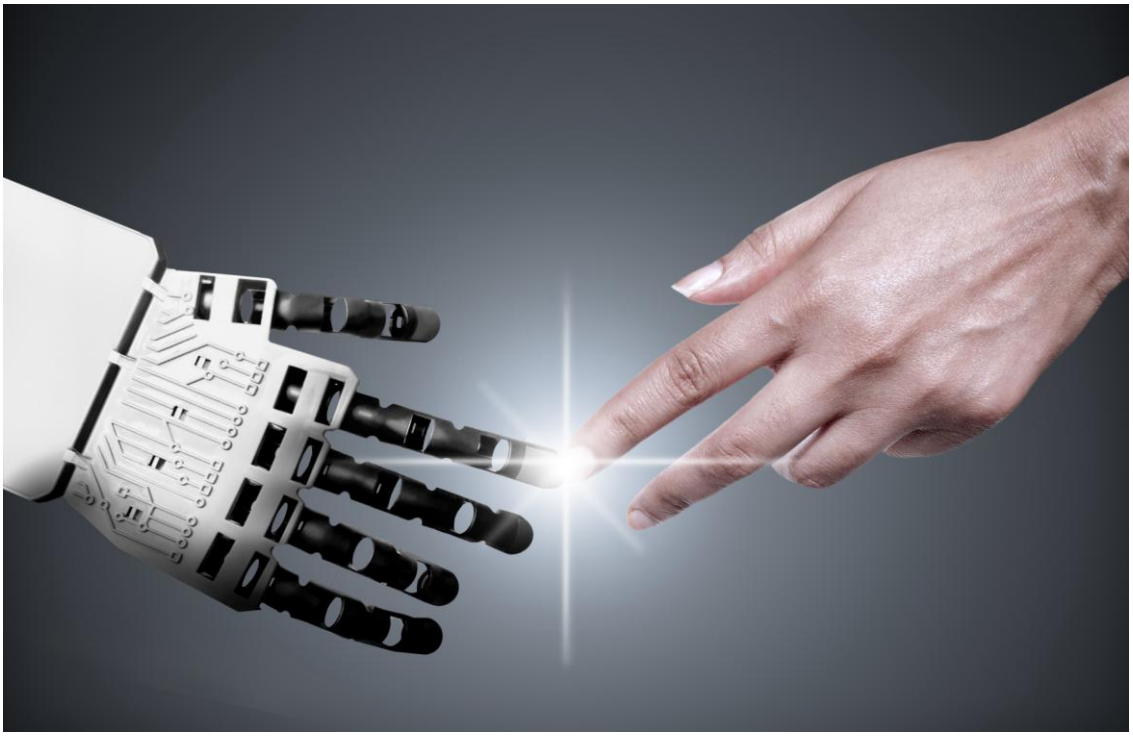
Dynamising the Uptake of Advanced Manufacturing Technologies in European Industries

8 Proposals for Policy Action

Insights from a Recent Project for the European Commission

Fraunhofer Institute for Systems and Innovation Research ISI
in cooperation with ITIA – CNR; IDEA Consult; VTT Finland



© iStockphoto.com/CharlieAJA

Karlsruhe
February 2017

Henning Kroll, Djerdj Horvat, Giacomo Copani, Els van de Velde, Magnus Simons
Angela Jäger, Golboo PourAbdollahian, Annelies Wastyn, Mika Naumanen

Starting Point and Empirical Basis

Manufacturing remains among the central driving forces of the European economy. It provides about 30 million jobs in Europe and generates an annual turnover of about €7 000 billion in 25 industrial sectors and over 2 million companies. Hence, industrial modernisation is of crucial relevance for economic dynamism in Europe and the lasting creation of growth and jobs in the EU. In ways going far beyond mere digitalisation, seminal transformations of the production system appear on the horizon in which firms and EU Member States will only participate if they succeed in adopting advanced manufacturing technologies (AMT) in due course.

Against this background, Fraunhofer ISI, together with its partner, conducted a study on the 'analysis of drivers, barriers and readiness factors for adopting AMT' on behalf of the European Commission's Directorate General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW).

The analysis that the following recommendations are based upon, constitute the first **robust empirical framework of reference** (qualitative and quantitative) that has been compiled from an unrelentingly **uptake- and user-centred** perspective across Europe, based on both surveys and on-site interviews.

Different from earlier analysis, study identifies not only relevant steps and actions towards the development of better manufacturing technologies but also much needed measures to prepare the ground for the broader uptake such technologies that is required to spur industrial modernisation at a broader scale.

Findings

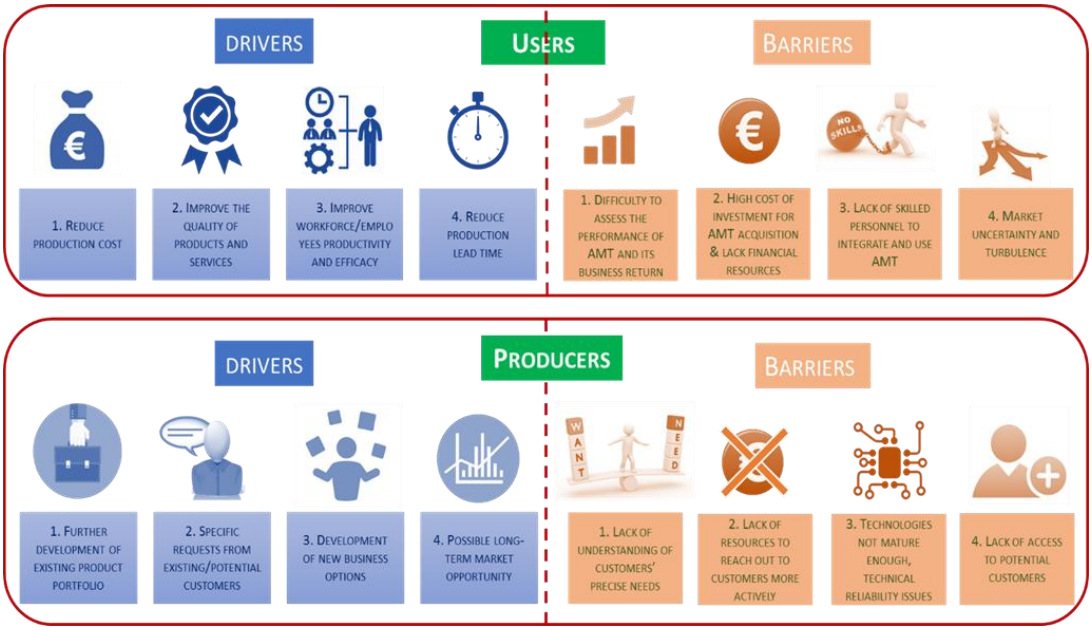
Overall, the empirical findings of the study suggest that **a strong need remains to accelerate the uptake of advanced manufacturing technologies, in particular amongst SMEs**. Their use remains too focused on specific countries and sectors to spur broad-based industrial modernisation across the continent.

Main **drivers for investing in advanced manufacturing technologies were found to be largely entrepreneurial, resulting from both commercial and technological considerations**: reducing production costs, improving the quality of products and services, improving employees' productivity and the reduction of production lead time. So far, the additional uptake of new technologies seems not to have been prompted by favourable external conditions, policy driven or not.

Obstacles to AMT investments, in contrast, are often made up by a mix of both internal and external factors. For nearly three quarters of the surveyed firms, high investment requirements and a corresponding lack of financial resources remain core barriers. Moreover, about half of all firms indicate difficulties in assessing the performance and the potential business return of novel technologies and/or a lack of skilled personnel required to adopt and adapt them to their concrete business effort. Finally, market uncertainty and turbulences play a major role.

An overview of drivers and barriers to technology uptake is given in Figure 1 below.

Figure 1: Drivers and Barriers of Technology Uptake



Source: European Commission, 2016: 65

Policy Context

Based on the surveyed firms' own statements, the empirical analysis suggested a need for policy action in the following fields: provision of risk-compensating financial resources for technology uptake (in SMEs), support for qualification efforts to address competence and skills issues (in SMEs), creation of new frameworks and infrastructures for cooperation along value chains, creation of comprehensive yet efficient networks of service provision, and a better consolidation of the existing multi-level support framework.

Subsequently, these, at firm level, commonly expressed needs were clustered along several major dimensions: "finance and funding", "competence and skills", "technological challenges", "supply chain cooperation", "service offerings", and "policy framework" and contrasted with a **mapping of existing policy measures and service offerings** at European, national and regional levels.

On this basis, it identified a number of **relevant remaining gaps** which to be taken up and integrated into **eight headline proposals for policy action** on grounds of relatedness and available political options. In the following, this paper will present these headline policy recommendations.

Proposals for Policy Action

In summary, the proposals of this paper can be subsumed under four headings:

I. Broadly strengthen uptake capacity in SMEs

Currently, many manufacturing firms do not yet have sufficient capacities to adopt advanced technologies. Related shortcomings include know-how, human capital as well as organisational and managerial capacity. Without better ecosystem for SMEs that support the building of such capacities in all areas of advanced manufacturing any more advanced support offers will have difficulty to become effective.

II. Promote high-end manufacturing technology uptake

More advanced industrial SMEs need high-quality demonstration environments and suitable framework conditions that allow them to pilot the implementation of advanced manufacturing technologies and to adopt lessons from relevant research projects in cooperation with research and technology organisations (RTOs) as well as other manufacturing firms from relevant fields.

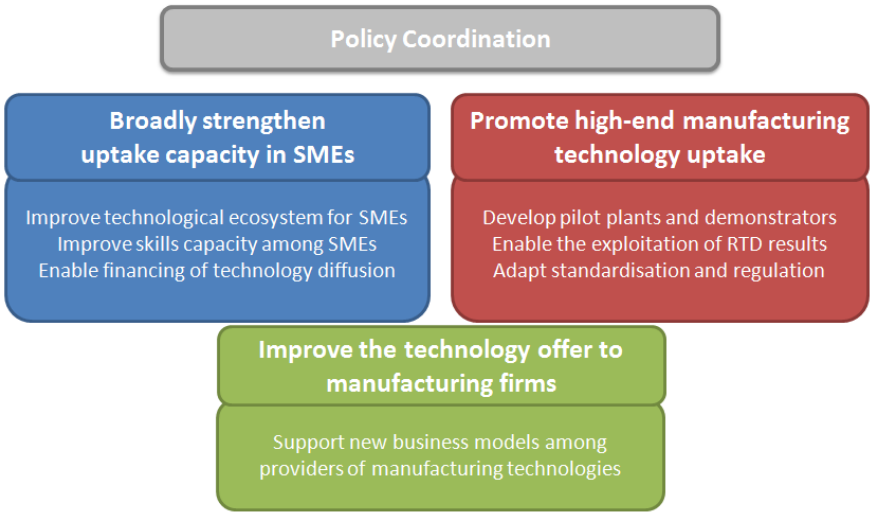
III. Improve the technology offer to manufacturing firms

Currently, many providers of advanced manufacturing technologies concede that they do not understand their relevant markets well and have not yet developed suitable business models to effectively reach out to potential clients, mitigate risk and manage uncertainty. To strengthen the uptake of technologies, new business models have to be promoted among these firms.

IV. Strengthen policy coordination

While many pertinent support measures are already available in the EU, their coordination across different levels of policy making needs to be improved, in particular if new ones shall be added to the existing portfolio.

Figure 2: Suggested Areas of Policy Support



Source: European Commission, 2016: 15

1 Broadly strengthen uptake capacity in SMEs

1.1 Improve and extend the "technological ecosystem for SMEs" across Europe

The analysis identified heterogeneity between regional innovation ecosystems and intermediaries, evident in disparities of access to services resulting from a lack of knowledge about service providers or an outright lack of qualified intermediaries in the surveyed firm's environment.

To overcome these issues, it is recommended that nations and regions improve the quality and the availability of service offering systems for SMEs "on the ground", promoting dedicated initiatives in the logic of smart specialisation. Clusters and other intermediaries, like regional development agencies, should more dynamically act as orchestrators of regional service capabilities and contact points for SMEs to improve the access to existing offerings of different types of services (e.g. financial, training, technology, consulting) that, due to the heterogeneity and fragmentation of potential suppliers, remain underexploited. This effort should be enabled in a subsidiary manner. Only local actors have a deep enough knowledge of the needs of local firms to effectively direct them towards suitable funding opportunities, coordinate distributed entrepreneurial momentum and facilitate joint investment.

1.2 Improve skills capacities among European SMEs

The analysis identified a lack of manufacturing technology-related competences in SMEs; weak cooperation between public research organisations, universities and training organisations for advanced manufacturing technology-related training and education and weak cooperation between SMEs and public research organisations or universities in the joint development of technological solutions.

To overcome these issues, this study recommends promoting new cooperation models between universities and SMEs for tailor-made training systems centred around regional specialisations. This can be realised through the establishment of relevant frameworks and initiatives that support collaboration between companies and universities and the development of skills and competences in smaller firms.

To provide practical training on technologies and industrial applications of real relevance to SMEs, it is recommended to focus on industry/university cooperation in selected groups of technologies based on regional specialisations, introducing new approaches such as teaching factory and e-learning. Also, it is recommended to promote and disseminate proven cooperation models for the co-creation of technological solutions between SMEs and RTOs.

1.3 Provide adequate financial support for the diffusion of technologies

The analysis identified issues resulting from high adoption risks in a situation of limited investment capacities but unclear benefits; complicated by either the lack of instruments supporting the uptake (in particular more mature) technologies or the a fragmentation, complexity and bureaucratisation of existing public funding instruments. Currently, few instruments allow trans-national and trans-regional cooperation and many SMEs lack information about the opportunities there are.

To overcome these issues, financial support from public sources remains needed to add momentum to the uptake of more proven technologies on a broader basis and thus contribute to industrial modernisation. Even investments in established manufacturing technologies entail a number of risks and organisational changes for the company that will typically make them 'unbankable' on the private market for finance. In some countries such as Germany or Italy efficient public funding systems are in place. In most others, the issue of access to finance remains – in practice – unresolved. To overcome this barrier, the potential of existing European support instruments should be better exploited. Often, their availability remains unclearly communicated and many SMEs fail to understand their purpose. In addition, at regional level, it is recommended to promote new financing mechanisms and to improve the existing financial models to allow the involvement of technology providers outside the region or even nation of the funding authority.

12 Concrete Suggestions to Strengthen Uptake Capacity

- establish "innovation hubs" for all advanced manufacturing technologies,
- reinforce communication-oriented instruments such as EEN,
- monitor the uptake of manufacturing technologies at European level,
- incentivise clusters to improve service offering systems,
- leverage structural funding to hire the qualified staff needed to do so,
- support trans-regional/national cooperation
- design European curricula for manufacturing technologies,
- support novel education paradigms like teaching factories and e-learning,
- promote the secondment of researchers and students to SMEs,
- prolong the EIF's SME initiative,
- differentiate financial instruments by technology and geographic area,
- offer multi-step support (from voucher schemes to venture capital).

2 Promote high-end manufacturing technology uptake

2.1 Promote the development of joint pilot plants and demonstrators

Even among well-qualified firms, the analysis identified a lack of awareness and understanding of the benefits of advanced manufacturing technologies, doubts about their robustness and performance, difficulties to usefully integrate them into existing processes. Additionally, it found a disparity of access to service and innovation infrastructure across Europe, a lack of specific manufacturing technology-related training offers for SMEs and weak cooperation between manufacturing SMEs and research organisations.

To overcome these issues, momentum should be added to existing efforts in the area of setting up Europe-wide networks of regionally-anchored pilot plants and demonstrators. Pilot plants should be conceived in the logic of smart specialisation, guaranteeing synergies at the European level. These pilot plants and demonstrators should offer SMEs access to innovative equipment at a technology readiness level suitable for different purposes such as: to understand which novel technological options are available in detail, assess the economic potential for a firm's specific business, to develop tailored solutions in cooperation with AMT suppliers, to evaluate technical performance parameters and conduct financial analyses to elaborate concrete business plans, to train own personnel on the machines, etc. Importantly, however, future pilot plants and demonstrators should be not only hardware installations but function as ecosystems where SMEs can interact with service providers offering multidisciplinary support for uptake and qualification.

2.2 Enable the exploitation of Horizon2020 research results by SMEs

Even among well-qualified firms, the analysis identified barriers to the uptake of advanced manufacturing technology solutions generated in research projects funded from European Union and other sources. Typically, new ideas or leverage points for future development remain underexploited by both the project partners and other firms – despite the substantial investment made in their generation.

In order to overcome this barrier to cutting edge technology uptake and dynamic co-creation among leading technology firms, novel applied research results in the field of advanced manufacturing technologies should be better valorised among small and medium sized firms, adding momentum to existing large-scale measures such as the Factories of the Future PPP. For some years, the European Commission has embraced the logic of clustering research-funded projects of similar thematic areas with the intent of achieving synergies and generating higher critical mass for exploitation. In the future, such clusters of advanced manufacturing technology related projects should undertake joint efforts with respect to communication and dissemination activities, enlarging the number of prospective users knowing about their outcome and participate with more weight in standardisation committees. Existing models of such joint undertakings can be used for inspiration.

2.3 Adapt standardisation and regulation to enable the diffusion of technologies

The analysis identified several standardisation and regulation issues that impose limits on a more broad-based exploitation of advanced manufacturing technologies. In particular, standardisation was mentioned as a prevalent obstacle in the area of information and communication technologies, where robust standards for Industry 4.0 and related applications still have to be developed, and in the area of sustainable manufacturing, where regulation is at the same time the strongest driver of and the potentially most powerful obstacle to future dynamism.

To better overcome this issue, a strong commitment to the development of future standards and the improvement of existing regulation is needed. In the future, the digital manufacturing revolution can be beneficial to SMEs because it enables the establishment of efficient, real-time managed value chains between geographically dispersed SMEs. However, this will be possible only if the deployed ICT solutions are interoperable, i.e. if various applicative solutions can easily exchange data among themselves, and if they are customisable to the various applicative domains of SMEs. Hence, the promotion of open standards allowing interoperability is an important enabler for the digital revolution of SMEs. Both firms and intermediaries need the necessary resources and time to engage in these discussions. Concerning sustainable technologies, enabling regulation will play an important role. Hence, existing regulation needs to be improved in order to prompt a more agile re-use, re-manufacturing and recycling of products and processes in order to implement circular economy concepts. In this area, arenas of discussion need to be set up with all industries and intermediaries concerned to better understand their needs and to act accordingly.

12 Concrete Suggestions to Enable High-end Uptake

- provide enabling support to existing initiatives on pilot plants (*Vanguard*),
- support the set up of additional joint initiatives anchored in a RIS3 context,
- create transnational funding mechanisms for pilot plant networks,
- support new business models to open up pilot plants to (more) SMEs,
- explore and then support public-private funding models for pilot plants,
- include exploitation partners in research projects from the beginning,
- set clear and measurable valorisation targets for research projects,
- launch actions dedicated to the uptake of project results in pilot plants,
- communicate opportunities resulting from research projects to SMEs,
- enable leading firms to vigorously participate in the definition of standards,
- support the follow-up of research projects' implications for standardisation,
- create a centralised point of contact to report issues of regulation.

3 Improve the technology offer to manufacturing firms

Support new service-based business models for the diffusion of technologies

The analysis identified several issues relating to the general framework conditions that potential buyers of advanced manufacturing technologies have to deal with: high adoption risk resulting limited investment capacity in a situation of yet unclear benefit, market uncertainty and turbulence, not yet proven performance of new technology at the point of acquisition, lack of own staff's skills to introduce and operate the new technology. Currently, moreover, it was found that this known situation was not simply due to an overly phlegmatic mindset on the side of potential users but notably aggravated by a limited engagement of technology suppliers in customer-supplier relationships.

To address the above-mentioned issues, technology providers need to explore and adopt unconventional business models that provide novel options for the acquisition of AMT through closer customer-supplier relationships and risk sharing. Examples of such business models are leasing, renting, pay-per-part models (from the financial perspective), the provision of skilled personnel and support for operations management (from the skills' perspective), models guaranteeing the availability of machinery and adequate production capacity to meet market turbulences or a predefined quality of manufacturing (from a technical and operational point of view). Such innovative business models offered by technology providers would be particularly needed when production needs to be scaled up in SMEs and relevant knowledge and practical capabilities can no longer be acquired in pilot plants or demonstrators alone. Hence, it is recommended that concepts, ideas and suggestions for tools developed in past research projects and academic analyses shall be finally exploited for the diffusion of advanced manufacturing technologies in practice.

4 Concrete Suggestions to Promote Better Business Models

- capitalise on existing knowledge about servitisation and business models,
- financially support novel business models drawing on the structural funds,
- support clusters in their efforts to build relevant strategic partnerships,
- diffuse success stories of business models driving regional ecosystems.

4 Strengthen policy coordination

Improve the better alignment of European, national and regional policies

In the course of the analysis, many firms mentioned that while they were aware of some support measures and had experienced them as effective in specific cases, they remained confused by a multitude of offers at different levels, which, more often than not, appeared overlapping or even contradictory. The fragmentation and complexity of existing funding opportunities makes it impossible for firms to be aware of all of them and in the end may discourage them from applying for any.

Hence, a better alignment among support policies at various levels is needed to exploit synergies and complementarities, as well as to achieve a higher critical mass of support actions for the uptake of advanced manufacturing technologies by SMEs. This better alignment of policies needs to be achieved from a perspective of both substance (i.e. the thematic areas supported in different policies) and finance (i.e. enabling the combination of relevant sources of funding). Policy-makers at different levels should cooperate based on their respective competences. At the regional level, policy makers have best knowledge of local enterprises' practical needs and can leverage the local system of intermediaries. At the national level, policy makers are able to summon the greater amount of critical mass needed to design excellence-oriented innovation policies with global ambitions. The European level, finally, provides an ideal arena to consolidate and connect existing efforts at a higher level, along value chains, co-ordinating mutual good-practice learning, financing high-profile projects and filling gaps with regard to dissemination.

4 Concrete Suggestions to Improve Policy Coordination

- support and empower regions in the elaboration of innovation strategies[1],
- involve local clusters as partners in the process of policy definition,
- set up and strengthen European 'platforms for industrial modernisation'[2],
- set aside resources for trans-regional cooperation for technology uptake[3].

[1] Smart Specialisation Strategies (RIS3)

[2] e.g. the current Smart Specialisation Platform for Industrial Modernisation

[3] through e.g. further initiatives following the example of the Vanguard Initiative

Conclusions

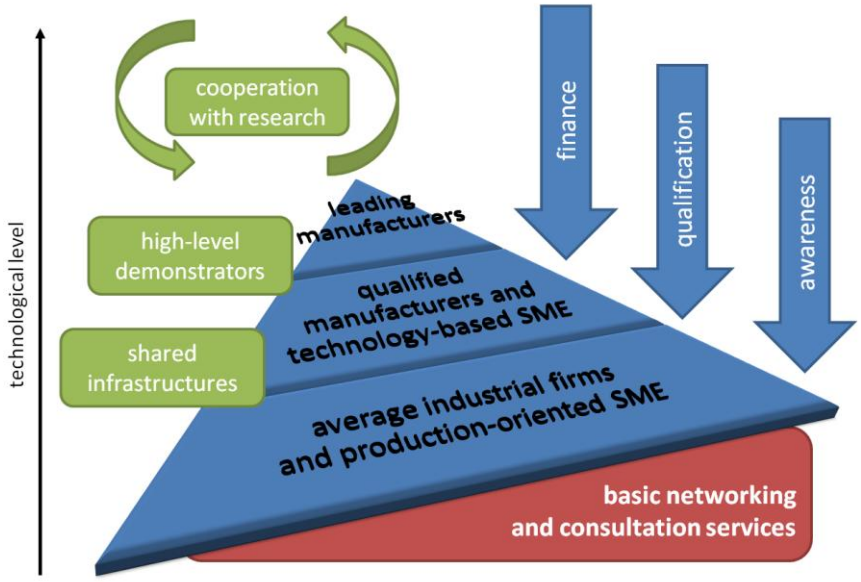
In conclusion, this paper suggests an effective, multi-level strategy for European industrial modernisation that will have to rest on three main pillars:

- measures and actions on the **supply (or provider) side** that improve access to relevant technologies and related services at various levels of sophistication;
- measures and actions on the **demand (or user) side** that enable and qualify more firms to take part in, and profit from, related offers;
- enabling measures **on the basis of European industry** which ensure that the benefits of technology uptake can be leveraged by as many firms as possible.

If pursued in an integrated manner, all three support areas form an organically connected system of policy support that, at the same time, would allow

- a large number of firms to gradually move up the "readiness ladder" with a view to technology uptake (by **strengthening capacities**),
- leading user firms to forge ahead globally be taking up and further develop manufacturing technologies in co-creation (by **enabling high-end uptake**),
- leading providers of manufacturing technologies to liaise and integrate efforts with potential users of their products (by **improving technology offers**)

Figure 3: Leverage Points of Different Types of Policy Action in the Industrial System



Source: European Commission, 2016: 61

References

European Commission, 2016: An analysis of drivers, barriers and readiness factors of EU companies for adopting advanced manufacturing products and technologies. Private Authors: Henning Kroll, Giacomo Copani, Els Van de Velde, Magnus Simons, Djerdj Horvat, Angela Jäger, Annelies Wastyn, Golboo Pourabdollahian, Mika Naumanen. Catalogue Number, ET-07-16-158-EN-N, European Commission, Brussels.

Contact

Dr. Henning Kroll

Fraunhofer Institute for Systems and Innovation Research ISI
Breslauer Straße 48
76139 Karlsruhe

henning.kroll@isi.fraunhofer.de

Note & Disclaimer

This publication is a summary of an in-depth report to the European Commission with the central purpose of increasing the accessibility of its findings. Repeatedly, specific wording and terminology have been adapted to ensure better readability for a non-expert audience. However, none of the presented findings deviates in substance from the original report. Sometimes, only the most central among several aspects listed in the full report were retained for presentation. Hence, the in-depth report remains the authoritative source on all findings of the study.

In any case, neither this paper's authors nor their employing organisations have the intention to represent the official opinion of the European Commission as contracting authority.