

T1 - Assessment of the SMEs needs through  
existing networks

D1 - Assessment of SMEs' needs  
and preferred topics through  
surveys in the four regions of  
interest



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# Executive Summary

This deliverable consisted of analysing the results provided by a survey launched in four different countries covering dissimilar topics related to the size of the company, knowledge of Industry 4.0 solutions implementation level and use of Industry4.0 tools, and the willingness of the companies to pay for courses related to Industry4.0.

The survey was designed to be easy to answer and to take as little time as possible. The average time was lower than 15 minutes and consisted of 50 questions, combining yes/no questions, multiple choice questions and open questions. A total number of 67 answers were obtained combining the answers from different countries (Czech Republic, Germany, Italy and Spain), giving a small but heterogonous sample, which could provide interesting insights about how companies perceive Industry 4.0.

Although the survey was thought to be focused on SMEs, also 20% of the answers came from companies with more than 250 employees and with revenue higher than 50 million euro. All the answers were analysed together, regardless of the origin of the answer, as the same trend was reported in the four countries involved. Although all the samples were analysed in depth, it is worth mentioning that around 75% of the companies answered yes to the question about receiving Industry4.0 formation, being around 60% willing to pay for these courses. This result itself just prove the general lack of knowledge with regard to Industry4.0 and the real necessity showed by the companies about being taught in Industry 4.0.

As a general overview of the results, around 90% of companies considered interesting and beneficial for the development of the company to apply Industry4.0 solutions, regardless of the size of the company. However, when they are directly asked for the interest in receiving courses, small companies seem to show caution. In contrast, when the company gets bigger, they showed a clear interest in Industry 4.0 formation, the majority being willing to pay for the courses.

In addition, the survey also shows that it is a very long way to go regarding the introduction of Industry4.0 in the companies as, for instance, CAD solutions are still prevalent in comparison to simulation or even CAM approaches. Also, another clear example is that only 25% of the companies used additive manufacturing. The experience with small bath productions, although it is quite common, is treated with a rigid system, which seems not to be the most appropriate approach. It should be also highlighted that data processing is mainly based on storage on data analysis and only 5% of the companies established automatic process monitoring. The implemented of Machine2Machine protocols is low, just close to 25%. These are some examples, among others, which justify the necessity of developing new learning approaches in order to introduce Industry4.0 in the companies.

# 1. Introduction

The main aim of the project is to create a new approach to education in the manufacturing field, mainly focused on SMEs companies. The project will help SMEs in developing a better use of Industry 4.0 thanks to the creation of new learning experiences. However, before developing any learning experience it is of great relevance to know the position and knowledge of companies about Industry 4.0 and the necessity of investing in education about this field.

For instance, a survey carried out in March 2021 in the north of Italy stated that companies usually understand how Industry 4.0 could be beneficial for their productive environment. In addition, companies answered to be interested in investing in these instruments but highlighting the necessity of specific and targeted courses to implement them in production.

Therefore, these kinds of surveys are an efficient tool to understand and analyse the feelings and opinions about Industry 4.0. As a first step in the project, a general survey was launched among the SMEs from the different regions to define the needs related to Industry 4.0 and understand the reasons that hamper their implementation. Based on the results, different training courses and learning paths will be defined using nuggets already available in the GLP and, if gaps are found, new one will be created. The main goal is to show and educate mainly SME companies so that they are well prepared to use and implement Industry 4.0 solutions.

Also, other surveys have been launched in the past by the involved partners, as it is mentioned in the paper by Rupert Glass et al., (2018). These authors analysed the barriers for implementing Industry 4.0 approaches in manufacturing industry. Raj et al., (2020) identified 15 barriers in their comprehensive study, being, the most important ones, the lack of standards and regulation, lack of internal digital training and the low maturity level among others, proving the necessity of investing in education about these issues. It is literally stated that “For a generalization of the research findings, more responses from multiple industries could be collected and analysed”, proving the necessity of having direct inputs from companies about Industry 4.0. These results are in agreement with those reported by Kamble et al. (2018). Also, a survey carried out by Deloitte said that less than 15% of companies are confident about the use of Industry 4.0 in their companies. In a study by McKinsey, it is stated that only the 40% of the companies have made progress in implementing Industry 4.0 (Raj et al., 2020). Other authors such as Kiel et al., 2017 also reported lack of skilled workforce as one of the main barriers for implementing Industry 4.0. Thus, this brief analysis of the literature gives a clear insight about the necessity of a deeper knowledge about Industry 4.0 and how implement it on their companies and also the formation of their workers.

The developed survey consisted of a list of different of questions divided in three topics:

1. General company information: to obtain information about the size, revenues or sectors, in order to know the company profile interested in Industry 4.0.
2. Machine tools and organization: questions about the number and kind of machines (manual, CNC), additive manufacturing, kind of numerical control, communication protocols between machines, software employed, automation experience or data processing, among others.

3. Industry 4.0: question mainly focused on Industry 4.0 solutions and the position of the different companies regarding Industry 4.0, including the possibility of receiving different courses on this topic.

The survey was developed with an estimated answering time lower than 15 minutes and simple to answer. It is worth mentioning that the abovementioned list represents the main body of the surveys and slight variations could be observed between the questions, considering the different environments of the dissimilar countries involved. Nevertheless, these slight variations do not affect the overall analysis. The analysis of the surveys was carried out in global, just making special focus on differences in countries when needed.

Once the survey is analysed, LIVE4.0 partners will make use of previous results of the Mach4.0 EIT M project in preparing learning nuggets, together with other relevant nuggets from the GLP, to create specific courses on the practical implementation of Industry 4.0 tools.



## 2. Survey results

In this section, the results of the survey are analysed. First, the average answering time was lower than 15 minutes for all the countries involved in the survey. A total amount of 67 answers were received (19 in Spain, 24 in Italy, 17 in Czech Republic and 7 in Germany). Therefore, although the number of samples is not very high, it can be considered representative of the overall overview of the companies' position about Industry 4.0 in Europe. Each different question was analysed separately.

### 2.1 General company information

The aim of this group of questions is to give a general overview about the companies that participated in the survey. In the following section the companies that participated in the survey are analysed.

#### 2.1.1 What is the size of your company?

With the first question, the size of the company regarding the number of employees can be described as it is summarized in Figure 2.1. According to this figure, among all the companies questioned about Industry 4.0, most companies have a range from 10 to 249 employees (66%). It is worth mentioning that also some bigger companies (27% of the answers) participated in the survey.

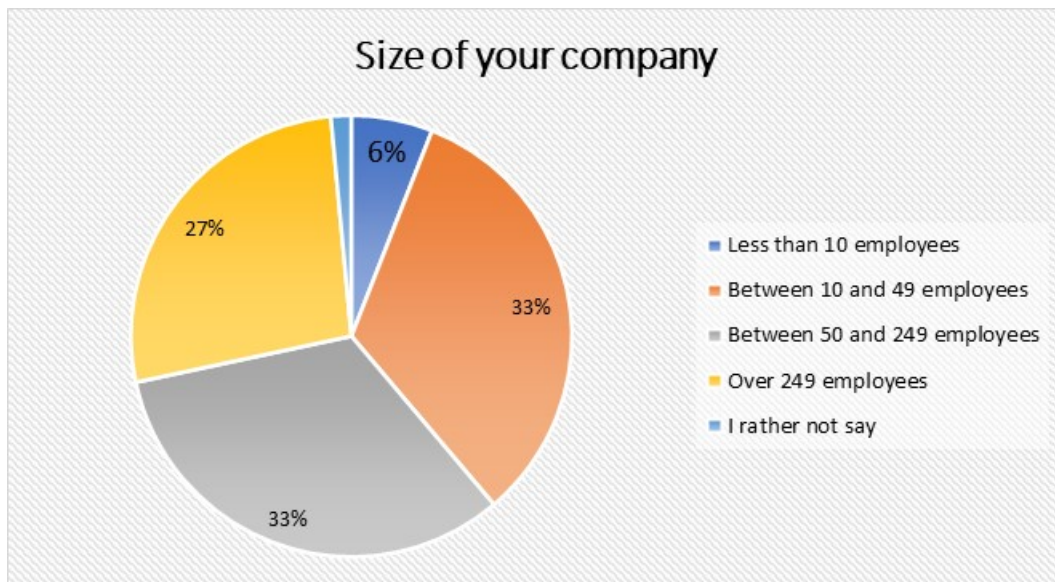


Figure 2.1. Distribution of company sizes regarding the number of employees

### 2.1.2 What is the yearly revenue of your company?

In a similar way, in Figure 2.2 the size of the companies regarding the yearly revenue is shown. In general, the revenue is lower than 50 million euro (representative of SMEs).

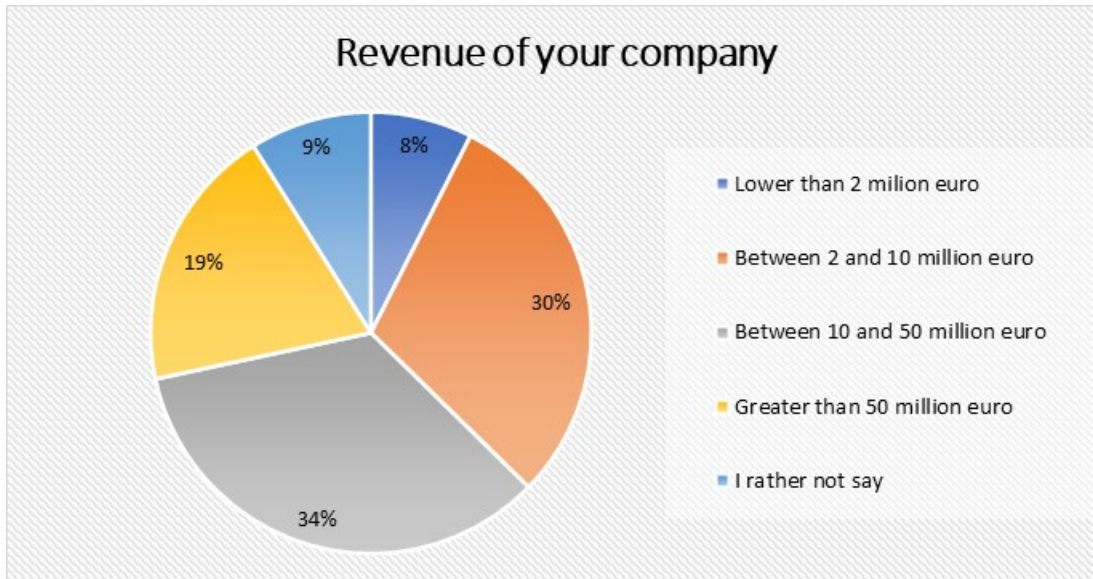


Figure 2.2. Distribution of revenues from different companies

### 2.1.3 In which sector does your company operate in?

In this question, the participation companies were asked for the main sector they are operating in. Since the list of sectors which may be interested in Industry 4.0 solutions could be large, just some of the main sectors the production industry is active were included in the survey. In the case that none of them was representative of the companies, they were allowed to answer others, specifying the sector. The results are shown in Figure 2.3. The term others represent sectors such as teaching (1 answer), industrial machines (1 answer) or robotics (1 answer).

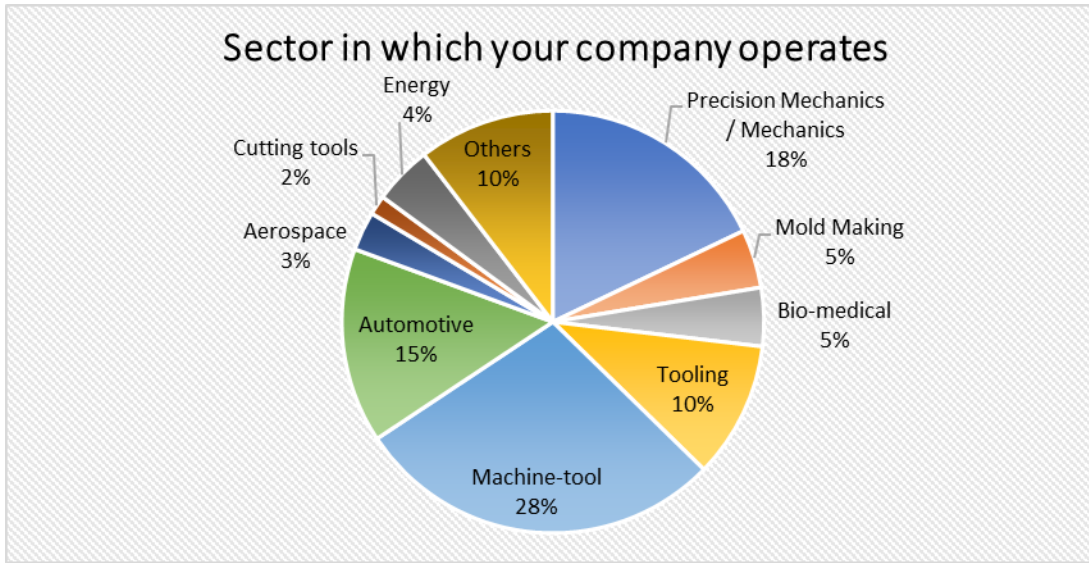


Figure 2.3. Distribution of different sectors

#### 2.1.4 What is your role in the company?

As can be seen in Figure 2.4, most of the answers to the survey came, from CEOs, or R&D managers and technical directors. This proves the interest of companies in Industry4.0 solutions as the main roles of the companies answered the survey themselves.

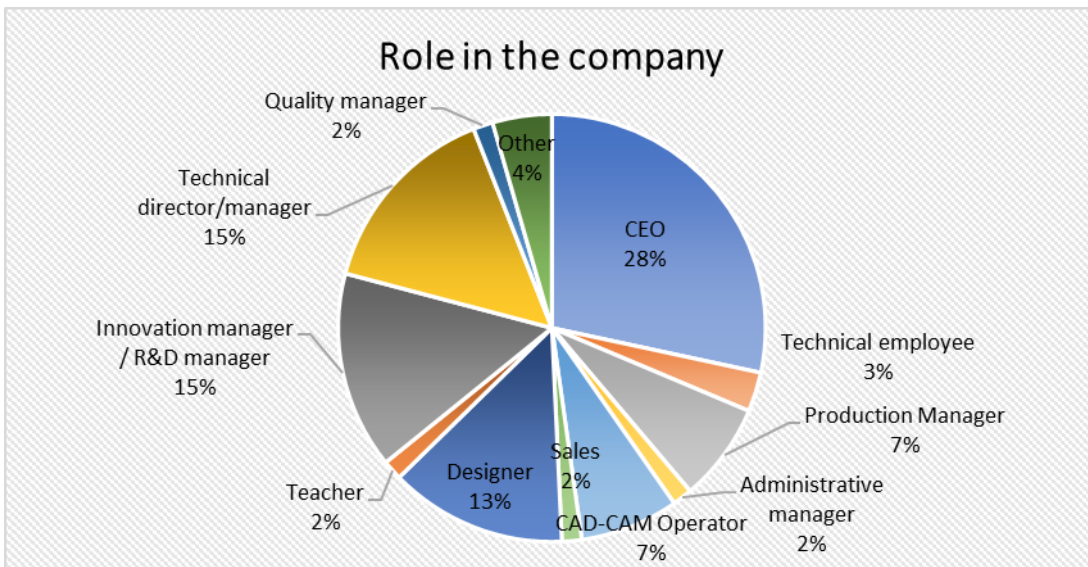


Figure 2.4. Role in the company of the person who answered the survey

## 2.2 Machine tools and organization

The purpose of this group of questions was, to identify the used machinery in quantity and machine types and the size of the production. Also, the processes that need to be addressed in learning paths can be extracted.

### 2.2.1 Which machine tools are most used in your company?

First, to see the size of the companies asked the number of machine tools used is shown in Figure 2.5. The majority of the companies reported to have more than 30 machine tools, which shows that the companies which could be interested in Industry 4.0 are well equipped.

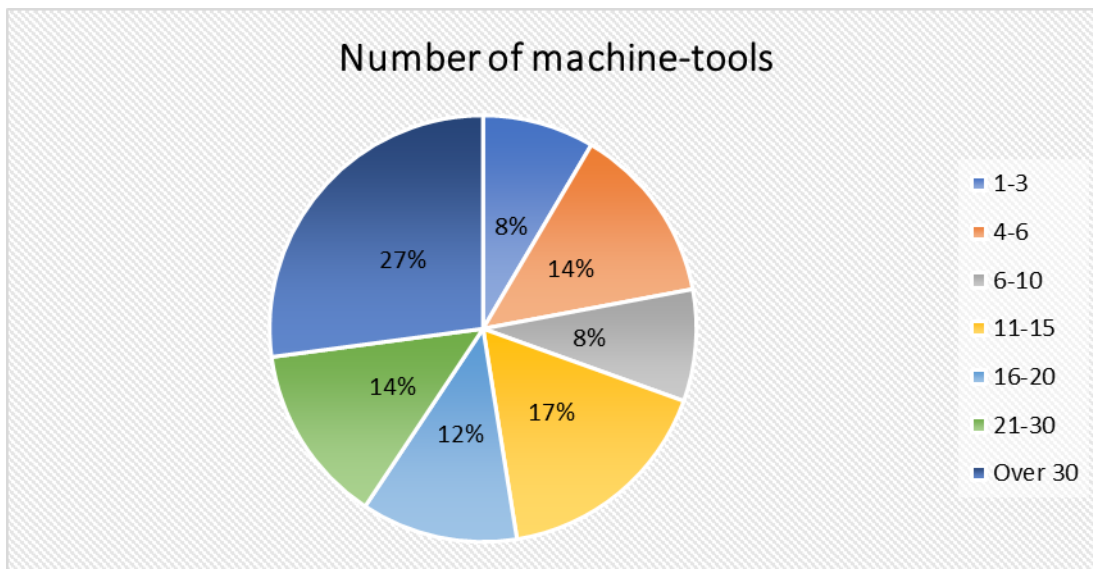


Figure 2.5. Number of machine tools available in the companies

Among all the possible machines, in Figure 2.6 the machine tools used in the companies were classified in terms of percentages, to see which are the most widely used. In this sense, many companies used grinding machines (including all the possibilities) and CNC mills with 5 and 3 axes respectively.

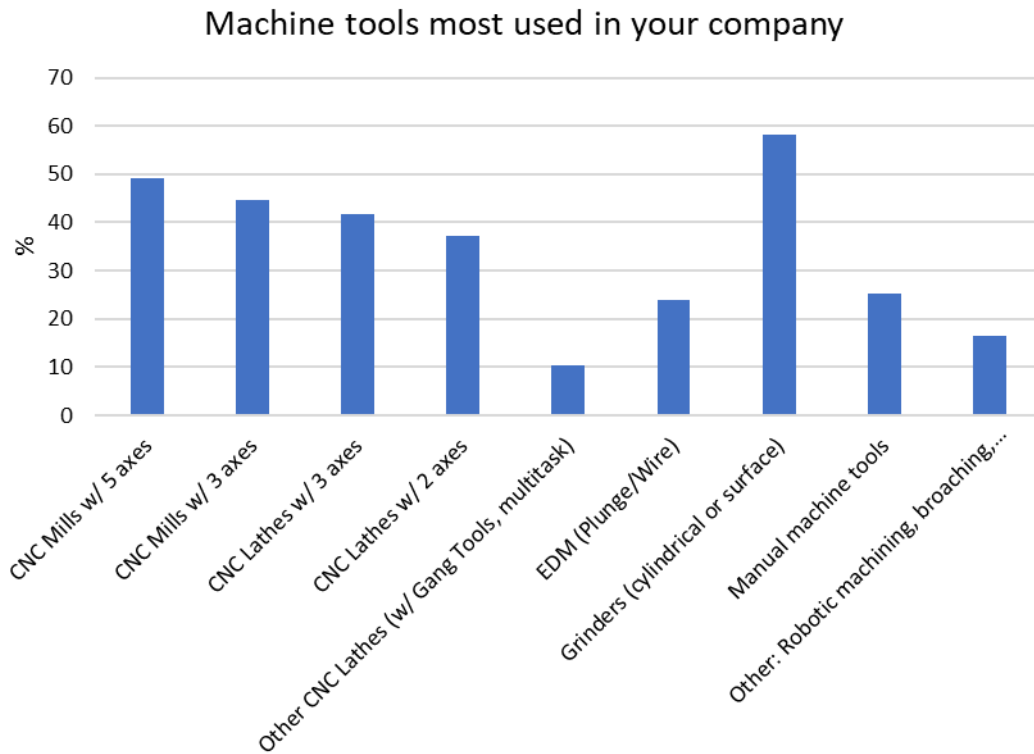


Figure 2.6. Percentage of machine tools in the different companies

## 2.2.2 Does your company utilize Additive Manufacturing?

One of the emerging techniques nowadays in manufacturing is Additive Manufacturing (AM). Companies which used this kind of technique are assumed to be technological and interested in innovation, so they could be potential customers of Industry 4.0 formation. The following graph (see Figure 2.7) shows the ratio between the companies which have answered no to the use of AM to the ones which have said yes and, among all of them which have answered yes, the kind of AM technology used.

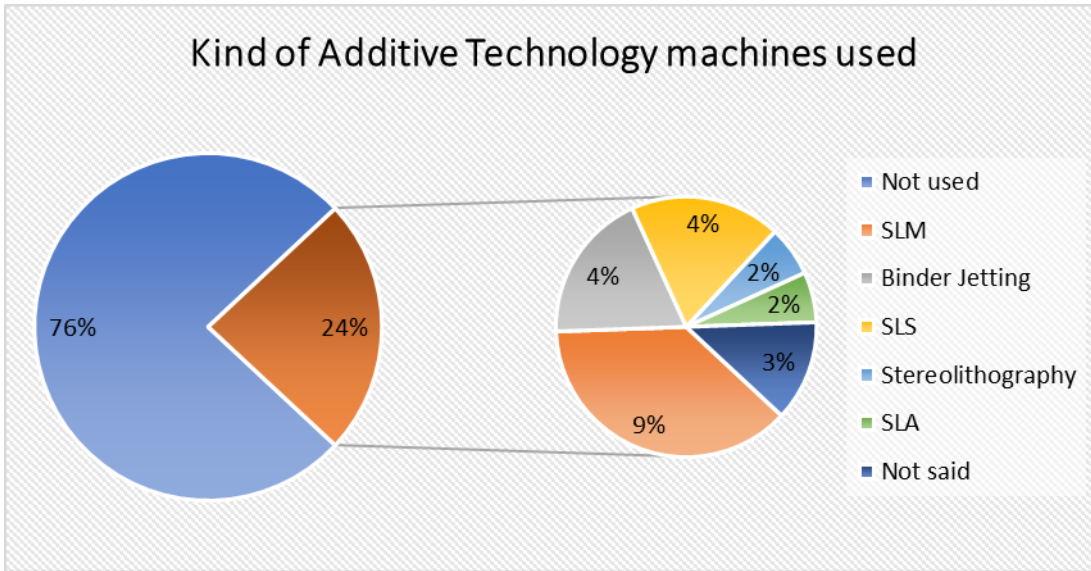


Figure 2.7. Distribution of AM technologies in the companies

It can be seen that AM is still not widely spread in companies nowadays, being reported for more than 75% of them that they are not using it. Among all the companies which said yes, SLM seems to be the prevalent option but with no clear trend observed. It should be highlighted that, as the majority of the companies answered no, the results related to yes may be taken with caution, as the sample may not be high enough to report clear conclusions.

### 2.2.3 In your company which numerical control is prevalent?

There are different options available to carry out the numerical control in the companies, as can be seen in Figure 2.8. However, despite such a varied offer, the vast majority of the companies have chosen between Siemens, Heidenhain and Fanuc, covering more than 85% of the answers. Some caution has to be applied here as many companies use more than one brand for the controller, so a deeper analysis should be made to refine these results. In any case, it is based on what the companies feel to be their reference CNC brand.

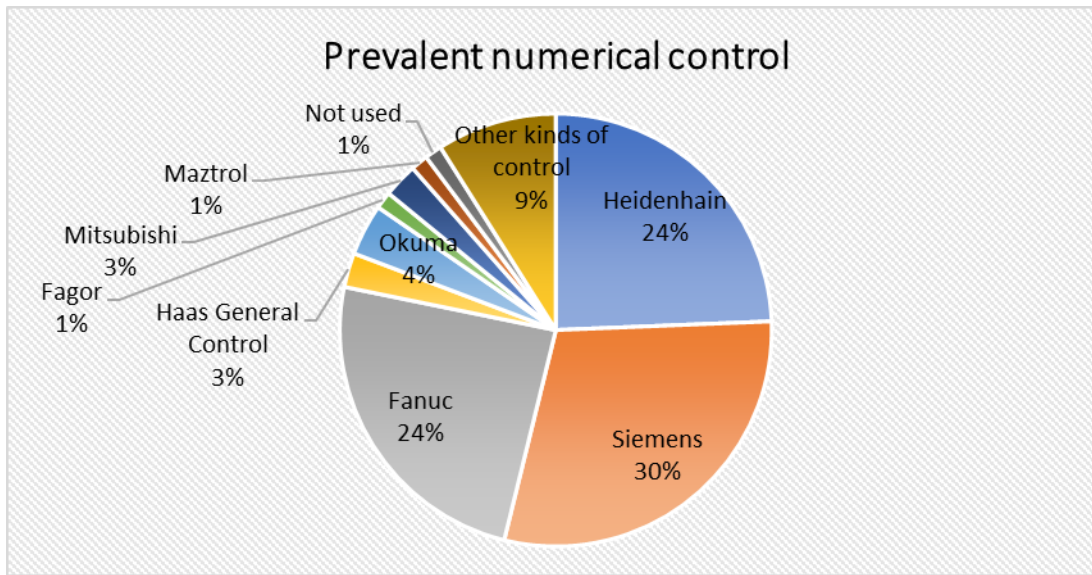


Figure 2.8. Distribution of numerical controls used in the companies

## 2.2.4 In your company what communications protocols are mostly used?

In a similar way, there is a varied offer about communication protocols as can be seen in Figure 2.9. However, it seems that the prevalent options are Profinet and Profibus, together with OPC-UA and Ethercat.

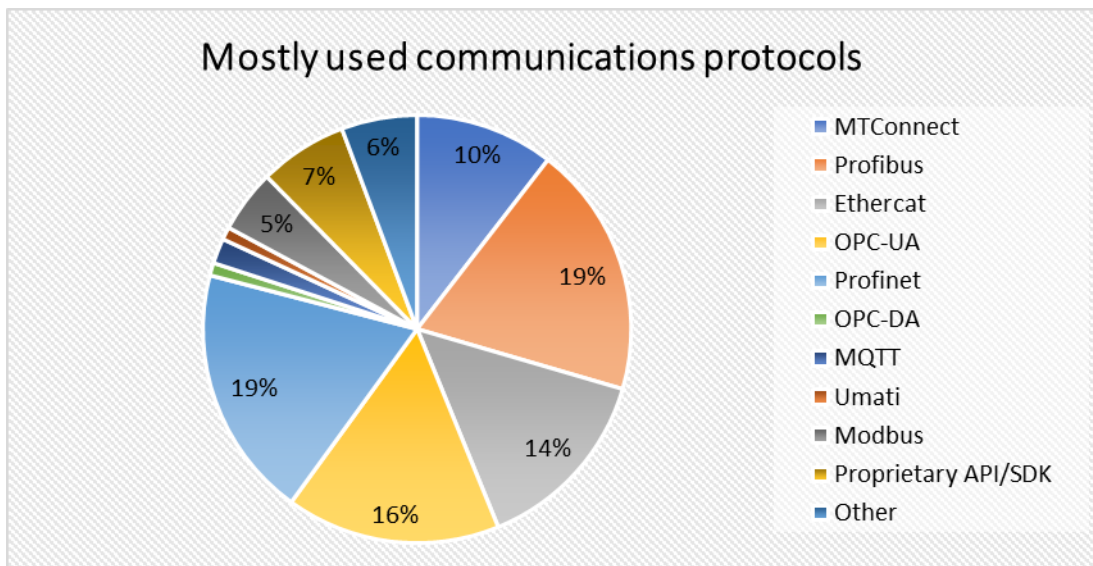


Figure 2.9. Distribution of communication protocols used in the companies

## 2.2.5 In your company which software are most used during the phases of product design and production?

To optimize production phases and to predict what could occur during these phases, different software could be used, mainly focused on CAM approaches, CAD approaches or Simulation approaches. Among all, as it can be seen in Figure 2.10, CAD approaches are still the prevalent option nowadays, with very little room for simulation. It is worth mentioning that the number of companies not using software is almost insignificant.

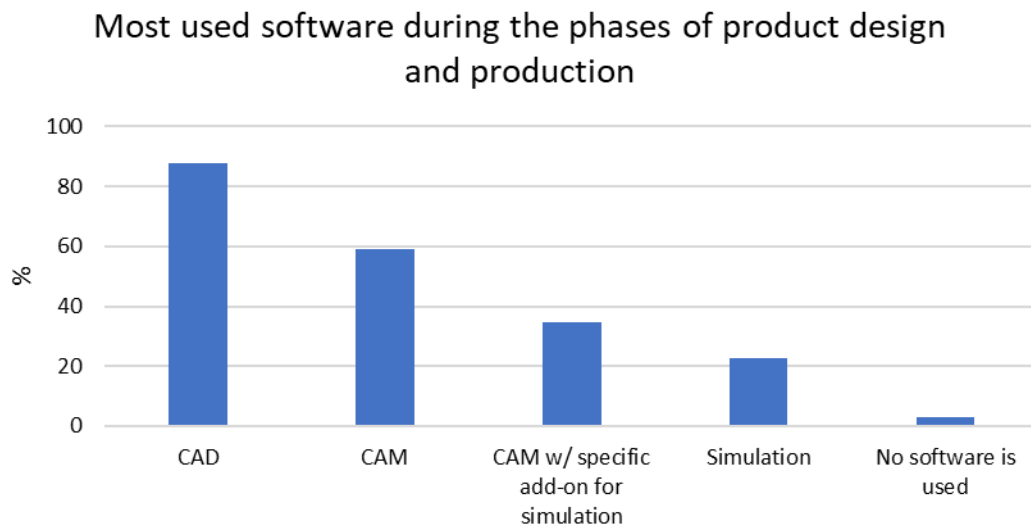


Figure 2.10. Prevalent used software in companies

## 2.2.6 In your company do you have experience with automation?

With regard to automation, robotic manipulation during production phases seems to be the prevalent option, with close to 40% of the answers (see Figure 2.11). It is worth mentioning that almost all the companies which have answered the survey reported to use some kind of automation, which could be an indicator of the interest they could have in Interest 4.0 solutions.



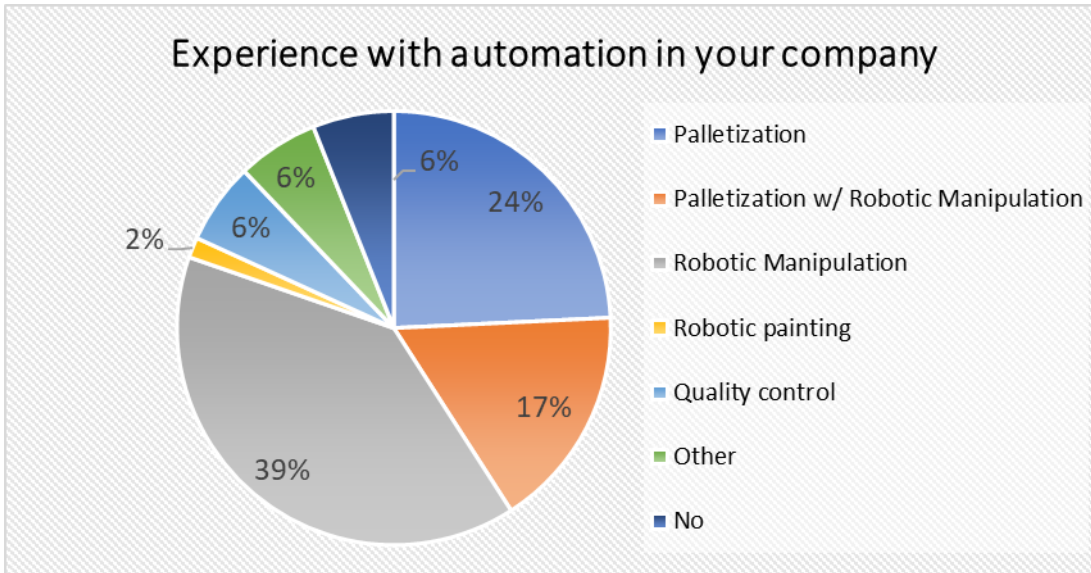


Figure 2.11. Distribution of automation experience in the companies

## 2.2.7 In your company which production phase is most costly/complex?

The aim of developing Industry 4.0 skills is to reduce production times and costs. As can be seen in Figure 2.12, despite the advances in automation nowadays, Product fine tuning (that is, testing and refinement with trial and error) still represents more than 30% of the answers, together with Product design and Actual production.

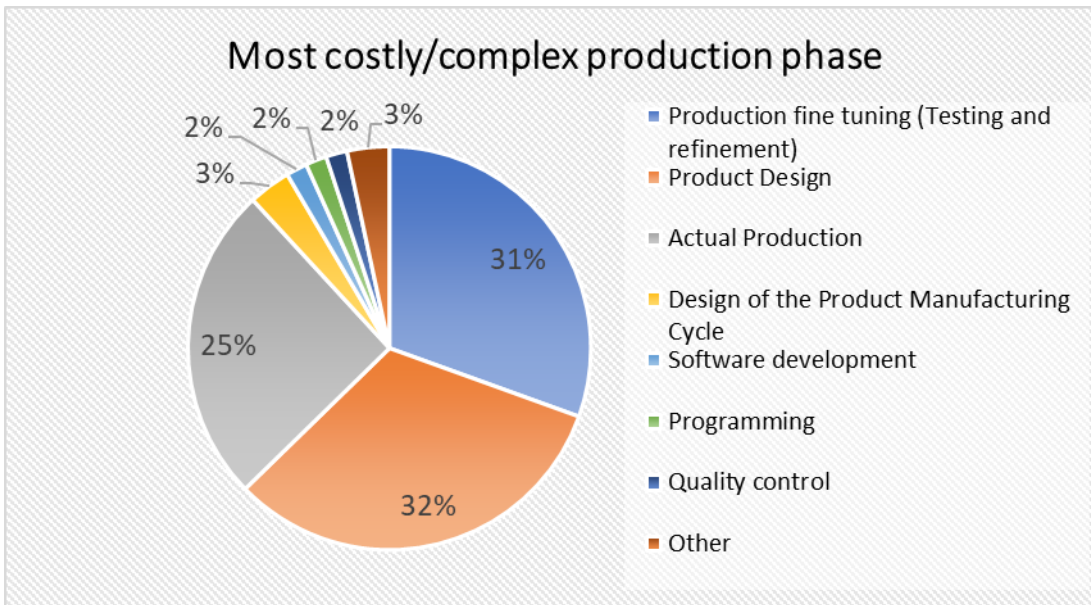


Figure 2.12. Distribution of costly production phases according to the companies

### 2.2.8 Is your company using a production planning system?

All the companies answered yes to this question, with the distribution shown in Figure 2.13. As can be seen, many of the companies used ERP solutions although there are still 15% of them using empiric solutions (that is, based on trial and error or experimental databases). This trial and error approach is usually very expensive and time consuming.

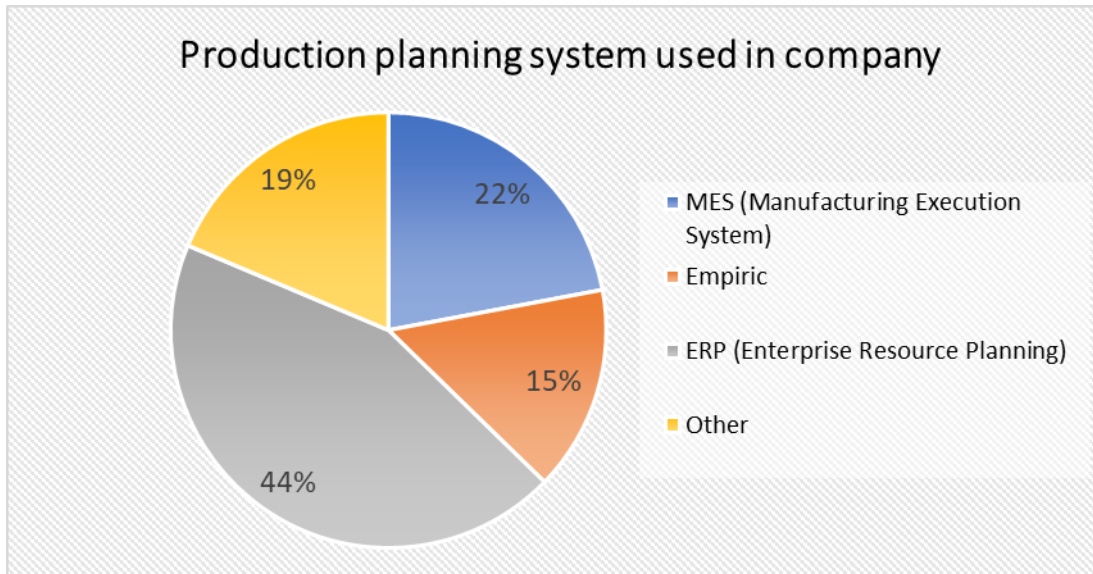


Figure 2.13. Distribution of production planning systems used the companies

### 2.2.9 Has your company implemented data processing during production?

As can be seen in Figure 2.14, the majority of the companies have experience with data processing, although 27% answered no. Among all the companies which said yes, similar number of answers were obtained for analysing data for process planning/control, analysing data for process monitoring and storage of data for documentation. Automatic process planning/monitoring is only implemented in 5% of the companies.

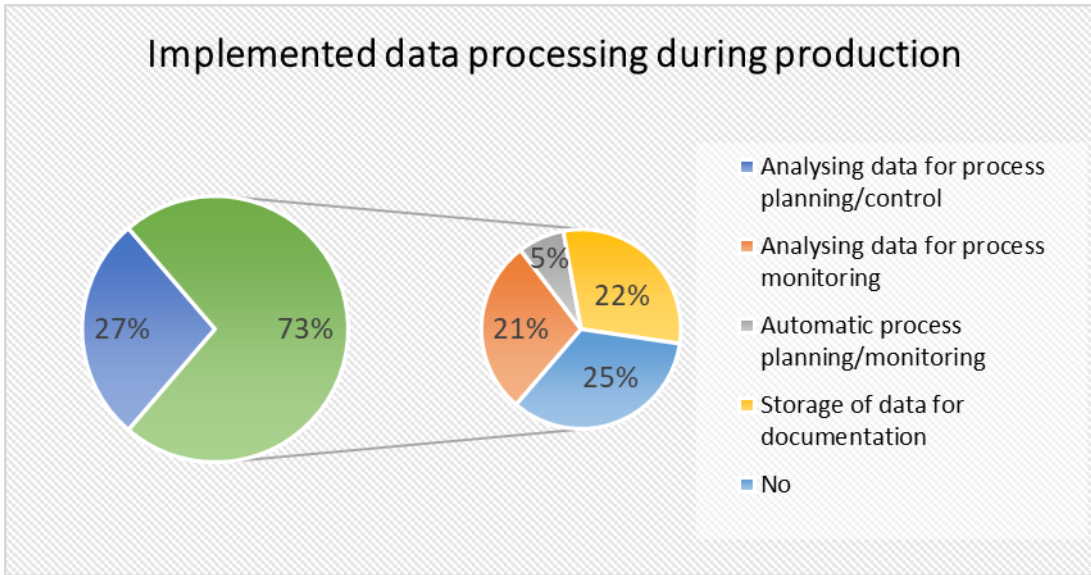


Figure 2.14. Experience with data processing in companies

## 2.2.10 Has your company implemented Machine2Machine communication?

In Figure 2.15 it can be seen that the majority of the companies have not included any kind of Machine to Machine communication in their production stages, which happens in all the countries analysed. Among all which said yes, most of them have industrial Ethernet interfaces. Web services with a specific M2M software is very residual, as just one single company answer yes to this option.

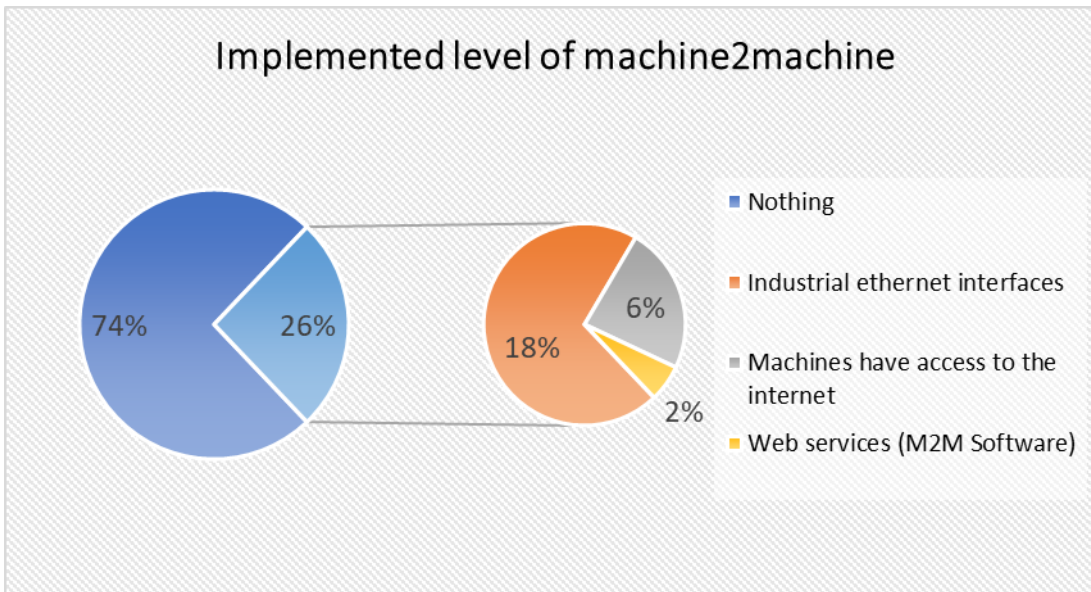


Figure 2.15. Distribution of implemented level of machine to machine communication

### 2.2.11 Has your company implemented company-wide networking with the production?

Figure 2.16 shows the results related to wide networking. Almost 50% of the companies answered no to the question, which proves that there is a very long way to go. Among all those who said yes, the majority shows to have inter-divisional fully networked solutions IT solutions.

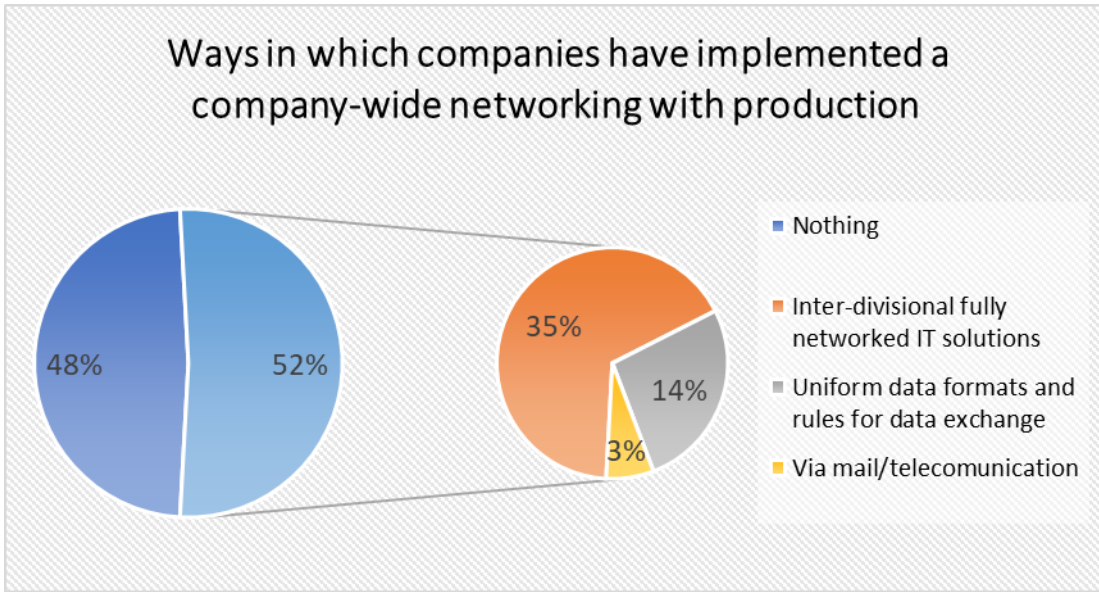


Figure 2.16. Distribution of wide networking solutions

## 2.2.12 Has your company implemented an ICT infrastructure in production?

As in the previous case, many companies answered no (more than 40%) as shows in Figure 2.17, whereas those which answered yes are mainly focused on central servers in production.

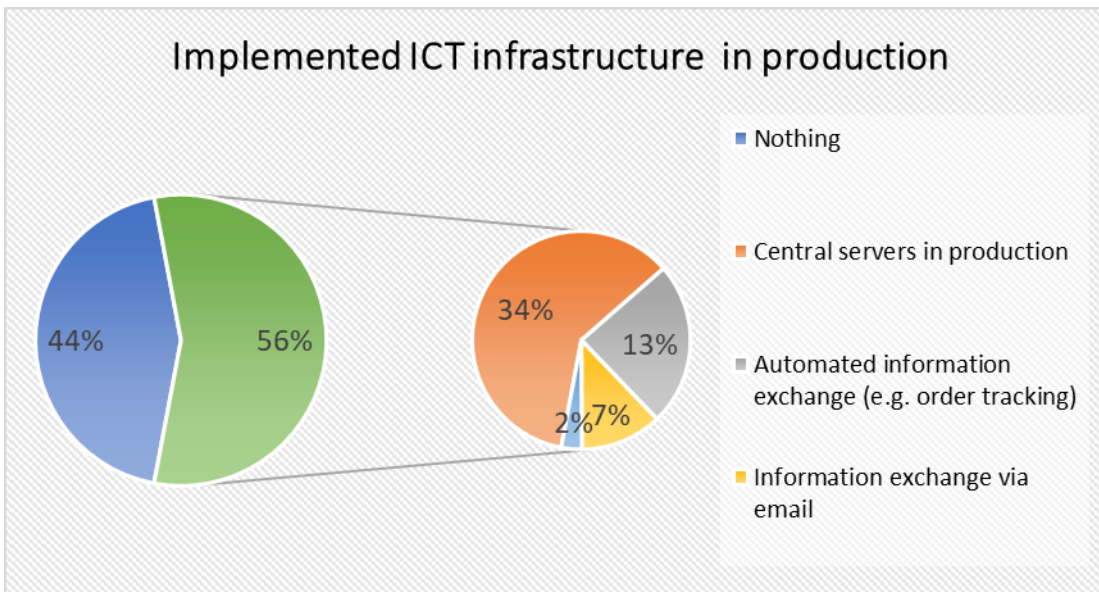


Figure 2.17. Distribution of ICT solutions implanted in companies

### 2.2.13 Has your company implemented any Human-Machine Interfaces (HMI)?

Regarding HMI, similar results were obtained as can be seen in Figure 2.18. Almost half of the companies answered no to the question. Among all those which said yes, the most widely implemented HMI solutions were based on local user interfaces and production monitoring and control, both centralized and decentralized.

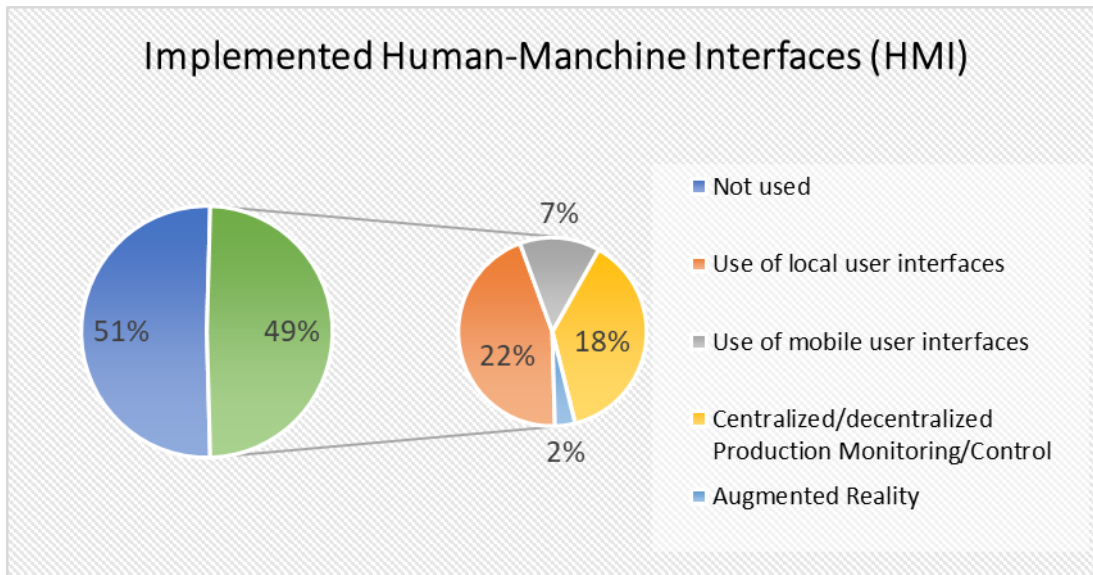


Figure 2.18. Distribution of HMI implanted in companies

### 2.2.14 Does your company deal with small batch productions?

This question is divided in two. First a yes-no question about the experience of the company with these small batches. Then, what kind of experience, in terms of efficiency level, was reached dealing with small batch production. Concerning the first one, it can be seen in Figure 2.19 that the majority of the companies are used to dealing with this kind of productions.

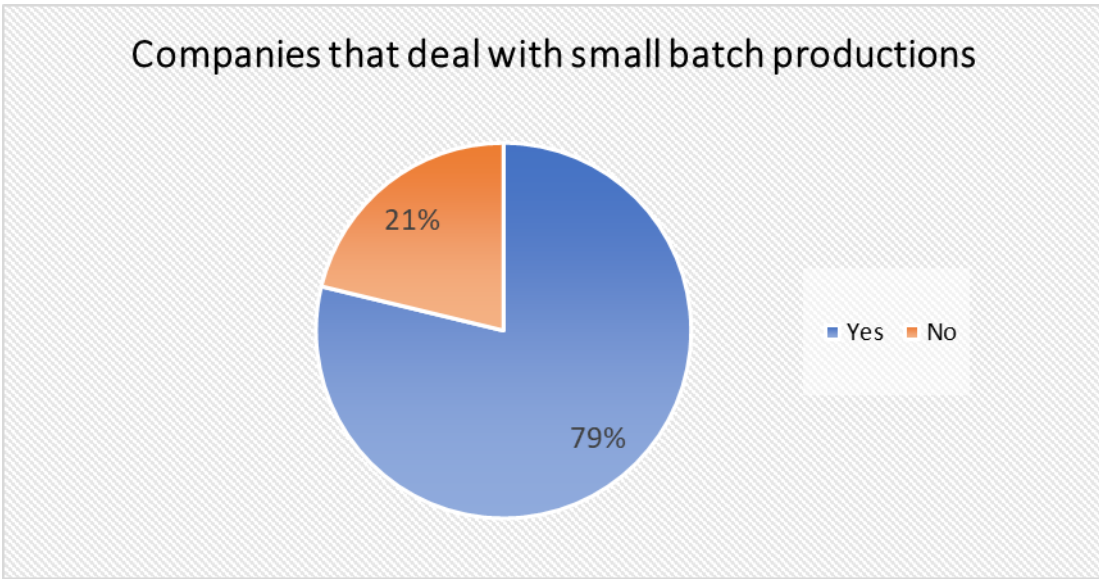


Figure 2.19. Experiences of the companies with small batch productions

Although most of companies are used to working with small batch productions, the majority is based on rigid production systems (see Figure 2.20) which could not be the most efficient way of dealing these productions.

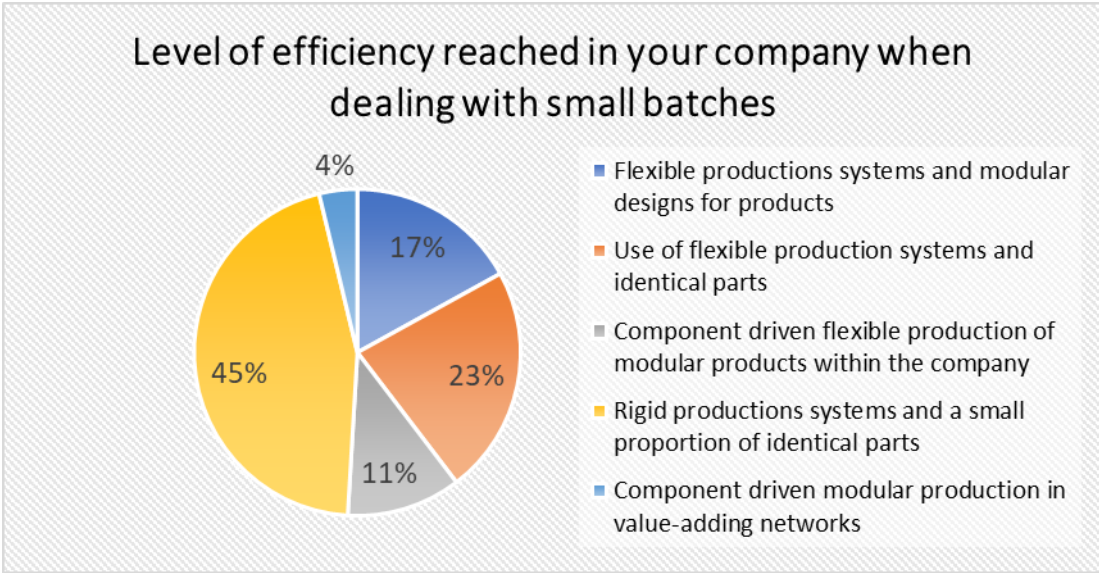


Figure 2.20. Level of efficiency reached with small batches production

## 2.3 Industry 4.0 experience

The last group of questions aim to know the real opinion of the companies about Industry 4.0 solutions and what would be their point of view with regard to introduce Industry4.0 formation in their companies.

### 2.3.1 Do you believe I4.0 solutions can be applied to your company's ecosystem?

The aim of this question is to reveal the real interest of the companies in Industry 4.0 solutions in order to see potential clients. 90% of the companies answered yes to this question (see Figure 2.21), which proves the relevance of this issue to companies. Unfortunately, it is not possible to know the reasons leading the companies to answer no to this question.

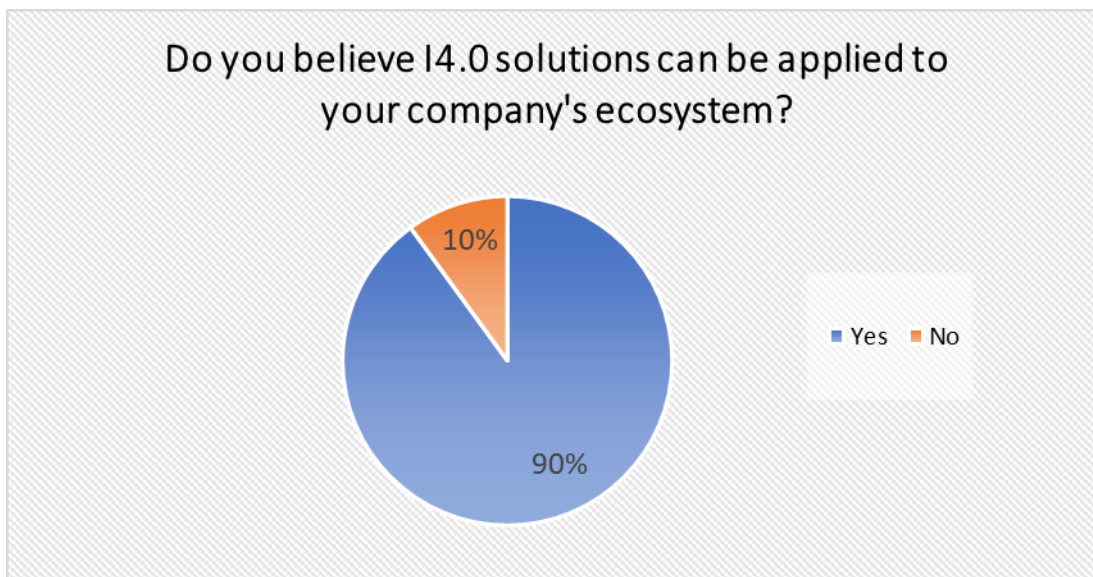


Figure 2.21. Interest of the companies in Industry4.0

Among all the possibilities, companies, when asked for their interests in Industry 4.0 solutions, choose data analysis as first option (see Figure 2.22). It is worth mentioning that some companies that answered no to the previous question then chose some of the options shown in Figure 2.22. This proves that some companies are still not used to dealing with the term of Industry 4.0. Also, it should be highlighted that some companies have chosen others which includes digital process chain or predictive maintenance.



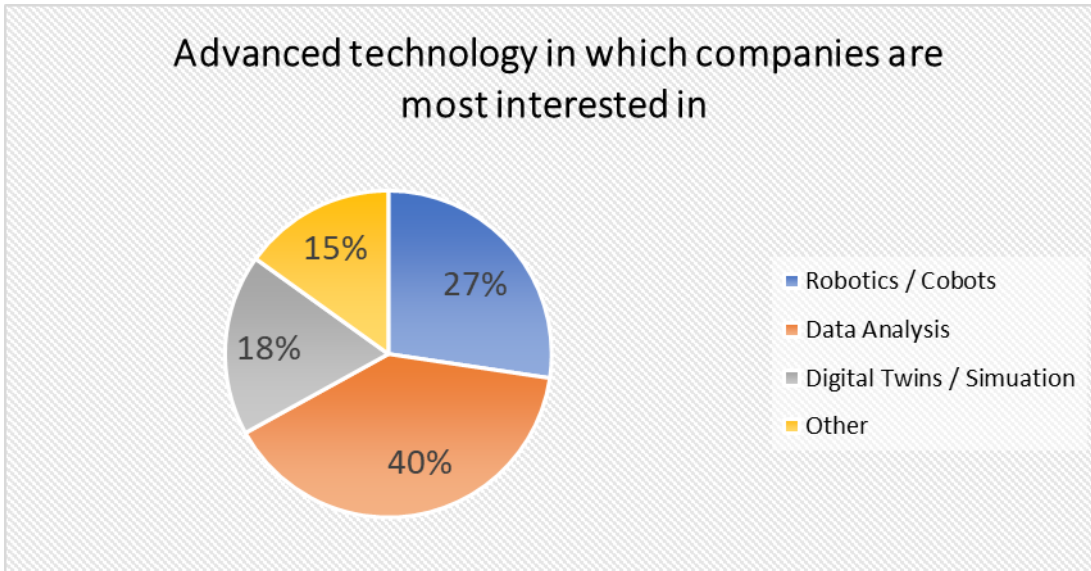


Figure 2.22. Level of interest of the different companies in Industry4.0 solutions

### 2.3.2 Would your company be interested in process monitoring with the goal of foreseeing tool life and tool breakage whilst increasing part quality?

Process monitoring could be one of the main advantages of introducing Industry 4.0 in companies. As it can be seen in Figure 2.23, more than 75% of companies answered yes to this question. Nevertheless, it would be of great interest to know the reasons why more than 20% of the companies said no.

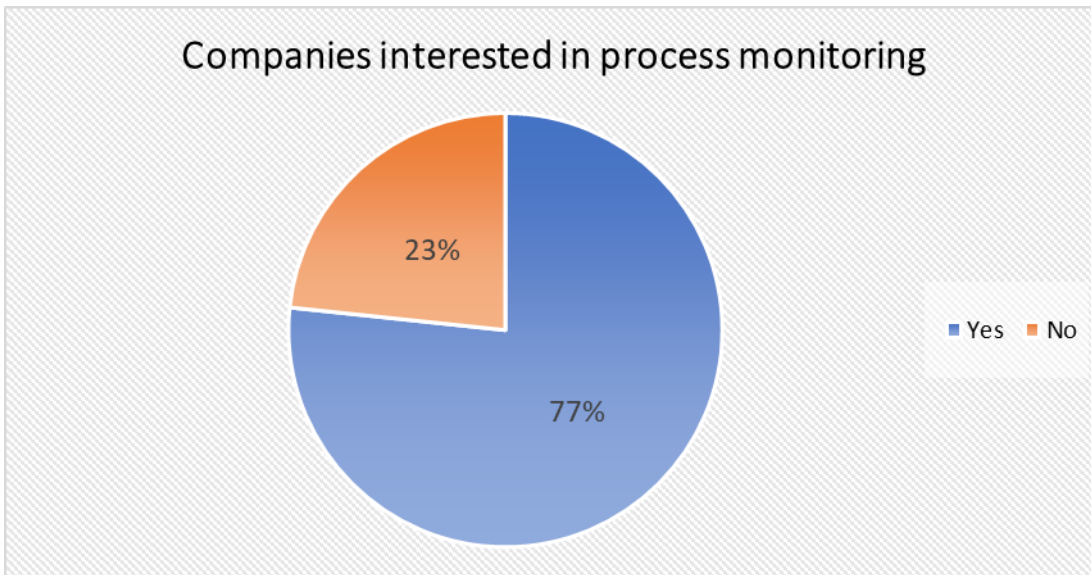


Figure 2.23. Interest of companies in process monitoring

### 2.3.3 Would your company be interested in simulating the production process with the goal of shortening set up times and fine tuning whilst also increasing finished part quality?

Similar to previous question, the potential of simulation solution was asked as can be seen in Figure 2.24. Around 75% of the companies answered that they are interested in simulation solution to optimize the production. 25% of the companies said no, which could be a hint on the barriers and obstacles and would need further studies.

Companies interested in simulating the production process with the goal of shortening set up times and finetuning whilst also increasing finished part quality

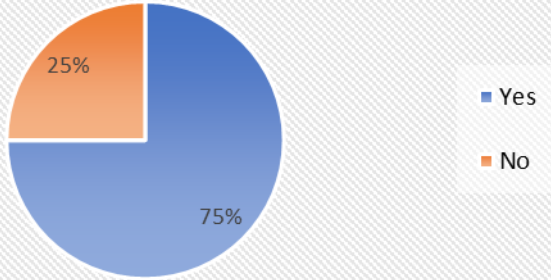


Figure 2.24. Interest of companies in simulating the process

When they are asked about the kind of software, simulation and, more precisely, simulation software for tool life prediction are the preferred options (see Figure 2.25).

Software in which companies invest in provided adequate training

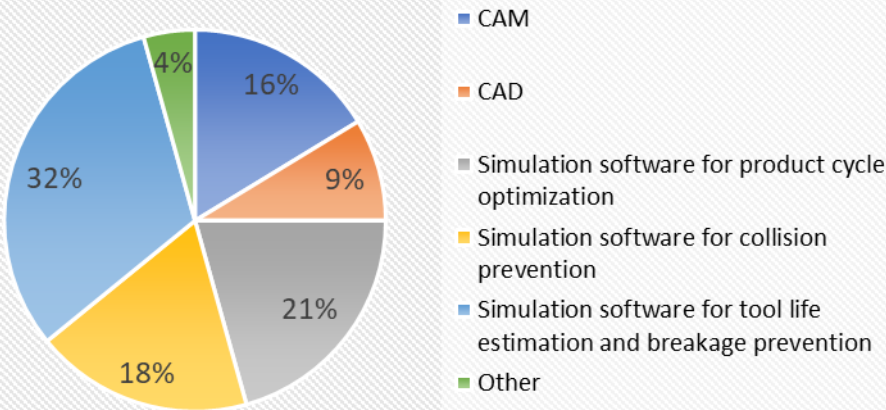


Figure 2.25. Software chosen by the companies

### 2.3.4 Would your company be interested in courses aimed at teaching I4.0 tools for improving the companies bottom line?

Based on the results previously shown, it can be assumed that companies could show interest in Industry 4.0 solutions. It is worth mentioning that when they are directly asked for this the most chosen option is yes, directly proving the interest of companies in being taught about Industry 4.0 (see Figure 2.26).

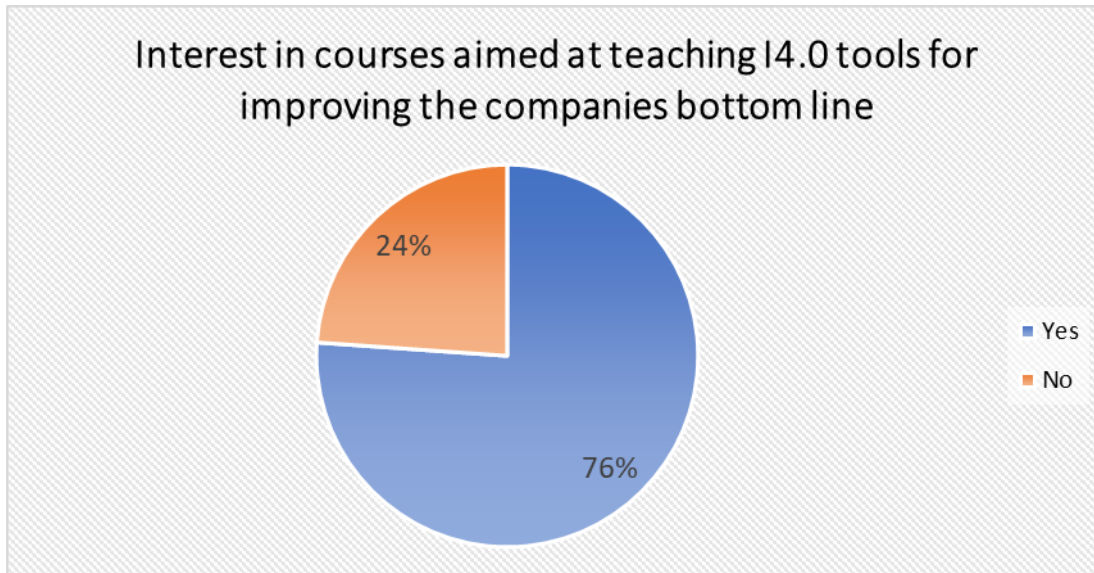


Figure 2.26. Interest of companies in Industry4.0 courses

### 2.3.5 Would your company be willing to pay for said courses?

In addition, most of the companies would be willing to pay for these courses (around 60%, see Figure 2.27). It should be highlighted that a great number of the companies also answered, "not said", which could be assumed that the decision may depend on the price.

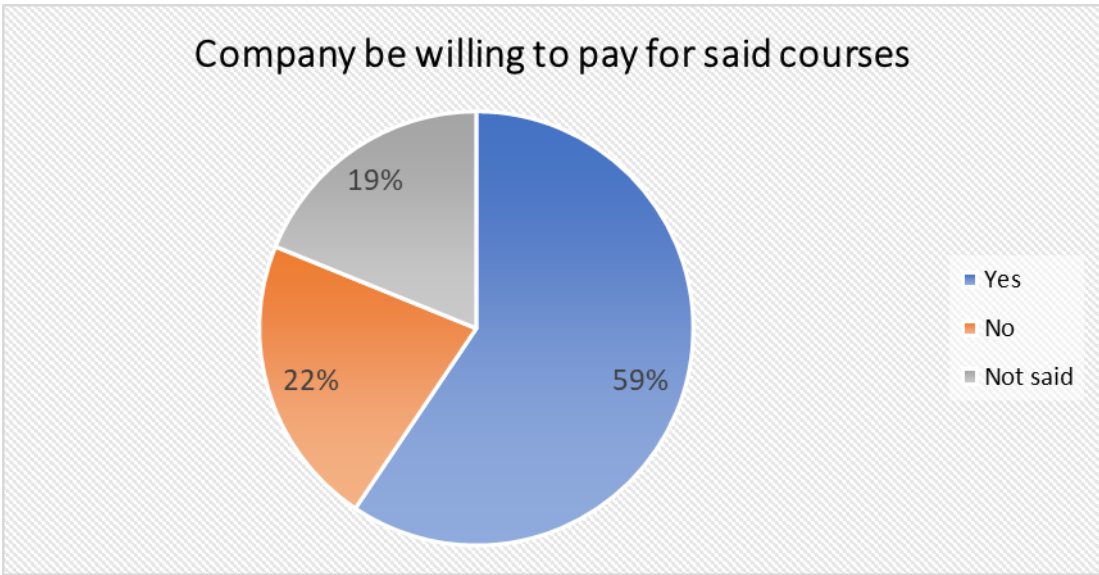


Figure 2.27. Willingness of the companies to pay for the courses

### 3. Analysis of the results

After analysing each question separately, the information of different questions was combined. First the type of machines and the size of the companies are combined as can be seen in Figure 3.1 (in terms of number of machines). Larger companies have a higher number of machine tools, and a more diverse portfolio. On the other hand, the small and middle companies (1-3 or 4-6) are more specialized regarding the type and number of machines. The representation of all kinds of machine tool in this category is probably caused by diverse specialization of companies in the survey.

Another interest point is the relation between the kind of software used and the experience with small batch productions of companies, among all the companies which answered yes to this question, which can be seen in Figure 3.2. In contrast of what is expected, more sophisticated software is not correlated with higher efficiency of dealing with the small batch production. Companies probably depends on the experiences and skills of the individual employees, which also proves the necessity of Industry 4.0 skills formation.

Analysing the relation between the revenue and the kind of software implemented, high dispersion was observed in the results (see Figure 3.3). In general, although the sample is too low to state it, small companies (lower than 2 million of revenue), are more focused on CAM approaches. As the company gets bigger, CAM approach is still prevalent, but simulation approaches gain in relevance, with no clear trend.

The higher the revenue of the company, the more experience with automation can be seen in the company (again, the number of answers for high companies may be small to conclude). For bigger companies, palletization is not an important point as it can be seen in Figure 3.4.

Finally, interest in Industry 4.0 education was compared taking into account the company's turnover (see Figure 3.5 and Figure 3.6). First, it should be mentioned that some surveys offered the possibility to choose whether they would be willing to pay or not for the courses, regardless of the previous answer would be positive or negative, which explains the small differences between the figures in Figure 3.5 in comparison to Figure 3.6.

Another conclusion is that small companies do not see the benefit of Industry 4.0 and therefore are not interested. Among those who are interested in Industry 4.0, it is representative that none of them would be willing to pay for Industry 4.0. Here it becomes clear that especially the small companies do not see the importance of Industry 4.0 and miss the opportunity to align their companies to the future.

WatAJet, who is partner of this project, has obviously a different opinion about the utility of Industry 4.0 solutions and it is willing to pay for courses on these topics. The WatAJet's questionnaire has been kept apart for the general analysis as it is a particular case of SME, being a spin-off company of Politecnico di Milano. A couple of useful comments came from WatAJet regarding the dependence of the questionnaire's result on the person filling it in, e.g. the opinion and knowledge of the company's CEO is obviously different from the operator's ones. Another comment is about the CNC brands that are used in the company. Next questionnaires will refine this questions by giving the possibility of multiple selections to the users.

With bigger companies, the situation changes drastically and the vast majority of the companies with revenues higher than 2 million euro showed interest in Industry 4.0 and they were, in general, willing to pay for the courses.

LIVE4.0’s partners believe this kind of questionnaire is useful to tune their action within the project and they will ask the attendants of the developed learning experiences to fill it in with the purpose of increasing its representativeness.

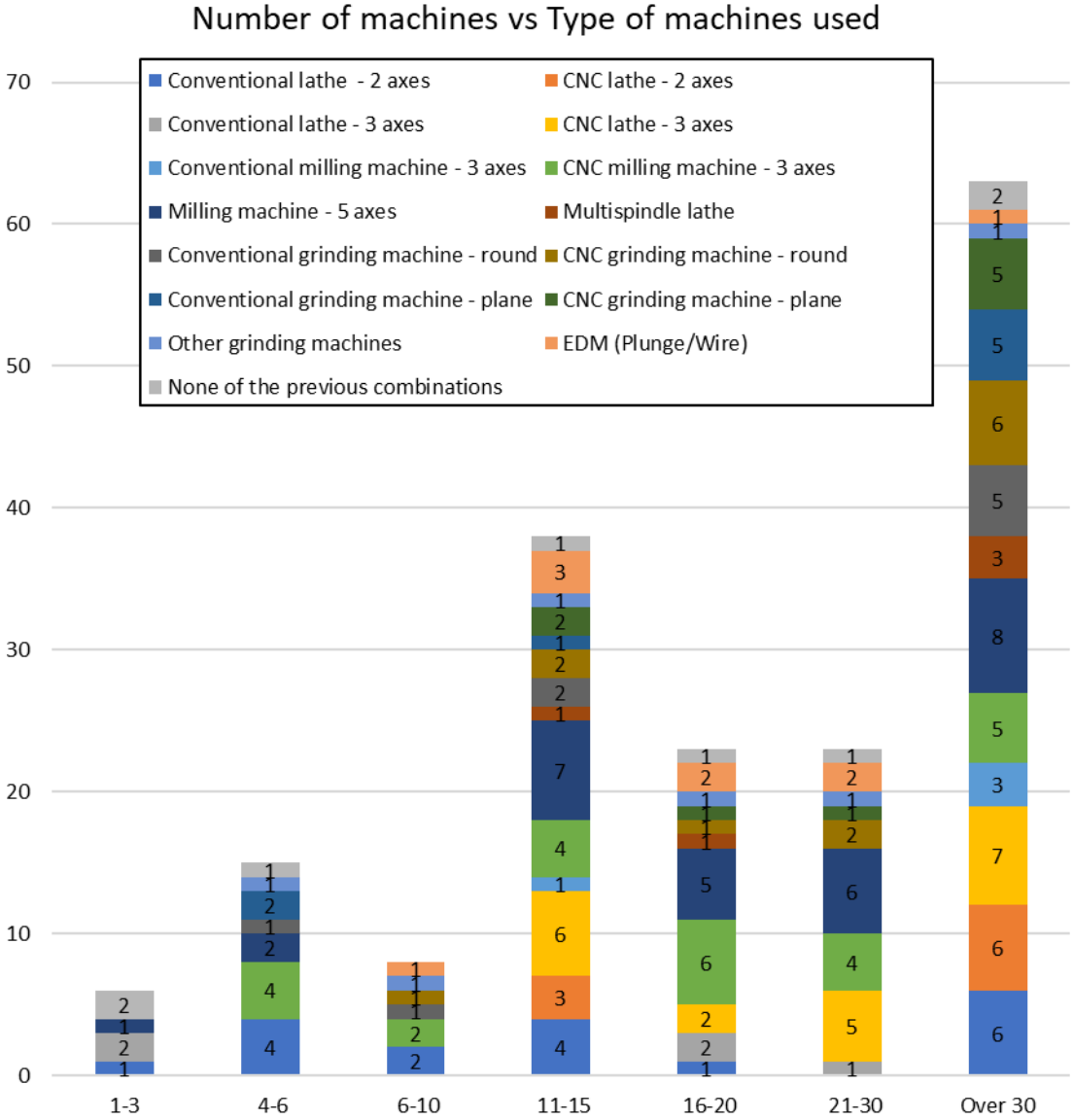


Figure 3.1. Number of machines related to type of machines

### Small batch production vs Software used

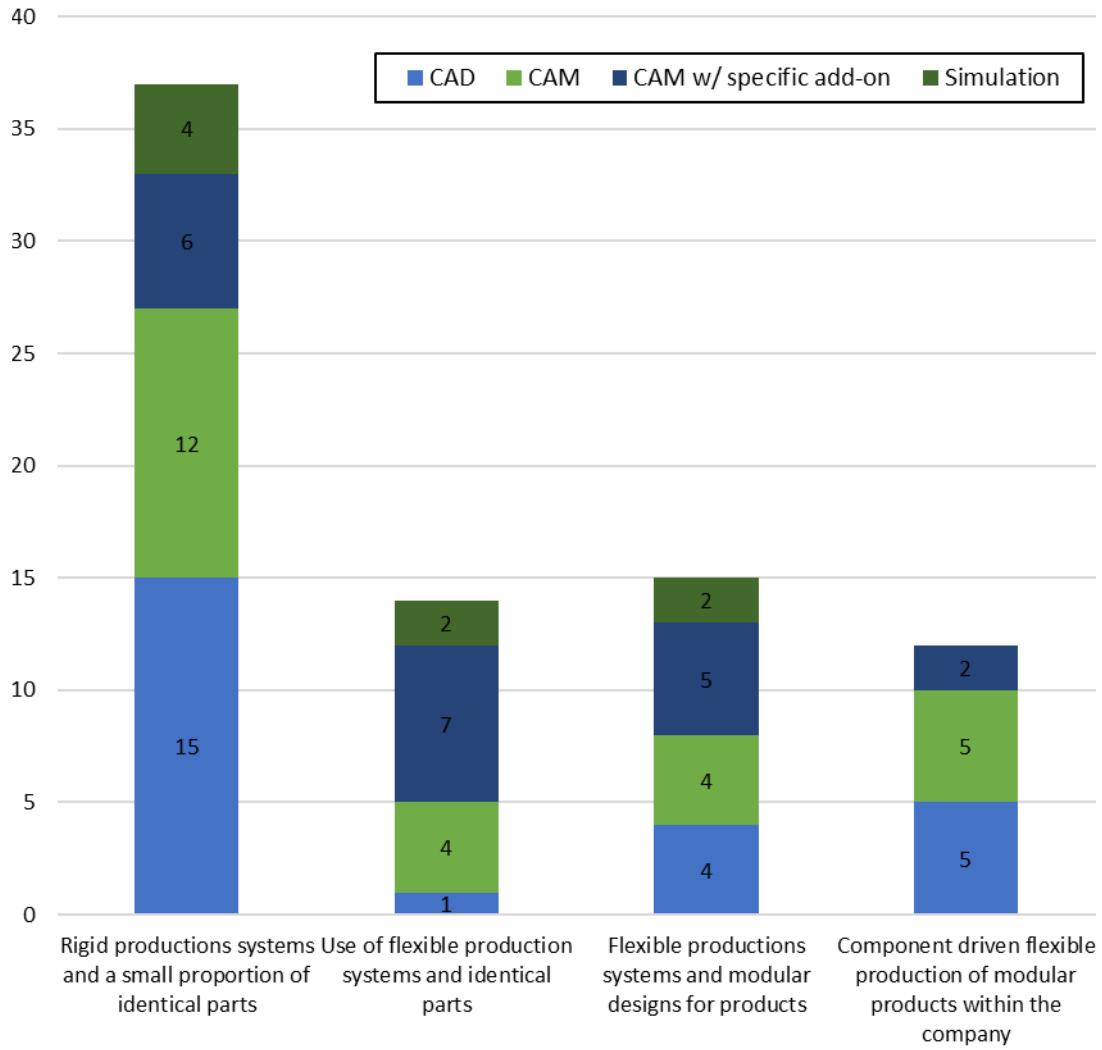


Figure 3.2. Relation between the kind of software and the experience with small batches



### Revenue vs Software SMEs would like to use

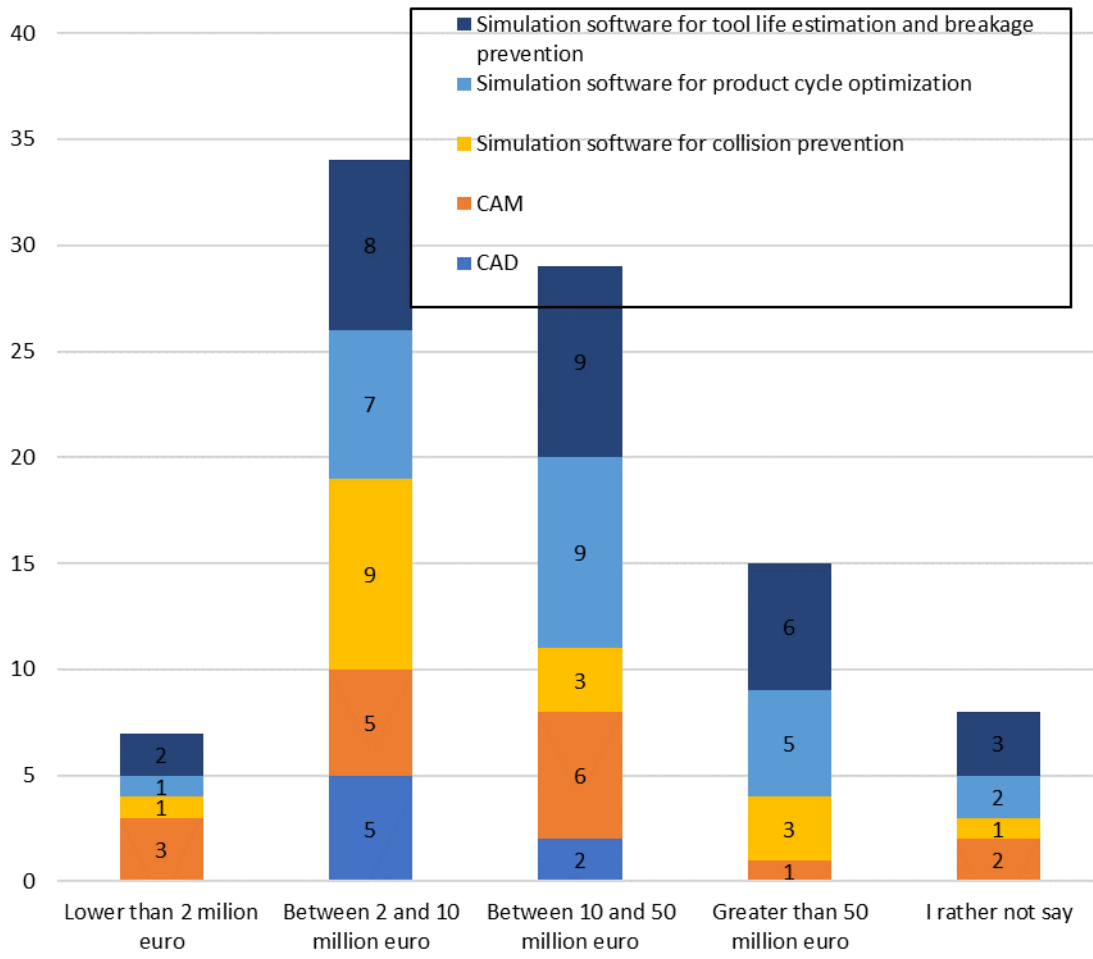


Figure 3.3. Relation between the kind of software and the revenue

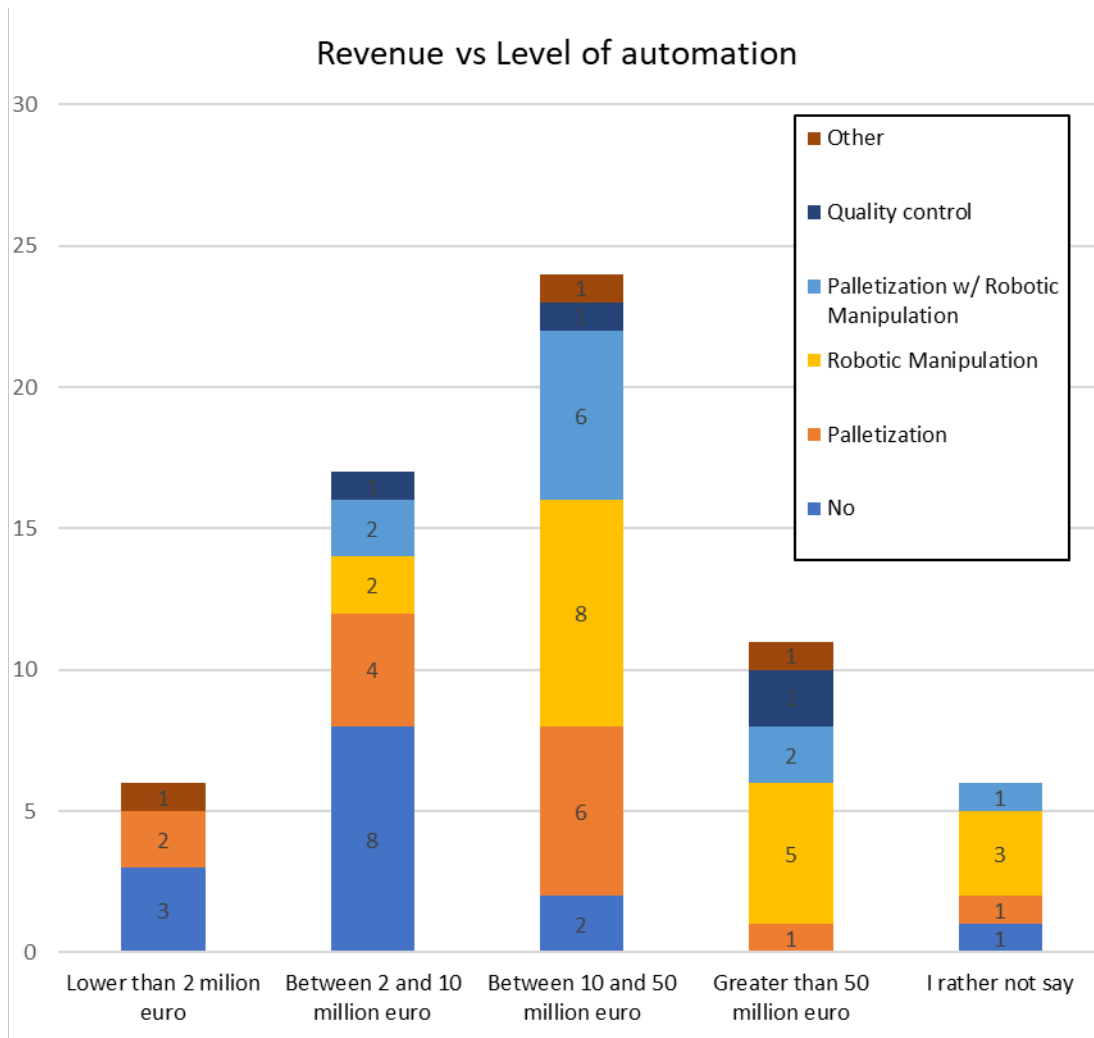


Figure 3.4. Relation between the revenue and the level of automation

### Revenue vs Interest in Industry4.0 courses

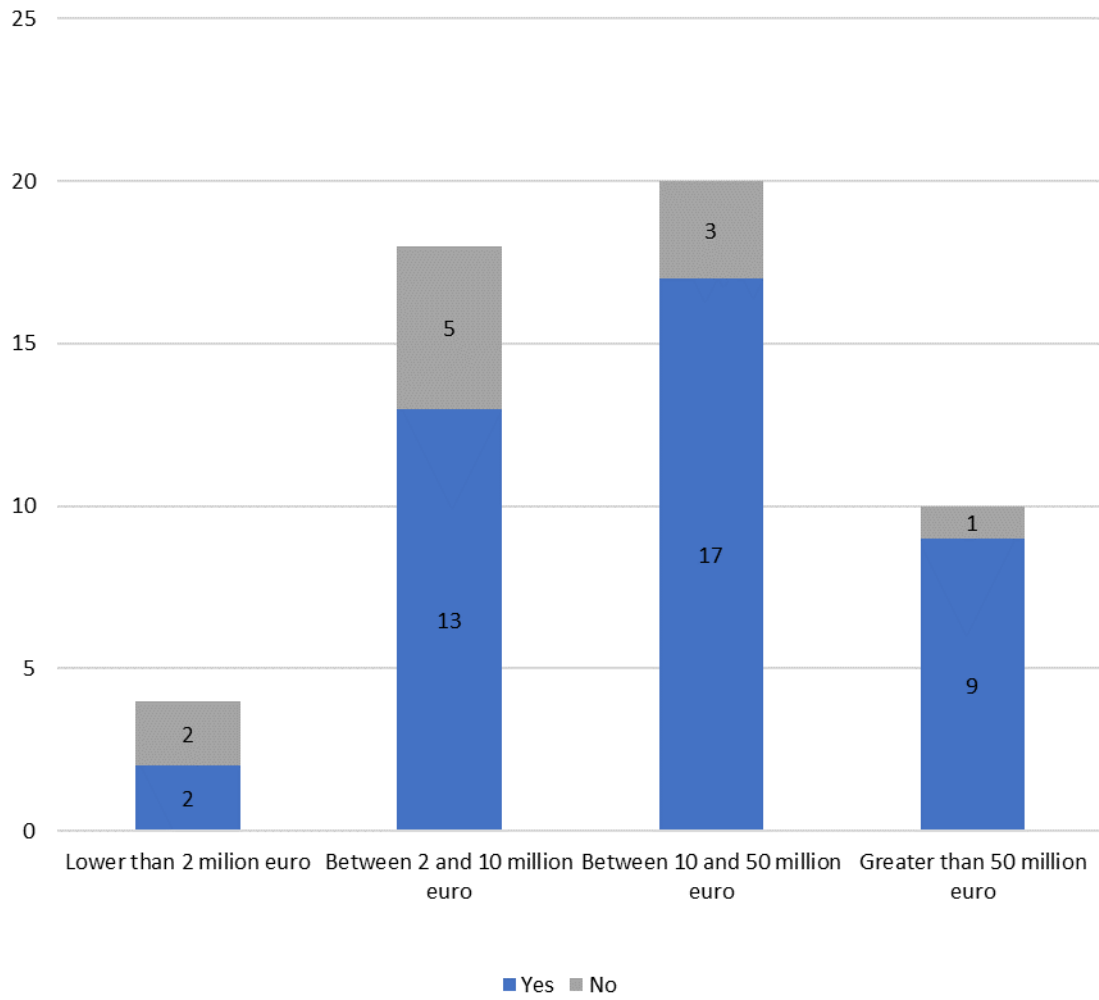


Figure 3.5. Revenue of the company against interest in Industry4.0 formation courses

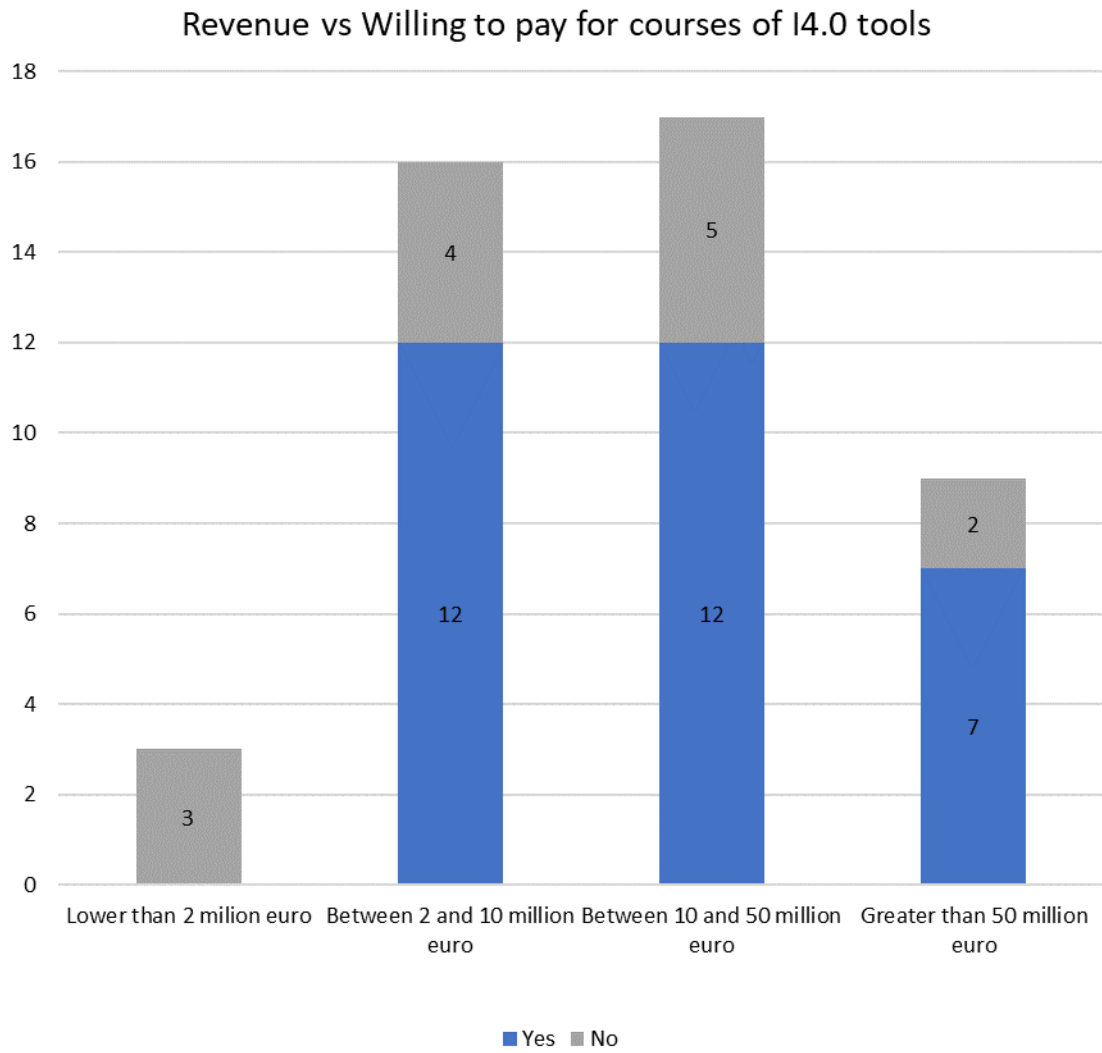


Figure 3.6. Revenue of the company against willingness to pay for Industry4.0 formation courses

## 4. Conclusions

The main conclusions that can be drawn after analysing the survey results are:

- More than 70% of the companies asked are interested in Industry 4.0 solutions and in receiving courses to improve their knowledge about these solutions. In addition, close to 60% of the companies would be willing to pay for receiving such courses.
- Regarding the size of the companies, it seems that when the company gets bigger it is more interested in investing in these kinds of solutions. Nevertheless, it is worth highlighting that the number of answers related to small companies is still very low to state that.
- Among all the possible solutions, data analysis cover more than 40% of the options chosen for the companies. It should be highlighted that 90% of the companies answered yes to the question about if they believe Industry 4.0 could be beneficial for the company.
- Another interest data is that less than 25% of the companies are used to using additive manufacturing. In addition, close to 80% are used to dealing with small batch productions, but the majority of them are based on rigid production systems, which could be improved through Industry 4.0 solutions.

## 5. References

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