Interreg Sudoe

EUROPEAN UNION

ADDITOOL

European Regional Development Fund

DIAGNOSTIC REPORT OF METALIC ADDITIVE MANUFACTURING (MAM) TECHNOLOGIES IN THE TOOLING SECTOR

www.additool.eu

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1. INTRODUCTION

The ADDITOOL project (www.additool.eu), which is a continuation of the ADDISPACE project (www.addispace.eu), is focus on an important industrial sector: Tooling.

Based on an in-depth analysis of the sector, the consortium will carry out a short, medium and long-term study of Metal Additive Manufacturing (MAM) determining, as accurately as possible, the needs of the tooling industry and taking advantage of the maturity of all available technologies.

This document presents the survey results carried out in GT1- "Identification of needs and definition of application cases" with 2 main objectives:

• Perform a Diagnosis of MAM in the tooling sector

• Carry out an Opportunities study – Analysis of different potential applications in the tooling sector.

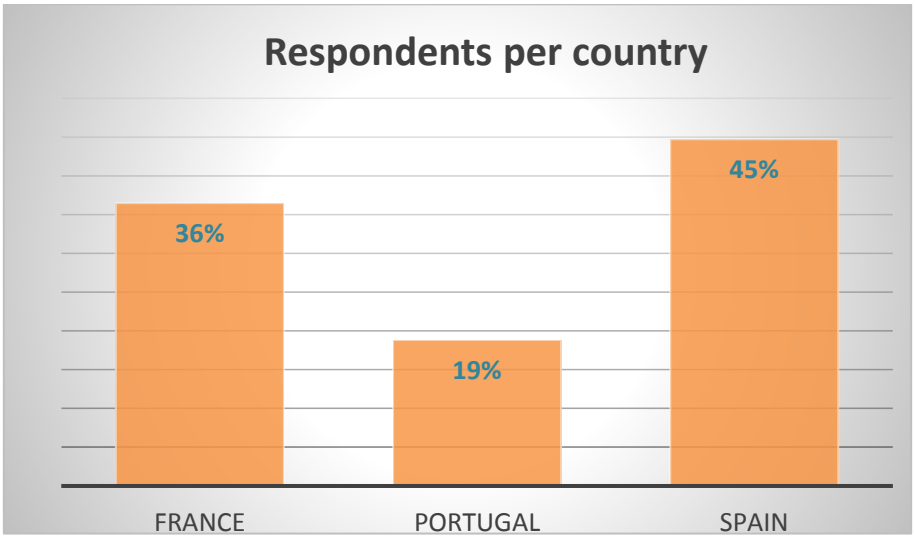
Various strategic sectors such as aeronautics, automotive, rail, oil industry, energy, agribusiness, etc. have been analysed in this survey from the MAM point of view.

2.THE RESPONDENTS

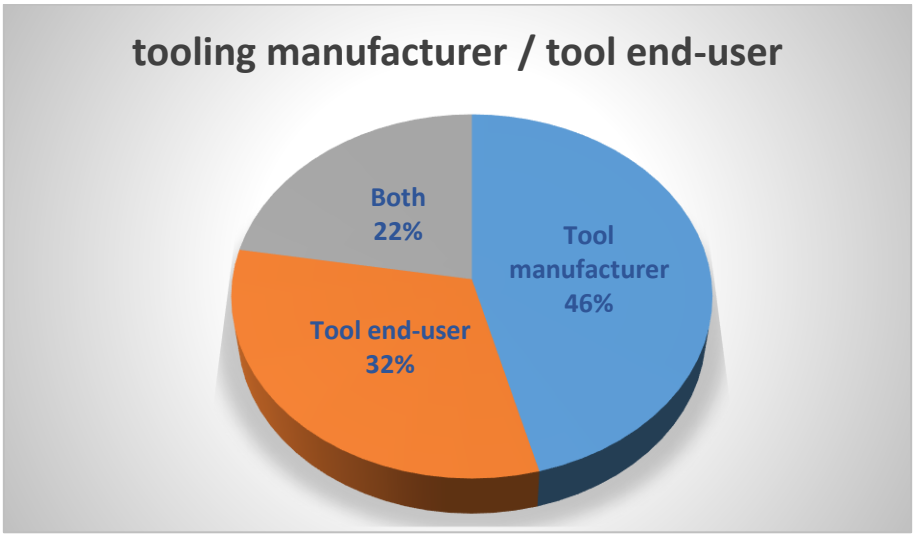
The first part of the survey was aiming at identifying the respondents base by acquiring general information such as the use of the tool (tool provider or tool end user), the activity sector of the company or the most common types of tooling manufactured or used.

Moreover, the respondents have been also been asked about the types of materials, or even the requirements in terms of size, surface finish and dimensional tolerances.

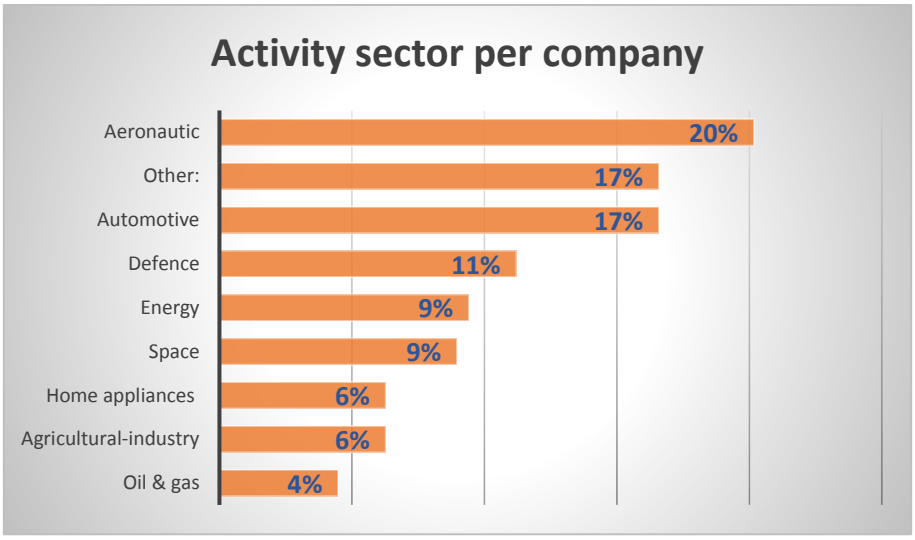
A total of 85 entities from the Tooling sector in the SUDOE region, encompassing Portugal, Spain and France have answered this survey.



The survey is targeting both tooling manufacturer and tooling end user. 46% of the respondents are tooling manufacturer while 32% are tooling end users. Only 22% are both, manufacturer and end users.

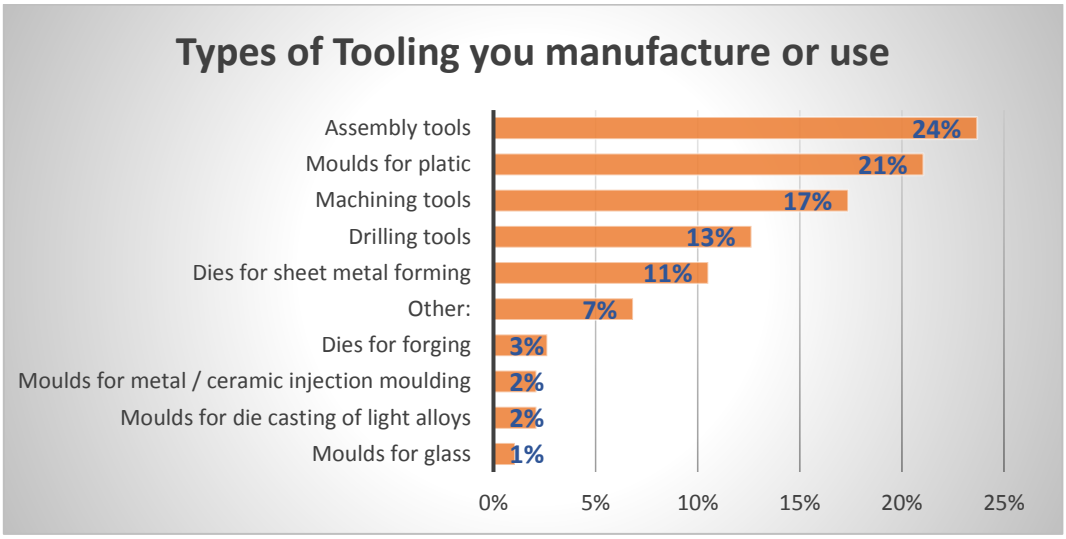


The distribution of entities that have participated in the survey reveals that Aeronautic (20%), Automotive (17%) and Defence (11%) are the sector with greater participation in the survey.



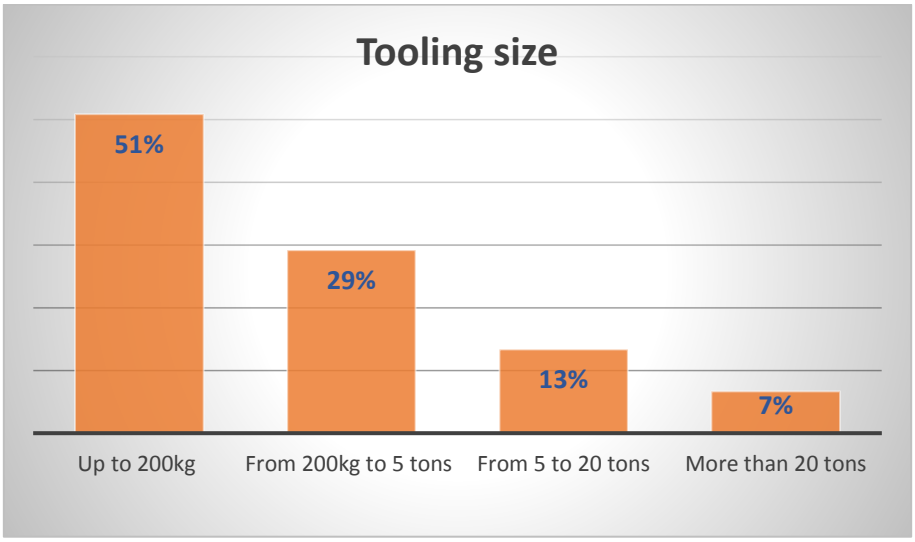
We must also take into consideration the great diversity of sectors not listed above that have also participated (Other: 17%), such as: Medical, naval, Educational, toys, building sector, mining sector, etc.

The most common types of manufactured (provider) or used (end user) tooling according to survey results are assembly, moulds for plastic and machining tools.

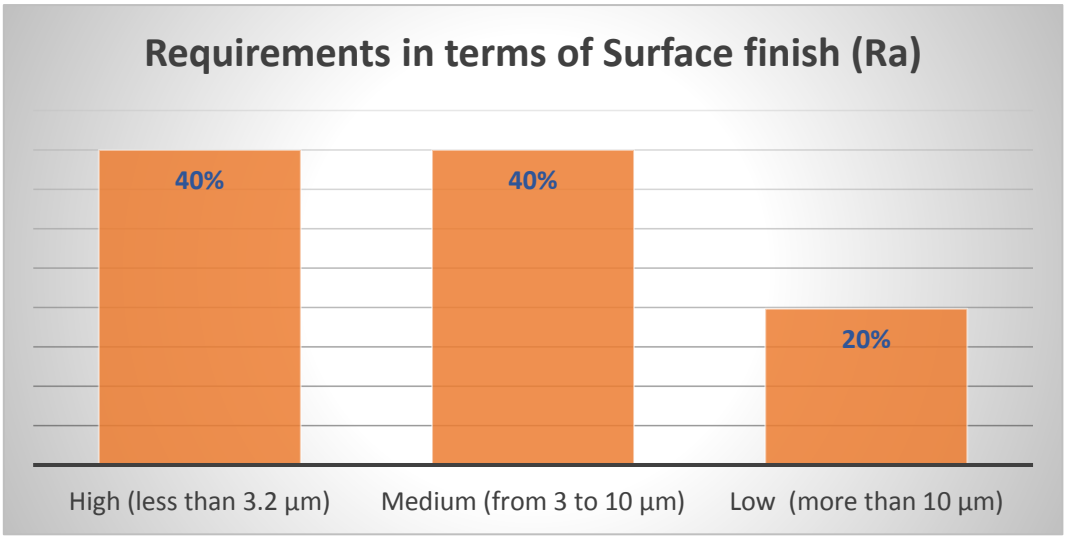


According to the results obtain in this survey, Steel is the most common material used for tooling manufacturing or for final parts (39%). Also, Aluminum alloys and Polymers are popular materials in the tooling sector (26% and 22% respectively).

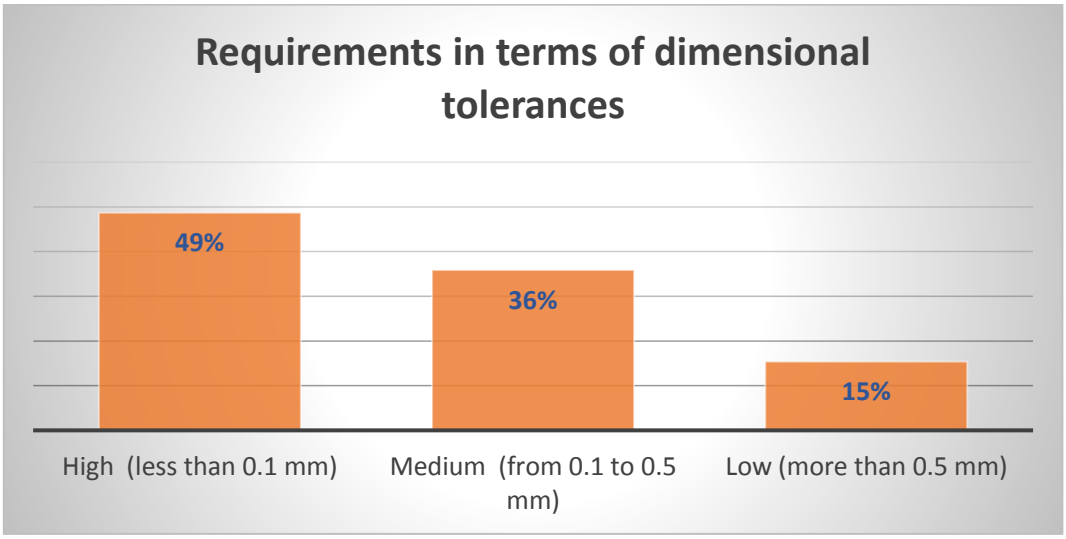
Regarding the tooling size, most of the companies that have answered to this survey manufacture or use medium-small tools. More than a half of the respondents work with tools below 200kg, and 80% use or manufacture tools below 5 tons. Only 7% of the surveyed companies use tools with more than 20 tons.



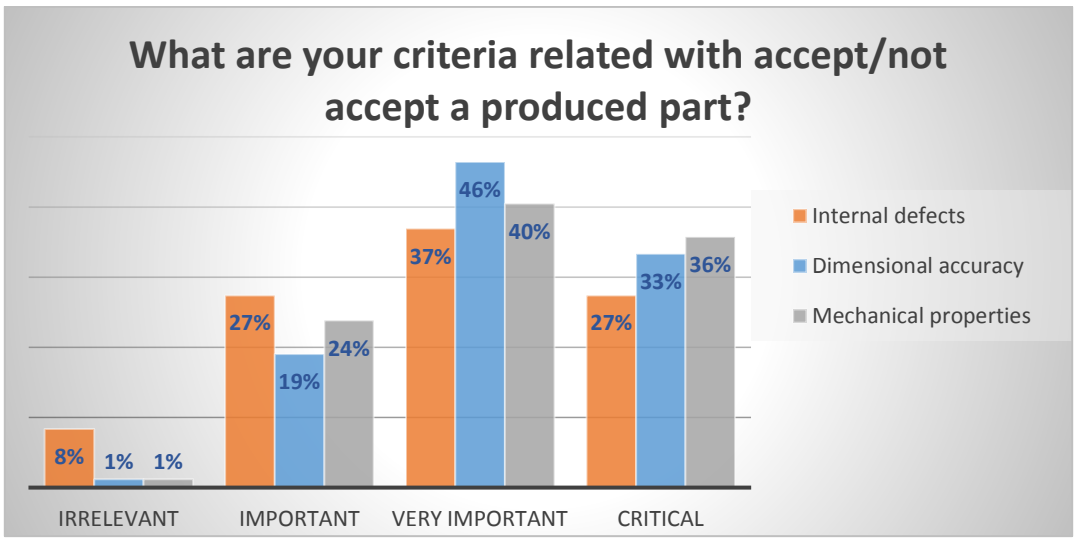
In terms of requirements in surface finish (Ra), 80% of the respondents are interested in acquiring good results (less than 10µm).



More than 80% of the surveyed companies are concerned in acquiring good dimensional tolerances. Only 15% of the respondents do not need dimensional accuracy below 0.5mm.



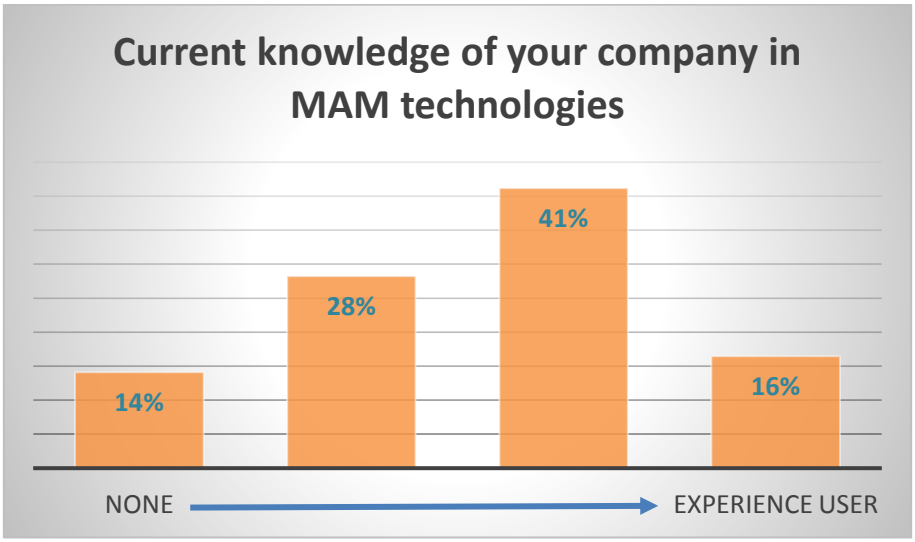
In terms of the criteria related with accept/not accept a produced part, the questionnaire results show only few answers considering Internal defects/Dimensional accuracy/mechanical properties irrelevant. The criteria which has been considered more important (critical) is the mechanical properties, followed by dimensional accuracy and finally, internal defects.



3.USAGE OF MAM TECHNOLOGIES

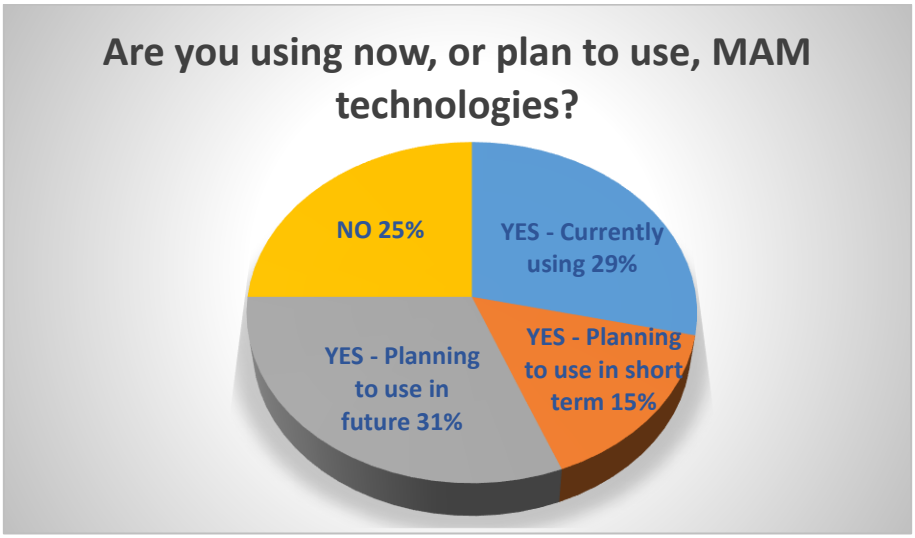
The second part of the survey pretend to collect the information related with the usage that the companies bring about MAM technologies. For this purpose, the respondents have been asked about their current knowledge, plans to use, purpose or source of MAM in each company. Other consideration as investment, benefits or obstacles of MAM in tooling sector have been enquired as well.

In terms of profile base, 86% of the participants in this survey are aware of the features and informed about Metallic Additive Manufacturing, and 57% are on a very good condition to provide proper technical feedback and educated contributions.

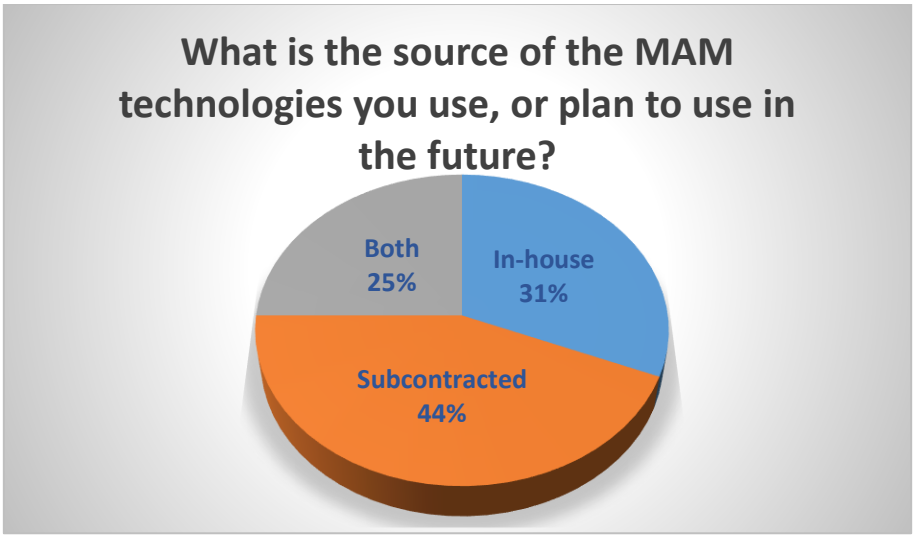


These results show the respondents base is statistically relevant and has a good level of expertise in Metal Additive Manufacturing.

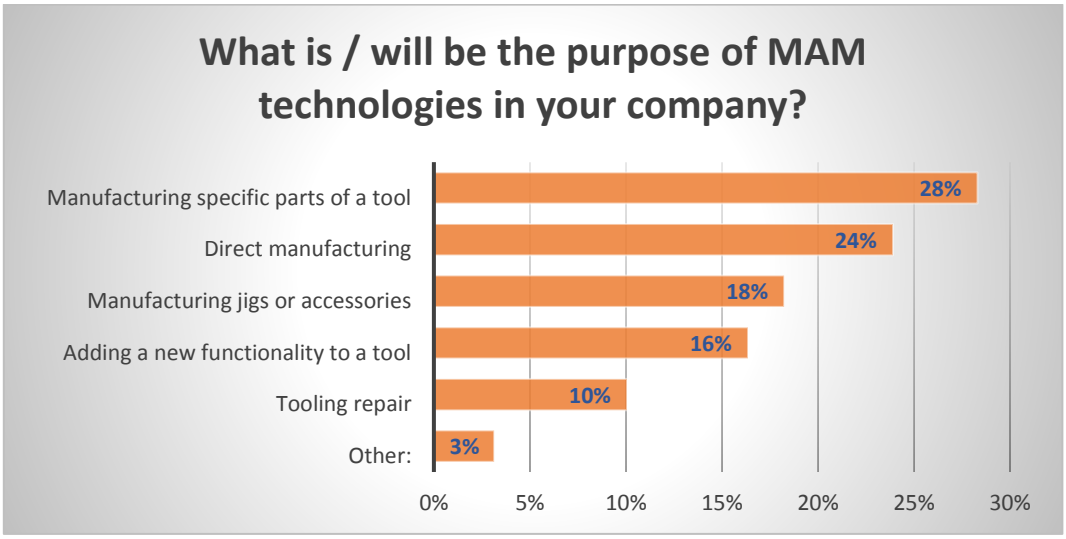
25% of the respondents are not concerned in using MAM technologies, while 46% of the companies included in this study planned to use it in the future.



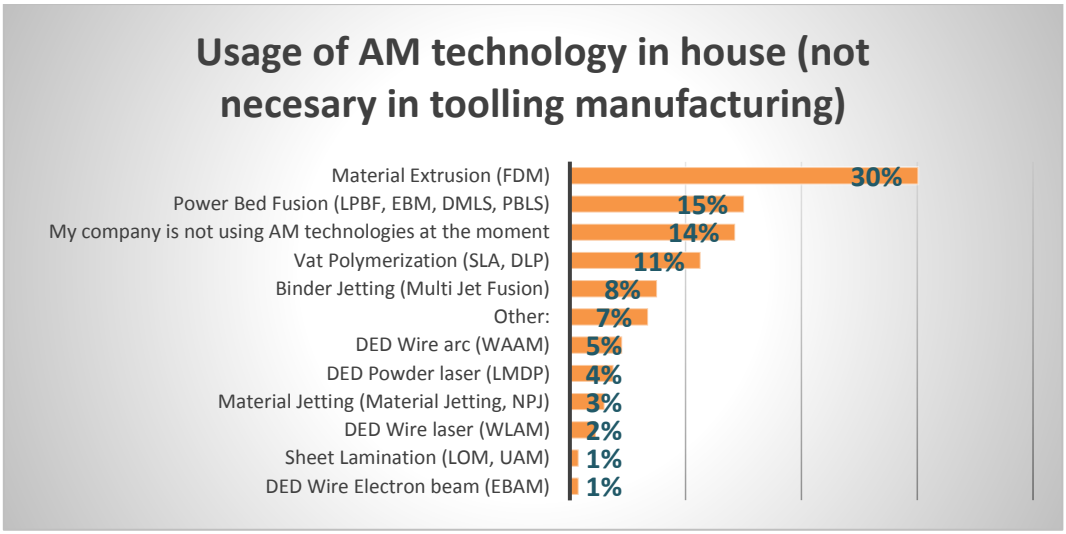
According to the questionnaire results related with the source of MAM technologies, the surveyed companies are more interested in Manufacturing Service (44%) than in acquiring MAM technologies (31%).



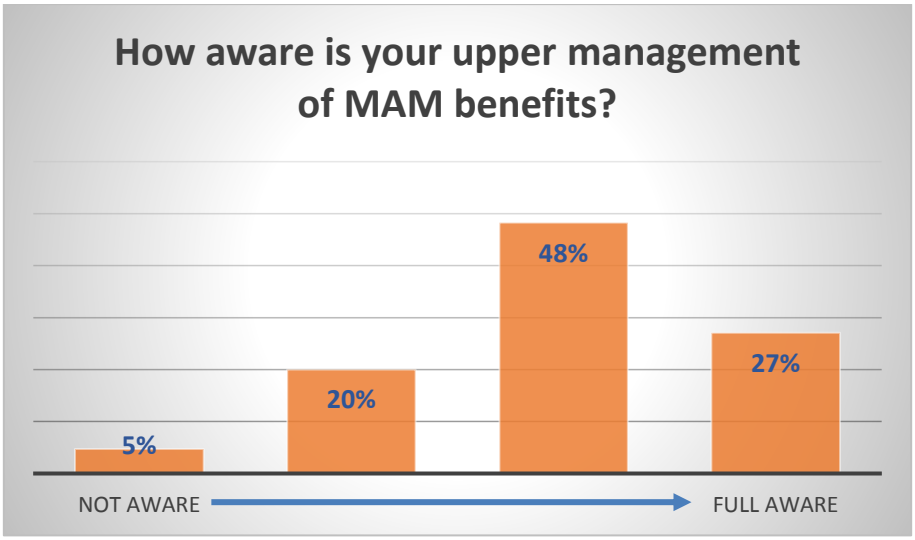
The outcome of the survey shows more interest in manufacturing a specific part of a tool or a part itself rather than in using MAM technologies to repair or to add new functionality to a tool.



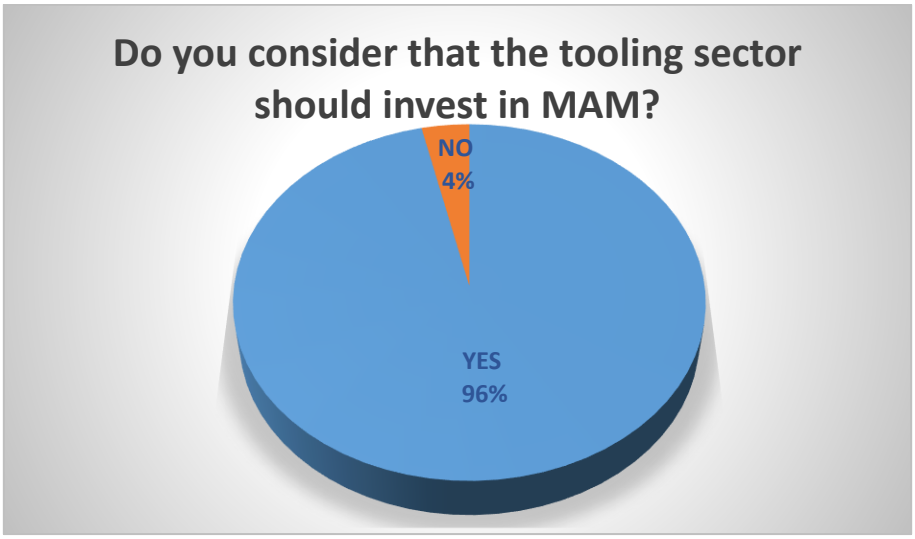
The companies have also been asked about the AM technologies used in house (not necessary in tooling manufacturing). As this question is not exclusive of Metal Additive Manufacturing, the survey outcome shows a wide quantity of companies already using Material Extrusion (FDM) mainly used with polymers or plastics. Regarding MAM, the technology identified as the most used by the respondents is Powder Bed fusion. On the other hand, 15% of the companies included in this study are not using AM technologies at the moment.



According to the outcome of the survey the internal awareness of the respondents and their Upper Management is higher than 75%, which sets the ground for educated decisions on future MAM investments.

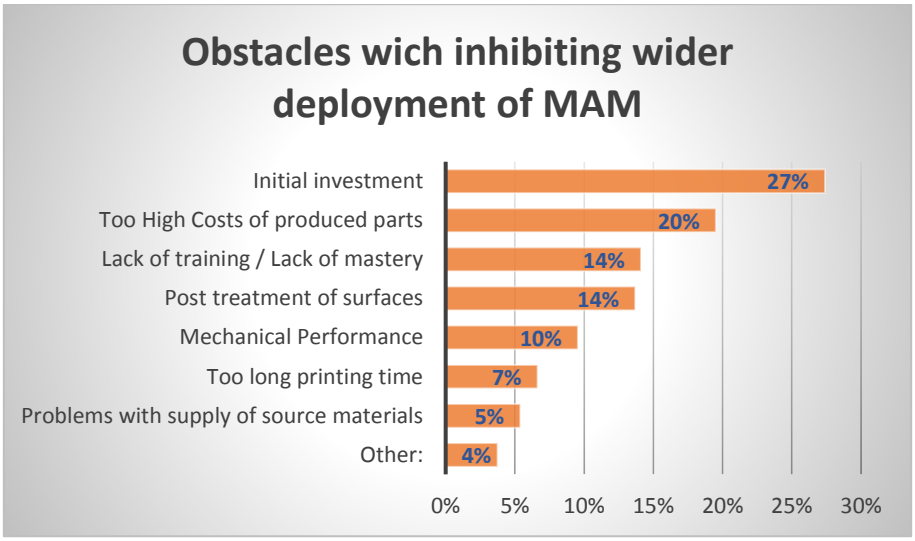


Regarding if the tooling sector should invest in MAM, the bulk 96% of the respondent's base gave a strongly positive answer showing the relevance of this study.

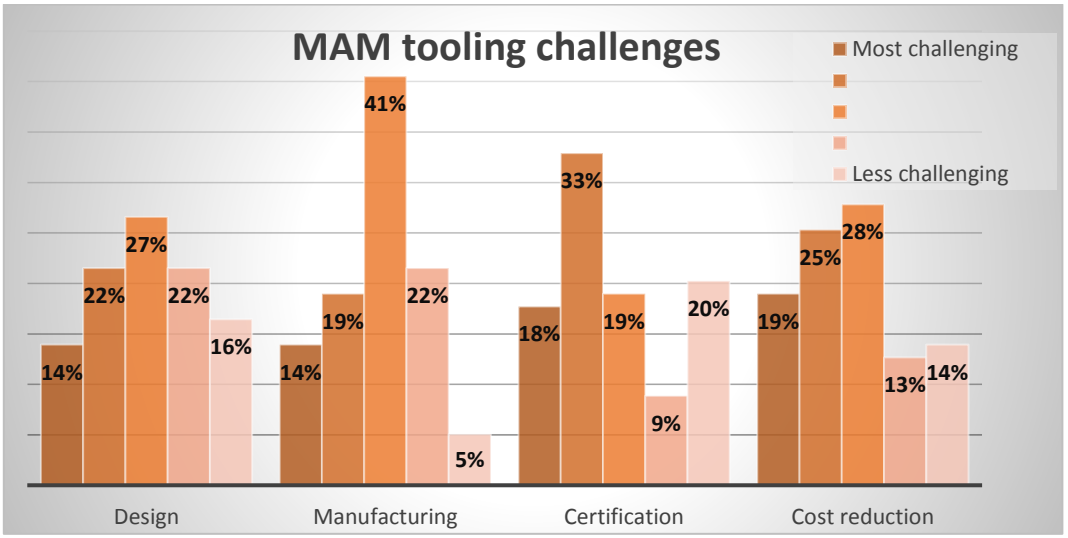


The respondents have also identified the main obstacles inhibiting a wider deployment of MAM to the Tooling sector. Although previous chart shows the desire of the

respondents in investing in MAM, the outcome of the next study present the initial investment (27%) as the first obstacle, followed by the costs of produced parts (20%).

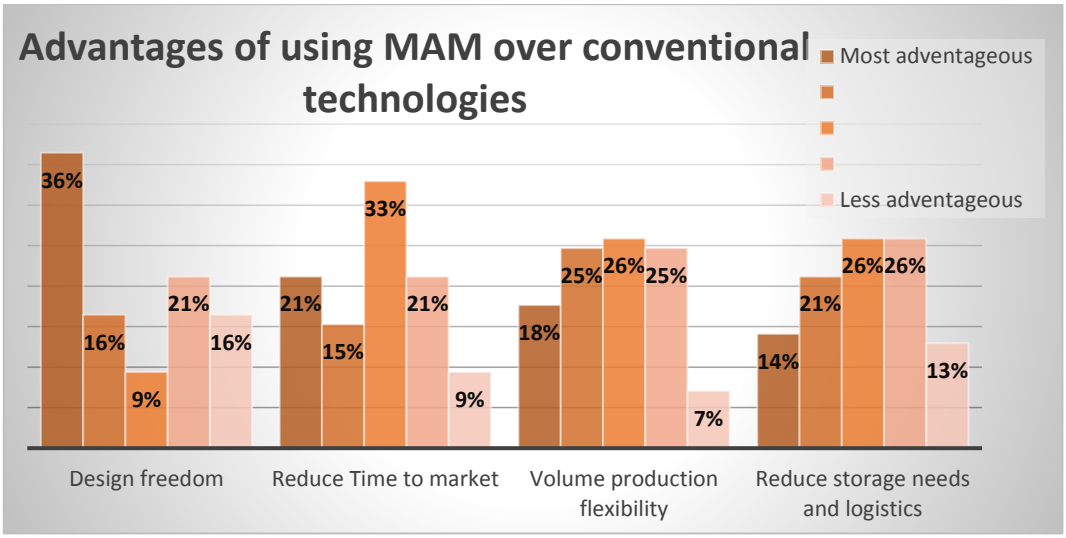


The survey also includes a question about MAM tooling challenges at present. Although there are no great differences between the 4 options, the respondents have considered certification and cost reduction more challenging than design or Manufacturing.

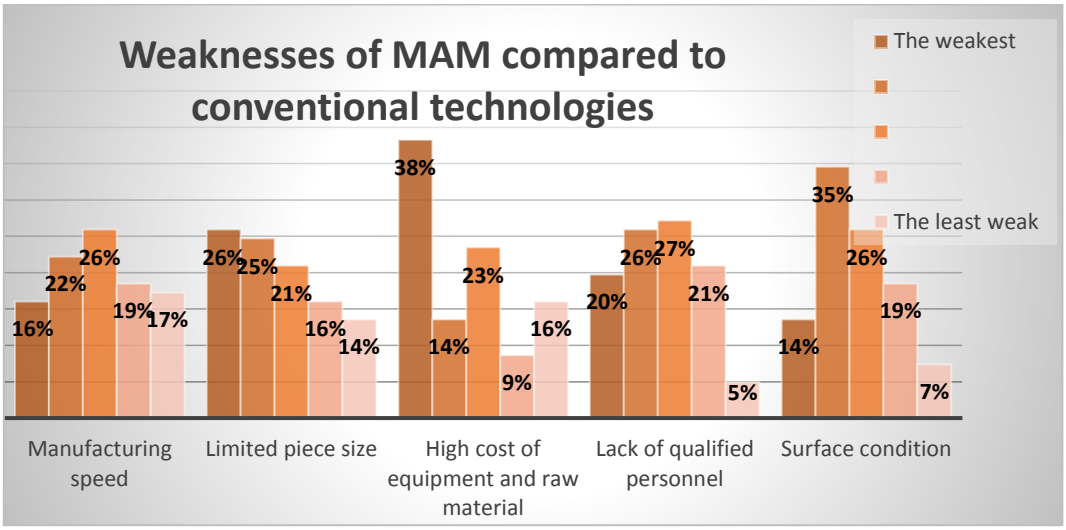


The search for the reasons why MAM is so appealing led to the question on advantages over conventional subtractive technologies. The respondents have selected between

four advantages. The freedom in design (52%) has been selected as the most advantageous and storage and logistic reduction as the less advantageous.



The question about the weakness of using MAM compare with conventional techniques includes 5 different options. The respondents have selected the high cost of equipment and raw material as the weakest (52%) and the Manufacturing speed as the least weak (36%).

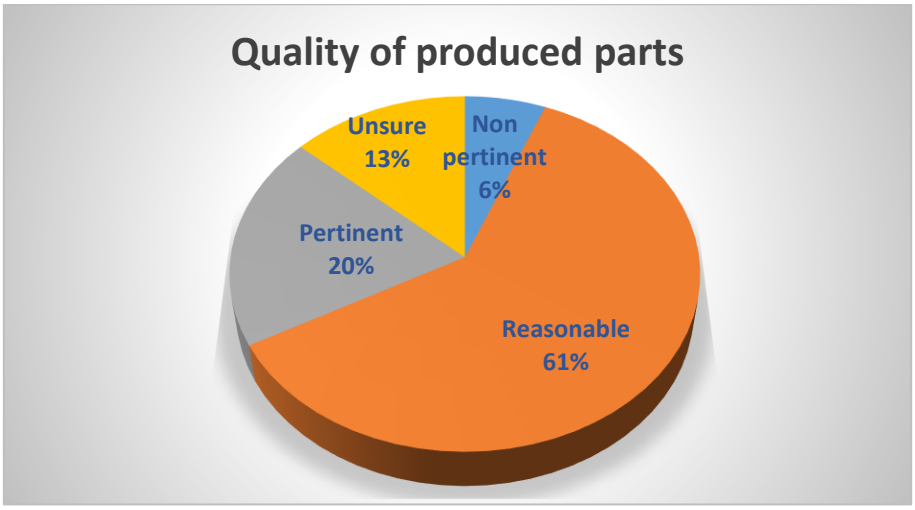


4.WORTHINESS OF MAM TECHNOLOGIES

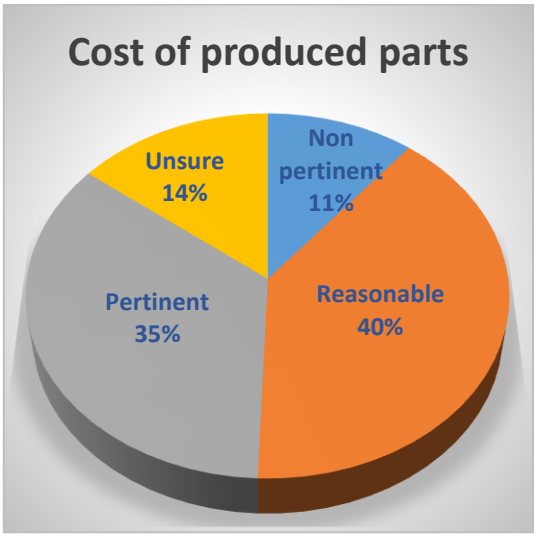
Regarding worthiness of MAM technologies, the respondents have been asked as well to evaluate if the cost are reasonable in relation with the inspection and quality of the produced parts.

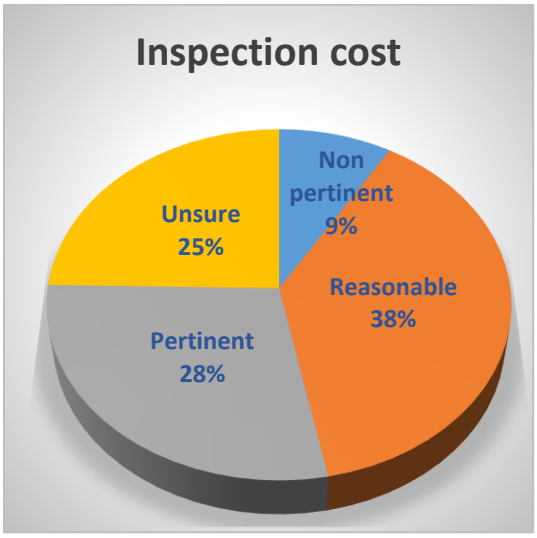
On the other hand, it is widely accepted that alternative processes such as Metallic Additive Manufacturing requires every part produced to be screened and tested. In this context, the survey also includes a question related with most suitable inspection techniques to be applied.

A wide quantity of the respondents (81%) consider pertinent-reasonable the quality of the parts produced by MAM technologies.

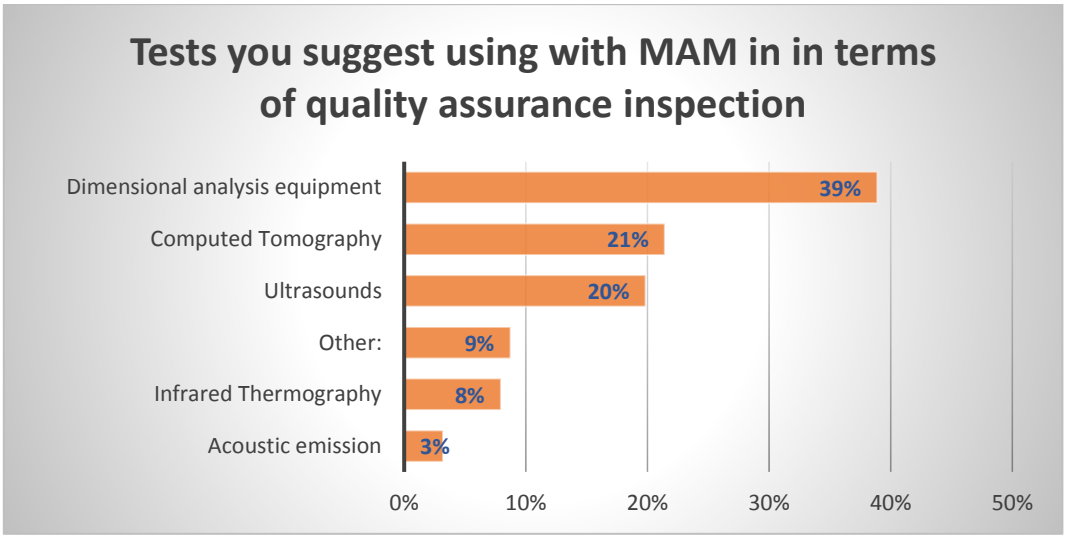


Although cost of the produced parts have been detected as one of main obstacles inhibiting a wider deployment of MAM to the Tooling sector, it has been considered by the respondents that this cost together with the inspection costs are pertinent-reasonable (66%-75%).





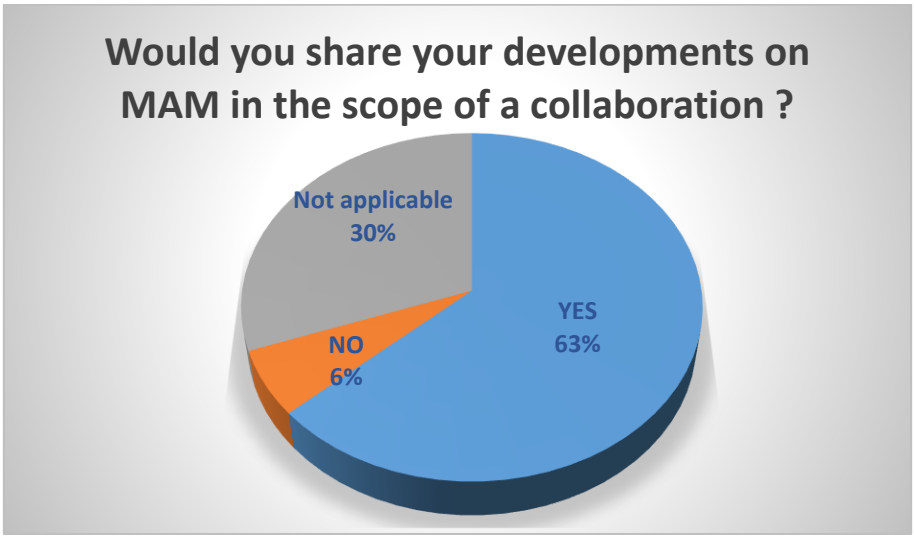
The respondents were also asked to identify the non-destructive tests they suggest for MAM. The result shows Dimensional Analysis, Computed Tomography and ultrasound are clearly preferred over thermography and acoustic emission. Other techniques suggested by the respondents and not listed are: Functional tests, process monitoring, magnetic particles inspection, penetrant testing, etc.



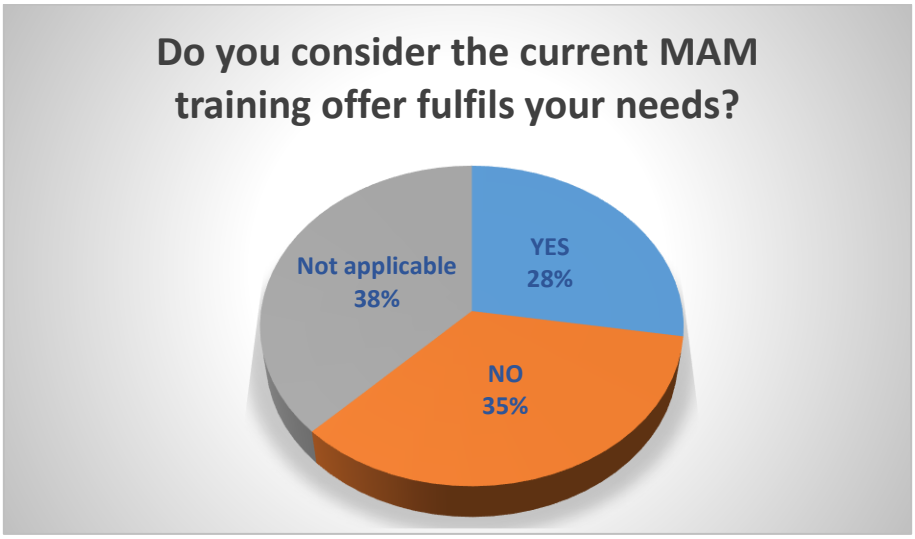
5.TECHNOLOGICAL TRANSFER & TRAINING

Technological transfer, training and hiring staff are important for MAM development, therefore the inquiry should also be focused on Human Resources (HR) related issues.

A very interesting outcome is the 63% willingness of the respondents to share data and developments. Only 6% answer “No” to this question. Other outcome extracted from this chart is that 30% of the respondent’s answers “not applicable” probably because it depends on the confidentiality of the development or they still do not use MAM technologies.

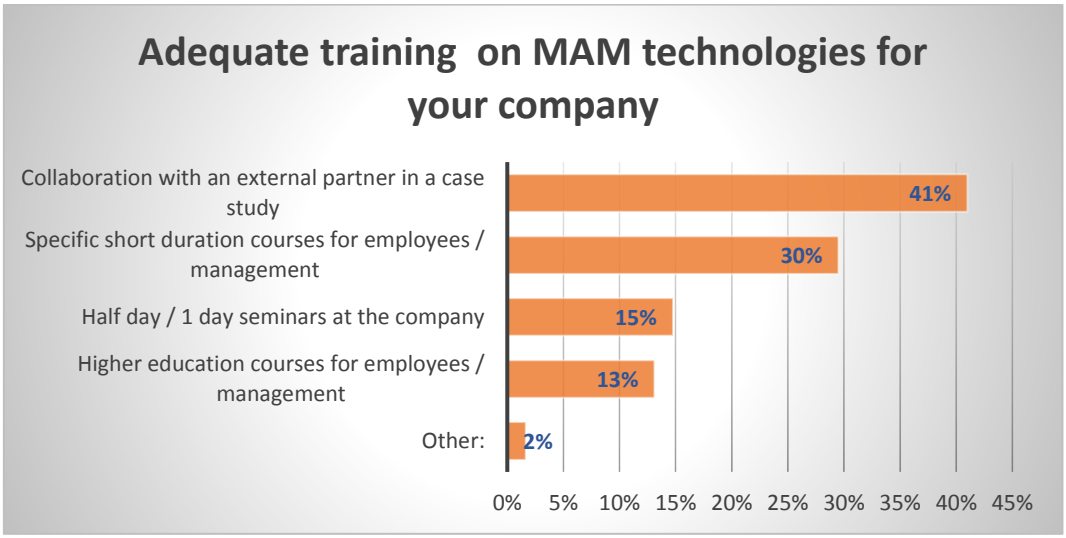


The answer to the question on available training offer has received divided answers from the respondents with a slight negative answer (35%) against positive (28%). An interesting outcome is that 38% has answered “not applicable”, which probably means the lack of knowledge from the respondents related with the MAM training offer at the moment.



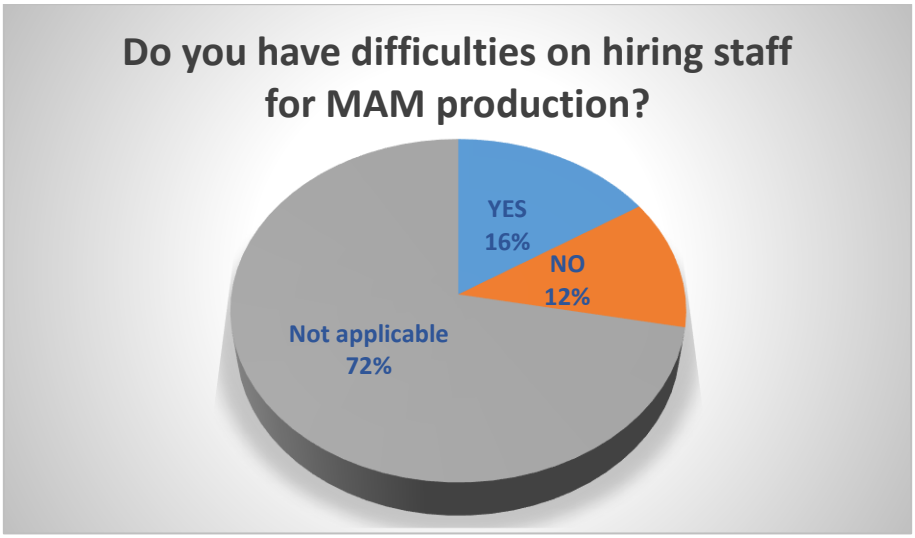
The respondents have also been asked to select the adequate training on MAM for their companies. Collaboration with an external partner in a case study has been considered as the most suitable (41%).

Regarding training or courses, specific short duration courses to employees (30%) has been considered more adequate than seminars or long-term training.

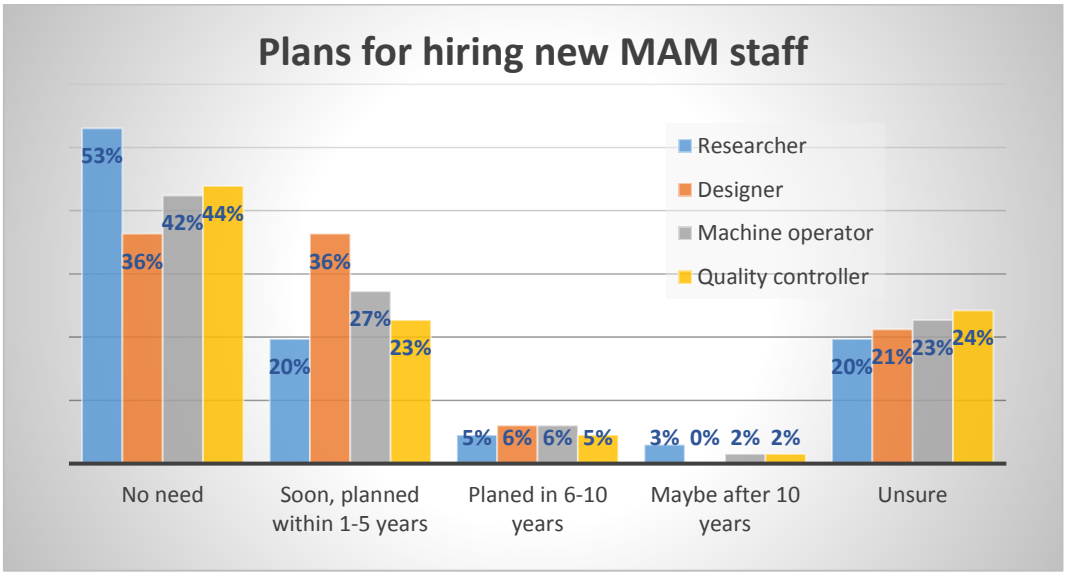


In terms of surprising results, the question “How difficult it is to hire staff for MAM production?” received from the respondents a wide number of “not applicable” answers

(72%). This result could be explained if a large majority of respondents are not currently in need of hiring staff.



As it can be observed in the chart below, most of the surveyed companies do not have plans for hiring MAM staff (or do not know-Unsure). If we take into account the results in terms of hiring, the survey results indicate that designer is the most demanded profile in this sector.



6.CONCLUSIONS

Some conclusions about the survey results are presented below and may be used as baseline for the study of opportunities for Metal Additive Manufacturing technologies in the tooling sector.

Participants/Entities

A total of 85 responses was obtained encompassing Portugal, France and Spain from the ADDITOOL survey. Greater participation in the survey have been found in sector such as Aeronautic, Automotive and Defence. More than a half of the respondents are on a very good condition to provide proper technical feedback and educated contributions.

It has been observed more interest in outsourcing manufacturing service than acquiring equipment. Also, more interest in manufacturing a specific part rather than to repair or to add new functionality to a tool.

Technologies/Applications

The most common types of manufactured (provider) or used (end user) tooling according to survey results are assembly, moulds for plastic, and machining tools.

Steel has been selected as the most common material. Most of the participants use or manufacture tools below 5 tons, surface finish below 10µm and dimensional accuracy below 0.5mm.

In terms of acceptance criteria, mechanical properties have been selected as the most critical factor to accept/ not accept a part.

In relation with Additive Manufacturing Technologies, Material extrusion and Powder Bed fusion are presented as the most used technologies.

Advantages/Obstacles/ Challenges

Regarding MAM tooling challenges, certification and cost reduction have been considered more challenging than design or manufacturing. On the other hand, freedom in design has been selected as the biggest advantage of using MAM over conventional technologies.

Again, compare with conventional technologies, high cost of equipment and raw material have been chosen as the weakest factor of using MAM.

In terms of obstacles which inhibit wider deployment of MAM, initial investment has been selected as the first obstacle, followed by the costs of produced parts.

Hiring/ Training

In terms of developing knowledge, collaboration with an external partner has been considered as the most adequate training for developing skills followed by specific short duration courses.

Most of the surveyed companies do not have plans for hiring MAM staff (or do not know).

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