SECTOR SKILLS STRATEGY
IN ADDITIVE MANUFACTURING

SKILLS STRATEGY ROADMAP 2021

SHORT - VERSION

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

PROJECT NO. 601217-EPP-1-2018-1-BE-EPPKA2-SSA-B

WWW.SKILLS4AM.EU

THE SAM PROJECT

Advanced Manufacturing is one of the key enabling industries for sustainable economic growth, being Additive Manufacturing (**AM**), more commonly known as 3D printing, widely used in a wide range of Manufacturing processes or technologies applications.

As Europe seeks to retain its leading position in industrial competitiveness, there is an urgent need to establish a platform for AM skills at European, National and Regional levels. To meet this challenge the project Sector Skills Strategy in Additive Manufacturing (SAM) started in January 2019 and will run for 4 Years.

SAM'S MAIN OBJECTIVES ARE:

A Skills Strategy in Additive Manufacturing providing solutions capable to foster and support the growth, the innovation and competitiveness of the AM sector;

A methodology for a sustainable and continuous assessment of current and future skills needs in AM through the establishment of the Observatory in Additive Manufacturing;

Design, review and deployment of relevant qualifications in the AM sector, built with a learning outcomes approach and linked with EU Frameworks and Tools such as the EQF, e-CF, EntreComp, ECVET and ECTS;

Promotion of the attractiveness of the AM sector as a career choice for primary, general education, Vocational Education and Training (VET) and university's students through a awareness campaign in the field of AM;

One online Qualifications Catalogue to continuously update and enlarge the European AM Qualification System, integrating all the developed and to be developed sectoral qualifications.

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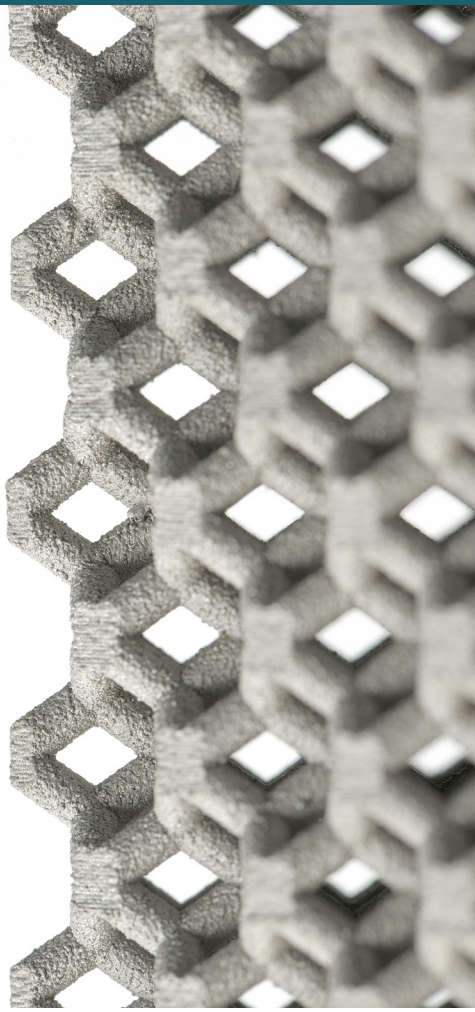
CONTENT



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SAM

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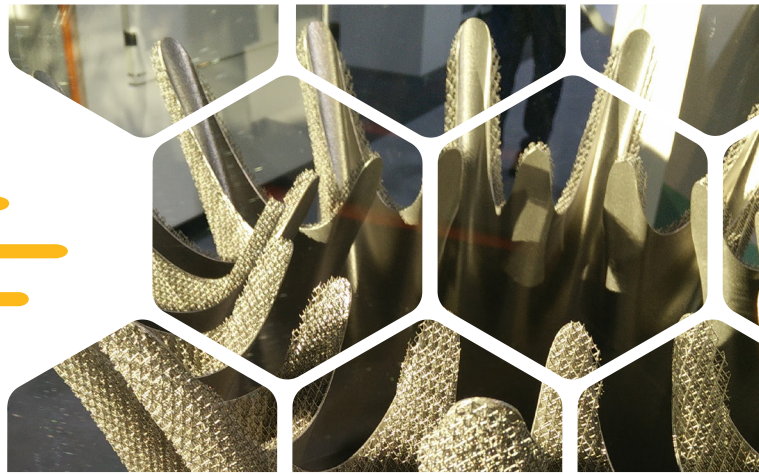

INTRODUCTION

Welcome to the
Skills Strategy Roadmap.

This Roadmap is providing the overall guidance for implementing SAM's strategy until 2030, outlining how the project intends to address the evolving sector needs and challenges towards AM skills development.

Two versions of the Roadmap will be published in different periods, namely, in 2020 and 2022, in order to reflect the dynamic features of the sector and increasing speed in which AM technologies are evolving.

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This Skills Strategy Roadmap includes:

- Key Challenges facing the AM Sector ("Gap Drives")

- Input of Strategic Objectives and outline of the proposed supporting actions and implementation activities put forward by SAM and beyond

- Proposed Timeline – Referencing the specific Implementation Actions and their relation to SAM tasks and deliverables.

- Mind map of the AM Skills Roadmap representing the required Professional Profiles, Qualifications and Skills linked with the AM value -chain, materials and processes.

- Summary conclusion about the Strategy

This is a short version of the Roadmap, the full Skills Strategy Roadmap is available online: **www.skills4am.eu**

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HOW DOES IT WORK?

1. Strengthen the collaboration between industry and training organisations

About this challenge:

- AM sector growth and development happens more quickly than the adaptation of the educational system (learning pace);
- Companies are increasingly demanding talented professionals that can work with and optimise the whole AM process and part production;
- Existing courses on design, engineering and management related to advanced or digital manufacturing do not systematically deliver the necessary skills and knowledge for an effective deployment.

Strategic Objective	1: Straighten the collaboration between industry and training organisations	Short term scenario	Foresight term scenario	
		2021	2022	2030
IMPLEMENTING ACTIONS	A1.1 Identify and anticipate skills needs in the AM sector	S4AM		
	A1.2: Engage industry in the identification of skills and validation of training programmes	S4AM		
	A1.3: Create an open platform for industries to provide their inputs on skills and qualifications for AM	S4AM		
	A1.4: Define a joint skills strategy with the main industrial partners	S4AM		
	A1.5 Implementation of Mainstreaming Steering Committees	S4AM		

Figure 1 -Timeline for the Implementation of Actions to Strengthen the Collaboration between Industry and Education

GAP DRIVER:

1

Mismatch between industry needs and educational / training offer

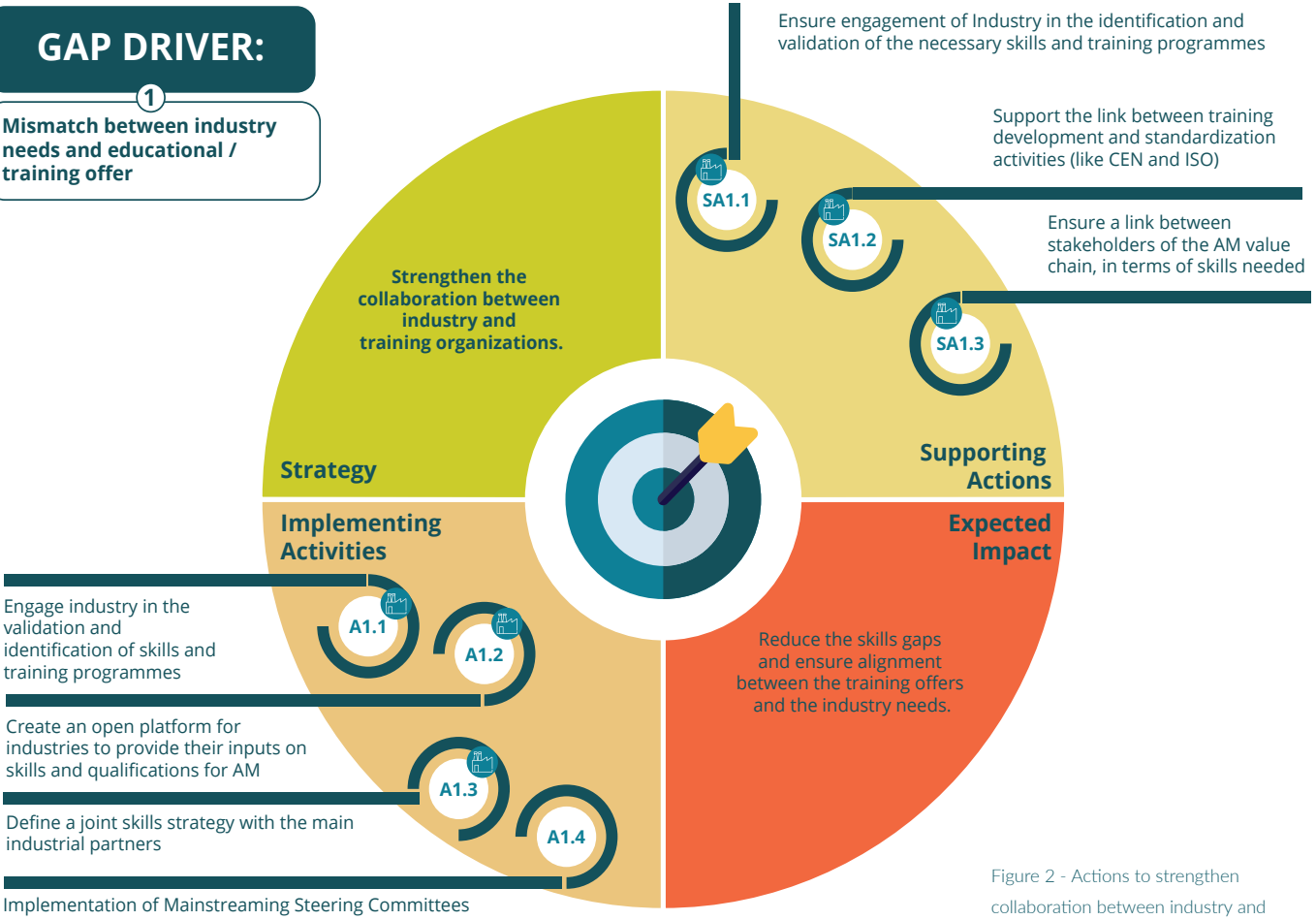

Figure 2 - Actions to strengthen collaboration between industry and training organisations

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2. Tackle the lack of AM personnel at the European level

About this challenge:

- The growing use of AM technology in industry is increasing the demand for AM workers, but the offer doesn't match the existing need, thus generating high competition for skilled AM workforce.

- Absence of concerted actions in terms of possible synergies between institutions to overcome the lack of equipment in training institutions;

- Lack of data regarding the number of job offers and current positions in AM, which creates increasing difficulties in providing a targeted/matching training offer and may cause an unbalance between training offers and the needs of the market.

Strategic Objective	2: Tackle the lack of AM personnel at the European Level	Short term scenario	Foresight term scenario	
		2021	2022	2030
IMPLEMENTING ACTIONS	A2.1: Implement the International AM Qualification System	S4AM		IAMOS
	A2.2: Funding for the preparation of training centres	S4AM		
	A2.3: Create an open platform for AM training providers to provide information on skills and qualifications for AM they can offer	S4AM		
	A2.4: Promote International Qualifications in AM, through national events and through supporting activities focused on training centres (both VET and HE)	S4AM		
	A2.5: Establish mutual recognition protocols between training providers	S4AM		
	A2.6: Share data on AM Workforce Employability	S4AM		

Figure 3 - Timeline for Implemention of Actions to Tackle the Lack of AM Personnel

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GAP DRIVER:

2

Competition for skilled AM workers and lack of knowledge of AM from existing workers/students

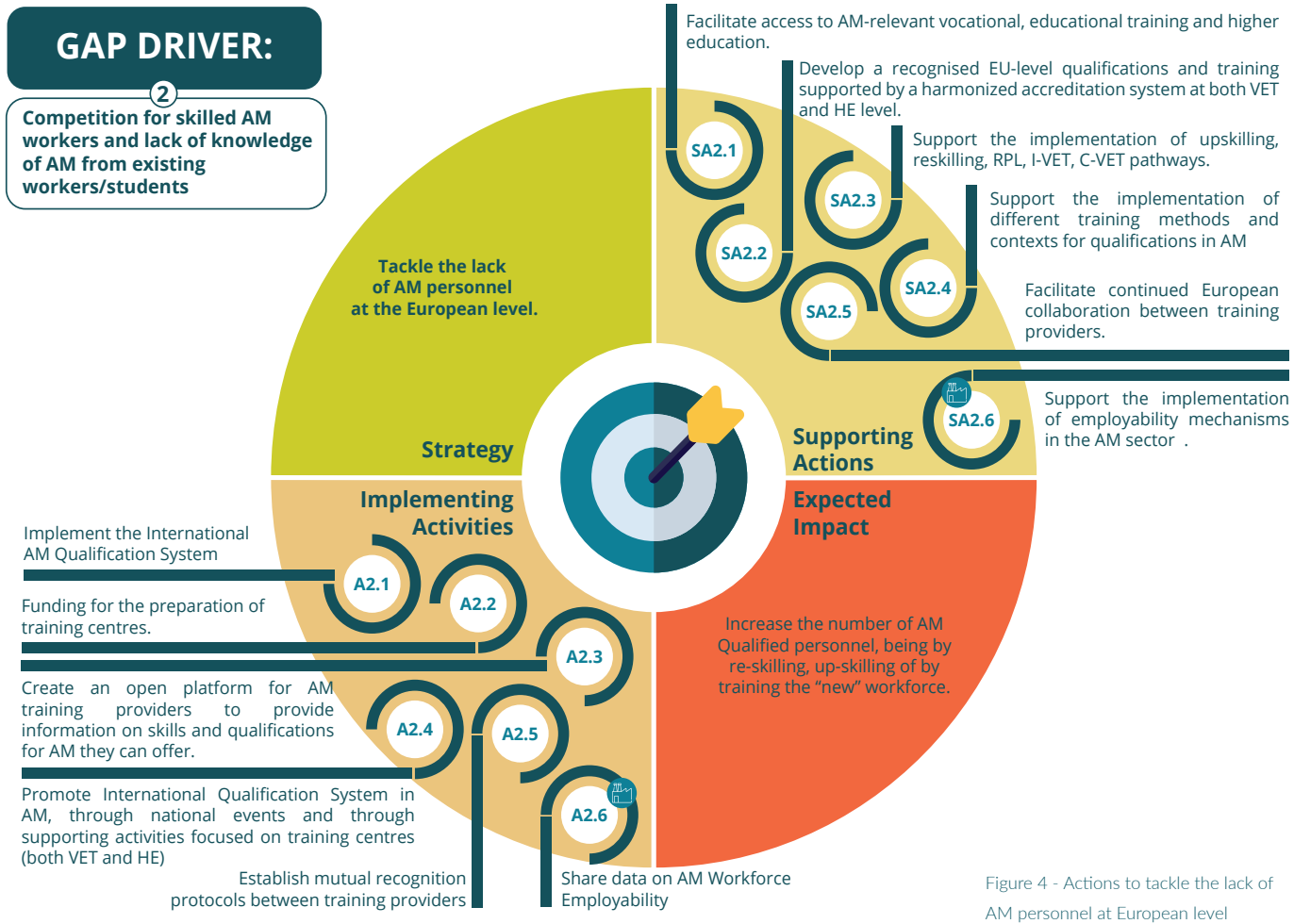

Figure 4 - Actions to tackle the lack of AM personnel at European level

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3. Prepare European, National and Regional organisations to tackle the challenges of AM, in terms of Qualified personnel

About this challenge:

- AM educational provision focus on higher qualification levels (e.g. EQF levels 6 to 8), with very few training offers at vocational level for EQF levels 4 and 5;

- The lack of training facilities with ready access to AM equipment is hampering the provision of education and up-skilling;

- The lack of competence and knowledge of the training staff also influences why training centres cannot provide training.

Strategic Objective	3: Prepare European, National and Regional organizations to tackle the challenges of AM, in terms of Qualified personnel	Short term scenario	Foresight term scenario	
		2021	2022	2030
IMPLEMENTING ACTIONS	A3.1: Engage industry, academia, training organizations and authorities in projects for collaborative implementation of AM training, supported by a Quality Assurance System	S4AM		IAMOS
	A3.2: Create a Network of AM Training providers (National and Transnational)	S4AM		IAMOS
	A3.3: Funding for the "upskilling" of training centres with a focus in AM	S4AM		
	SA3.4: Support the development and implementation of Harmonized trans-national curricula	S4AM		IAMOS
	SA3.5: Define training programmes for trainers (VET teachers,...)	S4AM		

Figure 5 -Timeline for the Implementation of the Actions to Prepare Organisations to tackle AM Challenges

GAP DRIVER:

3

Shortage of training centres, specially at VET level, capable of delivering AM training.

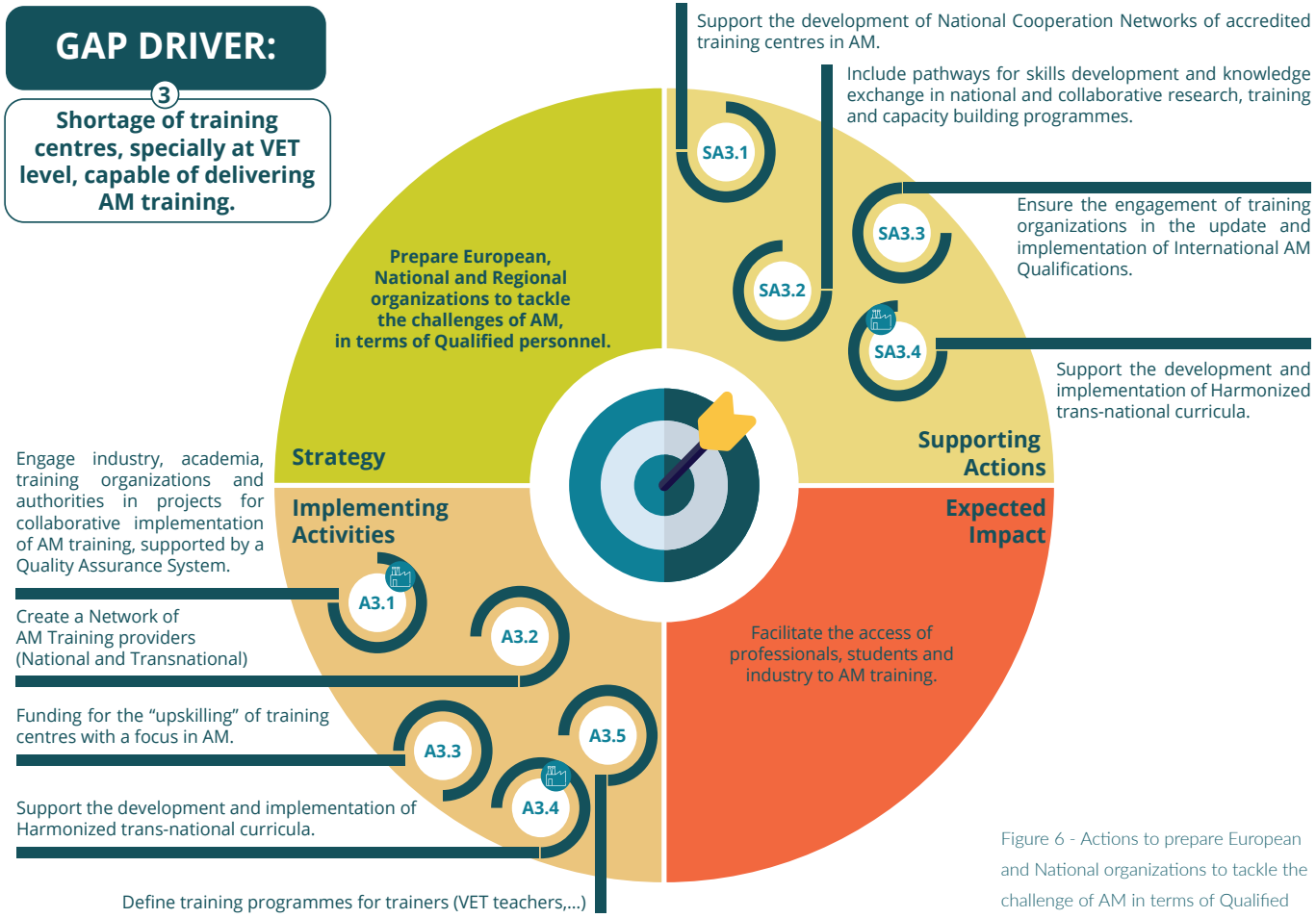

Figure 6 - Actions to prepare European and National organizations to tackle the challenge of AM in terms of Qualified Personnel

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4. Tackle the diversity of sectors and applications of AM

About this challenge:

- There is a lack of a harmonised approaches for training involving different sector stakeholders to address the skills development programmes focused on sector-specific needs in AM;

- There are not enough skilled professionals available to meet the demands, and especially to operate across sectors

- There is a lack of combined approaches involving stakeholders from different sectors including standardisation bodies, educational and industrial councils to develop relevant qualifications to educate the diverse workforce of AM professionals to meet sector-specific requirements.

Strategic Objective	4: Tackle the diversity of sectors and applications of AM	Short term scenario	Foresight term scenario	
		2021	2022	2030
IMPLEMENTING ACTIONS	A4.1: Engage with different sectoral organizations to allow a sectoral view on skills and qualifications for AM (sectors like Aerospace, Medical, Automotive, Maritime, etc)	S4AM		
	A4.2: Use a modular approach in the development of the training with some sector/process specific modules	S4AM		IAMGS
	A4.3: Identify common requirements between the different sectors	S4AM		
	A4.4: Implement International Qualifications that are recognised by different sectors supported by a Quality Assurance System	S4AM		
	A4.5: Organise events and disseminate the International AM Qualifications to different industrial sectors	S4AM		

Figure 7 - Timeline for the Implementation of the Actions to Tackle the diversity of AM Sectors and Applications

GAP DRIVER:

4

Sector and process specific requirements for AM, that are also reflected on the qualifications of professionals

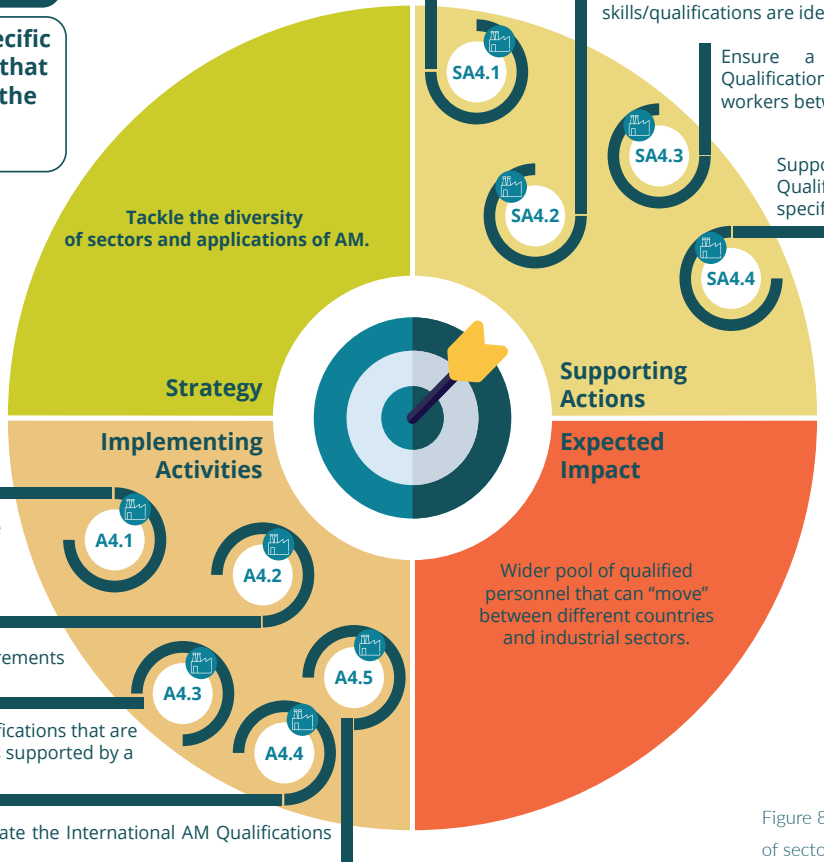

Figure 8 - Actions to tackle the diversity of sectors and applications of AM

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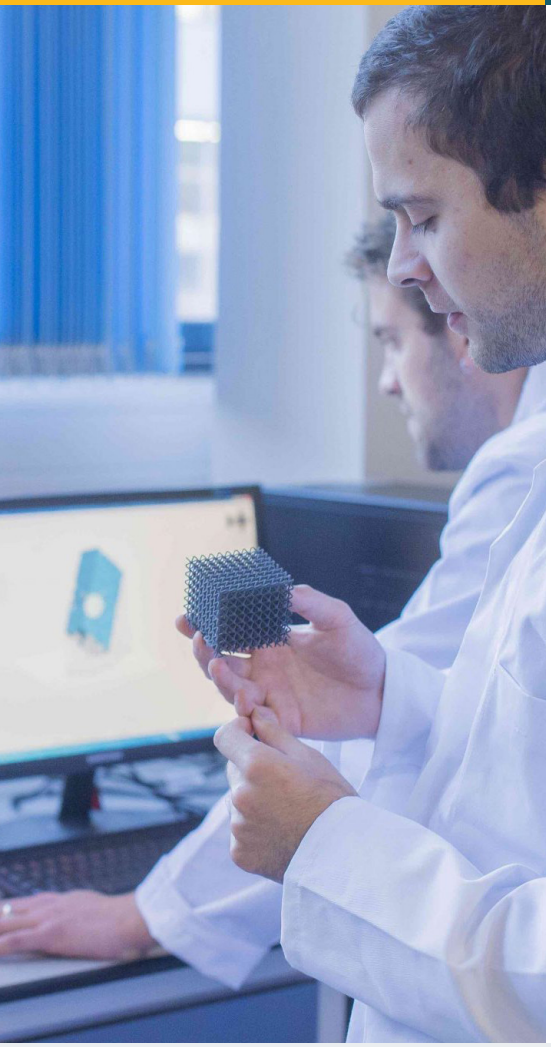

5. Constant update of the AM European workforce

About this challenge:

- There is a sharp rise of new processes or the evolvement of “old” processes, also the quick adaptation of needs in terms of automated post-processing technologies

- New topics will enter the market such as cybersecurity, multi-materials, machine learning and printed electronics.

- The continuous watching of the market while using a strategic approach to cover the most important trend is required.

Strategic Objective	5: Constant update of the AM European workforce	Short term scenario	Foresight term scenario	
		2021	2022	2030
IMPLEMENTING ACTIONS	A5.1: Develop and promote skills mapping mechanisms and anticipation tools	S4AM		
	A5.2: Develop and update, in a continuous way, modules related to new advances in AM	S4AM		
	A5.3: Carry out market searches, with a focus on Research Organizations, to identify new trends in AM	S4AM		
	A5.4: Development of knowledge and skills in AM to keep up with the fast-evolving technology	S4AM		

Figure 9 - Timeline for the Implementation of the Actions to Continuously Update the AM European Workforce

GAP DRIVER:

5

Fast evolving technology and industry

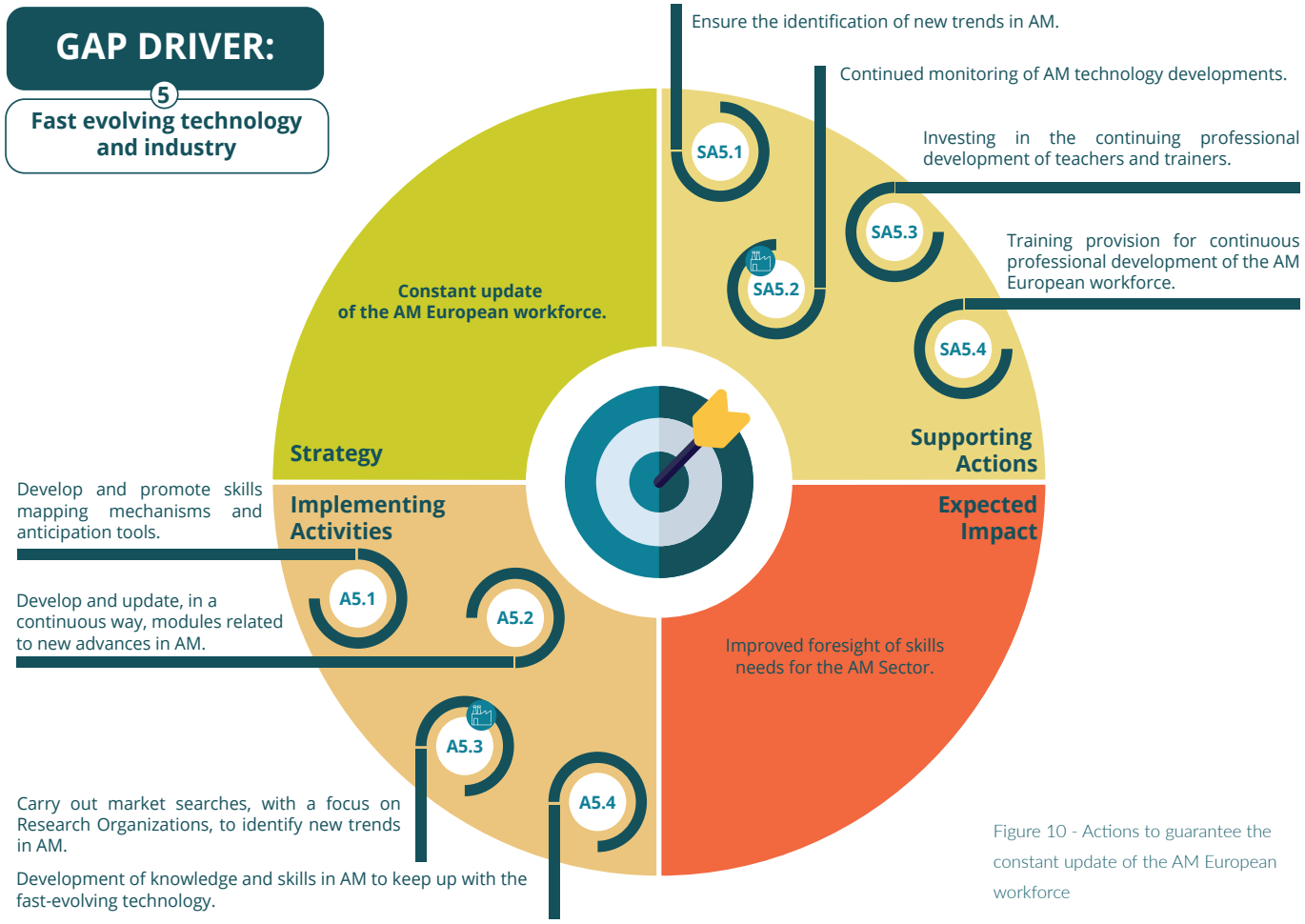

Figure 10 - Actions to guarantee the constant update of the AM European workforce

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6. Prepare the AM Future Workforce

About this challenge:

Combined factors are at the origin of the lack of AM awareness, such as the fast development of the technology, absence of a role-model industry in the sector able to create visibility and interest towards the technology, together with the lack of substantial promotion of AM courses in academia or professional trainings.

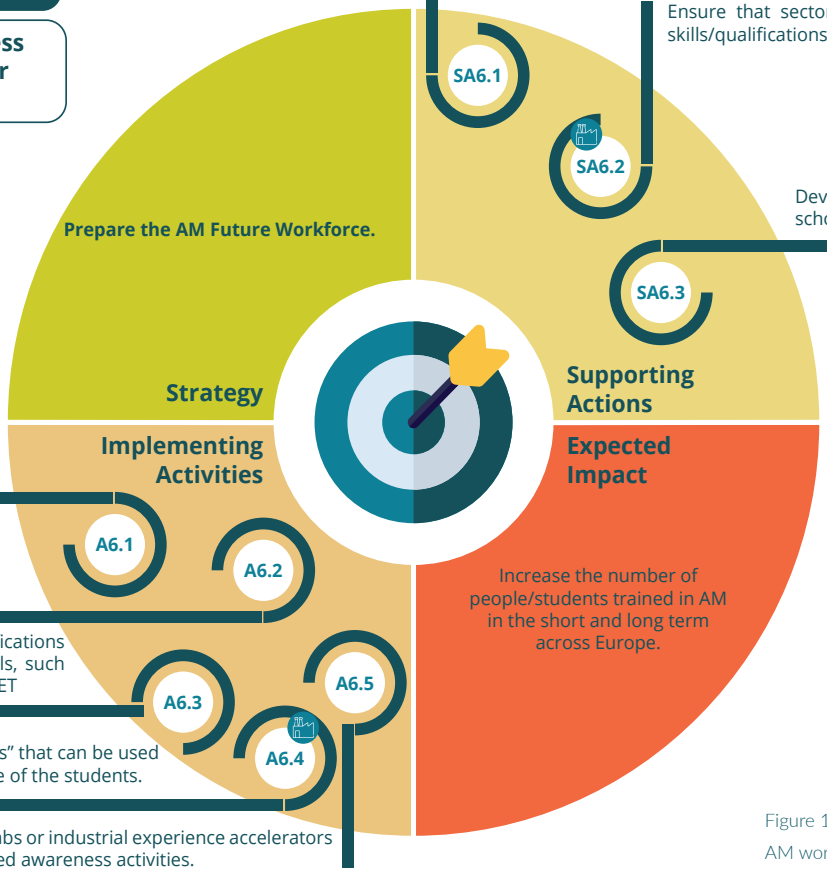
Strategic Objective	6: Prepare the AM Future Workforce	Short term scenario	Foresight term scenario	
		2021	2022	2030
IMPLEMENTING ACTIONS	A6.1: Raise Awareness campaign focused on different target groups	S4AM		
	A6.2: Organize events to raise awareness of AM and its capabilities, focusing on creativity, for young students	S4AM		
	A6.3: Relate European AM Qualifications with NQF using European tools, such as EQF, ECTS, ECVET and EQAVET	S4AM		
	A6.4: Create AM awareness "activities" that can be used by schools according to the age of the students	S4AM		
	A6.5: Funding to equip schools, fab labs or industrial experience accelerators and allow them to do AM related awareness activities	S4AM		

Figure 11 - Timeline for the Implementation of the Actions to Prepare the AM Future Workforce

GAP DRIVER:

6

Lack of AM awareness among the younger generations.



Formulate strategic and future-oriented visions for AM-related skills and their national roll-out.

Ensure that sector and/or AM process specific skills/qualifications are identified and addressed.

Develop the use of AM at different school levels.

Raise Awareness campaign focused on different target groups.

Organize events to raise awareness of AM and its capabilities, focusing on creativity, for young students.

Relate European AM Qualifications with NQF using European tools, such as EQF, ECTS, ECVET and EQAVET

Create AM awareness "activities" that can be used by schools according to the age of the students.

Funding to equip schools, fab labs or industrial experience accelerators and allow them to do AM related awareness activities.

Increase the number of people/students trained in AM in the short and long term across Europe.

Figure 12 - Actions to prepare the future AM workforce

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7. Leverage on existing funding programmes and mechanisms

About this challenge:

- Mostly only big companies have the ability to invest in AM process awareness and training;

- Smaller companies face challenges with AM implementation and training, which hampers them to have a fair profit from the AM advantages in manufacturing and industrial lines.

Strategic Objective	7: Leverage on existing funding programmes and mechanisms	Short term scenario	Foresight term scenario	
		2021	2022	2030
IMPLEMENTING ACTIONS	A7.1: Funding to equip training centres and schools with AM equipment and software	S4AM		
	A7.2: Map and promote funding relevant for AM skills and qualifications	S4AM		
	A7.3: Recommend calls for AM-specific activities	S4AM		
	A7.4: Organise events to facilitate networking and collaboration in EU and National calls for AM	S4AM		

Figure 13 - Timeline for the Implementation of the Actions to Leverage on Existing Funding

GAP DRIVER:

7

Necessity of more "infrastructures" for AM training

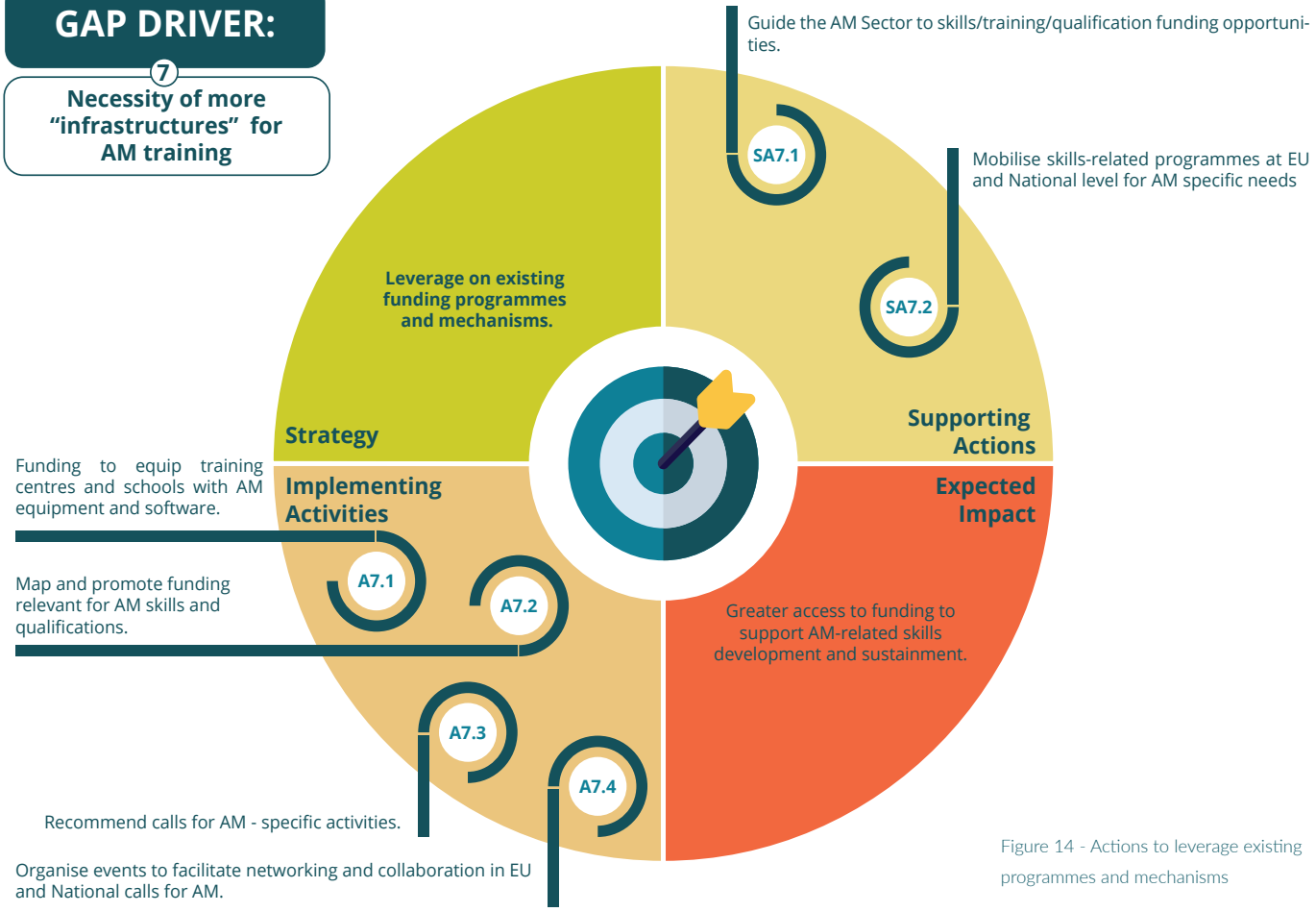

Figure 14 - Actions to leverage existing programmes and mechanisms

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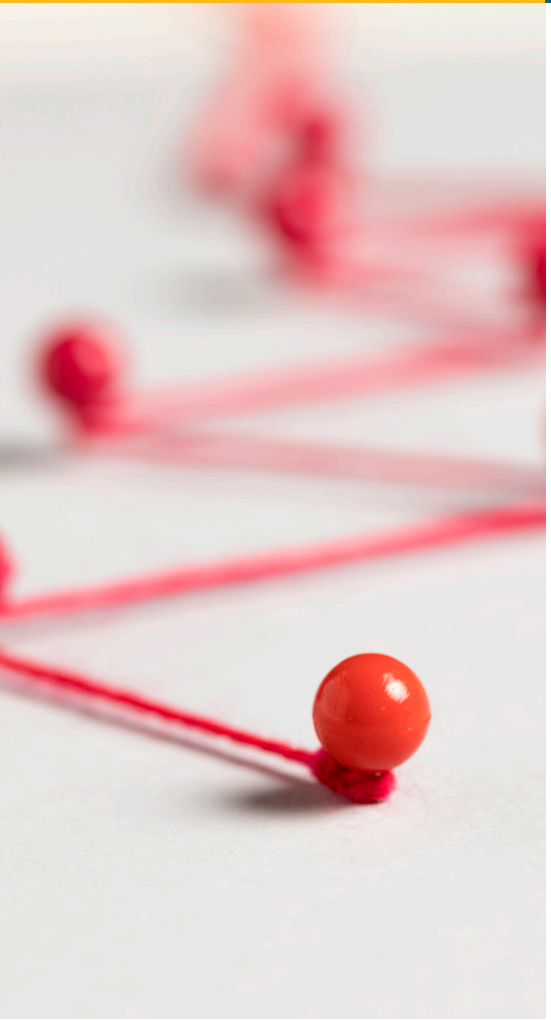

AM SKILLS ROADMAP

The mind map pathways for skills development in AM follows the AM Value chain flow, meaning that the set of skills required by each Professional Profile are grouped according to the specific AM value chain segments (e.g. Modelling & Design, Materials, AM Process, Post-Processing, Product and End of Life), see Figure 15.

Prior findings, supported by ongoing validation sessions to align the Occupational Standards with industrial requirements, lead to the development of Metal AM Professional Profiles and skills for the AM Process Engineer, AM Designer, AM Inspector and AM Operator levels.

These AM Profiles and Skills for each Professional Profile and qualifications are composed by a set of Units of Learning Outcomes / Competence Units (CUs) with different proficiency levels (e.g. Independent, Specialised, Advanced and Expert) in alignment with the correspondent Professional Profile which enable the progress inside one or different qualifications, thus fostering up-skilling (improving existing skills) and re-skilling (training in new skills).

AM SKILLS ROADMAP

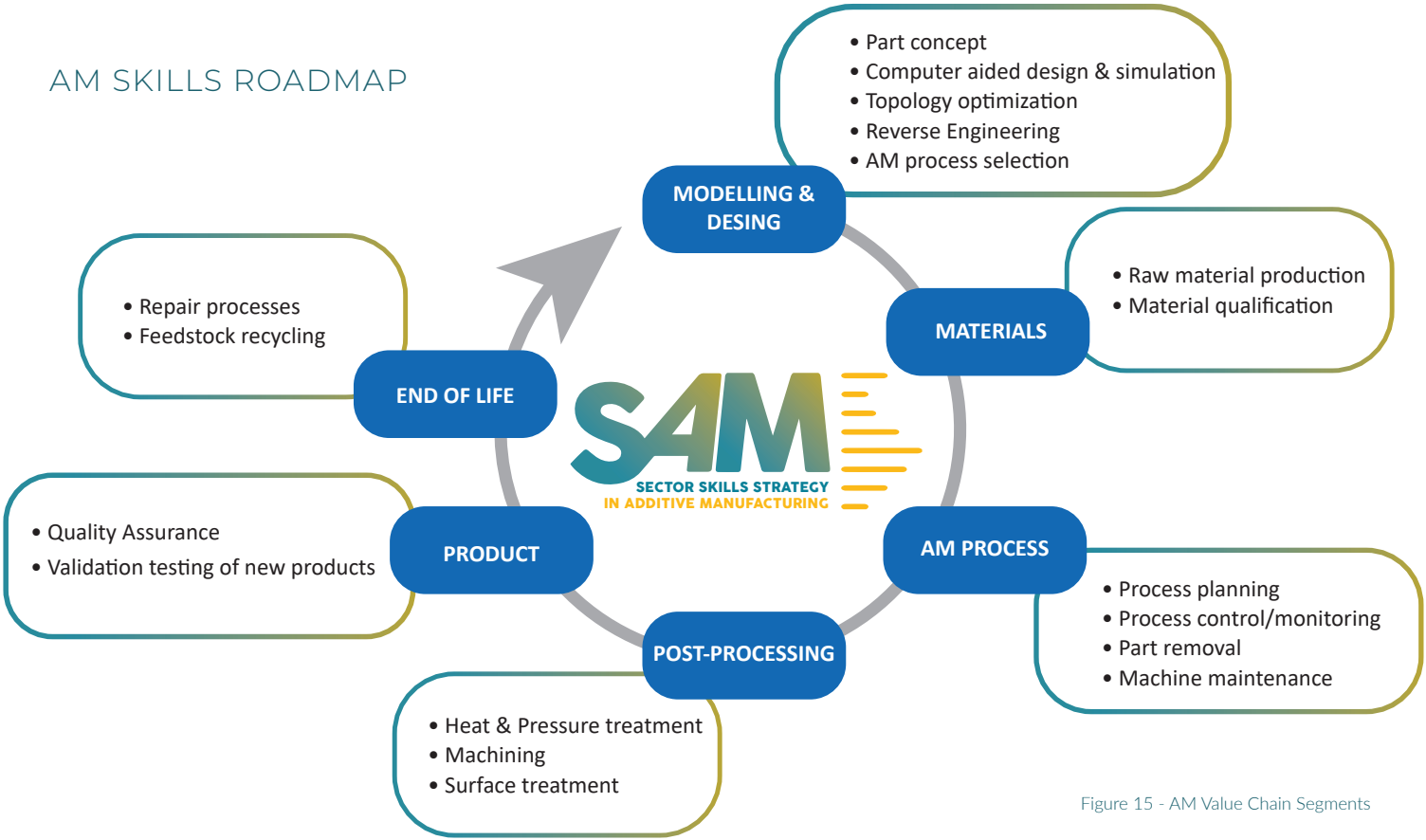

Figure 15 - AM Value Chain Segments

CONCLUSIONS

This Skills Roadmap has outlined the complex challenges that the AM sector currently faces, in the form of "Gap drivers" (challenges) between what the industry needs in terms of educational/training offer and what is currently available, thus placing forward key strategic initiatives and concrete activities to address each of the main seven strategic objectives:

- Strengthen the collaboration between industry and training organisations
- Tackle the lack of AM personnel at the European level
- Prepare European, National and Regional organizations to tackle the challenges of AM, in terms of Qualified personnel
- Tackle the diversity of sectors and applications of AM
- Constant update of the AM European workforce
- Prepare the future workforce
- Leverage on existing funding programs and mechanisms

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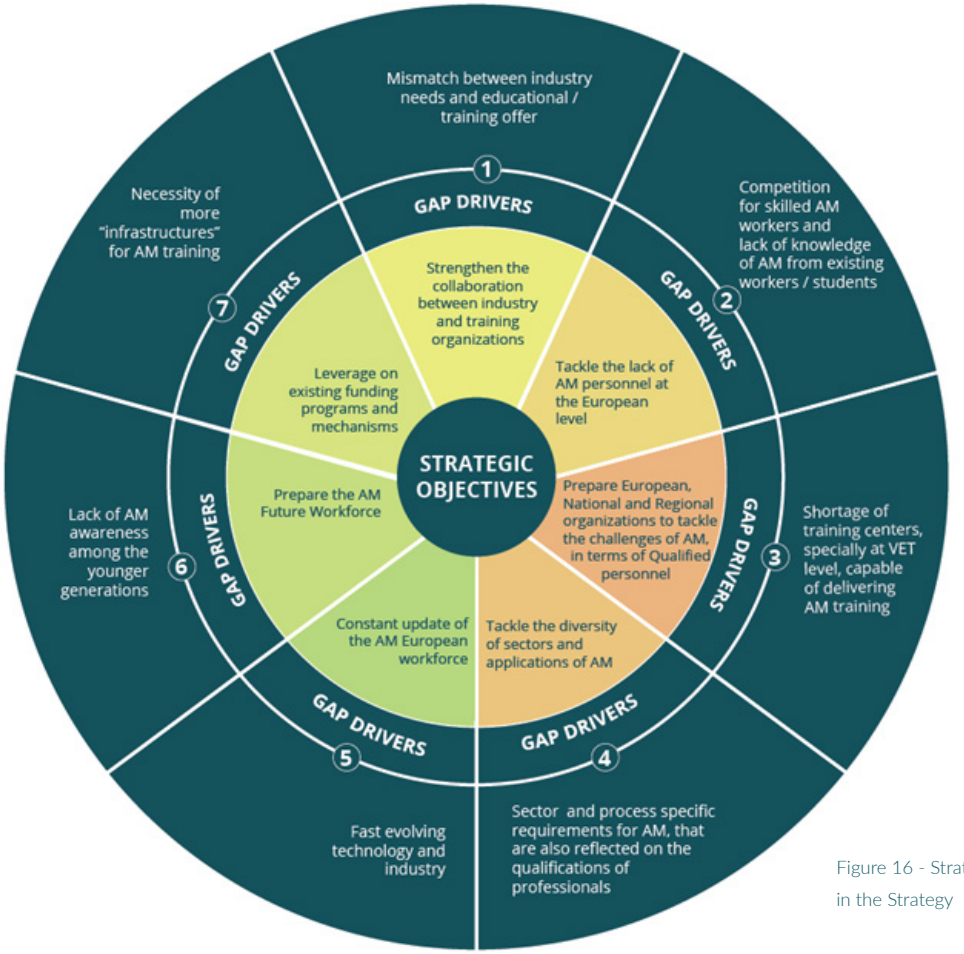
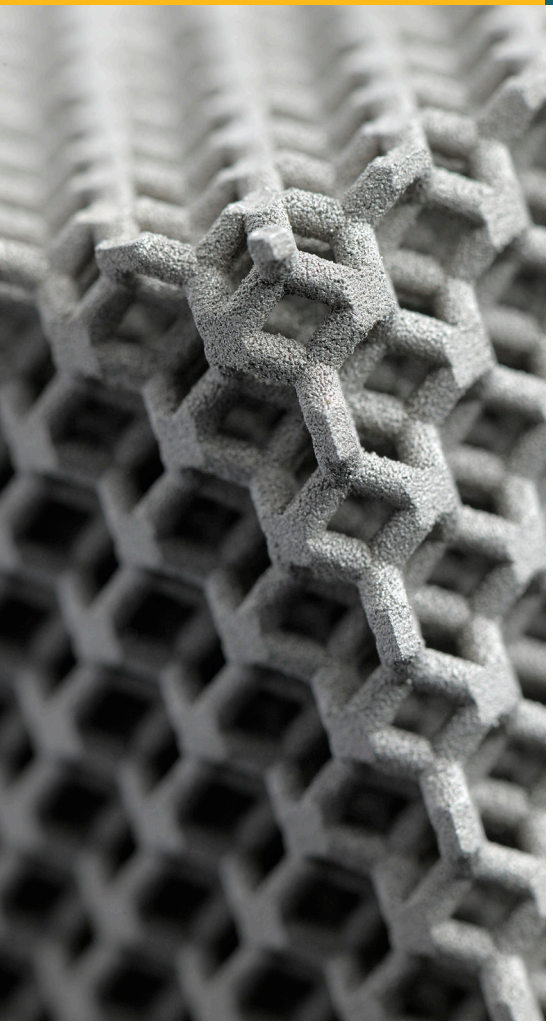


Figure 16 - Strategic Objectives foreseen in the Strategy



CONCLUSIONS

SAM has structured a “Roadmap” that will allow each strategic initiative (and their related activities) to be implemented in a realistic and measurable manner grounded in the AM Observatory and the deployment of the International AM Qualification System (IAMQS) through a network of training providers, sustained by a robust Quality Assurance System and a strong connection between a wide range of industrial sectors, which are applying AM in their activity or intend to do so (see Figure 17).

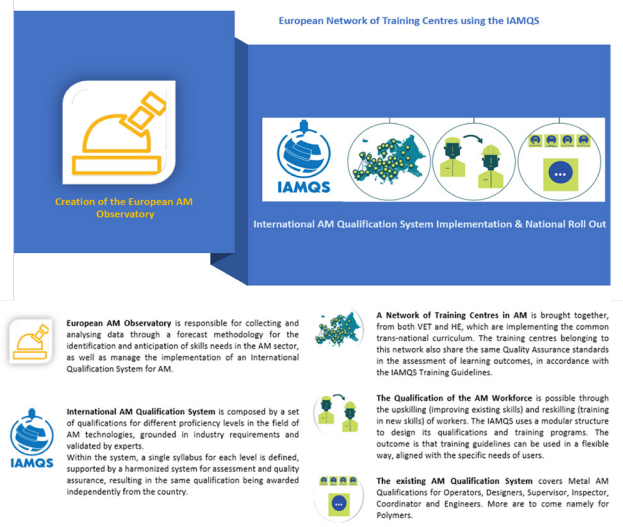


Figure 17 - Skills Strategy Roadmap flagship activities

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The **European Additive Manufacturing Skills Strategy** and **Roadmap** is public and open to all organisations wishing to support it.

If you would like to be involved in the **IAMQS** or be part of the **European AM Observatory**, please contact us at **ewf@ewf.be** or follow the SAM Project **www.skills4am.eu**

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SUPPORTING THE AM SKILLS STRATEGY

The Additive Manufacturing Skills Strategy is supported by:

AM PLATFORM

SAM SECTOR SKILLS STRATEGY IN ADDITIVE MANUFACTURING

Associated partners and other supporting entities:

AITA (Italian Association of Additive Technologies), AFPM Alexander Daniels, Global Limited, CESOL, Digital Additive Production DAP - RWTH Aachen University, 3D Printing Industry, 3D System, DVS German Welding Society, Frederik University, FPT VIMAG, Heinz-Piest Institute fur Handwerkstechnik,Hybrid Manufacturing Technologies, IMAPS - Steinbies, IQS School of Engineering, I-Form, Inspire AG – innovation Centre for Additive Manufacturing, Istituto Italiano Della Saldatura (IIS), Joanneum Research Center, Klastr Mechatronika, Laser Zentrum Hannover e., Llyods' Register, MiB - Association of Turkish Machine Manufacturers', Otto Brenner Shule (BBSme), Politecnico Di Torino (PoliTo), Research Center Non-Destructive Testing (RECENDT), Sensima Inspection, SINTEF Raufoss Manufacturing AS (SRM), SLM Solutions, Swiss Additive Manufacturing Group (Swiss MEM), TECNALIA Research and Innovation, The Welding Institute (TWI), The Manufacturing Technologies Association (MTA), VDMA, Vestas.

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