FLAME

FURNITURE AND LANGUAGE
INNOVATIVE INTEGRATED LEARNING
FOR SECTOR ATTRACTIVENESS
AND MOBILITY ENHANCEMENT

Module 5

Automated production and software

FLAME

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Module 5

Automated production and software

AIM OF THE MODULE

This module describes Information Technology (IT) based production management. It describes the main systems which are important in furniture production including CAD – Computer Aided Design, CAM – Computer Aided Manufacturing, and CAE – Computer Aided Engineering.

LEARNING OUTCOMES

Knowledge

furniture construction
joining techniques
mounting and assembly techniques
upholstery making

Skills

producing furniture parts
selecting and mounting fittings
combining furniture parts to create a complete piece of furniture
combining different furniture to a system
sewing covers
cutting materials to size

LEARNING PLAN

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Unit 5.2 \ Hardware - pg. 11

Unit 5.3 \ Software - pg. 19

Unit 5.4 \ Automated processes - pg. 24

Unit 5.5 \ Robotics - pg. 32

ESCO PROFILES

7523 Woodworking-machine tool setters and operators

8172 Wood processing plant operators

1321s Industrial production manager

9329 Factory hands - Manufacturing labourers not elsewhere classified

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Unit 5.1

Information about IT/ICT technology

EDUCATIONAL APPROACH

Course book

Additional readings

External links

Exercises and games

ASSESSMENT

Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

0.04

Credits / 0.2 total of the module

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ERP (Enterprise Resource Planning) 5

E-COMMERCE 5

CRM (Customer Relationship Management) 6

BI (Business Intelligence) 6

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Unit 5.1 Information about IT/ICT technology

The most common ICT (Information and Communications Technologies) applications used in the furniture sector are, above all, ERP, as well as, to a lesser extent, e-commerce systems, customer management and decision-making dashboards in the area of business intelligence.

ERP (Enterprise Resource Planning)

These are multi-tier or multi-layered computing applications that integrate enterprise data and management processes into a single database (DB). This database works as a hub that stores, shares, and circulates data across different departments and areas of the enterprise. Although the DB is the core of these systems, features and applications are what really make one ERP different from another. There are two types of ERP overall: those specifically designed to manage the typical processes of a particular sector or activity (vertical ERP), and those designed to meet the generic needs of any type of industry or trade (horizontal ERP). In the latter case, some programming is normally required to adapt the generic functionalities to the particular aspects of each company.

The functionalities of an ERP are usually grouped in Modules, which represent processes or transactions carried out in the companies' generic management areas: Accounting and Finance, Commercial, Procurement, Production, Warehouses, Quality, Etc.

Applications: An ERP is used for business process management in a company's different functional areas. Applications include the most common processes, although depending on the type of ERP, singular processes can be added in certain industrial or commercial sectors. Typically, the modules included in an ERP facilitate the management of the following functional or analytical processes: **Accounting and financial management (1)**; Product setting; **Purchasing management (2); Production management (3);** Commercial management; **Warehouse management (4); Project management (5); Human resources management (6); Quality management (7); Presence monitoring (8).**

Industry Solutions: There are ERP systems specific to the furniture sector such as: QUONEXT (Microsoft Dynamics NAV (Navision)); NUBIT (Microsoft Dynamics NAV (Navision)); TECON (Microsoft Dynamics NAV (Navision)); EXPERT-FURNITURE (proprietary development); TEOWIN ERP (specialised in the manufacture of kitchens and cabinets); DEMON PRODUCTION ERP (proprietary development); UNYBASE (proprietary development); GPD-AIDIMME (proprietary development); SAGE MURANO FURNITURE ERP (based on Sage Murano); AQUA EMOBLE SUITE 2016 (proprietary development in collaboration with CETEM): PROLOGIC (proprietary development); PRODMANAGER (proprietary development); NAVISION DYNAMICS (generic but extended use in furniture); ABAS (generic but extended use in furniture); SAP (generic but extended use in furniture); SIMGEST (proprietary development, specialised in upholstery and rest sector, among others).

E-COMMERCE

The e-Commerce concept refers to the use of electronic means to conduct business transactions. It fundamentally means selling products over the Internet. **B2B (business to business) (9)** is an acronym related to business models where business transactions occur between companies; **B2C (business to consumer) (10)** refers to business transactions that companies develop to directly reach the end customer or consumer. In the case of B2B, the buyer is the company while in B2C platforms the buyers are the final consumers.

Today, the so-called "Platform Economics" has an impact on the new B2C and B2B business models through digital platforms. At the same time, a new generation of online shops related to Industry 4.0 is emerging, allowing the customer to choose, define or customise digital

models and pay for them to be created in the physical world. The synergy between this new generation of B2C online shops and the new B2B online manufacturing platforms is significantly interesting.

Applications: The application of B2C and/or B2B platforms consist of their use as an online sales channel by furniture and habitat manufacturers. The e-commerce B2C platform would be aimed at the large public and B2B to client companies, both should allow for purchases and for a specific final "product" to be designed in a completely customised way online.

Industry Solutions
- B2C e-commerce platforms: Archiproducts: products for architecture and design; Arredilick: furniture; Houzz: products and professionals for housing design and remodelling; Sayduck: habitat products in 3D and augmented reality; Form.bar: online shop that allows you to graphically design the geometry of the furniture, the end user can customise it.

- B2B e-commerce platforms: HiContract: hotels interior e-marketplace; Architonic: architecture and design products; ArchiExpo: architecture and design products; Eporta: architecture and design products; AllforHabitat: furniture.

CRM (Customer Relationship Management)

Customer Relationship Management (CRM) systems are software systems to support customer relationship management, sales and marketing. The system may include several features: sales and customers management; sales automation and promotion; **data warehouse (11)** technologies to add transactional information and provide a reporting layer, **key business dashboards (12)** and indicators, marketing campaign tracking and business opportunity management capabilities, sales forecasting and predictive capabilities, etc.

These tools use data analysis of customer history with the company to improve those business relationships, focusing specifically on retaining customers and ultimately driving sales growth. They collect data from a variety of communication channels, including the website, phone, email, live chat, marketing materials and, more recently, company social media.

Increasingly, CRM must be capable of being extended to support enterprise resource planning capabilities such as engineering, manufacturing, purchasing, finance and service management. Since enterprise CRM, or strategic CRM, is an integral part of the ERP, it provides complete customer information about the project, invoices, inventory, etc.

Applications: The modules included in a CRM are usually and with certain singularities: **CRM as a management model (14), social CRM (13), sales module (15),** and market module.

Industry Solutions: There are no solutions developed specifically for the furniture industry, since the most popular CRM applications are commonly horizontal. Some worth mentioning include: Microsoft Dynamics NAV; ForceManager; ProsperWorks; NetHunt; ActiveCampaign; Capsule; SalesMate; OnePage; Streak CRM.

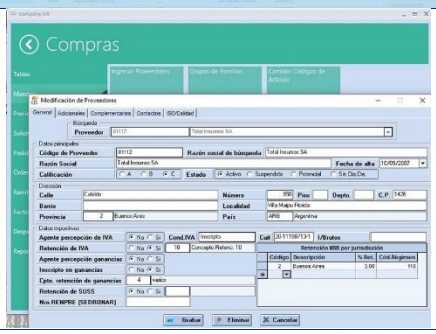
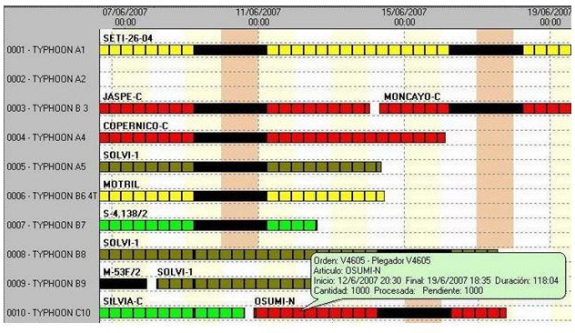
BI (Business Intelligence)

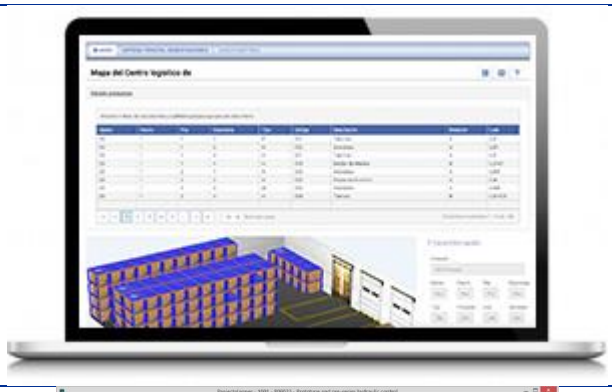
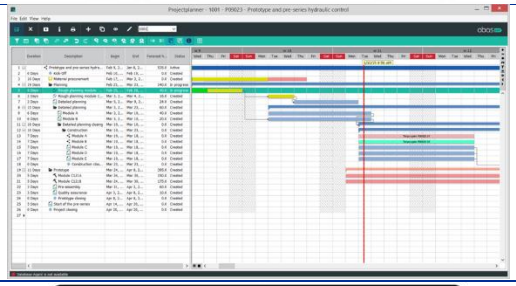
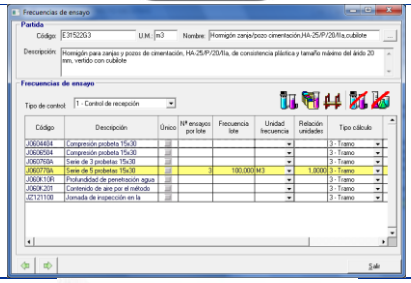
The term business intelligence refers to the use of data in an enterprise to facilitate decision-making. It encompasses understanding the company's current functioning, as well as anticipating future events, with the aim of providing knowledge to support business decisions. Business Intelligence (BI) leverages software and services to transform data into actionable intelligence that informs an organisation's strategic and tactical business decisions. BI tools access and analyse data sets and present analytical findings in reports, summaries,

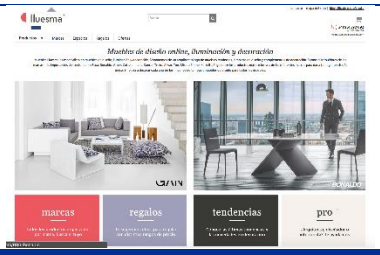
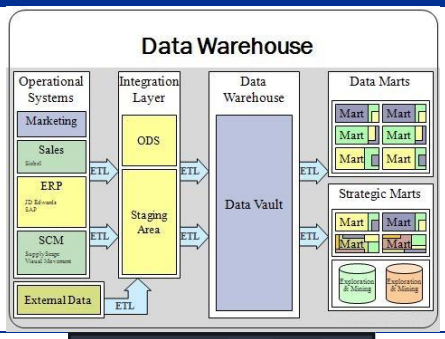
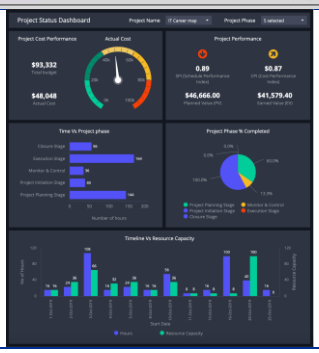
dashboards (16), graphs, and maps to provide users with detailed information about the status of the business.

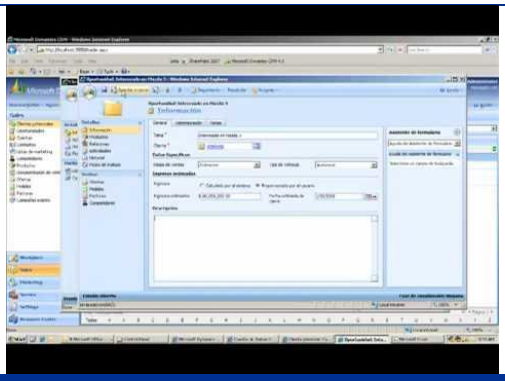
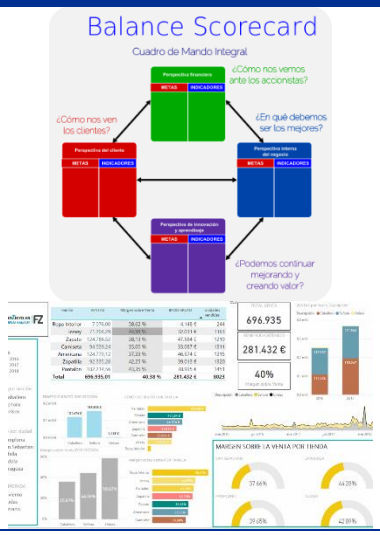
Applications: This set of tools and methodologies have the following applications in common: Accessibility to information. Data are the main source of this concept. These types of tools and techniques must firstly ensure users' access to the data regardless of where they come from; they should provide support in decision-making. The aim is to go further in presenting the information, so that users have access to analysis tools that allow them to select and manipulate only those data that interest them; orientation to the end user. Another objective is to ensure users do not need to have specific technical knowledge to be able to use these tools.

Industry Solutions: IBM Analytics; Stratebi; Quodata; Microsoft PowerBi; Qlik; Tableau.

ERP (Enterprise Resource Planning)		
Keyword	*Description*	*Image*
(1) Accounting and financial management	Management accounting consists of using, analysing and interpreting information obtained from financial accounting for short-term decision-making.	
(2) Orders management	Orders is the logistics function through which a company is provided with all the material necessary for it to operate properly.	
(3) Production management	Production management or operations management is the management of the organisation's productive resources. This area is responsible for the planning, organisation, management, control and improvement of systems that produce goods and services.	

(4) Warehouse management	The main objective of the warehouse management systems is to maintain the stock values of the goods and their location in the warehouse correctly and all the information on the movements of the goods within a warehouse.	
(5) Project management	Project management is the discipline that studies the planning, organisation, motivation and control of resources in order to achieve one or more objectives.	
(6) Human resources management	Specific modules to manage jobs and hiring, training and assessing employees.	
(7) Quality management	Module covering different approaches in the company, such as the management of "non-conformities", documentary management, purchasing parameters, production parameters, etc.	
(8) Presence check	The Presence Check Module provides real-time presence and access information, schedules, timetables, etc.	
E-COMMERCE		
(9) B2B (business to business)	Business transactions between companies	

(10) B2C (business to consumer)	Business transactions to directly reach the end customer or consumer	
CRM (Customer Relationship Management)		
(11) Data Warehouse	Data Warehouse is an integrated, non-volatile and time-variable data collection that helps make decisions on the entity in which it is used.	
(12) Dashboard	A type of graphical user interface that often provides at-a-glance views of key performance indicators relevant to a particular goal or business process.	
(13) Social CRM	Social CRM is the updated and modern traditional CRM that focuses on making it easier for companies to participate and generate value in social networks, where their current and potential customers are, with the goal of fostering brand loyalty and creating long-term relationships.	
(14) CRM management	Customer relationship-based management: an organisation-wide management model based on customer satisfaction.	

(15) CRM sales module	Section that manages and allows access to all the company's sales or potential sales.	
BI (Business Intelligence)		
(16) Dashboard	A dashboard is configured by KPIs accompanied by a graphical representation, so that information can be accessed visually and quickly. This type of tool allows for the optimisation of both strategic and tactical decision-making processes	

Unit 5.2

Hardware

EDUCATIONAL APPROACH

Course book

Additional readings

External links

Exercises and games

ASSESSMENT

Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

0.04

Credits / 0.2 total of the module

CONTENT

Hardware 12

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Unit 5.2 Hardware

This category brings together the most conventional machinery used in the furniture sector; the most advanced machinery (capable of fully automating production processes) will be dealt with in the "process automation" chapter.

WOOD SAWING

Sawing and sectioning are the first machining operations to be carried out transforming various pieces of wood that will make up the object or piece of furniture.

- **Band saw (17):** old and popular machine. Formed by a steel blade that only moves vertically and downwards. It cuts curved parts of different widths. The cut is less accurate than that of a mitre saw.
- **Mitre saw (18):** The main function of this machine is to make crosscuts; this machine will allow us to make straight or tiltable cuts up to 45º to finish joints to "miter" or "mitre".

PANEL SECTIONING

This category includes chipboard, finger-jointed board, plywood, etc. Conventional panels include **horizontal or circular saws (19):**

- Table saw (sliding table saw): This is a rotating saw blade that is located in the centre of the bench or table and protrudes above it. It has guides and stops and is mainly used to cut boards, although it could be used to cut wood.
- **Vertical circular saw (20):** Also known as wall saw, this machine is specially designed and adapted for cutting boards manufactured in a vertical position.

PLANING, THICKNESSING AND MOULDING

Once the wood has been properly sectioned with the saws and cutting discs, the following procedure is the planing and thicknessing of the boards, since the machine's own cutting tool leaves a highly irregular surface on the wood, uneven and rough. The aim is to obtain a perfectly balanced and levelled piece.

- **Planer (21):** The main objective of this machine is to even the wood, leaving it with the best possible finish, levelling it in the two axial directions (face and edge) thanks to its axis with blades, where the machine performs the planing with a circular cutting movement. The piece of wood will slide forward toward the blade holder axis.
- **Thicknesser (22):** The aim of this machine is to deliver the wood with the final width and thickness, having previously planed its face and its edge. This machine reduces the section, making all faces parallel to each other and equal.
- **Milling spindle moulder (23):** A very versatile machine that allows the operator to carry out many different operations (moulding, grooving, etc.). The axis of the machine allows the cutting tools (mills) to be changed. The forward movement is always generated by the wooden piece itself, which is machined by the circular rotation movement of the cutter inserted into the axis of the machine.

Vertical table milling machines or tupís carry out many operations and have a number of accessories, such as saws, mills, etc., that can be exchanged with each other.

MACHINING OF ASSEMBLIES

The delivery of assemblies and couplings in wood is a work that is carried out continuously in any workshop or factory dedicated to handling and transforming wood (doors, windows, furniture, etc.). This is mainly due to the dimensional limitations inherent in wooden boards, as a result of the sawing of the trunk. The characteristics of the furniture and elements that are manufactured in carpentry make it necessary on most occasions for them to fit together in a perpendicular or oblique manner. These connections are made by means of assemblies **(tenon and mortise (24)** or grooves.

- Tenon machining (25): This machine consists of a very robust body containing the entire engine and accessories which, in turn, contain a special trimming unit and a system of guides that allow the movement of oscillation of that group and of the working tables on which the parts are placed to machine them.
- Mortise machining (26): In any wooden assembly, it is essential to make the mortise, which receives the tenon. The automatic mortise machine has a rotary drill movement and at the same time an oscillating one, so the swing will create a mortise in the piece with the same length as the swing motion. They can be replaced by vertical drills or by combined planers; they are placed with a mortise accessory.
It is used to make holes, boxes and mortises for all kinds of joints.
- Dovetail joints: Dovetailer (27): This type of machine is mainly used in large industries dedicated to the manufacture of furniture. They allow companies to make large-scale, productive, high-level dovetail assemblies with a quality finish.
- Multi-hole and semi-automatic drilling (28): One of the most important machining works carried out, especially in the modular furniture and kitchen industry, is the drilling of the boards, due mainly to the growing implementation of removable or in-kit furniture and the need to machine all fittings, assembling systems and components of the piece of furniture. The in-line drilling phase is located just after the sectioning and cutting of the board, leading to the end of the machining of the piece.

EDGEBANDING (29)
In order to achieve a perfect result when working with a panel, it is necessary to edgeband it. This process uses glue strips or tape on the edges of the board to hide its unappealing interior. These veneers or strips can be found in very different colours and textures, from a natural wood veneer to PVC or other synthetic materials to achieve the same appearance as the board. The process of edgebanding a wooden board is fairly simple and can even be done without specialised machinery. However, to achieve a proper, long-lasting result, it is necessary to use industrial machinery or processes.
- Pre-glued edgebanding machines: The gluing system is very simple, since it mainly uses the glue that has its own edging veneer as a starting material. A jet of hot air that is projected onto the surface of the veneer melts the adhesive. Subsequently, a system of rollers presses against the edge of the board and, within a few seconds, the glue cools down and is attached to it.

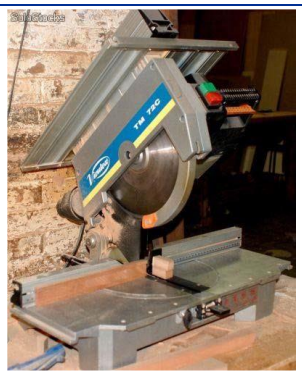
UNIVERSAL COMBINATION MACHINE (30)
This machine is found in many carpentry workshops; it manages to include different work equipment in a single machine. On example of configuration can be the following: multi-function combination of 6 desktop operations (Planer - thicknesser - Drill - Circular saw - Sliding carriage - Vertical spindle moulder.) This is a small and compact machine ideal for bench use, which is suitable for small carpentry and craftwork.

SANDERS
A good finish is impossible without being perfectly sanded. As a rule of thumb, the wood must be sanded whenever it can be in the direction of the grain, first with rough or half sandpaper and finishing with very fine sandpaper.
- Belt sander (31): This type of machine is based on the operation of the calibration sander; applied manually, the operator will sand the surface until the entire part is finished.
- Edge sander (32): Commonly, the edges of the parts also require sanding, and so-called edge sanders are quite useful. It is very simple to operate. A belt-shaped piece of sandpaper placed on a vertical plane will sand the edge surfaces easily. These machines can be fitted with a feeder similar to the one used for spindle moulder machines.

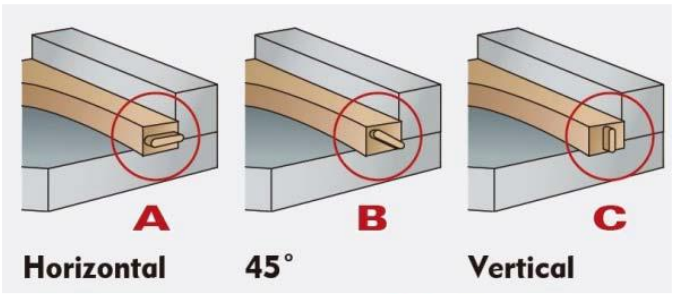
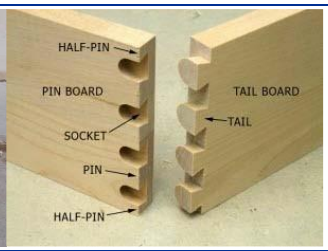
SIMPLE BOOTHS FOR FINISHING (paint and lacquer application)

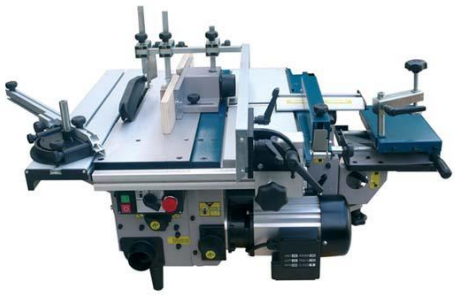
The last process in manufacturing a piece of furniture is **finishing (33).** A good finish depends on two fundamental factors: correctly preparing the surface and the procedures followed for the finish itself, which include applying the dye, drying the dye, applying the background, drying the background, sanding the background layer, applying the finishing and drying the finish. Sometimes, if a high gloss finish is desired, a polishing process is also performed.

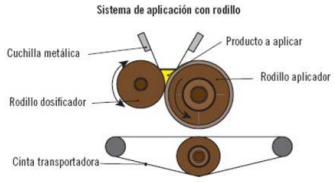
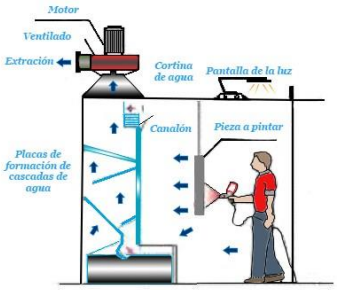
- **Dry filter booth (34):** These are paint booths that have an extraction hood that ensures that the airflow is homogeneous across the entire surface.
- **Water curtain spray booths (35):** The volatile compounds from the application of paint and varnish pigments are filtered by means of water curtains.

HARDWARE		
Keyword	*Description*	*Image*
(17) Band saw	Bandsaw for wood	
(18) Mitre saw	Wood saw for long cuts	
(19) Horizontal circular or table saw (sliding table saw)	Circular saw to cut panels	

(20) Vertical circular saw	Vertical circular saw to cut panels	
(21) Planer	Blade machine to level the piece in two axial directions (face and edge)	
(22) Thicknesser	Blade machine responsible for reducing the section making all faces parallel and equal to each other	
(23) Milling spindle moulder	Milling and other operations	

(24) Tenon and mortise	Joints and assemblies	
(25) Tenoner	Machining of tenon for “tenon-mortise” joints	
(26) Mortiser	Machining of mortises for “tenon-mortise” joints	 *Escopleado realizado en máquina*
(27) Dovetailer	Dovetail joints	 

(28) Drilling	Multiple and semi-automatic drill	TALADRO SEMIAUTOMATICO TALADRO MÚLTIPLE
(29) Edgebander machines	Edgebanding	
(30) Universal combination machine	Small machine for several tasks: planing, thicknessing, sawing, drilling, etc.	
(31) Belt sander	Machine for manual surface sanding	
(32) Edge sander	Machine for manually sanding edges	

(33) Roller application	For applied finishing	
(34) Dry filter booth	Paint booths	
(35) Water curtain booth	Paint booths	

Unit 5.3
Software

EDUCATIONAL APPROACH

Course book

Additional readings

External links

Exercises and games

ASSESSMENT

Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

0.04

Credits / 0.2 total of the module

CONTENT

MES (Manufacturing Execution System) 20
B2B (Business to Business Manufacturing Platforms) 20
WMS (Warehouse Management System) 21
DRP (Distribution Resource Planning) 21
In-Plant Data Capture (RFID) SWb 21
Collaborative Working Environment (CWE) 21

Co-funded by the Erasmus+ Programme of the European Union

Unit 5.3 Software

Due to their current success, collaborative work platforms will be included in this section next to the other specific software applications that are detailed below.

MES (Manufacturing Execution System)

MES systems (36) (also known as MOM, *Manufacturing Operations Management*) are computer tools that facilitate the management of operational processes, which bridge management systems (ERP) and plant control elements (PLCs, sensors, actuators, etc.). These systems use data obtained from both processes to transform them into useful information for decision-making.

MES systems always use up-to-date, specific data, which allows them to report and give quick responses under changing operating process conditions. They allow indicators to be calculated accurately (such as OEE, Overall Equipment Effectiveness).

The scope of a MES system is immense, ranging from systematic oriented operations to planning operations to managing and controlling the main characteristics associated with manufacturing: Product manufacturing; controlling the start-up of productive equipment; measuring parts; changing manufacturing orders; reading measurements; programming and reprogramming machine orders; allocating inventory; moving inventory to workstations; allocating personnel; working in progress management; setting alarm signals; etc.

Applications: To gather, store, process and manage data related to intelligent processes, machines and devices resulting from increased interconnectivity and deployment of advanced sensor networks; to process the collected data to provide the necessary information and to guide optimal decision-making resulting in agile and flexible factories; to ensure product and process quality; comprehensive traceability for the different production processes, while also associating the corresponding manufacturing conditions; to process performance monitoring and management by providing tools to analyse all necessary data and lead to improvement actions.

Industry Solutions: There are no sector-wide solutions, as the existing ones are of horizontal nature: Edinn; Mapex; Sima; Simatic it Mes (Siemens); Captor; Mesbook; Doeet.

B2B (Business to Business Manufacturing Platforms)

In Industry 4.0 machines are highly equipped, with sensors, Internet connectivity and the ability to be integrated modularly into cells or lines of automatic and flexible manufacturing. The integration of a MES managing Industry 4.0 systems with a digital platform offers a broad range of applications with enormous potential. Industry 4.0 allows the principles of lean production to be brought to the limit, minimising waiting times, stocks and defects. The platform is powered by digital models that inform the production system the characteristics of the product to be manufactured and the manufacturing orders. These models are part of the **B2B (37)** transaction itself.

Industry Solutions:
TAPIO: Manufacturing system aggregation platform 4.0 of the furniture sector developed by HOMAG;
SOPHIA: BIESSE Internet Of Things Platform.

WMS (Warehouse Management System)

A **Warehouse Management System (WMS) (38)** is a computer tool used to control, coordinate and optimise the movements, processes and operations in a warehouse. Its main objective is to maintain the stock values of the products and their positions in the warehouse correctly, as well as to manage all the information of the movements of the products and articles.

Its main functions include: Receiving goods; gathering logistic data (bar codes or RFID tags), choosing the ideal location in the warehouse for each loading unit. For that purpose, the software takes into account parameters such as the rotation and coverage of items (products A, B or C), the types of containers used to consolidate how items are grouped, the families or types of products that are handled, the danger or incompatibility of certain items with others so that they are not placed together or close to one another, the volume of the products, etc.

A WMS aims to minimise the movement of goods within the facility. It is applied before proceeding to the final loading location. This function is executed as long as picking positions have been set. The WMS is able to provide complete and useful information about the stock in managing stored products.

DRP (Distribution Resource Planning)

Distribution Resource Planning (DRP) (39) is a method used in business administration to plan the issuance of product orders within the supply chain. DRP sets certain parameters for inventory control and to calculate the stock requisition time. This module performs its own set of functions with the aim of achieving efficient inventory distribution planning.

Its main functions include: planning and issuing of supply orders; tracking supply orders; allocating supplies when there is a shortage of a product; planning shipping capacity.

In-Plant Data Capture (RFID) SW

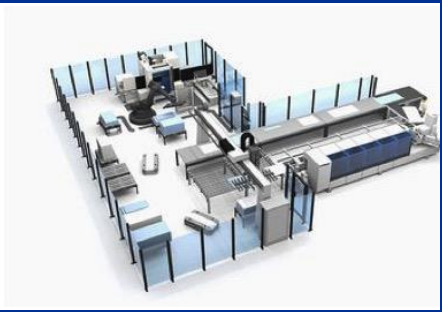
Radio Frequency Identification (RFID) is a system to store, retrieve, transmit and simultaneously identify data. Real-time database access is carried out by encoding and decoding information. Radio frequency identification technology is capable of transmitting the identity of an object using radio waves, so products that are encoded by radio frequency technology have a chip, which contains all the information about them. This information is encoded by specialised readers with antennas, which at a certain distance, automatically read the hosted information.

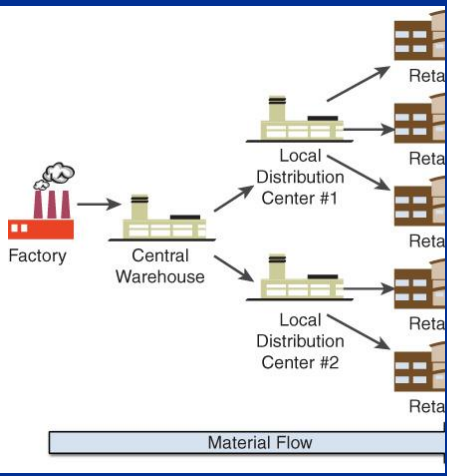
Collaborative Working Environment (CWE)

The term **CWE (Collaborative Working Environment) (40)** refers to environments that enable professionals to collaborate regardless of their geographical location through an electronic and communications system, both synchronously and asynchronously. The Building Information Model (BIM) is a new way to create digital models which has gained momentum in the building sector and it is also spreading to equipment and furniture. The actors involved in the BIM are builders, installers, architects, structural engineers, interior designers, designers and the owners themselves. The European EUBIM (www.eubim.EU) project works along the liens of creating a body of knowledge and a base of standards for the application of BIM.

<u>Industry Solutions:</u>
GRABCAD: Collaboration platform for professionals, designers and students in which digital CAD models are shared; OpenDesk: Open repository of 3D digital models related to the world of furniture; Blophome: Application of interior design that allows users to design, decorate and

reform 3D spaces; BIMARIUM: Repository of BIM models of parts and elements for furniture design and construction; BIM.ARCHIPRODUCTS: Warehouse of thousands of BIM and CAD objects related to furniture and the habitat sector; BIMOBJECT: Repository of nearly 300,000 BIM objects that can be downloaded free of charge. BIM objects are classified into 22 large families, including: furniture and decoration, kitchens, doors, etc.

B2B (Business to Business Manufacturing Platforms)		
Keyword	*Description*	*Image*
(36) MES	Manufacturing Execution System	
WMS (Warehouse Management System)		
(37) B2B	Digital platforms to connect businesses	
DRP (Distribution Resource Planning)		
(38) WMS	Warehouse Management System	

In-Plant Data Capture (RFID) SW		
(39) DRP	Distribution Resource Planning	
Collaborative Working Environment (CWE)		
(40) CWE	Collaborative Working Environment	

Unit 5.4

Automation processes

EDUCATIONAL APPROACH

Course book

Additional readings

External links

Exercises and games

ASSESSMENT

Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

0.04

Credits / 0.2 total of the module

CONTENT

Automation processes 25

Co-funded by the Erasmus+ Programme of the European Union

Unit 5.4 Automation processes

WOOD SAWING (41)
- Panel cutting saw: to achieve higher productivity in woodcutting, the cutting system can be arranged longitudinal to the table and the sectioning of the panels can be performed automatically.

SAWING OF PANELS using CNC
- **Panel cutting saw (42):** The CNC machine is in charge of sectioning the panels. These machines are well suited to work with large panels. The worktable is the same as or similar to the table in the solid wood machining centre. They are quite large machines.

AUTOMATIC MOULDERING
- **Moulders (43):** These machines are capable of combining certain fundamental cycles of wood machining (planing, thicknessing, moulding, etc.), thereby saving a considerable amount of time. They prevent the operator from moving through the various machining phases and save space in the workshop; they do not require one or more operators to operate each station. Moulder machines are compact and relatively small compared to the volume and space that would be occupied in the workshop by separating the machine's functions among different machines.

MACHINING OF CURVED PARTS
- **Milling machine (44):** in order to obtain a curved piece made of wood, the machine must saw using the belt saw; we need to first mark the curved shape on it beforehand, or have a belt saw with the cutting system driven by an automatic system. This machine, called a milling machine, will mill according to the movement of the cutting elements on a template with the final shape of the part. This is generally a dual operation, milling two faces at once.

EDGEBANDING
- **EDGEBANDER with EVA adhesives (45):** unlike the previous machine, this edgebander includes a reboiler to warm up the EVA adhesive which is applied on the panel when the glue is applied. These are larger machines, traditionally used to edgeband panels in the furniture manufacturing industry. The machine includes milling tools to cut the exceeding edge along the panel and finish the process of joining the two objects.

- **EDGEBANDER with PUR adhesives (46):** thermosetting Polyurethane adhesive hardens in a unique way when it comes in contact with air and humidity and not when it cools down after being applied like thermosetting EVA adhesives. Thus, it requires certain specific conditions for it to be used and thorough equipment maintenance. Its use is recommended only in continuously manufacturing large series in high production edgebanders with specific deposits and premelters.

- Laser edgebander: Laser technology for the edging can be considered as the latest innovation in the process. The final goal is to achieve an imperceptible joint between edge and surface (invisible or zero join). This process uses no adhesive. The edge must include a polypropylene layer in its front. The PP reacts, melts and penetrates the board, so the joint between edge and board is almost invisible.

SANDERS AND AUTOMATIC WIDE BELT SANDERS (47)
Also known as wide belt sanders, these machines are robust, large and square with approximate dimensions of 1,900 x 1,950 x 2,080 mm. They operate in a manner very similar to thicknessers; however, the blade axis is occupied by a roller system which enables the belt

sanders to rotate. One of the main advantages of these sorts of machines is that they are able to accurately sand to a few tenths of a millimetre, controlled by an operator and by means of the previous adjustment of the table. This makes them as ideal for sanding fragile surfaces such as manufactured panels with natural coatings.

MACHINING IN CNC MACHINE CENTRES (48)
CNC is used in the manufacturing of a great number of carpentry, joinery and other products. CNC systems applied to machines and tools have provided a unique boost to production and they have enabled operations which were difficult to carry out with conventional machines, such as, spherical surfaces with a high degree of dimensional accuracy. There are infinite settings depending on what is required each time, including elements such as drills, milling groups, and disc saws.

FINISHING LINES
These lines are usually divided into modules that increase versatility and the ability to adapt to the needs of each organisation. Some of the modules that integrate these finishing lines are mentioned below, including their description and main features.

- **Brush cleaner (49):** This is a module composed of brushes inside it, which turn in the opposite direction to how the parts (always flat) move forward. The function is to clean the parts.

-Curtain coating system: This is a system to apply varnishes and lacquers on flat (or relatively flat) parts, as long as their surface rests inside the projected curtain.

- **Roller coater (50):** For this system, a pump releases the material to two rollers, which are positioned one after the other.

HEAT-ACCELERATED DRYING PROCESS (DRYING TUNNELS)

These systems are of great importance in finishing lines since they represent a continuous process where parts have certain products applied to them. These products must be dried during the cycle in order to apply the following product. Typically, a product application module is followed by a drying module. In accelerated drying, there are several methods that contribute to accelerating the productive or industrial processes of finishing furniture, while optimising the time required.

- **Drying by thermal transfer (51):** This process is based on the physical principle that when two bodies or elements with different temperatures come into contact, their temperature tends to be regulated by transferring heat the warmer object to the colder one. As with drying at room temperature, this process requires rooms built for this purpose, where heaters or hot air tunnels are installed. The wooden parts enter the booth by transfer, rails, overhead conveyors, etc., and when they exit at the other end, they are already dry and ready to receive another product if it is required.

- **Drying by IR radiation (52):** IR rays are certain long-wave and short-frequency electromagnetic waves that carry heating energy. Infrared rays, located on the electromagnetic radiation scale between the visible spectrum of light waves and short radio waves, with a wavelength between 7,700 and 4,000,000 A, are highly suitable in order to dry wood.

- **Drying by ultraviolet radiation (53):** This system is based on the principle that certain electromagnetic waves of shorter wavelength and higher frequency stimulate the fluorescence of certain substances. Ultraviolet rays, which are scaled to electromagnetic

radiation between the X-rays and the visible colour field, have a wavelength between 150 and 3,900 A and are suitable for the stimulation or initiation of the photo drying processes.

FINISHING BOOTHS

- **Pressurised booth (54):** These booths feature a closed, insulated chamber with automatically regulated and constant temperature and humidity conditions. Powerful fans perform the suction and water curtains or dry cardboard filters perform the filtration.

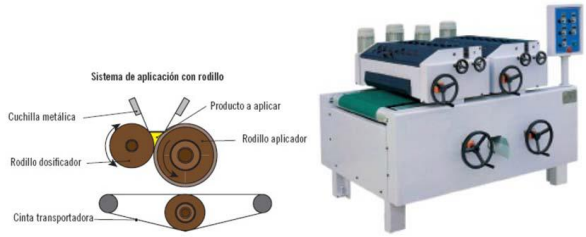
- **Drying zone (56):** This can sometimes be considered part of a temporary storage area, since the product must be kept under adequate conditions during the drying or curing process, so that the characteristics of the applied substance and/or the support where it has been applied are not altered.

SPRAYING ROBOTS (55): These are high-tech, computer-controlled automatic painting machines. Robots are used for applying products with pistols, applying water or solvent dyes, background or finishing varnishes, pigments or transparent finishes, whether polyurethane, nitrocellulose, polyesters, conventional drying acrylics, etc.

PRODUCT SANDING (57): Sanding varnishes is key to get a good finished product. With the sanding process we must aim for a perfect level, removing the imperfections from the top of the surface, until we reach a completely homogeneous layer. The sanding must be performed in the direction of the vein, so that the final scratches are unnoticeable. For the sanding, we use automatic two-belt machines.

AUTOMATION PROCESSES		
Keyword	*Description*	*Image*
(41) Wood sectioning	Automatic system to section wood in a transverse direction	
(42) Panel sawing	CNC system for panel sectioning	
(43) Moulder	Complete system with planing, thicknessing and moulding	
(44) Milling machine	Construction of curved parts	

(45) Edgebander with EVA adhesives	Edgebanding with EVA	
(46) Edgebander with PUR adhesives	Edgebanding with thermoset polyurethane glue	
(47) Sanders and automatic wide belt sanders	Automatic roller sander	
(48) Machining in CNC machine centres	Computerised machinery for several applications: drilling, milling, grooving, etc.	
(49) Brush cleaner	To clean parts before applying the finishing	

(50) Roller coater	For the finishing application	
(51) Drying by thermal transfer	To dry parts before applying the finishing	
(52) Drying by IR radiation	To dry pieces by means of IR rays	
(53) Drying by ultraviolet radiation	To dry parts by ultraviolet rays	
(54) Pressurised booth	Conditioned area for finishing and drying processes	

(55) Spray robots	Robots to apply sprays, background or finish	
(56) Heating air dryers	To dry products (both after staining and varnishing)	
(57) Product sanding	To sand products after varnishing	

Unit 5.5
Robotics

EDUCATIONAL APPROACH

Course book

Additional readings

External links

Exercises and games

ASSESSMENT

Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

0.04

Credits / 0.2 total of the module

CONTENT

Robotics in production 33
Robotics in logistics 33
Collaborative Robotics 34

Co-funded by the Erasmus+ Programme of the European Union

Unit 5.5 Robotics

The ISO standard defines an industrial robot as "an automatically controlled, reprogrammable, multipurpose manipulator, programmable in three or more axes […]". In the furniture sector, robotics are increasingly used to execute industrial processes, thanks to their many advantages. Within the sector, robotics is divided into three key fields of application: Robotics in production, robotics in logistics, and collaborative robotics.

Robotics in production

Robotic manufacturing can radically change the production lines of the furniture industries. The main benefits of robotics as a means of automating production processes are productivity, flexibility, quality and job safety.

Robotics can provide a series of advantages in process automation in the furniture industry: Reduced times, greater autonomy and control, greater accuracy and precision, high levels of reliability, increased final quality, avoiding reprocessing, high versatility (as it offers the most flexible technology within the automation alternatives), etc. As humans no longer perform the most dangerous tasks, robotics also reduces the risk of accidents.

The inclusion of robotic cells in the industry allows companies to increase production levels, reduce personnel costs, avoid unwanted downtime and increase overall productivity.

Applications: Handling of materials and components (**loading and unloading**); welding (arc, spot, laser, etc.); final spraying (**painting**, **varnishing**, lacquering, enamelled, adhesive application, etc.); connections and assemblies; **packaging;** assembly and disassembly; organisation of finished products and stocks; other processes (cutting, chipping, sanding, machining, etc.)

Sector solutions: nowadays there are developed solutions suitable to be implemented in furniture companies:

- KUKA: **Robots for painting (58),** production, assembly and **polishing.**
- RIVAS ROBOTICS: **Robots for loading and unloading (59),** CNC feed, machining, varnishing and **palletising.**
- PROBOT: **Robots for handling (60),** assembly, **sanding**, painting, production, stapling, etc.
- TAMAUTOMATION: TOPAZ series for **sanding and polishing (61).**
- CMA ROBOTICS**: Varnishing robots (62).**
- NIPUER: Robots **for palletising, handling and machining (63).**
- Barberan: Varnished robots.
- EPISTOLIO ROBOTS: Robots for painting.
- BERRIAK AUTOMATISMOS: Robots for feeding and stacking parts.
- ABB: Robots for **handling materials**, paint and coatings, polishing, sanding and finishing.

Robotics in logistics

Logistics includes reception, storage and movement within the warehouse and production plant. The interest in the use of robotics in logistics is based on the ability to release operators from complex, monotonous or taxing physical tasks.

Many of the tasks to be carried out in managing a warehouse can be solved today by means of different forms of automation, but always complying with certain standards so that its use is

optimal: controlled measures and weights, safety in handling, homogeneity in characteristics, etc.

In logistics, robotic applications are classified into two large groups:

- Loading robots: these have movements on three axes and are able to move large loads between two points.
- Logistics robots: these are programmed to move freely and are capable of moving shelves and drawers full of products.

The main advantages of robotics in logistics include process optimisation, reduced operator movements and optimisation in resource and raw material use.

Applications: Robotics in logistics processes aims to perform the tasks of lesser value input and to free operators from riskier and heavier activities, performing complex tasks such as: Packaging, **palletising (65),** de-palletising and preparation for shipping; loading and unloading operations; picking jobs: collecting products stored on shelves or other similar items; packaging and customisation: removing and introducing products, repositioning and labelling; storage: automatic translifters, which run through the aisles of the shelves; intelligent industrial **unmanned vehicles (66):** by automatic track guidance or AGV.

Industry solutions:

- ABB: Picking, packaging and palletising.
- YASKAWA MOTOMAN: Palletised and palletised with 2D and 3D vision systems; packaging robots.
- ADEPT LYNX: Internal logistics and freight and offload travel.
- SMARLOGY LOGISTICA: Palletised with anthropomorphic and Cartesian robots.
- SMART TECHNOLOGY: AGVs, unmanned vehicles for the transport of all kinds of goods.
- KUKA - SWISSLOG: **Order Preparation (67)** System.
- ROBOPAC: Robots for **packaging (68).**
- INSER ROBOTICS: Robotic packaging; formed and filled **cardboard boxes and trays (69).**

Collaborative Robotics

Collaborative robotics is the latest branch of robotics and consists of lightweight, flexible and easy-to-install robotic arms, capable of interacting with humans in a shared workspace, without the typical safety restrictions of industrial robotics (no safety fencing required).

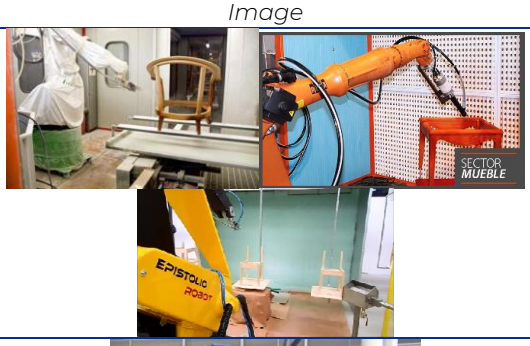
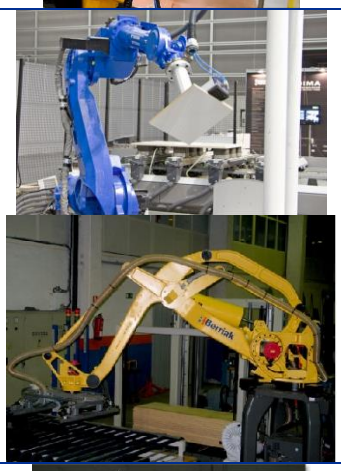
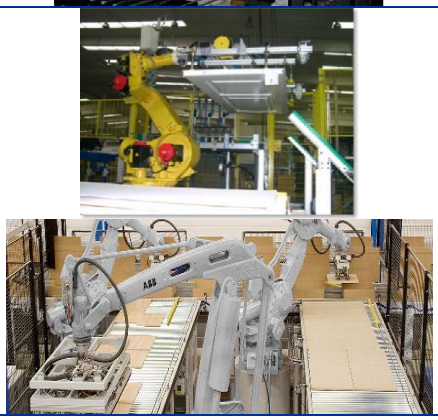
In the collaborative environment, humans are responsible for providing skill, flexibility, analysis and problem resolution, and the collaborative robots are responsible for accuracy, strength and endurance.

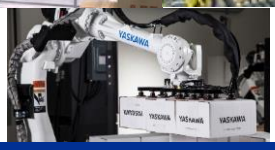
Collaborative robots can be easily programmed, require no specialised technicians and can be configured to operate in different industries or industrial processes.

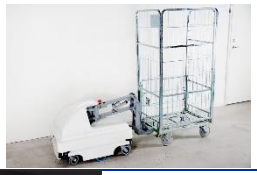
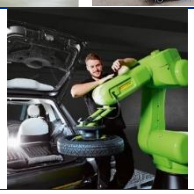
Applications: Examples of activities carried out by collaborative robots within the habitat sector include: handling materials; artificial vision to recognise and position parts; furniture resistance testing; spring manufacturing; seat bolting; material handling of heavy furniture, material joining, packaging, joining, part placement; part testing, palletising, assembly, gluing, painting, welding and polishing.

Industry solutions:

- **Universal Robot 5 (UR5) (70):** Load of 5 kilos. This robot provides the help needed to move objects of considerable size.
- MIR: **Internal transport (64).** 100 kg load, 300 kg carry-over. This robot contains sensors and an integrated map of the layout of the work building to perform its mission.
- MEKATRONIKA SISTEMAK: This robot performs part testing, assembly, gluing, painting, welding and polishing.
- RETHINK ROBOTICS: Sawyer: CNC machining; loading and unloading, moulding operations, packaging.
- FANUC: CR-35iA system**: Transporting heavy parts (71)** (up to 35 kg). FANUC.
- Yumi: Flexible. **Assembly of small parts (72),** feeding of parts to the systems, locating parts with cameras and next generation robotic control. ABB.

Robotics in production		
Keyword	*Description*	*Image*
(58) Robotics for painting	Automation of the paint application process by anthropomorphic robot and specific paint head	
(59) Loading and unloading	Automation of the loading and unloading processes of machines using robotic manipulators and suction unit heads or similar ones	
(60) Material handling	Handling and exchange of materials between machines and internal transport systems	

(61) Sanding and polishing	Automation of sanding and polishing processes of wood surfaces and edges	
(62) Varnishing	Application of varnishing by rotating robots	
(63) Packaging and palletising	Packaging and palletising of elements and housing in boxes and pallets	
Robotics in logistics		
(65) Special palletising	Specific palletised items based on anthropomorphic and Cartesian robots, applicable to a wide variety of products and formats.	
(66) Unmanned vehicles	Unmanned vehicles for the transport of all kinds of goods	
(67) Order preparation	Handling and inserting parts in boxes or housings according to sequence	

(68) Packaging	Stand-alone pallet packaging systems and similar items.	
(69) Carton box production systems	Formed and filled cardboard boxes and trays. Palletising and depalletising with automatic labelling	
Collaborative Robotics		
(70) Universal robots	Collaborative robots adaptable to a wide range of loads and work areas.	
(64) Internal transport	Internal transport between known points	
(71) Transporting heavy parts	Transport of heavy parts (up to 35 kg).	
(72) Assembly of parts	Assembly of small parts, feeding of parts to the systems, locating parts with cameras and next generation robotic control.	

References

Books

AIDIMME, AMUEBLA, CENFIM, CETEM (2018). *HABITAT 4.0 project - viability analysis for the implementation of the "connected industry initiative 4.0" in the habitat sector.*

Webpages

ABB: <https://new.abb.com/es> [Query: 22/01/2020].

BARBERAN: <https://www.barberan.com/es> [Query: 20/01/2020].

BIESSE: <https://www.biesse.com/es/madera/> [Query: 18/01/2020].

BIESSE: <https://www.biesse.com/es/madera/> [Query: 20/01/2020].

BIESSE: <https://www.biesse.com/es/madera/> [Query: 22/01/2020].

BIM.ARCHIPRODUCT: <*bim.archiproducts.com* > [Query: 22/01/2020].

BIMARIUM: <*www.bimarium.com*> [Query: 18/01/2020].

BIMOBJECT: *www.bimobject.com/es* [Query: 18/01/2020].

DIOTTI.COM. *Arrecdaclick*. <https://www.diotti.com/> [Query: 29/01/2020].

DOEET:< https://doeet.es/>[Query: 18/01/2020].

EDINN: <https://edinn.com/> [Query: 18/01/2020].

FANUC: <https://www.fanuc.eu/es/es> [Query: 22/01/2020].

GRABCAD: <*www.grabcad.com* > [Query: 18/01/2020].

HOMAG: <https://www.homag.com/es/> [Query: 15/01/2020].

HOMAG: <https://www.homag.com/es/> [Query: 20/01/2020].

HOMAG: <https://www.homag.com/es/> [Query: 22/01/2020].

HOMAG: https://www.homag.com/es/ [Query: 18/01/2020].

HOUZZ. <https://www.houzz.es/> [Query: 29/01/2020].

IBM ANALYTICS: <https://www.ibm.com/es-es/analytics> [Query: 29/01/2020].

KUKA: <https://www.kuka.com/es-es> [Query: 22/01/2020].

MESBOOK: <https://mesbook.com/> [Query: 18/01/2020].

MICROSOFT NAVISION. <https://dynamics.microsoft.com/es> [Query: 29/01/2020].

MICROSOFT POWERBI: <https://powerbi.microsoft.com/es-es/> [Query: 29/01/2020].

ON-IDENTITY:< https://onidentityrfid.com/> [Query: 18/01/2020].

PROBOT: <https://probot.es/> [Query: 22/01/2020].

SCM: <https://www.scmgroup.com/es> [Query: 20/01/2020].

SCM: <https://www.scmgroup.com/es> [Query: 15/01/2020].

UNIVERSAL ROBOT: <https://www.universal-robots.com/> [Query: 22/01/2020].