAT)

	YEAR / number of enterprises in EU28			
Enterprise size by persons employed	**2011**	**2012**	**2013**	**2014**
from 0 to 9	110,000	108,157	104,606	104,885
from 10 to 19	8,589	7,933	7,900	7,675
from 20 to 49	4,839	4,680	4,478	4,282
from 50 to 249	2,756	2,590	2,510	2,412
250 or more	425	420	410	404
Total	**126,000**	**123,774**	**119,921**	**119,656**

The key stages of the sector **value chain** are: Design, Production, Marketing & Sales and Distribution, which are composed by different sub-stages that are properly described in the related full report. *digit-fur.eu/documents*

In 2014, the **sector total employment** in Europe (EU 28) was almost one million jobs (955,521), covering about 3% of European manufacturing workers with some countries having a very high and relevant number of employees, as shown in the table.

Table 2.- Manufacture of furniture and number of persons employed (Source: EUROSTAT)

Furniture	Employees in 2014	% weight[1]
European Union (28 countries)	955,521	3%
Poland	161,187	7%
Germany	142,679	2%
Italy	136,185	4%
United Kingdom	70,940	3%
Romania	61,504	5%

[1] % Persons employed furniture / Persons employed manufacturing.

One of the sector challenges in relation to its workers is the **workforce aging** during the last decades. The sector faces a growing lack of attractiveness among youngers. Sector digitization can possibly reverse this negative trend. Two other relevant trends of the sector are the **products customization** and the **development of ICT within companies**. These have already affected the main four skills types demanded by the furniture sector: Manual, ICT, Design and Soft. These trends have already had an impact and caused changes on several occupational profiles of the sector in terms of tasks and the related skills required.

In recent years, **VET** has moved high up on the policy agenda in order to harmonize EU National VET systems that are still widely different. Two main tools were developed with this objective, the European Qualification Framework (**EQF**) and the European Credit system for Vocational Education and Training (**ECVET**), facilitating the comparison of learning outcomes from the different qualifications and educational pathways in the different EU countries. There are some shared solutions that have been adopted, but need further development, also within the furniture sector: more work-based learning (WBL) and business-education partnerships, more opportunities to validate non-formal and informal learning, greater support for teachers and trainers and their mobility and a modernization of higher education. Overall, to make VET system more efficient and effective, there is clear need to **better align it with labour market needs** through a better and stronger cooperation among educational (institutional) partners, social partners and sector organisations.

In relation to **OHS risks**, woodworking in the furniture industry can be hazardous for workers because of the use of machinery and tools, handling heavy materials, exposure to dust, noise and chemicals - potentially harmful events can happen at any time. Digitization poses **new challenges for occupational health and safety**. New types of workplaces, new processes, and new technologies may increase workers' safety and health thanks to human-friendly work systems, but digitization may create new risks for workers, if environmental, social and psychological aspects are not taken into account.

The **technological development** in digitisation capabilities during the last couple of decades has initiated a **massive transformation** in the technology across industries and society in general. The pace of this change is rapid. To maximize the benefit, it is critical to set the agenda around the rapid digitisation of businesses and government services, to push national SME's to become European in terms of market ambition and to improve innovative digital skills in general.

The complete report can be found at: *digit-fur.eu/documents*

Forecasting: survey and workshop results

The second project key delivery was the implementation of a Forecasting Survey among 56 professionals from 15 EU countries with different expertise: Digitization, Furniture, Economy, VET and OHS. Results provided a **ranked list of 108 factors** that will affect the wood furniture sector in 2025, in relation to their **probability** of happening and the relevance of their impact on the sector. The **survey objectives** were:

- Identify **which factors / situations / impacts are more probable to happen in 2025**.
- Identify which of the **factors will have a more important impact** on the wood furniture sector.
- Create a **first draft list of drivers of change and factors**, supposed to be the most relevant for the wood furniture sector.

This survey was built upon a previous Forecasting study published by the Joint Research Centre, Scapolo (2014).

Survey results showed a list of 32 factors with the highest values for Impact and a high / relevant probability of happening.

These factors were at the centre of the DIGIT-FUR Workshop held in Brussels in October 2017, which involved twenty-one experts from the above-mentioned fields of expertise. These, grouped according to their field of expertise, firstly discussed these 32 factors and identified their implications for the sector and shortlisted the most impacting ones. Secondly, they analysed all together these shorter lists and their impact from a multidisciplinary point of view.

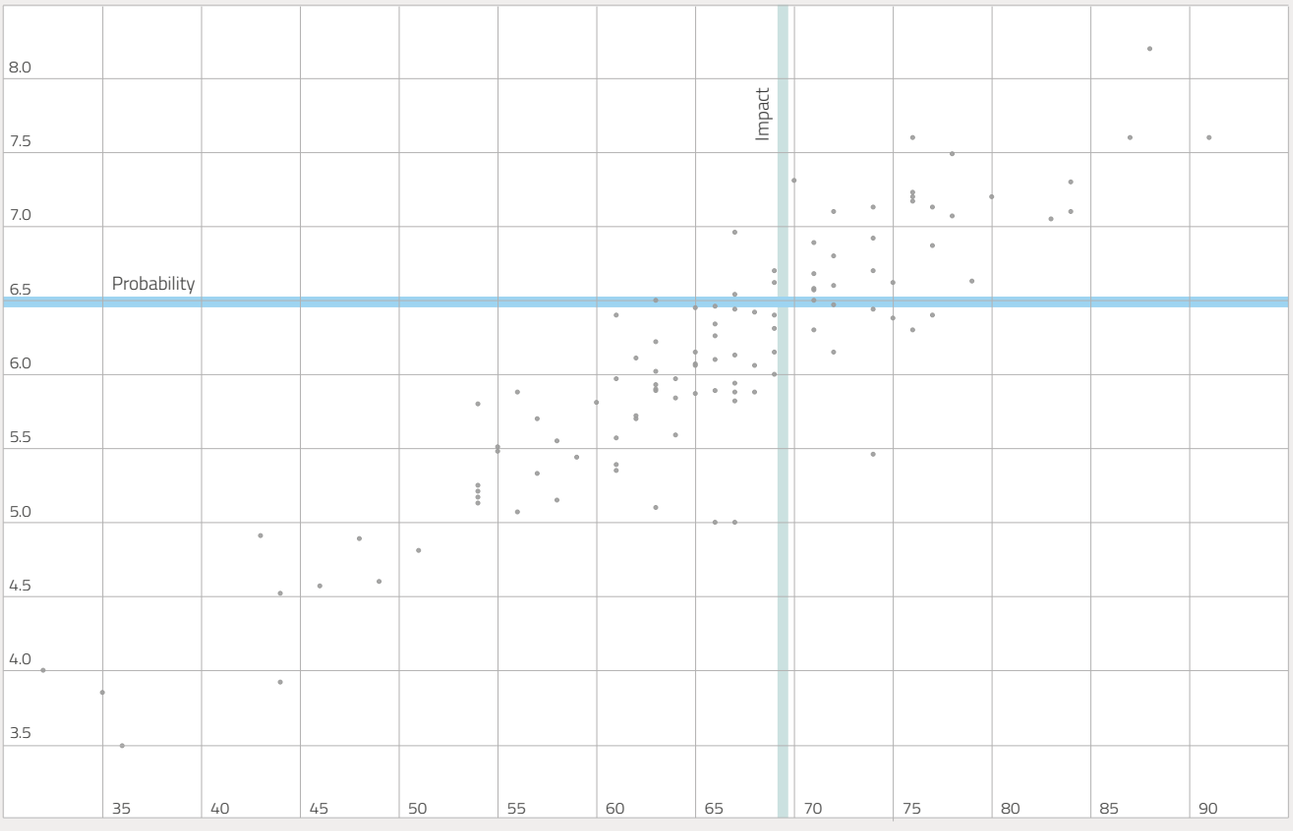
The results of this two steps research were collected, analysed and reported by the project Digitalization expert in the document Forecasting Scenario of the EU Wood Furniture Industry in 2025, which includes a clear and understandable **European wood furniture industry vision** for 2025. This is a view into how the future can offer to Europe an even stronger wood furniture manufacturing industry with increased competitiveness on the global market. Moreover, it can be used as a tool to stimulate strategic thinking about future strategic investments. The vision statement is:

By 2025, with a massively **connected and globalised economy**, the wood furniture manufacturing industry will offer **personalised smart products and services** based on **digital manufacturing, logistics and sales systems** supplied by **resource-efficient and sustainable industries** with an immense need for enough **digitization talents and skills** securing a competitive transformation of the industry.

This document describes as well the status and the industrial landscape responses for each of the five key elements of the vision statement and it has been the key document supporting the preparation of following DIGIT-FUR project reports to forecast the changes related to targeted occupational profiles tasks, VET needs and OHS.

The complete reports can be found at: *digit-fur.eu/documents*.

Figure 2.- Distribution of the 108 factors in relation to their probability and impact values.



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Factors that survey results showed as the most relevant in impacting the furniture sector production and management systems.

Table 3.- Main drivers of change identified by the survey

Rank	Factors	Importance *Prob. x Imp. Max: 1.000*	Probability *Mean Value. Max: 100*	Probability *Standard Deviation*	Impact *Mean Value. Max: 10*	Impact *Standard Deviation*
1	Big Data and the Internet of Things	720	88	15	8,20	0,92
2	Secure and Resilient ICT Infrastructure	692	91	11	7,60	2,37
3	Data Visualisation	662	87	14	7,60	2,17
4	Data Process for Knowledge Acquisition	614	84	19	7,30	2,21
5	Upgraded ICT Networks	596	84	15	7,10	2,47
6	Customer-Oriented Design	586	78	21	7,49	1,88
7	Sustainable Knowledge Infrastructure	583	83	13	7,05	2,01
8	Competition for Skills and Talent	576	76	20	7,60	1,93
9	Upgraded, Integrated Infrastructure Networks	575	80	13	7,20	1,81
10	Personalisation	551	78	16	7,07	2,18
11	Mass Customisation	548	76	18	7,17	2,04
12	Advanced Robotics	548	77	21	7,13	2,02
13	Consumer Innovation	547	76	13	7,20	1,62
14	Smart Logistic Tools	547	76	22	7,23	2,14
15	Sustainable Manufacturing	532	77	18	6,87	1,96
16	Agile Manufacturing	530	74	19	7,13	1,76
17	Niche Industries	523	79	19	6,63	2,31
18	Virtual Enterprise Environments	513	70	21	7,31	1,59
19	Eco-Industry Services	511	74	19	6,92	2,13
20	Developing Talents	508	72	20	7,10	2,18
21	Additive Manufacturing	495	75	21	6,62	2,04
22	Complex Value Chain	495	74	12	6,70	1,61
24	Open Innovation	492	72	13	6,80	1,48
25	Social Manufacturing	490	71	21	6,89	2,19
29	Intel. and Intermodal Transport Infrastructure	473	72	28	6,60	2,76
30	Circulation of Materials and Parts	472	71	23	6,68	2,03
31	Waste Minimisation	471	71	21	6,58	2,05
32	Personalised Production Lines	470	71	20	6,57	2,17

Factor in the 1st Quadrant: Probability > 69 & IMPACT > 6,5

34	'Circular Economy' Business Models	466	67	25	6,96	2,19
35	Digital Engineering Tools	465	69	21	6,70	1,97
37	'Craftsmanship' Approach	454	69	26	6,62	2,33
42	Design for Sustainability	437	67	17	6,54	1,79

Factors in the 3rd Quadrant: Probability <= 69 & IMPACT > 6,5

Aspects taken into account for the occupational profiles analysis

The first of the next sections presents the forecast of the percental volume jobs change in the wood furniture sector due to its digitization in 2025. The other following three sections include short descriptions/explanations of the concepts that were used to assess the changes produced by the wood furniture industry digitization: McKinsey levers, industry 4.0 technologies, wood furniture industry risks and hazards, and finally skills, knowledge and competences. Their clear comprehension is needed to properly understand the section tables.

Workers volume changes expected for 2025

At overall level, to understand the sector jobs structure and their related relevance, we analysed as well the **impact of digitization on the volume of the different jobs categories and the targeted occupational profiles**. The table below provides an overview of furniture sector jobs functions categories, their approximate volume in 2014, and their link with the occupational profiles targeted, the values of automation probability, and the expected change of workers volumes in 2025 due to sector digitization.

Table 4.- Workers volume changes expected for 2025

Job function categories[1]	Approx. vol. in 2014[2]	Professional profiles targeted by DIGIT-FUR (ESCO occupational profiles)	% Automation probability[3]	Expected change for 2025[4]
Managers	66.886	No covered by this study	-	-
ICT Professional	9.555	No covered by this study	-	-
Designers	9.000	2163s Furniture Designer	2,9%	+ 1,1%
Production manager	19.110	1321s Industrial production manager	3,0%	+ 4,3%
Sales and marketing staff	19.110	1221 Sales and marketing managers + additional profiles not covered by this study	1,4%	+ 3,8%
Supply chain managers	9.000	1324s Supply Chain manager	59,0%	- 1,0%
Administrative support staff	95.552	No covered by this study	-	-
Plant and machinery maintenance and repair workers	57.331	2141s Maintenance & repair engineer + additional profiles not covered by this study	2,9%	+ 3,2%
Skilled handicraft workers (Cabinet Makers and Upholsterers)	477.761	7522 Cabinet-makers and related workers	91,5%	- 0,9%
		7534 Upholsterers and related workers	15,9%	- 3,2%
		8219s Furniture assembler	97,0%	+ 2,7%
Machine operators	38.221	7523 Woodworking-machine tool setters and operators	97,0%	- 0,9%
		8172 Wood processing plant operators	86, 0%	- 0,9%
Labourers	66.886	9329 Factory hand	74,8%	- 0,9%

[1] Jobs functions categories from the study TNO, ZSI, SEOR (2009), EC.
[2] 955.521 workers, EU 28 Furniture Sector total number of workers according to EUROSTAT data.
[3] Automation probability refers to the likelihood a human job and/or its tasks are undertaken by a machine thanks to the development of new technologies. Data from Hernández (2018).
[4] Expected change in workers volume in 2025 due to sector digitization Based on elaboration of Vogler-Ludwig (2016) data.

McKinsey levers and industry 4.0 technologies

We can find on the right short descriptions of the McKinsey levers and industry 4.0 technologies. They will help to properly understand the tables presenting the tasks changes for each of the analysed occupational profiles.

Consultancy firm McKinsey created the "digital compass" identifying 26 practical Industry 4.0 levers that are changing (and will change further) the companies functioning and production processes. We selected 23 of these levers affecting the production process targeted by DIGIT-FUR project.

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Smart energy consumption
Monitoring the energy consumption throughout the entire manufacturing system allows optimizing the consumption from the perspective of the whole system.

Real-time yield optimization
Real-time optimization (RTO) is a type of closed-loop control system able to automatically regulate a process optimizing its performance in real time.

Intelligent IoTs
The industrial Internet of Things is the interconnection through Internet of devices embedded in objects and machines, enabling them to send and receive data to company's information systems.

Routing flexibility
Ability of more than one machine to perform the same process or adjust for changes in capacity or volume.

Machine flexibility
Ability of the machine to reconfigure and do more than one task.

Remote monitoring and control - asset utilization
Remote monitoring is the process of supervising and controlling systems using locally installed agents that can be accessed by a distant service provider.

Predictive maintenance
Predictive maintenance techniques can help determine the condition of in-service equipment in order to predict when maintenance should be performed.

Augmented reality for MRO (Maintenance, repair, and operations)
Augmented reality is a live indirect view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video or graphics on top of the real world.

Human-robot collaboration
A collaborative robot, or cobot, is a robot intended to physically interact with humans in a shared workspace.

Remote monitoring and control - labour
Remote monitoring is the process of supervising and controlling systems using locally installed agents that can be accessed by a distant service provider.

Automation of knowledge work
Advances in artificial intelligence, machine learning and natural user interfaces (voice, video, text etc.) are making it possible to automate many current knowledge worker tasks.

Digital performance management
Digital performance management includes activities which ensure that pre-set goals are consistently being met in an effective and efficient manner.

Batch size 1
It is the ability of doing mass customisation to a batch size of 1.

Real-time SC optimization
Availability of real-time data, including the entire supply chain, allows for optimisation of asset utilization along the entire production process.

In situ 3D printing
In situ 3D printing is the ability to produce components in a distributed manner – on site.

Digital quality management
Digital quality management ensures that a process, a product or service are consistent. It typically has four components: quality planning, quality assurance, quality control and quality improvement.

Statistical process control (SPC)
Statistical process control is a quality control method. It uses massive amounts of data and statistical models to monitor and control the different processes.

Advanced process control (APC)
Advanced process control is an add-on to more basic control mechanics and can involve a broad range of technologies and techniques.

Data-driven demand prediction
The ability to predict customer demands before they happen, based on solid data.

Data-driven design to value
Designing products not only for functionality but also for value, based on real data.

Rapid experimentation and simulation
Rapid experimentation refers to a set of techniques used to quickly fabricate a scale model of a physical part or assembly using three-dimensional computer aided design modelling or additive manufacturing.

Customer co-creation/ open innovation
Creating products in processes where the customer is fully integrated.

Concurrent engineering
Concurrent engineering is an engineering methodology emphasizing the parallelisation of tasks.

Moreover, there is a set of evolving technologies that are currently widely recalled as the key ones to be adopted by Industries to implement their digital transformation and generally are defined as the industry 4.0 technologies.

Big data and analytics
The extraction of new information from massive amounts of data using machine learning software algorithms.

Autonomous robots
Autonomous robots and machines that are able to make their own decisions on how to operate in a particular situation.

Simulation
Accurate predictions of how elements behave.

Horizontal and vertical system integration
The accumulated effect of the convergence of the new digital technologies accelerating the impact of the digital transformation.

The industrial internet of things
The network communication technology providing the necessary connectivity to have access to all relevant data is referred to as the Industrial **Internet of Things.**

Cybersecurity
Cyber threats can hit any part of the manufacturing chain as well as the actual smart products itself.

The cloud
Cloud computing is a shared pool of configurable computer system resources and higher-level services that can be rapidly provisioned with minimal effort.

Additive manufacturing
Additive manufacturing is any of various processes in which material is joined or solidified under computer control to create a three-dimensional object.

Augmented reality
A live indirect view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video or graphics on top of the real world.

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, or injuries such as a loss of fingers or even death.

The Table 5 shortly describes the different kinds of hazards that workers of wood furniture production companies can face. It is the product of our OHS external expert, based on different sources of information. We highlighted in RED, the new hazards due to the sector digitization in 2025.

Table 5.- Common and new risks and hazards in the wood furniture industry

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. Unprotected moving parts: Risk of entanglement of body parts into rotating parts or machinery. Flying objects: Risk of eye injury from flying particles (wood chips, broken tools, metal parts).
▪ 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	
▪ Heavy loads/heavy dynamic work	Risk of pain from heavy loads and heavy dynamic work.
▪ Awkward position/unbalanced strain	Risk of pain or injury from working in awkward positions.
▪ 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	
▪ Noise	Exposure to loud noise from machinery and tools.
▪ Vibration	Risk of hand-arm vibration from vibrating tools or workpieces.
▪ Laser light	Exposure to laser light from laser cutting machines.
Fire and explosion hazards	
▪ Flammable substances	Explosion: Explosion risks from materials, including wood dust and chemicals. Fire: Risk of fire from chemicals and wood dust.
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.

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Hazards through dangerous substances	
▪ Dust	Cancer risk from wood dust. Risk of allergic respiratory symptoms from wood dust.
▪ Solvents (neurotoxic, allergens)	Risks from chemicals, solvents and other materials - dermatitis, allergic reactions or respiratory problems, organ damage.
▪ Carcinogens	Cancer risks from chemicals (adhesives and coating agents are used in finishing wood products, such as solvents in paints, glues, varnishes and lacquers, and paint stripping chemicals.)
▪ Chemical burns	Risk of burns and other skin effects from chemicals
▪ New materials (e.g. Nanomaterials)	Risk of exposure to nanomaterials: there are large gaps in the knowledge about health hazards associated to nanomaterials.
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 lead 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.
▪ 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 at stress.
▪ Repetitive, monotonous work	
▪ Cognitive strain	Cognitive interactions with autonomous equipment and virtual reality put workers at stress.
▪ 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.
▪ 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.
▪ Lack of involvement in making decisions that affect the worker	Workers that do not see themselves respected and appreciated, they feel themselves 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 at stress.
▪ Working alone/isolation	Working alone without colleagues or only with robots put workers at stress and isolation.
▪ Unbalanced workload: overload/underload	Unbalanced workload put workers at stress.

A short description of skills, knowledge and competences

The definitions of the following concepts are the same in ESCO and in the European Qualifications Framework (EQF).

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

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Occupational profiles: current and forecasted changes in 2025

This report section includes the details of the changes forecasted within the **wood furniture sector** due to its digitization in 2025: the **updated tasks** of the targeted occupational profiles, the **existing and new OHS risks** and the u**pdated skills, knowledge and competencies needs**. They are presented through specific tables focusing on each of these aspects.

Tasks changes

Current and forecasted tasks changes due to sector digitization for each occupational profile.
In these blue tables, the first column on the left includes a detailed description for each profile of the current/updated tasks (in 2018). The columns and cells in the middle identify which tasks are affected by the different McKinsey Levers and industry 4.0 technologies. The following column forecast the temporal horizon of this impact. The following 4 columns forecast which is the probability of those changes to happen in each of the four classified groups of companies. The last column on the right presents the forecast of the updated tasks in 2025, identifying in red all the changes.

Hazards and risks changes

Current and forecasted risks changes due to sector digitization 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 black the ones that should not change, in red the new ones and in yellow the ones reduced thanks to the new technologies. Following this table, another section contains the **details of current and forecasted hazards and risks**.

Skills and competences needs

Forecast of training new needs due to sector digitization for each occupational profile.

In these green tables, on the left column you will find the list of current and new skills, knowledge and competences needs. The second column will tell you for each profile if they will be updated (YES, changed), still needed (YES or NO) or new ones (NEW). 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.

In all the following tables, we used the red colour text to identify any change to the current situation.

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Sales and marketing managers

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.

Sales and marketing managers

ISCO 1221

2018 ⏭

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 profile tasks	McKinsey Levers: Resource process – Smart energy consumption	Resource process – Real-time yield optimization	Resource process – Intelligent IoTs	Asset utilization – Routing flexibility	Asset utilization – Machine flexibility	Asset utilization – Remote monitoring and control	Asset utilization – Predictive maintenance	Asset utilization – Augmented reality for MRO	Labor – Human-robot collaboration	Labor – Remote monitoring and control	Labor – Automation of knowledge work	Labor – Digital performance management	Inventories – Batch size 1	Inventories – Real-time SC optimization	Inventories – In situ 3D printing	Quality – Digital quality management	Quality – Statistical process control (SPC)	Quality – Advanced process control (APC)	Supply/ demand match – Data-driven demand prediction	Supply/ demand match – Data-driven design to value	Time to market – Rapid experimentation and simulation	Time to market – Customer co-creation/ open innovation	Time to market – Concurrent engineering	Industry 4.0 technologies – Big data and analytics	Industry 4.0 technologies – Autonomous robots	Industry 4.0 technologies – Simulation	Industry 4.0 technologies – Horizontal and vertical system integration	Industry 4.0 technologies – The industrial internet of things	Industry 4.0 technologies – Cybersecurity	Industry 4.0 technologies – The cloud	Industry 4.0 technologies – Additive manufacturing	Industry 4.0 technologies – Augmented reality	Forecast temporal horizon for change
A	Planning and organizing special sales and marketing programmes based on sales records and market assessments.			▪									▪				▪			▪	▪		▪		▪			▪	▪		▪			before 2025
B	Determining price lists, discount and delivery terms, sales promotion budgets, sales methods, special incentives and campaigns.			▪									▪				▪			▪	▪		▪		▪			▪	▪		▪			before 2025
C	Establishing and directing operational and administrative procedures related to sales and marketing activities.												▪				▪			▪	▪		▪		▪			▪	▪		▪			before 2025
D	Leading and managing the activities of sales and marketing staff.												▪				▪			▪					▪			▪	▪					before 2025
E	Planning and directing daily (sales and marketing) operations.																▪		▪	▪	▪		▪		▪			▪	▪		▪		▪	before 2025
F	Establishing and managing budgets and controlling expenditure to ensure the efficient use of resources.	▪		▪			▪	▪	▪		▪		▪				▪		▪						▪			▪	▪	▪	▪			before 2025
G	Overseeing the selection, training and performance of staff.								▪				▪				▪		▪						▪			▪	▪		▪		▪	before 2025
H	Representing the enterprise or organization at sales and marketing conventions, trade exhibitions and other forums.												▪							▪	▪		▪	▪	▪			▪	▪		▪		▪	before 2025

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Tasks changes

Current and forecasted tasks changes due to sector digitization for the occupational profile Sales and marketing managers - ISCO 1221

2025

Occupational profile

Description forecast of the occupational profile in 2025

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

	Probability of technologies adoption in the following groups of companies				
	A1	A2	B1	B2	
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)	**Profile tasks forecast**
	High	High	High	Medium	A Planning and organizing special sales and marketing programmes based on connected customers ecosystem, sales records and global digitized market assessments.
	High	High	Medium	Light	B Determining price lists, discount and delivery terms, sales promotion budgets, sales methods, special incentives and campaigns using digitized inputs from customer ecosystems and a globally connected distribution and marketing network.
	High	High	Medium	Light	C Establishing and directing digitized operational and administrative procedures related to sales and marketing activities.
	High	High	High	Medium	D Leading and managing the activities of sales and marketing staff in highly digitized organizations.
	High	High	High	Medium	E Planning and directing daily (sales and marketing) operations within a highly digitized entreprise-customer ecosystem.
	High	High	Medium	Light	F Establishing and managing budgets and controlling expenditure to ensure the efficient use of resources in a fully connected and digitized system.
	High	High	High	High	G Overseeing the selection, training and performance of staff exploting tools and instruments of an highly connected and digitized company.
	High	High	High	High	H Representing the enterprise or organization at sales and marketing conventions, trade exhibitions, in online platforms and other face-to-face or virtual forums.

Sales and marketing managers

ISCO 1221

2018 ⏭

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 profile 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)	**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 ■ New ones ■ Reduced

[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 digitization for the occupational profile Sales and marketing managers - ISCO 1221

2025

Occupational profile

Description forecast of the occupational profile in 2025
Sales and marketing managers plan, direct and coordinate the sales and marketing activities of highly digitized enterprises or organizations, or of enterprises that provide sales and marketing services to other digitized enterprises and organizations.
Use digitization tools 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 hazards forecast
A		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Planning and organizing special sales and marketing programmes based on connected customers ecosystem, sales records and glob al digitized market assessments.
B		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Determining price lists, discount and delivery terms, sales promotion budgets, sales methods, special incentives and campaigns using digitized inputs from customer ecosystems and a globally connected distribution and marketing network.
C		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Establishing and directing digitized operational and administrative procedures related to sales and marketing activities.
D		▪	▪	▪		▪	▪	▪	▪		▪		▪	Leading and managing the activities of sales and marketing staff in highly digitized organizations.
E		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Planning and directing daily (sales and marketing) operations within a highly digitized entreprise-customer ecosystem.
F		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Establishing and managing budgets and controlling expenditure to ensure the efficient use of resources in a fully connected and digitized system.
G		▪	▪	▪		▪	▪	▪	▪		▪		▪	Overseeing the selection, training and performance of staff exploting tools and instruments of an highly connected and digitized company.
H		▪	▪	▪		▪	▪	▪	▪		▪		▪	Representing the enterprise or organization at sales and marketing conventions, trade exhibitions, in online platforms and other face-to-face or virtual forums.

Comments on hazards and risks forecast

2018 Current situation	2025 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.
Mechanical hazards ▪ Slips and trips, obstacles, table edges, moving vehicles, machines. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	**Mechanical hazards** ▪ 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** ▪ Ergonomic hazards: from poor ergonomic conditions and inactivity. Digitization 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** ▪ 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. **Effect:** eyestrain, headache, colds, cardiovascular problems.	**Work environmental hazards** ▪ Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effect:** 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. ▪ Social relationship: difficult clients, difficult colleagues. ▪ 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.	**Psychosocial hazards** ▪ Organisation of work/content of work: tight deadlines, performance pressure, high responsibility, overload, lack of training and information, increased demand on flexibility. ▪ Social relationship: difficult clients, difficult colleagues, lack of social contacts. ▪ 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. **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 digitization for the occupational profile Sales and marketing managers - ESCO 1221

		Will it continue to be needed?	Main reasons of change			
			Use digitization tools to work in a customer-oriented manner	Using digitized input from customer ecosystems and a globally connected distribution and markeling network	Working within a highly digitized entreprise-customer ecosystem	Working in a fully connected and digtized 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				
	Project management	YES				
	Risk management	YES, changed		▪		▪
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪	▪		▪
	Collaboration Across Networks and Leading by Influence	NEW	▪	▪	▪	
	Agility and Adaptability	NEW	▪	▪	▪	▪
	Initiative and Entrepreneurship	NEW		▪		
	Effective Oral and Written Communication	NEW	▪	▪		
	Assessing and Analyzing Information	NEW	▪	▪	▪	▪
	Curiosity and Imagination	NEW			▪	
	Digital literacy	NEW	▪	▪	▪	▪
	Data security	NEW	▪	▪	▪	▪

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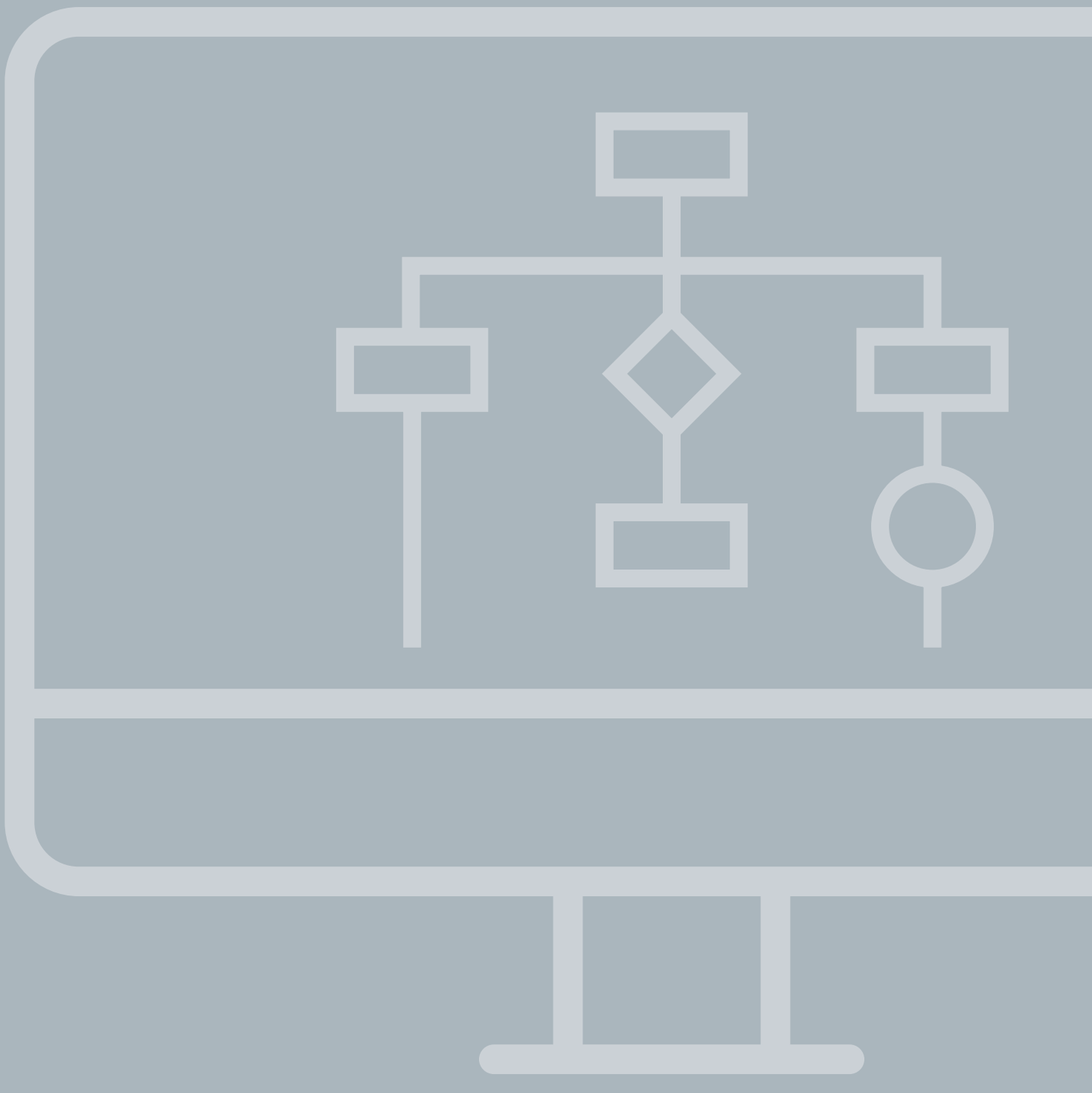
Industrial production manager

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.



Industrial Production manager

ISCO 1321s

2018 ⏭

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 profile tasks		McKinsey Levers																			Industry 4.0 technologies									Forecast temporal horizon for change
		Resource process			Asset utilization					Labor				Inventories			Quality			Supply/ demand match		Time to market										
		Smart energy consumption	Real-time yield optimization	Intelligent IoTs	Routing flexibility	Machine flexibility	Remote monitoring and control	Predictive maintenance	Augmented reality for MRO	Human-robot collaboration	Remote monitoring and control	Automation of knowledge work	Digital performance management	Batch size 1	Real-time SC optimization	In situ 3D printing	Digital quality management	Statistical process control (SPC)	Advanced process control (APC)	Data-driven demand prediction	Data-driven design to value	Rapid experimentation and simulation	Customer co-creation/ open innovation	Concurrent engineering	Big data and analytics	Autonomous robots	Simulation	Horizontal and vertical system integration	The industrial internet of things	Cybersecurity	The cloud	Additive manufacturing	Augmented reality	
A	Determining, implementing and monitoring production strategies, policies and plans.	▪		▪	▪	▪	▪	▪	▪		▪	▪	▪	▪	▪		▪	▪	▪	▪			▪	▪	▪		▪	▪	▪	▪	▪		▪	before 2025
B	Planning details of production activities in terms of output quality and quantity, cost, time available and labour requirements.				▪	▪	▪	▪	▪		▪	▪	▪				▪	▪	▪	▪	▪		▪		▪			▪	▪		▪		▪	before 2025
C	Controlling the operation of production plant and quality procedures through planning of maintenance, designation of operating hours and supply of parts and tools.	▪	▪		▪	▪	▪	▪	▪		▪	▪	▪				▪	▪	▪	▪	▪		▪		▪			▪	▪		▪			before 2025
D	Establishing and managing budgets, monitoring production output and costs, and adjusting processes and resources to minimize costs;processes and resources to minimize costs.	▪	▪		▪	▪	▪	▪	▪		▪	▪	▪				▪	▪	▪	▪	▪		▪		▪			▪	▪		▪			before 2025
E	Consulting with and informing other managers about production matters.		▪	▪	▪			▪			▪		▪		▪		▪	▪	▪			▪	▪		▪			▪	▪	▪	▪			before 2025
F	Overseeing the acquisition and installation of new plant and equipment.	▪	▪	▪	▪						▪		▪				▪	▪	▪						▪		▪	▪	▪	▪	▪			before 2025
G	Controlling the preparation of production records and reports.			▪													▪	▪	▪									▪	▪	▪	▪			before 2025
H	Coordinating the implementation of occupational health and safety requirements.																	▪																before 2025
I	Identifying business opportunities and determining products to be manufactured.		▪				▪	▪	▪	▪	▪	▪	▪				▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	2025
J	Researching and implementing regulatory and statutory requirements affecting manufacturing operations and the environment.									▪	▪	▪	▪				▪	▪	▪					▪				▪						before 2025
K	Overseeing the provision of quotations for the manufacture of specialized goods and establishing contracts with customers and suppliers.																▪	▪	▪					▪				▪						before 2025
L	Overseeing the selection, training and performance of staff.		▪					▪	▪	▪	▪		▪				▪							▪	▪	▪	▪	▪	▪	▪	▪		▪	before 2025

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Tasks changes

Current and forecasted tasks changes due to sector digitization for the occupational profile Industrial production manager - ISCO 1321s

2025

Occupational profile

Description forecast of the occupational profile in 2025

Industrial production managers oversee the operations and the resources needed in highly digitised industrial plants and manufacturing sites for a smooth running of the operations. Supported by data and instruments of highly digitized systems, 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. Use digitization tools to work in a customer-oriented manner.

	Probability of technologies adoption in the following groups of companies				
	A1	A2	B1	B2	
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)	**Profile tasks forecast**
	High	High	High	Medium	A Determining, implementing and monitoring production strategies, policies and plans exploiting the possibilities of a highly digitised manufacturing plant.
	High	High	High	Medium	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.
	High	High	Medium	Light	C Controlling the operation of a highly digitised production plant including handling of quality procedures through planning of maintenance, designation of operating hours and supply of parts and tools.
	High	High	Medium	Light	D Establishing and managing budgets, monitoring production output and costs, and adjusting processes and resources to minimize costs in a highly connected digital manufacturing chain.
	High	High	High	Medium	E Securing distribution of information of all production matters to other managers as part of digital performance management as well as consultations with other managers in general.
	High	High	High	Medium	F Overseeing the acquisition and installation of highly digitised new plants and equipment.
	High	High	Medium	Light	G Securing the preparation of fully integrated and digitised production records and reports.
	High	High	High	High	H Coordinating the implementation of occupational health and safety requirements as part of the highly integrated digital enterprise ecosystem.
	High	Medium	Medium	Light	I Identifying business opportunities and determining smart (digital) products to be manufactured in an extremely digitised manufacturing ecosystem.
	High	High	High	High	J Researching and implementing regulatory and statutory requirements affecting highly digitised manufacturing operations, the environment and the general company ecosystem.
	High	High	High	High	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.
	High	High	High	High	L Overseeing the selection, training and performance of staff exploiting tools and instruments of an highly connected and digitized company.

Industrial Production manager

ISCO 1321s

2018 ⏩

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 profile 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)	**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;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 ■ New ones ■ Reduced

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Hazards and risks changes

Current and forecasted risks changes due to sector digitization for the occupational profile Industrial production manager - ISCO 1321s

2025

Occupational profile

Description forecast of the occupational profile in 2025

Industrial production managers oversee the operations and the resources needed in highly digitised industrial plants and manufacturing sites for a smooth running of the operations. Supported by data and instruments of highly digitized systems, 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. Use digitization tools 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 hazards forecast
A		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Determining, implementing and monitoring production strategies, policies and plans exploiting the possibilities of a highly digitised manufacturing plant.
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.
C		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Controlling the operation of a highly digitised production plant including handling of 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 in a highly connected digital manufacturing chain.
E		▪	▪	▪		▪	▪	▪	▪		▪		▪	Securing distribution of information of all production matters to other managers as part of digital performance management as well as consultations with other managers in general.
F		▪	▪	▪		▪	▪	▪	▪		▪		▪	Overseeing the acquisition and installation of highly digitised new plants and equipment.
G		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Securing the preparation of fully integrated and digitised production records and reports.
H		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Coordinating the implementation of occupational health and safety requirements as part of the highly integrated digital enterprise ecosystem.
I		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Identifying business opportunities and determining smart (digital) products to be manufactured in an extremely digitised manufacturing ecosystem.
J		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Researching and implementing regulatory and statutory requirements affecting highly digitised manufacturing operations, the environment and the general company ecosystem.
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.
L		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Overseeing the selection, training and performance of staff exploiting tools and instruments of an highly connected and digitized company.

Comments on hazards and risks forecast

2018 Current situation	2025 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.
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. Digitization 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. **Effect:** eyestrain, headache, colds, cardiovascular problems.	▪ Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effect:** 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. ▪ Social relationship: difficult clients, difficult colleagues. ▪ 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.	▪ Organisation of work/content of work: tight deadlines, performance pressure, high responsibility, overload, lack of training and information, increased demand on flexibility. ▪ Social relationship: difficult clients, difficult colleagues, lack of social contacts. ▪ Working method: digital equipment, cognitive interactions between autonomous techniques and virtual reality, virtual conferences. Digital equipment, cognitive interactions with autonomous machines and virtual reality, virtual conferences. 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. **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 digitization for the occupational profile Industrial production manager - ESCO 1321s

		Will it continue to be needed?	Main reasons of change				
			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					
	Adjust production schedule	YES, changed	▪	▪	▪		
	Assess impact of industrial activities	YES, changed	▪	▪	▪		
	Check material resources	YES, changed	▪	▪	▪		
	Control financial resources	YES					
	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					
Essential knowledge	Industrial health and safety measures	YES					
	Industrial engineering	YES, changed	▪	▪	▪	▪	▪
	Manufacturing processes	YES, changed	▪	▪	▪	▪	▪
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪	▪	▪	▪	▪
	Collaboration Across Networks and Leading by Influence	NEW	▪	▪	▪		
	Agility and Adaptability	NEW	▪	▪	▪	▪	▪
	Initiative and Entrepreneurship	NEW			▪	▪	
	Effective Oral and Written Communication	NEW			▪	▪	
	Assessing and Analyzing Information	NEW	▪	▪	▪	▪	▪
	Curiosity and Imagination	NEW			▪	▪	
	Digital literacy	NEW	▪	▪	▪	▪	▪
	Data security	NEW	▪	▪	▪	▪	▪

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Supply chain manager

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.

Supply chain manager

ISCO 1324s

2018 ⏭

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.

		McKinsey Levers																				Industry 4.0 technologies									Forecast temporal horizon for change
		Resource process			Asset utilization					Labor				Inventories			Quality			Supply/ demand match		Time to market											
		Smart energy consumption	Real-time yield optimization	Intelligent IoTs	Routing flexibility	Machine flexibility	Remote monitoring and control	Predictive maintenance	Augmented reality for MRO	Human-robot collaboration	Remote monitoring and control	Automation of knowledge work	Digital performance management	Batch size 1	Real-time SC optimization	In situ 3D printing	Digital quality management	Statistical process control (SPC)	Advanced process control (APC)	Data-driven demand prediction	Data-driven design to value	Rapid experimentation and simulation	Customer co-creation/ open innovation	Concurrent engineering	Big data and analytics	Autonomous robots	Simulation	Horizontal and vertical system integration	The industrial internet of things	Cybersecurity	The cloud	Additive manufacturing	Augmented reality	
	Current profile tasks																															
A	Determining, implementing and monitoring purchasing, storage and distribution strategies, policies and plans.						▪		▪		▪		▪				▪	▪	▪						▪			▪	▪	▪	▪			before 2025
B	Preparing and implementing plans to maintain required stock levels at minimum cost.			▪			▪		▪		▪		▪				▪	▪	▪						▪			▪	▪	▪	▪			before 2025
C	Negotiating contracts with suppliers to meet quality, cost and delivery requirements.			▪									▪				▪	▪	▪									▪						before 2025
D	Monitoring and reviewing storage and inventory systems to meet supply requirements, and control stock levels.			▪									▪				▪	▪	▪									▪						before 2025
E	Overseeing the dispatch of road vehicles, trains, vessels or aircraft.			▪									▪				▪	▪	▪									▪						before 2025
F	Operating recording systems to track all movements of goods, and ensuring reordering and restocking at optimal times.			▪									▪				▪	▪	▪									▪						before 2025
G	Liaising with other departments and customers concerning requirements for outward goods and associated forwarding transportation.			▪									▪				▪	▪	▪									▪						before 2025
H	Overseeing the recording of purchase, storage and distribution transactions.												▪				▪	▪	▪									▪						before 2025
I	Establishing and managing budgets, controlling expenditure and ensuring the efficient use of resources.												▪				▪	▪	▪									▪						before 2025
J	Establishing and directing operational and administrative procedures.												▪				▪	▪	▪									▪						before 2025
K	Planning and directing daily operations.												▪				▪	▪	▪									▪						before 2025
L	Overseeing the selection, training and performance of staff.								▪																▪							▪		before 2025

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Tasks changes

Current and forecasted tasks changes due to sector digitization for the occupational profile Supply Chain manager - ISCO 1324s

2025

Occupational profile

Description forecast of the occupational profile in 2025

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 with the support of updated and continuous data collected in an highly connected and digitized company system. 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. Use digitization tools to work in a customer-oriented manner.

	Probability of technologies adoption in the following groups of companies				Profile tasks forecast	
	A1	A2	B1	B2		
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)		
	High	High	High	Medium	A	Determining, implementing and monitoring purchasing, storage and distribution strategies, policies and plans of the digitised ecosystem.
	High	High	High	Medium	B	Preparing and implementing plans to maintain required stock levels of the highly digitised enterprise ecosystem at minimum cost.
	High	High	Medium	Medium	C	Negotiating contracts with suppliers to meet quality, cost and delivery requirements of the highly digitised enterprise ecosystem.
	High	High	Medium	Medium	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.
	High	High	Medium	Medium	E	Overseeing the dispatch of road vehicles, trains, vessels or aircraft through digitised updated and continuous data collected in an highly connected and digitized enterprise ecosystem.
	High	High	Medium	Medium	F	Operating recording systems to track all movements of goods, and ensuring reordering and restocking at optimal times of the highly digitised enterprise ecosystem.
	High	High	High	Medium	G	Liaising with other departments and customers concerning requirements for outward goods and associated forwarding transportation using the highly digitised ecosystem inside and outside the company.
	High	High	Medium	Medium	H	Overseeing the recording of purchase, storage and distribution transactions as an integrated part of the digitised work process of the digital factury ecosystem.
	High	High	Medium	Medium	I	Establishing and managing budgets, controlling expenditure and ensuring the efficient use of resources as integrated part of the highly interconnected and digitised company ecosystem.
	High	High	Medium	Medium	J	Establishing and directing operational and administrative procedures in the highly digitised company ecosystem.
	High	High	High	High	K	Planning and directing daily operations both physically and digitally using the connected cloud.
	High	High	High	Medium	L	Overseeing the selection, training and performance of staff exploting tools and instruments of a highly connected and digitized company.

Supply Chain manager

ISCO 1324s

2018 ⏩

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 profile 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)	**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 ■ New ones ■ Reduced

[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 digitization
for the occupational profile Supply Chain manager - ISCO 1324s

2025

Occupational profile

Description forecast of the occupational profile in 2025
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 with the support of updated and continuous data collected in an highly connected and digitized company system. 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. Use digitization tools 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 hazards forecast
A		▪	▪	▪		▪	▪	▪	▪		▪		▪	Determining, implementing and monitoring purchasing, storage and distribution strategies, policies and plans of the digitised ecosystem.
B		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Preparing and implementing plans to maintain required stock levels of the highly digitised enterprise ecosystem at minimum cost.
C		▪	▪	▪		▪	▪	▪	▪		▪		▪	Negotiating contracts with suppliers to meet quality, cost and delivery requirements of the highly digitised enterprise ecosystem.
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.
E		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Overseeing the dispatch of road vehicles, trains, vessels or aircraft 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.
G		▪	▪	▪		▪	▪	▪	▪		▪		▪	Liaising with other departments and customers concerning requirements for outward goods and associated forwarding transportation 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 factury ecosystem.
I		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Establishing and managing budgets, controlling expenditure and ensuring the efficient use of resources as integrated part of the highly interconnected and digitised company ecosystem.
J		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Establishing and directing operational and administrative procedures in the highly digitised company ecosystem.
K		▪	▪	▪		▪	▪	▪	▪		▪		▪	Planning and directing daily operations both physically and digitally using the connected cloud.
L		▪	▪	▪		▪	▪	▪	▪		▪		▪	Overseeing the selection, training and performance of staff exploting tools and instruments of a highly connected and digitized company.

Comments on hazards and risks forecast

2018 Current situation	2025 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.
Mechanical hazards ▪ Slips and trips, obstacles, table edges. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	**Mechanical hazards** ▪ Slips and trips, obstacles, table edge. **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** ▪ Ergonomic hazards: from poor ergonomic conditions and inactivity. Digitization 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** ▪ 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. **Effect:** eyestrain, headache, colds, cardiovascular problems.	**Work environmental hazards** ▪ Work environmental hazards: software not appropriate, poor lighting and inappropriate indoor air quality and temperature. **Effect:** 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. ▪ Social relationship: difficult clients, difficult colleagues. ▪ 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.	**Psychosocial hazards** ▪ Organisation of work/content of work: tight deadlines, performance pressure, high responsibility, overload, lack of training and information, increased demand on flexibility. ▪ Social relationship: difficult clients, lack of social contacts. ▪ Working method: digital equipment, cognitive interactions with autonomous technologies and virtual reality, virtual conferences. Digitization 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. **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 digitization for the occupational profile Supply chain manager - ESCO 1324s

		Will it continue to be needed?	Main reasons of change				
			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	NO					
	Manage supplies	YES, changed	▪	▪		▪	▪
	Order supplies	NO					
	Strive for company growth	YES, changed	▪	▪		▪	▪
Essential knowledge	Corporate social responsibility	YES					
	Supplier management	YES, changed	▪	▪			
	Supply chain management	YES, changed				▪	▪
	Supply chain principles	YES					
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪	▪	▪	▪	▪
	Collaboration Across Networks and Leading by Influence	NEW		▪	▪	▪	▪
	Agility and Adaptability	NEW	▪	▪	▪	▪	▪
	Initiative and Entrepreneurship	NEW				▪	▪
	Effective Oral - Written Communication	NEW		▪		▪	▪
	Assessing and Analyzing Information	NEW	▪	▪	▪	▪	
	Curiosity and Imagination	NEW				▪	▪
	Digital literacy	NEW	▪	▪	▪	▪	
	Data security	NEW	▪	▪	▪	▪	▪

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Maintenance & repair engineer

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.

Maintenance & repair engineer

ISCO 2141s

2018 ⏩

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 profile tasks		McKinsey Levers																				Industry 4.0 technologies									Forecast temporal horizon for change
		Resource process			Asset utilization					Labor				Inventories			Quality			Supply/ demand match		Time to market										
		Smart energy consumption	Real-time yield optimization	Intelligent IoTs	Routing flexibility	Machine flexibility	Remote monitoring and control	Predictive maintenance	Augmented reality for MRO	Human-robot collaboration	Remote monitoring and control	Automation of knowledge work	Digital performance management	Batch size 1	Real-time SC optimization	In situ 3D printing	Digital quality management	Statistical process control (SPC)	Advanced process control (APC)	Data-driven demand prediction	Data-driven design to value	Rapid experimentation and simulation	Customer co-creation/ open innovation	Concurrent engineering	Big data and analytics	Autonomous robots	Simulation	Horizontal and vertical system integration	The industrial internet of things	Cybersecurity	The cloud	Additive manufacturing	Augmented reality	
A	Establishing standards and policies for installation, modification, quality control, testing, inspection and maintenance according to engineering principles and safety regulations.						▪	▪	▪		▪		▪				▪	▪	▪	▪							▪	▪	▪	▪		▪	before 2025
B	Inspecting plant to improve and maintain performance.						▪	▪	▪		▪		▪				▪	▪	▪	▪				▪			▪	▪	▪	▪		▪	before 2025
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)				▪		▪	▪	▪		▪		▪				▪	▪	▪					▪	▪		▪	▪	▪	▪			before 2025
D	Advising management on new production methods, techniques and equipment.			▪			▪	▪	▪		▪	▪								▪	▪	▪		▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	before 2025
E	Liaising with materials buying, storing and controlling departments to ensure a steady flow of supplies.			▪		▪	▪	▪	▪		▪		▪				▪	▪	▪					▪	▪		▪	▪	▪	▪	▪			before 2025

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2025

Occupational profile

Probability of technologies adoption in the following groups of companies				
	A1	A2	B1	B2
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)
	High	High	High	Light
	High	High	Medium	Light
	High	High	Medium	Light
	High	High	High	Light
	High	High	High	Light

Description forecast of the occupational profile in 2025

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

- 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- 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 activities.

	Profile tasks forecast
A	Establishing standards and policies for installation, modification, quality control, testing, inspection and maintenance according to engineering principles and safety regulations in a highly digitised manufacurting plant ecosystem.
B	Monitoring, inspection and digital registration of the plant to improve and maintain performance.
C	Directing the digital handling of 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, ICT...). ▪ Plans, develops, executes approved modifications to the installation(s).
D	Advising management on new smarter production methods, digital techniques and equipment.
E	Liaising with materials purchaising, storing and controlling departments to ensure a steady flow of supplies within and around the entire digital ecosystem.

Maintenance & repair engineer

ISCO 2141s

2018 ⏩

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.

⏩

New categorization of hazards

Current profile 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)	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 ■ New ones ▪ Reduced

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Hazards and risks changes

Current and forecasted risks changes due to sector digitization for the occupational profile Maintenance & repair engineer - ISCO 2141s

2025

Occupational profile

Description forecast of the occupational profile in 2025

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

- 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- 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 activities.

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 hazards forecast	
	▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	A	Establishing standards and policies for installation, modification, quality control, testing, inspection and maintenance according to engineering principles and safety regulations in a highly digitised manufacurting plant ecosystem.
	▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	B	Monitoring, inspection and digital registration of the plant to improve and maintain performance.
	▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	C	Directing the digital handling of 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, ICT...). ▪ Plans, develops, executes approved modifications to the installation(s).
	▪	▪	▪		▪	▪	▪	▪		▪		▪	D	Advising management on new smarter production methods, digital techniques and equipment.
	▪	▪	▪		▪	▪	▪	▪		▪		▪	E	Liaising with materials purchasing, storing and controlling departments to ensure a steady flow of supplies within and around the entire digital ecosystem.

Comments on hazards and risks forecast

2018 Current situation	2025 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.
Mechanical hazards ▪ Mechanical hazards from moving machines and tools. **Effects:** severe bruises, amputations, cuts and sharp injuries, crushing. ▪ Slips and trips, obstacles, table edges, moving vehicles, machines. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	**Mechanical hazards** ▪ Mechanical hazards from moving machines and tools and from moving cobots and robots. **Effects**: severe bruises, amputations, cuts and sharp injuries, crushing. Risks from mechanical hazards may decrease, depending on takeover of specific task by cobots/robots. ▪ Slips and trips, obstacles, table edge. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards ▪ Ergonomic hazards: from poor ergonomic conditions, awkward position, confined spaces, heavy physical workload. **Effects:** musculoskeletal diseases.	**Ergonomic hazards** ▪ 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 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. **Effects:** musculoskeletal diseases, overweight, cardiovascular problems.
Electrical hazards ▪ Electrical hazards: contacts with live parts or connections or exposure to arc flash. **Effect:** fatal accident.	**Electrical hazards** ▪ Electrical hazards: contacts with live parts, defective cables (Computer and other electric devices). **Effect:** fatal accident.
Hazards due to physical effects/physical agents ▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease). ▪ Electrical hazards: contacts with live parts or connections or exposure to arc flash. **Effect:** fatal accident.	**Hazards due to physical effects/physical agents** ▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease). ▪ Electrical hazards: contacts with live parts or connections or exposure to arc flash. **Effect:** fatal accident. Exposure to noise and vibration risks may decrease, depending on takeover of specific task by cobots/robots.

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Hazards and risks changes

Current and forecasted risks changes due to sector digitization for the occupational profile Maintenance & repair engineer - ISCO 2141s

2018 Current situation	2025 Situation forecast
Fire and explosion hazards	
▪ Explosion and fire hazards from materials, including wood dust, solvents and chemicals. **Effects:** burns, fatal accidents.	▪ Explosion and fire hazards from materials, including wood dust, solvents and chemicals. **Effects:** burns, fatal accidents. Risks from explosion and fire may decrease, depending on takeover of specific task by cobots/robots.
Work environmental hazards	
▪ Work environmental hazards: excessive heat and cold, poor lighting. **Effects:** cardiovascular diseases, negative effects on muscles, tendons and joints, cold, eye strain, poor concentration.	▪ Work environmental hazards: excessive heat and cold, poor lighting. **Effects:** cardiovascular diseases, negative effects on muscles, tendons and joints, cold, eye strain, poor concentration.
Hazards through dangerous substances	
▪ Chemical hazards/dust: asbestos, glass fibre, vapours, fumes, dust, solvents. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, cancer. 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. ▪ Biological hazards: bacteria, mould and fungi (e.g. lubricants may contain biological hazards). **Effects:** contamination/intoxication, skin diseases, respiratory diseases, infections.	▪ Chemical hazards/dust: asbestos, glass fibre, vapours, fumes, dust, solvents. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, cancer. 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. Risks may decrease with use of cobots/robots. ▪ 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. ▪ Biological hazards: bacteria, mould and fungi (e.g. lubricants may contain biological hazards). **Effects:** contamination/intoxication, skin diseases, respiratory diseases, infections. Risks may decrease with use of cobots/robots.
Psychosocial hazards	
▪ Organisation of work: time pressure, shift work, stress, often related to poor work organisation and lack of training. ▪ Social relationship: difficult discussion with the management, difficult partners, lack of information. ▪ Working method: teamwork, working outside of "core working hours". **Effects:** stress, burnout.	▪ 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. ▪ Social relationship: difficult discussion with the management, difficult partners, lack of information, lack of social contacts. ▪ 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. **Effects:** stress, burnout.

Skills and competences needs

Forecast of training new needs due to sector digitization for the occupational profile Maintenance and repair engineer - ESCO 2141s

		Will it continue to be needed?	Main reasons of change				
			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	NO					
	Create solutions to problems	YES, changed		▪			▪
	Inspect industrial equipment	NO					
	Inspect machinery	NO					
	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	▪	▪	▪	▪	
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪	▪			▪
	Collaboration Across Networks and Leading by Influence	NEW		▪			▪
	Agility and Adaptability	NEW	▪	▪			▪
	Initiative and Entrepreneurship	NEW					▪
	Effective Oral and Written Communication	NEW			▪	▪	▪
	Assessing and Analyzing Information	NEW	▪	▪	▪	▪	▪
	Curiosity and Imagination	NEW					▪
	Digital literacy	NEW	▪	▪	▪	▪	▪
	Data security	NEW	▪	▪	▪		▪

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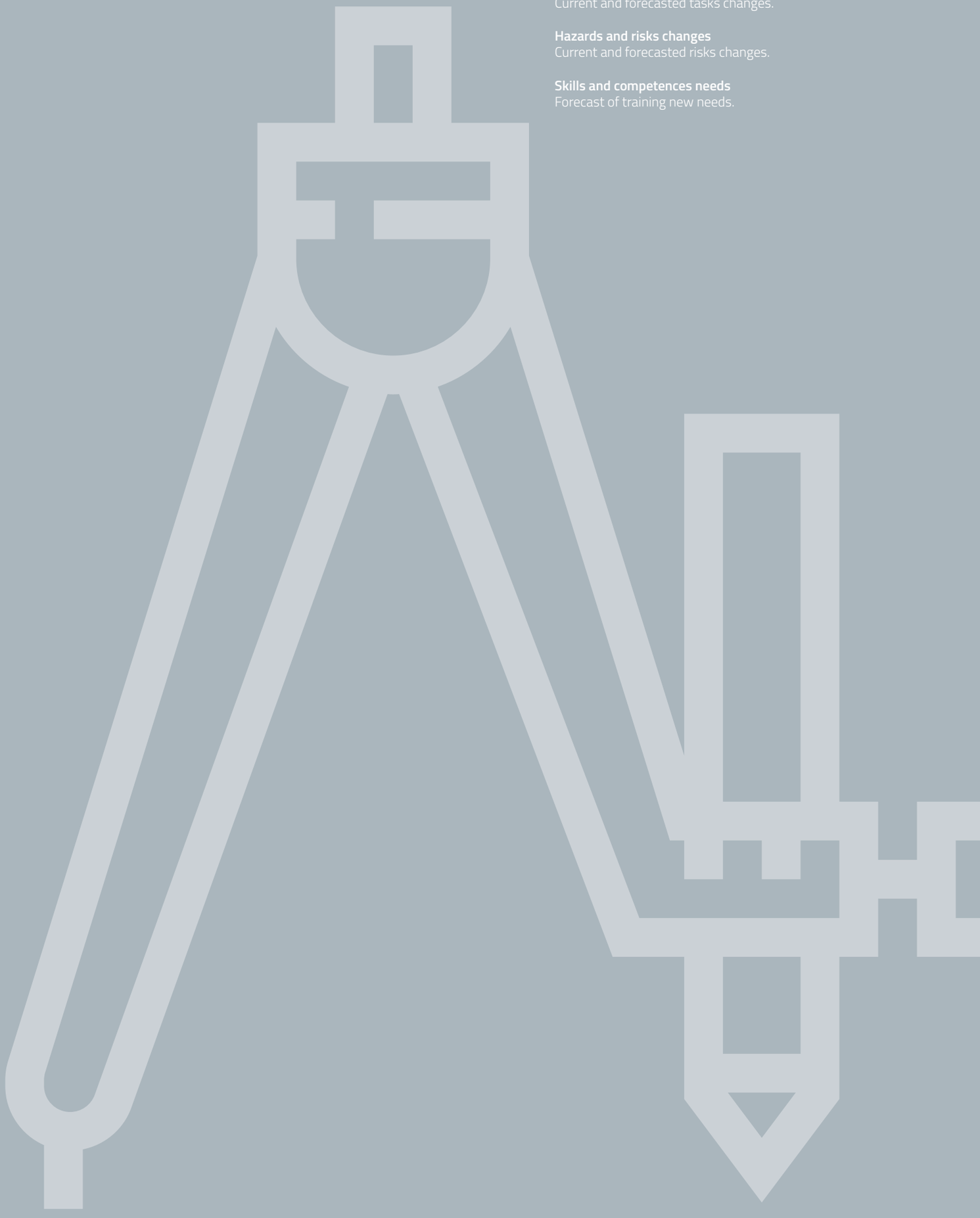
Furniture designers

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.



Furniture designers

ISCO 2163s

2018 ⏩

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 profile tasks		McKinsey Levers: Resource process			Asset utilization					Labor				Inventories			Quality			Supply/ demand match		Time to market			Industry 4.0 technologies											Forecast temporal horizon for change
		Smart energy consumption	Real-time yield optimization	Intelligent IoTs	Routing flexibility	Machine flexibility	Remote monitoring and control	Predictive maintenance	Augmented reality for MRO	Human-robot collaboration	Remote monitoring and control	Automation of knowledge work	Digital performance management	Batch size 1	Real-time SC optimization	In situ 3D printing	Digital quality management	Statistical process control (SPC)	Advanced process control (APC)	Data-driven demand prediction	Data-driven design to value	Rapid e•perimentation and simulation	Customer co-creation/ open innovation	Concurrent engineering	Big data and analytics	Autonomous robots	Simulation	Horizontal and vertical system integration	The industrial internet of things	Cybersecurity	The cloud	Additive manufacturing	Augmented reality	
A	Determining the objectives and constraints of the design brief by consulting with clients and stakeholders.								▪					▪							▪	▪	▪			▪					▪	▪	before 2025
B	Formulating design concepts for industrial, commercial and consumer products.							▪					▪									▪	▪			▪					▪	▪	before 2025
C	Harmonizing aesthetic considerations with technical, functional, ecological and production requirements.												▪									▪	▪			▪						▪	before 2025
D	Preparing sketches, diagrams, illustrations, plans, samples and models to communicate design concepts.							▪					▪									▪	▪			▪					▪	▪	before 2025
E	Negotiating design solutions with clients, management, and sales and manufacturing staff.							▪					▪									▪	▪			▪						▪	before 2025
F	Selecting, specifying and recommending functional and aesthetic materials, production methods and finishes for manufacture.							▪					▪							▪	▪	▪	▪			▪					▪	▪	before 2025
G	Detailing and documenting the selected design for production.							▪												▪	▪	▪	▪			▪					▪	▪	before 2025
H	Preparing and commissioning prototypes and samples.							▪					▪							▪	▪	▪	▪			▪					▪	▪	before 2025
I	Supervising the preparation of patterns, programmes and tooling, and of the manufacturing process.							▪					▪							▪	▪	▪	▪			▪					▪	▪	2025

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Tasks changes

Current and forecasted tasks changes due to sector digitization
for the occupational profile furniture designers - ISCO 2163s

2025

Occupational profile

Description forecast of the occupational profile in 2025

Furniture designers work on items of future furniture and related products exploiting the newest 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 requirements and aesthetic appeal.

- Use digitization tools to work 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, ICT and technical services).
- Assists in the implementation of quality assurance activities.

	Probability of technologies adoption in the following groups of companies				
	A1	A2	B1	B2	
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)	**Profile tasks forecast**
	High	Medium	Light	Light	A Determining the objectives and constraints of the design using real life computational simulation models and by consulting with clients and stakeholders.
	High	Medium	Light	Light	B Formulating design concepts, using rapid experimentation and digital models, for industrial, commercial and consumer products.
	High	High	Medium	Light	C Use virtual models to help harmonizing aesthetic considerations with technical, functional, ecological and production requirements.
	High	High	Medium	Light	D Make digital (virtual) models and physical samples and models through rapid prototyping to communicate design concepts.
	High	High	Medium	Medium	E Negotiating digital design solutions with clients, management, and sales and manufacturing staff.
	High	High	Medium	Medium	F Selecting, specifying and recommending functional and aesthetic materials, production methods and finishes for manufacturing using the highly digitised set of tools.
	High	High	Medium	Medium	G Detailing and documenting the selected digital design for production.
	High	High	Medium	Light	H Preparing and commissioning physical and digital prototypes, models and samples.
	High	High	Medium	Light	I Supervising the preparation of patterns, programmes and tooling, and of the digital manufacturing process.

Furniture designers

ISCO 2163s

2018 ⏭
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 profile 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)	**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 ■ New ones ■ Reduced

[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 digitization for the occupational profile furniture designers - ISCO 2163s

2025

Occupational profile

Description forecast of the occupational profile in 2025

Furniture designers work on items of future furniture and related products exploiting the newest 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 requirements and aesthetic appeal.

- Use digitization tools to work 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, ICT and technical services).
- Assists in the implementation of quality assurance activities.

Profile hazards forecast		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
A	Determining the objectives and constraints of the design using real life computational simulation models and by consulting with clients and stakeholders.		■	■	■		■	■	■	■		■		■
B	Formulating design concepts, using rapid experimentation and digital models, for industrial, commercial and consumer products.		■	■	■		■	■	■	■		■	■	■
C	Use virtual models to help harmonizing aesthetic considerations with technical, functional, ecological and production requirements.		■	■	■		■	■	■	■		■	■	■
D	Make digital (virtual) models and physical samples and models through rapid prototyping to communicate design concepts.		■	■	■		■	■	■	■		■		■
E	Negotiating digital design solutions with clients, management, and sales and manufacturing staff.		■	■	■		■	■	■	■		■		■
F	Selecting, specifying and recommending functional and aesthetic materials, production methods and finishes for manufacturing using the highly digitised set of tools.		■	■	■		■	■	■	■		■		■
G	Detailing and documenting the selected digital design for production.		■	■	■		■	■	■	■		■	■	■
H	Preparing and commissioning physical and digital prototypes, models and samples.		■	■	■		■	■	■	■		■		■
I	Supervising the preparation of patterns, programmes and tooling, and of the digital manufacturing process.		■	■	■		■	■	■	■		■		■

Comments on hazards and risks forecast

2018 Current situation	2025 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 digitisation tools.
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** ▪ 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** ▪ Ergonomic hazards: from poor ergonomic conditions and inactivity, prolonged sitting and from poor ergonomic practices with mobile devices. Digitization 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 digitisation. **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** ▪ 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** ▪ 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 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.	**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; digitization 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. Workers are also at risk of being permanent available outside working hours. 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 require 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 digitization for the occupational profile furniture designers - ESCO 2163s

		Will it continue to be needed?	Main reasons of change				
			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					
	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					
	Ergonomics	YES					
	Industrial design	YES, changed	▪		▪	▪	▪
	Manufacturing processes	YES, changed			▪	▪	
	Mathematics	NO					
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪	▪		▪	
	Collaboration Across Networks and Leading by Influence	NEW	▪	▪	▪	▪	▪
	Agility and Adaptability	NEW	▪	▪	▪	▪	▪
	Initiative and Entrepreneurship	NEW	▪		▪	▪	▪
	Effective Oral - Written Communication	NEW			▪		▪
	Assessing and Analyzing Information	NEW	▪	▪	▪	▪	▪
	Curiosity and Imagination	NEW			▪	▪	▪
	Digital literacy	NEW	▪	▪	▪	▪	▪
	Data security	NEW	▪	▪	▪	▪	▪

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Cabinet-makers and related workers

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.

Cabinet-makers and related workers

ISCO 7522

2018 ⏭

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 profile tasks	McKinsey Levers																					Industry 4.0 technologies									Forecast temporal horizon for change
		Resource process			Asset utilization				Labor				Inventories			Quality			Supply/ demand match		Time to market											
		Smart energy consumption	Real-time yield optimization	Intelligent IoTs	Routing flexibility	Machine flexibility	Remote monitoring and control	Predictive maintenance	Augmented reality for MRO	Human-robot collaboration	Remote monitoring and control	Automation of knowledge work	Digital performance management	Batch size 1	Real-time SC optimization	In situ 3D printing	Digital quality management	Statistical process control (SPC)	Advanced process control (APC)	Data-driven demand prediction	Data-driven design to value	Rapid experimentation and simulation	Customer co-creation/ open innovation	Concurrent engineering	Big data and analytics	Autonomous robots	Simulation	Horizontal and vertical system integration	The industrial internet of things	Cybersecurity	The cloud	Additive manufacturing	Augmented reality	
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.		▪	▪		▪	▪	▪	▪	▪	▪	▪	▪			▪	▪	▪	▪	▪				▪	▪	▪	▪		▪		▪			before 2025
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.			▪									▪				▪		▪	▪		▪		▪	▪		▪	▪	▪		▪		▪	before 2025
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.	▪	▪	▪		▪	▪	▪		▪		▪	▪				▪	▪		▪	▪		▪		▪	▪			▪		▪	▪			before 2025
D	Making, restyling and repairing various wooden articles such as cabinets, furniture, vehicles, scale models, sports equipment and other parts or products.		▪	▪		▪	▪	▪	▪	▪	▪	▪	▪			▪		▪	▪	▪		▪			▪	▪	▪		▪		▪		▪		2025
E	Decorating furniture and fixtures by inlaying wood or applying veneer and carving designs.				▪		▪	▪	▪		▪	▪				▪			▪		▪	▪	▪		▪	▪	▪	▪	▪		▪		▪		2025
F	Finishing surfaces of wooden articles or furniture.	▪	▪	▪			▪		▪	▪	▪	▪	▪				▪		▪	▪					▪	▪		▪	▪		▪				before 2025

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2025

Occupational profile

Description forecast of the occupational profile in 2025

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 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.
- Use digitization tools to work 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, ICT and technical services).
- Assists in the implementation of quality assurance activities.

	Probability of technologies adoption in the following groups of companies				
	A1	A2	B1	B2	
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)	**Profile tasks forecast**
	High	Medium	Medium	Light	A Operating connected, digitized 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 and highly automated woodworking machines.
	High	High	High	Medium	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 specifications.
	High	Medium	Medium	Light	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.
	High	Medium	Medium	Light	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.
	High	Medium	Medium	Light	E Create 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 machines such as laser-cutting cobots and other human-robot collaboration.
	High	High	Medium	Light	F Finishing surfaces of wooden articles or furniture through highly automated, even autonomous machines, cobots and robots, that can be remotely operated (with the help of Augmented Reality) using big data.

Cabinet-makers and related workers

ISCO 7522

2018 ⏭

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.

New categorization of hazards

Current profile 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)	**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.			▪	■		■			▪	▪	▪					▪	▪	■		▪		■	■	■		▪	▪	▪	■		■

■ No changes ■ New ones ▪ Reduced

[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 digitization for the occupational profile Cabinet-makers and related workers - ISCO 7522

2025

Occupational profile

Description forecast of the occupational profile in 2025

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 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.
- Use digitization tools to work 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, ICT and technical services).
- Assists in the implementation of quality assurance activities.

	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 hazards forecast
A		▪	▪	▪		▪	▪	▪	▪	▪	▪	▪	▪	Operating connected, digitized 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 and highly automated woodworking machines.
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 specifications.
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.
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.
E		▪	▪	▪		▪	▪	▪	▪	▪	▪	▪	▪	Create 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 machines such as laser-cutting cobots and other human-robot collaboration.
F		▪	▪	▪		▪	▪	▪	▪	▪	▪	▪	▪	Finishing surfaces of wooden articles or furniture through highly automated, even autonomous machines, cobots and robots, that can be remotely operated (with the help of Augmented Reality) using big data.

Comments on hazards and risks forecast

2018 Current situation	2025 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.
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). **Effects:** severe bruises, amputations, cuts and sharp injuries, crushing. ▪ Slips and trips, obstacles, table edges, moving vehicles, machines. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	▪ 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. **Effects:** severe bruises, amputations, 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: poor ergonomic conditions, heavy physical workload. **Effect:** musculoskeletal diseases.	▪ Ergonomic hazards: poor ergonomic conditions, heavy physical workload. Risks from ergonomic hazards may decrease, depending on takeover 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. **Effect:** musculoskeletal diseases.
Electrical hazards	
▪ Electrical hazards: contacts with live parts or connections or exposure to arc flash. Electrical hazards from woodworking machines. **Effect:** fatal accident.	▪ 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.
Hazards due to physical effects/physical agents	
▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease).	▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease). ▪ Exposure to noise and vibration may decrease, depending on takeover of specific tasks by cobots/robots. ▪ Laser: wood processing plant operators may be exposed to laser light. **Effect**: eye damage, negative effects similar to sunburn.

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Hazards and risks changes

Current and forecasted risks changes due to sector digitization for the occupational profile Cabinet-makers and related workers - ISCO 7522

2018 Current situation	2025 Situation forecast
Fire and explosion hazards	
▪ Explosion and fire hazards from materials, including wood dust, solvents and chemicals. **Effects:** burns, fatal accidents.	▪ Explosion and fire 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. **Effects:** burns, fatal accidents.
Work environmental hazards	
▪ Work environmental hazards: poor lighting, climate and temperature. **Effects:** cardiovascular diseases, cold, eyestrain, headache.	▪ Work environmental hazards: poor lighting, climate and temperature. **Effects:** cardiovascular diseases, cold, eyestrain, headache.
Hazards through dangerous substances	
▪ Hazards from dangerous substances: asbestos, glass fibre, vapours, fumes, dust, solvents, new materials (nanomaterials). **Effects:** contamination/intoxication, skin diseases, respiratory diseases, cancer.	▪ Hazards from 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. **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.
Psychosocial hazards	
▪ Organisation of work: time pressure, shift work, stress, often related to poor work organisation lack of training. ▪ Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues. ▪ Working method: operating woodworking machines, working with colleagues. **Effects:** stress, burnout and emotional distress, suffering from depression, cardiovascular problems, sleep disorders.	▪ 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. ▪ Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues, lack of social contacts. ▪ 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 digitization for the occupational profile Cabinet-makers and related workers - ESCO 7522

		Will it continue to be needed?	Main reasons of change				
			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 (w ith 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		▪		▪	
Essential knowledge	Construction products	YES, changed	▪		▪		▪
	Furniture trends	YES, changed	▪		▪		
	Sanding techniques	YES, changed		▪		▪	
	Technical drawings	YES, changed	▪		▪		▪
	Types of wood	YES					
	Wood products	YES					
	Woodturning	YES, changed		▪		▪	
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪	▪	▪	▪	
	Collaboration Across Networks and Leading by Influence	NEW	▪		▪	▪	▪
	Agility and Adaptability	NEW	▪	▪	▪	▪	▪
	Initiative and Entrepreneurship	NEW		▪	▪		▪
	Effective Oral - Written Communication	NEW					▪
	Assessing and Analyzing Information	NEW	▪	▪	▪	▪	▪
	Curiosity and Imagination	NEW			▪		▪
	Digital literacy	NEW	▪	▪	▪	▪	▪
	Data security	NEW	▪		▪		▪

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Woodworking machine tool setters and operators

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.

Woodworking machine tool setters and operators

ISCO 7523

2018 ⏭

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 profile tasks	McKinsey Levers																					Industry 4.0 technologies									Forecast temporal horizon for change
		Resource process			Asset utilization					Labor				Inventories			Quality			Supply/ demand match		Time to market											
		Smart energy consumption	Real-time yield optimization	Intelligent IoTs	Routing flexibility	Machine flexibility	Remote monitoring and control	Predictive maintenance	Augmented reality for MRO	Human-robot collaboration	Remote monitoring and control	Automation of knowledge work	Digital performance management	Batch size 1	Real-time SC optimization	In situ 3D printing	Digital quality management	Statistical process control (SPC)	Advanced process control (APC)	Data-driven demand prediction	Data-driven design to value	Rapid experimentation and simulation	Customer co-creation/ open innovation	Concurrent engineering	Big data and analytics	Autonomous robots	Simulation	Horizontal and vertical system integration	The industrial internet of things	Cybersecurity	The cloud	Additive manufacturing	Augmented reality	
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.			▪			▪		▪		▪	▪	▪				▪	▪	▪			▪			▪	▪		▪	▪	▪	▪			before 2025
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.	▪	▪	▪	▪	▪	▪		▪	▪	▪	▪	▪		▪	▪	▪		▪			▪		▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	2025
C	Operating preset special-purpose woodworking machines to fabricate wooden products such as coat hangers, mop handles, clothespins and other products.	▪		▪		▪	▪	▪		▪	▪	▪	▪	▪		▪	▪	▪	▪	▪					▪	▪	▪	▪	▪		▪		▪	before 2025
D	Selecting knives, saws, blades, cutter heads, cams, bits or belts according to work piece, machine functions and product specifications.		▪			▪	▪	▪	▪	▪	▪	▪			▪		▪		▪	▪				▪	▪	▪			▪		▪		▪	before 2025
E	Installing and adjusting blades, cutter heads, boring-bits and sanding-belts, and using hand tools and rules.		▪			▪		▪	▪	▪	▪	▪			▪		▪		▪	▪				▪	▪	▪	▪	▪	▪		▪			before 2025
F	Selects, controls, mounts and replaces cutting tools on the woodworking machines.		▪			▪		▪	▪	▪	▪	▪			▪		▪		▪	▪				▪	▪	▪	▪	▪	▪		▪			before 2025
G	Setting and adjusting various kinds of woodworking machines for operation by others; reading and interpreting specifications or following verbal instructions.		▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪		▪	▪	▪	▪	▪	▪	▪				▪		▪		▪		▪		▪	before 2025

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Tasks changes

Current and forecasted tasks changes due to sector digitization for the occupational profile Woodworking machine tool setters and operators - ISCO 7523

2025

Occupational profile

Description forecast of the occupational profile in 2025

Woodworking machine tool setters and operators set-up, operate and monitor semi-automatic or fully automated, even autonomous 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.
- Use digitization software tools to work 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, ICT- and technical services).
- Assists in the implementation of quality assurance activities.

	Probability of technologies adoption in the following groups of companies				
	A1	A2	B1	B2	
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)	**Profile tasks forecast**
	High	High	Medium	Medium	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 specifications.
	High	High	Medium	Light	B Setting up, programming, operating and monitoring several types of connected 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.
	High	High	Medium	Light	C Operating special-purpose automated and real-time optimized woodworking machines to fabricate wooden products such as coat hangers, mop handles, clothespins and other products.
	High	High	Medium	Medium	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.
	High	High	Medium	Light	E Installing and adjusting blades, cutter heads, boring-bits and sanding-belts using cobots and semi-autonomous robots.
	High	High	Medium	Medium	F Use cobots for the autonomous selection, control, mounting and replacing of cutting tools on the woodworking machines.
	High	High	High	Medium	G Setting and adjusting through digitized and remote controls various kinds of connected woodworking machines for operation by others; studying and interpreting specifications using simulation models and mixed/augmented reality.

Woodworking machine tool setters and operators

ISCO 7523

2018 ⏭

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.

New categorization of hazards

Current profile 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)	**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 woodworking machines to fabricate wooden products such as coat hangers, mop handles, 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, cutter heads, boring-bits and sanding-belts, and using hand tools and rules.		■	■	■		■						■		■		■	■					■	■								■		
F	Selects, controls, mounts and replaces cutting tools on the woodworking machines.		■	■	■		■						■		■		■	■					■	■								■		
G	Setting and adjusting various kinds of woodworking machines for operation by others; reading and interpreting specifications or following verbal instructions.												■										■	■								■		

■ No changes ■ New ones ■ Reduced

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

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2025

Occupational profile

Description forecast of the occupational profile in 2025

Woodworking machine tool setters and operators set-up, operate and monitor semi-automatic or fully automated, even autonomous 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.
- Use digitization software tools to work 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, ICT- and technical services).
- Assists in the implementation of quality assurance activities.

	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 hazards 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 specifications.
B		▪	▪	▪		▪	▪	▪	▪		▪		▪	Setting up, programming, operating and monitoring several types of connected 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 special-purpose automated and real-time optimized woodworking machines to fabricate wooden products such as coat hangers, mop handles, clothespins and other products.
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.
E		▪	▪	▪		▪	▪	▪	▪		▪		▪	Installing and adjusting blades, cutter heads, boring-bits and sanding-belts using cobots and semi-autonomous robots.
F		▪	▪	▪		▪	▪	▪	▪		▪		▪	Use cobots for the autonomous selection, control, mounting and replacing of cutting tools on the woodworking machines.
G		▪	▪	▪		▪	▪	▪	▪		▪		▪	Setting and adjusting through digitized and remote controls various kinds of connected woodworking machines for operation by others; studying and interpreting specifications using simulation models and mixed/augmented reality.

Comments on hazards and risks forecast

2018 Current situation	2025 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.
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). **Effects:** severe bruises, amputations, cuts and sharp injuries, crushing. ▪ Slips and trips, obstacles, table edges, moving vehicles, machines. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	▪ 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. **Effects:** severe bruises, amputations, cuts and sharp injuries, crushing. Risks from mechanical hazards may decrease, depending on takeover of specific task by cobots/robots. ▪ 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, awkward positions, heavy physical workload. **Effect:** musculoskeletal diseases.	▪ Ergonomic hazards: from poor ergonomic conditions, awkward positions, heavy physical workload. **Effect:** musculoskeletal diseases. Ergonomic risks may decrease, depending on takeover of specific task by cobots/robots.
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.
Hazards due to physical effects/physical agents	
▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease).	▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease). Risk of being exposed to noise and vibration may decrease, depending on takeover of specific task by cobots/robots.

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Hazards and risks changes

Current and forecasted risks changes due to sector digitization for the occupational profile Woodworking machine tool setters and operators - ISCO 7523

2018 Current situation	2025 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: wood dust. **Effects:** contamination/intoxication, respiratory diseases, wood dusts (carcinogens, allergens) may cause nasal or lung cancer. Wood dust may put workers at risk of explosions.	▪ Chemical hazards: wood dust. **Effects:** contamination/intoxication, respiratory diseases, wood dusts (carcinogens, allergens) may cause nasal or lung cancer. Wood dust may put workers at risk of explosions. Exposure to chemicals (wood dust) may decrease, depending on takeover of specific task by cobots/robots. ▪ 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.
Psychosocial hazards	
▪ Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility, repetitive, monotonous work. ▪ Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues. ▪ Working method: working with colleagues. **Effects:** stress, burnout.	▪ Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility and digital know how, repetitive, monotonous work. ▪ Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues, lack of social contacts. ▪ 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.

Skills and competences needs

Forecast of training new needs due to sector digitization for the occupational profile Woodworking-machine tool setters and operators - ESCO 7523

		Will it continue to be needed?	Main reasons of change				
			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					
	Dispose of cutting waste material	YES					
	Maintain furniture machinery	NO					
	Monitor automated machines	YES, changed	▪			▪	▪
	Operate furniture machinery	YES, changed		▪	▪	▪	
	Remove inadequate workpieces	YES, changed					▪
	Remove processed workpiece	NO					
	Set up the controller of a machine	YES, changed		▪			
	Supply machine	YES					
	Supply machine with appropriate tools	YES, changed		▪	▪	▪	
Essential knowledge	Machine tools	YES					
	Quality standards	YES, changed					▪
	Types of wood	NO					
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪		▪	▪	▪
	Collaboration Across Networks and Leading by Influence	NEW	▪			▪	
	Agility and Adaptability	NEW	▪	▪	▪	▪	▪
	Initiative and Entrepreneurship	NEW			▪		
	Effective Oral - Written Communication						
	Assessing and Analyzing Information	NEW	▪	▪	▪	▪	▪
	Curiosity and Imagination						
	Digital literacy	NEW	▪	▪	▪	▪	▪
	Data security	NEW	▪			▪	

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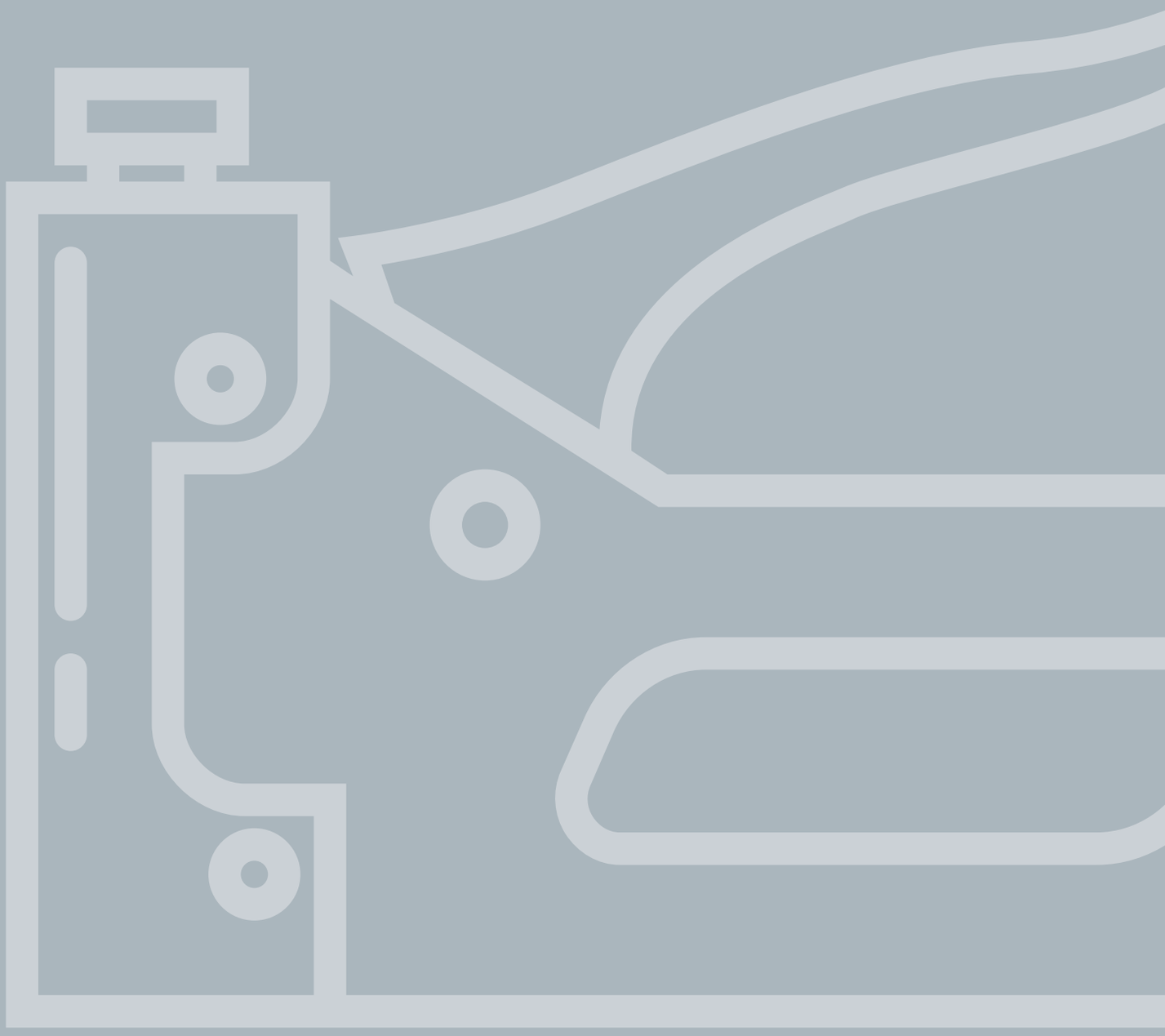
Upholsterers and related workers

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.



Upholsterers and related workers

ISCO 7534

2018 ⏭

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 profile tasks		McKinsey Levers																					Industry 4.0 technologies									Forecast temporal horizon for change
		Resource process			Asset utilization					Labor				Inventories			Quality			Supply/ demand match		Time to market											
		Smart energy consumption	Real-time yield optimization	Intelligent IoTs	Routing flexibility	Machine flexibility	Remote monitoring and control	Predictive maintenance	Augmented reality for MRO	Human-robot collaboration	Remote monitoring and control	Automation of knowledge work	Digital performance management	Batch size 1	Real-time SC optimization	In situ 3D printing	Digital quality management	Statistical process control (SPC)	Advanced process control (APC)	Data-driven demand prediction	Data-driven design to value	Rapid experimentation and simulation	Customer co-creation/ open innovation	Concurrent engineering	Big data and analytics	Autonomous robots	Simulation	Horizontal and vertical system integration	The industrial internet of things	Cybersecurity	The cloud	Additive manufacturing	Augmented reality	
A	Discussing upholstery fabric, colour and style with customers and providing cost estimates for upholstering furniture or other items.			▪			▪		▪												▪	▪	▪		▪		▪						▪	after 2025
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.		▪	▪					▪	▪		▪			▪						▪	▪		▪	▪		▪	▪	▪		▪			2025
C	Making upholstery patterns from sketches, customer descriptions or blueprints.									▪											▪	▪	▪										▪	after 2025
D	Laying out, measuring and cutting upholstery materials following patterns, templates, sketches or design specifications.								▪	▪								▪		▪	▪	▪	▪		▪		▪						▪	2025
E	Installing, arranging and securing springs, padding and covering material to furniture frames.					▪			▪	▪		▪							▪	▪				▪	▪	▪	▪	▪	▪	▪	▪		▪	before 2025
F	Sewing upholstery materials by hand to seam cushions and joining sections of covering materials.					▪				▪		▪		▪							▪													2025
G	Sewing rips or tears in material, or creating tufting, using needle and thread or hand operated machines for sewing-/locking.			▪		▪				▪	▪	▪	▪												▪	▪			▪		▪			before 2025
H	Tacking, gluing or sewing ornamental trims, buckles, braids, buttons and other accessories to covers or frames on upholstered items.			▪		▪				▪	▪	▪	▪														▪						▪	2025
I	Laying out, cutting, fabricating and installing upholstery: ▪ Installing upholstery on the structure. ▪ Finishing of the upholstery.			▪		▪	▪			▪	▪	▪								▪		▪	▪				▪						▪	after 2025
J	Renovating antique furniture using a variety of tools including ripping chisels, magnetic hammers and long needles: magnetic hammers and long needles: ▪ Ripping off the seats and sofas. ▪ Demounting of the (structural) parts. ▪ Renovating of the upholstery.					▪				▪		▪													▪									after 2025
K	Collaborating with interior designers to decorate rooms and coordinate furnishing fabrics.			▪		▪															▪	▪	▪				▪						▪	before 2025
L	Making quilts, cushions and mattresses. ▪ Filling up cushions. ▪ Filling up mattresses.		▪	▪		▪	▪		▪	▪		▪									▪		▪		▪	▪	▪	▪	▪	▪		▪	▪	before 2025

Tasks changes

Current and forecasted tasks changes due to sector digitization for the occupational profile Upholsterers and related workers- ISCO 7534

2025

Occupational profile

Description forecast of the occupational profile in 2025

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 using 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.
- Use digitization tools to work 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, ICT- and technical services).
- Assists in the implementation of quality assurance activities.

	Probability of technologies adoption in the following groups of companies				
	A1	A2	B1	B2	
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)	**Profile tasks forecast**
	High	High	High	Medium	A Using digital simulation models, discussing upholstery fabric, colour and style with customers and providing cost estimates for upholstering furniture or other items.
	High	High	High	Medium	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 specifications.
	High	High	Medium	Medium	C Making upholstery patterns from digital models, sketches, customer descriptions.
	High	High	Medium	Medium	D Laying out, measuring and cutting upholstery materials using advanced digital process control following patterns, templates, sketches or design specifications.
	High	Medium	Light	Light	E Highly automated installing, arranging and securing springs, padding and covering material to furniture frames.
	High	Medium	Light	Light	F Sewing upholstery materials to seam cushions and joining sections of covering materials using semi-automated processes and connected cobots.
	High	Medium	Light	Light	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 machines for sewing-/locking.
	High	Medium	Light	Light	H Semi-autonomously tacking, gluing or sewing ornamental trims, buckles, braids, buttons and other accessories to covers or frames on upholstered items using cobots.
	High	High	Medium	Light	I Highly automated laying out, cutting, fabricating and installing upholstery using autonomous robots connected to the big data cloud: ▪ Installing upholstery on the structure. ▪ Finishing of the upholstery.
	Medium	Medium	Light	Light	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. ▪ Renovating of the upholstery.
	High	High	Medium	Medium	K Using digital models and augmented reality to collaborate with interior designers to decorate rooms and coordinate furnishing fabrics.
	High	High	Medium	Light	L Fully automated manufacturing of quilts, cushions and mattresses. ▪ Filling up cushions. ▪ Filling up mattresses.

Upholsterers and related workers

ISCO 7534

2018 ⏭

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.

⏭

New categorization of hazards

Current profile 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)	**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: 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.												■				▪	▪					■	■			▪			■		■

Hazards and risks changes

Current and forecasted risks changes due to sector digitization for the occupational profile Upholsterers and related workers - ISCO 7534

2025

Occupational profile

Description forecast of the occupational profile in 2025

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 using 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.
- Use digitization tools to work 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, ICT- and technical services).
- Assists in the implementation of quality assurance activities.

	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 hazards forecast
A		▪	▪	▪		▪	▪	▪	▪		▪		▪	Using digital simulation models, discussing upholstery fabric, colour and style with customers and providing cost estimates for upholstering furniture or other items.
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 specifications.
C		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Making upholstery patterns from digital models, sketches, customer descriptions.
D		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Laying out, measuring and cutting upholstery materials using advanced digital process control following patterns, templates, sketches or design specifications.
E		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Highly automated installing, arranging and securing springs, padding and covering material to furniture frames.
F		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Sewing upholstery materials to seam cushions and joining sections of covering materials using semi-automated processes and connected cobots.
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 machines for sewing-/locking.
H		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Semi-autonomously tacking, gluing or sewing ornamental trims, buckles, braids, buttons and other accessories to covers or frames on upholstered items using cobots.
I		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Highly automated laying out, cutting, fabricating and installing upholstery using autonomous robots connected to the big data cloud: ▪ 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. ▪ Renovating of the upholstery.
K		▪	▪	▪		▪	▪	▪	▪		▪		▪	Using digital models and augmented reality to collaborate with interior designers to decorate rooms and coordinate furnishing fabrics.
L	▪	▪	▪	▪		▪	▪	▪	▪	▪	▪	▪	▪	Fully automated manufacturing of quilts, cushions and mattresses. ▪ Filling up cushions. ▪ Filling up mattresses.

Comments on hazards and risks forecast

2018 Current situation	2025 Situation forecast
Work area Workshops with upholsterer machines (sewing machine), hand ad 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.
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). **Effects:** severe bruises, cuts and sharp injuries. ▪ Slips and trips, obstacles, table edges, moving vehicles, machines. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	▪ 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. **Effects:** severe bruises, cuts and sharp injuries. Risks from mechanical hazards may decrease, depending on takeover of specific task by cobots/robots. ▪ 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, awkward positions. **Effect:** musculoskeletal diseases.	▪ Ergonomic hazards: from poor ergonomic conditions, awkward positions. **Effect:** musculoskeletal diseases. 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.
Electrical hazards	
▪ Electric hazards: contacts with live parts or connections or exposure to arc flash. **Effect:** fatal accident.	▪ Electric hazards: contacts with live parts or connections or exposure to arc flash. **Effect:** fatal accident.
Hazards due to physical effects/physical agents	
▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease).	▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease). Exposure to noise and vibration risks may decrease, depending on takeover of specific task by cobots/robots. ▪ Laser light: exposure to laser light 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.

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Hazards and risks changes

Current and forecasted risks changes due to sector digitization for the occupational profile Upholsterers and related workers - ISCO 7534

2018 Current situation	2025 Situation forecast
Fire and explosion hazards	
▪ Explosion and fire hazards from materials, including glue, solvents and other chemicals. **Effects:** burns, fatal accidents.	▪ Explosion and fire hazards from materials, including glue, solvents and other chemicals. Risks from explosion and fire may decrease, depending on takeover of specific task by cobots/robots. **Effects:** burns, fatal accidents.
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: wood dust, solvents, preservatives, formaldehyde, glues. Upholsterers usually require an extensive use of solvents. 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. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, allergies, cancer.	▪ Chemical hazards: wood dust, solvents, preservatives, formaldehyde, glues, new substances/materials. Upholsterers usually require an extensive use of solvents. 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. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, allergies, cancer. Exposure to chemicals may decrease, depending on takeover of specific task by cobots/robots. ▪ 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.
Psychosocial hazards	
▪ Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility, repetitive work. ▪ Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues. ▪ Working method: working with colleagues.	▪ Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility and digital know how, repetitive work. ▪ Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues, lack of social contacts. ▪ 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.

Skills and competences needs

Forecast of training new needs due to sector digitization for the occupational profile Upholsterers and related workers - ESCO 7534

		Will it continue to be needed?	Main reasons of change			
			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	NO				
Essential knowledge	Furniture industry	YES				
	Furniture trends	YES				
	Textile materials	YES, changed	▪		▪	
	Upholstery fillings	YES, changed	▪		▪	
	Upholstery tools	YES, changed	▪			
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪	▪		▪
	Collaboration Across Networks and Leading by Influence	NEW		▪	▪	
	Agility and Adaptability	NEW	▪	▪	▪	▪
	Initiative and Entrepreneurship	NEW	▪		▪	
	Effective Oral - Written Communication	NEW			▪	
	Assessing and Analyzing Information	NEW	▪	▪	▪	▪
	Curiosity and Imagination	NEW			▪	
	Digital literacy	NEW	▪	▪	▪	▪
	Data security	NEW		▪	▪	▪

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Wood processing plant operators

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.

Wood processing plant operators

ISCO 8172

2018 ⏩

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 profile tasks	McKinsey Levers																						Industry 4.0 technologies									Forecast temporal horizon for change
	Resource process			Asset utilization					Labor				Inventories			Quality			Supply/ demand match		Time to market											
	Smart energy consumption	Real-time yield optimization	Intelligent IoTs	Routing flexibility	Machine flexibility	Remote monitoring and control	Predictive maintenance	Augmented reality for MRO	Human-robot collaboration	Remote monitoring and control	Automation of knowledge work	Digital performance management	Batch size 1	Real-time SC optimization	In situ 3D printing	Digital quality management	Statistical process control (SPC)	Advanced process control (APC)	Data-driven demand prediction	Data-driven design to value	Rapid experimentation and simulation	Customer co-creation/ open innovation	Concurrent engineering	Big data and analytics	Autonomous robots	Simulation	Horizontal and vertical system integration	The industrial internet of things	Cybersecurity	The cloud	Additive manufacturing	Augmented reality	
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.	▪	▪	▪			▪			▪	▪	▪	▪				▪	▪	▪	▪		▪		▪	▪	▪		▪	▪	▪	▪			before 2025
B	Operating and monitoring log in-feed and conveyor systems.	▪	▪	▪	▪	▪	▪	▪		▪	▪	▪	▪				▪	▪	▪					▪	▪	▪		▪	▪	▪	▪			before 2025
C	Preparation of the work, by removing strange elements (in metal, stone…), removing bark, etc…	▪	▪	▪	▪	▪	▪	▪		▪	▪	▪	▪	▪			▪	▪	▪						▪	▪			▪	▪	▪			after 2025
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.	▪	▪	▪	▪	▪	▪			▪	▪	▪		▪			▪		▪	▪				▪	▪	▪	▪	▪	▪	▪	▪			before 2025
E	Selecting, controlling, mounting and replacement of cutting tools on the woodworking machines.		▪	▪	▪	▪				▪	▪	▪	▪		▪		▪	▪	▪						▪	▪	▪	▪	▪	▪	▪			before 2025
F	Operating and monitoring plywood core-laying machines and hot-plate plywood presses and machines which cut veneer.		▪	▪	▪	▪	▪			▪	▪	▪	▪		▪		▪	▪	▪	▪		▪		▪	▪	▪	▪	▪	▪	▪	▪			2025
G	Cleaning and lubricating sawmill equipment.		▪	▪				▪			▪	▪	▪				▪	▪							▪	▪			▪	▪	▪			before 2025

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Tasks changes

Current and forecasted tasks changes due to sector digitization for the occupational profile wood processing plant operators - ISCO 8172

2025

Occupational profile

Description forecast of the occupational profile in 2025

Wood processing plant operators monitor, operate and control digitized, connected and automated 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.
- Use digitization tools to work 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, ICT- and technical services).
- Assists in the implementation of quality assurance activities.

	Probability of technologies adoption in the following groups of companies				
	A1	A2	B1	B2	
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)	**Profile tasks forecast**
	High	Medium	Medium	Medium	A Examining logs and rough lumber, using fulled automated, computer vision, big data and cloud connectivity to determine size, condition, quality and other characteristics to decide best lumber cuts to carry out, or operate automated equipment to convey logs through different sensors, like laser scanners, to determine the most productive and profitable cutting patterns.
	High	High	Medium	Medium	B Operating and monitoring log autonomuos and highly automated in-feed and conveyor systems.
	High	High	Medium	Medium	C Automated, semi-automated preparation of the work, by removing strange elements (in metal, stone…), removing bark, etc…
	High	High	High	Medium	D 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.
	High	High	High	Medium	E Autonomous selection, controlling, mounting and replacement of cutting tools on the highly digitized connected woodworking machines.
	High	Medium	Medium	Light	F Automated operating and remote monitoring of digitized plywood core-laying machines and hot-plate plywood presses and machines which cut veneer.
	High	High	Medium	Medium	G Data driven predictive maintenance and quality assurance through cleaning and lubricating of sawmill equipment.

Wood processing plant operators

ISCO 8172

2018 ⏭

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 profile 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)	**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.		■				■				■		■		■		▪				▪		■	■				▪	▪	■		■

■ No changes ■ New ones ▪ Reduced

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

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2025
Occupational profile

Description forecast of the occupational profile in 2025
Wood processing plant operators monitor, operate and control digitized, connected and automated 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.
- Use digitization tools to work 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, ICT- and technical services).
- Assists in the implementation of quality assurance activities.

	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 hazards forecast
A		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Examining logs and rough lumber, using fulled automated, computer vision, big data and cloud connectivity to determine size, condition, quality and other characteristics to decide best lumber cuts to carry out, or operate automated equipment to convey logs through different sensors, like laser scanners, to determine the most productive and profitable cutting patterns.
B		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Operating and monitoring log autonomuos 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…
D		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	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.
E		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Autonomous selection, controlling, mounting and replacement of cutting tools on the highly digitized connected woodworking machines.
F		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Automated operating and remote monitoring of digitized plywood core-laying machines and hot-plate plywood presses and machines which cut veneer.
G		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Data driven predictive maintenance and quality assurance through cleaning and lubricating of sawmill equipment.

Comments on hazards and risks forecast

2018 Current situation	2025 Situation forecast
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 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, programming of machines, storing and transporting raw timber, handling heavy timber.
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). **Effects:** severe bruises, amputations, cuts and sharp injuries, crushing. ▪ Slips and trips, obstacles, table edges, moving vehicles, machines. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	▪ 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. **Effects:** severe bruises, amputations, cuts and sharp injuries, crushing. Risks from mechanical hazards may decrease, depending on takeover of specific task by cobots/robots. Effect: musculoskeletal diseases, overweight, cardiovascular problems. ▪ 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, awkward positions, heavy physical workload. **Effect:** musculoskeletal diseases.	▪ Ergonomic hazards: from poor ergonomic conditions, awkward positions, heavy physical workload, digitization put workers at risk of inactivity because of operating autonomous techniques from office workstations. **Effect:** musculoskeletal diseases. 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. Inactivity may increase with digitisation.
Electrical hazards	
▪ Electrical hazards: caused by contact with defective or unearthed electrical equipment. **Effect:** fatal accident.	▪ Electrical hazards: caused by contact with defective or unearthed electrical equipment. **Effect:** fatal accident.
Hazards due to physical effects/physical agents	
▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease).	▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease). The risk of being exposed to noise and vibration may decrease, depending on takeover of specific task by cobots/robots. ▪ Laser: Wood processing plant operators may be exposed to laser light. **Effect:** eye damage, effects similar to sunburn.

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Hazards and risks changes

Current and forecasted risks changes due to sector digitization for the occupational profile wood processing plant operators - ISCO 8172

2018 Current situation	2025 Situation forecast
Fire and explosion hazards	
▪ Explosion and fire hazards from materials, including wood dust and chemicals. **Effects:** burns, fatal accidents.	▪ Explosion and fire hazards from materials, including wood dust and chemicals. **Effects:** burns, fatal accidents.
Work environmental hazards	
▪ Work environmental hazards: poor lighting, inadequate temperature and climate. **Effect:** negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.	▪ Work environmental hazards: poor lighting, inadequate temperature and climate. **Effect:** negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.
Hazards through dangerous substances	
▪ Chemical hazards: wood dust, preservatives, formaldehyde. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, wood dusts (carcinogens, allergens) may cause nasal or lung cancer. Wood dust may put workers at risk of explosions. ▪ Biological hazards: bacteria, mould and fungi. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, infections.	▪ Chemical hazards: wood dust, preservatives, formaldehyde. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, wood dusts (carcinogens, allergens) may cause nasal or lung cancer. Wood dust may put workers at risk of explosions. The risk of being exposed to chemicals may decrease, depending on takeover of specific task by cobots/robots. ▪ 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. ▪ Biological hazards: bacteria, mould and fungi. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, infections. Risks may decrease with use of cobots/robots.
Psychosocial hazards	
▪ Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility, repetitive, monotonous work. ▪ Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues. ▪ Working method: working with colleagues. **Effects:** stress, burnout.	▪ Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility and digital know how, repetitive, monotonous work. ▪ Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues, lack of social contacts. ▪ 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.

Skills and competences needs

Forecast of training new needs due to sector digitization for the occupational profile wood processing plant operators - ESCO 8172

		Will it continue to be needed?	Main reasons of change		
			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			
	Ensure conformity to specifications	YES, changed		▪	▪
	Ensure equipment availability	YES			
	Handle timber	NO			
	Handle timber-based products	NO			
	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	NO			
	Remove processed workpiece	NO			
	Supply machine	YES			
	Troubleshoot	YES, changed		▪	▪
	Wear appropriate protective gear	YES			
	Work safely with machines	YES			
Essential knowledge	Cutting technologies	YES			
	Types of wood	YES			
	Wood cuts	YES			
	Woodworking processes	YES, changed	▪	▪	
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪	▪	▪
	Collaboration Across Networks and Leading by Influence	NEW		▪	
	Agility and Adaptability	NEW	▪	▪	▪
	Initiative and Entrepreneurship	NEW	▪	▪	
	Effective Oral and Written Communication				
	Assessing and Analyzing Information	NEW	▪	▪	▪
	Curiosity and Imagination				
	Digital literacy	NEW	▪	▪	▪
	Data security	NEW		▪	▪

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Furniture assembler

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.

Furniture assembler

ISCO 8219s

2018 ⏭

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 profile tasks	McKinsey Levers																					Industry 4.0 technologies										Forecast temporal horizon for change
	Resource process			Asset utilization				Labor					Inventories			Quality			Supply/ demand match		Time to market												
	Smart energy consumption	Real-time yield optimization	Intelligent IoTs	Routing flexibility	Machine flexibility	Remote monitoring and control	Predictive maintenance	Augmented reality for MRO	Human-robot collaboration	Remote monitoring and control	Automation of knowledge work	Digital performance management	Batch size 1	Real-time SC optimization	In situ 3D printing	Digital quality management	Statistical process control (SPC)	Advanced process control (APC)	Data-driven demand prediction	Data-driven design to value	Rapid experimentation and simulation	Customer co-creation/ open innovation	Concurrent engineering	Big data and analytics	Autonomous robots	Simulation	Horizontal and vertical system integration	The industrial internet of things	Cybersecurity	The cloud	Additive manufacturing	Augmented reality	
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…		▪	▪		▪	▪		▪	▪	▪	▪	▪	▪	▪		▪	▪	▪			▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	before 2025
B	Reviewing work orders, specifications, diagrams and drawings to determine materialsneeded and assembly instructions.		▪	▪		▪	▪		▪	▪	▪	▪	▪	▪	▪		▪	▪	▪			▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	before 2025
C	Recording production and operational data on specified forms.			▪			▪		▪		▪	▪	▪		▪		▪	▪	▪	▪					▪	▪	▪	▪	▪	▪	▪		▪	before 2025
D	Inspecting and testing components and completed assemblies.			▪						▪		▪		▪	▪	▪	▪							▪	▪			▪	▪	▪	▪			before 2025
E	Rejecting faulty products.		▪	▪			▪				▪	▪	▪		▪		▪	▪	▪		▪	▪			▪	▪	▪	▪	▪	▪	▪		▪	2025

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Tasks changes

Current and forecasted tasks changes due to sector digitization
for the occupational profile furniture assembler - ISCO 8219s

2025

Occupational profile

	Probability of technologies adoption in the following groups of companies			
	A1	**A2**	**B1**	**B2**
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)
	High	High	High	Medium
	High	High	High	Medium
	High	High	High	High
	High	High	High	Medium
	High	High	Medium	Light

Description forecast of the occupational profile in 2025

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.
- Use digitization tools to work 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, ICT- and technical services).
- Assists in the implementation of quality assurance activities.

	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…
B	Reviewing work orders, specifications, diagrams and drawings to determine materials needed and assembly instructions of the highly digitised enterprise ecosystem.
C	Recording production and operational data of the highly digitised manufacturing plant on specified digitilized forms.
D	Inspecting and testing components and completed assemblies as integrated part of the fully digitised smart manufacturing ecosystem of the company.
E	Supervising the highly autonomous rejection system of faulty products.

Furniture assembler

ISCO 8219s

2018 ⏭

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 profile 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)	**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 materialsneeded and assembly instructions.						■						■										■	■									■
C	Recording production and operational data on specified forms.												■										■	■									■
D	Inspecting and testing components and completed assemblies.		■				■						■				■						■	■									■
E	Rejecting faulty products.		■				■						■				■						■	■									■

■ No changes ■ New ones ■ Reduced

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

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2025

Occupational profile

Description forecast of the occupational profile in 2025

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.
- Use digitization tools to work 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, ICT- and technical services).
- Assists in the implementation of quality assurance activities.

	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 hazards 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…
B		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Reviewing work orders, specifications, diagrams and drawings to determine materials needed and assembly instructions of the highly digitised enterprise ecosystem.
C		▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	Recording production and operational data of the highly digitised manufacturing plant on specified digitilized forms.
D		▪	▪	▪		▪	▪	▪	▪			▪	▪	Inspecting and testing components and completed assemblies as integrated part of the fully digitised smart manufacturing ecosystem of the company.
E		▪	▪	▪		▪	▪	▪	▪			▪	▪	Supervising the highly autonomous rejection system of faulty products.

Comments on hazards and risks forecast

2018 Current situation	2025 Situation forecast
Work area Working on site, operate wood processing machines, use of hand and power tools to place together furniture and auxiliary items.	**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.
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). **Effects:** severe bruises, cuts and sharp injuries. ▪ Slips and trips, obstacles, table edges. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	▪ 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. **Effects:** severe bruises, cuts and sharp injuries. Mechanical risks may decrease, depending on takeover of specific task by cobots/robots. ▪ Slips and trips, obstacles, table edges. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.
Ergonomic hazards	
▪ Ergonomic hazards: from poor ergonomic conditions, awkward positions, heavy physical workload. **Effect:** musculoskeletal diseases.	▪ Ergonomic hazards: from poor ergonomic conditions, awkward positions, heavy physical workload. **Effect:** musculoskeletal diseases. 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.
Electrical hazards	
▪ Electrical hazards: contacts with live parts or connections or exposure to arc flash. Electrical hazards from woodworking machines. **Effect:** fatal accident.	▪ 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.
Hazards due to physical effects/physical agents	
▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease)	▪ Noise **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease) Exposure to noise and vibration may decrease, depending on takeover of specific tasks by cobots/robots. ▪ Laser: wood processing plant operators may be exposed to laser light. **Effect:** eye damage, negative effects similar to sunburn.

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Hazards and risks changes

Current and forecasted risks changes due to sector digitization
for the occupational profile furniture assembler - ISCO 8219s

2018 Current situation	2025 Situation forecast
Fire and explosion hazards	
▪ Explosion and fire hazards from materials, including wood dust, solvents and chemicals. **Effects:** burns, fatal accidents.	▪ Explosion and fire 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. **Effects:** burns, fatal accidents.
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: wood dust, solvents, preservatives, formaldehyde, glues, new substances/materials. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, allergies, cancer.	▪ Chemical hazards: wood dust, solvents, preservatives, formaldehyde, glues, new substances/materials. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, allergies, cancer. Chemical risks may decrease, depending on takeover of specific task by cobots/robots. ▪ 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.
Psychosocial hazards	
▪ Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility, repetitive and monotonous work. ▪ Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues. ▪ Working method: working with colleagues. **Effects:** stress, burnout	▪ Organisation of work: time pressure, lack of experience, training and information, increased demand on flexibility and digital know how, repetitive and monotonous work. ▪ Social relationship: lack of involvement in making decisions that affect the worker, difficult colleagues, lack of social contacts. ▪ 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

Skills and competences needs

Forecast of training new needs due to sector digitization for the occupational profile furniture assembler - ESCO 8219s

		Will it continue to be needed?	Main reasons of change		
			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			
	Assemble prefabricated furniture	YES, changed	▪		
	Clean wood surface	YES			
	Create furniture frames	YES			
	Create smooth wood surface	YES			
	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	▪		
Essencial knowledge	Technical drawings	YES, changed		▪	
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪	▪	▪
	Collaboration Across Networks and Leading by Influence	NEW	▪		
	Agility and Adaptability	NEW	▪	▪	▪
	Initiative and Entrepreneurship				
	Effective Oral and Written Communication	NEW		▪	
	Assessing and Analyzing Information	NEW		▪	
	Curiosity and Imagination	NEW	▪	▪	▪
	Digital literacy	NEW	▪	▪	▪
	Data security	NEW		▪	▪

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Factory hand

You will find three different types of tables for each occupational profile, where the forecasted changes due to sector digitization are in red colour.

Tasks changes
Current and forecasted tasks changes.

Hazards and risks changes
Current and forecasted risks changes.

Skills and competences needs
Forecast of training new needs.

Factory hand

ISCO 9329

2018 ⏩

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 profile tasks		McKinsey Levers																						Industry 4.0 technologies									Forecast temporal horizon for change
		Resource process			Asset utilization					Labor				Inventories			Quality			Supply/ demand match		Time to market			Big data and analytics	Autonomous robots	Simulation	Horizontal and vertical system integration	The industrial internet of things	Cybersecurity	The cloud	Additive manufacturing	Augmented reality	
		Smart energy consumption	Real-time yield optimization	Intelligent IoTs	Routing flexibility	Machine flexibility	Remote monitoring and control	Predictive maintenance	Augmented reality for MRO	Human-robot collaboration	Remote monitoring and control	Automation of knowledge work	Digital performance management	Batch size 1	Real-time SC optimization	In situ 3D printing	Digital quality management	Statistical process control (SPC)	Advanced process control (APC)	Data-driven demand prediction	Data-driven design to value	Rapid experimentation and simulation	Customer co-creation/ open innovation	Concurrent engineering									
A	Conveying goods, material, equipment and other items to work areas, and removing finished pieces.	▪		▪	▪		▪				▪	▪	▪				▪		▪					▪	▪			▪	▪		▪			before 2025
B	Cerifying specifications of goods, material, equipment and other items and checking the quality in order to ensure adherence to specifications.												▪				▪											▪	▪		▪			before 2025
C	Loading and unloading vehicles, trucks and trolleys.		▪		▪		▪				▪	▪	▪				▪		▪					▪	▪	▪		▪	▪		▪			before 2025
D	Clearing machine blockages, and cleaning machinery, equipment and tools.		▪				▪	▪																▪				▪	▪		▪			before 2025
E	Carrying out manual sorting of products or components.						▪				▪		▪											▪				▪	▪		▪			before 2025
F	Recording operational data on specified forms.	▪	▪	▪	▪	▪	▪		▪	▪	▪	▪	▪				▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪		▪	before 2025

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Tasks changes

Current and forecasted tasks changes due to sector digitization
for the occupational profile factory hand - ISCO 9329

2025

Occupational profile

Probability of technologies adoption in the following groups of companies					
	A1	A2	B1	B2	
	Early adopters with high abilities (investments and digital capacities, trained staff) to adopt all new technologies	Early adopters with high digital capacities, trained staff, but with limited capacities to adopt technologies requiring high investment	Companies with limited digital capacities, with intermediate trained staff (independent from company dimension) to adopt new technologies. Facility to learn and implement only technologies easy to adopt	Companies with low digital skills and low trained staff able to adopt only new essential technologies (independent from company dimension)	**Profile tasks forecast**
	High	High	High	Medium	A Conveying goods, material, equipment and other items to highly digitized, connected and automated work areas, and removing finished pieces.
	High	High	High	High	B Digitally verifying specifications of goods, material, equipment and other items and checking the quality in order to ensure adherence to specifications.
	High	High	High	Medium	C Loading and unloading vehicles, trucks and trolleys in a digital manufacturing plant.
	High	High	Medium	Light	D Clearing machine blockages, and cleaning machinery, equipment and tools when predictive maintenance and online realtime monitoring could not prevent this.
	High	High	High	Medium	E Carrying out semi-automated sorting of products or components when necessary in highly digitized factory.
	High	High	High	High	F Recording operational data of the digital factory on specified forms.

Description forecast of the occupational profile in 2025

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, ICT and technical services)
- Assists in the implementation of quality assurance activities

Factory hand

ISCO 9329

2018 ⏩

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.

⏩

New categorization of hazards

Current profile 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)	Psychosocial hazards	Excessive workloads
A	Conveying goods, material, equipment and other items to work areas, and removing finished pieces.		■	■	■		■			■	■	■					■	■					■	■	■		■	■	■	■		■
B	Cerifying 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.																						■	■								■

■ No changes ■ New ones ■ Reduced

[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 digitization
for the occupational profile factory hand - ISCO 9329

2025

Occupational profile

Description forecast of the occupational profile in 2025

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, ICT and technical services)
- Assists in the implementation of quality assurance activities

	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 hazards forecast**
A	▪	▪	▪	▪	▪			▪	▪	▪	▪		▪	Conveying goods, material, equipment and other items to highly digitized, connected and automated work areas, and removing finished pieces.
B		▪	▪	▪		▪		▪	▪		▪	▪	▪	Digitally 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 in a digital manufacturing plant.
D	▪	▪	▪	▪				▪	▪	▪	▪		▪	Clearing machine blockages, and cleaning machinery, equipment and tools when predictive maintenance and online realtime monitoring could not prevent this.
E	▪	▪	▪	▪	▪		▪	▪	▪	▪	▪	▪	▪	Carrying out semi-automated sorting of products or components when necessary in highly digitized factory.
F	▪	▪	▪	▪			▪	▪	▪		▪	▪	▪	Recording operational data of the digital factory on specified forms.

Comments on hazards and risks forecast

2018 Current situation	2025 Situation forecast
Work area Working on site, cleaning and tidying up the workshop and machines, passing tools and materials, storage activities, supporting machine operators.	**Work area** Working on site, cleaning and tidying up the workshop and machines, passing tools and materials, storage activities, supporting machine operators using digitalized instruments.
Mechanical hazards	
▪ Mechanical hazards from moving machines and tools and means of transportation, uncontrolled moving parts and parts with dangerous shapes. **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. **Effects:** squeezing, cutting, twisting, spraining, bumps and bruises.	▪ Mechanical hazards from moving machines and tools and means of transportation, uncontrolled moving parts and parts with dangerous shapes. Hazards from moving cobots/robots. **Effects:** severe bruises, amputations, cuts and sharp injuries, crushing, roll over or being crushed by means of transportation, forklift trucks etc. Risks may decrease with use of cobots/robots. ▪ 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, awkward position, confined spaces, handling heavy loads. **Effect:** musculoskeletal diseases.	▪ Ergonomic hazards: from poor ergonomic conditions, awkward position, confined spaces, handling heavy loads. **Effect:** musculoskeletal diseases. Risks may decrease with use of cobots/robots.
Electrical hazards	
▪ Electrical hazards: caused by contact with defective or unearthed electrical equipment. **Effect:** fatal accident.	▪ Electrical hazards: caused by contact with defective or unearthed electrical equipment. **Effect:** fatal accident.
Hazards due to physical effects/physical agents	
▪ Noise: sawmill, other wood processing machines. **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease).	▪ Noise: sawmill, other wood processing machines. **Effects:** hearing loss, headache, nervousness, poor concentration. ▪ Vibrations **Effects:** hand-arm-vibration syndrome (e.g. white finger disease). Exposure to noise and vibration risks may decrease, depending on takeover of specific task by cobots/robots.
Fire and explosion hazards	
▪ Explosion and fire hazards from materials, including wood dust and chemicals. **Effects:** burns, fatal accidents.	▪ Explosion and fire hazards from materials, including wood dust and chemicals. **Effects:** burns, fatal accidents.
Work environmental hazards	
▪ Work environmental hazards: excessive heat and cold, poor lighting. **Effects:** cardiovascular diseases, negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.	▪ Work environmental hazards: excessive heat and cold, poor lighting. **Effects:** cardiovascular diseases, negative effects on muscles, tendons and joints, cold, poor concentration, eye strain.

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Hazards and risks changes

Current and forecasted risks changes due to sector digitization
for the occupational profile factory hand - ISCO 9329

2018 Current situation	2025 Situation forecast
Hazards through dangerous substances	
▪ Chemical hazards/dust: asbestos, glass fibre, vapours, fumes, dust, solvents. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, cancer. 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. ▪ Biological hazards: bacteria, mould and fungi. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, infections.	▪ Chemical hazards/dust: asbestos, glass fibre, vapours, fumes, dust, solvents. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, cancer. 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. Risks may decrease with use of cobots/robots. ▪ 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. ▪ Biological hazards: bacteria, mould and fungi. **Effects:** contamination/intoxication, skin diseases, respiratory diseases, infections. Risks may decrease with use of cobots/robots.
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. ▪ Social relationship: Lack of involvement in making decisions that affect the worker. ▪ Working method: unskilled work, working with colleagues. **Effects:** stress, burnout.	▪ 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. ▪ 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 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. **Effects:** stress, burnout. 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 digitisation tools may change the task for factory hand totally and require new training and competences.

Skills and competences needs

Forecast of training new needs due to sector digitization
for the occupational profile factory hand - ESCO 9329

		Will it continue to be needed?	Main reasons of change	
			Working in highly digitized, connected and automated work areas	Step 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	NO		
	Maintain work area cleanliness	YES, changed	▪	▪
	Supply machine	YES, changed	▪	▪
	Supply machine with appropriate tools	YES, changed	▪	
	Wear appropriate protective gear	YES		
Essential knowledge	Cleaning products	NO		
	Cleaning techniques	YES, changed	▪	
	Industrial tools	YES, changed	▪	▪
NEW skills, knowledge and competences	Critical Thinking and Problem Solving	NEW	▪	▪
	Collaboration Across Networks and Leading by Influence			
	Agility and Adaptability	NEW	▪	▪
	Initiative and Entrepreneurship	NEW		▪
	Effective Oral - Written Communication			
	Assessing and Analyzing Information	NEW	▪	▪
	Curiosity and Imagination			
	Digital literacy	NEW	▪	▪
	Data security	NEW	▪	

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National Industrial Policy Guidelines 2014 -2020. Latvia
bit.ly/2B2Dpve bit.ly/2zJI05N
bit.ly/2QjnTFG

Smart Industry. Sweden
bit.ly/2B3lpAR bit.ly/2RLSEA1
bit.ly/2Uw244u bit.ly/2RRNdQ9

Manufacturing Academy of Denmark
made.dk bit.ly/2SCVs2i
bit.ly/2BYNR8D bit.ly/2BYBppA

Smart Industry. Netherlands
smartindustry.nl bit.ly/2BZSvDr
bit.ly/2B44gap bit.ly/2GkoCIJ

Made different – Factories of the future. Belgium
madedifferent.be bit.ly/2C1jb73
bit.ly/2rst0o8 bit.ly/2PtQCIR

HVM Catapult. UK
hvm.catapult.org.uk bit.ly/2B2MWCw
bit.ly/2SCA0u9

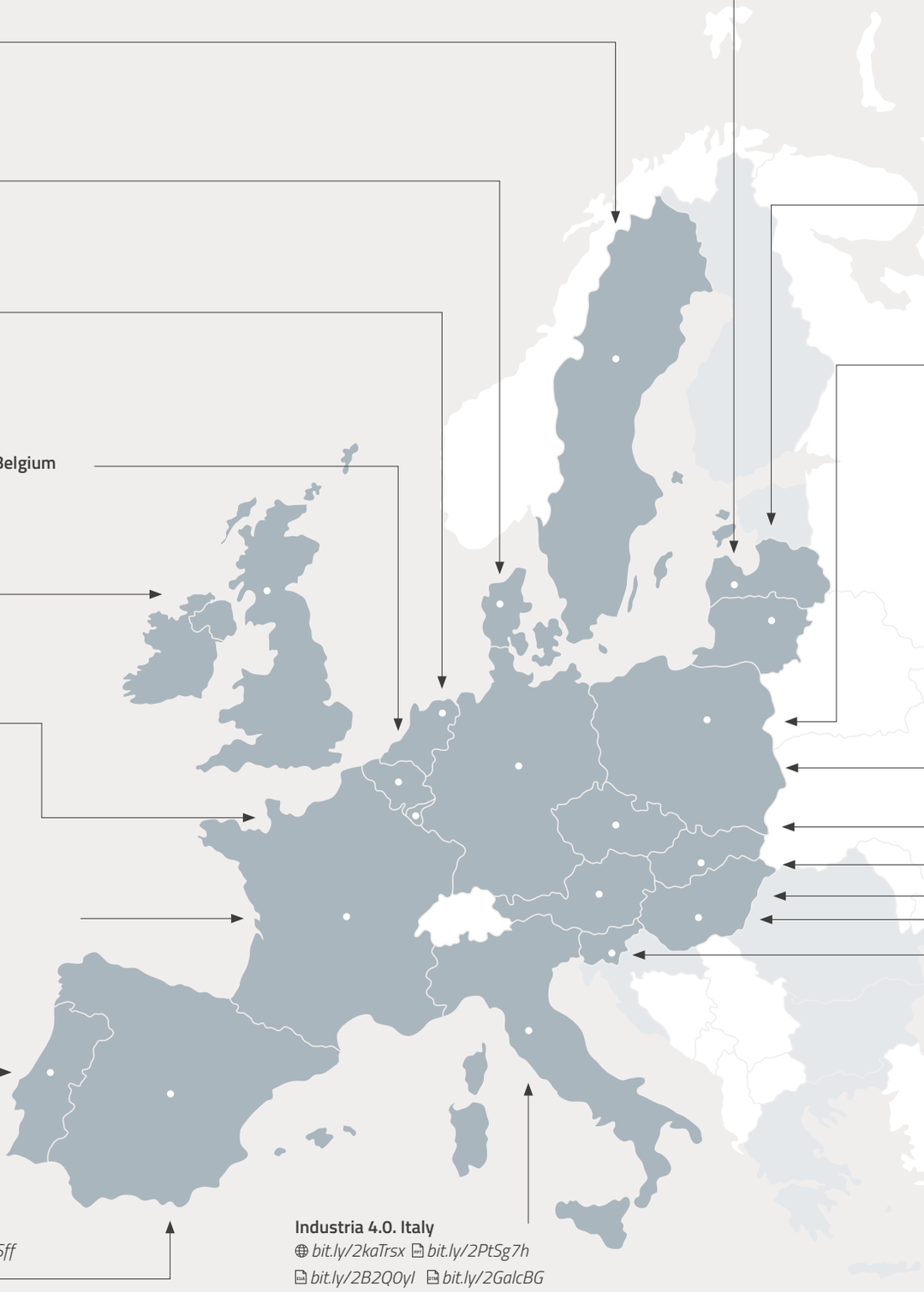
Digital For Industry. Luxembourg
digital4industry.lu bit.ly/2G8MSXP
bit.ly/2RRDFog bit.ly/2zOQ3hs

Alliance pour l'Industrie du Futur. France
industrie-dufutur.org bit.ly/2G5zvrj
bit.ly/2G7UnOG bit.ly/2BdV0Rd

Indústria 4.0. Portugal
industria4-0.cotec.pt bit.ly/2G7XplQ
bit.ly/2C0BadF bit.ly/2EknpZz

Industria Conectada 4.0. Spain
industriaconectada40.gob.es bit.ly/2QleSff
bit.ly/2G7U5ay bit.ly/2FgjkX7

Industria 4.0. Italy
bit.ly/2kaTrsx bit.ly/2PtSg7h
bit.ly/2B2Q0yl bit.ly/2GalcBG



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The 19 EU national initiatives to boost the industry digitalization

As part of the "Digital Single Market - DSM" strategy package, during the last years, the EU Commission has been working hard on different initiatives and actions to facilitate and stimulate the digitization of the European industry. The DIGIT-FUR project collected the information currently available on those national initiatives designed and implemented by member states to **support the whole complex and challenging process of digitizing their industries**. They can represent a reference supporting the different and several stakeholders and actors involved or affected in different ways by this new industrial revolution. In EU, until the date (November 2018), there are 19 approved National initiatives.

The **following Figure 3** shows which are the 19 initiatives and provide links to details and information about each of them. The source of the majority of the following information was The European platform of national initiatives on digitising industry, which aims **to collect an important number of practical experiences and facilitate the interchange of information** about the different initiatives planned and implemented by the different countries, regions and companies. It is part of the Coordination of European, national & regional initiatives, which **supports the coordination of the different initiatives and thus increase their effectiveness by focusing on common challenges and avoid duplication** of the same actions.

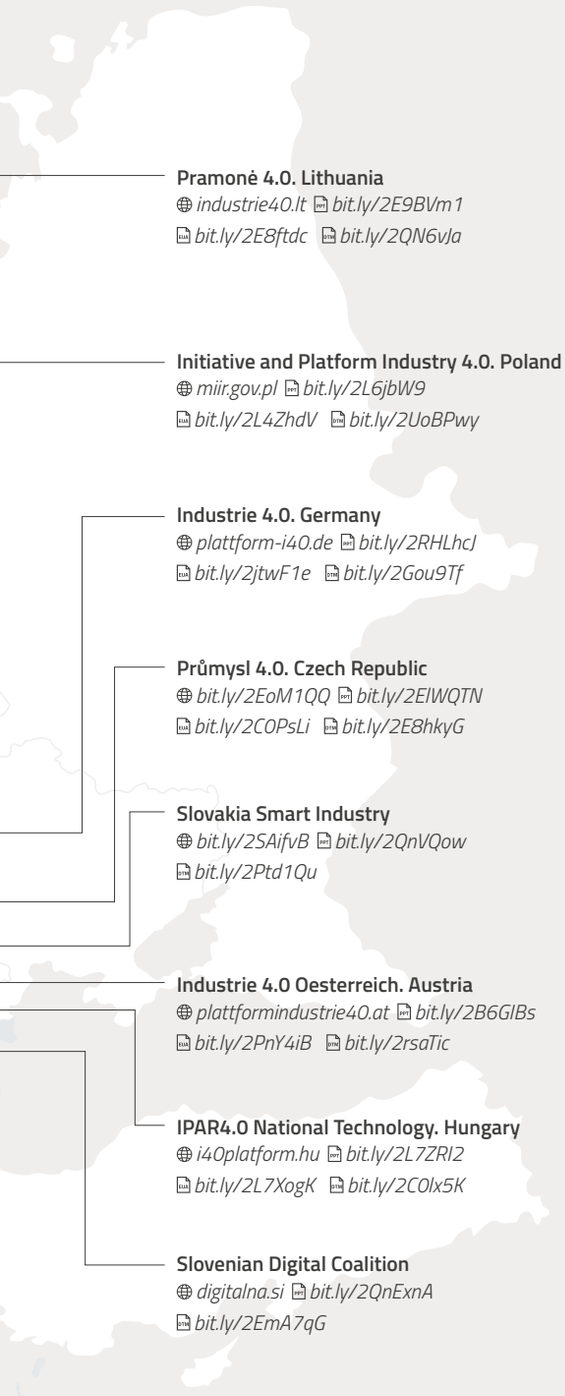

Figure 3.- Existing national initiatives for digitising industry across the European Union

Initiative Name and webpage.

Individual presentation - information relevant for digitising industry link.

EU analysis of the Initiative link.

Countries DTM (Digital Transformation Monitor) link.

Conclusions and recommendations

Conclusions

With a massively connected and globalised economy, the wood furniture manufacturing industry will offer personalised smart products and services based on **digital manufacturing systems** supplied by resource-efficient and sustainable industries with an immense need for enough digitization talents and skills securing a competitive transformation of the industry. A number of technologies, like cheap advanced sensors, internet of things and next generation Internet, data analytics and artificial intelligence, virtual and augmented reality, collaborative robots and programmable materials offer transformative business potentials, both in terms of the actual products that can be developed and produced but also to the manufacturing process itself, for those able to utilise them. Especially, the accumulated effect of the combination of several of these new technologies together can accelerate the impact. Most of the technologies can be utilised by SME's as well as large enterprises, making them suitable for at large part of the European wood furniture industry. The biggest challenge to the wood furniture industry might well be the lack of available skills within engineering, science, technology and ICT.

The furniture industry is rapidly transforming from a traditional industry into a computerized, industrial sector. Based upon the expected changes in the analyzed job profiles - using the McKinsey levers and taking into account the Industry 4.0 technologies - we 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 behavioral skills will become a priority. People will no longer being 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.

Digitization poses new challenges for **occupational health and safety**. New types of workplaces, new processes, new technologies can increase the safety and health of workers. Robots and digital technologies can make work that is physically demanding or monoto-nous easier or more efficient. Workers may be removed from hazardous environments, and sensors may automatically indicate whether a machine need maintenance and thus reduce the risk 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.

However, digitalization gives also rise to many new challenges and stresses for workers in the furniture industry. Increasing automation can lead to a lack of sufficient understanding of the new processes and technologies. This may lead to accidents due to someone doing something inappropriate or not knowing what to do when something goes wrong. Workers may also be exposed to time pressure and to an increased pace of work. They may face increasing workloads and task complexity, excessive working hours and constant reachability. Cognitive interactions between workers and robots/cobots and other digital techniques can lead to mental stress. The use of robotics/cobots and other digital techniques increases the risk of working alone and feeling isolated. Long working hours on computer screens and poor ergonomic design of non-office visual display unit workplaces may lead to musculoskeletal disorders (MSDs) due to fixed body postures and physical inactivity at work (EU OSHA, 2013a).

Recommendations

The furniture industry, which is transforming from a relatively traditional industry into a modern industrial sector due to different factors including the relevant sector digitization, creates a **demand for new specific competences and skills** of the workforce. Anticipating and building skills for the future is essential in a rapidly changing 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 the demand for skills, indeed, there is a **clear gap among the skills needed** in the near future by the furniture sector **and the current education offer and provision**. For sure, this will become even more challenging in the future.

Effective methods to anticipate future skill needs and to avoid potential mismatches 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.) at national and international (EU) level are needed. **Appropriate joint actions** are required to all stakeholders, including industry, sector organizations and social partners, training institutes, education and other relevant governmental entities. The **challenges and opportunities are enormous.**

All studies on future skills demand endorse the often-heard **importance of soft skills, collaboration and digital competences**. Therefor a **better cooperation** between education and sector is needed, especially for technical programs. The debate on education and training must continue to be conducted in the **context of digitization**. The sector future employees need not only to 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 significantly and **companies will demand higher and more specialized qualification levels**.

In relation to the **different learning provision systems** we can present some reflections that are relevant at general level and some others that are important at specific level:

- Existing **initial VET-systems and continuous VET-systems** need to adopt in their training courses the new technologies.

Digital competences must be included in the programs. But there must be attention also for new materials and products, new machines and software, etc. As the **work floor** becomes a key training floor, training providers have to closely work with companies and develop accordingly, especially in relation to the rapidly changing technological aspects of the furniture sector and looking at the compulsory evolution of the VET systems.

- The **VET systems** need to be **adaptive and continuously evolving** (in a smart way).
- **Recognizing skills developed outside the normal learning pathways**, will become more important. This recognition must be transparent and must be accepted by all stakeholders, including governmental partners.
- There is an increased 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 unemployment services and governmental partners (ministries of education and work). For example, for the recognition of skills, to develop **skills alliances within the sector, but also cross-sectoral**.
- The **recognition of skills** needs involvement and acceptance of all stakeholders, including the governmental partners. Yet in the past, one had to learn several skills and competences on the work floor. For example, one conclusion is that a 'diploma' that used to be a certificate of knowledge and high skills loses this meaning more rapidly than ever before. As after just only a few years away from the (high-)school/university, the acquired technical knowledge and skillsets become somehow obsolete due to the rapid changing environment.
- Importance of a **formal educational degree versus the skills adequacy** for the demanded profession. A degree should be devaluated, if not used during several years (a degree, depending on its content, should become limited in time). Only continuous VET (in formal, informal or non-formal ways) guarantees the validation the degree.
- **Lifelong learning becomes even more important**, but it also has limitations. For example, there is the question of people's developability, or what basic skills are. Workers need to be given time or freed up to properly learn and benefit their companies.

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 should 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.

- **Schools and training centers cannot always keep up with the investments needed** by new technologies evolving increasingly rapid. There is a greater need for including in the formal training an offer of Work Based Learning, Dual Learning and Apprenticeships.
- **The learning expectancy is increasing and the learning opportunities as well**, for example, via digital learning methods. There is also a call for more e-learning via MOOCS (Massive Open Online Courses).
- The 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 and in dual learning (set up jointly between sector and education).

Initial-VET vs Continuous-VET

The way of teaching is changing. The **need for adapted training methods to learn the new competencies** is important. Some new training methods are being implemented in practice, but the **need for new training methods and content on digitization remains high**. Not only technical skills and specialized domain-specific knowledge, but also the defined other (soft) skills are crucial. **New courses are needed to remove resistance to digitization among staff**. The fear that their work is threatened by digitization is often caused by fear of the unknown. Digitization is a broad concept and making this concrete can help.

Dual learning is a very important issue, also in C-VET. Today, teachers are trained once and they do not receive enough continuous training. They should be **closer to furniture and other sectors industries**. In addition, the **importance of soft skills is endorsed**. Companies are already responding to this and are starting to look more and more at the potential of the person.

- There is an **increasing importance of demand driven systems as apprenticeships, dual learning or work-based learning**. These systems need to be implemented in both VET-systems.

Informal and non-formal learning

Employees learn in many different ways, in training sessions, but also beyond. People search for information wherever they can find it and start working on it. **Tutorial videos** provide poor or valuable experiences, such as sectorial fora do. **Youngsters look for short learning moments** - a podcast, a webinar, an app, etc. People manage themselves partly through **trial and error** and partly through **training that brings everything together**, with related processes: short films, quizzes, apps and an extensive training that allows to lift all those micro-experiences to a higher level. The challenge is to **ensure that learners access qualitative information** (see digital literacy).

- **Informal and non-formal learning systems become more important** and a part of the lifelong curriculum (C-VET). Through

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the (formal) recognition of skills and competences, informal and non-formal learning pathways show their importance in an **adaptive labour market**.

- **Agile learning** will be needed on the part of workers, as they shift from routine jobs to new, **previously unimagined job contents and tasks**. We need to learn the right skills and competences **at the right time, in the right place and environment** (on demand).

- There must be given **more attention to the highly educated workforce for innovation**, but in a way, **they must also train the lower-skilled workforce**.

Overall this requires that all stakeholders' attention and actions focus on several aspects in a complementary and collaborative manner:

- **VET regulatory and educational governmental entities** should create the conditions to ensure that the development of soft skills, collaboration and digital competences starts already in primary education and these skills must be further developed during secondary education.

- **Training providers** should provide an educational framework where training itself needs to be more flexible and adaptive. Lifelong learning will become more and more important and ways to provide the needed training courses at the right time and in the right format is a key change in the education provision.

- **Companies** should create closer links with training providers and closely collaborate with them in order to create, facilitate and strengthen work-based, dual learning and apprenticeships. Their role in facilitating and providing continuous learning will become bigger than it is now. They will have a relevant role in developing internally those skills and knowledge that they will require to their employees. OHS risks analysis will have to be continuously updated.

- **Workers Social partners** should provide key inputs and support to workers in order to facilitate them information and proper conditions enabling them to obtain a proper proficiency in the needed skills, knowledge and capacities within the sector. They will have to look into OHS risks change and create closer links with companies and workers to reduce their negative impacts.

- **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 proficiency in learning and self-improvement concerning skills for:

  1. Critical thinking and problem solving
  2. Collaboration across networks
  3. Agility and adaptability
  4. Initiative and entrepreneurship
  5. Effective communication
  6. Information retrieval
  7. Curiosity and innovation
  8. Digital literacy
  9. Data security

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IMPACTS OF THE DIGITAL TRANSFORMATION IN THE WOOD FURNITURE INDUSTRY

Lead partner:

CENFIM

Home & Contract furnishings cluster and innovation hub

With financial support from the European Union.

Associated organizations:

European Federation of Building and Woodworkers

EFBWW

UEA

EFIC

European Furniture Industries Confederation