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## Progress of the European Metrology Network for Advanced Manufacturing

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### Abstract

The European Metrology Network (EMN) for Advanced Manufacturing has been established in June 2021. Currently nine EMNs focussing on different important topics of strategic importance for Europe exist and form an integral part of EURAMET, the European Association of National Metrology Institutes (NMI). All EMNs are tasked to develop a high-level coordination of the metrology community in Europe in a close dialogue with the respective stakeholders. The development of a Strategic Research Agenda (SRA) is a key task for all EMNs in their thematic areas as important input for the European Partnership on Metrology programme in alignment with other relevant European Partnerships. This task will be based on an analysis of the existing metrology infrastructure and capabilities of the NMIs, the metrology research needs for advanced manufacturing identified in close cooperation with industrial stakeholders and a resulting gap analysis. Here we report on the progress of the EMN for Advanced Manufacturing.

advanced manufacturing, metrology, European Metrology Networks (EMN), Strategic Research Agenda (SRA), stakeholder, Industry 4.0

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### 1. Introduction

Metrology, the science of measurement and its applications, is a key element of quality infrastructures and thus also the base to assure the quality of manufactured parts and systems. To foster a high-level coordination of the activities and capabilities of the European metrology institutes in support of the European manufacturing industry, the European Metrology Network (EMN) for Advanced Manufacturing was established in June 2021. The background of the EMN and its supporting joint network project (JNP) were described before [1, 2]. Here we will report on the current status of the EMN, its achievements so far and its planned near-term and long-term activities.

### 2. Achievements of the EMN for Advanced Manufacturing

Here we will report on the achievements of the EMN so far.

#### 2.1. EMN application and approval process

The proposal for the EMN for Advanced Manufacturing was developed with input from experts of 18 National Metrology Institutes (NMI) and Designated Institutes (DI) in Europe, supported by the JNP AdvManuNet [3]. Expertise from different technical committees (TC) of EURAMET was included in the EMN proposal, because advanced manufacturing requires expert knowledge in dimensional, thermal, mechanical, and other material and process-related disciplines. Moreover, metrology requirements related to digitalization aspects in flexible manufacturing infrastructures have to be addressed as well.

Guided by the perspective on whole manufacturing chains, the work within the EMN was proposed to be organised internally

along the entire life cycle of products manufacturing chain including design for manufacture and recyclability. The proposed three main topical areas or sections were: 1) advanced materials, 2) smart manufacturing systems, and 3) manufactured components and products.

The proposal for the EMN for Advanced Manufacturing was submitted to EURAMET, presented and discussed at its General Assembly (GA), the highest authority and decision making body of EURAMET, and was approved by the GA on June 8, 2021.

#### 2.2. EMN members, partner organizations and stakeholder council

The current EMN members are the following 18 NMIs and DIs (abbreviated names in alphabetical order with country code): BAM (DE), CEM (ES), CMI (CZ), CNAM (FR), DFM (DK), DTI (DK), GUM (PL), INRIM (IT), IPQ (PT), LNE (FR), METAS (CH), RISE (SE), NPL (UK), PTB (DE), SMD (BE), UME/TUBITAK (TR), VSL (NL), VTT (FI). The EMN members have all signed a Memorandum of Understanding to confirm their joint interest and willingness to support the work of the EMN for Advanced Manufacturing, which is intended as a sustainably operated and integrated structure of EURAMET. Nominated primary contact persons, cross-sectional experts and sectional experts are allowed to participate in annual general meetings (AGM) of the EMN. The EMN members, nominated experts and the EMN officials (chair, vice-chairs, secretary) are also listed on the EMN website [4].

For the progress of the EMN activities, links to important partner organizations were established, based on identified mutual interest in a strategic cooperation. On the EMN stakeholder events, the partner organizations presented themselves. These currently are: European Technology Platform

(ETP) ManuFuture [5], EFFRA / Made in Europe Partnership [6], NanoFabNet [7], and euspen [8].

The EMN has identified 13 key industry sectors (KIS) which have strong metrology needs for the development of advanced manufacturing within these sectors [2]. A stakeholder council (SC) has been established consisting of appointed high-level experts, who represent the different KIS as best as possible and who are expected to provide strategic advice for the activities within the EMN. The SC currently has 11 members from industry and academia from the following countries: CH, DE, DK, FR, IT, and UK.

### 2.3. EMN communication activities

The EMN has organized a short introductory meeting on June 23, 2021 presenting its approach and a half-day stakeholder meeting on October 11, 2021, both held as open online events. The events offered talks of high-level experts from industry, as well as contributions of the EMN partner organizations and other EURAMET organizations with close links to the EMN topics [4].

A contribution of the EMN for Advanced Manufacturing was also presented at a seminar series on Metrology for Digital Transformation, organised by EURAMET in September 2021 [9].

The 1<sup>st</sup> annual general meeting (AGM) of the EMN took place on October 12, 2021, in combination with the 1<sup>st</sup> meeting of the stakeholder council.

The EMN for Advanced Manufacturing has been presented at the two international metrology conferences in 2021.

### 2.4. EMN Logo

The logo of the EMN for Advanced Manufacturing was required in alignment with general EURAMET design rules. The chosen icon, Figure 1, combines and intertwines the symbol of a gear, representing a typical manufactured complex component, and a symbol of interconnected points, representing autonomously interacting manufacturing systems in flexible and smart advanced manufacturing infrastructures.



Figure 1. Logo of the EMN for Advanced Manufacturing

## 3. EMN Activities in 2022/2023

The main focus of the EMN activities in 2022 is the development of a draft Strategic Research Agenda (SRA) in close cooperation with the stakeholders. An important driver for these activities is the planned call for research projects in the thematic programme 'metrology for industry' of the European Partnership on Metrology in 2023 [10]. At the first stage of the call, which is expected to be opened in January 2023, proposals for potential research topics (PRT) may be submitted. The aim is to have a first draft of the SRA available for reference by PRT proposals detailing the identified metrology capability gaps.

The EMN provides a forum to discuss possibilities to steer the research directions of the European Partnership on Metrology in different ways: a) draft call scope documents are circulated to the TCs and EMNs by EURAMET at an early stage for discussion,

before the call scopes are published when the call is opened, b) TCs and EMNs may also provide input for the orientation pages of the calls, and c) the EMNs are tasked with the development of the SRAs for their topical areas.

In order to define the metrology needs of the advanced manufacturing sector, a targeted interaction with the stakeholders are required to generate high-level documents which best address the identified broad metrology needs of the sector. To discuss the metrology needs, stakeholder workshops and accompanying questionnaires are planned in the EMN sections. However, care will be taken to also identify the cross-sectional metrology requirements across all three sections and along whole manufacturing chains and recycling.

## 4. Long-term activities of the EMN

Beyond 2022/2023 EURAMET plans to also open another 'metrology for industry' call late., Therefore it is important to identify long-term metrology research needs for advanced manufacturing. This also holds beyond the duration of the Horizon Europe and the European Partnership on Metrology programme.

The support of the EMN by the JNP AdvManuNet will end after four years in June 2024. By then, the following targets have to be achieved: a) a final version of the SRA has been developed which will be regularly updated by the EMN, b) a final version of the EMN website [4] has been developed which offers access to the EMN knowledge base, information on training events and a helpdesk, all related to metrology issues for advanced manufacturing, and c) in addition to the SRA, which focusses on metrology research gaps and needs, a strategic agenda (SA) has to be developed, which addresses ways for a sustainable operation of the EMN for Advanced Manufacturing beyond the running European Partnership on Metrology programme, i.e. beyond 2027.

## 5. Summary and outlook

We have reported on the current status and planned short- and long-term activities of the EMN for Advanced Manufacturing.

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