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## AdvManuNet: a networking project on metrology for advanced manufacturing

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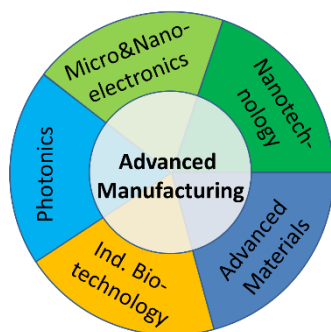
### Abstract

The networking project AdvManuNet has been started recently to accelerate the process of establishing an European Metrology Network (EMN) on Advanced Manufacturing. EMNs are intended by EURAMET, the association of metrology institutes in Europe, to provide a sustainable structure for ongoing stakeholder interaction in different thematic areas. Advanced manufacturing has been identified by the European Commission (EC) as one of six Key Enabling Technologies (KETs) with applications in multiple industries. Various EURAMET projects have partly addressed metrology needs for advanced manufacturing. However, a high-level coordination of the metrology community is currently absent and limits the impact of metrology developments on advanced manufacturing. AdvManuNet will address these limits by establishing a single hub for stakeholder consultation, a knowledge base on research results, and a strategic agenda for research and training to push forward advanced manufacturing and related KETs and strengthen Europe's position in advanced manufacturing via the EMN.

Advanced Manufacturing, Key Enabling Technology (KET), Strategic Research Agenda (SRA), European Metrology Network (EMN)

### 1. Introduction

The EC has identified Key Enabling Technologies (KET) as the basis for innovation [1]: "KETs are a group of six technologies: micro and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials, photonics, and advanced manufacturing technologies. They have applications in multiple industries and help tackle societal challenges. Countries and regions that fully exploit KETs will be at the forefront of creating advanced and sustainable economies".



**Figure 1.** Advanced Manufacturing and its related Key Enabling Technologies (KET)

In [2] it was stated that "Manufacturing, with its approximately 20 industrial sectors, is the backbone of the European economy." And that "Manufacturing 2030 reflects a time scale in which a fundamental change – initiated by research activities and technical innovations – can be reached." The European Metrology Network on advanced manufacturing directly addresses the above-mentioned topics to strengthen the European position in the KET advanced manufacturing by accelerating the development of innovative metrology focused on the needs of advanced manufacturing and optimising stakeholder

interaction with the metrology community. Innovative developments in advanced materials resulting in new or improved material properties are often related to enhancement by the addition of nanomaterials. These advanced materials can then be utilised in advanced manufacturing processes to realise new or optimised products. One example is the use of Carbon Nanotube Enhanced Composite Materials for aerospace applications [3]. Another example is the development of additive manufacturing technologies based on the flexible processing of raw powder materials, offering a completely new class of applications in advanced manufacturing [4]. However, it also puts challenges on the integration of additively manufactured components into established manufacturing chains within the framework of flexible manufacturing infrastructures, described in concepts like Industry 4.0 linking Cyber-Physical Production Systems (CPPS). There are many outstanding metrology challenges in this aspect of advanced manufacturing alone (e.g. temperature control in the powder beds) and optimised input from the metrology community to this highly innovative area of the different KETs is essential.

According to [5], 2.1 million enterprises were classified as "manufacturing" in the EU in 2015 with nearly 30 million employees. In addition to companies, different organisations on the national and European level exist, which focus on manufacturing topics (societies, institutes, universities). On the EURAMET level, some Technical Committees (TCs) have a strong impact on advanced manufacturing, like TC-Length, TC-Temperature, TC-Mass and related quantities, however, to date there is not yet a single contact point for all issues of relevance to the KET advanced manufacturing and related KET.

Within the EMRP and EMPIR programmes several joint research projects (JRP) covering topics of advanced manufacturing were successfully completed, most within the thematic programme "Metrology for Industry" [6]. Several of these JRPs addressed objectives, which required expertise from different EURAMET TCs to address the challenging development targets with innovative approaches. However, neither the results of the EMRP and EMPIR research projects nor the H2020 research projects have yet been systematically analysed with respect to their potential for impact on the KET advanced manufacturing and its related KET advanced materials and KET nanotechnology.

Optimising the uptake of relevant research results in important KET areas is the main objective of the knowledge sharing programme.

Along with the preparation of the EMRP and EMPIR programmes, the EURAMET TC's have developed different roadmaps describing metrology challenges to be addressed in specific topics. However, a proper roadmapping approach for metrology demands in advanced manufacturing and its related KET topics does not yet exist. This roadmap should systematically consider the expertise, facilities and research capabilities of several TCs and the input from stakeholder communities including project consortia resulting from public-private-partnership (PPP) programmes, such as e.g. Factories of the Future PPP with the European Factories of the Future Research Association (EFFRA) AdvManuNet will establish a close link to ManuFuture, discussing the impact of metrology on major issues addressed in the strategic document ManuFuture -VISION 2030 [7]. In addition, roadmapping of future metrology requirements has been prepared by various learned societies across Europe (e.g. InstMC [8]). The development of a strategic roadmap will be based on a gap analysis and facilitate the future planning of research, training and service provision in metrology for advanced manufacturing across Europe.

## 2. Aims of AdvManuNet

The overall objective of this joint network project (JNP) is to accelerate the implementation of the future European Metrology Network on advanced manufacturing. The specific aims are:

1. To establish a regular, constructive dialogue and liaison between the project and stakeholders in advanced manufacturing, as well as overlapping areas in advanced materials and nanotechnology. The project should foster new and existing collaborations including those with relevant societies and standardisation bodies.
2. Using the feedback from stakeholders in aim 1, to develop a Strategic Research Agenda (SRA) and roadmaps for advanced manufacturing metrology. The SRA should identify gaps in current metrological capabilities and take into account existing networks and roadmaps.
3. Using the feedback from stakeholders in aim 1, to set up a knowledge-sharing programme for advanced manufacturing stakeholders, in order to promote the dissemination and uptake of results, including those from previous, relevant EMRP and EMPIR projects. This should take into account existing training programmes and include a range of regularly hosted activities, e.g. exchange of researchers, industry focussed events and training courses.
4. Using the feedback from stakeholders in aim 1, to develop a web-based platform for advanced manufacturing stakeholders. The platform should include easy access to European metrology capabilities and links to other relevant European and international networks, as well as a service desk. It should be developed in a manner that allows it to be maintained by a future EMN.
5. To develop a plan for a joint and sustainable European metrology infrastructure for advanced manufacturing via a European Metrology Network. The plan should be completed within 12 months of the start of the project and should (i) use coordination and smart specialisation of capabilities (ii) align with other running initiatives and projects, (iii) promote the development of emerging member states, and (iv) consider how to extend collaboration to third countries.

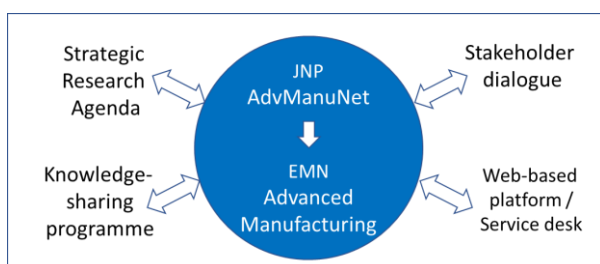


Figure 2. Scheme of JNP/EMN on Advanced Manufacturing

## 3. Work programme and key deliverables of AdvManuNet

The work programme of the JNP AdvManuNet is structured in 5 different work packages, which are substructured with tasks and activities. The 5 work packages (WP) are:

1. Dialogue with stakeholders (lead INRIM)
2. Strategic road mapping and plan for EMN (lead NPL)
3. Technical infrastructure for EMN operation (lead PTB)
4. Creating Impact (lead BAM)
5. Management and coordination (lead PTB)

The key deliverables of the 4 year project AdvManuNet are:

1. Plan for a joint and sustainable European metrology infrastructure for advanced manufacturing via an EMN ready to be presented to the EURAMET General Assembly 2021. (=> M12)
2. Report on a knowledge sharing programme for advanced manufacturing stakeholders. The programme includes promotion of the dissemination and uptake of research results on advanced manufacturing and a range of regularly hosted activities. (=> M44)
3. Final lists of metrology needs for stakeholders in advanced manufacturing, including input from stakeholders in new and existing collaborations and those with relevant societies and standardisation bodies. (=> M40)
4. Report on the final testing of the functionality of the web-based platform for advanced manufacturing stakeholders. The platform includes easy access to European metrology capabilities and links to other relevant European and international networks, as well as service desk to answer stakeholders' questions. (=> M44)
5. Strategic Research Agenda (SRA) for metrology for advanced manufacturing. (=> M48)
6. Examples of early uptake of project outputs by end users. Examples of contributions to new or improved international standards. (=> M48)

## 4. Outlook

To achieve the aims of the project, the establishment of a regular, constructive dialogue and liaison between the project and stakeholders in advanced manufacturing is vital. One forum to be used for the stakeholder dialogue are international conferences with a focus on advanced manufacturing, such as the euspen international conference and exhibition (ICE) and the euspen special interest group meetings.

It is planned to have workshops and training events organised at future euspen events – along with similar interactions at other suitable conferences and meetings as well as a targeted questionnaire sent to the identified stakeholders. The aim of the questionnaire is to receive detailed feedback from the stakeholder community to address the identified metrology needs in the area of advanced manufacturing. The work will be supported by a stakeholder committee representing different industrial sectors of relevance for advanced manufacturing.

## Acknowledgement

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