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Fuel for SME Competitiveness

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Contents

List of abbreviations

ADSL	Asymmetric Digital Subscriber Line
B&H	Bosnia and Herzegovina
BAM	Konvertible Mark
CAD	Computer-aided Design
CAE	Computer-aided Engineering
CAM	Computer-aided Manufacturing
CAP	Computer-aided Planning
CNC	Computer Numerical Control
CRM	Customer Relation Management
EDC	Enterprise Data Collection
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
EU	European Union
GIZ	Gesellschaft für Internationale Zusammenarbeit
ICT	Information and Communication Technology
IoT	Internet of Things
OECD	Organization for Economic Cooperation and Development
PPS	Production Planning System
RFID	Radio Frequency Identification
SDSL	Symmetric digital subscriber line
SME	Small and medium Enterprise
TQM	Total Quality Management
VDSL	Very high-speed digital subscriber line

Abstract

The aim of the present study is to identify potential fields and application ideas for further improvement of the competitiveness of companies in the metal and wood sectors through the increased use of ICT technologies and the development and implementation of appropriate solutions in selected SMEs.

Based on an analysis of the current situation of needs and potentials of an increasing ICT use in the companies, potential fields of action will be developed with the aim of further increasing the innovative strength and competitiveness of companies and sectors themselves.

Within this framework, EU ProLocal supported projects in 27 selected companies that contained ICT components (mainly the use of CNC production technology and related programming systems) and that were launched in a timely manner were examined and interviews were conducted with the management of the companies and 12 different funding organizations (supporters, intermediaries) on the basis of prepared, structured questionnaires. All these companies and intermediary institutions were supported through grant co-financing within EU ProLocal Grant Scheme, implemented 2017 – 2018, aiming at improvement of competitiveness of SMEs through innovation and strengthening the municipal management capacities for economic recovery and development.

As a result of the analysis, the current situation can be presented, further needs identified, and recommendations for action formulated. For the companies visited, written recommendations were drawn up for a further, more in-depth use of ready to use ICT. Information is given on the services, and business environment companies need in order to initiate a digital transformation process. Business development agencies, universities, associations, clusters and chambers (intermediaries) can play a decisive role in this context in the future.

By organizing 3 separate round tables, the findings and the results of the study could be presented and verified with the local actors. The study concludes that the current understanding of digitalization in the two sectors mainly focusses on the isolated use of individual solutions.

Innovative business ideas which entirely build on improved, digitalized business processes have not yet been fully identified.

1. The research methodology

Qualitative research is based on in-depth, semi-structured interviews with directors of B&H companies and their associates, as well as with representatives of supporting institutions / organizations regarding the current status of digitalization in their companies and possibilities for improvement. Quantitative research is based on questionnaires (different questionnaires for SMEs and for supporting institutions / organizations). The questionnaires for SMEs aimed to identify the extent and range of digitalization companies use to increase their competitiveness. The questionnaires for supporting institutions / organizations aimed at identifying capacities for providing support in the digitalization process. The key findings are presented in the following chapters and shown in detail in the Annex. The research was conducted in B&H from December 2018 to March 2019. The target group included 27 SMEs (16 metal processing companies and 11 wood processing companies) and 12 supporting institutions / organizations located at the EU ProLocal program area.

Table 1. SMEs and supporting institutions/organizations interviewed for the study

Metal processing companies	Wood processing companies	Supporting institutions
Armako d.o.o., Prnjavor	Artisan d.o.o., Tešanj	City of Gradiška
Art Line d.o.o., Derventa	Gavranović d.o.o., Prijedor	Chamber of Commerce and Industry of Republic of Srpska
Braća Karić d.o.o., Zenica	Glovis d.o.o., Zenica	Eda - Enterprise Development Agency, Banja Luka
Bravarija Pile d.o.o., Laktaši	Interlignum d.o.o., Teslić	Faculty of Economics, Zenica
Euro Prost d.o.o., Gračanica	Karpenteri Vitorog d.o.o., Prijedor	Faculty of Mechanical Engineering, Computing and Electrical Engineering, Mostar
Kalim profil d.o.o., Tešanj	Nansi d.o.o., Žepče	HERAG - Development Agency of West Herzegovina County
Kovan d.o.o., Gračanica	Obrt comerc d.o.o., Gračanica	LIR Evolution, Banja Luka
Metal d.o.o., Teslić	Oglavina d.o.o., Brčko	PREDA - Agency for Economic Development of the City of Prijedor
Miviko d.o.o., Posušje	Pero d.o.o., Zenica	RAŽ - Development Agency Žepče
RM-LH d.o.o., Zenica	Reflex d.o.o., Gradiška	TÜV Adria, Sarajevo
SIK d.o.o., Mostar	Tursunprom d.o.o., Gračanica	Wood Cluster Herzegovina
TIKT Manufaktura d.o.o., Gradiška		ZEDA - Zenica Development Agency
Topling d.o.o., Prnjavor		
TPE d.o.o., Laktaši		
TT kabeli d.o.o., Široki Brijeg		
Vendom d.o.o., Laktaši		

The research results were validated and completed with inputs gathered from approximately 80 representatives of public institutions, private companies and intermediaries who participated on the round tables organized in Banja Luka, Zenica and Mostar, April 15-17, 2019.

2. Baseline analysis wood and metal sector in B&H regarding ICT usage

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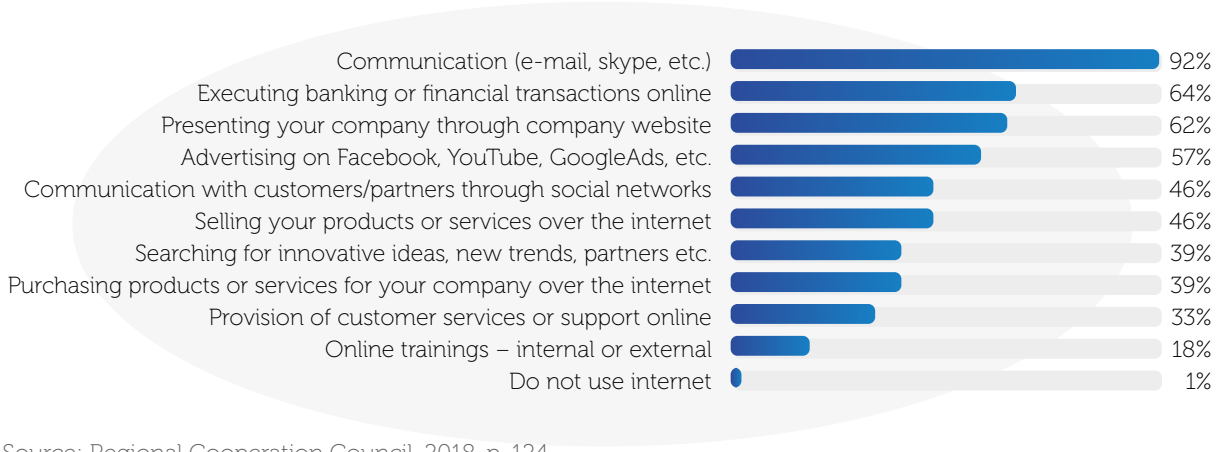
2.1. Perception of digitalization and ICT usage in SMEs

The level of usage of information and communication technologies (ICT) in B&H enterprises, regardless of the sector, is quite high. Namely, 98.8% of enterprises use computers and 97.8% has internet access, so it is obvious that the Internet penetration and usage of ICT related services significantly expanded and improved in the last couple of years. Some 96.3% of enterprises use the Internet over a fixed broadband connection (e.g. ADSL, SDSL, VDSL, cable networks, optical networks), while 65.2% of enterprises use mobile broadband connection to the Internet via portable devices using 3 G mobile telephone network. Speaking about the speed of the Internet connection, some 36.6% of enterprises use the Internet which speed is between 10 and 30 Mbit/s, while some 35,7% of enterprises use the Internet which speed is from 2 to 10 Mbit/s (Agency for Statistics of B&H, 2018a, p. 24, 26). Some 17.5% of enterprises hired ICT experts and almost 20% of companies organized trainings for employees to improve ICT skills (Agency for Statistics of B&H, 2018b, p. 1-2).

Own web site has some 63.7% of enterprises. Social networks are becoming increasingly present in the business of enterprises – some 44.3% of enterprises use social networks for business needs. The most popular tools among enterprises are social networks (Facebook, LinkedIn) used by 42% of companies and websites for sharing the multimedia content (YouTube, SlideShare) used by 15.8% of companies. Enterprises use social media most often for the purpose of advertising of companies (40.6%) and gathering customer opinions or answering customer questions (27.6%). It is also interesting that some 24.7% of enterprises pay for advertising on the Internet. Only 5.1% of companies use paid cloud services. During 2016, only 15.3% of enterprises in B&H received orders for products or services through a website or application. The share of the total value of net turnover received via the website, application or EDI (**Electronic Data Interchange**) type of messages in 2016 was 8.8% (Agency for Statistics of B&H, 2018a, p. 28-30).

Enterprises in B&H use the Internet overwhelmingly for: communication via e-mail, Skype, etc. (83%), executing banking or financial transactions (64%), presenting the company through website (62%), advertising on internet social networks (57%), communication with customers/partners via internet social networks (46%), selling products/services over the internet (46%) etc. In average, 22% of total sales is generated through online sales (Regional Cooperation Council, 2018, p. 124-125).

Figure 1. Does your company use the Internet for...?



Source: Regional Cooperation Council, 2018, p. 124

The project „Information Technology - Fuel for SME Competitiveness" focused at the metal and wood processing sectors. These two sectors are among the most competitive industry sectors in B&H (Eda – Enterprise Development Agency, 2013, p. 98-100).

There are more than 800 companies which are active in the metal processing industry in B&H [1]. They employ around 16,300 people and generate income of approximately BAM 1.8 billion, of which more than 50% refers to exports, mainly in EU countries.

The wood processing industry is also very important for the economy of B&H. There are more than 430 companies which produce furniture and products of wood, cork, straw and plaiting materials. These companies employ about 6,600 people and generate income of approximately BAM 509 million, of which about 59% refers to exports.

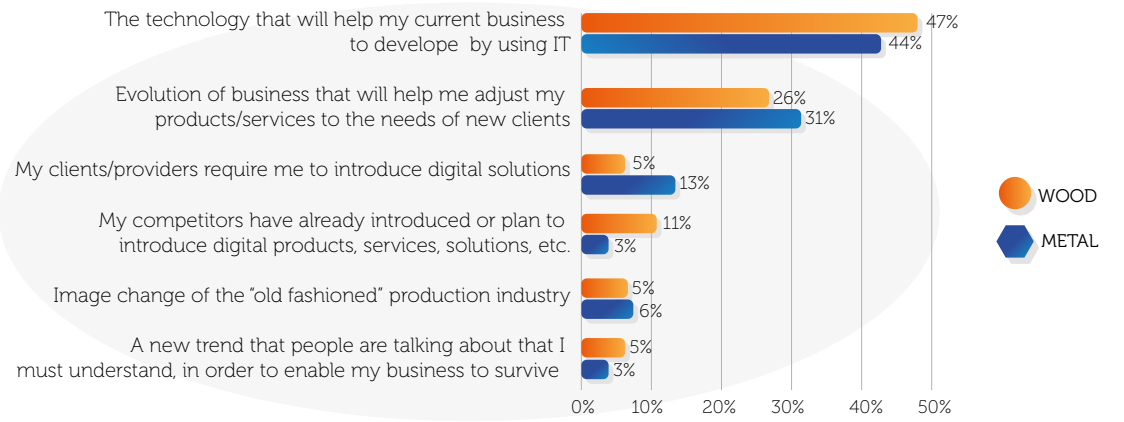
Within the scope of the study 27 companies were analysed. The sample was relatively small, but since all companies were forerunners, leaders in their respective sectors, research results gave rather clear picture and could be utilized as a basis for consideration of diverse approaches and actions in future, being even more relevant for reinforcing progress in ICT utilization in the coming years.

1 These companies are active in the following areas: manufacture of structural metal products; manufacture of tanks, reservoirs and containers of metal; manufacture of steam generators, except central heating hot water boilers; treatment and coating of metals; machining; manufacture of cutlery, tools and general hardware; manufacture of other fabricated metal products.

During the visit to companies from metal and wood processing sector and interviews with their directors, it was noticed that companies mostly use CAD / CAM production-support software, self-developed Excel-tools and partial ERP solutions, mainly individually programmed. On the other hand, most of the companies do not use any ICT solutions in marketing / sales (e. g. web visualisation tools, customer web-interface, CRM systems etc.), material tracking (e.g. via barcode or RFID[2]), warehouse / logistics, human resources management, controlling, etc. This indicates that most producers focus only on the production, while other lines of business are ignored and / or underdeveloped. It is important to emphasize that some companies are not yet prepared for digitalization because their production and administrative processes are not sufficiently organized. In such companies, it would be important to optimize production and administrative processes first, and subsequently introducing appropriate ICT solutions. It should be kept in mind that process innovations are important types of innovations (OECD/Eurostat, 2018, p.72) and that there are already some positive local experiences that improving processes lead to improving ICT solutions and organization[3] (Eda – Enterprise Development Agency, 2016, p. 23).

Most of the interviewed companies understand digital transformation as the use of information technologies that will help their businesses to develop (47% of wood processing companies and 44% of metal processing companies). 31% of metal processing companies and 26% of wood processing companies perceive it as an evolution of business that will help companies to adjust their products/services to the needs of new clients.

Figure 2. What is digital transformation for you?

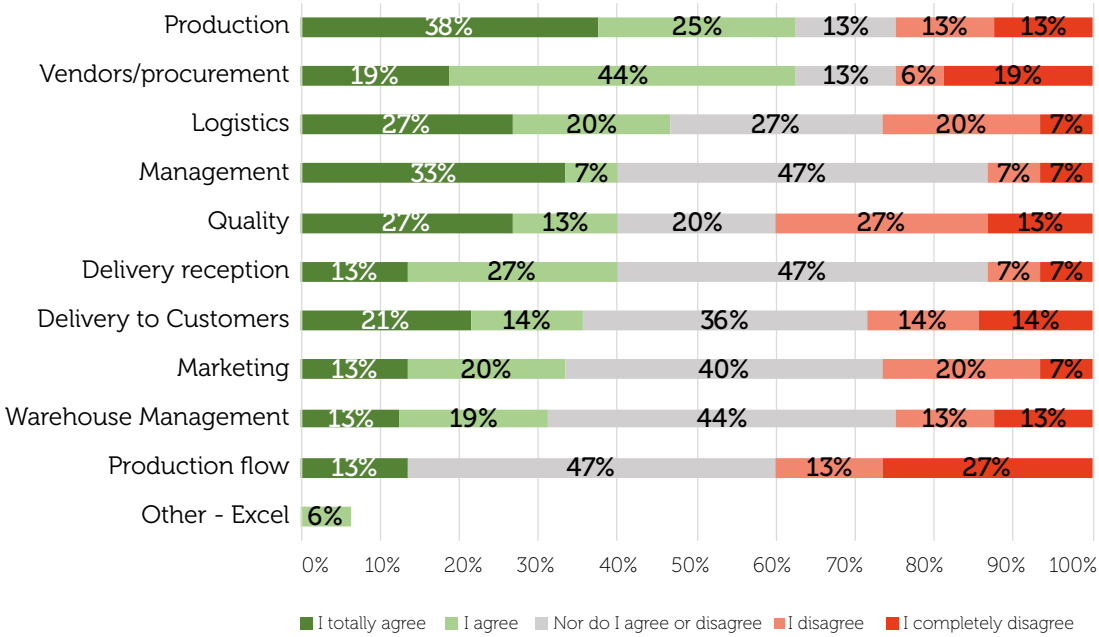


2 RFID (Radio-frequency identification) uses electromagnetic fields to automatically identify and track tags attached to objects. The use of RFID technology can help in improving the accuracy, efficiency, and reliability across manufacturing, distribution and transportation. RFID allows real-time visibility of material and assets needed to keep the manufacturing process efficient.

3 Mr. Goran Kecman, director of the company Spektra DMG, regarding implementation of the 5S project in his company was stated: „Advisory services from the 5S project have helped us a great deal in the improvement of organization of work places and we changed the philosophy of thinking of all the employees, as they directly participated in the implementation of the 5S project, where we started another avalanche of problem solving through the ICT system and resolving the problem of inconsistencies, so the very project was rather useful."

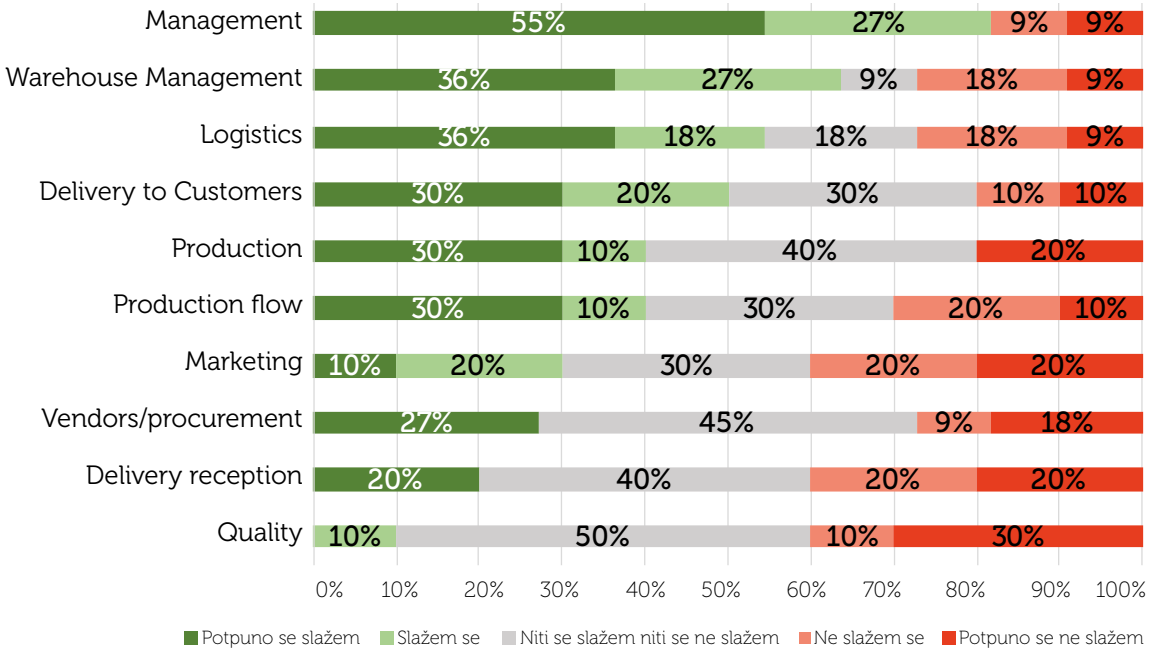
All metal processing companies and 82% of wood processing companies have an internal computer network. Companies in metal processing sector use appropriate computer / software tools in production and procurement (63% totally agree and agree), logistics (47% totally agree and agree), management, quality, delivery reception and delivery to customers (63% totally agree and agree). On the other hand, most companies do not use appropriate computer / software tools in production flow (only 13% totally agree and agree) and warehouse management (only 31% totally agree and agree).

Figure 3. Metal processing sector - Our company uses appropriate computer/software tools in:



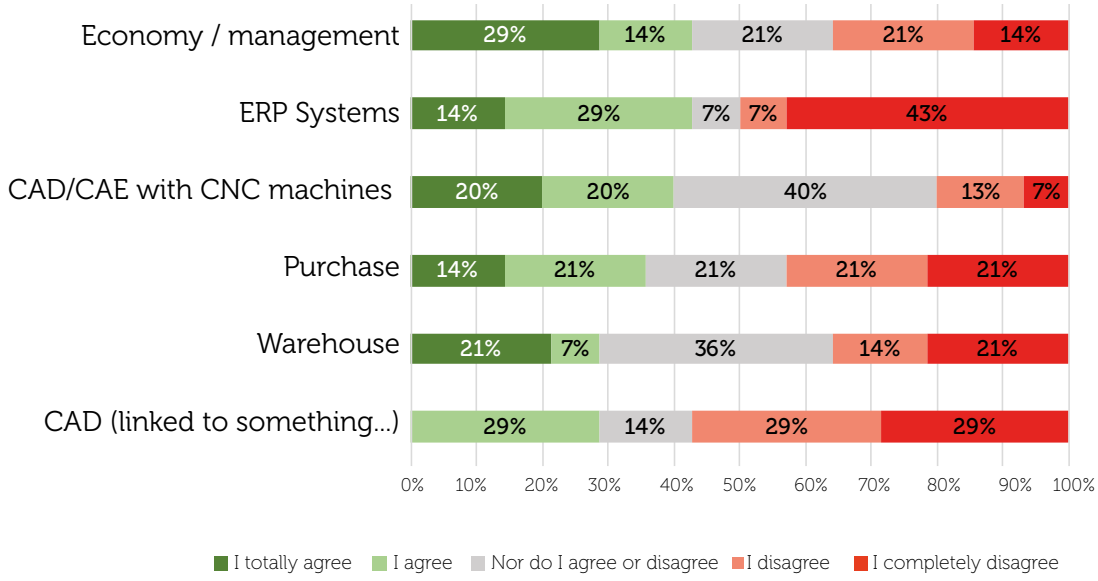
Companies in wood processing sector use appropriate computer/software tools in management (82% totally agree and agree), warehouse management (64% totally agree and agree), logistics (55% totally agree and agree) and delivery to customers (50% totally agree and agree). On the other hand, most companies do not use appropriate computer/software tools in quality (only 10% totally agree and agree) delivery reception (only 20% totally agree and agree).

Figure 4. Wood processing sector - Our company uses appropriate computer/software tools in:



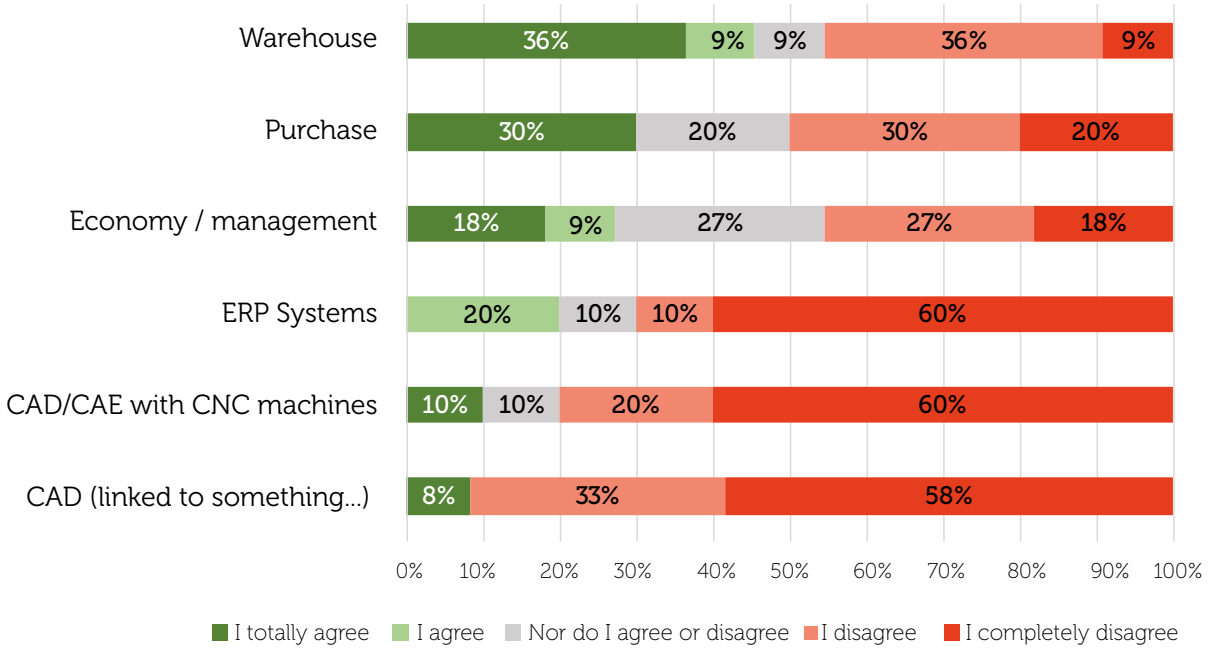
Regarding integration of computer/software systems with other systems, it is interesting that the most linked / integrated functions with other systems in the metal processing companies are economy/management and ERP systems (43% totally agree and agree), and CAD/CAE with CNC machines (40% totally agree and agree). On the other hand, the least linked/integrated function with other systems is CAD and warehouse (29% totally agree and agree).

Figure 5. Metal processing sector - In the computer/software systems of our company, the following functions are linked/integrated with other systems:



The situation is quite different with wood processing companies where the most linked/integrated functions with other systems are warehouse (45% totally agree and agree), purchase (30% totally agree and agree) and economy/management (27% totally agree and agree. On the other hand, the least linked/integrated function with other systems is CAD (8% totally agree and agree) and CAD / CAE with CNC machines (10% totally agree and agree).

Figure 6. Wood processing sector - In the computer/software systems of our company, the following functions are linked/integrated with other systems:



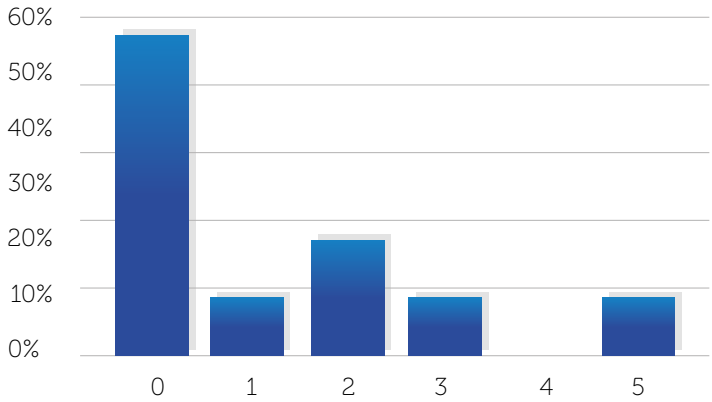
2.2. Servicing SMEs regarding digitalization

As a part of the analysis, very different organizations were interviewed. These included universities, business development agencies, as well as clusters / associations. Due to the diversity of the surveyed institutions, there are major differences in services for companies.

Traditional business development agencies are supporting local companies in regulatory and administrative matters, brokering contacts and advice in the area of public funding. Further areas of work of local business development agencies are location marketing and the support of start-ups. Associations and clusters organize the exchange of experience between companies (e.g. Wood-Cluster Herzegovina and Metal Cluster at the University of Mostar) in the areas of production technologies, internationalization and qualification. Universities offer mainly qualification support (University of Zenica) as well as concrete advice in the field of process optimization (Lean Management Project of the University of Mostar).

The supporting institutions / organizations for SMEs in B&H obviously lack capacities for providing professional support in the field of digitalization. Almost 60% of the supporting institutions have no employees explicitly offering consulting for digitalization. However, 42% of the interviewed supporting institutions / organizations do provide with at least one qualified person consulting services regarding digitalization / industry 4.0.

Figure 7. Number of employees working in consulting for digitalization



Complete findings of the quantitative research are available in the Annex of the Study.

2.3. Validation of research results

The research results were validated on the round tables organized in Banja Luka, Zenica and Mostar in April 2019, when some additional information and reflections from participants were gathered. Some participants expressed their fear that digitalization comprises a high risk in terms of loss of competitiveness as relatively low wages and low production costs (one of the main competitive advantages for many metal and wood companies in B&H) are not anymore significant competitive factors in a world of automated production. In order to use digitalization as a chance, an "eco-system" on digitalization needs to be set up, but there are some challenges in this respect:

- Missing interaction between the production sectors and the ICT sector;
- Lack of support and services from service providers (weak capacities of intermediaries);
- Lack of affordable ICT services for companies;
- Lack of support to local ICT companies to engage more in the issues of developing and transferring methods, knowledge and services on digitalization to companies.

Although companies recognize that they are overwhelmed with the issue of digitalization, they still "don't know what they don't know". Therefore, knowledge transfer between ICT companies and production enterprises should be improved, as well as facilitating interactions between them.

3. ICT usage in production – current trends / key fields

3.1. Production processes

The planning and control of production is becoming more and more determined due to the increasing number of product variants, the shift to demand-oriented production processes and the increase in dynamic production influences. These influences include, for example, the sequence of (machine) processing, the use of various tools, internal material flows, the availability of personnel, etc. The production process is also subject to a few other factors. In the case of individual production or small batch sizes (both in the wood and metal industries), production is triggered by individually placed orders. Differentiated demand forecasts are hardly possible. Production for "lot-size 1" is often organized in the form of workshops. The planning focus is usually on process planning, since when several orders are processed, their throughput must be carefully connected through different production stations. This makes efficient production planning increasingly complex.

Currently, the production planning and control of most companies in the wood and metal sector in B&H is based on self-developed Excel tables or on inflexible isolated used software systems. On the other hand, modern systems integrate planning, control and calculation with EDC (Enterprise Date Collection) and ERP (Enterprise Resource Planning) based on uniform data management. They are structured in such a way that they do not complicate the planning and control processes but reduce the complexity of the tasks. Uniform data management is a prerequisite for more reliable and faster calculation: both in the preparation of quotations and in production controlling. This shows that professional production planning and control is made much easier, in some cases even possible, by using suitable ICT systems.

Experience has shown that the introduction of suitable planning and control systems is increasing productivity and reducing costs by:

- Reduction of inventories
- Reduction of capital commitment
- Reduction of throughput times
- Improvement of adherence to delivery dates
- Greater planning reliability
- Faster response to customer and market requirements
- More efficient use of capacity

The internal use of ICT solutions is important to document all processes without any further effort. Based on the documentation, the internal calculation will be based on real numbers. By saving the data from the existing products, that are produced and all relevant construction data, further innovations are much easier to be implemented. In the deal ICT environment, all data are available in one click. This is still fiction, but a lot of unnecessary steps can be eliminated already. Times are long gone, where one had to call the secretary to pull a letter out of the archives as an original, make a copy and put it on in folder on the desk. The folder on the desk is nowadays on the desktop. In a modern construction environment, the products are visible and transparent. Every piece and all components can be traced. Also, more importantly, all related information is accessible. If it is properly documented, if one is looking for a simple screw, it cannot only be traced in which products it is found but also exactly where it is, even with the related torque used, that was documented simultaneously during the production process. Internal data will directly lead to internal innovation.

3.2. Business processes

The use of digital solutions to manage administrative, business processes is currently very low at companies in B&H. Most companies only have an accounting program in order to be able to provide the necessary balance sheet to the tax authorities. Still, a fundamental prerequisite for increasing productivity and initiating digital transformation is a modern ICT system infrastructure. Therefore, it is necessary to introduce integrated systems that link and control the processes in all departments (purchasing, sales, accounting, warehousing, etc.).

3.3. Interface with customers / sales

The digital bridge to the customer in an ideal world acts as a communicating channel that gives backwards valid information to the company. That may include specific orders, requests to evaluate the possibility to place orders, or requests that could be used as indication were the further demand will take its directions. Orders can be processed seamlessly, that means with no human intervention involved. The customers' feedback may include production time and a schedule. Based on the data for the requested goods, other data of the internal system are required. Sales may not be calculated in a proper way if the data needed are not generated on the other end in procurement.

3.4. Interface with procurement / purchases

Pricing of goods is always based on multiple decisions; a major impact is volatility on international markets. Therefore, it is essential to include the market pricing in a further business model. In an ideal case, this can be accomplished by the effort to implement the pricing that is found by public trading that is published. Beyond that, a track record has to be established to enable the organization to implement the pricing evaluation into everyday calculation process. Prices vary, so if there is a connection to the market, the volatility of the prices is part of the calculation. The link between market prices and possible dates of deliverance is accomplished here. The goal here is to achieve a complete supply chain management. E-procurement also means a direct connection to the supplier, where warehouse date can be exchanged, and suppliers can be rated. There is also a control mechanism to check on the goods received in their own warehouse.

3.5. The bottom line: no structure, no data

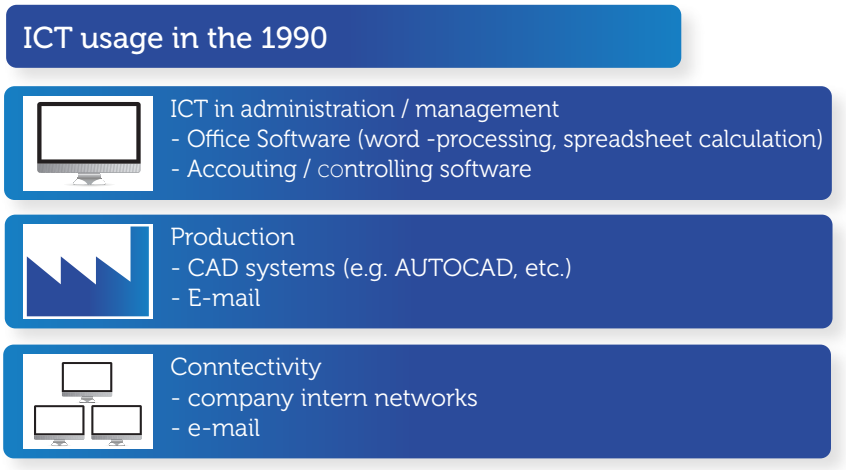
In order that the instruments of the orchestra, the different departments, can work together, the instruments must be synchronised with a concert pitch. A frequency of all players in the system must agree on as a base. Gathering the data will be an individual process in each organization. That is the key point, and the stepstones are based on individually tailored processes that can be digitally mirrored. So, the task is not finding the perfect software, but finding the perfect process first. The awareness process, what really impacts the way to go more digital will not present positive results from day one. There is always an initial phase that causes a higher level of effort were no immediate results can be measured.

3.6. Speed up the process

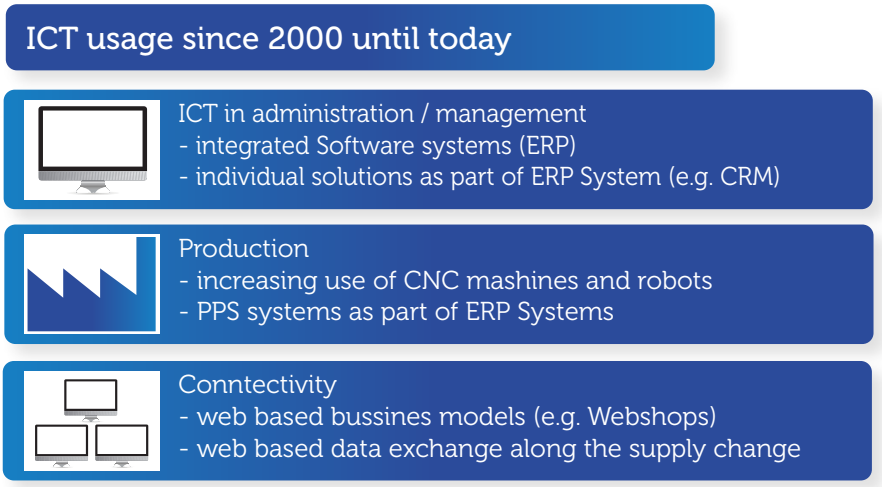
Time matters. Measures to speed up the process of going more digital and combining local existing ICT resources require positive input that must be organized. The main issue is not advising the companies where to go to but coaching them to improve their processes.

4. Development level of ICT usage in manufacturing industry

Since the 1980s, information technologies have also been increasingly used in medium-sized manufacturing companies. By the 1990s at the latest, the majority of companies in Germany had PC workstations. The performance of the hardware used also made it possible to use CAD technologies and today's common office software. With the aim to centralize data storage, increasing data quality and avoiding redundant data, companies set up internal company networks back.



At the beginning of the 2000s, medium-sized manufacturing companies became increasingly involved in the use of integrated software systems. At that time, large companies were already frequently using ERP software. During this time, numerous providers of industry-oriented ERP solutions or partial solutions developed, which enabled cross-departmental control of business processes by exchanging and using data in other software applications. In production, the use of new production technologies (CNC machines, robot technology, etc.) further reduced operational production costs. Production planning systems were used by PPS systems sometimes as part of integrated ERP systems. In the area of connectivity, SMEs also began to develop new internet-based communication tools along the value chain (e.g. development of web-shops, cross-company electronic data exchange, etc.).



Even in the industrialized countries of Western Europe, small and medium-sized enterprises must gradually adapt to the challenges of industry 4.0. Information and communication technologies are being linked even more closely with production machines and robots. Current trends such as big data, cloud computing and the Internet of Things will lead to an integrated networked production along the value chain. In production, machines communicate with machines and adapt automatically production processes. Technologies which are used here are e.g. RFID tags, embedded systems, sensors, actuators, mobile-end devices and production systems that are interconnected, exchange data and optimize processes.

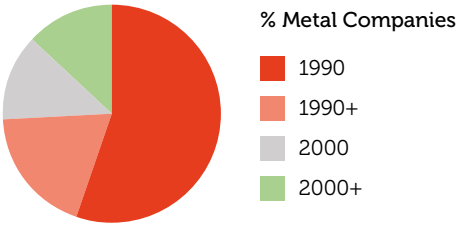
In this context, it should be noted that most small and medium-sized enterprises in Germany have only just started the process of digitalization (Lichtblau, Schleiermacher, Goecke & Schützdeller, 2018, p. 8). However, many of manufacturing SMEs in Germany are using ICT systems intensively (Lichtblau at all, p. 20), which leads to the conclusion that these companies are on the level shown in the diagram "ICT usage since 2000 until today".

The companies visited within the scope of the study can be categorized according to the criteria as shown in the figures "ICT usage in 1990" and "ICT usage since 2000 until today". Some of the companies visited are on a level between the above-mentioned categories, i.e. they are better in terms of ICT usage than in 1990, but they have not reached the level of the year 2000. Another smaller number of the companies have already fulfilled the criteria of the year 2000 and are on their way to implementing automated production. The companies are therefore divided into the following categories:

- 1990: ICT usage in 1990 (companies that are currently at the ICT usage level of 1990)
- 1990+: ICT usage more developed than 1990 (but not yet at 2000 level)
- 2000: ICT usage in 2000 (companies that reached the level of the year 2000)
- 2000+: ICT usage more developed than 2000 (but not fully automated/digitalized production yet)

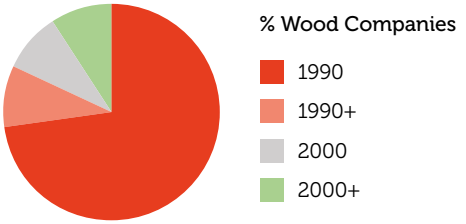
Regarding the 16 visited metal sector companies, the analysis shows the following distribution:

Level of ICT usage	% of the visited Metal companies
1990	56%
1990+	19%
2000	13%
2000+	13%



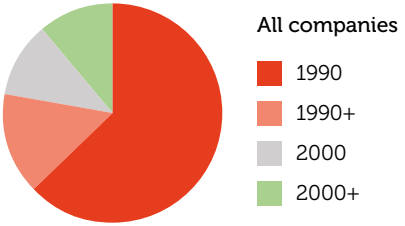
Regarding the 11 visited wood sector companies, the analysis shows the following distribution:

Level of ICT usage	% of the visited Wood companies
1990	73%
1990+	9%
2000	9%
2000+	9%



The following overview shows the total distribution of all visited companies.

Level of ICT usage	% of the allvisited companies
1990	63%
1990+	15%
2000	11%
2000+	11%



Some important indications, regarding the development status in ICT usage of the manufacturing companies in B&H were given, and it became clear that most of the B&H companies visited as part of this study have not yet reached needed levels. Only 22% of the visited companies were on the satisfactory level according to the diagram "ICT usage since 2000 until today".

5. Digitalization examples from medium-sized companies in Germany

In the history of digitization, systems have been isolated and workplaces and personal computers completely separated from the production process in the medium-sized industry.

Nowadays, innovations in ICT Software are still considered to be one of the key drivers in the future development of SMEs. There is no doubt that a brilliant digital solution can speed up almost every well-defined existing process. When we oversee SME from the metal and wood processing companies in Germany over the last 25 years, a tremendous process of automatization took place.

However, this was not a simultaneous process in production and administration. The ideal digitalized company only exists as a model, e.g. as a strictly theoretical approach. "Internet 4.0", a phrase defined by the initiative "Forschungsunion" funded by the German Government, became a synonym for the advances in ICT in the course of this development. Here, not only machines communicate with each other but also entire production plants are functioning in autonomy and even communicate with other plants by means of a cloud. The cloud is supposed to be the next level. In future, this is where orders will be placed and driven by AI (Artificial Intelligence). Companies will find all parts produced with international capacities on existing designs to a perfect "product 4.0" in it, or, if no solution or design exists, a design process will be initiated, so that missing parts will be created. This product 4.0, as well as the bill, will then be shipped to the customer automatically. From order to final payment: all digital.

There will be no core company, or core process anymore. A living company with human skills, tradition and experience will no longer exist. The production process is shredded into pieces, split up in small parts, operated by several companies. The loss of homogenous processes within plants is, in many aspects, a dark vision.

The core business of each individual company is to be considered the sole and only ticket to success. There are multiple successful companies out there. The following companies shall demonstrate what is possible.

Another recent Study shows that in Germany we find more growth in processes optimization and new fields like AI (artificial intelligence) projects and less in core ICT projects, that are only focused on upgrading existing solutions. There is always a trend to stick to working processes and working ICT. Companies tend to develop the digital process based on their own business model (HypoVereinsbank, 2018).

5.1. The wood processing industry

The timeline in the wood processing industry reaches back centuries. Craftsmanship and experience enabled wooden constructions, where nowadays mighty programs calculate, design, and produce with C - Technology. The production process became more and more complex, and over the last 25 years, machines took over the workload of skilled workers. The saw based on waterpower is now equipped with laser measurement to place the ideal cut. The modern tool is a robot connected with the construction department. Precision sawing tables do the work of dozens of skilled workers in now almost empty halls. The production is planned with PPS systems, which are defined as a part of the ERP process. Nevertheless, even in most efficient companies that process wood, the company ICT is not homogenous and completely digital. Modern machines and production cells are little digital islands, and around them ICT cycles are created.

The commercial part of the administration has its own ICT circle. Bookkeeping, warehouse, invoices, and parts of the ERP process are often separate systems. Many processes are digital by now, but you won´t find any paperless office. The first widely implemented digital process involving outside companies was online banking. Based on this data, liquidity planning, billing and controlling tools were integrated. Those tools spread out in the late 90ties. In the early beginning of ERP software, some major players proposed an ideal ICT infrastructure recommended, that all companies processing wood should adapt their processes to their own ideal ICT solution to be most profitable.

The degree of innovation in the production processes in the wood industry in Germany is extremely high. Several suppliers offer complete production lines that enable small teams to produce high output on standardized wood products. Manpower with specialists in the production can no longer be found, while on the other hand, in the production process, more and more skills are needed.

Industrial wood processing starts after harvesting at the sawmill. The production in a sawmill, traditionally located near the woods, must be more cost-efficient, than the transport of the wood plus the cost of cheaper production in another sawmill that is far away. That is a formula valid for every production, may it be wood or iron. This pressure on costs resulted in very efficient digital automated processes. Laser scan the trunks; the data is processed simultaneously to the cutting process. After that, the logs are booked into the inventory, with their exact position in the storage.

Figure 8. SAB sawmill

Source: Hönle, 2015

The wood processing industry depends on the output of the sawmills. The raw material is then processed in a highly automated production circle. Machines do the job. The process to feed them and to care of the output is also highly automated.

At the manufacturer, the raw material from the saw is processed in automated cells, where the value-adding processes of woodworking are executed. Whether that is planning, fingering gluing, milling wood. All these processes are completely computerized.

Figure 9. WEINIG Powermat 2500

Source: HOLZ-HER, 2019a

Many other steps are embedded in the process. If, for example, a long piece of wood goes into the production cell and gets, for example, glued together with two other long parts. Then one new part comes out of the cell and is cut into smaller pieces, which are stocked in the warehouse. How many parts do we have now after several hours of production? Certainly, too many to count. The system counts how many parts went out of the warehouse and how many new parts are created. Also, the time for the production process is important for further calculation. Thus, the production steps need to be connected. The vertical integration is one of the key achievements in a modern wood processing plant.

Figure 10. WEINIG Conturex 125 Vario

Source: HOLZ-HER, 2019b

Again, all theory is grey, so let´s have a look at a real wood manufacturing company, that managed to ship around all cliffs and stays extremely successful.

5.1.1. Gigler Holz Design, Neubeuren, Germany

With about 20 craftsmen the Gigler company based in Neubeuren, Germany, the highly skilled craftsmen can realize an extremely wide range of high-class solutions around the material wood. Some exceptional solutions that are realized by Gigler shall be presented here.

Figure 11. The exhibition booth of Gigler, Industriemesse in Hannover HMI, April 2015

Source: GIGLER holz-design, 2019a

Figure 12. A Conference Table cut of one tree length 18 Meters. All cabling is hidden

Source: GIGLER holz-design, 2019b

A wall of wood looks like a sculpture, but it functions as noise reduction.

Figure 13. Wall of wood

Source: GIGLER holz-design, 2019c

Even equipped with the most modern machinery, the drivers in the process of Gigler Holz Design are craftsmanship and know how, according to manager and owner Josef Gigler. To stay flexible is one of the core achievements of the company. At Gigler Holz Design, every piece ever produced is saved, with all its parts. Thus, the knowledge is growing and growing and continuously the people working there, who are the most valuable capital of the company, are increasing their know-how, also. ICT and a highly automated construction and manufacturing process is only able to be a vehicle to transport knowledge into the production process. Already 10 years ago, Josef Gigler proposed a Batch 1 strategy in his company. This strategy is based on the goal that the production process must be so flexible, that the cost of a single unit produced, shall be no higher, than the cost of a unit, produced in monotonous mass production. Software and ICT is helping here, says Josef Gigler, but for his company, it never opened new doors. Gigler Holz Design is connected to several Universities and offers dual degree education. The significant technological step of development over the last years were new production methods, where the object can be moved in the production cell axis and can be processed around five rotary axes. This makes the design procedure of complex pieces easier.

Figure 14. Kuka

Source: Kuka

Overall, Josef Gigler considers the know-how of his skilled workers to be his biggest asset. The best technology will not provide any advantage if there is nobody skilled, who can handle it to its best.

"If we can determine, where the technology is directed to, we do have the advantage" claims Mr Gigler.

The key is the great flexibility from restoration works at an antique building, to a futuristic exhibition booth. The range of their products seems to be unlimited.

Each part ever produced, is stored in a database, and it can easily be determined how exactly this specific part was produced. With the help of this library, new 3D objects can be created, based on existing experience. Not only the design can be determined during the construction process, but also the production process itself.

Based on this experience, it is also possible to calculate new projects with a high degree of liability, to be able to compete in a challenging market. The forecast of costs and time needed is a key factor of success. Therefore, the lean process, combined with extraordinary skills, that are cultivated in the company to its best, creates a complex formula of success. It´s not about where digitalization leads us, but were we lead digitalization to, states Josef Gigler.

5.1.2. Kurt Junghans, Dörles-Esbach, Germany

Another wood processing company developed from a small company in the 19-fifties building cushion frames for upholstery industry to an extremely innovative company, that is still building cushion frames for the upholstery industry as well as 2D and 3D shaped wood.

Kurt Junghans, a company located in Dörfles- Esbach, Germany, was founded in 1958 and since then, the family-owned company, now in second generation lead by the two sons of the founding couple is very successful. Over the last 20 years, there was tremendous pressure on the market. Cheap product swapped over from the east of Europe, and unions of resellers put tremendous pressure on prices. Nevertheless, the company even managed to grow and be more prosperous, like a phoenix out of the ashes. Still, there is no single concept for that success, like a good recipe, that, used with the exact measurements, can be copied, like the famous Sacher cake.

Digitalization was a must because highly qualified workers wandered away to industries, that simply paid better, explains Ulrich Junghans, one of the directors of the company. To be the cheapest mass producer was never an option. Batch size 1, the industry goal, is realized here to its best.

A customer may bring a digital plan, or a simple drawing by hand, order 1 or 50 units and this order will be flawlessly integrated into the production process. Of course, a lot of intellectual property is embedded in the planning process and the design process. A production cell is not discriminating or in distress, if it must produce 10 equal, or 10 different pieces. The whole production process here is bent around that issue, that brilliant complex planning ends up in an excellent workflow. A huge step taken in 2016 was the introduction and integration of 5 axis production robots, that gave more freedom to the design process.

With about 70 employees, the company is still flexible enough, to be able to be profitable with a small batch size 1 to 5 production in unsurpassed high quality. Even though the production is highly digitalized, digitalization is not mandatory: a single part, that must be processed may be integrated into the production process with a handwritten piece of paper.

At Junghans, many processes are digital, but if a customer may show up with a drawing by hand, the company is able to integrate and to improve this process prior to integrating it into the production. This is the key expertise, helping to build up value for the customer and simultaneously adding as much value as possible to the company's production process.

Figure 15. Five axes

Source: Junghans, 2019

5.2. The metal processing industry

Different products and services are clustered in the category metal and steel processing industry in Germany. 77% of approximately 5300 companies, with roughly 455 000 employees in total, are smaller than 100 employees and mainly family owned. The companies are organized in 14 different industry organizations, that may demonstrate the wide range in that production sector (Bundesministerium für Wirtschaft und Energie, 2019).

A typical company in this sector with up to 100 employees processes different parts or surfaces with modern production cells, or standalone CAP (computer-aided production), that are not necessarily connected. Flexibility is the key production success factor. Highly skilled workers start their professional life at one company in Germany, where they often stay until retirement, or they make only one or two changes of the workplace in their professional lives.

In order to get a reliable outline of the level of digitalization in that industry branch, it is important to realize that the innovation improvements came with the new production cells. Hardware was first. Metal processing machinery has already been digital during the last 40 years. But the robots

will never "talk" anything but zero and one. The driving momentum is always to be seen in the living knowledge, that is part of a prosperous company.

There are no reliable studies out there that define exactly the point where digitalization is an add-on, not only a cost producing necessity. There are examples of extremely successful companies that can function as a role model, even though the processes cannot be simply copied. Each company must find its own way to be successful and productive.

5.2.1. Wolf Druckguss, Regensburg, Germany

Founded in 1933 Wolf Druckguss developed an exceptional business model, that lasted, and stayed successful over the century. The company managed over time, to integrate the complete production process of vertical integration of the production process. The family-owned company is highly innovative, with around 100 employees in its original production place in Germany. The company expanded in every dimension. Without a brilliant ICT process integrated into international development, this would have been simply impossible to implement.

The companies head is still located in Germany, while the construction and controlling processes including the production locations are situated at a cooperation plant in Hungary, that was later completely taken over by Wolf. In Europe, the construction and production of the forms are organized, and the diecast is taking place in Europe and China, as a result of international growth.

The company's head is located where the central development takes place: at their home base in Germany. The production process is highly vertical integrated. Thus Wolf is developing and producing its own tools, with the most advanced production cells. Wolf was working in a cloud, long bevor the cloud was defined.

This is the perfect role model of digitalization. A core business model is extremely successful, and with the help of ICT, it can spread out internationally. Again, at Wolf ICT processes are defined to their best, and it is always challenging to coordinate production in Germany, Europe and China. That is one answer to the question of why German companies developed over the last 20 years in such a brilliant way — driven by Technology.

5.2.2 Scherzinger Metallbau, Bäunlingen, Germany

A typical example for a small company that is successful in the metal and steel processing industry is Scherzinger Metallbau, located in Germany, Bäunlingen. The company's motto is "Perfect production process creates perfect products". With around 60 employees, they manage to produce high-quality frames for the machinery industry, and besides that a wide range of specialized products, that can only be integrated into the production process by a high degree of flexibility in exactly this production process. Therefore, the production must be planned on a high level, with production planning and control tools. This PPC software helps Scherzinger to produce different types of products, that seem to be completely independent from each other. The ERP Software allows to calculate and to manage the material flow. The core of Scherzinger is not brilliant software, but the combined knowledge and experience of the people. What they are doing is indeed very impressive: A broad range of different products, including innovative products. One could even say product lines, but that's an expression from the mass production process. If different types of products are named here, they are in no hierarchy. These are complete standalone products. It is in no way a ranking, that is nothing else than an enumeration.

The first type of machinery's produced are different types of cross-cut saws. An already existing product that Scherzinger took over many years ago and integrated into their existing production and sales process.

Figure 16. Cross cut saw

Source: MTS Scherzinger, 2019a

The second type of product is an assembly and clamping table.

Figure 17. Assembly and clamping table

Source: MTS Scherzinger, 2019b

The third type of product are positioning systems.

Figure 18. Positioning systems

Source: MTS Scherzinger, 2019c

With the positioning system, you can hold and turn metal pieces up to 1200 kg without an engine, simply by men craft. The intellectual property behind that invention is easy: find the point of gravity, fix the object exactly there, and it can be easily moved around two axes.

Hydraulic welding tables (belongs to the third type).

Figure 19. Hydraulic welding tables

Source: MTS Scherzinger, 2019d

Hydraulic welding tables can position even larger objects in the exactly right size. Production can be triggered on demand.

The fourth type is the suppliers machine building.

Figure 20. Suppliers machine building

Source: MTS Scherzinger, 2019e

Special cases to shield production cells are customer ready manufactured products. If the products do not really fit each other, there is a product that we may call it a production line since it combines bending surfaces and different materials.

The fifth product range is window-sills.

Figure 21. Window sills

Source: MTS Scherzinger, 2019f

In a way, it's hard to imagine, but window-sills in numerous variations are one of the core abilities of Scherzinger. They come in al RAL colour and in numerous different ways. Different complex products that can be produced, not simultaneously, but together in one process, are very complex tasks to fulfil.

Besides that, Scherzinger does various types of contract production for around 15 different types of industry, which is, in a way hard. To be completely flexible, with a high level of quality. That can only be done in a company with processes up to its best. This is only possible if all resources are planned perfectly, and the company is improving its processes continuously.

There are other examples of success out there in the industry, but nevertheless, to define where you are right now in the industry, and where you want to be in future, is without any doubt a key factor of success.

6. Required measures to support B&H production industry in digitalization

6.1. SME as drivers of the further economic development in B&H

The hope of further economic development in B&H is realistically seen in the SME. "This sector could become the initial force of the development of the country" (Džafić, Rovčanin, Klopić, 2008, p. 88). The SMEs cannot sufficiently grow fast enough on their own. Why is that? The answer is simple: Competition.

A process of inclusion and transmission in a European Economy, depends on support, according to the study of the University of Tuzla. This first of several studies date from the year 2008, and it is more actual than ever. It is more than reasonable that an effort to improve the local economy may not be seen in focusing on larger, or the largest companies. If it comes to the question where to invest or to promote with the most measurable output, the conclusion can only be to focus on the SME.

The team of professors of the University Tuzla goes even further: "We consider that the philosophy on which the market structure in Bosnia and Herzegovina should be established is the following: 5 firms with 200 employees are safer than 1 firm with 1000 employees, and 1000 firms with 10 employees are more flexible than 10 firms with 100 employees." (Džafić, Rovčanin, Klopić, 2008, p. 102).

6.2. Digitalization to keep international competitiveness

As described elsewhere, manufacturing companies in B&H need to streamline their processes and implement digital solutions to maintain their competitiveness. The companies in B&H mostly produce homogeneous products that are easily substitutable. So far, they have been able to hold their own in international markets due to comparatively low prices and good to high product quality. The profound transformation due to digitalization will hit production companies, in particular, those not prepared for the digital transformation and sticking to traditional methods.

Digital transformation optimizes processes, changes structures and organizations in companies. Digital structures perform on several levels:

- Reduced Process Costs: Automating digital workflows reduces the need for manual intervention and reconciliation, reducing process costs
- Short reaction times: The communication effort along the value chain is greatly reduced, which shortens reaction times. Companies are faster to deliver and can react quickly to market changes.
- Stronger customer orientation: Flexible production makes it possible to produce small quantities at decreasing costs. At the same time, digitalized companies benefit from a fast "time to market".
- More information: Transparent information enables better control of operational performance. Data is stored centrally, easily retrievable and prepared for decision-making. This enables continuous improvement of the company processes.
- Higher product quality: The automated tracking of material and workflow, as well as ICT technologies in the production process, increases transparency and product quality. Sensors and measuring instruments deliver quality data in arbitrarily short sequences. This information can be used to optimize workflows and guarantee consistently high product quality continuously.

6.3. Digitalization as a key driver for innovation

"Innovation has a positive impact on the growth and development of small and medium-sized manufacturing enterprises in B&H." That is the main hypotheses in a study (Dzafic & Omerbasic, 2018), where besides a wide spectrum and different approaches, the fact is stressed that SMEs in B&H are very important for the development of the economy, as they make up 99% of the total number of enterprises, which make about 60% of GDP. The most powerful process to go there can be seen in going for more "digital."

Digitalization offers companies the opportunity to develop new business models and to develop new customer groups and existing markets through innovations. Especially for B&H companies, it is important to develop unique selling points in the medium term and to gradually shed the image of a "standard provider" from a "low-wage country". Products that can be easily substituted at low prices will soon no longer be enough to survive on international markets. The creation of preferences for one's own products and services must be in the foreground. With the help of digitalization, new products are created that contain, for example, services or data. Some companies in B&H have already recognized this and are working on digital solutions, such as the remote maintenance of technical products or equipping their own products with sensors and measuring instruments (their own IoT product solutions), which represent a greater service for the customer. Companies in the wood and furniture industry are working on user-friendly, online-based visualization modules for their customers.

6.4. Awareness raising – information and sensitization of companies

In the course of the study, it became clear that many companies are not yet aware of the changes to be expected with digitalization. The notions of digitalization are partly abstract and inaccurate. It is, therefore, necessary to sensitise, inform and support SMEs in tapping the technological and economic potential of digitalization. This includes, in particular, the development of practice-oriented, target group-oriented information, qualification, transfer and support services. Intermediaries such as associations, chambers or business development agencies can make an important contribution here by preparing appropriate events, workshops, training courses as well as print and online information for SMEs in a target-group-oriented manner.

6.5. Practice projects digitalization – flag-ship projects

Digitalization and industry 4.0 must be made comprehensible and tangible for SMEs. This can be made possible by visiting the lighthouse or reference projects. Trying out digital solutions at experience stations illustrates the benefits of digitalization and gives impulses for implementation in one's own company. With the learning factory at the University of Mostar (Stojkić & Bošnjak, 2019), where the functionality of Lean Management can already be "experienced", there are first approaches to achieve a sensitization of companies through illustration and testing. Visits to digitalized companies or projects also contribute to illustrating and experiencing the benefits of digitalization. In recent years, for example, various projects, study trips for companies and intermediaries in the wood and metal industry have been undertaken from B&H to Germany to visit industry 4.0 companies and digital projects (e.g. Smart Factory Fraunhofer Institute, Lemgo; Digitalwerk, Werder (Havel), Hettich Kirchlengern, etc.). These information possibilities should be made available to other companies of the target group.

6.6. Consulting in digitalization

Companies need a qualified consulting to determine the current situation, design and accompany the digital transformation. In many cases, companies do not know how to start the digitalization process. Qualified consulting helps to check whether the company has the necessary degree of maturity for digitalization. This status quo analysis must be carried out with a focus on digital readiness (business processes) and performance. The development of an individual digitalization strategy is also based on well-founded market analysis and builds on the identified competencies of the company. The company's individual digitalization strategy forms the basis for the company's digital transformation. A digital roadmap defines concrete measures and individual development projects. For example, it is important to identify relevant key figures and target figures for the various divisions. In addition to technical and market-oriented aspects, the digitalization strategy can also include supporting companies in their digital re-organization, for example, by accompanying change processes. Finally, qualified consulting also opens up impulses for digital innovations, for example, through product and business model developments.

6.7. Qualification for digital use

Most companies currently have little or no internal know-how in ICT, digitalization and industry 4.0. Companies that are already working with digital solutions usually work with ICT freelancers. Qualified specialists are hard to find locally. However, the development of in-house specialists and the qualification of personnel in the use of digital technologies are essential for a successful digital transformation. In the digital transition, the demands on the abilities, skills and knowledge of employees are continuously increasing. It is to be expected that not only selected employees will have ICT skills in the future. In fact, the proportion of employees with ICT skills will continue to grow. The digital transformation of companies must not be seen as a one-off process. The idea of digitalization must be deeply rooted in the company in order to enable continuous adaptation of technologies and processes. With the digital change, the demands on the social skills of employees are also increasing. Flexible work organizations, working in virtual teams and decentralized decision-making structures require employees to be highly cooperative, strong in communication and able and willing to organize themselves and their own work independently and on their own responsibility. Therefore, qualification offers tailored to the needs of the local companies are needed (workshops, training, in-house training, e-training, webinars, etc.).

6.8. Networking and exchange of experiences

The exchange of experience between companies as part of a systematic "knowledge management" should be established and expanded. Manufacturing companies have similar experiences, processes and problems. In order to meet the challenges of digital change and to organize a regular exchange of experience, the bundling / clustering of companies is necessary. Experience has shown that there are reservations about the exchange of experiences, especially among medium-sized companies within a sector, since there are significant competitive relationships here. Today, however, small and medium-sized enterprises must think far beyond their own company and in synergy effects instead of competitive categories. The targeted establishment and expansion of industry clusters, therefore, make sense in order to accelerate the process of digitalization. B&H already has several regional and local cluster initiatives (Wood-Cluster Herzegovina, Metal Cluster at the University of Mostar, as well as several initiatives of local and regional chambers) that could take on the role of a platform for the exchange of experience.

Another challenge is the further development of a suitable ICT service infrastructure. Although B&H has numerous innovative ICT service companies, most of them work for foreign customers. Initiatives should be launched here to support the development of innovative start-ups from the ICT environment. Supporting corporate networks and clusters also makes sense in the ICT business environment. The ICT association Bit Alliance is already an industry association for the ICT industry. The initiation of cross-cluster events by bringing together cluster initiatives at the production industry level with industry associations from the ICT sector can contribute here to supporting the digital transformation process of manufacturing companies.

6.9. Implementation and financing of digital solutions

The implementation of digital projects does not only require continuous support through qualified consulting. Digitalization projects are often associated with high investments. Small and medium-sized enterprises, in particular, have difficulties financing these investments. Buildings, vehicles and partly also machines can often be financed by bank loans if the earnings situation is good. Financing investments in consulting, software or other digital solutions via the traditional banking system is often difficult. What often remains is the division of digitalization projects into sub-steps, each of which can only be implemented at long intervals due to a lack of financing possibilities. Here it makes sense to support SMEs in accessing financing opportunities. Projects

already started, and financing possibilities can be included here. For example, the EBRD implemented a credit access programme called the B&H SME Competitiveness Support Facility (CSF), which was launched in 2016 (BIH-SME-CSF, 2016). The EBRD enables local banks to hand out credits to SME. The B&H-SME-CSF helps to speed up the process and acts for the SME. It acts central, with a clear catalogue of projects that can be financed. Local companies and local business developer have access. Besides, there is a 50 million loan of the World Bank (The World Bank, 2019).

6.10. Further actions according to the findings at the companies

The results of the company visits provide information which concrete measures are useful to support companies in the areas of ICT use, digitalization and innovation.

It must be considered that the companies visited during the survey show large differences with regard to the respective target markets and business models. These differences are also shown within the industries (wood and metal industry).

The following tables provide an overview of the most important company-related fields of action in relation to the sub-sectors identified within the sectors (wood and metal industry).

Wood- / Furniture Sector	
Sub-Sector	Main field of actions identified / possible Services
Production Sawn timber and solid wood products (furniture parts, scantlings, friezes, panels)	Field of actions identified: Digital process control Efficiency of material usage Log measuring Finding digital business models Possible services: Optimization of business processes Supporting in quality management Increasing ICT competence of the staff
Furniture from chipboard and massive wood, chairs	Field of actions identified Digital process control Integrated ICT systems Web presentation (3D presentation) Possible services: Optimization of business processes Improving market access Increasing ICT competence of the staff

Do it Yourself / Retail	Field of actions identified: Customer Interface (Web-shop, integrated ordering system) Technical qualification of staff Possible services: Increasing ICT competence of the staff Online-Marketing E-Training
Playground equipment	Field of actions identified: Digital process control Integrated ICT systems Possible services: Optimization of business processes Increasing ICT competence of the staff

Metal sector

Sub-Sector	Main field of actions identified / possible Services
Metal processing (laser cutting, laser-welding, bending)	Field of actions identified: Digital process control, especially production planning Reduction of Set-up time (change production process due to small batches) Product calculation Market-orientation Possible services: Optimization of business processes Increasing ICT competence of the staff Improving market access
Grids for reinforcement / construction industry	Field of actions identified: Digital process control Reduction of Set-up time Knowledge about construction market (technique, trends, potential customer) Possible services: Optimization of business processes Improving market access Increasing ICT competence of the staff
Heating boiler	Field of actions identified: Digital process control Integrated ICT Software system Remote maintenance for customers Possible services: Optimization of business processes Improving Market access Online-Marketing Customer relation management Increasing ICT competence of the staff

Elevator / moving walks	Field of actions identified: Digital process control, especially material management Integrated ICT systems Possible services: Optimization of business processes Increasing ICT competence of the staff
Cable production	Field of actions identified: Improving digital process control Automatic rescheduling of production Updating integrated ICT Software system Energy efficiency (optimization of energy consumption) Possible services: ICT Consulting / Mentoring Exchange of experiences / market knowledge about digital solutions

Based on the company analyses carried out, the following measures to support the metal and wood industry in B&H appear to make sense:

Consulting services

Process optimization / Quality management: Optimized processes are a prerequisite for the introduction of digital solutions. Digital change will have a significant impact on the organization and processes of companies. The step-by-step introduction of digital solutions therefore requires continuous improvement of internal company processes. The following methods, for example, offer helpful approaches to optimizing business processes: TQM, Lean Management, Kaizen or Six Sigma.

Quick-Check ICT: The Quick-Check determines how a company is positioned in digitized production and what digitalization potential exists. In addition, the possibilities of product and process innovations are evaluated.

Consulting to improve market access: The recognition and understanding of market developments, purchasing behaviour, technologies and trends creates opportunities to develop new products adapted to the market and to significantly improve the innovation potential of companies. Suitable for this are, for example, the support of companies at trade fairs, B2B events and the establishment and expansion of international business contacts.

Qualification / Training

ICT / Technology oriented Qualification: In order to increase the know-how in the company, training in ICT and digital solutions is required (e.g. ERP systems, IoT, digital production, CRM, online business, etc.). It is possible that this can be carried out in cooperation with the industry association Bit-Alliance.

Marketing and Foreign trade: Marketing, sales, foreign trade and initiation of international business relations increase the innovation potential of companies. New business contacts often require new solutions and adapted technologies. The companies in B&H are more product-oriented than market-oriented. This is often an obstacle to tread new innovative paths in product development and process innovation.

Development of an innovation friendly business environment

In addition, measures are needed to help companies to develop new innovative business models. For this, a suitable innovation-friendly business environment must be created. This can be done by initiating, promoting, developing and building up the following activities:

- Encouraging the exchange of experience within the sector (development of cluster initiatives).
- Promotion of cross-industry cooperation (matching event, events - production meet ICT)
- Promotion of cooperation between companies, universities and public administration (triple helix approach)
- Creation of an innovation-friendly environment, for example by promoting innovative start-ups through the expansion of incubators and the development of a business angel and mentoring network.

7. Role of supporting institutions / organizations

7.1. Supporting institutions / organizations and their capacities

Supporting institutions / organizations are already an important segment of the meso level of the Systemic Competitiveness Framework. By creating targeted policies, relevant infrastructure and conditions for doing business, they influence significantly on the competitiveness of an economy (Eda – Enterprise Development Agency, 2018a, p. 16-17) and that is, for sure, one of the main areas of activities needed to be done in the future, too.

As already emphasized (Chapter 2.2.) the conducted quantitative research showed lack of intermediaries' capacities for providing support in the area of digitalization. Having in mind that most participants of the round table were sceptic regarding the presented results of intermediaries' capacities and services, as well as their comments in that context, the situation may be even worse.

Some of the intermediaries started their own projects to create services for manufacturing companies. Still, it was clear that most of the institutions need to build up their own capacities in providing services in the context of digitalization.

Nevertheless, almost all of them plan to engage more significantly into supporting businesses in their competitiveness increase, to be based on more intensive digitalization utilization. Knowing that SMEs can only make sustainable progress with support of digital technologies, most of the interviewed intermediaries already prepared project frameworks, to be used for application for future available projects/calls for proposals, supported/funded by international development organizations operating in Bosnia and Herzegovina. Joint features of these project drafts could be summarized as support to:

7.1.1. Innovation activities

In OECD's Oslo Manual 2018, a business innovation is defined as „a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm" (OECD/Eurostat, 2018, p. 68). In addition to that there is explanation that „innovation activities include all developmental, financial and commercial activities undertaken by a firm that are intended to result in an innovation for the firm" OECD/Eurostat (2018, p. 68).

Traditional sources of growth are declining in importance. Many countries have declining or stagnating populations, and this reduces the role of labour input in long-term economic growth. Investments in physical capital face diminishing returns and may be insufficient to strengthen long-term growth, especially in advanced economies. Innovation will be increasingly needed to drive growth and employment and improving living standards. This is true as well for emerging economies that look to innovation as a way to enhance competitiveness, diversify their economy and move towards higher value-added activities (OECD, 2010, p. 9).

According the results of the SME Policy Index: Western Balkans and Turkey 2019, Bosnia and Herzegovina has the lowest score in the region for dimension Innovation policy for SMEs. The score is 1.86 which is well behind Kosovo (2.40) and Albania (2.48) (OECD, 2019, p. 577). One should be aware that market mechanisms alone cannot ensure optimal levels of business investment in innovation, because innovation suffers from three market failures:

1. uncertainty (both technological and commercial), which is much higher than the risk taken in usual business situations;
2. indivisible upfront fixed costs (such as the cost of developing a new product) and
3. the public good nature of innovation outputs which makes it difficult for a firm to accrue the full benefit for itself (OECD, 2018, p. 363).

On the other hand, private sector actors are not systematically consulted when innovation policies are developed and there are no evaluation practices in place. The institutional set-up for innovation policy is highly decentralised across the various levels of government and there is no mechanism to co-ordinate these actors. Also, there have been no innovation vouchers or collaborative grants implemented in Bosnia and Herzegovina so far (OECD, 2019, p. 578). All these findings are pointing out the space for intermediary institutions to intervene and try to solve existing failures and inefficiencies.

As a first step, as a significant role for intermediary institutions in supporting innovation activities could be recognized an awareness raising effort. An evident lack of relevant information regarding meaning and importance or innovations is noted with decision makers in B&H SMEs. Further, to create a better environment for innovations, activities related to improvement of research & development coordination should be supported, especially due to specific internal structure of the country. These activities would increase demand and open new space for innovations in SMEs in Bosnia and Herzegovina.

There is a need to support SMEs in innovations-related project design and preparation, due to poor internal resources and experience on company level. Support in implementation is also

expected to be provided by the intermediaries, what would also contribute to good practices development, creating a foundation to expand it to broader SME network.

Financial resources available for R&D, innovative approach in production and introduction of new technologies in B&H are rather scarce, because the banking sector, as almost only source of funding for local economy, is reluctant to provide seed-funding and to finance new and not tested undertakings in SME sector. Therefore, intermediary institutions should interfere and create funding opportunities for the innovative companies, usually with additional support from the public sector or, more often, international donors – appropriate financing instruments, innovation voucher schemes, innovation credit lines, support to business angel networks, support to development of risk capital funds etc.

7.1.2. Networking – interactions among key actors

An interaction is the mutual action or influence which may exist between two or more objects, two or more organs, and even two or more phenomena, and it is always followed by one or several effects (Cordier, Debarsy, & Ertur, 2017, p. xxi). Speaking about interactions and cooperation between stakeholders relevant for economic development in the project area, relevant are findings of the research conducted within the project KRIN - Creating Regional Innovation Network, implemented by Eda – Enterprise Development Agency in August 2017 – November 2018[4]. Research results show that co-operation between companies exists but is modest, sporadic, short-lived (lasting only until a current problem is solved) and it functions without any special rules. Factors that hinder cooperation are mentality, lack of trust and previous bad experiences in cooperation. Those companies that had concrete cooperation with one of the supporting institutions (faculties, secondary schools, agencies, consultants) are mostly satisfied with the achieved effects. A significant part of companies did not cooperate with support institutions, and led by prejudice, has no positive opinion of them. In order to increase cooperation, a better, more honest and more intensive exchange of information is needed (Borojević, Miovčić, Šipragić, & Janković, 2018, p. 26, 37). There are needs for strengthening interactions and enhancing cooperation and there are positive examples that prove that this is the correct approach that leads to more innovations in enterprises. On the other hand, there is a need for many improvements to bring more innovation to businesses (Eda – Enterprise Development Agency, 2018b, p. 4).

Intermediary institutions in B&H already play a role in SME networking, but further improvement of interactions is obviously still needed. These interactions should be supported on both, macro and micro level, starting on macro level with triple helix model, bringing together government (policies), industry (SMEs engaged in production) and academia (universities creating innova-

4 Information about the project KRIN is available at: https://edabl.org/wp-content/uploads/2018/04/KRIN-ENG.pdf.

tive solutions with companies), but continuing to quadruple helix, also including civil society (NGOs), creating the multidisciplinary approach, promoting team work, collaboration and sharing of ideas. Intermediary institutions are more and more often coming from the civil sector, playing more important and visible role in networking, especially with companies and academia. For example, new curriculum, suitable for the industry needs, cannot be developed without a full cooperation between educational institutions and companies, and intermediary institutions could play a role of a facilitator of such interactions.

Intermediaries can contribute to networking on industry level primarily by facilitating direct communication (sectoral boards, industry associations, clusters etc.), including exchange of information and strengthening of mutual trust between companies, as a precondition to good cooperation. Appropriate study tours can enhance the communication between SMEs, while in the same time bringing new technologies and even new buyers to participating B&H companies, what on the other hand, creates an impetus for innovations.

Also, intermediaries should engage in creation of appropriate, reliable and constantly updated set of information related to technological capacities and/or needs for new capacities (equipment, know-how, products, raw materials etc.) of local companies, enabling them to swiftly react to market demand and introduction of new products, very often based on innovative solutions and technologies applied.

Of course, networking supported by intermediaries should include cooperation between companies and consulting capacities, dealing with product design, business process improvement (very important area, as a necessary precondition for digitalization), provision of information related to new technologies and digital solutions etc., directly affecting companies' capacities to improve competitiveness.

As one of the most important results of successful networking, that could be supported by intermediary institutions, is support to industry sectors in defining clear messages towards public sector, making it possible to influence public policies, including creation of supporting measures to boost development, innovations, digitalization process and companies' competitiveness in general. Institutions could coordinate and support the processes within working groups established to define such measures/policies, providing for participation of stakeholders and relevant participants, ranging from business associations, chambers and clusters, to development agencies and relevant institutions.

7.1.3. Knowledge flows

Knowledge is assimilated information and the understanding of how to use it (Hess and Ostrom, 2007, p. 8, cited in Fazekas & Burns, 2011, p. 5). An essential component of this is that the quantity of knowledge does not diminish with use, but rather it increases its value as more and more people use it. Policy relevant knowledge is knowledge concerning policy issues and shared by at least some policy makers either within or outside the state (Grin and Loeber, 2007, cited in Fazekas & Burns, 2011, p. 5).

Knowledge flow is firmly connected with innovations and networking, described above, and makes an integral part of efforts to increase companies' competitiveness through innovative approach and digitalization efforts. Intermediaries should have a decisive role in translation of knowledge and technologies from creators to users in a business context. Creators here include universities, research organizations, institutes and others, but also innovative businesses, usually leaders in their respective industry branches.

To bring the knowledge to the company level, intermediaries must closely collaborate with companies in need for knowledge on one side, and with sources of knowledge (creators) on the other side, creating efficient and affordable mechanisms to achieve the desired results. Very often, there is a strong need for support in defining the needs of companies, not being aware of their current problems and even less aware of possible solutions to tackle their problems and create preconditions to evolve, to increase their competitiveness through internal/organizational interventions (new technologies, materials, trends, products, markets etc.).

Intermediaries should play a role of a generally independent third parties, supporting collaborative activities (networking) in any aspect of the innovation process (innovations) for the mutual benefit of two or more parties, for example: (i) assistance in acquisition and utilization of relevant technology, (ii) identification of potential collaborators, (iii) brokering a transaction between two or more parties, (iv) acting as a mediator with already collaborating organizations, (v) defining and directing knowledge (know-how, advice etc.), funding and support for the innovation outcomes of such collaborations, what would all contribute to knowledge flow, fulfilling the goal to increase companies competitiveness and ability to preserve their business activities even in the environment of ever stronger competition.

7.2. Future tasks for supporting institutions/organizations

There is no doubt that capacities of supporting institutions/organizations regarding digitalization/industry 4.0 should be improved, as the prerequisite for creating adequate targeted policies and business environment. Also, interactions between key stakeholders in this area should be strengthened, including probes and "safe2fail" experiments, which enable creating an experience, learning, and reaching adjacent possible goals. That may be subject of new projects that should contribute to:

- improving capacities of supporting institutions/organizations (e.g. combination of training, coaching, study visits, etc.);
- facilitation communication and cooperation between key stakeholders in this area (supporting institutions, SMEs, service providers and consultants);
- awareness raising, education and strengthening the demand of SMEs in wood and metal sector towards tailored ICT solutions, including improvement of their business processes (e.g. study visits, training, participation on relevant ICT events, voucher schemes etc.) and
- supporting the development of ICT solutions and services for industry SMEs (metal and wood processing) by domestic service providers and consultants.

Bearing in mind poor experience with efficiency of state-level institutions and specific structure of B&H state, where all economy related activities, including SME/business support, are placed on lower administrative levels (entities of BH Federation and Republika Srpska, cantons in BH Federation and LGUs – cities and municipalities in the entire country), it is to expect that digitalization related support activities should be developed by existing business support network, by local, regional, cantonal on entity development (and similar) agencies.

As mentioned above, ten of twelve visited intermediary institutions already developed their vision, transformed into concrete project drafts, aimed at supporting SMEs to increase their competitiveness through increased use of digital technologies, combined with knowledge transfer and business development support in broader sense. So, the concrete projects, so far prepared as drafts, were aiming following activities:

- establishment and development of new institutional/project capacities – digital transformation centres in various forms, varying from learning factories or innovation labs supporting information and knowledge flows, to institutional arrangements providing the whole variety of services related, among others, to:
    - supporting businesses in their restructuring/re-organization of production and processes, very often being a prerequisite to introduce digitalization into the company;

  - delivering smart/digitalization services to businesses, including creation of pool of certified digital consultants, being able to support businesses with tailor-made digital roadmaps and implementation strategies;
  - supporting business angels' network to actively engage in Bosnia and Herzegovina, bringing new source of capital for local businesses but also matching innovative businesses with appropriate private investors (business angels), accelerating the implementation of innovations and adaptation of SMEs to challenges of digitalization;
  - developing and implementing contemporary education programs;
  - engaging in networking – cooperation with similar centres supporting digital transformation world-wide, primarily in EU, but also supporting networking on local level, especially between businesses and local ICT capacities, firms and experts;
  - supporting businesses in improving communication with local administration, including researching on needs for digitalization, resulting in defining measures to improve organization, transfer of knowledge, and supporting businesses to procure needed software and hardware components, etc.

- development and implementation of services related to awareness raising on digitalization, especially amongst the companies, including the awareness of the need to properly structure processes as a priority step of digitalization process to ultimately result in competitiveness increase for the company itself, followed by activities supporting communication, interactions between stakeholders, dissemination and promotion;

- redesign, advocacy activities and implementation of new curriculum, adjusted to the needs of the companies, being able to produce staff with skills currently needed by local businesses, with focus on ICT skills, supported also by appropriate trainings and education programs, available for companies, as a more immediate tool to obtain needed staff in shorter period;

Inevitably, also in accordance with experiences from the last 20 years, a significant role is expected to be played by international development agencies active in B&H in the field of SME/business/local economic development support, bringing resources in the form of know-how and partial funding of priority activities.

Efforts to be made in the direction of mobilizing local and international institutional capacities in the direction of supporting the digitalization of B&H SMEs, metal and wood processing companies, in particular, should be eased due to the fact that the digitalization itself, accompanied with innovations is a priority on the development agenda for the years to come.

8. Summary and recommendations

Based on the deficits identified in many of the visited companies, concrete recommendations for actions could be derived. In the following section, the identified deficits are briefly summarized and, building on this, specific recommendations for action for companies, supporting organizations and international donor organizations were given.

Deficits of the most SMEs visited

- Often not optimized business processes
- Insufficient knowledge of the benefits of digitalization
- Missing or insufficiently developed ICT / digitalization strategy (the use of modern ICT solutions is presently not a high priority for most of the companies)
- Companies are often unwilling to invest in the qualification of their employees. (The development of soft skills would be necessary in the areas of ICT application, process optimization and marketing, among others.
- Mostly no use of integrated software systems (ERP systems)
- No integrated production e.g. via DNC
- Problems in product calculation, including measurement and recording of working times
- No or insufficient market orientation (no use of CRM tools)
- Inadequate use of online communication possibilities on the customer side (web interface, web shop, input of customer enquiries and basic data by the customer himself)
- No or only limited use of Virtual Reality or Augmented Reality

The following specific fields of actions for SMEs, intermediaries and donors emerge on the basis of the deficits presented in aggregated form.

Recommendations for SMEs:

- Participation in events and study trips with the aim of acquiring knowledge about the possibilities of digitalization;
- Participation in training courses and workshops on the topic of digitalization;
- Participation in working groups with the aim of exchanging experiences with other companies in the production industry, with companies from the ICT sector and universities;

- Optimization of production processes, introduction of quality management systems but also continuous maintenance of the quality management system (CIP = Continuous Improvement Process);
- Step-by-step development of internal ICT competence (ICT department);
- Review of possibilities to make business processes more efficient through digital solutions (if necessary, with external support / ICT Quick-Check);
- Development of a digitalization strategy (definition of a sequence or a priority list which processes can be digitized);
- Ongoing review of the company's own corporate strategy, in particular regarding the digitalization strategy;
- Establishing and expanding further international market contacts in order to find opportunities in the development of new digital business models;
- Introduction of integrated software systems (ERP system), including CRM and web interface for customer communication;
- Gradual introduction of digital solutions in production (integrated production, IoT, material tracking, real time process control, etc.).

Recommendations for supporting organizations:

- Establishment and development of internal competence in the field of digitalization (training of employees):
  - Development of internal consulting competence to carry out initial consulting;
  - Building knowledge about solution providers of digital techniques and software;
  - Nomination of an employee responsible for consulting in digitalization in the organization;
  - Step-by-step development of an own department "Digitalization".
- Development of information material (printed and online);
- Establishment of a specialized consulting pool with external experts for partial areas of digitalization (e.g. experts for process optimization, ERP systems, Virtual Reality, etc.);
- Clustering of production companies to promote the exchange of experience between companies;
- Implementation of cross-industry events to bring ICT and production companies together;
- Promotion of innovative start-ups, especially in the ICT sector;
- Organizing events and conferences about digitalization;
- Establishment of a local mentoring and Business Angels networks.

Recommendations for international donor organizations:

- Development of information service about Digitalization, e.g. by setting up an online information platform;
- Supporting intermediaries in building internal competencies;
- Support in the development of online/web-based training modules;
- Supporting intermediaries in setting up a pool of consultants including external consultants who can support companies in special digitalization issues (possibly by developing common guidelines for the accreditation of qualified consultants);
- Supporting companies in optimizing production processes, establishing international business contacts, participating in trade fairs, international events and study tours;
- Creation of financing opportunities for SMEs to invest in digital solutions:
- Promotion of ICT-oriented start-ups;
- Support in development of mentor / Business Angels networks.

Most of the visited companies have considerable potential to increase their international competitiveness by deploying new digital solutions. The prerequisite for this is that companies prepare their workflow and processing processes for digitalization/automation by optimizing them. The first step in most of the visited companies is therefore a reorganization towards meaningful automatable (digitizable) processes and the transfer of corresponding know-how into the companies or to specialized consulting services/partners.

However, the goal of digitalization must not only be to use digital technologies in order to sustainably reduce production and organizational costs. Rather, digitalization should improve the innovation potential of companies, which should contribute to the development of new innovative business models. Currently, the international competitiveness of companies is based on good product quality and an internationally competitive price. However, the products are easy to substitute. Innovative products, services or business models are hardly developed. In the medium term, however, companies will have to deal with the development of new innovative business models in order to avoid ruinous price competition.

Another obstacle is the lack of cooperation between local ICT service providers and manufacturing companies in the sectors studied. Existing companies in the ICT sector either focus on international markets as suppliers or offer accompanying services for the implementation of foreign standard products. So far, there is no sufficient infrastructure (environment) for the development and implementation of locally developed, industry-oriented software solutions. As a result, companies often have ICT freelancers develop individual, isolated solutions tailored to

their current processes. At the company level, the inadequately developed ICT service offering results in a currently high demand for (unproductive) in-house services, which are not geared to the development and application of solutions, but to their pure operational security. It is therefore also necessary to further develop ICT companies that offer a sufficient range of services for the regional market. In order to achieve this, measures that enable an innovation- and business-friendly environment appear suitable. This includes the further expansion of start-up support, for example through incubators or the establishment of business support networks, such as business angel and / or mentor networks.

Companies cite the lack of qualified specialists and corresponding know-how as a barrier in the field of increasing competitiveness and innovative strength. Further automation and digitalization in the companies will lead to an increasing demand for qualified personnel or corresponding resources and capacities. In some cases, resources can be mobilised from the reorganization of company processes and the abolition of low-skilled activities (change in the nature of work). In addition, however, efforts by society as a whole to reform and modernise the education, training and further training system will also be required in this context.

Annexes

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Annex 2. Questionnaire for SMEs

Company Information and contact information

This questionnaire is designed for SMEs, aiming to improve their competitive position through, among other things, increased use of digital technologies in their everyday activities. This questionnaire will display where you are using the advantages of digitalization in your company. With this questionnaire we would like to verify the digital competitiveness of your company.

Your contact information _____
Surname _____
Name _____
E-mail _____
Phone _____
Mobile No. _____
Your level of education _____
Your position _____
Name of the firm _____
Address _____
Web Address _____

Introduction

1. What is digital transformation for you? (mark one or more true statements)

☐ A new trend that people are talking about that I must understand, in order to enable my business to survive
☐ The technology that will help my current business be developed and to increase using IT
☐ Evolution of business that will help me adjust my Products/Services to the needs of new clients
☐ My competitors have already introduced or plan to introduce digital products, services, solutions, etc.
☐ My clients/providers require me to bring in and I import digital solutions
☐ Image change and transfer of the "old fashioned" production industry

What type of industry does your company belong to? _____

Total Number of employed male persons ☐

Total Number of employed female persons ☐

In relation to expectations, Level of your profit is:

Considerably above the expected ☐

Above the expected ☐

Expected ☐

Below expected ☐

Considerably below the expected ☐

Your company works well in the area of:

Management ☐

Marketing & Sales ☐

Product development ☐

Production ☐

Logistics ☐

Quality ☐

Your company has a need to employ more workers with the following qualifications:

Vocational education - Technical profession ☐

Vocational education – Economy Profession ☐

University Education in Technical sciences ☐

University education In Economic sciences ☐

Researchers in Technical sciences (Mr, Dr) ☐

Researchers in Economic sciences (Mr, Dr) ☐

What type of training would you like your workers to pass over the next 12 months?

AutoCAD/Solidworks/Other? ☐

Certification of Welders ☐

CNC Mechanical processing ☐

Lean Production ☐

Strategic goals of your Company in the next few years include:
(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree)

	1	2	3	4	5
Stabil business	☐	☐	☐	☐	☐
Growth of production volume	☐	☐	☐	☐	☐
Growth through introduction of new products	☐	☐	☐	☐	☐
Growth through buying new jobs	☐	☐	☐	☐	☐
Networking with others	☐	☐	☐	☐	☐
Opening new business lines	☐	☐	☐	☐	☐
Selling some parts existing activities	☐	☐	☐	☐	☐
Sale of all our activities	☐	☐	☐	☐	☐
Subcontracting the production	☐	☐	☐	☐	☐
Specialization in the area of R&D and marketing & sales	☐	☐	☐	☐	☐
Subcontracting od R&D (less own R&D)	☐	☐	☐	☐	☐
To become deliverers of the complete system	☐	☐	☐	☐	☐
Maintenance, servicing, repairs, renovation	☐	☐	☐	☐	☐

2. Products and processes of construction/production

In this part of the questionnaire, we are interested in more details about the products your company offers, as well as for information about your construction and manufacturing processes in the company.

Possible errors in products are usually revealed in:
(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree).

	1	2	3	4	5
Conceptual phase of designing	☐	☐	☐	☐	☐
Detailed phase of designing	☐	☐	☐	☐	☐
Stage of production	☐	☐	☐	☐	☐
Stage of assembly	☐	☐	☐	☐	☐
During final controlling process, during delivery	☐	☐	☐	☐	☐
When the product is already in use	☐	☐	☐	☐	☐

In the design phase we use:

(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree)

	1	2	3	4	5
Methods for the development of the product	☐	☐	☐	☐	☐
Drawings	☐	☐	☐	☐	☐
Budgets	☐	☐	☐	☐	☐
Models/prototypes	☐	☐	☐	☐	☐
Functional simulations	☐	☐	☐	☐	☐
2D CAD	☐	☐	☐	☐	☐
3D CAD	☐	☐	☐	☐	☐
Other - please define	☐	☐	☐	☐	☐

In the production stage we use:

(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree)

	1	2	3	4	5
Drawings on paper	☐	☐	☐	☐	☐
CNC manual programming	☐	☐	☐	☐	☐
CNC-CAD/CAM programming	☐	☐	☐	☐	☐
Robots	☐	☐	☐	☐	☐
Automated production lines	☐	☐	☐	☐	☐

Usual time from receiving the order to the beginning of production is:

☐ < 1 day ☐ < 1 week ☐ < 2 weeks ☐ < 1 month ☐ < 3 months ☐ > 3 months

Usual time from the beginning of production to delivery in our production is:

☐ < 1 day ☐ < 1 week ☐ < 2 weeks ☐ < 1 month ☐ < 3 months ☐ > 3 months

We see options for improving some parts of the production process with:
(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree)

	1	2	3	4	5
CNC machines	☐	☐	☐	☐	☐
Robots	☐	☐	☐	☐	☐
CAD-CAM integration	☐	☐	☐	☐	☐
ERP software	☐	☐	☐	☐	☐
More efficient logistics	☐	☐	☐	☐	☐
By stimulating innovation	☐	☐	☐	☐	☐
Establishment of cooperation in order to transfer knowledge	☐	☐	☐	☐	☐
Lean production	☐	☐	☐	☐	☐
Options exist, but we must know more about it	☐	☐	☐	☐	☐
Another – please define	☐	☐	☐	☐	☐

3. ICT

In this part of the questionnaire we are interested in detail on available software and computer networks inside your company.

Does your company have an internal computer network?

Yes ☐

Ne ☐

Which kind of internet access does your company use?

☐ DSL bandwidth (connection size) in Mbit
☐ Fiber optic bandwidth (connection size) in Mbit
☐ Radio link bandwidth (connection size) in Mbit
☐ Satellite link bandwidth (connection size) in Mbit

Our information structure uses:

(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree)

	1	2	3	4	5
Databases	☐	☐	☐	☐	☐
Synchronization (of system files and data)	☐	☐	☐	☐	☐
Exchange of files	☐	☐	☐	☐	☐
Product Data Management (PDM)	☐	☐	☐	☐	☐
Product Lifecycle Management (PLM)	☐	☐	☐	☐	☐
Email in everyday business processes	☐	☐	☐	☐	☐
Intranet	☐	☐	☐	☐	☐
WEB-portal (on-line access to documentation)	☐	☐	☐	☐	☐
Wiki	☐	☐	☐	☐	☐
Blog/weblog	☐	☐	☐	☐	☐
Another – please define	☐	☐	☐	☐	☐

Our company uses appropriate computer/software tools in:

(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree)

	1	2	3	4	5
Management	☐	☐	☐	☐	☐
Marketing	☐	☐	☐	☐	☐
Production	☐	☐	☐	☐	☐
Quality	☐	☐	☐	☐	☐
Logistics	☐	☐	☐	☐	☐
Vendors/procurement	☐	☐	☐	☐	☐
Delivery reception	☐	☐	☐	☐	☐
Warehouse management	☐	☐	☐	☐	☐
Production flow	☐	☐	☐	☐	☐
Delivery to customers	☐	☐	☐	☐	☐
Other - please define	☐	☐	☐	☐	☐

In the computer/software systems of our company, the following functions are linked/integrated with other systems:
(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree)

	1	2	3	4	5
CAD (linked to something...)	☐	☐	☐	☐	☐
Purchase	☐	☐	☐	☐	☐
Warehouse	☐	☐	☐	☐	☐
CAD/CAE its CNC machines	☐	☐	☐	☐	☐
ERP systems	☐	☐	☐	☐	☐
Economy / management	☐	☐	☐	☐	☐

Our company sees interesting potential for digital tools in:
(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree)

	1	2	3	4	5
Planning and simulation of production	☐	☐	☐	☐	☐
CAD/CAE	☐	☐	☐	☐	☐
Logistics	☐	☐	☐	☐	☐
Comprehensive ERP system	☐	☐	☐	☐	☐
Other - please define	☐	☐	☐	☐	☐

4. Relations with business partners

The main suppliers of your company are:

Local %	☐
Regional %	☐
National %	☐
International %	☐

Our company expects from vendor:

(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree)

	1	2	3	4	5
Convenience in prices	☐	☐	☐	☐	☐
Convenience in terms of delivery	☐	☐	☐	☐	☐
Quality	☐	☐	☐	☐	☐
Technological progress	☐	☐	☐	☐	☐
Care for the environment	☐	☐	☐	☐	☐
Other - please define	☐	☐	☐	☐	☐

Cooperation with suppliers? Please highlight the most frequent ones:

	Long term contracting	Temporary, depend on the situation	Without cooperat.
R&D prototypes	☐	☐	☐
Quality control	☐	☐	☐
Exchange of production data	☐	☐	☐
Purchase	☐	☐	☐
Common logistic solutions (transport, inventory, warehouse, etc.)	☐	☐	☐
Other - please define	☐	☐	☐

Cooperation with customers? Please highlight the most frequent ones:

	Long term contracting	Temporary, depend on the situation	Without cooperat.
R&D prototypes	☐	☐	☐
Exchange production data	☐	☐	☐
Exchange sales information	☐	☐	☐
Common logistic solutions (transport, inventory storage, etc.)	☐	☐	☐
Other - please define	☐	☐	☐

5. **Competition**

In this part of the questionnaire we are interested in detail on the current situation in your company's target market and competition your company is facing.

Which of the markets are your main current markets - specify amounts, in %, in relation to your total revenue?

Local %	☐
Regional %	☐
National %	☐
International %	☐

Your competitive advantages are (please highlight)

	Local Market	Regional Market	National Market	International Market
Leadership in price	☐	☐	☐	☐
Superior quality	☐	☐	☐	☐
Innovative products	☐	☐	☐	☐
Flexibility of Services (quick response,	☐	☐	☐	☐
flexibility according to changes in the market)	☐	☐	☐	☐
Product variability	☐	☐	☐	☐
Other-please define	☐	☐	☐	☐

The main competitors of your company are?

- Local % ☐
- Regional % ☐
- National % ☐
- International % ☐

According to your expectations, in the period of next 5-10 years, the competition will be:
(1. Significantly larger 2. Larger 3. No change 4. Smaller 5. Significantly smaller)

- Local % ☐
- Regional % ☐
- National % ☐
- International % ☐

If the competition increases, please define this competition in view of:
(1. I totally agree 2. I agree 3. Nor do I agree or disagree 4. I disagree 5. I completely disagree)

	1	2	3	4	5
Prices	☐	☐	☐	☐	☐
New product	☐	☐	☐	☐	☐
Agility (quick response to market changes)	☐	☐	☐	☐	☐
Better services	☐	☐	☐	☐	☐
I do not know	☐	☐	☐	☐	☐
Other - please define	☐	☐	☐	☐	☐

Additional comments (if needed):

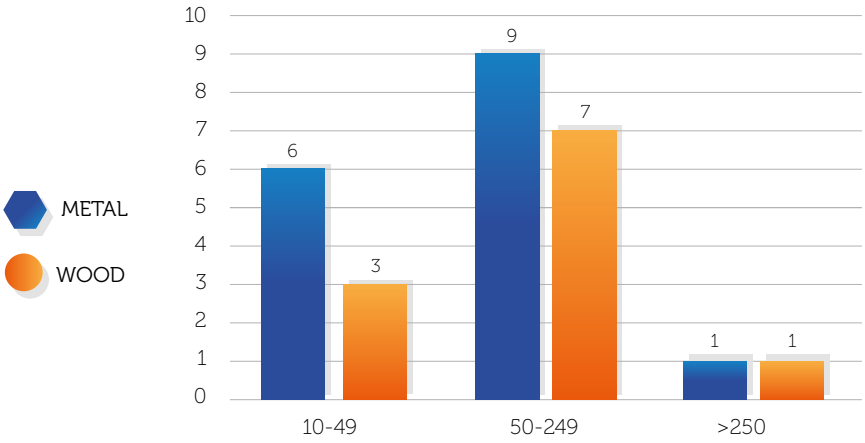
Annex 3

Findings of the SME research

1. Sample of companies

In total, 16 metal processing companies and 11 wood processing companies filled in the questionnaire. Having in mind the number of employees, there are 9 small companies (6 in metal and 3 in wood processing sector), 16 medium companies (9 in metal and 7 in wood processing sector) and 2 large companies (1 in metal and 1 in wood processing sector).

Figure 1. Number of small, medium and large companies, by sector



2. Structure of employees, by gender

In both sectors, most of the employees are men. In metal processing companies, 92% of employees are men, while that percentage in wood processing segment is slightly lower – 84%. In absolute figures, metal companies in the sample employ a total of 1.841, and wood processing 1.105 persons.

Figure 2. Employees in metal processing companies

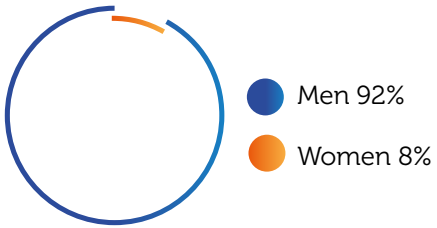
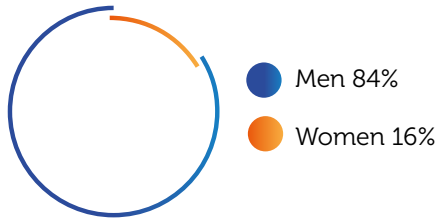


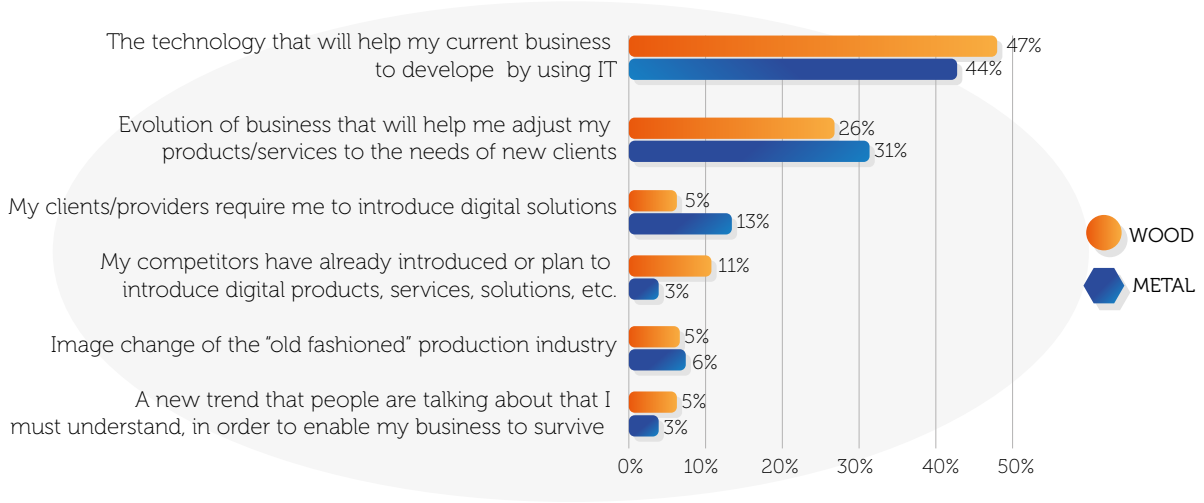
Figure 3. Employees in wood processing companies



3. Perception of digital transformation

Regarding perception, that is understanding of digital transformation, most companies perceive it as the technology that will help their businesses to develop by using IT (47% of wood processing companies and 44% of metal processing companies), and as an evolution of business that will help companies to adjust their products/services to the needs of new clients (31% of metal processing companies and 26% of wood processing companies).

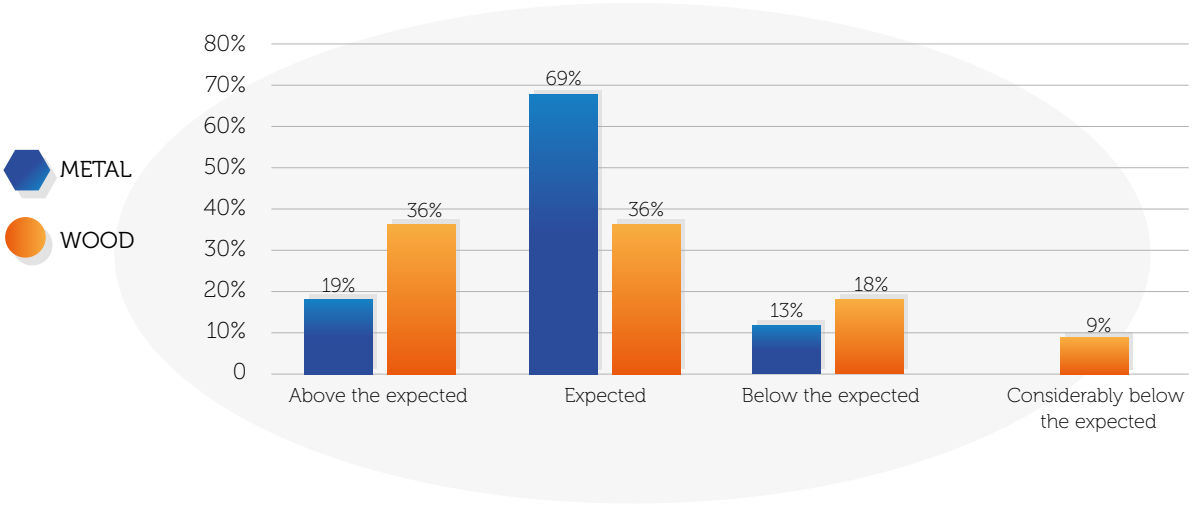
Figure 3. What is digital transformation for you?



4. Level of profit in relation to expectations

Most of the metal processing companies have their level of profit in line with expected (69%), while there are also 19% of companies with higher than expected level of profit and 13% of companies with lower than expected level of profit. With wood processing companies, the situation is quite different. Namely, there are 36% of companies with as planned and 36% of companies with a higher than expected level of profit. Also, there is 18% of companies with lower than expected and 9% of companies with considerably lower than expected level of profit.

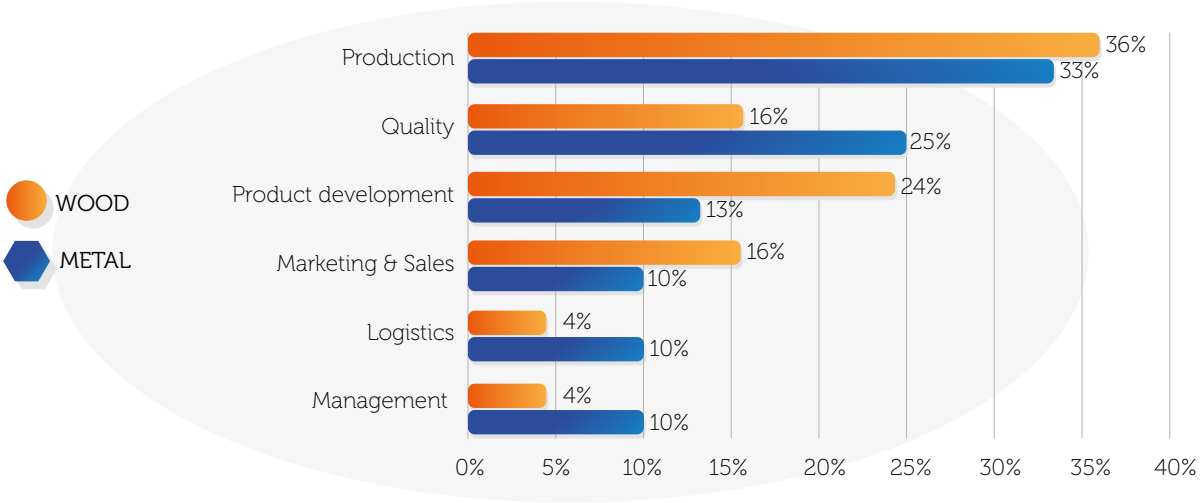
Figure 4. In relation to expectations, level of your profit is:



5. Core competence of the companies

Majority of companies find that they work well in the area of production – 36% of wood processing companies and 33% of metal processing companies. Hence, there is no doubt that production is their core competence. At the second position, there is "quality" for metal processing companies (25%) and "product development" for wood processing companies (24%). Companies find that they do not work well in marketing&sales, logistics and management.

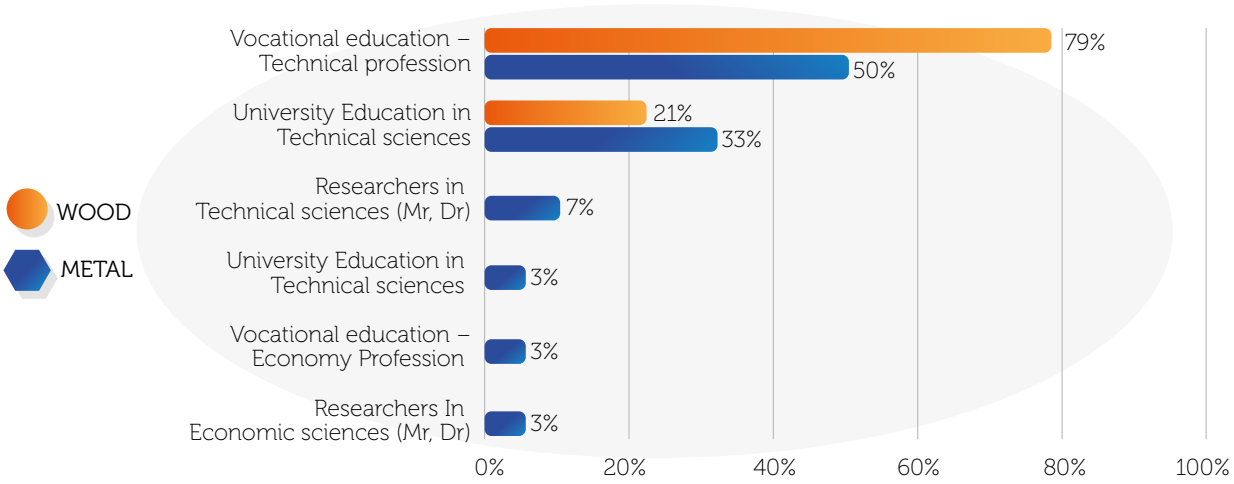
Figure 5. Your company works well in the area of:



6. Employment needs

Most companies have a need to employ more workers with vocational education – technical profession (79% of wood processing companies and 50% of metal processing companies). There is significantly less demand for employment of persons with university education in technical sciences (33% of metal processing companies and 21% of wood processing companies). Interestingly, there is only 7% of companies in the metal sector in need for a researcher in technical sciences, while there is no need at all for this profile by wood processing companies. Also, wood processing companies do not need employees of the economic profession at all, while some 3% of metal processing companies need economists.

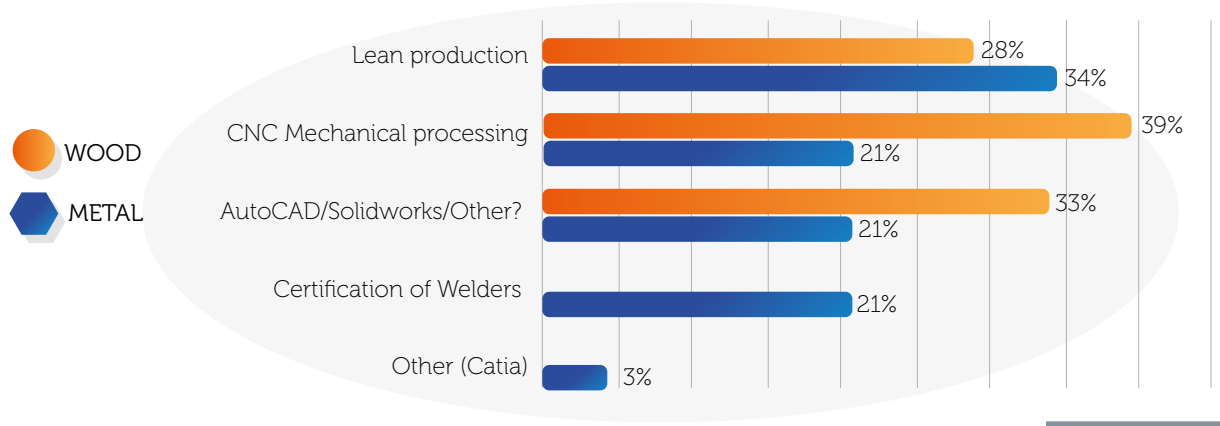
Figure 6. Your company has a need to employ more workers with the following qualifications:



7. Training needs

Metal processing companies are most interested in training regarding lean production (34%), while interest in other subjects (CNC mechanical processing, AutoCAD/SolidWorks, certification for welders) is equally distributed (21%). Wood processing companies are most interested in training regarding CNC mechanical processing (39%), AutoCAD/SolidWorks (33%) and lean production (28%).

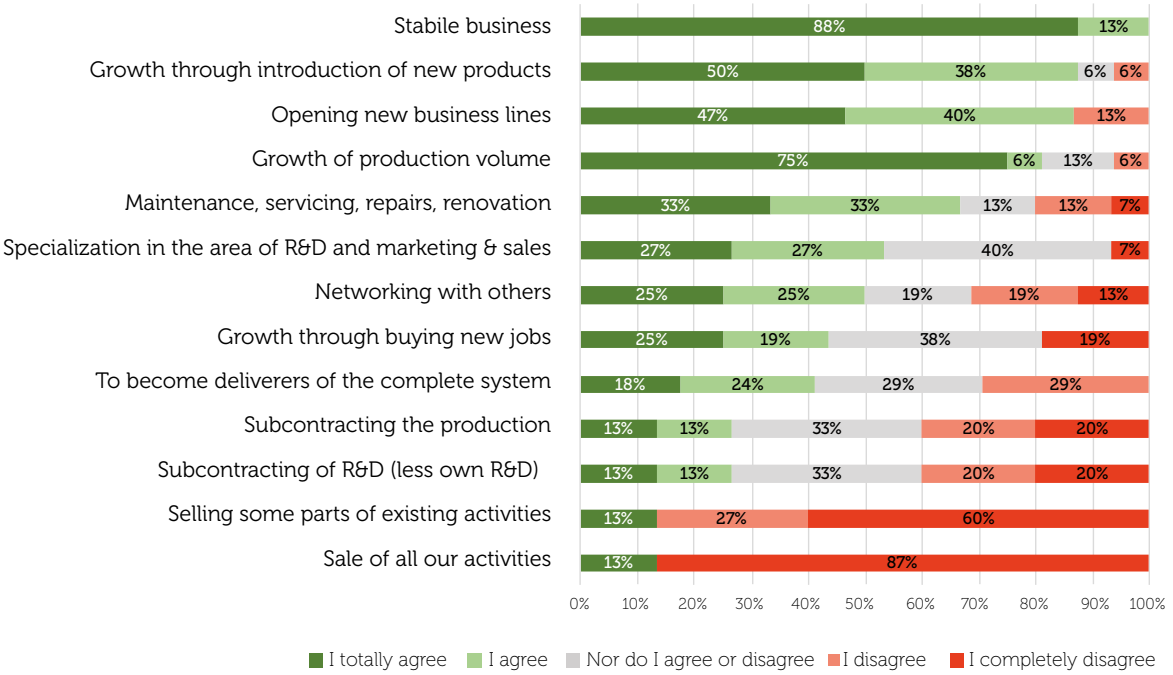
Figure 7. What type of training would you like your workers to pass over the next 12 months?



7. Strategic goals

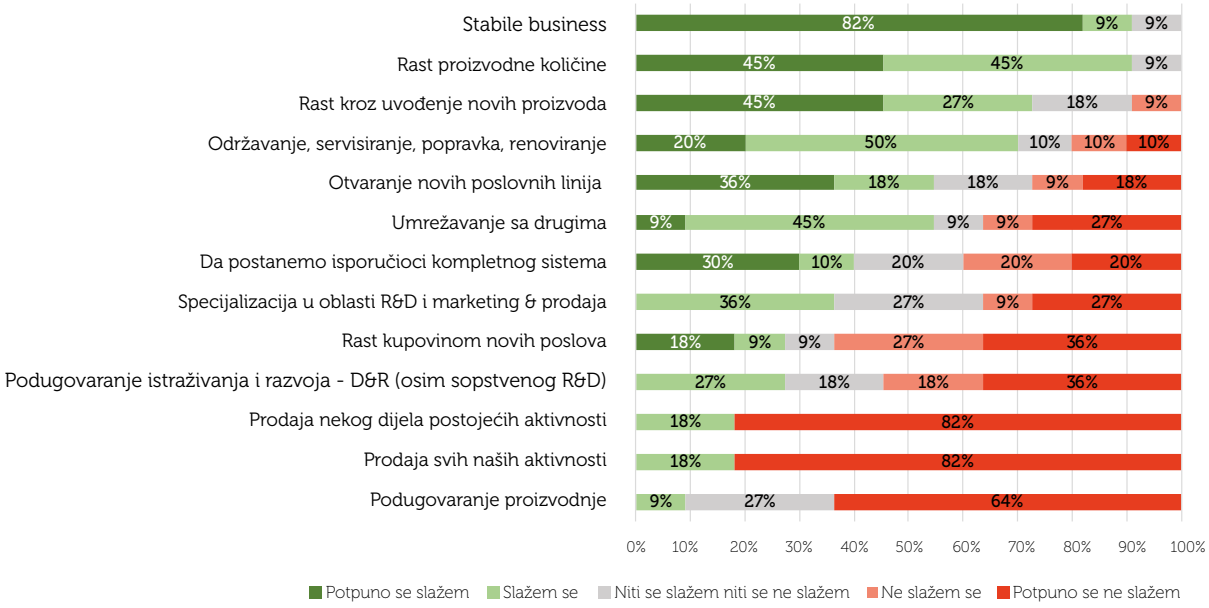
Strategic goals of most metal companies include: stabile business (100% of metal processing companies totally agree and agree), growth through introduction of new products (88% of metal processing companies totally agree and agree), opening new business lines (87% of metal processing companies totally agree and agree) and growth of production volume (81% of metal processing companies totally agree and agree). Other goals are not present so frequently.

Figure 8. Metal processing sector - Strategic goals of your Company in the next few years, include:



Strategic goals of wood processing companies are very similar tothe goals of metal processing companies: stabile business (91% of wood processing companies totally agree and agree), growth of production volume (91% of wood processing companies totally agree and agree), growth through introduction of new products (73% of wood processing companies totally agree and agree) and maintenance, servicing, repairs, renovation (70% of wood processing companies totally agree and agree).

Figure 9. Wood processing sector - Strategic goals of your Company in the next few years include:

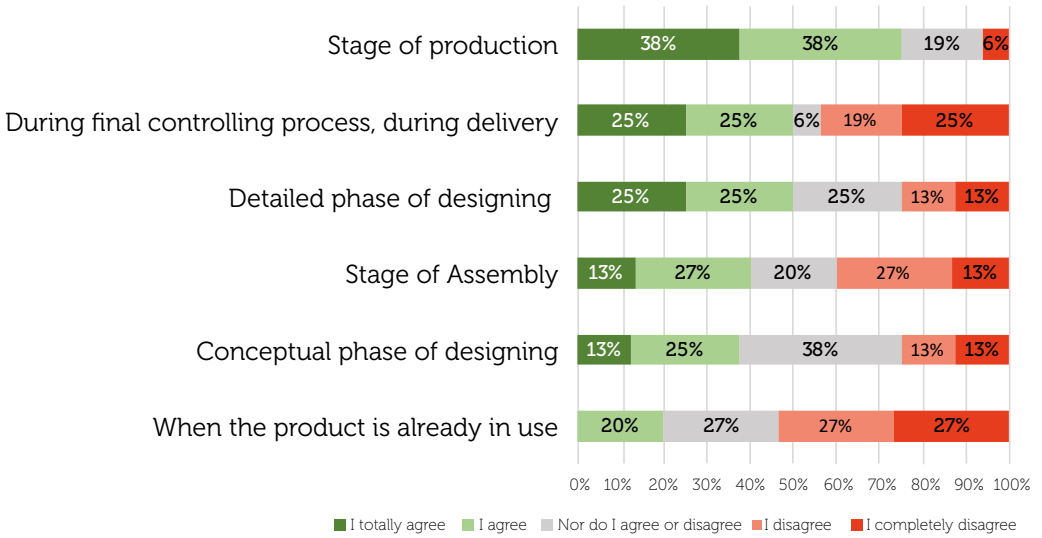


Products and construction/production processes

8. Revealing possible errors in products

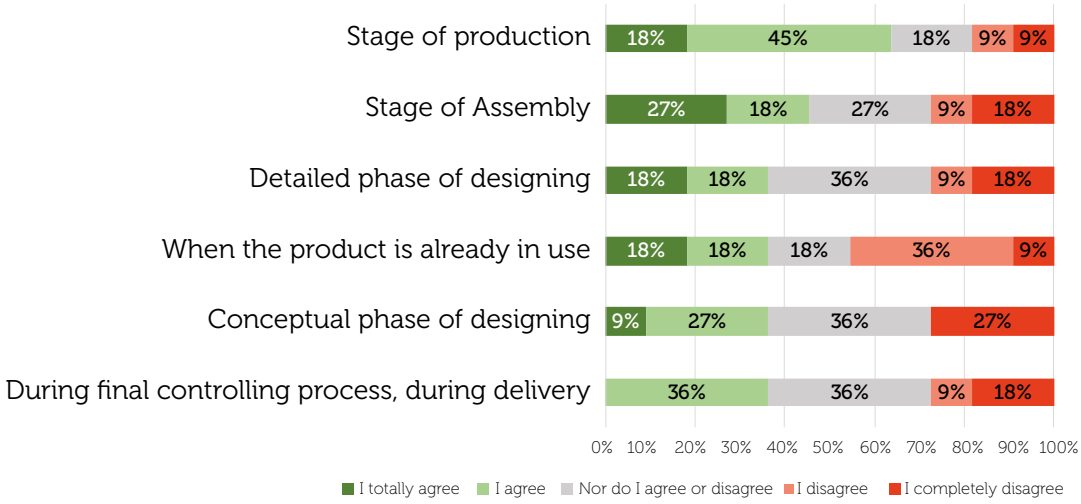
Most companies in the metal processing sector reveal possible errors in products in the following stages: production (75% totally agree and agree), during the final controlling process, during delivery (50% totally agree and agree), detailed phase of designing (50% totally agree and agree).

Figure 10. Metal processing sector - Possible errors in products are usually revealed in:



Most companies in the wood processing sector reveal possible errors in products in the stage of production (64% totally agree and agree), following the stage of assembly (45% totally agree and agree), detailed phase of designing (36% totally agree and agree) and when the product is already in use (36% totally agree and agree).

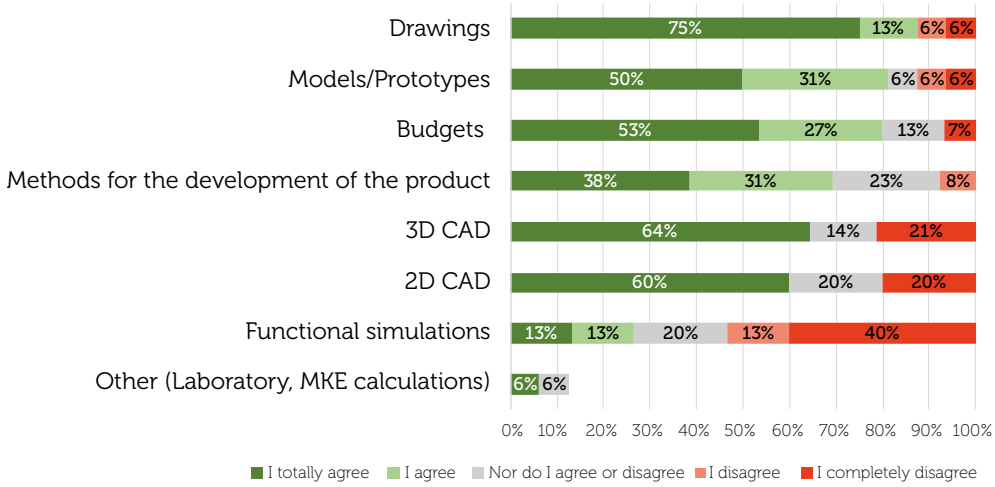
Figure 11. Wood processing sector - Possible errors in products are usually revealed in:



9. Design phase

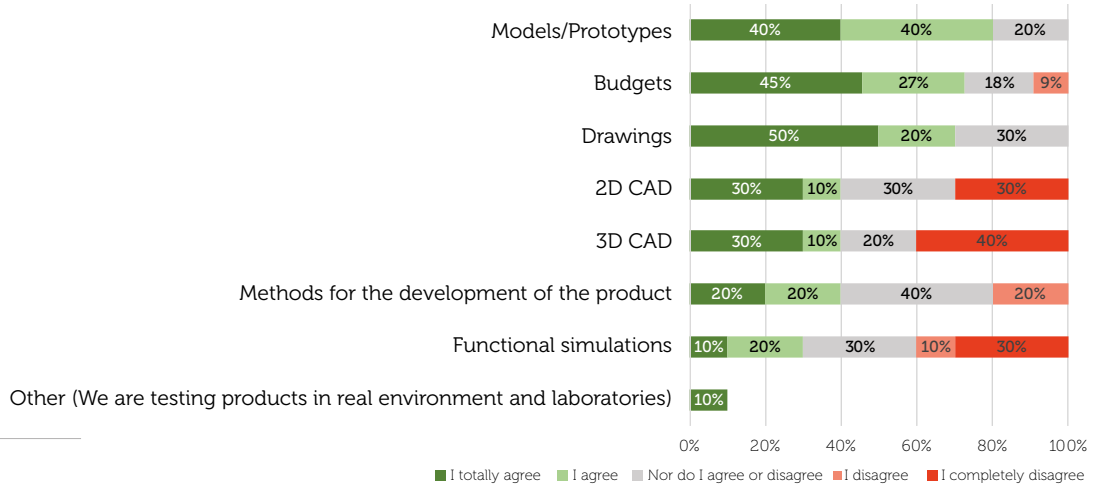
In the design phase, most companies in metal processing sector use drawings (88% totally agree and agree), models/prototypes (81% totally agree and agree) and budgets (80% totally agree and agree).

Figure 12. Metal processing sector - In the design phase, we use:



Most companies in wood processing sector in the design phase use models/prototypes (80% totally agree and agree), budgets (73% totally agree and agree) and drawings (70% totally agree and agree).

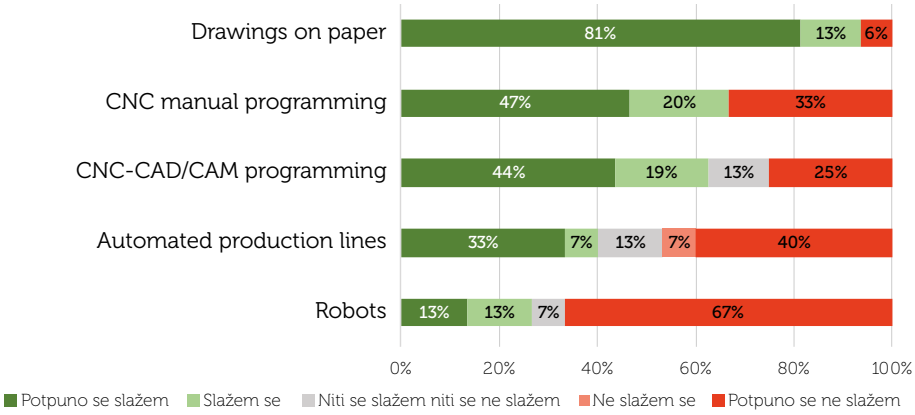
Figure 13. Wood processing sector - In the design phase, we use:



10. Production phase

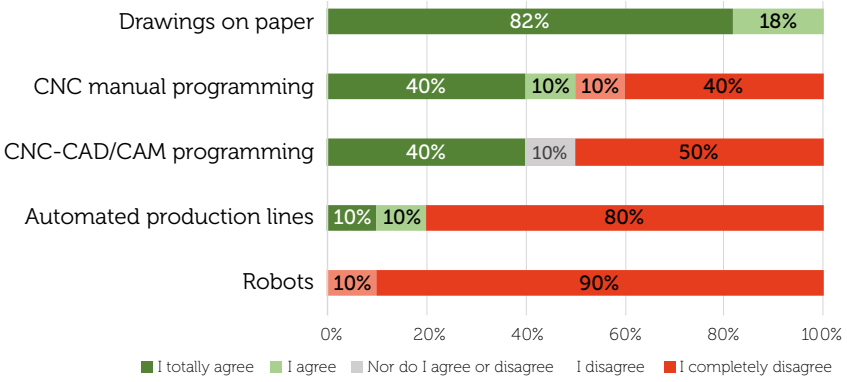
In the production stage, most metal processing companies use drawings on paper (94% totally agree and agree), CNC manual programming (67% totally agree and agree) and CNC-CAD/CAM programming (63% totally agree and agree).

Figure 14. Metal processing sector - In the production stage, we use:



In the wood processing companies, the situation is the same – most companies in the production stage use drawings on paper (100% totally agree and agree), CNC manual programming (50% totally agree and agree) and CNC-CAD/CAM programming (40% totally agree and agree).

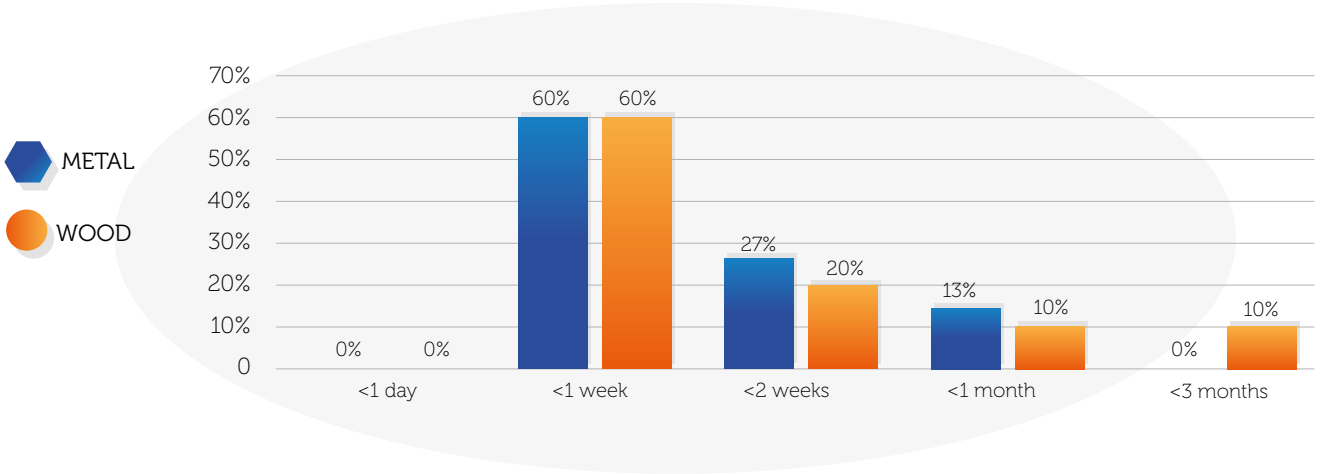
Figure 15. Wood processing sector - In the production stage, we use:



11. Production lead time

Usual time from receiving the order till the beginning of production for 60% of both metal and wood processing companies is less than 1 week. Some 27% of companies in the metal and 20% companies in the wood processing sector need less than 2 weeks from receiving the order till the beginning of production. Only 13% of companies in the metal and 10% of companies in the wood processing sector need less than 3 months from receiving the order to the beginning of production.

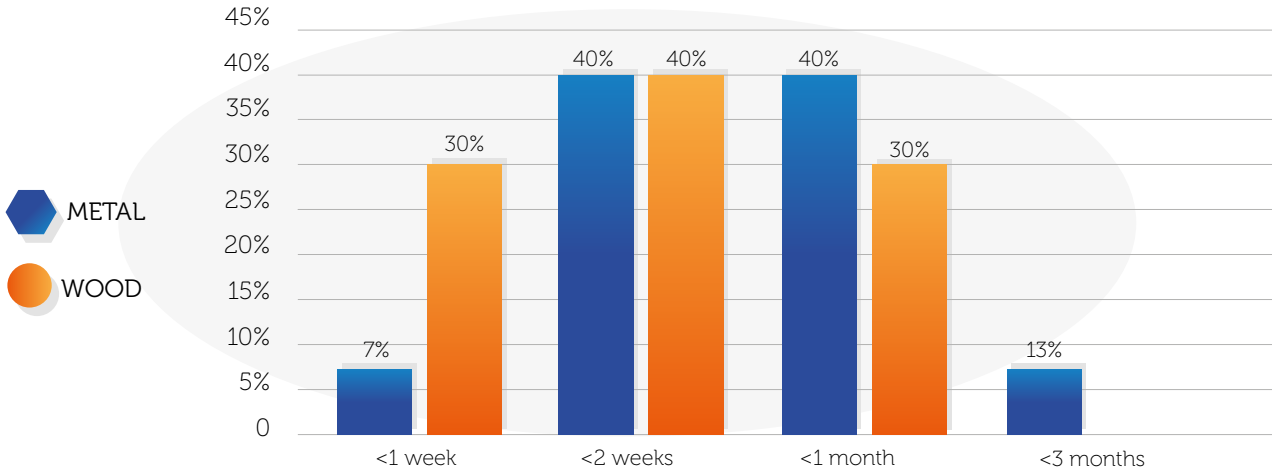
Figure 16. Usual time from receiving the order to the beginning of production is:



12. Delivery lead time

Usual time from receiving the order till the beginning of production for 40% of wood processing companies is less than 2 weeks. Some 30% of wood processing companies need less than 1 week and less than 1 month for delivery. Some 40% of metal processing companies need less than 2 weeks and less than 1 month for delivery. There are also some 7% of metal processing companies that need less than 1 week from receiving the order till the beginning of production, but also some 13% of metal processing companies that need less than 3 months from receiving the order till the beginning of production.

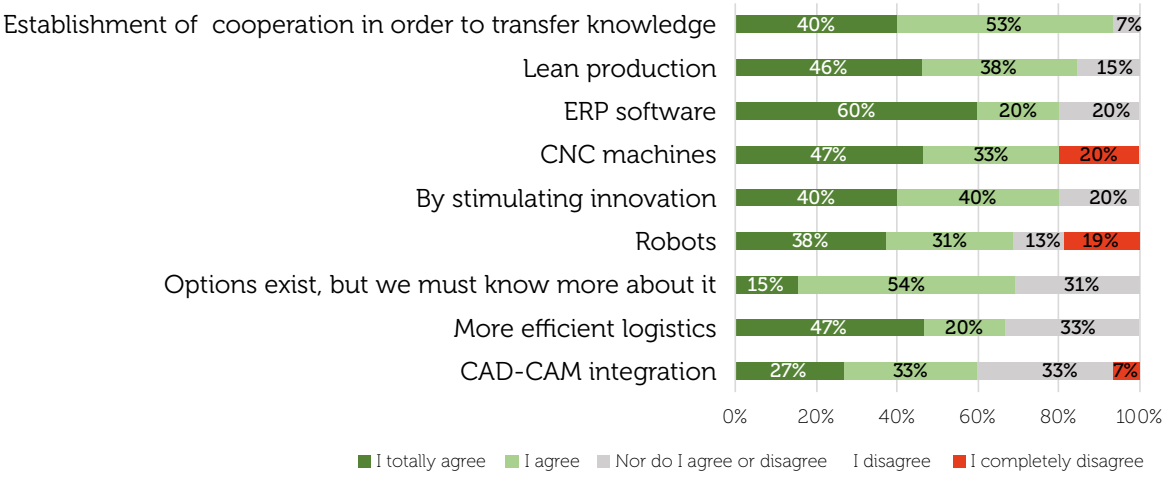
Figure 17. Usual time from the beginning of production to delivery in our production is:



13. Options for improvement of the production

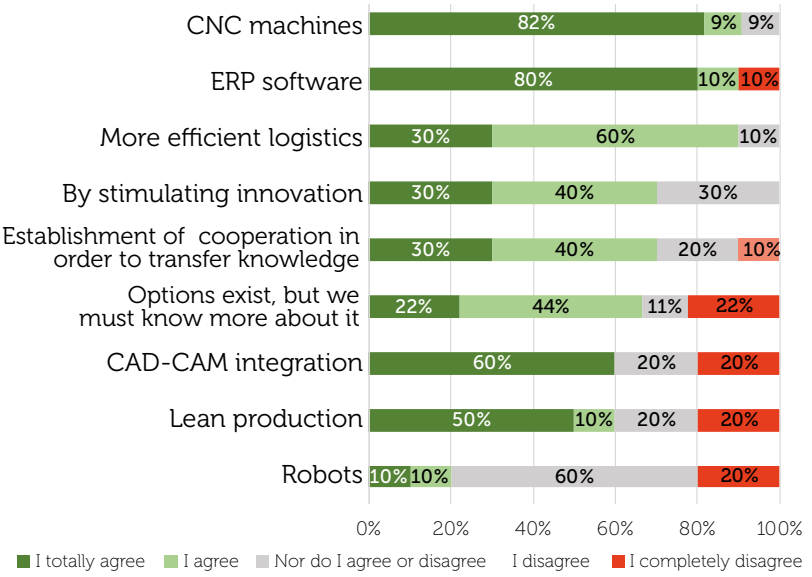
Companies in the metal processing sector find that some parts of the production process may be improved with: establishment of cooperation in order to transfer knowledge (93% totally agree and agree), lean production (85% totally agree and agree), ERP software, CNC machines and by stimulating innovation (80% totally agree and agree).

Figure 18. Metal processing sector - We see options for improving some parts of the production process with:



Companies in wood processing sector find that some parts of the production process may be improved with: CNC machines (91% totally agree and agree), ERP software and more efficient logistics (90% totally agree and agree), as well as by stimulating innovation and by establishment of cooperation in order to transfer knowledge (70% totally agree and agree).

Figure 19. Wood processing sector - We see options for improving some parts of the production process with:

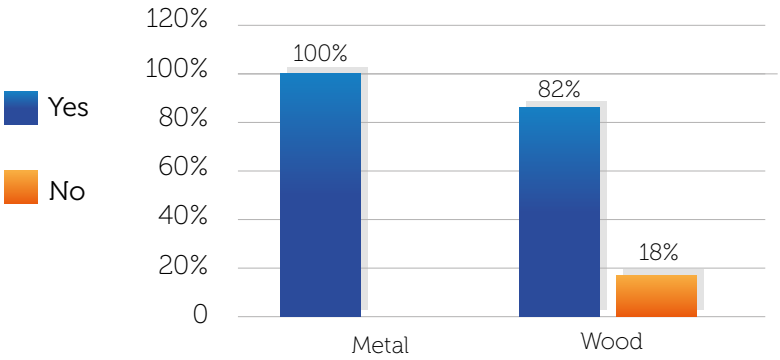


ICT technologies

14. Internal computer network

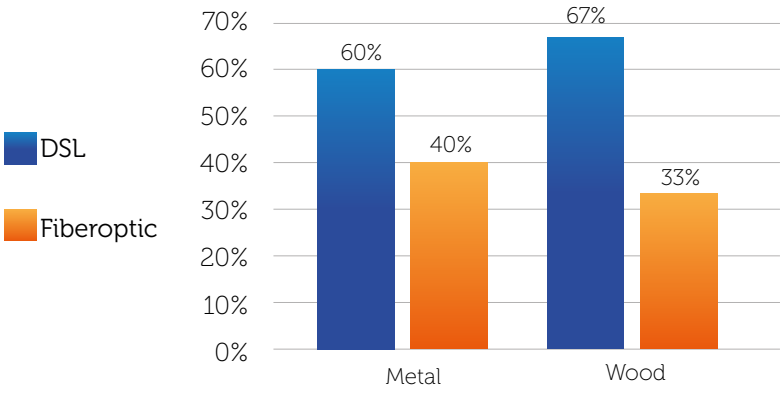
All metal processing companies and 82% of wood processing companies have an internal computer network.

Figure 20. Does your company have an internal computer network?



Some 60% of companies in the metal processing sector and some 67% of companies in the wood processing sector use DSL internet access. Other use fibre optic internet access. Regarding speed of the internet (download) in metal processing companies, it is in the range between 5-200 Mbit (average speed is 72), while in wood processing sector internet speed is in the range between 10-40 Mbit (average speed is 20).

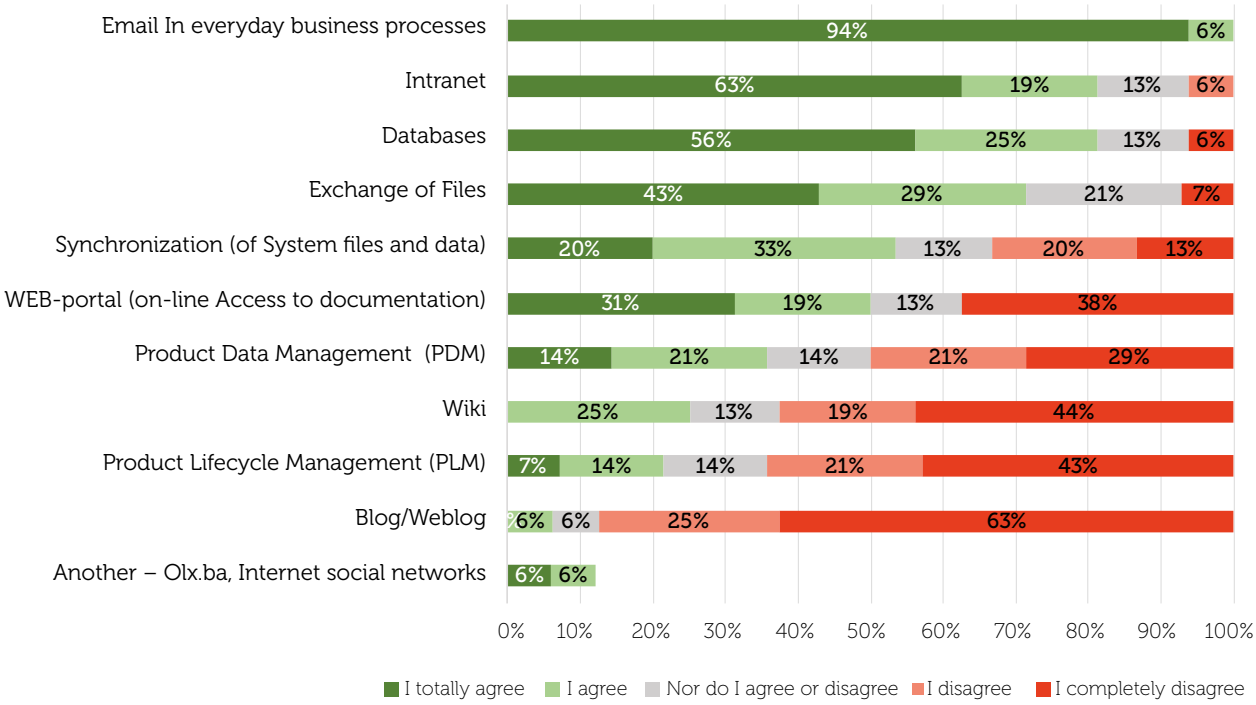
Figure 21. Which kind of internet access does your company use?



15. Information structure

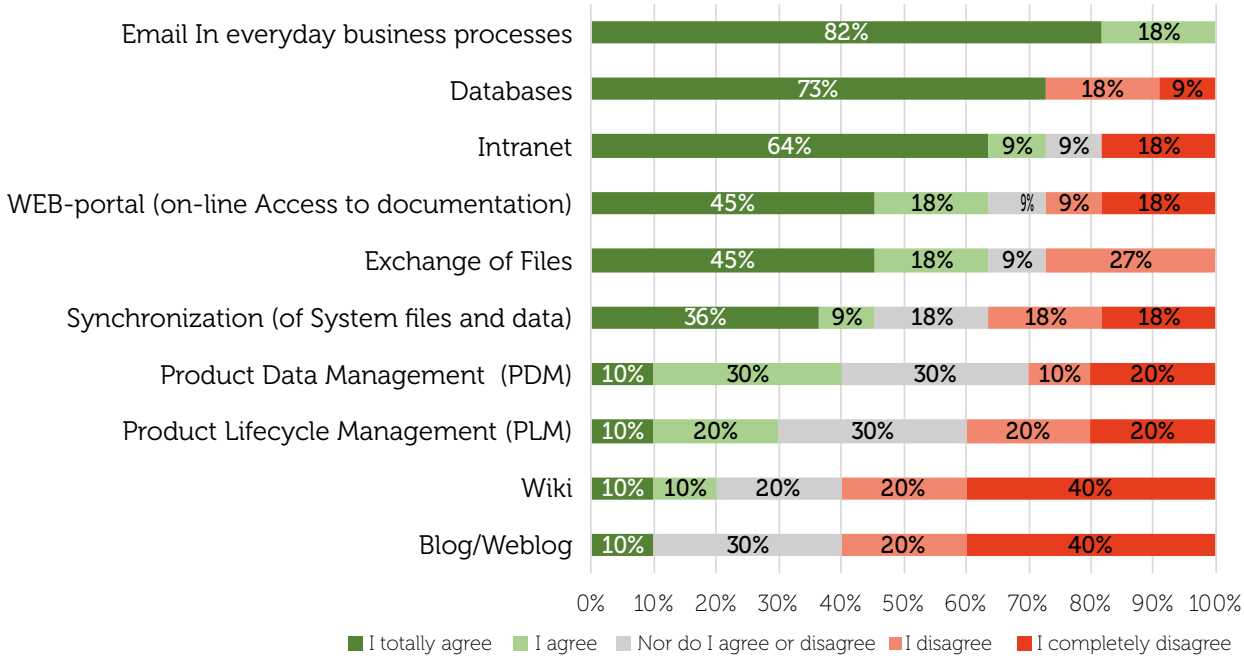
Companies in the metal processing sector use e-mail in everyday business processes (100% totally agree and agree), intranet (81% totally agree and agree), databases (81% totally agree and agree) and exchange of files (71% totally agree and agree), while other information structures are used less frequently.

Figure 22. Metal processing sector - Our information structure uses:



The situation in the wood processing sector is very similar. Namely, most companies use e-mail in everyday business processes (100% totally agree and agree), databases and intranet (73% totally agree and agree), WEB-portal - on-line Access to documentation and exchange of Files (64% totally agree and agree).

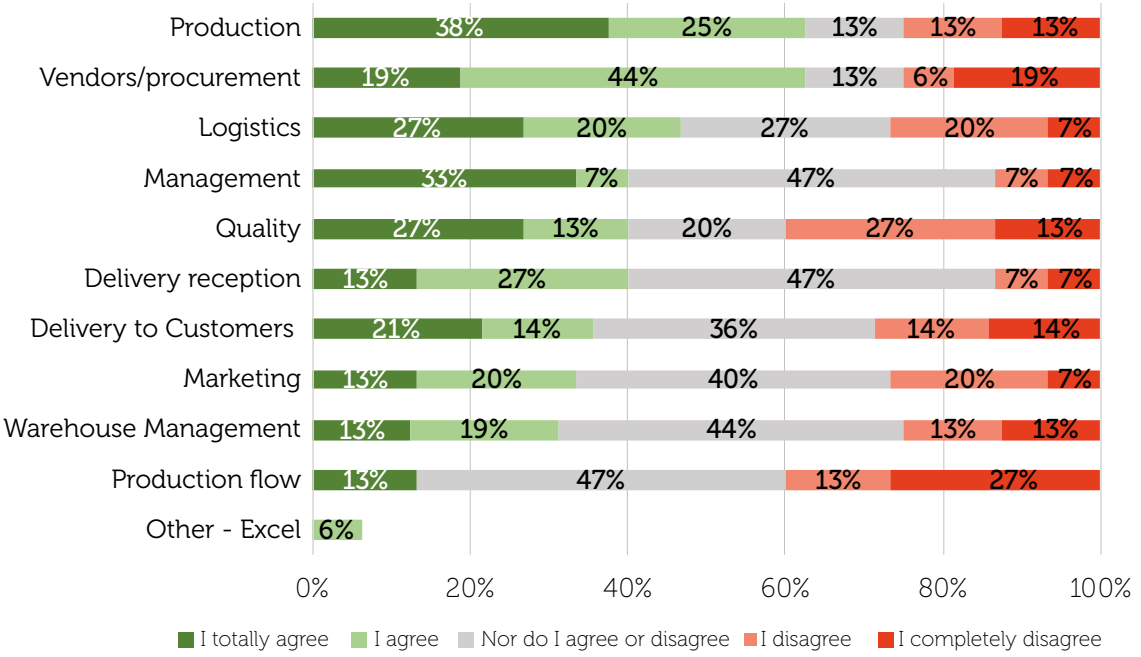
Figure 23. Wood processing sector - Our information structure uses:



16. Computer/software tools

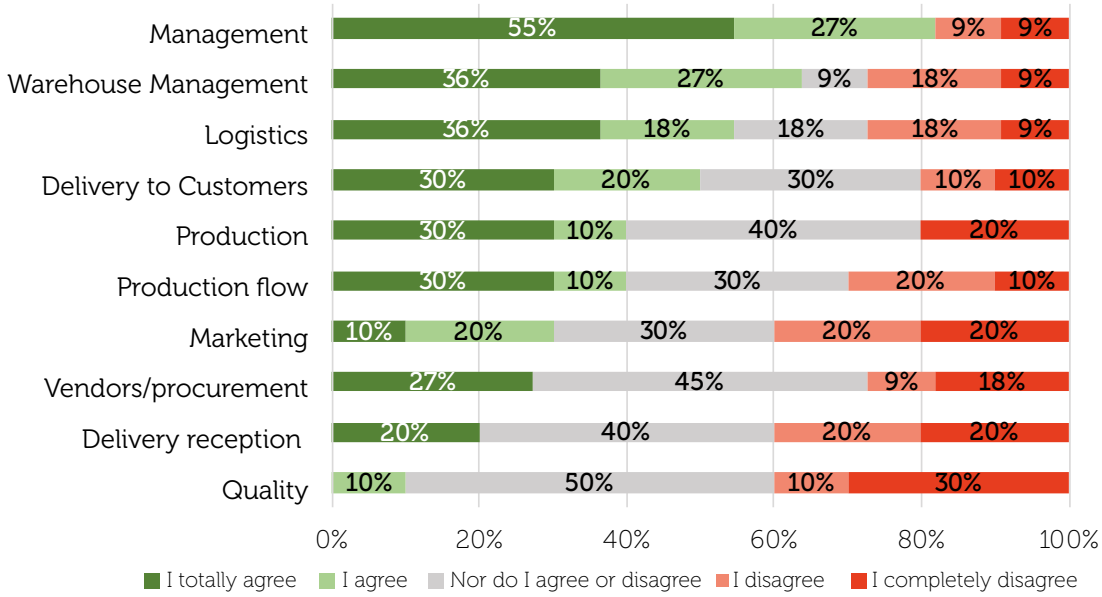
Companies in metal processing sector use appropriate computer/software tools in production and procurement (63% totally agree and agree), logistics (47% totally agree and agree), management, quality, delivery reception and delivery to customers (63% totally agree and agree). On the other hand, most companies do not use appropriate computer/software tools in production flow (only 13% totally agree and agree) and warehouse management (only 31% totally agree and agree).

Figure 24. Metal processing sector - Our company uses appropriate computer/software tools in:



Companies in wood processing sector use appropriate computer/software tools in management (82% totally agree and agree), warehouse management (64% totally agree and agree), logistics (55% totally agree and agree) and delivery to customers (50% totally agree and agree). On the other hand, most companies do not use appropriate computer/software tools in quality (only 10% totally agree and agree) delivery reception (only 20% totally agree and agree).

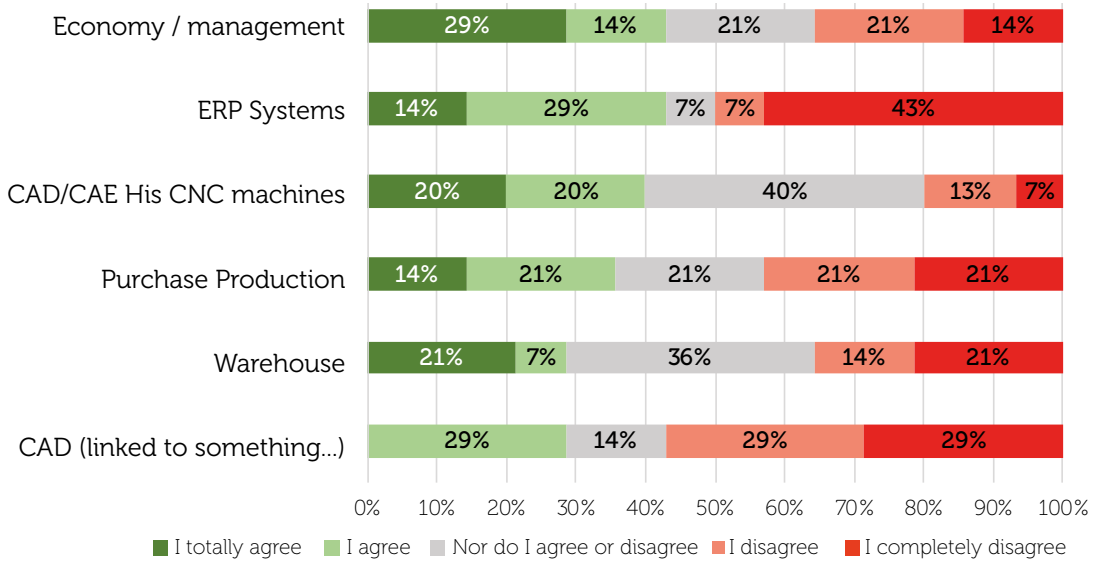
Figure 25. Wood processing sector - Our company uses appropriate computer/software tools in:



17. Integration of computer/software systems with other systems

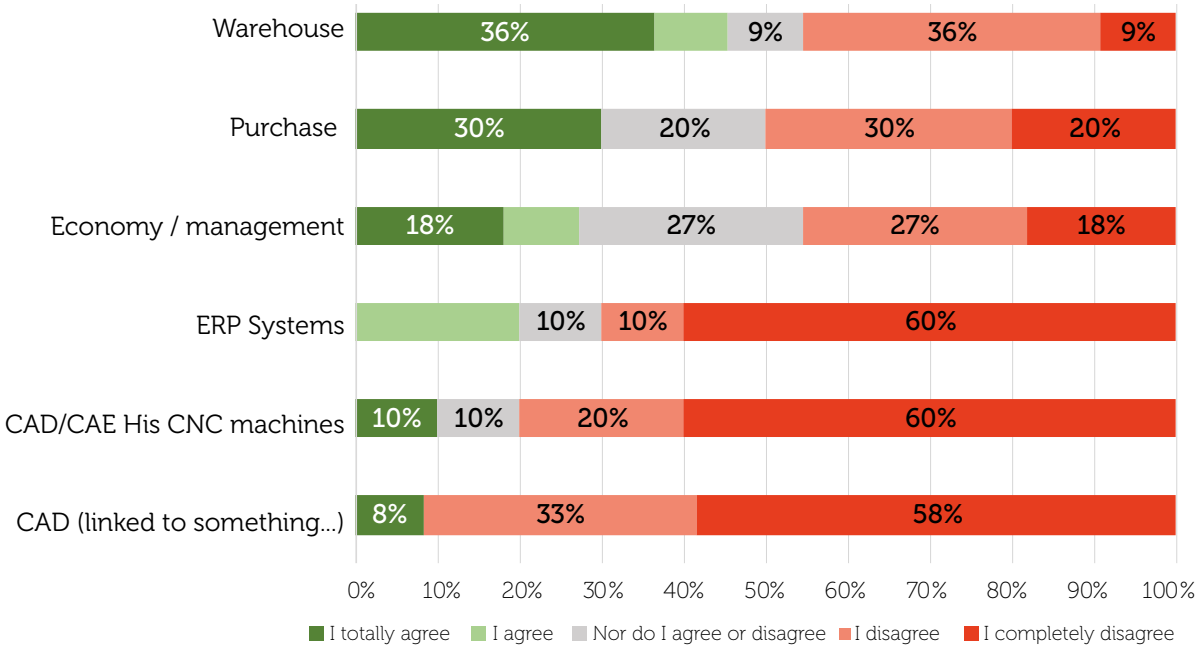
In the computer/software systems of metal processing companies, the most linked/integrated functions with other systems are the following: economy/management and ERP systems (43% totally agree and agree), CAD/CAE with CNC machines (40% totally agree and agree). On the other hand, the least linked/integrated function with other systems is CAD and warehouse (29% totally agree and agree).

Figure 26. Metal processing sector - In the computer/software systems of our company, the following functions are linked/integrated with other systems



In the computer/software systems of wood processing companies, the most linked/integrated functions with other systems are the following: warehouse (45% totally agree and agree), purchase (30% totally agree and agree) and economy/management (27% totally agree and agree. On the other hand, the least linked/integrated function with other systems is CAD (8% totally agree and agree) and CAD/CAE with CNC machines (10% totally agree and agree).

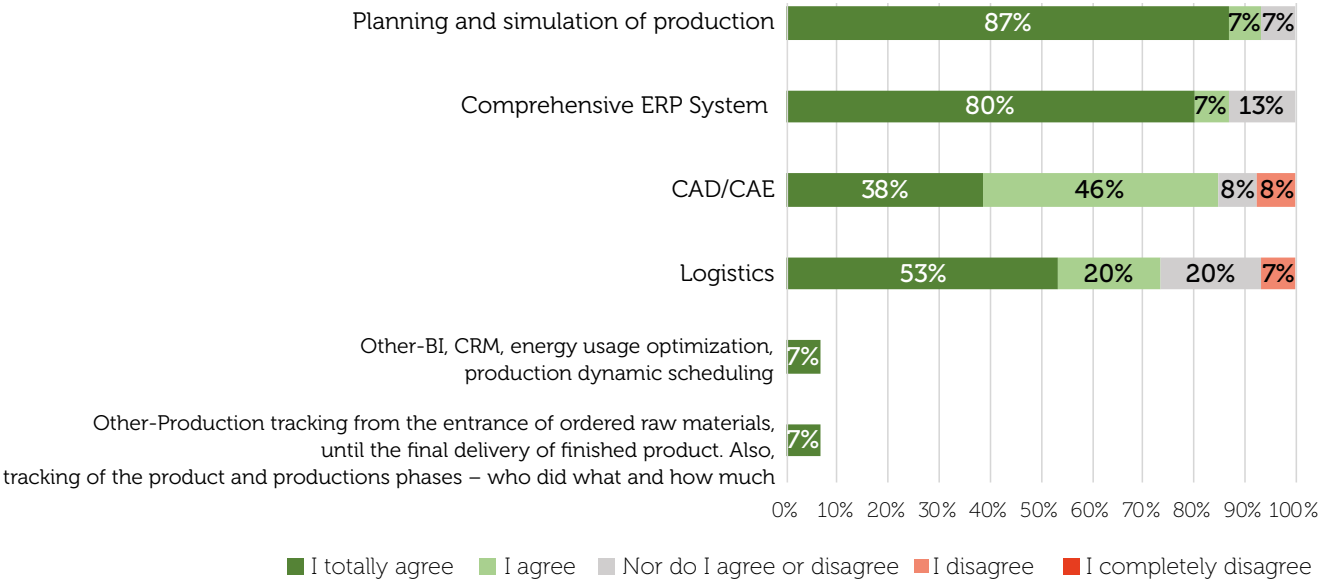
Figure 27. Wood processing sector - In the computer/software systems of our company, the following functions are linked/integrated with other systems:



18. Potential of digital tools

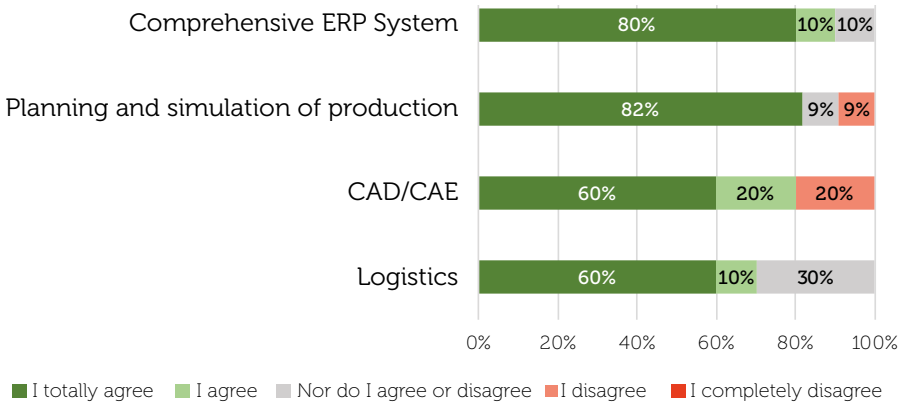
Most metal processing companies see interesting potential for digital tools in planning and simulation of production (93% totally agree and agree), a comprehensive ERP system (87% totally agree and agree) and CAD/CAE (85% totally agree and agree).

Figure 28. Metal processing sector - Our company sees interesting potential for digital tools in:



Most wood processing companies see interesting potential for digital tools in comprehensive ERP system (90% totally agree and agree), planning and simulation of production (82% totally agree and agree) and CAD/CAE (80% totally agree and agree).

Figure 29. Wood processing sector - Our company sees interesting potential for digital tools in:



Business partners – suppliers and customers

19. Structure of key suppliers

Most metal processing companies use international suppliers (71.33%). There are significantly less national (31.86%), regional (28.81%) and local (27.13%) suppliers.

Table 1. Metal processing sector - The main suppliers of your company are (in %):

	Average	Minimum	Maximum	Standard deviation
Local	**27.13**	2	100	29.67
Regional	**28.91**	3	70	26.18
National	**31.86**	10	90	27.16
International	**71.33**	20	100	26.12

Most wood processing companies use regional suppliers (55.83%). There are significantly less local (30.00%), national (26.25%) and international (20.00%) suppliers.

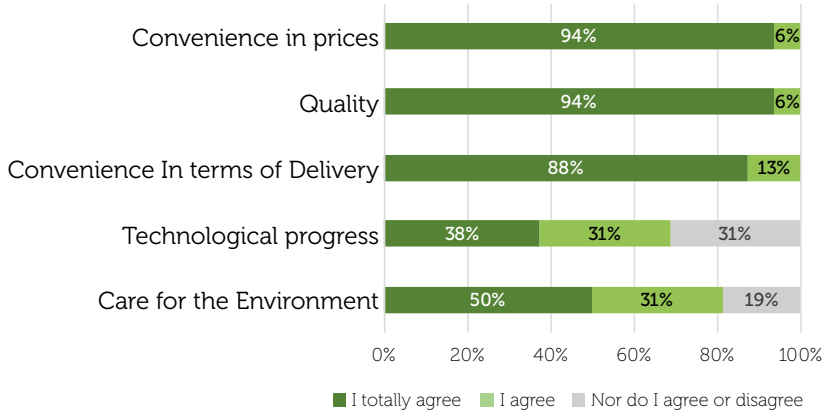
Table 2. Wood processing sector - The main suppliers of your company are (in %):

	Average	Minimum	Maximum	Standard deviation
Local	**30.00**	5	100	33.49
Regional	**55.83**	10	90	27.45
National	**26.25**	15	40	9.60
International	**20.00**	5	45	15.41

20. Expectations from vendors

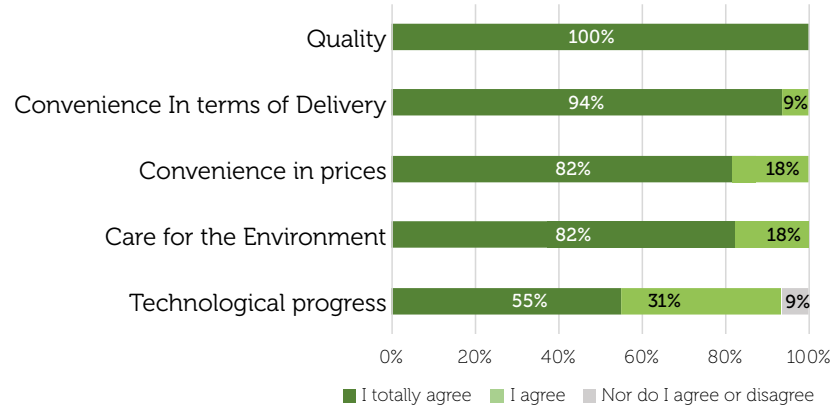
Metal processing companies expect from their vendors: convenience in prices, quality and convenience in terms of delivery (100% totally agree and agree).

Figure 30. Metal processing sector - Our company expects from vendor:



Wood processing companies expect from their vendors: quality, convenience in terms of delivery, convenience in prices, and care for the environment (100% totally agree and agree).

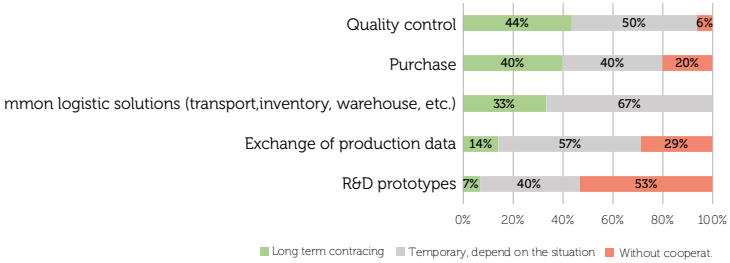
Figure 31. Wood processing sector - Our company expects from vendor:



21. Cooperation with suppliers

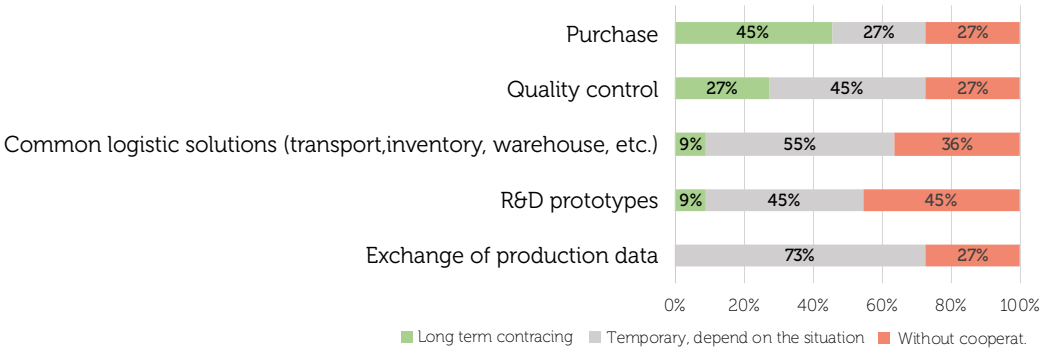
Metal processing companies cooperate with their suppliers mostly in the area of quality control (44% have long term contracts), purchase (44% have long term contracts) and logistics (33% have long term contracts). Cooperation with suppliers is evident from time to time (depending on the situation) in all other mentioned areas. Cooperation in the area of the R&D prototypes is the least frequent.

Figure 32. Metal processing sector - Cooperation with suppliers? Please highlight the most frequent ones:



Wood processing companies cooperate with their suppliers, mostly in the area of purchase (45% have long term contracts), and quality control (27% have long term contracts). Cooperation with suppliers is evident from time to time (depending on the situation) in all other mentioned areas. Cooperation in the area of the R&D prototypes is the least frequent.

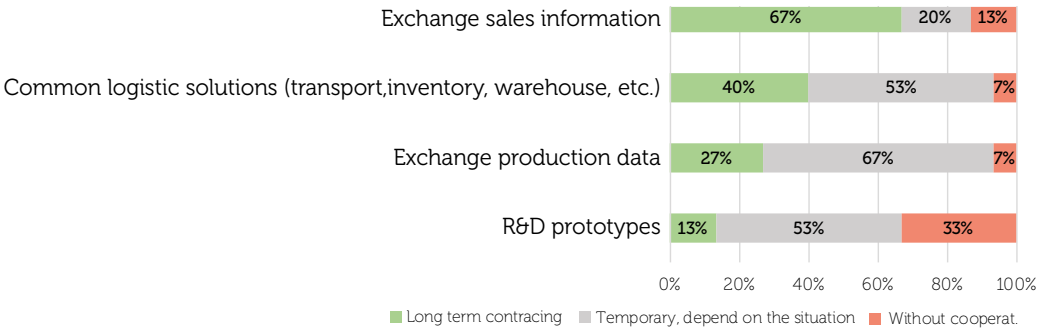
Figure 33. Wood processing sector - Cooperation with suppliers? Please highlight the most frequent ones:



22. Cooperation with customers

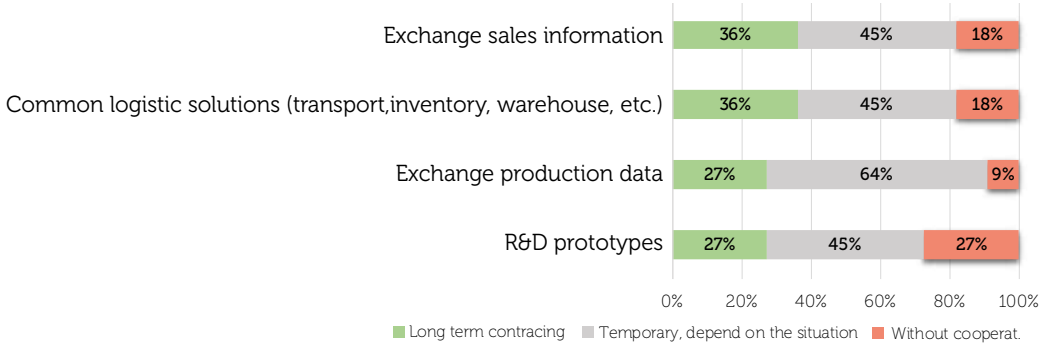
Metal processing companies cooperate with their customers mostly regarding the exchange of sales information (67% have long term contracts) and logistics (40% have long term contracts). Cooperation with customers is evident from time to time (depending on the situation) in all other mentioned areas. Cooperation in the area of the R&D prototypes is the least frequent.

Figure 34. Metal processing sector - Cooperation with customers? Please highlight the most frequent ones:



The situation in the wood processing sector is very similar to the situation in the metal processing sector. Namely, wood processing companies mostly cooperate their customers regarding the exchange of sales information and logistics (36% have long term contracts). Cooperation with customers is evident from time to time (depending on the situation) in all other mentioned areas. Cooperation in the area of the R&D prototypes is the least frequent.

Figure 35. Wood processing sector - Cooperation with customers? Please highlight the most frequent ones:



Target markets and competition

23. Key markets

With an average share of 66.57%, there is no doubt that most metal processing companies are oriented to international markets. Smaller the market, smaller the share, too: national (32.88%), regional (21.63%) and local (16.50%).

Table 3. Metal processing sector: Which of the markets are your main current markets - Specify amounts, in %, in relation to your total revenue?

	Average	Minimum	Maximum	Standard deviation
Local	**16.50**	2	50	15.31
Regional	**21.63**	3	70	20.30
National	**32.88**	5	70	21.13
International	**66.57**	17	100	29.89

Wood processing companies are also export-oriented – average share of international markets for wood processing companies is 63.22%. The second largest is the local market (27.86%), followed by regional (26.25%) and national (15.75%) market.

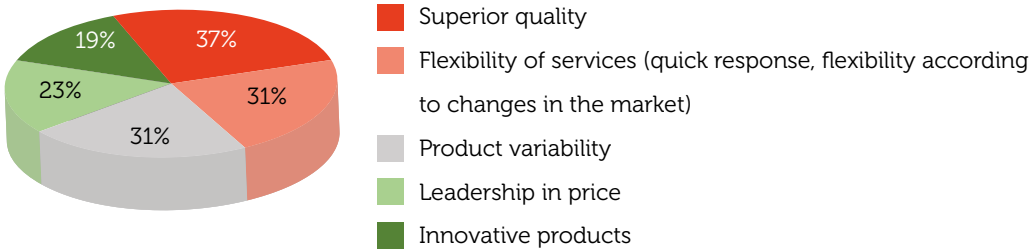
Table 4. Wood processing sector: Which of the markets are your main current markets - Specify amounts, in %, in relation to your total revenue?

	Average	Minimum	Maximum	Standard deviation
Local	**27.86**	2	98	31.40
Regional	**26.25**	5	90	25.83
National	**15.75**	1	40	12.46
International	**63.22**	2	100	31.18

24. Competitive advantages

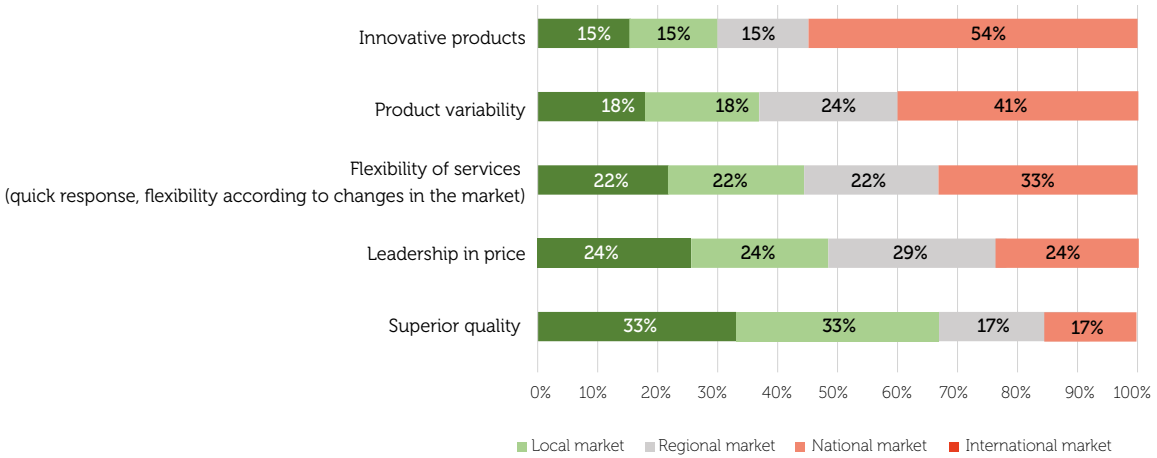
For the majority of metal processing companies, superior quality is the most important competitive advantage (37%), followed by the flexibility of services - quick response, flexibility according to changes in the market and product variability (31%).

Figure 36. Metal processing sector - Your competitive advantages (in general) are:



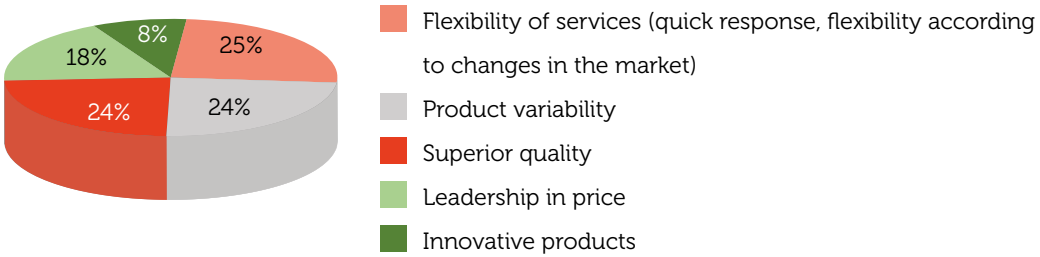
Looking at the competitive advantages by markets, it is interesting that at the international market (which is the most important for the metal industry), the main competitive advantages are: innovative products, product variability and flexibility of services - quick response, flexibility according to changes in the market (38%).

Figure 37. Metal processing sector - Your competitive advantages (by markets) are:



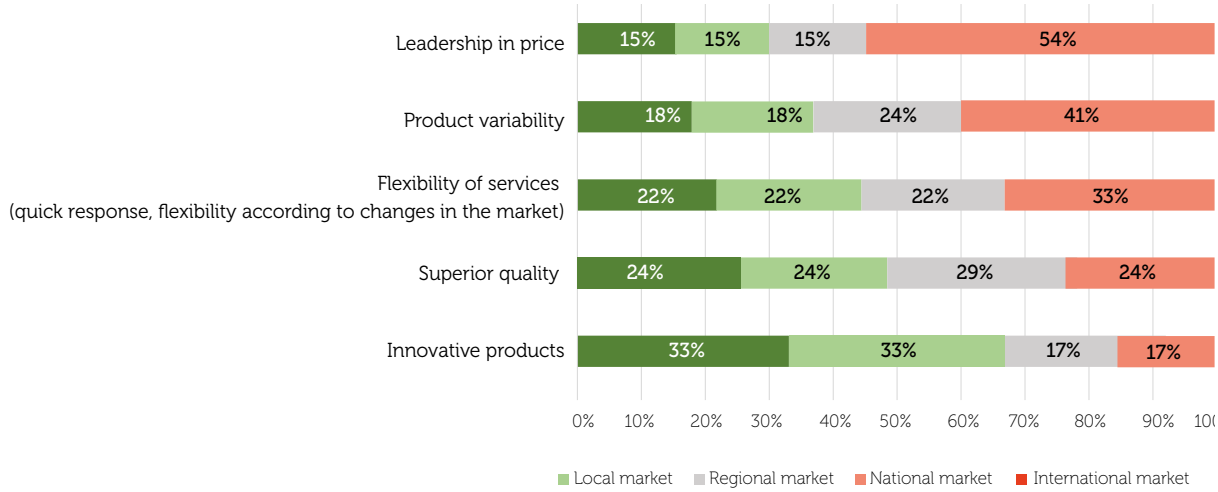
For the majority of wood processing companies, the flexibility of services (quick response, flexibility according to changes in the market) is the most important competitive advantage (25%), followed by product variability and superior quality (24%).

Figure 38. Wood processing sector - Your competitive advantages (in general) are:



At the international market (which is the most important for the wood processing industry), the most important competitive advantage is leadership in price (54%), followed by product variability (41%) and flexibility of services - quick response, flexibility according to changes in the market (33%).

Figure 39. Wood processing sector - Your competitive advantages (by markets) are:



Competitors

24. Main competitors

Main competitors of metal processing companies are international (81.82%), followed by local (60.00%), national (18.14%) and regional (15.50%) competitors.

Table 5. Metal processing sector: The main competitors of your company are (in %)?

	Average	Minimum	Maximum	Standard deviation
Local	**60.00**	10.00	100.00	37.42
Regional	**15.50**	3.00	30.00	8.83
National	**18.14**	2.00	50.00	15.70
International	**81.82**	40.00	100.00	19.34

Main competitors of wood processing companies are also international (55.00%), followed by national (49.17%), local (38.75%), and regional (30.00%) competitors.

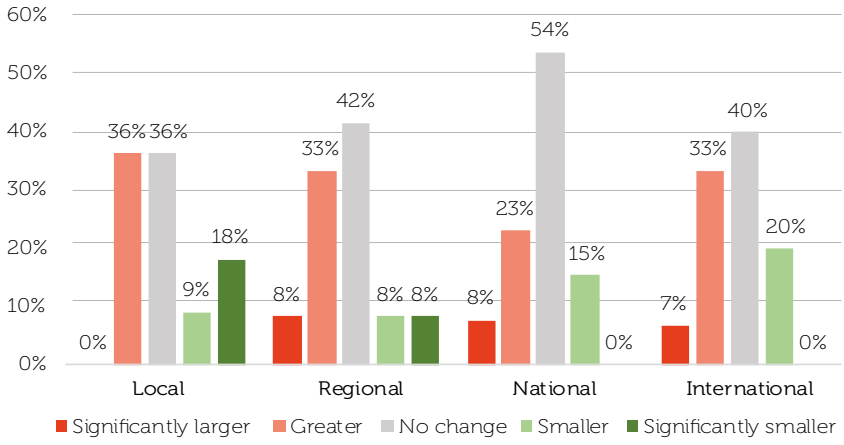
Table 6. Wood processing sector: The main competitors of your company are (in %)?

	Average	Minimum	Maximum	Standard deviation
Local	**38.75**	15.00	100.00	35.42
Regional	**30.00**	10.00	50.00	14.14
National	**49.17**	15.00	100.00	29.21
International	**55.00**	20.00	100.00	26.30

25. Expectations regarding the intensity of competition

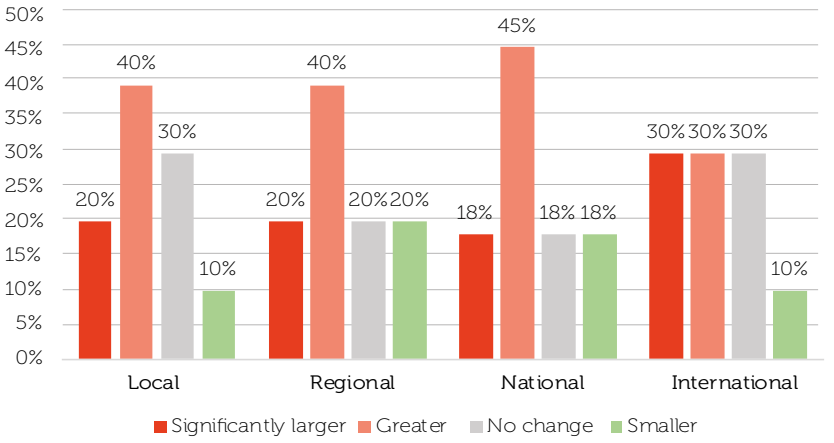
Two dominant expectations of metal processing companies (in all markets) are that in the period of the next 5-10 years, the competition will be greater, or it will remain the same. There are some expectations that competition will be significantly smaller in the local market (18%) and in the regional market, too (8%). On the other hand, there are expectations that competition will be significantly higher in regional, national (8%) and international market (7%).

Figure 40. Metal processing sector - According to your expectations, in the period of the next 5-10 years, the competition will be:



Dominant expectation of wood processing companies is that in the period of next 5-10 years, the competition will be greater (40% in the local and regional market, 45% in the national market and 30% in the international market). Other scenarios/expectations (that competition will be significantly larger, that there will be not change and that that competition will be smaller), are almost equally represented.

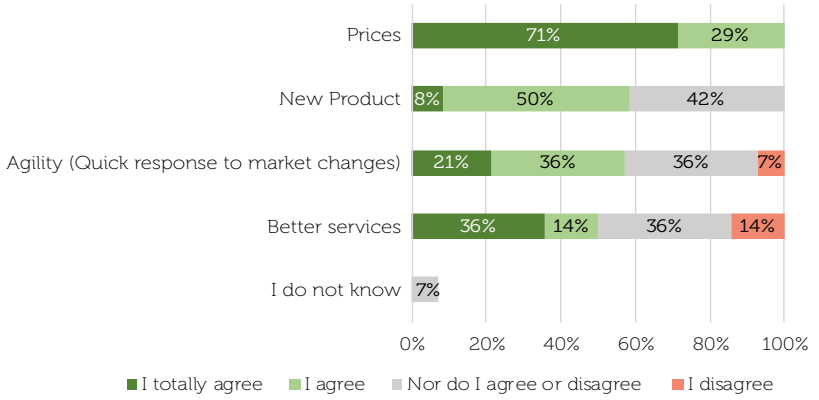
Figure 41. Wood processing sector - According to your expectations, in the period of next 5-10 years, the competition will be:



26. Expectations regarding the type of competition

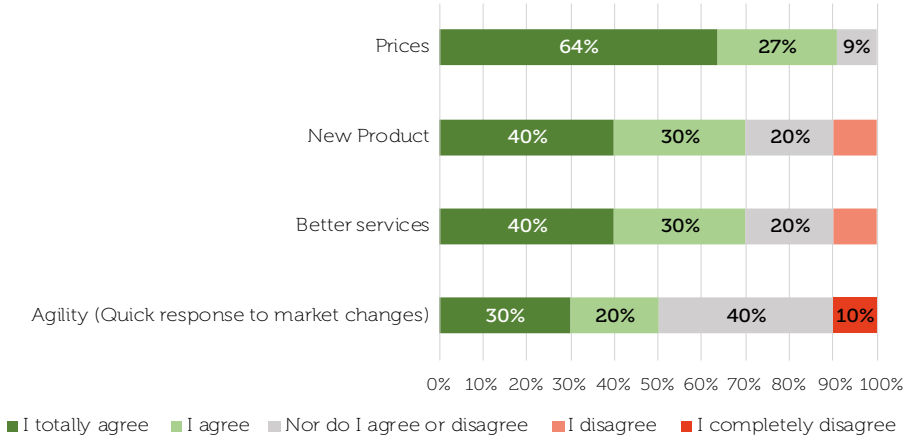
All metal processing companies expect that if the competition increases, it will be based on price (100% totally agree and agree). Other important forms of competition include new products (58% totally agree and agree), agility - quick response to market changes (57% totally agree and agree) and better services (50% totally agree and agree).

Figure 42. Metal processing sector - If the competition increases, please define this competition in view of:



Expectations are similar in the wood processing sector. Namely, the most wood processing companies expect that competition will be based on price (91% totally agree and agree), followed by new products and better services (70% totally agree and agree) and agility - quick response to market changes (50% totally agree and agree).

Figure 43. Wood processing sector - If the competition increases, please define this competition in view of:



Annex 4.

Questionnaire for supporting institutions/organizations research

1. Name institution: _____
2. Contact person: _____
3. Employees: _____
4. Number of consulting for SMEs / year: _____
5. Services general: _____
6. Offered consulting services in detail:
   - Consulting general
   - Foreign trade consulting
   - Consulting marketing / sales
   - Organisational Consulting / Quality management
   - Finance consulting / public grants
   - Digitalization / Industry 4.0

7. Services in digitalization
   - Initial consulting
   - ICT Audits
   - Workshops
   - Events / conferences Matchmaking manufacturing / ICT
   - In-house Qualification
   - Consulting for concept development
   - Placement of extern consultants / expert pool
   - Train-the-trainer concepts

8. Own capacities
   - Own experts in digitalization
   - Own department for consulting in digitalization
   - Information material / brochures for digitalization
   - Number of employees working in consulting for digitalization:

9. Special / Expert- Know-how in digitalization
   - CAD / CAD CAM
   - Web shops
   - Virtual Reality / Augmented Reality
   - Machine-to-Machine communication
   - ERP Systems (general)

- Order-Management
- Warehouse / Logistic management (incl. RFID or Barcode)
- Accounting / Controlling
- Material management
- Production planning
- Human resources management
- Supplier management

10. Does your institution have an own strategy to develop services in the area of digitalization / Industry 4.0, if yes please describe briefly:

_____
_____
_____
_____

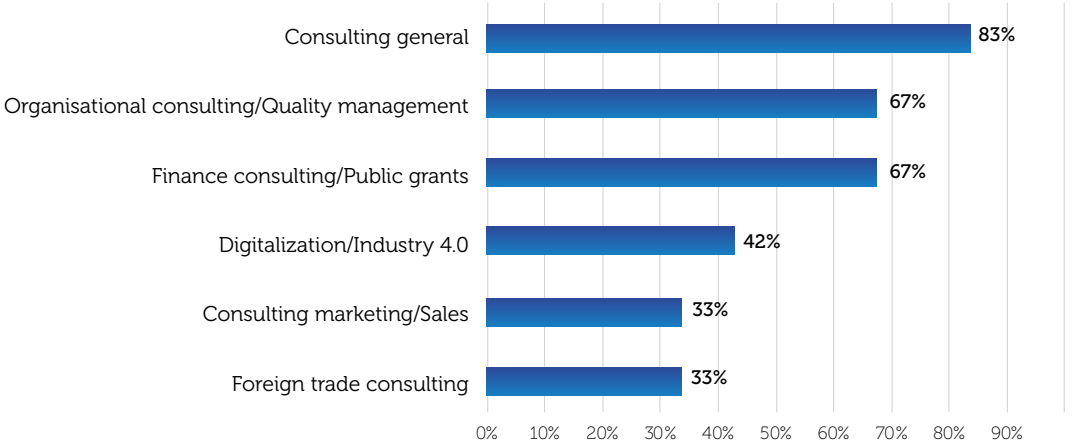
Annex 5

Findings of the supporting institutions/organizations research

1. Consulting services offered:

The most offered consulting services by supporting institutions/organizations are consulting in general (83%), followed by organizational consulting/quality management and finance consulting/public grants. Some 42% of supporting institutions/organizations offer consulting services in digitalization/industry 4.0.

Figure 44. Consulting services offered:



2. Provided services in digitalization

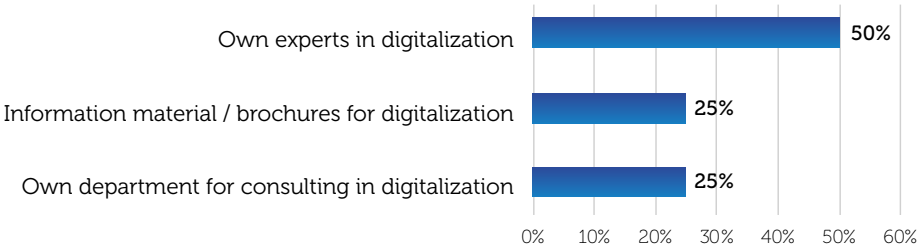
Speaking about services in digitalization, most supporting institutions/organizations provide initial consulting, workshops and placement of external consultants/expert pool (58%).

Figure 45. Services in digitalization

3. Digitalization capacities

Half supporting institutions/organizations have their own experts in digitalization, while only 25% have information material/brochures for digitalization and own department for consulting in digitalization.

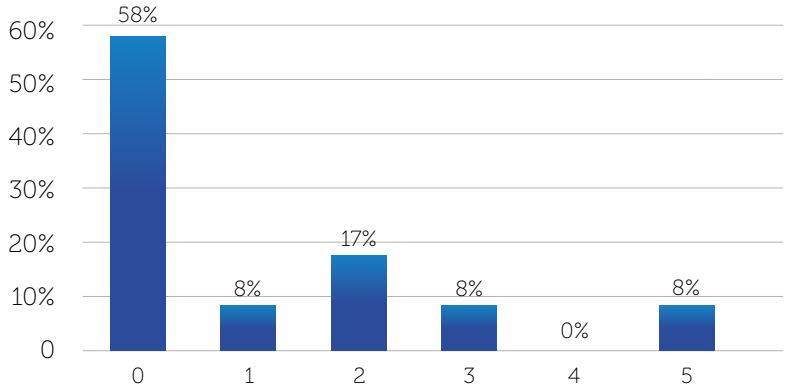
Figure 46. Own capacities



4. Employees working in consulting for digitalization

Almost 60% of supporting institutions/organizations do not have employees working in consulting for digitalization while others have 1 (8%), 2 (17%) 3 (8%) or 5 (8%) employees.

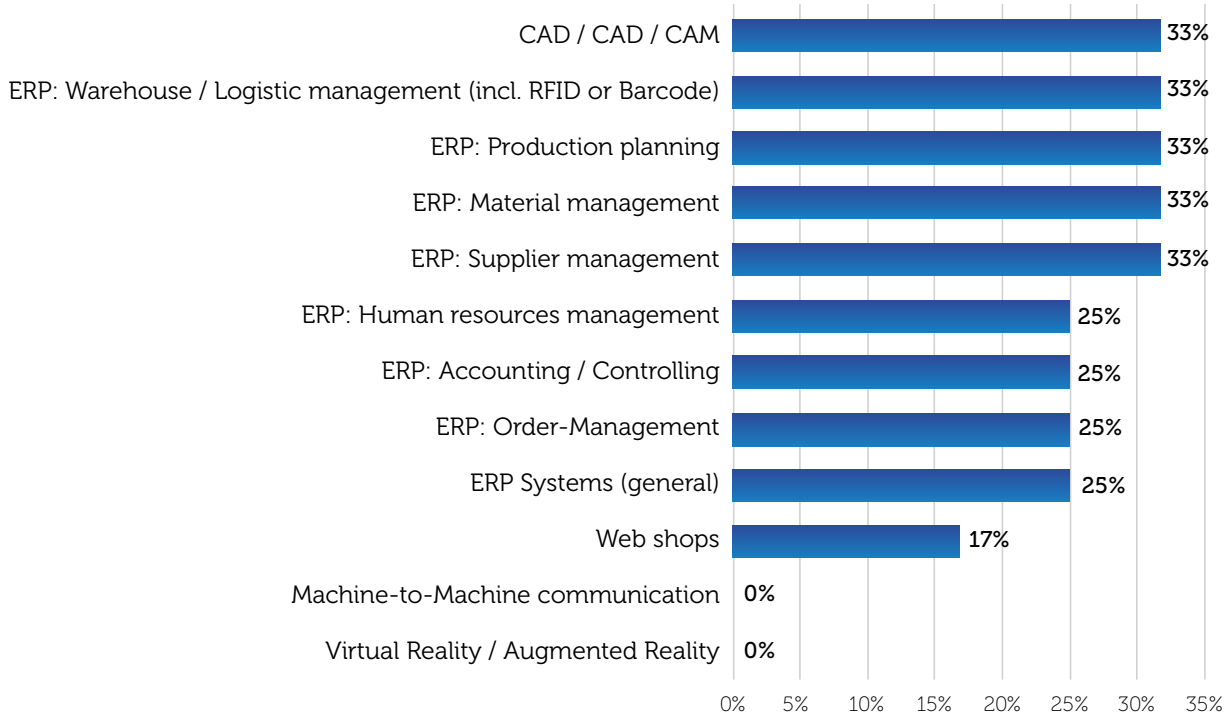
Figure 47. Number of employees working in consulting for digitalization



5. Special/expert know-how in digitalization

Some 33% of supporting institutions/organizations have special/expert know-how in CAD/CAD/CAM, ERP: warehouse / logistic management (incl. RFID or Barcode), ERP: production planning, ERP: material management and ERP: supplier management. On the other hand, there are no supporting institutions/organizations with know-how in virtual reality/augmented reality and machine-to-machine communication.

Figure 48. Special/expert know-how in digitalization



EU ProLocal Program
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Ured Banja Luka I Patrijarha Makarija Sokolovića 3, 78 000 Banja Luka
Bosna i Hercegovina
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