PHOTONICS PUBLIC PRIVATE PARTNERSHIP

Photonics21 – Photonics cPPP
Progress Monitoring Report 2020

Produced in 2020 based on data from 2019

Disclaimer:

This document has been prepared by Photonics21 and it reflects the views only of its authors.

Contents

Executive Summary

Photonics is one of the key "deep-technologies" for Europe. Only recently the European Investment Bank labeled photonics as one of these "essential key enabling building blocks for the digital transformation of Europe which will be based on deep technologies"[1]. Therefore, the European Commission and Photonics21 agreed to join forces and establish a Public Private Partnership in Horizon 2020.[2]

The Photonics cPPP represents a long-term commitment between the European Commission and the Photonics industry, represented by Photonics21, to jointly invest in Europe for *fostering photonics manufacturing, job and wealth creation in Europe*, *accelerating Europe's innovation process and time to market in Photonics* as well as *mobilizing, pooling and leveraging public and private resources to provide solutions for major societal challenges* facing Europe.

Photonics industry and academia joined forces and prepared an ambitious roadmap for Europe called *"Towards 2020 – Photonics driving economic growth in Europe"*[3] in 2013. Since then the Photonics cPPP roadmap is continuously updated by the community and research and innovation priorities are implemented via Horizon 2020 Photonics KET calls.

The Photonics Partnership projects demonstrated a 5x fold industry investment leverage. This even exceeds the commitment the European photonics industry provided in leveraging public funds. As a matter of fact, the European SME based Photonics industry is investing about 10 billion Euro per year in Research, Innovation and Manufacturing in Europe and belongs to the most innovative industries.

Since 2014, the Photonics cPPP has started about 117 Horizon 2020 Photonics KET (PPP) research and innovation projects, with a public investment of about €540M (*More details to be found in §2 and 3.3*).

The Photonics cPPP is looking back on a very successful year 2019 – as underlined by the following milestones *(More details to be found in §2 and §3)*:

- 17 new Horizon 2020 projects started with a total budget of € 105.551.394,31. - 106 industrial participants – representing 56 % of total participants - demonstrating a strong industrial commitment fiercely driven by end-user needs.
- Following the community based Strategic Vision Document "Europe's age of light! How photonics will power growth and innovation", 9 work groups with about 500 experts from the community involved were engaged to discuss the next Strategic Multiannual Roadmap.
- The"European Photonics Venture Forum" (EPVF) was conducted in Munich, bringing together >30 high tech investors and >30 photonics start-ups to responded to the so far unmet capital demand of innovative young photonics companies.
- The Photonics cPPP triggered joint funding activities between member states and regions (e.g. in the EUREKA call) and linked the Photonics PPP strategy with regional Smart Specialization Strategies (S^3)**.** More than 15 regions are involved in the photonics S^3 initiative, North Brabant being in the lead.
- Nearly 19Mio. readers were reached through Photonics cPPP project impact and success stories which were reflected by 240 articles in the media

More generally, and looking back at 5 years of activities, it can be stated that most objectives of the Photonics cPPP –have been achieved:

[1] European Investment Bank, Innovation Finance Advisory, European Investment Bank Advisory Services (2018): Financing the digital transformation – Unlocking the value of photonics and microelectronics, Luxembourg, 2018. P. 9.

[2] Photonics21 is an industry driven stakeholder organization representing more than 1700 photonics affiliations.

[3] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2013): Towards 2020: Photonics Driving Economic Growth in Europe: Multiannual Strategic Roadmap 2014-2020, Düsseldorf, 2013.

- European Photonics industry has grown by 62% (CAGR +5%) in the last 10 years, Since 2005, the European photonics industry has shown a solid long-term growth of 5% - turning out twice of the growth of the global GDP and despite the financial crisis experienced 2008/2009.
- In the same time (2005-2015), the number of people employed in the European Photonics industry has shown an impressive overall growth of + 23% (CAGR +2.1%) – leading to 290.000 people employed in this sector in 2015. This trend is expected to continue, and current estimations assume that 42.000 new jobs could be created by 2020 compared to 2011.
- Moreover, European Photonics Industry could successfully defend leading market position (30 – 50 % of global share) in its core segments Production Technology, Measurement and Machine Vision, optical Components and Systems and Medical technology and Life Science. All together it holds a strong # 2 position on the globe behind China but before Japan and US.
- Photonics related projects in H2020 cover all most of the megamarkets such as personalized Health Care, Industry 4.0., Secure Digital Society, Smart Cities and Homes & Digital Infrastructure and many more.
- European photonics companies are highly committed to research and innovation. The private sector's involvement in H2020 in the photonics segment is better-than-average with e.g. photonic SMEs succeeding better than average in submitting SME Instrument (SME-INT) projects.

The Photonics PPP conducted an update on the study on the Photonics impact in Horizon 2020 as well as on measuring KPIs using an updated online survey. Progress made in relation to the specific Key Performance Indicators (KPIs) has been measured among the participants of the 117 PPP Projects – project coordinators and participants - in Horizon 2020. The high response rate of 125 people, representing 48 projects, and the results shown concerning growth expectations, time-to-market, leverage effects, spin-offs and new job creations– underline the success of the Photonics cPPP. *(More details can be found in §3.2)*

Over the last years, the Photonics cPPP has developed to become a successful and increasingly effective partnership. Specifically, it is successful in involving the broad Photonics SME based community in the development and implementation of the European Innovation strategy in Photonics and with Photonics for many application areas. Key to involvement of SMEs is the fully open, democratic and transparent decision-making process of Photonics21 and the lean and effective structure of the platform – well accompanied by the new and lean SME instrument in Horizon 2020 which is used by many Photonics SMEs. As a matter of fact, Photonic SMEs have had a higher than average success rate in submitting 'SME Instrument' (SME-INT) projects, especially for the phase 2 calls. Nearly 15% of the projects which were funded under both phases 1 and 2 from 2014 to May 2017 were photonic projects. The consistency of the projects submitted by the photonic related SMEs was also recognized as 11.35% of the companies which signed a SME-INST-1 also signed a SME-INST-2, compared to the average 5.57% for all H2020. *(More details on lessons learned can be found in §4)*

However, planning for the next decade, the private partner of the partnership, Photonics21, consulted more than 3,000 people affiliated to more than 1,700 companies and research organisations in a series of workshops to prepare a major update of the European Photonics Strategic Roadmap, which was published and handed over to the European Commission on 27th March 2019.[4]

[4] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2019): Europe's age of light! How photonics will power growth and innovation – Strategic Roadmap 2021-2027, Brussels/Dusseldorf, 2019.

1. Introduction: The Photonics cPPP

On 17th of December 2013 Vice-President Neelie Kroes signed the agreement setting up the contractual Photonics Public-Private Partnership (Photonics cPPP). In recognition that – as one of six Key Enabling Technologies (KET's) in Europe – Photonics plays a major role for driving growth and employment in Europe and contributes to solve the major societal challenges such as aging society, energy efficiency, inclusion and smart living, the Photonics cPPP aimed at promoting and strengthening European photonics in a very competitive market[5] with strong non-European players like China or South-Korea.[6]

Against the background of the preparation of the 9th Framework programme *Horizon Europe*, the Photonics PPP has invested in an important strategy and roadmapping process involving aside of the whole European Photonics community also external experts in intense workshop sessions. This resulted in the Vision Paper for Photonics published end of 2017 demonstrating in 9 key megamarkets and application areas the ambitions Photonics has.[7] For example: by developing and fostering the use of core photonics technologies, food production will become more transparent and safer. Road transport will become nearly accident-free saving thousands of lives. Medical treatment can start earlier through instant diagnosis of diseases allowing citizen to live longer and healthier lives. Thousands of new manufacturing jobs will be created in Europe by introducing versatile laser-based technologies.

Based on this visionary approach of the impact of photonics for future application areas, the set-up of the Multiannual Strategic Roadmap started in 2018 and was finished in 2019, leading to the publication of the European Photonics Strategic Roadmap for the period 2021-2027 in March 2019. This will lay the ground for discussing research priorities to be funded in the upcoming bi-yearly EC Work Programmes – starting with 2021/2022.

2. Main activities and achievements during 2019

2.1 Overview on the Photonics PPP Projects and Calls

In 2019 the EU Commission funded 17 Photonics PPP projects in total: 8 Research and Innovation Action (RIA), 8 Innovation Actions (IA) and one CSA.

- ICT 05-2019 -Application driven Photonics Components - Call budget €76,5 mio.
- ICT 03-2019 - Manufacturing Pilot Lines - Call budget €30 mio.

The total effective funding for Photonics PPP projects in 2019 amounted to € 105,5 mio., which were going to 188 participants in the projects. The industrial participation was high with 56 % of the participants – thereof 50 % coming from SMEs, which brings the total SME participation in the 2019 Photonics PPP project funding to 28 %.

[5] The global market for photonics applications amounted for €447 billion (in 2015) - nearly doubled in the respective period 2005-2015 and is expected to exceed €615 billion in 2020.

[6] See also §4.

[7] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2017): Europe's age of light! How photonics will power growth and innovation", Photonics21 Vision Paper, Brussels / Düsseldorf / Berlin / Frankfurt am Main, 2017.

EU Commission Funding Photonics PPP Projects	2019
Total Funding for Projects (in €)	**105.551.394,31**
Number of Participants in Projects	188
Industrial Participation (# of Companies)	106
% of total participants	56%
of which are SME's (# of SMEs)	53
SME % of Industry participants	50%
SME % of total participants	28%
Budget for Industry (in €)	46.110.368,56
Budget for Industry % of total funding	44%

Source: DG Connect / Photonics Unit / March 2020.

Looking on the overall Photonics PPP funding in Horizon 2020 the picture is as follows: Total funding amounted to € 540 mio. which were granted to 1260 participants. Industry participation is ongoing on a high 55 % level of participants with 51 % of those coming from SMEs. Funding for industry makes up for 46 % of the budget – thereof 52 % going to SMEs.

EU Commission Funding Photonics PPP Projects	2014-2019
Total Funding for Projects (in €)	**540.061.841,01**
Number of Participants in Projects	1.260
Industrial Participation (# of Companies)	699
% of total participants	55%
of which are SME's (# of SMEs)	359
SME % of Industry participants	51%
SME % of total participants	28%
Budget for Industry (in €)	249.225.457,96
Budget for Industry % of total funding	46%
Budget/Grants for SMEs (in €)	128.934.087,53
Budget/Grants for SMEs in % of total funding)	24%

Source: DG Connect / Photonics Unit / March 2020.

2.2 Implementation of the calls for proposals evaluated in 2019

Photonics PPP projects demonstrate a strong industrial commitment and are driven by end-user needs.[8]

In 2019, the **ICT-05-2019 and the ICT-03-2018-2019** calls addressed photonics related proposals and covered Research and Innovation Actions (RIA), Innovation Actions (IA) and Coordination and Support Actions (CSA).

ICT-05-2019: Application driven Photonics Components

This call provided with a **budget of about 76.5 M€** focuses on Photonic technologies for health applications. Despite of significant technological results in the over the past decades, industrialization in this field is still lagging behind. The challenges are therefore "to develop methods that provide the clinicians with photonics enabled tools to improve or to assess the successes of therapies and to transform low TRL technologies into robust medical devices answering to clinician needs. Photonic circuits are typically employed in combination with high performance electronics, micro-optics while the thermal management and the efficient integration of these technologies is accordingly of major importance. The challenge is to

[8] All figures in the following paragraph: EC, DG CONNECT.

create and develop advanced techniques for intimate integration of sub-systems incorporating multiple technologies enabling application across multiple domains." [9]

More specifically, the focus was set on:[10]

a) Innovation Actions

i. Photonics devices to support monitoring therapeutic progress: The objective is to develop reliable (high sensitivity, specificity and accuracy), safe to operate, cost-effective and fast photonics enabled devices to support assessing the effects of treatments of major diseases like cancer (excluding skin cancer), infectious, degenerative and cardiovascular diseases, including determining individual dispositions (eg methods to assess drug resistance) and monitoring of therapy progress.

ii. Sensor-Based Optimization of Production Processes: Actions should address prototyping, demonstration, optimization and validation in real industry settings of highly advanced smart broadband multimodal photonic sensing solutions operating in the spectral range from the ultraviolet to the far infrared, and intended for improving production process through the monitoring of relevant process and product parameters (e.g. physical, chemical, imaging, geometrical and environmental). The focus is on cost-effective process-integrated solutions that are optimized in terms of speed, quality, and resource efficiency.

b) Research and Innovation Actions

i. Photonics System on Chip/ System in Package for optical interconnect applications: Actions should address advanced techniques for the intimate combination of photonic integrated circuit technology with other enabling circuits, devices and mother boards to realise major advances in the capability, performance and complexity of photonic system-on-chip and system-in-package components targeting photonic interconnect applications in the network, datacentre and consumer communication space. A holistic approach from design through to test is required. The targeted component technologies need to have demonstrable performance advantages in terms of speed, energy efficiency, cost and reliability and fit in the system and network architecture roadmaps of vendors.

ii. Photonics systems for advanced imaging to support diagnostics driven therapy: Actions should research ground-breaking, reliable (high sensitivity, specificity and accuracy), safe to operate, cost-effective and fast photonics enabled imaging system to support diagnostics during intervention and treatments of major diseases like cancer (excluding skin cancer), infectious, degenerative and cardiovascular diseases. Physicians/clinicians/surgeons and a medical equipment manufacturer must be closely involved from requirement specifications to validation in clinical settings. Validation should take gender specificities into account. Clinical trials are excluded.

c) Coordination and Support Actions:

i. Fostering careers in photonics: Actions should reach out to STEM graduates/PhD students and young postdocs in order to encourage more of them to pursue a career in photonics. Actions should help make students more industry ready and should provide the appropriate training, encourage innovation and entrepreneurship. Gender issues must also be addressed.

As a conclusion on the ICT-05_2019 calls it can be noticed that all subtopics and themes are covered by the retained proposals. There was a very strong participation of industry in the call with 61 % of the IA's and 53 % of the RIA's – as well as a very good SMEs participation in the proposals retained for funding with 40 % of the IA's and 33 % of the RIA's.

[9] European Commission, Work Programme 2018-2020, 5.i. Information and Communication Technologies, European Commission Decision C(2018) 7238 of 13 November 2018, p. 36.

[10] Based on the description in the European Commission, Work Programme 2018-2020, 5.i. Information and Communication Technologies.

Looking into the success rate of ICT-05-2019 the following table shows it by themes:

Topic ICT 05_2019 – Success Rate per Theme			
Theme	Received	Retained	Success rate
Sensor-Based Optimization	15	3	20%
Photonics devices to support monitoring	8	3	38%
Photonics systems for advanced imaging	24	5	21%
Photonics System on Chip/ System in Package	19	3	16%
Fostering careers in photonics	3	1	33%

Source: DG Connect / Photonics Unit / March 2020.

ICT-03-2018-2019: Photonics Manufacturing Pilot Lines for Photonic Components and Devices – budget about 30 M€

Acknowledging the fact that "Photonics is driving innovation in many different application areas", the challenge behind this call "is to help European companies become more competitive by improving their business/production processes as well as products and services by means of photonics technology. The aim is to accelerate the design, development and uptake of photonics technology, by a wide range of industrial players, in particular SMEs by providing low-barrier access to volume production of advanced photonics components available to a wide range of industrial players, in particular SMEs which would otherwise not have easy access. Photonics Manufacturing Pilot Lines should form the basis for future Photonics Digital Innovation Hubs."[11]

The focus of this call lay on Manufacturing Pilot Lines, i.e. on "actions [that] should provide open access to manufacturing of advanced photonics components and systems and offer related services including design and characterization".

The success rate of OCT-03_2019 is displayed below:

Topc ICT-03-2019 Success Rate by Themes			
Theme	Received	Retained	Success rate
Free Form Optics	7	1	14%
Medical Devices	1	1	100%

Source: DG Connect / Photonics Unit / March 2020.

The Photonics PPP projects, resulting from the 2019 calls, started in the last months of 2019 or 2020. An overview of the entire portfolio of the funded Photonics PPP projects can be found in the annex of this report (Stand: March 2019) as well as on www.photonics21.org/ppp-projects, where a summary of all the funded projects is provided, and divided by topic areas. Each project has a brief description of its objectives and is regularly updated.

Outlook on 2020 calls:

The EU Commission also gave an outlook on the Horizon 2020 calls foreseen in 2020 –the last year of Horizon 2020: In total the budget for Photonics PPP projects will amount to € 115,5 mio. assigned to 3 call topics:

[11] European Commission, Work Programme 2018-2020, 5.i. Information and Communication Technologies, European Commission Decision C(2018) 7238 of 13 November 2018, p. 12.

1. ICT-36-2020 - Disruptive photonics technologies – Call budget 47.5 M€

   Research & Innovation Actions

   i. 3D light field and holographic displays
   ii. Packaging and module integration for photonic integrated circuits (PIC)
   iii. Light to Fuel
   iv. Next generation biophotonics methods and devices as research tools to understand the cellular origin of diseases

   At least one proposal will be selected to cover each of these themes.

2. ICT-37-2020 - Advancing photonics technologies and application driven photonics components and the innovation ecosystem– Call budget 49 M€

   Research & Innovation Actions [30 M€]

   i. Flexible Farm-to-Fork Sensing
   ii. Novel Photonics Integrated Circuit (PIC) Technology building blocks

   Innovation Actions [15 M€]

   Smart Photonic for Environmental Pollution Detection Sensing

   Coordination and Support [4 M€]

   An industrial strategy for photonics in Europe

   At least one proposal will be selected to cover each of these themes

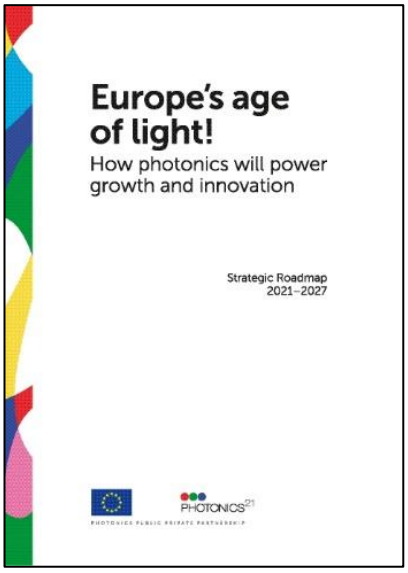
   Only 1 proposal will be funded under theme iv

3. DT-ICT-O4-2020 –Photonics Innovation Hubs – Call budget 19 M€

2.3 Mobilisation of stakeholders, outreach, success stories

Finalization of the European Photonics Strategic Roadmap 2021-2027

In designing a new strategy for European photonics, Photonics21 has built on the Photonics PPP's proven collaborative approach. In preparation of Horizon Europe, Photonics21 consulted in the course of 2018 with the European photonics community, including more than 3,000 people affiliated to more than 1,700 companies and research organisations. In a series of 12 workshops and based on the Photonics21 vision document "Europe's Age of Light! How photonics will power growth and innovation" the European photonics community developed the new European Photonics Strategic Roadmap, which was published and handed over to the European Commission on 27th March 2019 alongside the Photonics PPP Annual Meeting 2019.



The Photonics21 secretariat coordinated the overall strategy process, prepared the workshop sessions and was responsible to ensure an open and transparent community process where all members of the different Photonics21 work groups were invited to provide their feedback to the thematic chapters of the roadmap.

The new photonics roadmap outlines the future photonics research and innovation challenges for the next 7 years in following areas:

- Information & Communication
- Industrial Manufacturing & Quality
- Life Sciences & Health
- Emerging Lighting, Electronics & Displays
- Security, Metrology & Sensors
- Design & Manufacturing of Components & Systems
- Photonics Research, Education & Training
- Agriculture & Food
- Automotive & Transport

Following the publication of the photonics roadmap in 2019 the Photonics21 community has discussed and agreed on concrete proposals for photonics call topics for the new EU framework programme Horizon Europe work programme 2021-2022 based on the identified research and innovation challenges as outlined in the new photonics roadmap. This process started alongside the Photonics PPP Annual Meeting 2019 with interactive Photonics21 work group discussions and was continued throughout summer 2019 via electronic work group consultation. The final Photonics21 work group proposals for photonics call topics were presented during the Photonics21 Board of Stakeholder meeting which took place on 27th November 2019 in Brussels.

A pdf version of the photonics roadmap is available for download at the Photonics21 website:

https://www.photonics21.org/ppp-services/photonics-downloads.php

Following the assumption of office of the new von der Leyen Commission which has outlined their political priorities for the next years, the European Commission Photonics Unit has asked the Photonics21 secretariat to provide an update of the photonics roadmap which should reflect the new political priorities and which should be finalized in November 2020. The update of the photonics roadmap will also consider the restructuring of the Photonics21 platform and its new work groups when it comes to the update of the thematic chapters outlining the research and innovation challenges for 2021-2027.

Photonics PPP Annual Meeting 2019: Europe's age of light – How photonics will power growth and innovation

Handing over of the European photonics roadmap to Carl Buhr, Deputy Head of Cabinet of Commissioner Gabriel, European Commission, alongside the Photonics PPP Annual Meeting 2019 on 27th March 2019 in Brussels.
Source: Iris Haidau, Photonics21/VDI Technologiezentrum GmbH

The Photonics PPP Annual Meeting 2019 entitled *Europe's age of light – How photonics will power growth and innovation* was held on 27th and 28th March 2019 in the Royal Museum of Fine Arts and the Square Brussels Convention Centre. Keynote speaker of the symposium on the first day was Nobel Prize winner Professor Gérard Mourou who shared his insights in his keynote speech *'extreme light for the benefit of humanity'*. The European Commission underlined the role of Photonics as a Key Enabling Technology for the future of Europe and gave a clear message that it will support the topic in the next framework programme. Deputy Head of Cabinet of Commissioner Gabriel, Carl Buhr, discussed the possibilities that lie ahead for the structuring and administration of photonics funding throughout the next framework. With a view from industry, Chairman of the Executive Board of JENOPTIK AG, Stefan Traeger, had a positive message for the current position of light technologies. While European success was based on consistent, methodical approaches to government-funded research, Traeger stressed the importance of academia-industrial partnerships to maintain a world-leading position. After thanking the European Commission for its support in the current framework programme, the Photonics21 Executive Board officially handed over the new European Photonics Strategic Roadmap to Carl Buhr.

On the second event day, the activities of the Mirror Group, where member state authorities are represented, and the first joint Eureka-Photonics21 Mirror Group call for R&D proposals on photonics for advanced manufacturing were presented. A series of speakers from different Public-Private Partnerships, including 5G, European Construction Technology Platform (ECTP), European Technology Platform for High Performance Computing (ETP4HPC), European Cyber Security Organization (ECSO), European Green Vehicles Initiative Association (EGVIA), Electronic Component Systems for European Leadership (ECSEL) and Factories of the Future (FoF), outlined their views and priorities to create discussions and synergies for potential collaborations. The subsequent Photonics21 workshop sessions set about discussing and defining photonics research and innovation priorities for the first calls under Horizon Europe throughout 2021-2022.

Advocacy towards the European Parliament and member states

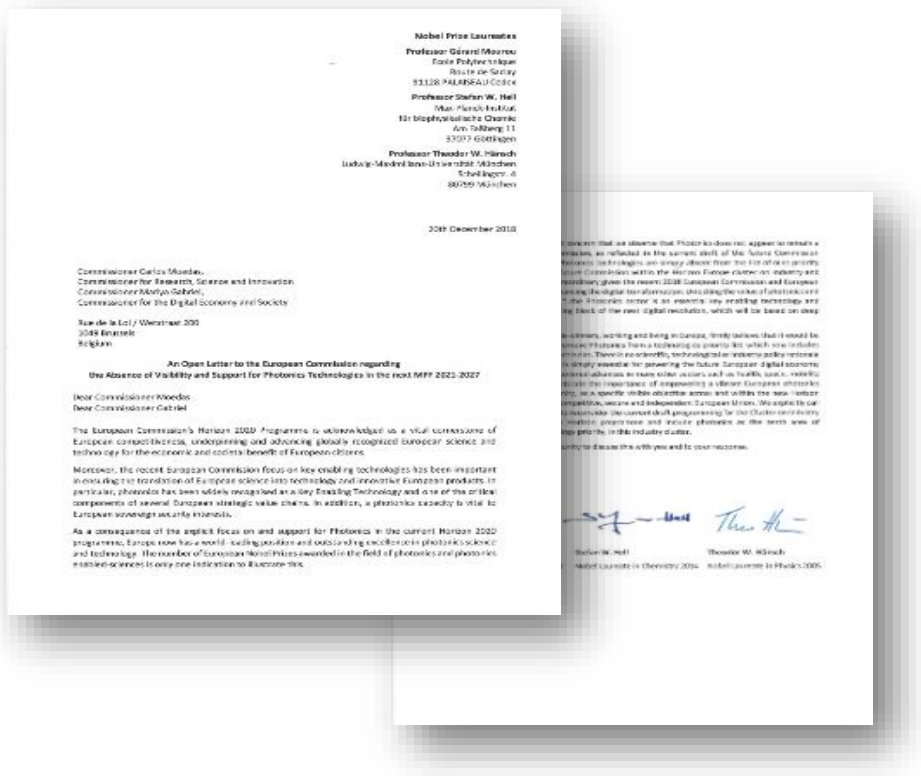
Against the background of the preparation of the next framework programme, 2019 was marked by strong advocacy activities towards the various decision-making bodies in the EU as well as towards the national ministries and governments.

The advocacy activities were supported by a broad alliance within the Photonics Community and included not only industry and science representatives and Nobel laureates, but also many national platforms, clusters, and associated industry associations.

Many international Photonics Organizations supported the initiative for future Photonics partnership
Source: Ohotonics21 / Websites of the Photonics organizations above

In addition to personal meetings and round table discussions with MEPs, EU Commission representatives, national parliament and ministry representatives, the efforts were supported in particular by an open letter from three Nobel Prize winners in physics, who jointly pointed out the great importance of photonics for the implementation of future technologies.

This letter of concern has been prepared and conducted which was signed by the Nobel Laureates Gerard Mourou, Stefan Hell and Theodor Hänsch. It was delivered in January 2019 to the Commissioner Gabriel and Moedas to raise concern about the future of photonics.



Nobel Prize Laureates

Professor Gérard Mourou
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Professor Stefan W. Hell
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37077 Göttingen

Professor Theodor W. Hänsch
Ludwig-Maximilians-Universität München
Schellingstr. 4
80799 München

20th December 2018

Commissioner Carlos Moedas,
Commissioner for Research, Science and Innovation
Commissioner Mariya Gabriel,
Commissioner for the Digital Economy and Society

Rue de la Loi / Wetstraat 200
1049 Brussels
Belgium

An Open Letter to the European Commission regarding the Absence of Visibility and Support for Photonics Technologies in the next MFF 2021-2027

Dear Commissioner Moedas
Dear Commissioner Gabriel

The European Commission's Horizon 2020 Programme is acknowledged as a vital cornerstone of European competitiveness, underpinning and advancing globally recognized European science and technology for the economic and societal benefit of European citizens.

Moreover, the recent European Commission focus on key enabling technologies has been important in ensuring the translation of European science into technology and innovative European products. In particular, photonics has been widely recognized as a key Enabling Technology and is one of the critical components of several European strategic value chains. In addition, a photonics capacity is vital to European sovereign security interests.

As a consequence of the explicit focus on and support for Photonics in the current Horizon 2020 programmes, Europe now has a world-leading position and outstanding excellence in photonics science and technology. The number of European Nobel Prizes awarded in the field of photonics and photonics enabled-sciences is only one indication to illustrate this.

Screenshot of the letter of concern
Source: Photonics21

The letter was followed by a personal 1:1 meeting of Prof. Mourou , Photonics21 Executive Board member Jean-Luc Beylat and Director of Photonics Bretagne, David Méchin with Commissioner Moedas on March 27th in Brussels. Another important meeting with Commissioner Oettinger and 3 representatives of the Photonics21 Executive Board followed on September 3rd, 2019 in the Berlaymont Building.

Gerard Mourou meeting Carlos Moedas in Brussels with Jean-Luc Beylat (right) and David Mechin (left)
Source: Jean-Luc Beylat/Twitter

In the course of the year more advocacy efforts followed as shown in the graphs below – also in close cooperation with the Industry Associations EPIC, Spectaris and VDMA. The European Photonics Industry Association EPIC got the support from 500 CEOs and 100 RTOs being strongly committed to form a future Photonics PPP in Horizon Europe.

Horizon Europe Advocacy Activities – Position Papers and Meetings

- Position Paper to National Minsitries involved in Horizon Europe Negotiation
- Position Paper to European Commission
- Request towards National Ministry on Position of Photonics in Horizon Europe
- Meetings with Member State Permanent Representatives
- 3 High Level Meetings with European Parliament Rapporteur Christian Ehler
- 1:1 talks…

Letters by Photonics Community.
Source: Photonics21

Horizon Europe Advocacy Activities – EPIC Positioning Paper representing about 600 Photonics Affiliations

EPIC Position Paper "Strengthening Photonics Industry Support Within the Future European Commission Multiannual Financial Framework (MFF) 2021-2027"

> 500 CEOs

> 100 RTO Directors

EPIC Position Paper.
Source: EPIC

Photonics21 also continued the close cooperation with Brussels based Networking Platform such as knowledge4innovation (k4i) and Science Business. Aside from attending Conferences, Work Shops and Parliamentarian Breakfast Sessions Photonics showed also presence in the k4i AI-Conference held in the EU Parliament in Brussels in December 2019, where the Photonics Industry Association EPIC was running a Dinner Event which was followed by a strong engagement in the frame of the 11. European Innovation Summit at the Brussels Parliament in February 2020 and at the Annual Meeting of Science Business also in February 2020.

Screenshots from the Science Business and knowledge4innovation websites onResearch & Innovation Events in 2019 in Brussels.
Sources: https://www.knowledge4innovation.eu/k4i-events/; https://sciencebusiness.net/events

Supporting the "European Photonics Venture Forum"

Responding to the needs of the European Photonics Industry, the platform Photonics21 is supporting the European Photonics Venture Forum (EPVF) seeking private equity for seed phase and entrepreneurs. The EPVF, which was first held in 2015 in Rome, is a meanwhile well-established event, taking place yearly in different regions and bringing "together entrepreneurs, investors, corporates and policy makers in an intense and high-energy programme of pitching, ideas sharing, networking and direction setting".[12]

The EPVF Edition 2019 took place in the frame of the "Laser.World of Photonics 2019", a community networking fair in Munich, bringing together the most of the innovative photonics companies. The Startup-World organised in the scope of the fair provided an additional incentive for venture and corporate venture capitalists to attend the event.

Photonics PPP also awarded the winner of the **"Prototype-your-idea" contest** in the frame of this EPVF. NextPho21 started this dedicated Innovation Challenge to push for more entrepreneurship in photonics. It addressed PhD students, master students and makers alike who have an idea for a photonics product that can transform into a real business. The winners were awarded a cash prize of €5000 and access to hand on support to Horizon 2020 PPP prototyping and small-scale production infrastructure to prototype their ideas. Access to prototyping infrastructure and hands on support was provided by ActPhast 4.0 worth up

[12] European Photonics Venture Forum, Event Report, www.techtour.com/EPVF18, p. 3.

to € 30,000 provided in kind by giving access to infrastructure. The award also included a meeting with an experienced photonics entrepreneur and as the case may be with potential first industry customers from Photonics21 membership.

European photonics success and impact stories - Show impact of photonics to end-user industry and the society at large

Preparation of European photonics success and impact stories

Photonics21 provides a central dissemination service to H2020 Photonics KET (PPP) projects. Topics are selected according to the expected impact of the project on a specific end-user industry and the assumed interest of the general public. By engaging with a professional public relation agency specialised in technology and science communication, the stories get professionally edited and distributed with appealing graphics to increase the chance of uptake by target media. Close coordination of messaging and content of success stories is done with the project coordinators and the European Commission project officers responsible for the project.

Distribution of photonics impact stories to end-user industry trade media

Photonics success and impact stories prepared are distributed to end-user industry trade media representing major photonics markets, such as *Automotive News Europe, Medical News Today,* etc. The stories promote the respective Horizon 2020 Photonics KET (PPP) projects to end-user industry in order to trigger collaboration.

Distribution of photonics impact stories to international opinion forming media

Photonics success and impact stories are distributed to international renowned public opinion forming media and websites having a broad readership. Target media include *The Times, The Independent, Daily Mail, Yahoo.com, MSN.com.*

Overview on 2019 Press releases of PPP Projects:

Headline	H2020 Photonics PPP Project
New fast Laser helps Doctors image eye in full	OCTLIGHT
New Blood Test to diagnose Sepsis in Minutes	RAIS
Powerful new Laser to boost Car Industry	PULSE
EU Photonics Project get thousands of Girls in STEM	PhabLabs
Strawberry-picking Robots gather enough Fruit for Wimbledon in 1 Week	OCTINION
Researchers use photonics to develop low-emission 1.6 Tb/s internet	TERIPHIC
New innovation Hub to accelerate Scientific Breakthroughs	ACTPHAST4R
Laser-engraved metal to reduce environmental impact	MULTIFLEX

Source: VDI TZ GmbH.

Further news arising from the projects themselves were then distributed to the photonics community through the Photonics21 dissemination channels website, newsletter, LinkedIn and Twitter.

Campaign Review 2019:

Key Indicators:

- 240 articles (107 End User Media) published
- global readership of over 19 million people
- advertising value totalling +€860K

Photonics Campaign Objectives

To promote photonics technology and its community of industry and research

Quick facts

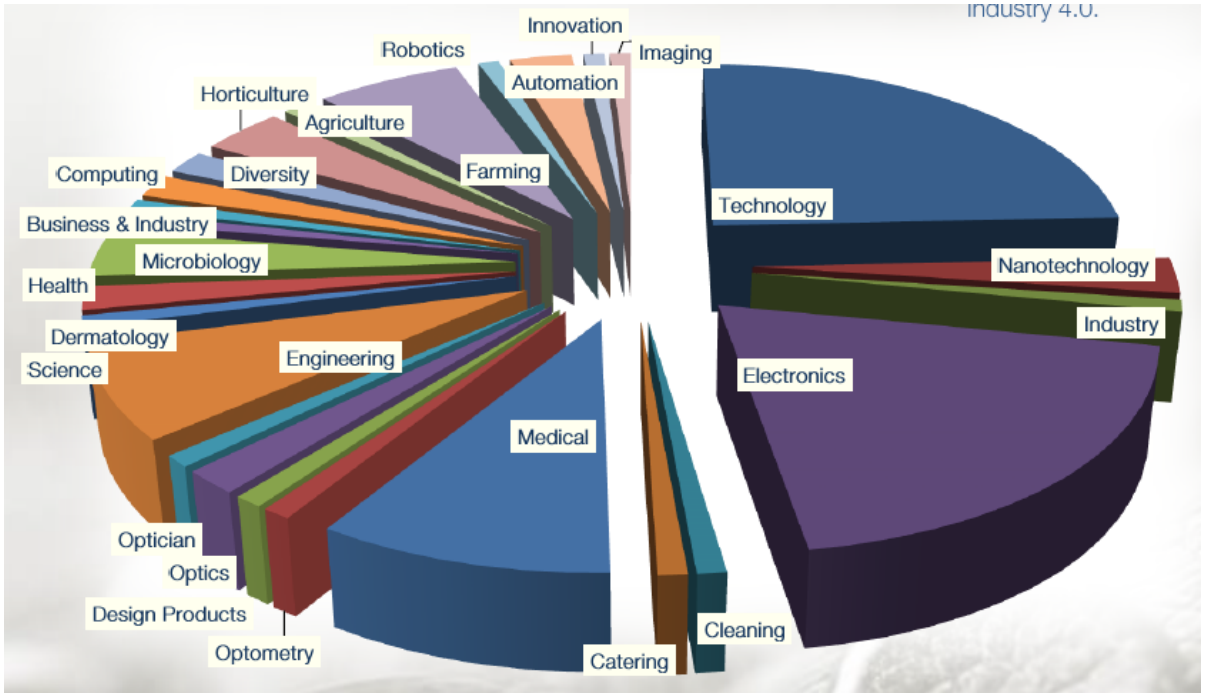
Table showing at-a-glance media coverage of the 8 projects stories as well as another 8 Photonics PPP stories for 2019.

Matter PR Code	Project Name	Press Release	Articles	Photonics	End User Media	News	Unique Monthly	Refined Readership
19 P01	Tresclean Video	*Lotus leaf inspires scientists to create world's first self-cleaning metals*	12	1	7	4	843,150	210,788
19 A01	OCTLIGHT	*New Fast Laser helps Doctors image eye in full*	19	5	13	1	4,934,810	1,644,937
19 P02	Nobel Laureates	*Nobel Laureates Slam EC over Funding Priorities*	17	10	4	3	415,350	138,450
19 P03	RAIS	*New Blood Test to diagnose Sepsis in Minutes*	15	3	11	1	3,229,770	807,443
19 P04	Annual Meeting	*Diary Notice: Summit to show top Megatrends depend on Photonics*	8	5	3	0	514,650	171,550
19 P05	Annual Meeting	*AGM highlights European Photonics Leading Position*	6	5	0	1	351,310	117,103
19 P06	PULSE	*Powerful new Lasser to boost Car Industry*	20	8	5	7	4,378,347	1,459,449
19 P07	Position Paper	*EU Photonics to invest Eur 100 Billion in Horizon Europe*	6	2	3	1	328,570	65,714
19 A02	PhabLabs	*EU Photonics Project get thousands of Girls in STEM*	17	7	9	1	1,097,290	393,294
19 A03	OCTINION	*Strawberry-Picking Robots gather enough Fruit for Wimbledon in 1 Week*	65	1	26	38	727,438,191	13,623,969
19 P08	Biophotonic Event	*DG Connect Biophotonic Event Workshop*	10	1	6	3	4,167,810	833,562
19 P09	Tematys 1	*5-Fold Leverage for Photonics Projects*	7	2	2	3	213,250	36,767
19 P10	Temeaty 2	*Photonics: Indispensable Technology Vital to Innovation*	7	2	3	2	381,660	56,964
19 P11	Tematys 3	*Photonics projects to create 3,500 new high-tech jobs*	10	3	5	2	276,610	34,192
19 P12	TERIPHIC	*Researchers use photonics to develop low-emission 1.6 Tb/s internet*	13	3	5	5	778,850	68,767
19 A04	ACTPHAST4R	*New innovation Hub to accelerate Scientific Breakthroughs*	8	2	5	1	435,020	53,773
19 P13	MULTIFLEX	*Laser-engraved metal to reduce environmental impact*						
Totals			240	60	107	73	749,784,638	19,716,722

Source: MatterPR.

End User Media Breakdown

In keeping with the strategy to promote photonics outside of the community of light, of the 240 articles produced, 107 are in end user media publications.



Source: MatterPR.

2.4 Governance

The Photonics cPPP has grown from the Photonics21 European Technology Platform, which was launched in 2005 with the aim to be the first European platform to bring together stakeholders from industry, academia, and policy in photonics. Since its establishment, the platform has steadily grown and today includes around 1700 organisations – two-fifths of them being companies – with more than 3300 members. In its self-understanding it is an industry-driven platform – which gets reflected also by the governance rule that at least 50 % of the Board of Stakeholder members need to come from industrial affiliations.

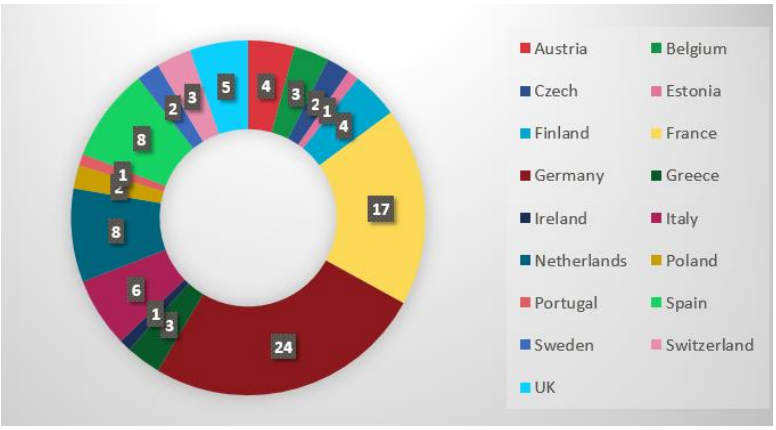
The rise from a niche technology sector to one of the most important industries for the future of Europe is a remarkable achievement and, in part, the result of a firm commitment from the European photonics industry. The photonics stakeholders have continuously worked on updating the European R&D Photonics strategy in an open, transparent, democratic and participative decision-making process, involving many experts across Europe and abroad. This open and transparent process is a cornerstone of the Photonics PPP as well as of the Photonics21 platform and its governance structures and open elections.

The governance structure as well as the principles of the decision-making process in the Photonics cPPP were presented in detail in several previous publications – for more information, please refer, for instance, to the cPPP Progress Monitoring Report 2018[13] and Progress Monitoring Report 2019[14]. As in the last years since the constituency of the PPP in 2019 there was also held an Online Board of Stakeholder Election which in detail is described in the Terms of reference (ToRs).

In the 2019 election 21 candidates (7 from industry, 7 from research and 7 from other organizations) applied for the 21 open seats. From the 224 voters registered, 176 casted a valid vote (78.57%) within October 22nd, 2019 and November 5th, 2019.

The new – and current Board of Stakeholders counts 94 members and is structured with 50 % Industry members (=47 members), 36% affiliations coming from research (=34 members) and 14% others (=13 members)– mainly representatives from industry associations and national photonics platforms. The new BoS is still far from gender balance, as it counts 98% male and only 2% female members. For future improvements it was suggested to put diversity and gender balance in the next PPP in the task and responsibility list of the Executive Board.

The geographical distribution is wide and finds representatives from many countries, including 17 member states. To avoid a too large dominance of the bigger photonics countries (in terms of market share) the maximum number of members from one country is limited to 50 %.



BoS Online Election 2019: Structure of the new Board by Countries
Source: VDI TZ GmbH.

[13] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2018): Photonics cPPP – Progress Monitoring Report 2018, Düsseldorf.

[14] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2019): Photonics cPPP – Progress Monitoring Report 2019, Düsseldorf.

Frequent Dialogue with the European Commission

2019 represents the sixth year of activity for the Photonics21 Association and the Photonics21 Association continued its intensive dialogue with the European Commission a PPP Partnership Board on reaching the Photonics PPP objectives (measured in KPIs) and proceeded the follow up reporting and KPI measuring requirements of the European Commission following the cPPP Mid-term Assessment. This comprises also a more close cooperation and contact with other cPPPs for seeking opportunities for cross cutting themes.

In 2019 two regular Partnership Board Meeting took place in the frame of the PPP Annual Meeting 2019 in Brussels in March and the Photonics21 BoS Meeting in November in Brussels.

Main Topics discussed in the Partnership Board meeting were around the status and positioning of Photonics in the next framework programme Horizon Europe and the future scope and focus. First proposals were discussed to re-structure the Photonics organization to better adapt it to the collaboration needs of the future with other partnerships, programmes and external stakeholders. Another topic was to adapt to the needs of the newly elected parliament and commission.

Aside from the cooperation of the private and public side in the partnership board a more intense exchange in weekly Jour Fix calls between the Photonics Unit of the European Commission and the Photonics21 Secretariat was established to closely co-work on an operational level.

Aside from contacts with the Photonics Unit there is also a frequent exchange with DG Connect and DG Research and other PPPs in the cPPP-Circle introduced. In this committee the various cPPPs presented their efforts to form future partnerships, present vision papers and Strategic Road Maps. How to demonstrate and proof evidence of impact by finding and defining the right KPIs for measuring success, cross-work with external shareholders along the value chain and also define milestones and exit strategies was another basic topic of those meetings with Commission representatives

2.5 Restructuring Photonics Platform – towards an even more open and transparent structure also for external stakeholders

Set-up for intense collaborations and value chain impact –

In the frame of discussing future partnerships within Horizon Europe, it became obvious that there is a need to adapt the current structure of the Photonics21 platform, as well as the PPP towards the new challenges ahead of us as well as to the progress made in the photonics technology since the founding of the European Technology Platform Photonics21 in 2005.

Analysing the future main tasks for a PPP the Executive Board started to develop options for a new set up of the work group structure and the governance model. Thereby the proposed Photonics Partnership aims to tackle the following problems and opportunities:

1. **Structural Challenge and Opportunity**
   The photonics industry is characterised by SMEs. Large pacemakers like those found in the automotive industry are not present. On the other hand, Europe has a unique ecosystem that enables, in principle, close cooperation of suppliers and user industries. In order to address this problem and at the same time make the best possible use of the situation, it is necessary to align fragmented R&I activities along a common roadmap. The close and trusting involvement of the users of photonic technologies is an essential factor for success because the potential of photonic solutions for specific applications is raised in the most effective way when a systemic or holistic approach is followed.

2. **Economic Challenges**
   Digitisation leads to changes in value creation. Smart products and data-based product-related services are gaining in importance as well as the need to design ecosystems and to occupy checkpoints. Technology leadership is necessary but not sufficient. In the future, economic success will also depend on whether it is possible to create an ecosystem with a large network effect. While the B2C sector is dominated by American and Chinese companies, Europe has an excellent starting position for the B2B sector thanks to its pluralistic industrial structure. To use this and not fall behind, however, a concerted approach is required. For the photonics industry and its users, the proposed European Partnership offers the necessary platform for such an approach.

3. **Deployment Challenge**
   Faster Photonics deployment is crucial for ultra-competitiveness. Despite many photonic solutions already existing that improve European competitiveness in different sectors, there are still barriers, which impede a photonics-based approach: often related to cost, size, efficiency, output power, or sensitivity that prevent photonic solutions from being widely deployed. These drivers tend to be common across many sectors and respond to market pull. To overcome those barriers and secure a faster deployment, using economies of scale will be at the core of the future Photonics Partnership.
   Support for both market pull and technology push is essential to ensure Europe makes the most of the transformational impact that photonics offers. For this undertaking, it is vital that we understand the trends that are common across all photonics areas. Solving them will enable a number of the challenges highlighted in the following thematic roadmaps. These key trends are:
   - Integration: making systems smaller and more robust; dealing with a large number of interfaces that can be bulky
   - Modularisation and platforms: developing photonics modules to be used as plug-and-play which requires the development of common standards;
   - Increasingly interdisciplinary R&D
   - Cross-fertilisation from one photonics application area to another

The continuous search for new materials that are more suitable, pushing boundaries on performance and operation across multiple wavebands, has been a trend for many years.
With increasing co-dependence on the advancement of the different photonics areas, the photonics Partnership needs to continue to expand the coordination along the value chains that has led to the decision to restructure our platform to closely cooperate with the value-chain partners and also increase speed to market.

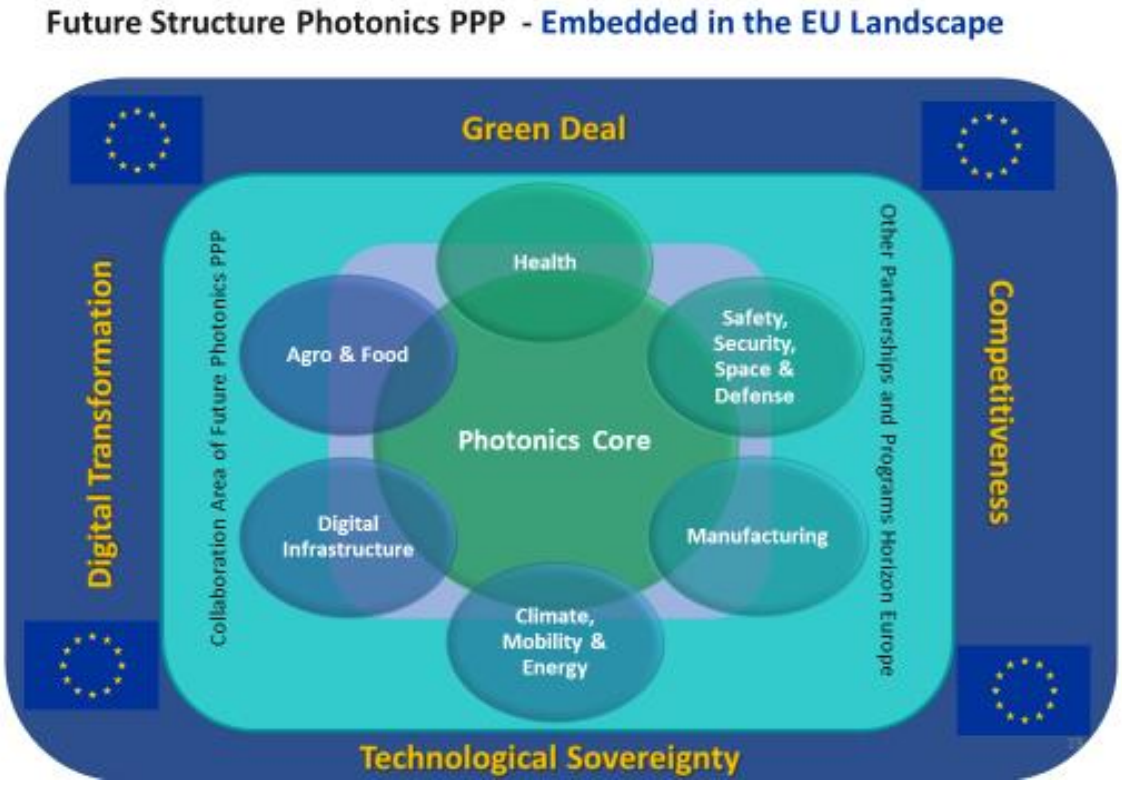
The new European Partnership on Photonics will build on the experiences collected during the recent years of activities; however, it will adapt to the changing needs of the new Horizon Europe framework programme responding to the new challenges the European economy is facing.

The proposed new structure – which in its first version was presented to the Board of Stakeholders in November 2019 - intends to not only secure a better focus on the R&I needs and specifications along the value chain, but also a closer cooperation in Skill Set Development, defining needs for Standards and Regulations, and common look and engagement to ensure Equality and Diversity. It was in his first draft basically very welcomed by the Boar d of Stakeholder members which were asked to provide their input in an internal survey started in December 2019.

In 2020 the work on the new structure and governance models continued whilst the Executive Board formed a 4-heads Steering committee which now works on the further details.

Basically, the proposal for a new structure intends to foster a faster market access of innovations due to targeted developments. It also will put a greater focus on innovations that serve a wider variety of applications and by that enables the use of economies of scale effects of funding Euros.

A major change towards the new Photonics Partnership structure is the set-up of two types of Workgroups with a "Core Photonics Work Group" in the Center and six application oriented work groups in the outer ring – seen as closer to the end-use markets and open for collaborations with new stakeholders from the economic, political and societal value chains.



Future Structure Photonics Partnership
Source: Photonics21 Secretariat – March 2020.

Both Workgroups will clearly have a close interaction and exchange: The application oriented workgroups (A-WGs) will focus on the concrete today's and future needs and specifications of the industry and society. They will be in close contact with the Photonics Core Platform work group to provide their up- and downstream expertise and needs.

The focus of the Photonics Core work group (C-WG) will be on the further development of photonics components, systems and processes – however to a large extend – but not only - steered by the requirements of the downstream needs being defined in the SRIAs of the A-WGs The future rule that those application needs for photonics core technologies will be in focus, which serve at least two major application areas or a really large market will secure the most efficient usage of public and private money to drive the European economy and society.

It is also new that horizontal tasks such as Standards and Regulations, Skill Sets, Impact on Green Deal and Technological Sovereignty and disruptive research are no longer covered in separate workgroups but are integrated tasks in each work group.

3. Monitoring of the overall progress since the launch of the cPPP

3.1 Achievement of the goals of the cPPP

The PPP under Horizon 2020 has managed to mobilise a strong community of industry and academic representatives, enhancing the number of Ph21 members to more than 3000 today, of which 40% representing private companies coming from sectors as diverse as manufacturing, medical engineering or information technology.

Recent analyses and market studies confirmed that the efforts made under Horizon 2020 have contributed to ***increase the production capacity and to strengthen the competitive capabilities of Europe's photonics industry***. The European photonics industry demonstrated a 62% growth in the last 10 years and the European Photonics production growth was by far outgrowing the EU GDP growth by 3.5 times and was also outgrowing global GDP by a factor of 2. The Photonics cPPP has had a positive impact on job creation – according to recent estimations based on a 2020 survey done together with Tematys amongst the 117 PPP Photonics Project partners (2014-2019), about 5800 jobs were created either during a PPP project or as a direct follow-up of a project.

Behind this macroeconomic success, the photonics PPP under Horizon 2020 has ***contributed to create and consolidate a strong Europe-wide Photonics innovation ecosystem*** by linking the various players such as National Platforms, Regional organisations and clusters, developing Core Photonics Technologies, components and systems to become and act as real photonics platform technologies for the next levels in the value chain and supporting upstream photonics technology distribution by supporting the building of demonstrators and pilots centres – for Photonics Start-ups and Photonics SMEs on their way to market, as well as Photonics-enabled and Photonics using Start-ups and SMEs in order to disseminate core photonic technologies towards OEMs and end-users. PPP pilot lines and prototyping projects have boosted industry's digital innovation capacities and helped to bridge the valley of death. According to Photonics PPP project participants, having participated in a PPP project has contributed to accelerating the time-to-market in the innovation process. Furthermore, the PPP has started to build cooperative downstream structures to define their needs and specs on photonic components and systems early on and so improve time-to-market. The positive effects of a European partnership have been shown in the running Photonics cPPP, which has helped to increase the R&I spending quota of the photonics industry in Europe to 10% of sales and fostered additional 4-5 % of sales in CAPEX. This has resulted in an annual €10 billion Euro investment by the European photonics industry research and innovation and an investment leverage of 5 in the scope of the Horizon 2020 PPP. More specifically, the Photonics cPPP has contributed to increasing the share of SME participation in Horizon 2020 projects to 26-27% - compared to 20.4% for all SMEs in Horizon 2020 projects and 23.3% in all projects resulting from ICT Calls (without SME instrument). Additionally, the Photonics cPPP has demonstrated positive impacts on Photonics SMEs – the backbone of the European photonics industry. On the one hand, the cPPP has been a very valuable instrument to mobilise SMEs and promote their involvement in R&D projects. On the other hand, the cPPP calls, which were the result of extensive discussions involving all Photonics21 stakeholders, have actually met the needs of SMEs, leading to a larger participation. Moreover, SMEs involved in Photonics cPPP projects expected an average growth of 6% p.a. – compared to an average growth of about 3% in the overall photonics industry – as well as the creation of 7.4 jobs in average per project. 80% of the companies involved in Photonics cPPP Projects expected the project results to positively affect other areas of their company's activities (see Annex 4 for more details).

The ***public-private partnership was vital for directing these investments along a well-coordinated strategy***. Over the period 2007-2013, the European Technology Platform Photonics21 coordinated two strategy processes, leading to 2 strategic roadmaps published in 2010 and 2013, *Lighting the way ahead*[15]

[15] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH (2010) Lighting the Way ahead, Strategic Research Agenda in Photonics, Düsseldorf, 2010.

and *Towards 2020 – Photonics driving economic growth in Europe*[16]. These roadmaps have played an essential role when designing the orientation of European funding policy in photonics and have contributed to secure financial support for Photonics R&D under both the 7th Framework Programme for Research (2007–2013) and Horizon 2020 (2014–2020). Photonics-related projects could be found in almost all Horizon 2020 programmes and covered all application markets of high relevance for tomorrow's society and economy from personalised healthcare, industry 4.0, smart cities to securing the digital society, connected mobility – to name but a few.

Furthermore, strong ties were forged between research institutions, companies and policymakers across the EU and beyond through a combination of agenda-setting events, training programmes, workshops, publications and many other channels of communication.

For more details, facts and figures on the achievements of the goals of the cPPP, please refer to the extensive description in §3.1 of the cPPP Progress Monitoring Report 2019.[17]

3.2 Measuring progress: Key Performance Indicators

In order to measure the overall progress of the Photonics cPPP, to control the bold commitment of the European Photonics industry, but also the functioning of the PPP itself, Key Performance Indicators (KPIs) were laid out in both the Horizon 2020 regulations as well as in the PPP contract. The KPIs cover the impact of the Photonics cPPP on the Industrial Competitiveness and Economy, its socio-economic impact as well as some operational aspects of the PPP (efficiency, openness and transparency of the PPP Consultation Process) and some performance aspects (a. o. time to contract, levels of response to calls, progress against technology roadmap timetable, Participation of Industry & SMEs in PPP projects).

The list of Key Performance Indicators presently used is given in the Annex – Part 1. Some of the KPIs are common to all cPPP under Horizon 2020 (*Common Priority Key Performance Indicators*), some of them were specifically designed for an individual or several cPPPs (*Specific Key Performance Indicators for the Photonics cPPP*), and some of them deal with the PPP contribution to programme goals (*Programme Level Key Performance Indicators*).

As in the past, the evaluation of the Key Performance Indicators (KPIs) has been performed combining desk research, additional market and impact studies on behalf of the Photonics21 Secretariat/Association as well as via an online survey among the project coordinators of past and current Photonics PPP projects.

Online Survey – Methodology & Main results

The online questionnaire was based on the questionnaire used for last year's survey[18] The survey was carried out in April / May 2020 and closed on 5th May 2020. It must be noticed that the survey was conducted at the height of the coronavirus crisis in Europe, under particularly negative economic conditions and against the background of relative pessimistic forecasts regarding short and medium-term developments. Therefore, the outcomes of the study should be interpreted against this very particular background.

Number of survey participants and response rate

Within Horizon 2020, the Photonics PPP conducted 117 projects with a total funding close to (cf. §3.3). In total, about 1200 project partners participated in these 117 projects.

[16] European Technology Platform Photonics21 c/o VDI Technologiezentrum (2013) Towards 2020 – Photonics Driving Economic Growth in Europe (Multiannual Strategic Roadmap 2014–2020), Brussels

[17] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2019): Photonics cPPP – Progress Monitoring Report 2019, Düsseldorf.

[18] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2019): Photonics cPPP – Progress Monitoring Report 2019, Düsseldorf.

Based on an evaluation of the Cordis database performed on May 15th 2020, the 117 projects funded in the scope of the Photonics PPP involved 699 participants coming from industry, i.e. 55% of all participants, 359 of which being SMEs, which corresponds to about 51% of all industrial participants or 28% of all participants. The budget allocated to industry participants was about 249.225 k€, representing about 46% of the total funding of 540.062 k€ allocated to all 117 PPP projects.[19]

The online questionnaire was addressed to all current and past photonics PPP Projects coordinators and – as last year – the project coordinators were asked to forward the online questionnaire to *all project partners*. Involving not only projects coordinators in the survey, but also partners which are only responsible of parts of the projects, enables to get more various insights on individual experiences and effects of the Photonics cPPP at company level.

In total we got 125 responses, 123 of which being valid responses, in the time from April 8th to May 5th 2020, representing 48 different projects[20], therefore a response rate of about 41% with regard to all 117 Photonics PPP projects – which is a quite good response rate for this type of online survey, especially against the background of having many Photonics cPPP projects completed in the meantime and the persons involved in these projects being no longer available and/or not willing to take part in such a study.

Among the 48 projects represented in the survey, 28 are still ongoing (about 58%) whereas the other 20 have been already completed (about 42%). This is not that far from the ratio of ongoing projects (48%) to completed ones (52%) among all 117 Photonics PPP projects. It should be noticed that there was a high participation (40%) from new projects, meaning from projects added from the 2019 call and started in late 2019 or early 2020. This might have to be considered when analyzing the results – since these new projects are still at the beginning of their efforts and might not have reached the milestones targeted yet.

Accuracy vs. limitations of the online survey

Companies account for 43% and RTO/Universities and research for 53% of all answers, the remaining 4% relate to "other" organizations like associations, etc.

These figures should be put in relation with the number of industrial participants in Photonics cPPP projects in the period 2014-2019 (cf. tables below):

The big companies especially were very few to respond to the Survey 2020 compared to their participations in the PPP Projects.

- RTOs and Universities displayed with 53 % the highest response rate – clearly above their percentage of participation (42 %) in PPP projects.
- Industries account for 53% of all participations in cPPP Photonics projects, but only for 43% of all respondents. Companies are therefore – as could have been expected – slightly underrepresented in the survey outcomes, however the divergence is still within an acceptable range and it can be expected that this will not affect the validity of the results of the online survey.
- More specifically, SMEs displayed a response rate of 31% - fairly above the 26% of participation in PPP Projects - whereas the response rate of large companies is with 12% far below the actual participation of big companies in PPP Projects (27%). This means that SMEs are quite *over*represented and big companies significantly *under*represented among the survey respondents. There might therefore be a slight bias regarding the analysis of companies' answers, and this should be beard in mind. However, given the fact that one of the focuses of this year's questionnaire was to get more reliable information of the impact of the PPP of SMEs than it had been done in the past years, the bias towards SMEs in the among the companies' respondents may even be positive.

[19] Source: DG Connect / Photonics Unit / March 2020, sell §2.1.

[20] For 2 of the 130 answers collected, the name of the project the respondent is participating in was not given.

Distribution of funding and project participants in Photonics cPPP projects:

EU Commission Funding Photonics PPP Projects	2014-2019
Total Funding for Projects (in €)	**540.061.841,01**
Number of Participants in Projects	1.260
Industrial Participation (# of Companies)	699
% of total participants	55%
of which are SME's (# of SMEs)	359
SME % of Industry participants	51%
SME % of total participants	28%
Budget for Industry (in €)	249.225.457,96
Budget for Industry % of total funding	46%
Budget/Grants for SMEs (in €)	128.934.087,53
Budget/Grants for SMEs in % of total funding)	24%

Source: DG Connect / Photonics Unit / March 2020.

Comparison between survey responses 2020 and Photonics cPPP Participation per type of organization:

	Survey Respondents		Participations	
	Number	%	Number	%
SME	38	31%	323	26%
Big company	15	12%	346	27%
RTO/University/Research	65	53%	533	42%
Other	5	4%	58	5%
Total	*123**	*100%*	*1260*	*100%*

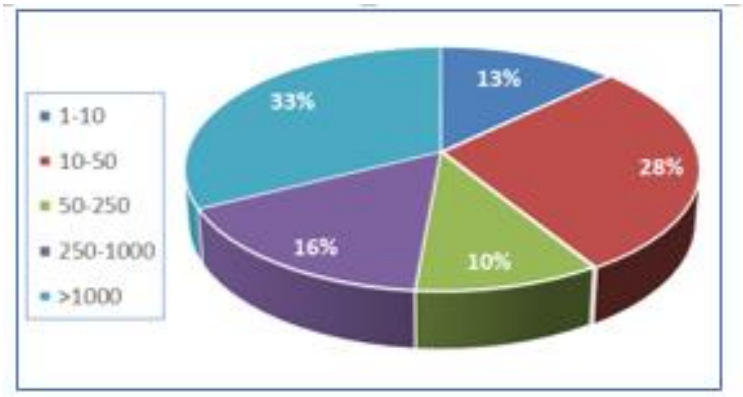
Source: Tematys, 05/20.

Structure of Photonics industry vs industrial structure in the Photonics PPP

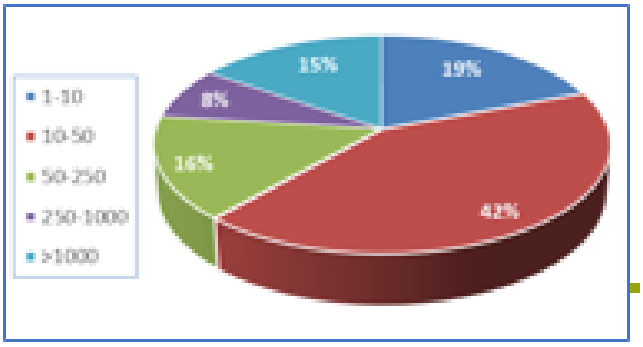
It is interesting to note that the structure of companies involved in the Photonics PPP is slightly different from the structure of the overall Photonics industry in Europe[21]:

- Very small companies (<10 employees), representing about 50% of all Photonics companies in Europe, represent only 13% of the companies involved in Photonics PPP Projects – but 19% of the survey respondents from the industry;
- Very big companies (>1000 employees), representing only 4% of all Photonic companies in Europe, account for 33% of the companies involved in Photonic PPP Projects – and for 15% of all survey respondents from the industry.

[21] Estimations by Tematys, Stand: 05/2020.



Distribution of the companies involved in the Photonics cPPP projects – per size
Source: Tematys, 05/2020.



Distribution of the companies per size among the survey respondents
Source: Tematys, 05/2020.

We present an overview of the results of the survey in the following; more details can be found in the Annex Part 4.

Expected growth in the next 3 years

Regarding the growth expectations following the project within the next 3 years the SMEs expect a much higher growth than the larger companies (or are more optimistic). On average the value for SMEs is 19.5% of expected growth (turn-over) whilst the larger industries only expect a growth of 7.7%. Logically, given the context, the response rate, which predicts no or small growth (0 to 5%) within 3 years, has risen from 37% to 42% compared to 2019 results, but the increase is moderate.

Compared with the results obtained in 2019, it can be noticed that there is only a slight difference regarding the growth expected by SMEs: 19.5% for the next 3 years, compared to 22.2% in 2019. There is even no difference concerning the answers given by big companies. This result is particularly interesting given the fact that the survey was carried out at the height of the Covid-19-crisis in Europe: The fact that photonic companies, even in this very challenging time, maintain similar positive forecasts as last year suggests that the photonic industry is particularly resilient against crisis.

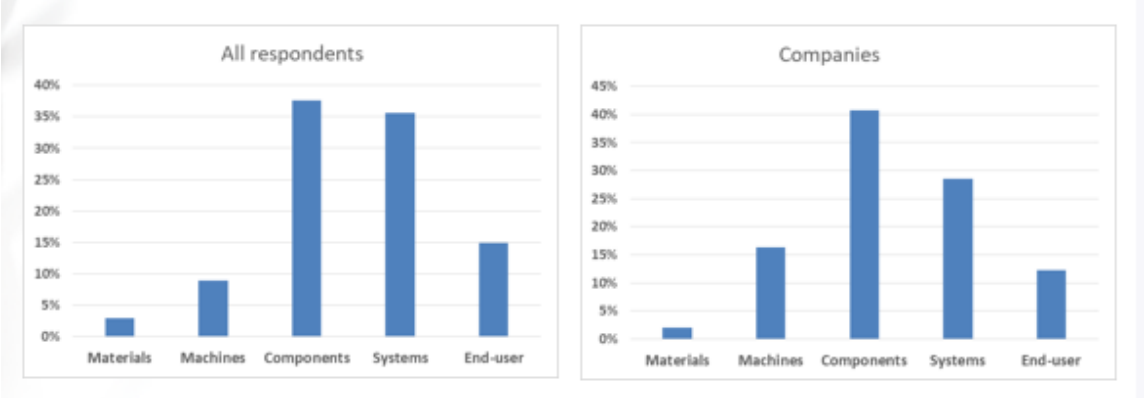
Expected Growth in the next 3 years – according to company respondents:

Expected Growth	Big companies	SMEs
No growth	0%	8%
1-5 %	38%	11%
5-10 %	38%	21%
10-20 %	23%	24%
20-30 %	0%	13%
>30%	0%	24%
Average	**7.7 %**	**19,5 %**

Source: Tematys, 05/2020.

Value Chain exposure of the Project Participants

Comparing the activities along the Photonics Value chain, the project participants demonstrate a close working together from Science to Industry as the pictures below show a very similar focus on materials, machinery, components, systems and End Users.



Activities along the value chain – all respondents vs companies
Source: Tematys, 05/2020.

New systems and/or technologies developed in PPP Projects

The average number of new systems or technologies developed is about 3 per project. By nature – high numbers come from the pilot lines. The zero numbers are mainly related to CSAs or Associations.

Patents applied linked to the PPP Projects

The average is around one patent applied per participant. Nearly 50% of the survey respondents declare to not apply for any patent in relation to the PPP project. These figures may seem quite low, but it should be kept in mind that 1) some respondents are coming from CSA that do not develop any patentable component or process; 2) may companies may prefer to have applied for a patent before starting a project and sharing their knowledge with other consortium partners. The number of patents already granted during the timeframe of the project is very small (less than 14% of the projects reported a patent already granted), but still, the high percentage of new projects among all respondents should be considered.

Commercialization – Time to market

Around 10% of the respondents declare that they will at the end of the project either directly be able to sell a product or to follow up with a prototype – corresponding to a TRL-level of 8-9. Even among those respondents declaring to need some more developments, slightly less than 50% estimate the time-to-market to be 1-2 years after completion of the PPP project – corresponding to a TRL-Level of about 7. About 47% of the respondents need more than 2 years and less than 5 years of future development.

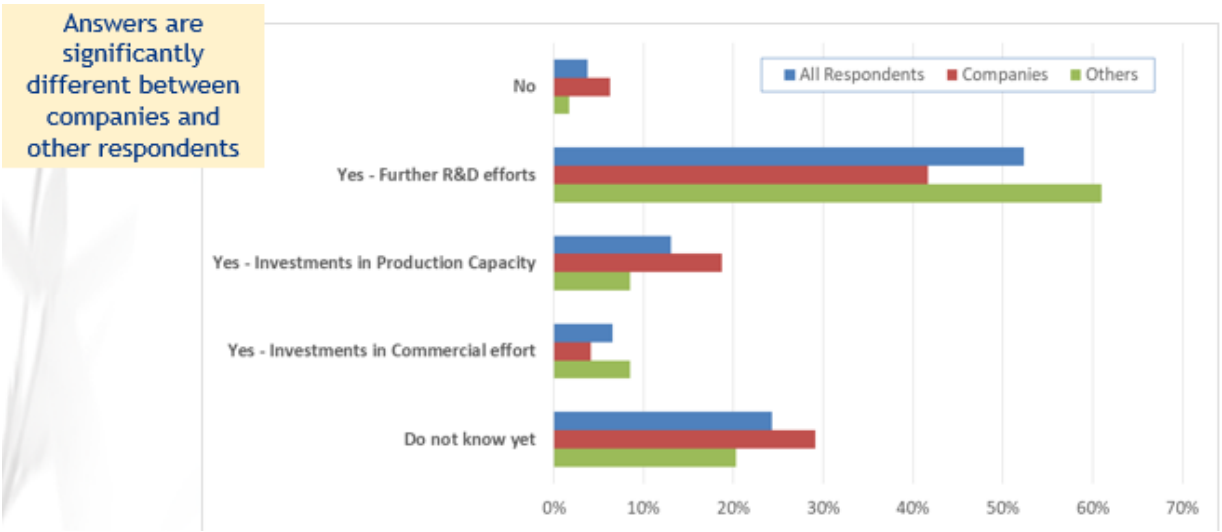
Midterm - Investment in new Assets

Compared to 2019, the level of investment in R&D and production after the project seems to have increased quite significantly. Half of the Project Participants plan to invest in new assets within the 3 years following the projects. Slightly more than 50% plan further investments in the follow-up of the projects, about 25 % do not know yet – possibly because in larger companies the Strategic Planning for new capacities is divided from those departments involved in the projects. Interestingly, the proportion of companies planning to invest in new assets is higher for SMEs (60%) than for big companies (46%).

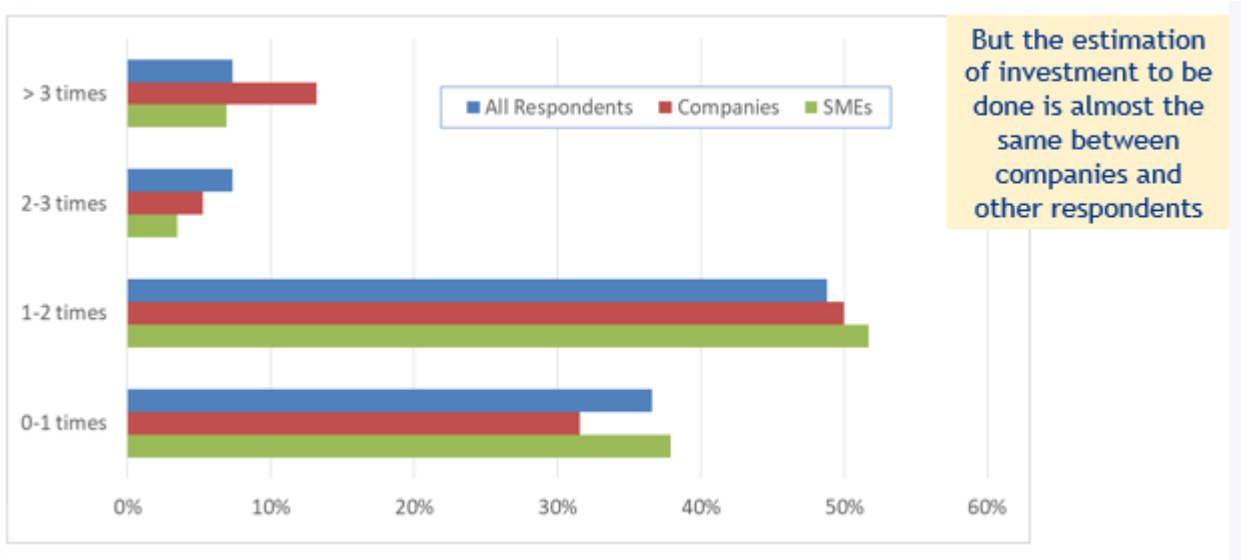
A majority goes to R+D efforts followed by Production capacity, as well as Commercial Efforts.

Comparing Companies and RTOs – by nature the investment in Production capacity and Commercial efforts are higher in the company area and the Scientific Area shows more investment in the R+D efforts.

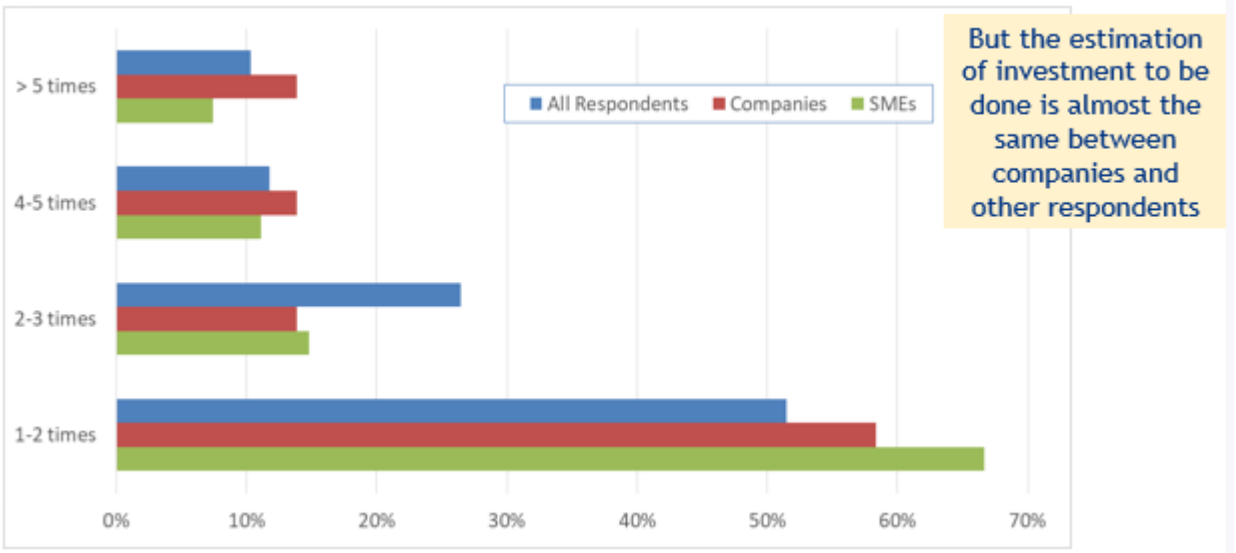
Regarding the multiple of the Project Budget, the most respondents say they will spend 1-3 times – a bit different when looking into multiples for R+D, Production capacity and Commercial Efforts.



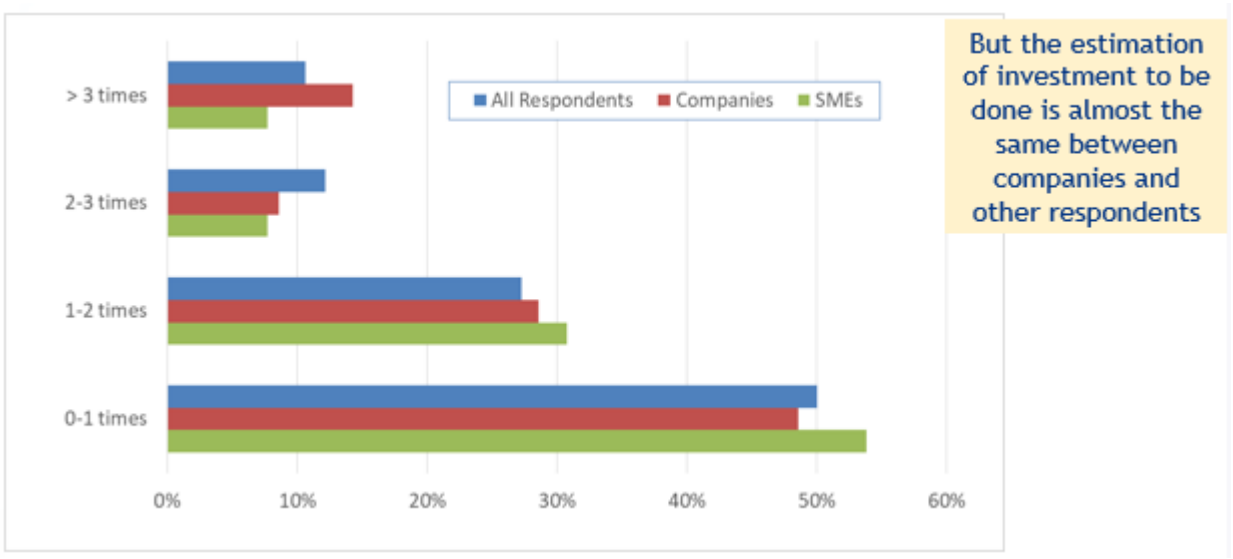
Investments planned in the follow-up of the project.
Source: Tematys, 05/2020.



Investments planned in R&D in the follow-up of the project – as a multiple of the project grant.
Source: Tematys, 05/2020.



Investments planned in production in the follow-up of the project – as a multiple of the project grant.
Source: Tematys, 05/2020.



Investments planned in commercial efforts in the follow-up of the project – as a multiple of the project grant.
Source: Tematys, 05/2020.

Cross cutting Effects of projects with other areas

A high percentage of about 80 % of Project Participants expect positive effects from the Horizon 2020 project to their other activities. Only 6 % neglect such effects.

New Jobs created as follow up from the Project

Most Project Participants (about 80%) claim that they will create new jobs as a follow up from the project. The number is quite the same for big companies and for SMEs. Compared to last year's results, the number of jobs created after the project is stable with 65% of the responses forecasting less than 5 jobs created after the project in 2020 as in 2019. Interestingly, big companies indicate a higher number of jobs planed than they did in 2019. Given the particular context of the survey, conducted at the height of the Covid-19-pandemic, in a time this suggests photonics companies – regardless of their size - to be particularly resilient.

In the short term – means directly related to the project – the majority claim to create 0- 5 jobs – only a very few claim to have more than 5 jobs to be created.

Regarding the functions needed when creating new jobs there is a broad variety of answers covering – aside from the R+D functions - also such cross-cutting jobs like quality management, IT skills, Marketing skills.

Common Priority Key Performance Indicators

In the beginning of 2019 and based on the recommendations of the EC evaluators made in 2018, the methodology used to assess the 4 common priority Key Performance Indicators was refined by the Photonics21 Secretariat and the subcontractor Tematys, leading to the following definitions and methodological aspects.

Overview of methodology used for the calculation of the Common Priority KPIs (same as 2019):

KPI	Name of KPI/Indicators	Data used	Methodology
KPI C1	**Mobilised Private Investments / Leverage**		
	A1 - Direct Leverage 1	1	Direct calculation
	A2 - Direct leverage 2	2	Aggregate and scale figures
	B1 - Indirect leverage 1	2	Aggregate and scale figures
	B2 - Indirect leverage 2	4	Use Secondary data
KPI C2	**Number of new skills and/or job profiles**		
	Number of jobs created or forecasted	2 & 4	Aggregate and scale figures Compare/use Secondary data
	New job profiles and skills	2 & 3	Survey and complement with interviews
	Exemplar case studies	3 & 4	Interviews + Clusters reports
KPI C3	**Impact of a cPPP on SMEs in Euros/Qualitative analysis**		
	Participation rates of SMEs	1	Direct calculation
	Map the SME community	2	Aggregate and scale figures
	Inclusion of some examples	3 & 4	Interviews + Clusters reports
KPI C4	**Significant Innovations**		
	Number of innovations including products, processes, methods, technologies …	2	Aggregate and scale figures
	Inclusion of some examples	3 & 4	Interviews + associations reports

Source: VDI TZ GmbH / Tematys, 05/2020.

KPI C1: Mobilised Private Investments / Leverage

The leverage of private investments, including expenditure linked to funded projects, is one of the core reasons for the public side to agree upon a public-private partnership. Therefore, a representative approximation of the level of industrial engagement within a given cPPP must be estimated and presented. The data provided should contain information at two levels:

- Total amount of actual private expenditure mobilised in cPPP projects;
- Estimation of private investment mobilised in other R&D activities related to the cPPP, including investments after end of the projects.

Regarding the potential leverage effects of the cPPPs, several types of leverage have been defined (s. figure below):

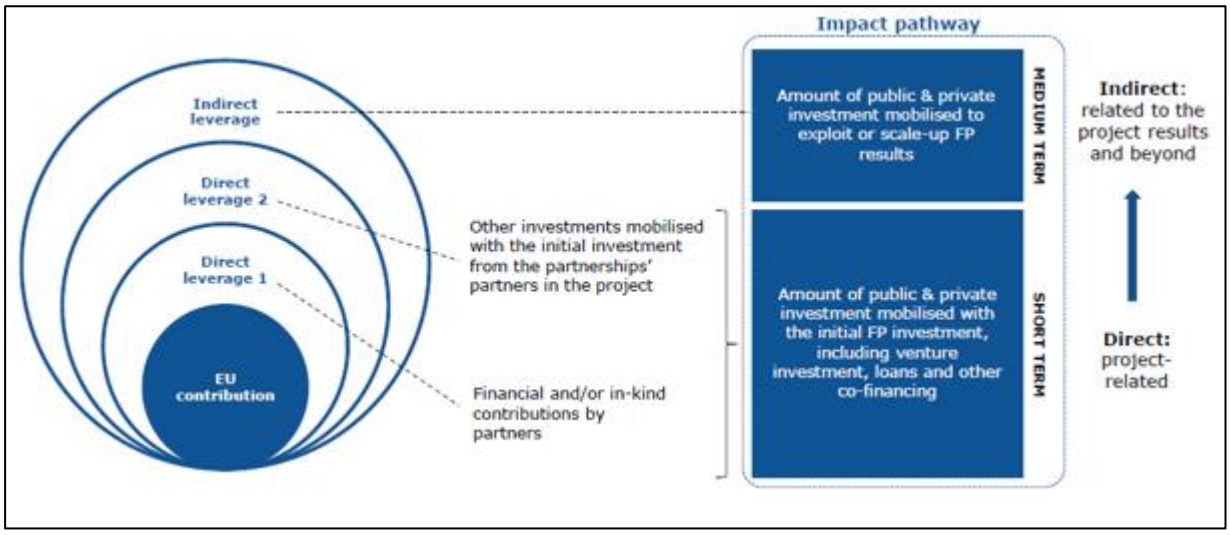
- Direct Leverage A1 defined as the financial and/or in-kind contributions by partners to support project execution. This corresponds to direct investment in funded actions and can be measured in Cordis as the difference between total cost of a project and EC contribution (provided cPPP projects can be identified in Cordis)

- Direct leverage A2 defined as all other investments mobilised with the initial investment from the partnerships' partners in the project to support project execution. This relates to expenditures not covered by direct funding and not recorded in Corda.

- Indirect leverage: defined as the investment mobilised to exploit or scale-up results (i.e. generated thanks to the projects, but not supporting the projects themselves). Two parts need to be differentiated:

- Indirect leverage B1: Data on the Follow-up of the project to be monitored via survey/interview to get a sample of data, then aggregate and scale figures at the level of the cPPP.

- Indirect leverage B2: Data on the overall industry effort to be monitored via survey/interview to get a sample of data, then aggregate and scale figures at the level of the cPPP.



Definition of leverage effects
Source: EC, 2018.

Direct Leverage A1

The Leverage Effect A1 is about € 71.5 M€ – which corresponds to 29% of the EC funding (2019: 30%). The Calculations is as follows:

Budget/contribution	Total 2014-2018 (€)
Total Budget	622 460 745
EC contribution	551 005 453
Total Industry contribution Leverage A1 (€)	71 455 292
Total EC contribution for Industry (€)	247 571 609
Leverage A1 (%)	29%

Remarks:

In H2020 projects:

- The total costs in CSA and RIA are paid 100% by EC (so 0% "Leverage" for industry),
- The costs in IA are paid 70% by EC for industrial partners (so 30 (industry) / 70 (EC) = 43% "Leverage" from industry).

The PPP projects can be CSA, RIA and IA. So the total leverage is between 0% and 43% and closer to 43% because there are more industrial partners in IAs.

Direct Leverage A2

Period 2014-2018	Number of participations	% investing	Average investment (k€)	Companies /Participant part	Total investment (M€)	Companies /Participant part (M€)	Leverage factor
SMEs	323	60%	297	72%	57,6	41,4	2,6
Big companies	346	46%	250	85%	39,8	33,8	5,7
All companies	669	56%	287	79%	97,3	75,3	3,4
All participants	1260	49%	442	79%	272,9	215,6	3,8

Other investments mobilised from the partnerships' partners in the project to support project execution are:

- 97 M€ for companies in which their part represents 75 M€.
- 273 M€ for all participants in which their part represents 216 M€.
- Note that in 2019 the result was for all participants: 123 M€ for all participants in which their part represents 88 M€.
- The result seems high in 2020 for all participants: this may come from the high percentage of RTOs in Pilot Lines among the respondents.

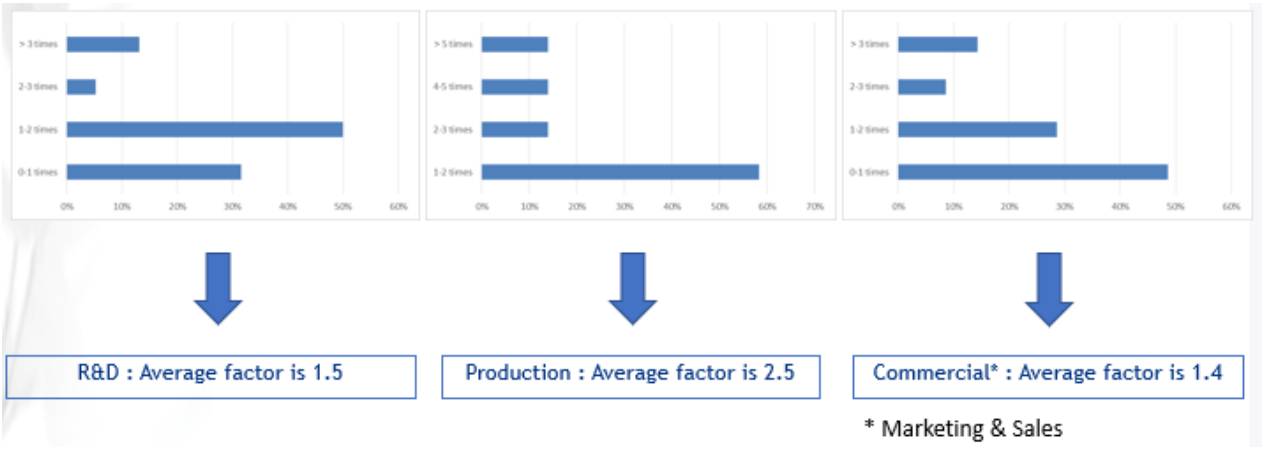
The direct Leverage Factor for all project Participants is therefore 3.8. For Industry it turns out to be 3.4 – whereas big companies display a leverage of 5.7 and SMEs a leverage of 2.6.

Summing up the results of the leverage A1 and A2, the private investment to support project executions is the following:

- Leverage A1: 71.5 M€
- Leverage A2: 75.3 M€
- Total Leverage A: 146.8 M€ (Total Private investment in Projects)

Relating these figures to the 247.6 M€ EC funding for companies over the period 2014-2018, the total leverage A amounts to 59% of this contribution.

Indirect Leverage B1:



Leverage B1: Investments planned in the follow-up of the projects.
Source: Tematys, 05/2020.

For EC contribution	100
Investment in Projects	60
Follow-up in R&D investments	150
Follow-up in Production investments	250
Follow-up in Commercial investments	140
Total Leverage B1	**540**
Total Leverage (A+B1)	**≈ 600**

- **The leverage in the follow-up of the projects (B1) is about 5 !**
- **The total leverage factor is about 6.**
- This means that for 247 M€ which represents the EC contribution for companies : the total Leverage of investment by companies in the projects and in the follow-up of the projects is 6 times this amount.
- **The Total Leverage is almost 1.5 B€ in total !**

Calculation of the Leverage B1.
Source: Tematys, 05/2020.

Indirect Leverage B2: This indicator focuses on the overall industry R&D investment effort and, more specifically, on investments and resources spent that support the objectives of the cPPP and that have been triggered / encouraged by the existence of the cPPP, but that are not following up the activities or results of the cPPP Projects as such.

The Photonics cPPP aimed at **leveraging Research & Development in Photonics.** Never before have the European Industry and European Policy worked so closely together in such an important technology domain. Acknowledging the importance of this Public-Private Partnership for fostering Photonics in Europe, the European Photonics Industry committed itself to increase significantly the level of private funding allocated to R&D in Photonics and, in particular, to match every Euro spent by the European Commission in the PPP with four Euro spent by Industry. The European Photonics industry also engaged to support SMEs and young workers through the creation of new jobs and skills.[22] In fact, and as the following figures already presented in last year's Progress Monitoring Report display, the measures taken have been efficient and lead to increased investments in Photonics R&D in Europe:

Nearly 10 billion EUR industry investments on Photonics Innovation in Europe in 2015[23]: In total European Photonics Industry showed in 2015 Innovation Spending (R&D spending and Capex) in Europe in the size of € 9.6 billion – about € 6.4 billion for R&D spending and € 3.1 billion for Investment (Capex). [24]

R&D intensity in the Photonics industry amounts to nearly 10%[25]: On average, European Photonics companies spent in 2015 9.7% of their revenues for R&D. In addition, they invested in average 4.7% of their revenues (Capex / sales) bringing the total R&D and investment quota to 13.8%.[26]

Of course, the R&D intensity does vary, depending on the Photonics segment as well as on single companies. For instance, R&D intensity at ASML, the largest Photonics producing company in Europe, is very high, amounting to 17.7%. The R&D intensity is comparably high in the communication segment (e.g. 17.7% for Adva Optical and 16.6% for Alcatel Lucent). The situation is similar when considering the Capex / sales ratio, which is particularly high for companies "operating in product segments requiring costly manufacturing equipment and facilities".[27]

In fact, the R&D intensity of companies of the Photonics segment may vary from 3% to 18% and the Capex / sales ratio ranges from 2% to 11%.

R&D intensity in the Photonics industry much higher than in most other industry sectors[28]: The European Photonics Industry is devoting much more funding to R&D than many other industry sectors do: the figure of 9.7% of its revenues spent by the European Photonics Industry for R&D has to be compared to the average industrial R&D intensity in Europe of about 3.2%[29]. When differentiating by industry sectors, it appears – according to a PwC Study - that the R&D intensity in the European Photonics industry is much higher than in most other industry sectors – even beyond the Aerospace & Defence sector, the automotive sector, the Industrials sector, and the Chemicals & Energy sector. [30]

[22] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2017): Jobs and Growth in Europe – Realizing the potential of Photonics, PPP Impact Report 2017, Düsseldorf.

[23] Ibid.

[24] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2017): Market Research Study, Photonics 2017, Brüssel / Düsseldorf / Tägerwilen, May 2017.

[25] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2017): Jobs and Growth in Europe – Realizing the potential of Photonics, PPP Impact Report 2017, Düsseldorf.

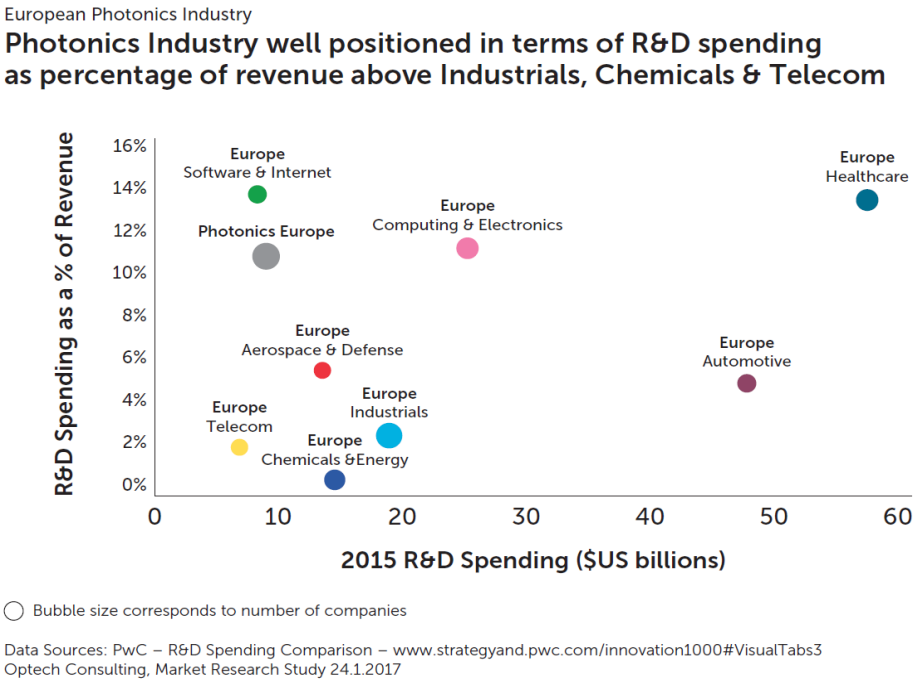
[26] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2017): Market Research Study, Photonics 2017, Brüssel / Düsseldorf / Tägerwilen, May 2017.

[27] Ibid.

[28] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2017): Jobs and Growth in Europe – Realizing the potential of Photonics, PPP Impact Report 2017, Düsseldorf.

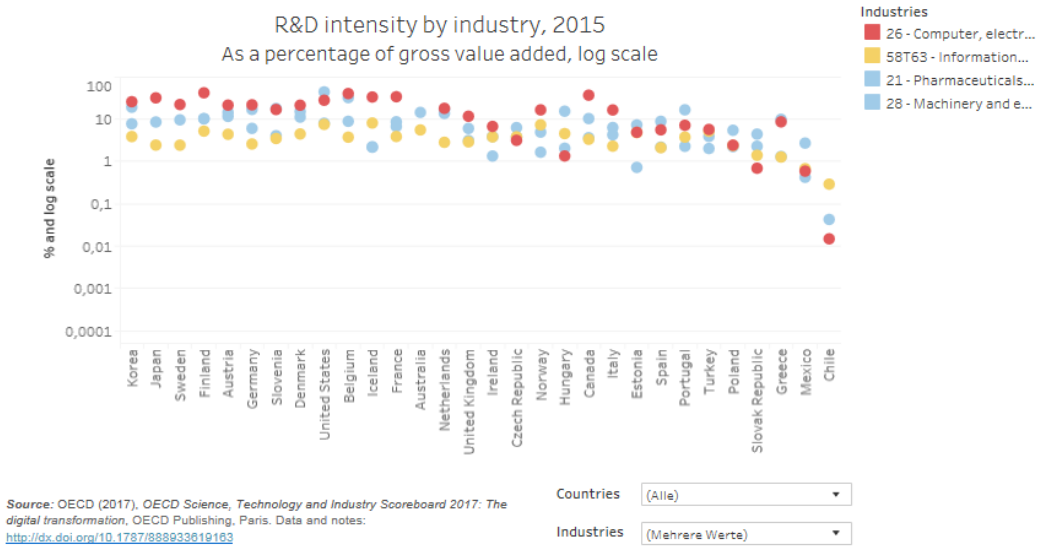
[29] Cf. The 2016 EU Industrial R&D Investment Scoreboard.

[30] Cf. PwC, The 2016 Global Innovation 1000 Study: Comparison of R&D Spending by Regions and Industries, PriceWaterhouse & Coopers. http://www.strategyand.pwc.com/innovation1000#VisualTabs3, last accessed on 2017/02/22.



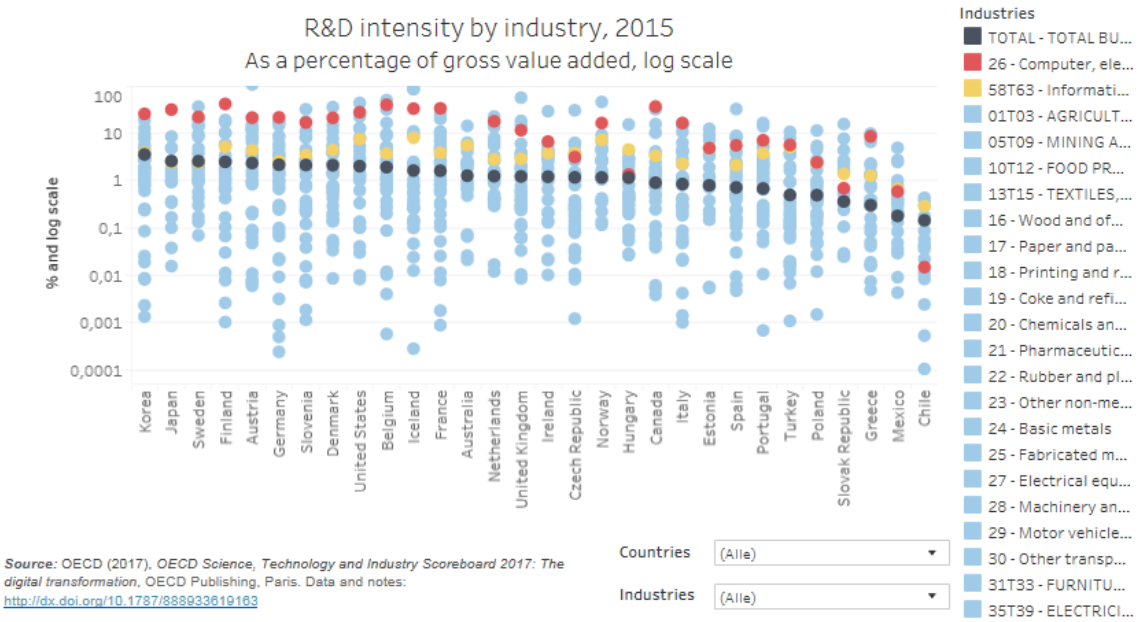
R&D Spending in the Photonics Industry compared to other sectors
Source: Key Data Photonics Research Study 2017, https://www.photonics21.org/ppp-services/photonics-downloads.php

Also, the OECD "BERD" analytics confirm the above average rate of most of the main photonics industries as being shown in the below interactive graphics for selected photonics areas compared with the entire industry.[31]



International comparison of R&D intensity by industry – Focus on Computer, electronic and optical products (Cat. 26), Information and Communication (Cat. 58T63), Pharmaceuticals, Medicinal chemical and botanic products (Cat. 21) and Machinery and Equipment (Cat. 28). -
Source: OECD 2017, OECD's Analytical Business Enterprise Research and Development (ANBERD) database: http://www.oecd.org/innovation/inno/anberdanalyticalbusinessenterpriseresearchanddevelopmentdatabase.htm, last accessed on 2018/09/06

[31] See OECD "BERD" Analytics, drawn on 16.07.2018 at: http://www.oecd.org/innovation/inno/anberdanalyticalbusinessenterpriseresearchanddevelopmentdatabase.htm.



International comparison of R&D intensity by industry – All industries considered
Source: OECD 2017, OECD's Analytical Business Enterprise Research and Development (ANBERD) database: http://www.oecd.org/innovation/inno/anberdanalyticalbusinessenterpriseresearchanddevelopmentdatabase.htm, last accessed on 2018/09/06

KPI C2: New skills and/or job profiles

In terms of job creations (relying on the survey: next 3 years):

- Big companies: created job = 2.3 + 7.6 = 9.9 / project. → Total ≈ 3400
- SMEs: created job = 2.5 + 4.9 = 7.4 / project. → Total ≈ 2400
- **Total created job → 5800 (1600 for projects and 4200 for follow-up)**

In terms of new skills:

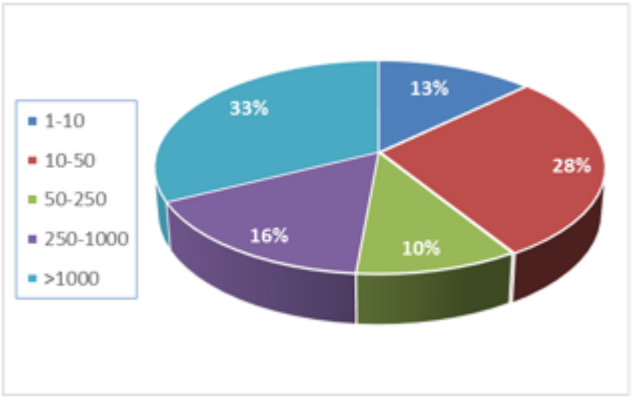
- R&D:
  - Chemistry and Physics Engineers,
  - Programmers, IT & Computer Scientists, Data scientists …
- Production:
  - Skilled production technicians,
  - Production and industrialization managers, …
- Support functions:
  - Business developers, Market developers (specially for medical market),
  - Managers for project, quality, certifications, IP, Production and safety control …
- Academic and technical skills are available, but marketing skills are underdeveloped.
- RTO have access to PhD Students and Post-Docs but it is more complicated for companies in very specialized areas. Very often in this case, companies turn to in-house training (6 to 12 months in general).

It must be noticed that The figures for SMEs are stable. For big companies, one is quite higher than last year (7.6 vs 4.8 for follow-up of projects).

KPI C3: Impact of a cPPP on SMEs

According to the 2018 evaluators' assessment report, the purpose of this KPI is to understand the economic evolution of SMEs benefitting from the cPPP in quantitative and/or qualitative terms. Approaches suggested by the EC include the assessment of turnover and/or the mapping of the SME community represented by each cPPP. Based on the outcomes of the survey, the following figures and facts can be highlighted (cf. Annex Part 4):

- The SME participation in the Photonics cPPP projects amounts to about 26% of the overall industry participation – compared to 18 % for profit SMEs in all H2020 projects, and 22% in all projects resulting from ICT Calls – cf. below. The cPPP seems on the one side therefore to be a very valuable instrument to mobilize SMEs and promote their involvement in R&D projects. On the other side, these figures underline the fact that the cPPP calls, which are the result of extensive discussions involving the whole Photonics21 players, do meet the needs of SMEs, leading to a bigger participation.
- SMEs involved in Photonics cPPP projects expect an average growth of 6% p.a. –this figure is only slightly smaller than last year's figure (7%), which again is a very positive indicator given the context of the survey.



Mapping of SMEs in Photonics PPP as well as big companies for comparison
Source: Tematys, 05/2020.

KPI C4: Significant Innovations

Based on the survey outcomes, the following facts and figures can be highlighted:

- In average, 3.1 new systems or technologies are developed per Photonics cPPP project.
- The total number of new systems or technologies developed within the cPPP is therefore of about 360.
- In average, each PPP project participant applies for one patent, leading to an estimated number of about 1000 patents for the whole Photonics PPP.

It should be noticed that companies and RTOs prefer to apply patents before reaching a project. Moreover, it is asked in proposal to show that participants have patents in the field of the project.

Specific and Programme Level Key Performance Indicators for the Photonics cPPP

The detailed estimations of these KPIs, mostly collected from the survey but also from previous studies by Photonics 21, can be found in Annex Part 2 and Annex Part 3.

3.3 Evolution over the years

Looking at the evolution of the Photonics platform, some basic trends should be mentioned:

There has been an increased involvement of members in the Photonics community and a closer cooperation with regions and clusters as well as actions supporting SMEs with laboratory and testing resources. Several measures and instruments have been implemented to optimize the innovation ecosystem in photonics, bridging the "valley of death" and ensuring quick market uptake of photonics innovation. An ongoing active involvement and collaboration with the strategic CSA and pilot and prototyping projects ensure a coordinated set of services towards the respective target groups like SMEs, cluster or regional authorities. Likewise, a network of Photonics Digital Innovation Hub under the "Industrial Modernisation Platform" has been promoted, offering end-to-end prototyping and pilot production facilities for the end-user industry.

A better access to finance for start-ups but also for SMEs in the growth phase remains an ongoing issue of concern and is still on a high priority of the agenda of the PPP.

Closer cooperation and networking down the value chain and involvement with megamarkets is the third – and whilst looking in the future – probably the largest challenge to meet of the PPP.

Photonics is one of these "important building blocks of the next digital revolution, which will be based on deep technologies"[32].– this is the key statement in the recent 2018 European Commission and European Investment Bank report on "Financing the digital transformation". This was seconded by a recent letter of three Nobel Laureates stating that "Photonics is simply essential for powering the future European digital economy…"[33].

In this role as a key enabler, Photonics has become even more important for Europe's future in many decisive areas and mega markets: Industry 4.0, Health, diagnosis and therapy of diseases, fighting cancer, securing save and sustainable food, smart farming, 5G, artificial intelligence, Internet of Things, Robotics, Quantum technology, additive manufacturing and many other technologies and applications. Light technologies, components and systems, are critical elements of many critical European strategic value chains from the automotive industry to the aeronautics sector.

Having this said, it has and will become increasingly important to include downstream value chain partners / end-users and associate experts in the work of the PPP to add to the members of the current PPP representing companies mainly from the supply side, research institutes and universities.

The photonics community has started to work on these changes. The current Horizon2020 partnership has already initiated more than 30 joint strategic actions with end user industry. It also launched several cross-regional networks of innovation hubs across Europe which the EU often supports by complementing funds coming from ERDF budget.

The Annual Meeting in 2019 also has set up networking sessions with other PPPs to early on and commonly work on future call topics and secure that downstream industries are involved in setting the specifications for the core photonics components and segments.

[32] European Investment Bank, Innovation Finance Advisory, European Investment Bank Advisory Services (2018): Financing the digital transformation – Unlocking the value of photonics and microelectronics, Luxembourg, 2018. P. 9.

[33] Mourou G., Hell, S. W., Hänsch, T. W. (2018): An open letter to the European Commission regarding the absence of visibility and support for Photonics Technologies in the next MFF 2021-2027. 20th December 2018. Available under: https://www.photonics21.org/news/Verlinkungen/2019/Nobel-Laureates-Letter-of-Concern.pdf, last accessed on 2019/05/28.

Overview of funding since 2014

Overall, the EC has funded 117 Photonics PPP Projects under the Horizon 2020 frame since 2014 to the totaling approximately €540M.

With regard to the 2019 calls, the industrial participation within PPP Projects accounts for 56% of which 50% were SMEs, which totals to an overall SMS participation of 28 % (cf. Table below).

EU Commission Funding Photonics PPP Projects	2019
Total Funding for Projects (in €)	**105.551.394,31**
Number of Participants in Projects	188
Industrial Participation (# of Companies)	106
% of total participants	56%
of which are SME's (# of SMEs)	53
SME % of Industry participants	50%
SME % of total participants	28%
Budget for Industry (in €)	46.110.368,56
Budget for Industry % of total funding	44%

Source: European Commission, DG CONNECT, Photonics Unit 03/2020.

An overview of the recent years in Horizon 2020 is provided in the table below. It shows that the industry participation is with 55 % in the time period of Horizon 2020 continuously high; the same can be said of the SME participation that is 51 % of the overall industrial participation over the time.

EU Commission Funding Photonics PPP Projects	2014-2019
Total Funding for Projects (in €)	**540.061.841,01**
Number of Participants in Projects	1.260
Industrial Participation (# of Companies)	699
% of total participants	55%
of which are SME's (# of SMEs)	359
SME % of Industry participants	51%
SME % of total participants	28%
Budget for Industry (in €)	249.225.457,96
Budget for Industry % of total funding	46%
Budget/Grants for SMEs (in €)	128.934.087,53
Budget/Grants for SMEs in % of total funding)	24%

Source: European Commission, DG CONNECT, Photonics Unit 03/2020.

4. Outlook and lessons learnt

Photonics will be the key enabler for Europe's ambitions for a climate-neutral, digital economy and society. European initiatives on Industry 4.0, Smart farming, Personal Healthcare, Quantum Computing and Communication, 5G, Artificial Intelligence and many other and strategic areas depend on innovations in photonic platform technologies. These are the critical elements to build up European strategic value chains from the automotive industry to the aeronautics sector and the medical sector. [34]

Europe has a leading position in photonics – thanks to a unique ecosystem that allows suppliers and users to drive innovation in close interaction between application requirements and the appropriate basic technology. However, the European photonics research and innovation landscapes are highly fragmented. Unlike other sectors where large companies often serve as a pacemaker to structure the research and innovation landscape, in photonics, the 5000 SMEs have neither the capacity nor capability to do so. Like other deep technologies Photonics is highly capital and R&I intensive. A quota of Research & Innovation spending of about 10% of turnover on average and a Capex of additional 4-5% of sales per year puts photonics in a leading position in terms of industrial R&I investments. The sum of these SME investments in Photonics R&I in Europe is very significant and will amount to over 100 billion euros over the next ten years. It is fundamentally important for Europe's competitiveness and for the development of solutions to the major societal challenges that these investments are coordinated and targeted, following a community-backed Strategic Research Agenda.

Therefore, a highly motivated photonics industry and academic community, represented by Photonics21 with its 3000+ members, has submitted a Proposal for a new Photonics Partnership under Horizon Europe. This community has shown in the current Horizon2020 Photonics Public Private Partnership that it meets its expectations. The photonics industry, which is characterised by SMEs, has kept its word and achieved, among other performance indicators, an investment leverage of 5. With an overall annual investment of more than 10 billion Euros in R&I in Europe, the industry is extremely committed to Europe. However, this is only the beginning of a success story that Europe can write in the development and use of this deep technology.

The future Photonics PPP under Horizon Europe is committed to build on these strengths and further develop the key table stakes to create impact such as:

- further strengthening of core photonics technologies with the most impact of EU's competitiveness and technical sovereignty
- further integration and enhancement of the Photonics Ecosystem in Europe in digital innovation hubs which will secure cross-links with other deep technologies and up- and downstream industries
- broadening and deepening the involvement of downstream industries in the definition and priority setting of Photonics core technologies to secure economies of scale, more market focus and thus faster development

[34] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2019): Europe's age of light! How photonics will power growth and innovation, Strategic Roadmap 2021-2027, Brussels / Düsseldorf, March 2019.

PMR: Annex

Annex – Part 1 - List of Key Performance Indicators (KPIs)

Common Priority Key Performance Indicators

KPI C1: Mobilised Private Investments

KPI C2: New skills and/or job profiles

KPI C3: Impact of a cPPP on SMEs

KPI C4: Significant Innovations

Specific Key Performance Indicators for the Photonics cPPP

KPI S1: Maintain / Increase the (European) market share of the global photonics market

KPI S2: (Develop) New photonics R&I capabilities

KPI S3: (Improve) the innovation potential of photonics companies and notably of SMEs

KPI S4: Number of people directly employed by the photonics industry

KPI S5: Education, training and skills development

KPI S6: Scale of diffusion of photonics in application areas and in solutions addressing societal challenges

KPI S7: R&I investments of the photonics industry in the PPP objectives

KPI S8: Efficiency, openness and transparency of the PPP Consultation Process / Metrics

KPI S9: PPP Project Performance

KPI S10: Success stories relating to key developments in photonics by H2020 funded projects

KPI S11: Coordination of the PPP Implementation with the Member States and the Regions

KPI S12: Dissemination and Awareness

Programme Level Key Performance Indicators

KPI PL1: Patents

KPI PL2: Standardisation activities (project level) / Contributions to new standards (PPP level)

KPI PL3: Operational performance

KPI PL4: H2020 - LEIT - Number of joint public-private publications

Annex – Part 2 Specific Key Performance Indicators for the Photonics cPPP[35]

	KPI domain	Key Performance Indicator (KPI)	Value in {2017}	Baseline at the start of H2020 (latest available)	Target (for the cPPP) at the end of H2020	*Comments*
1	Industrial Competitiveness and Economy Impact	KPI 1: Maintain / Increase the (European) market share of the global photonics market	European share of the global photonics market: 16.5% in 2015 62% Growth of the European photonics industry in the period 2005-2015 European Photonics Production Growth rate more than 3.5 higher than EU GDP Growth rate High long-term growth in European core photonics segments Compared to 2011, European Photonics core segments remained strong and could defend a leading world position up to 50 % - far beyond the average EU industry share of 15.5 %.	In 2012, the global market share of Europe was 18%	By 2020, keep a global market share of at least 18%	*Extensive data were collected in the scope of the PPP Impact Report 2017[36] as well as of the Market Study[37]*
2	Industrial Competitiveness and Economy Impact	KPI 2: (Develop) New photonics R&I capabilities	6 PPP Pilot Lines and 3 PPP Prototyping Services help end user industry to speed up product development			*Cf. Photonics 21 – Photonics PPP Annual Activity Report 2018[38]*

[35] The data displayed in the following table are based on the results on the online survey conducted in April/May 2019 among the coordinators and participants of the Photonics cPPP projects. As such, they might not be exhaustive or might reflect only part of the actual situation.

[36] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2017): Jobs and Growth in Europe – Realizing the potential of Photonics, PPP Impact Report 2017, Düsseldorf.

[37] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2017): Market Research Study, Photonics 2017, Brüssel / Düsseldorf / Tägerwilen, May 2017.

[38] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2019): Photonics21 – Photonics PPP Annual Activity Report 2018.

3	Industrial Competitiveness and Economy Impact	KPI 3: (Improve) the innovation potential of photonics companies and notably of SMEs	The pilot lines foresee open access, and SME are either involved already in the project or will be involved in a later stage. End user industry involvement in PPP Projects ensuring quick market uptake of innovation			*New open access infrastructures and services to design, prototyping, manufacturing or testing, etc., and involvement of SME stakeholders*
4	Socio-economic Impacts	KPI 4: Number of people directly employed by the photonics industry	By the end of 2015, the EU Photonics industry employed 290.000 people – compared to 271.000 employees in the sector in 2011. This represents a CAGR of +1.7%.	In 2012, there were 300 000 direct jobs	by 2020, increase by at least 10% new jobs in photonics	*Forecast: +42.000 jobs in 2020 compared to 2011.* *Cf. PPP Impact Report 2017*[39]*.*
5	Socio-economic Impacts	KPI 5: Education, training and skills development	Activities targeting training and learning: - for children and teachers - for universities - for companies and employees - - for the general public	An FP7 initiative 'the Photonics Explorer' is quite successful and is further expanding by external sponsorship		*Number of specific activities undertaken to attract young minds to photonics or the number of young students addressed by educational material on photonics* *Cf. §3.1 in the Photonics cPPP Progress Monitoring Report 2018*

[39] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2017): Jobs and Growth in Europe – Realizing the potential of Photonics, PPP Impact Report 2017, Düsseldorf.

6	Socio-economic Impacts	KPI 6: Scale of diffusion of photonics in application areas and in solutions addressing societal challenges	Involvement of end-user industry: Cf. §2.2 Success stories: Cf. §2.2 Photonics related projects in almost all H2020 programmes / Photonics related projects covering all application markets of high relevance for tomorrow's society and economy from personalized healthcare, industry 4.0, smart cities to securing the digital society, connected mobility – to name but a few.			*Representative examples of photonics in application areas and of breakthrough solutions for specific societal challenges* *A study on the role and contribution of Photonics in past and current H2020 projects was initiated by VDI TZ and carried out from September to December 2017. The study aimed at examining whether, in Horizon 2020 Photonics plays indeed the role of an enabling technology for new and innovative products, services and developments in areas far beyond obvious lighting application fields.* *This study has just been updated in March-April 2019 and the results are still valid.*
7	Socio-economic Impacts	KPI 7: R&I investments of the photonics industry in the PPP objectives	Nearly 10 billion EUR industry investments on Photonics Innovation in Europe in 2015			*Extensive data can be found in the PPP Impact*

			R&D intensity in the Photonics industry amounts to nearly 10% R&D intensity in the Photonics industry much higher than in most other industry sectors			*Report 2017[40] (published in 2017)*
8	Operational aspects of the PPP	KPI 8: Efficiency, openness and transparency of the PPP Consultation Process Metrics	Fully democratic structure and transparent decision-making processes: Cf. §2.3			
9	Operational aspects of the PPP	KPI 9: PPP Project Performance	Cf. Outcomes of the online survey §3.2 and Annex Part 4			
10	Operational aspects of the PPP	KPI 10: Success stories relating to key developments in photonics by H2020 funded projects	Photonics PPP project impact and success stories reflected in end-user media: in over 217 articles in newspapers, magazines, and websites in more than 15 countries, representing an advertising value in excess of around €420K; estimated readership of over 19.9 million people. Cf. §2.2			

[40] European Technology Platform Photonics21 c/o VDI Technologiezentrum GmbH, Photonics21 Secretariat (2017): Jobs and Growth in Europe – Realizing the potential of Photonics, PPP Impact Report 2017, Düsseldorf.

11	Operational aspects of the PPP	KPI 11: Coordination of the PPP Implementation with the Member States and the Regions	Linking up the Horizon2020 Photonics PPP actions with member states and regions to maximize impact of the Photonics PPP Coordinating the regional and European photonics strategy – joined implementation to link regional Smart Specialisation strategies Cf. §2.2			*-End-user workshops . Cooperation meetings with national technology platforms, etc. Cf. PPP Annual Activity Report 2018.*
12	Operational aspects of the PPP	KPI 12: Dissemination and Awareness	Photonics PPP project impact and success stories reflected in end-user media Promoting the visibility of Photonics and of the Photonics21 Platform in social media Cf. §2.2			

Annex – Part 3 Contribution to Programme-Level KPI's[41]

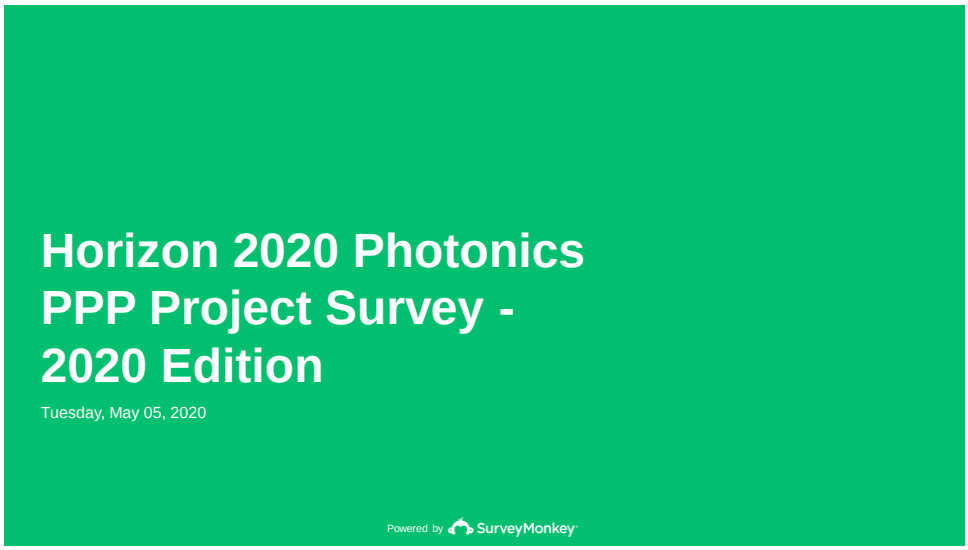
	Key Performance Indicator	Data	Baseline at the start of H2020 (latest available)	Target (for the cPPP) at the end of H2020	Comments
1	Patents	***Survey Outcomes, cf. Annex Part 4, Questions 11 and 12.***	5,2 per €10M funding	H2020: 3 patent applications per €10 million funding	H2020 indicator in Annex II – Council Decision 2013/743/EU Cf. Discussion in §3.2
2	Standardisation activities (project level) Contributions to new standards (PPP level)	***Survey Outcomes, cf. Annex Part 4, Questions 16 and 17.***	*Number of activities leading to standardization:* 2 (Based on 8 successful FP7 projects finished) *Number of working items in European Standardisation Bodies:* 4 (Based on 8 successful FP7 projects finished) *Number of pre-normative research files – prEN - under consultation in ESBs: Not reported*	No target	Baseline categories slightly different from the data collected in the online survey – not allowing a direct comparison.
3	Operational performance	Not known.	256 (baseline, as displayed in the cPPP PMR 2016).		

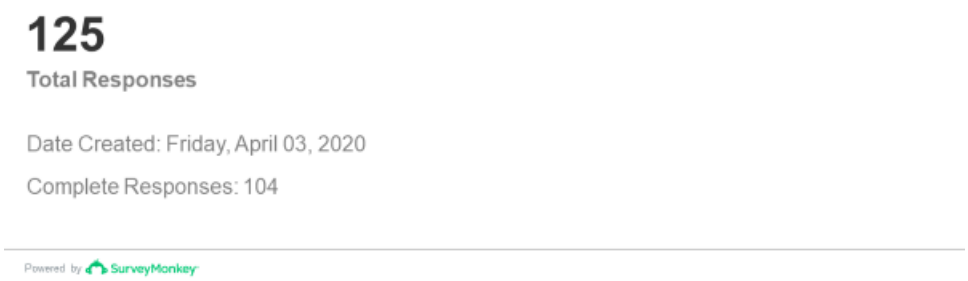
[41] The data displayed in the following table are based on the results on the online survey conducted in April/May 2019 among the coordinators and participants of the Photonics cPPP projects. As such, they might not be exhaustive or might reflect only part of the actual situation.

4	**H2020 - LEIT** - Number of joint public-private publications	***Survey Outcomes, cf. Annex Part 4, Question 15.***			

Annex – Part 4: Survey Results

The online survey was conducted in April-May 2020 using SurveyMonkey[42]. The detailed results of the survey are displayed in the following slides:[43]

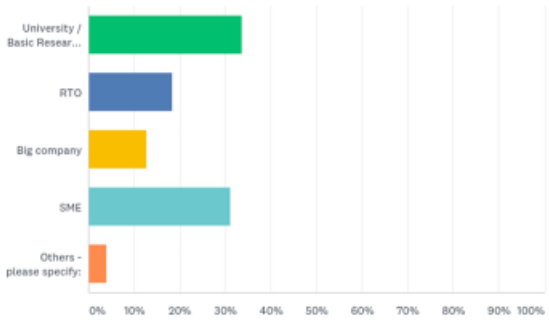




[42] SurveyMonkey Inc., San Mateo, California, USA, www.surveymonkey.com.
[43] Slides created by SurveyMonkey and edited by VDI TZ GmbH.

Q3: Type of Organization: Are you attending the Horizon 2020 project as:

Answered: 125 Skipped: 0



Powered by SurveyMonkey

Q3: Type of Organization: Are you attending the Horizon 2020 project as:

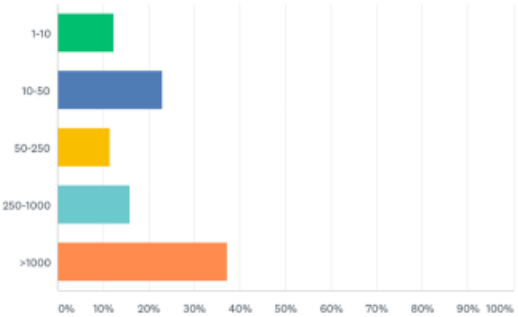
Answered: 125 Skipped: 0

ANSWER CHOICES	RESPONSES	
University / Basic Research / HEI	33.60%	42
RTO	18.40%	23
Big company	12.80%	16
SME	31.20%	39
Others - please specify:	4.00%	5
TOTAL		125

Powered by SurveyMonkey

Q4: Size of your company (numbers of employees):

Answered: 113 Skipped: 12



Powered by SurveyMonkey

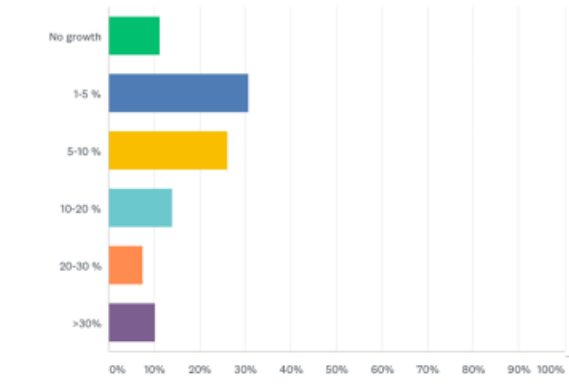
Q4: Size of your company (numbers of employees):

Answered: 113 Skipped: 12

ANSWER CHOICES	RESPONSES	
1-10	12.39%	14
10-50	23.01%	26
50-250	11.50%	13
250-1000	15.93%	18
>1000	37.17%	42
TOTAL		113

Q5: How do you estimate the growth perspective for your company within the next 3 years?

Answered: 107 Skipped: 18



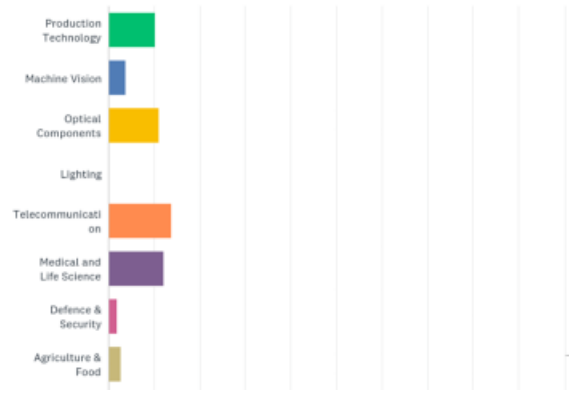
Q5: How do you estimate the growth perspective for your company within the next 3 years?

Answered: 107 Skipped: 18

ANSWER CHOICES	RESPONSES	
No growth	11.21%	12
1-5 %	30.84%	33
5-10 %	26.17%	28
10-20 %	14.02%	15
20-30 %	7.48%	8
>30%	10.28%	11
TOTAL		107

Q6: Area of Activity of your company:

Answered: 108 Skipped: 17



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Q6: Area of Activity of your company:

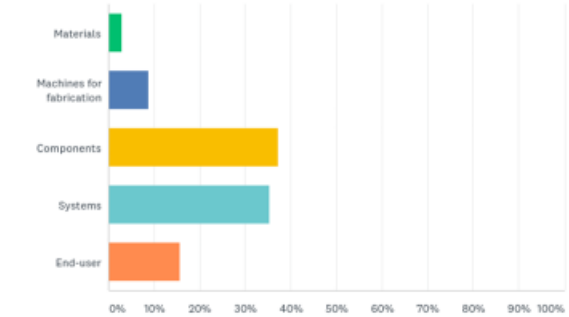
Answered: 108 Skipped: 17

ANSWER CHOICES	RESPONSES	
Production Technology	10.19%	11
Machine Vision	3.70%	4
Optical Components	11.11%	12
Lighting	0.00%	0
Telecommunication	13.89%	15
Medical and Life Science	12.04%	13
Defence & Security	1.85%	2
Agriculture & Food	2.78%	3
Displays	1.85%	2
Other - please specify:	42.59%	46
TOTAL		108

Powered by SurveyMonkey

Q7: Please indicate the range of your companies activities along the value chain:

Answered: 102 Skipped: 23



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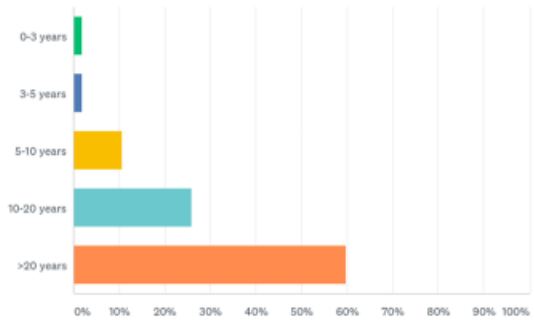
Q7: Please indicate the range of your companies activities along the value chain:

Answered: 102 Skipped: 23

ANSWER CHOICES	RESPONSES	
Materials	2.94%	3
Machines for fabrication	8.82%	9
Components	37.25%	38
Systems	35.29%	36
End-user	15.69%	16
TOTAL		102

Q8: Company's Age:

Answered: 112 Skipped: 13



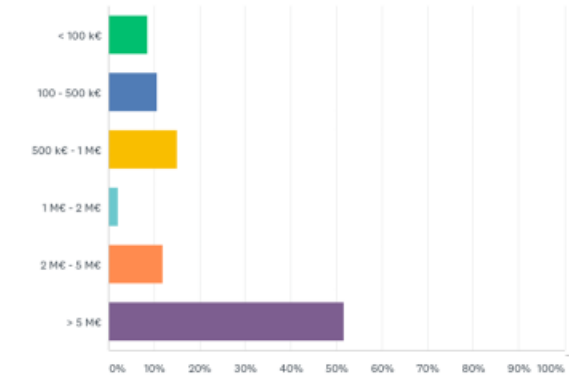
Q8: Company's Age:

Answered: 112 Skipped: 13

ANSWER CHOICES	RESPONSES	
0-3 years	1.79%	2
3-5 years	1.79%	2
5-10 years	10.71%	12
10-20 years	25.89%	29
>20 years	59.82%	67
TOTAL		112

Q9: Company's Equity

Answered: 93 Skipped: 32



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Q9: Company's Equity

Answered: 93 Skipped: 32

ANSWER CHOICES	RESPONSES	
< 100 k€	8.60%	8
100 - 500 k€	10.75%	10
500 k€ - 1 M€	15.05%	14
1 M€ - 2 M€	2.15%	2
2 M€ - 5 M€	11.83%	11
> 5 M€	51.61%	48
TOTAL		93

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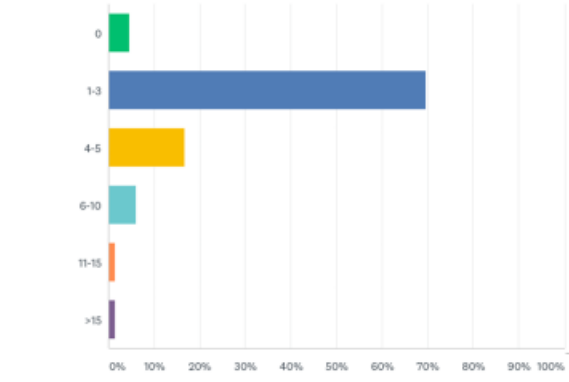
or do you plan to develop in the Project? (For project coordinators only)

Answered: 66 Skipped: 59



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or do you plan to develop in the Project? (For project coordinators only)

Answered: 66 Skipped: 59

ANSWER CHOICES	RESPONSES	
0	4.55%	3
1-3	69.70%	46
4-5	16.67%	11
6-10	6.06%	4
11-15	1.52%	1
>15	1.52%	1
TOTAL		66

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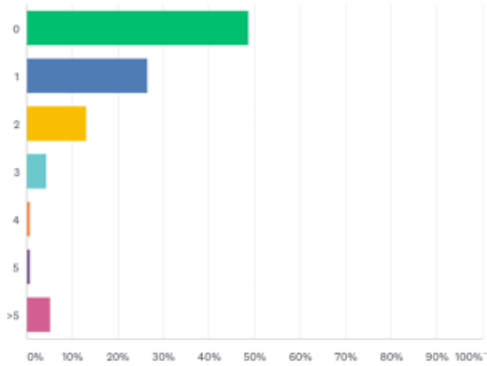
Q11: How many patents linked to the project have you already applied for / do you plan to apply for?

Answered: 113 Skipped: 12



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Q11: How many patents linked to the project have you already applied for / do you plan to apply for?

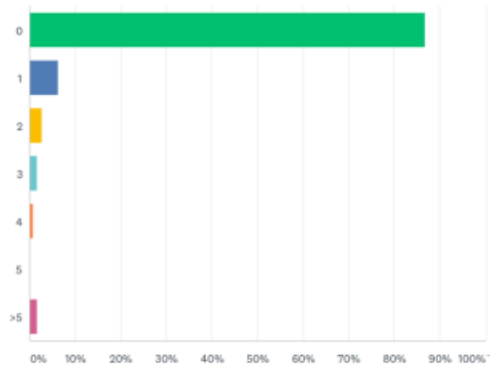
Answered: 113 Skipped: 12

ANSWER CHOICES	RESPONSES	
0	48.67%	55
1	26.55%	30
2	13.27%	15
3	4.42%	5
4	0.88%	1
5	0.88%	1
>5	5.31%	6
TOTAL		113

Powered by SurveyMonkey

Q12: How many patents linked to the project have been granted up to now?

Answered: 113 Skipped: 12



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Q12: How many patents linked to the project have been granted up to now?

Answered: 113 Skipped: 12

ANSWER CHOICES	RESPONSES	
0	86.73%	98
1	6.19%	7
2	2.65%	3
3	1.77%	2
4	0.88%	1
5	0.00%	0
>5	1.77%	2
TOTAL		113

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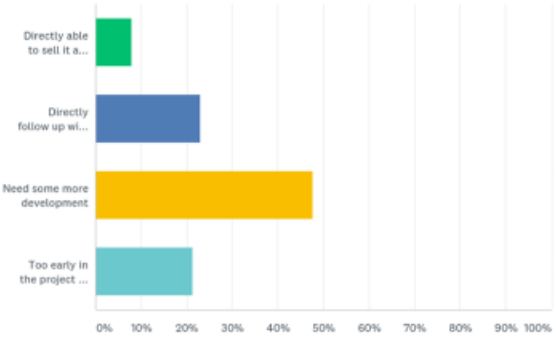
Q13: At the end of the project, what is your estimated time to market?

Answered: 113 Skipped: 12



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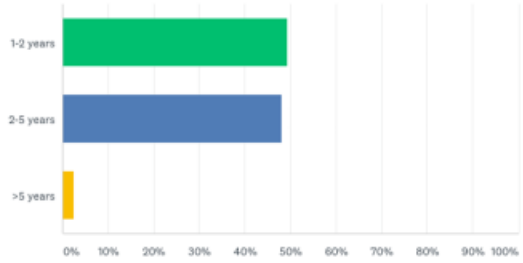
Q13: At the end of the project, what is your estimated time to market?

Answered: 113 Skipped: 12

ANSWER CHOICES	RESPONSES	
Directly able to sell it as a product	7.96%	9
Directly follow up with a prototype	23.01%	26
Need some more development	47.79%	54
Too early in the project to answer	21.24%	24
TOTAL		113

Q14: If you estimate that some more development is needed before entering the market, please estimate:

Answered: 81 Skipped: 44



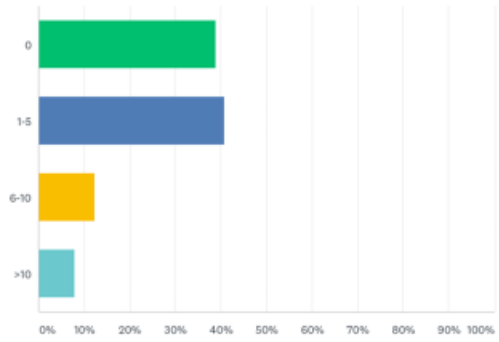
Q14: If you estimate that some more development is needed before entering the market, please estimate:

Answered: 81 Skipped: 44

ANSWER CHOICES	RESPONSES	
1-2 years	49.38%	40
2-5 years	48.15%	39
>5 years	2.47%	2
TOTAL		81

Q15: How many joint public-private publications have been issued in the scope of the project?

Answered: 113 Skipped: 12



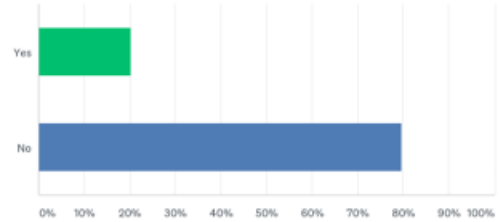
Q15: How many joint public-private publications have been issued in the scope of the project?

Answered: 113 Skipped: 12

ANSWER CHOICES	RESPONSES	
0	38.94%	44
1-5	40.71%	46
6-10	12.39%	14
>10	7.96%	9
TOTAL		113

Q16: For the purpose of the project, do you lead or take part to standardisation activities or to contribution to new Standards?

Answered: 113 Skipped: 12



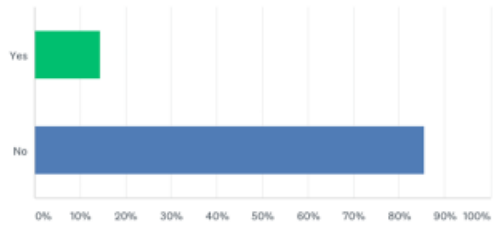
Q16: For the purpose of the project, do you lead or take part to standardisation activities or to contribution to new Standards?

Answered: 113 Skipped: 12

ANSWER CHOICES	RESPONSES	
Yes	20.35%	23
No	79.65%	90
TOTAL		113

project, do you think this is missing for the exploitation of the project results?

Answered: 83 Skipped: 42



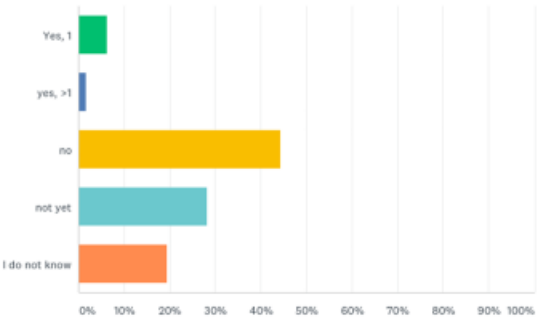
project, do you think this is missing for the exploitation of the project results?

Answered: 83 Skipped: 42

ANSWER CHOICES	RESPONSES	
Yes	14.46%	12
No	85.54%	71
TOTAL		83

Q18: Has any spin-off / start-up arised from the Project or is planned to be created?

Answered: 113 Skipped: 12



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Q18: Has any spin-off / start-up arised from the Project or is planned to be created?

Answered: 113 Skipped: 12

ANSWER CHOICES	RESPONSES	
Yes, 1	6.19%	7
yes, >1	1.77%	2
no	44.25%	50
not yet	28.32%	32
I do not know	19.47%	22
TOTAL		113

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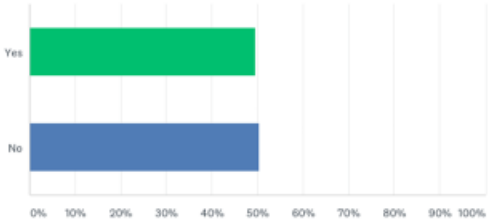
Q19: To reach project outcomes, did you have or do you plan to invest in new asset(s)?

Answered: 107 Skipped: 18



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Q19: To reach project outcomes, did you have or do you plan to invest in new asset(s)?

Answered: 107 Skipped: 18

ANSWER CHOICES	RESPONSES	
Yes	49.53%	53
No	50.47%	54
TOTAL		107

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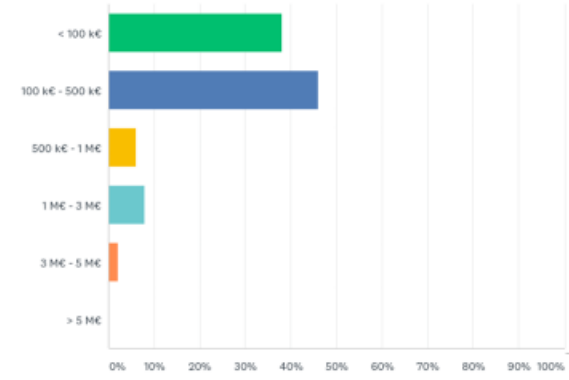
Q20: If yes, what is the level of investment?

Answered: 50 Skipped: 75



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Q20: If yes, what is the level of investment?

Answered: 50 Skipped: 75

ANSWER CHOICES	RESPONSES	
< 100 k€	38.00%	19
100 k€ - 500 k€	46.00%	23
500 k€ - 1 M€	6.00%	3
1 M€ - 3 M€	8.00%	4
3 M€ - 5 M€	2.00%	1
> 5 M€	0.00%	0
TOTAL		50

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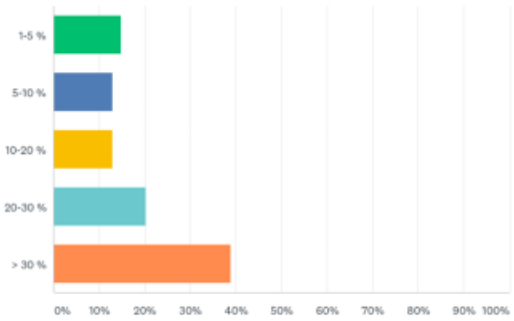
Q21: What is the part covered by the grant?

Answered: 54 Skipped: 71



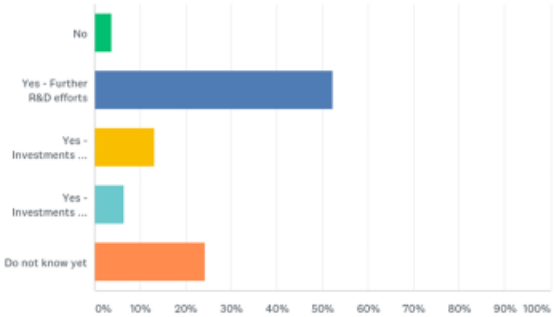
Q21: What is the part covered by the grant?

Answered: 54 Skipped: 71

ANSWER CHOICES	RESPONSES	
1-5 %	14.81%	8
5-10 %	12.96%	7
10-20 %	12.96%	7
20-30 %	20.37%	11
> 30 %	38.89%	21
TOTAL		54

Q22: Do you plan to further invest in the follow-up of the project?

Answered: 107 Skipped: 18



Q22: Do you plan to further invest in the follow-up of the project?

Answered: 107 Skipped: 18

ANSWER CHOICES	RESPONSES	
No	3.74%	4
Yes - Further R&D efforts	52.34%	56
Yes - Investments in Production Capacity (incl. Pilots / Demonstrators)	13.08%	14
Yes - Investments in Commercial effort (incl. staff / tools)	6.54%	7
Do not know yet	24.30%	26
TOTAL		107

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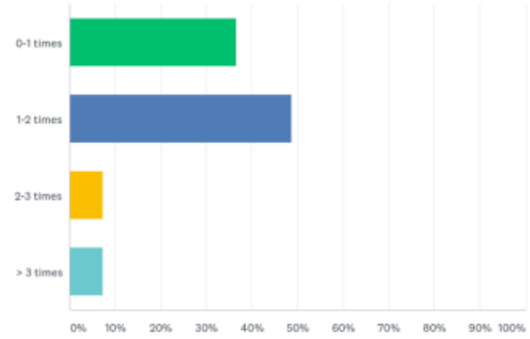
Q23: Regarding further R&D efforts, how do you estimate the R&D efforts will be compared to your project Budget?

Answered: 82 Skipped: 43



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Q23: Regarding further R&D efforts, how do you estimate the R&D efforts will be compared to your project Budget?

Answered: 82 Skipped: 43

ANSWER CHOICES	RESPONSES	
0-1 times	36.59%	30
1-2 times	48.78%	40
2-3 times	7.32%	6
> 3 times	7.32%	6
TOTAL		82

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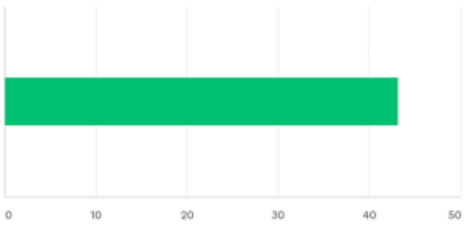
Q24: If you plan further R&D efforts, how do you estimate the cost share of the private and public sides?

Answered: 68 Skipped: 57



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Q24: If you plan further R&D efforts, how do you estimate the cost share of the private and public sides?

Answered: 68 Skipped: 57

ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	43	2,938	68
Total Respondents: 68			

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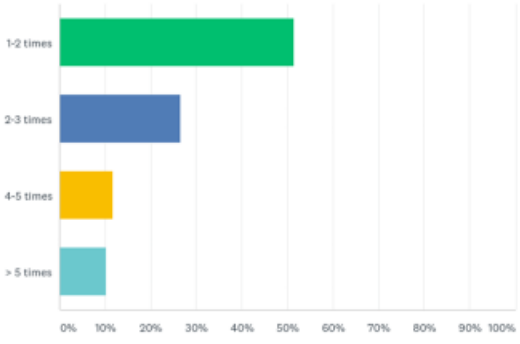
Q25: Regarding production investments, how do you estimate the production Investment will be compared to your project budget?

Answered: 68 Skipped: 57



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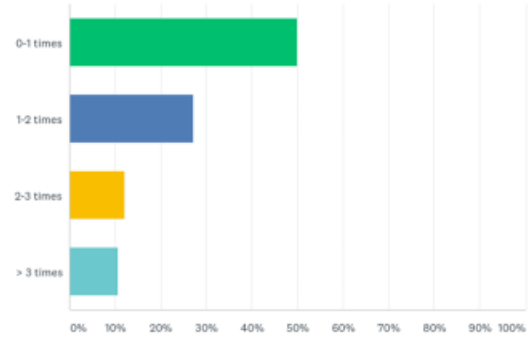
Q25: Regarding production investments, how do you estimate the production Investment will be compared to your project budget?

Answered: 68 Skipped: 57

ANSWER CHOICES	RESPONSES	
1-2 times	51.47%	35
2-3 times	26.47%	18
4-5 times	11.76%	8
> 5 times	10.29%	7
TOTAL		68

Q26: Regarding commercial efforts, how do you estimate the commercial efforts will be compared to your project budget?

Answered: 66 Skipped: 59



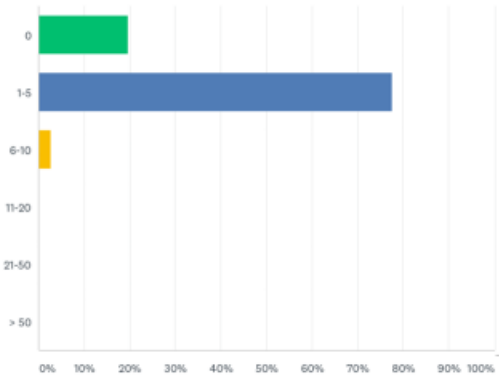
Q26: Regarding commercial efforts, how do you estimate the commercial efforts will be compared to your project budget?

Answered: 66 Skipped: 59

ANSWER CHOICES	RESPONSES	
0-1 times	50.00%	33
1-2 times	27.27%	18
2-3 times	12.12%	8
> 3 times	10.61%	7
TOTAL		66

Q27: Please roughly estimate the number of new jobs that have been created from the project in your company:

Answered: 107 Skipped: 18



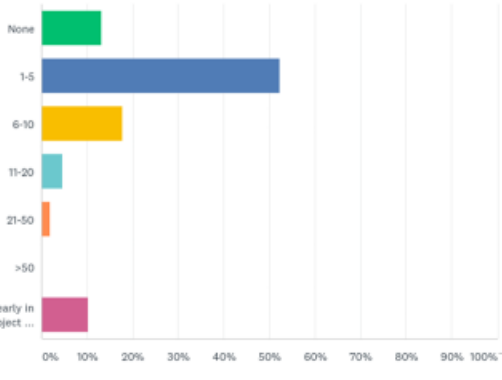
Q27: Please roughly estimate the number of new jobs that have been created from the project in your company:

Answered: 107 Skipped: 18

ANSWER CHOICES	RESPONSES	
0	19.63%	21
1-5	77.57%	83
6-10	2.80%	3
11-20	0.00%	0
21-50	0.00%	0
> 50	0.00%	0
TOTAL		107

follow-up from the project in your company within the next 3 years:

Answered: 107 Skipped: 18



follow-up from the project in your company within the next 3 years:

Answered: 107 Skipped: 18

ANSWER CHOICES	RESPONSES	
None	13.08%	14
1-5	52.34%	56
6-10	17.76%	19
11-20	4.67%	5
21-50	1.87%	2
>50	0.00%	0
Too early in the project to answer	10.28%	11
TOTAL		107

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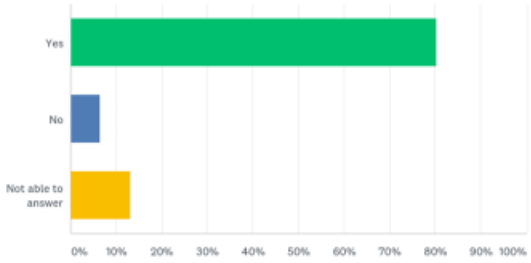
Q29: Do you think the project results will positively affect other areas of your company's activities?

Answered: 107 Skipped: 18



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Q29: Do you think the project results will positively affect other areas of your company's activities?

Answered: 107 Skipped: 18

ANSWER CHOICES	RESPONSES	
Yes	80.37%	86
No	6.54%	7
Not able to answer	13.08%	14
TOTAL		107

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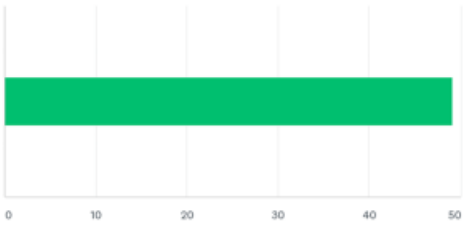
Q30: If yes, at what level will your activity be impacted?

Answered: 70 Skipped: 55



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Q30: If yes, at what level will your activity be impacted?

Answered: 70 Skipped: 55

ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	49	3,438	70
Total Respondents: 70			

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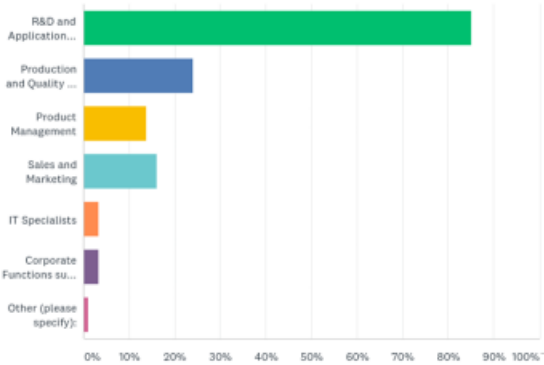
follow up from the project (cf. question 28): which functions do you foresee to be needed?

Answered: 87 Skipped: 38



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follow up from the project (cf. question 28): which functions do you foresee to be needed?

Answered: 87 Skipped: 38

ANSWER CHOICES	RESPONSES	
R&D and Application Development	85.06%	74
Production and Quality & Safety Control people	24.14%	21
Product Management	13.79%	12
Sales and Marketing	16.09%	14
IT Specialists	3.45%	3
Corporate Functions such as Accounting and Controlling, Law, HR	3.45%	3
Other (please specify):	1.15%	1
Total Respondents: 87		

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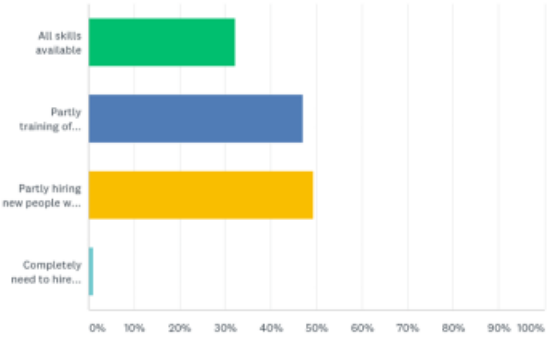
Q33: Do you have the skills needed in-house or do you need to either hire or train people?

Answered: 87 Skipped: 38



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Q33: Do you have the skills needed in-house or do you need to either hire or train people?

Answered: 87 Skipped: 38

ANSWER CHOICES	RESPONSES	
All skills available	32.18%	28
Partly training of in-house people	47.13%	41
Partly hiring new people with new skills	49.43%	43
Completely need to hire new people	1.15%	1
Total Respondents: 87		

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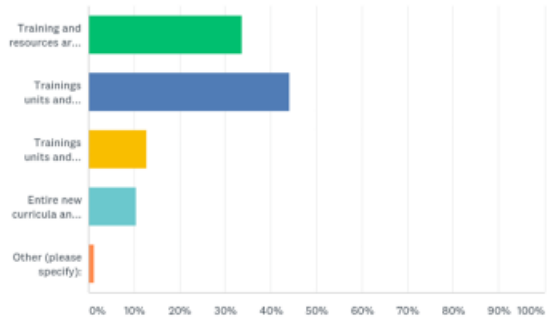
Q34: Are the new type of skills and appropriate training already existing and easy to access?

Answered: 86 Skipped: 39



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Q34: Are the new type of skills and appropriate training already existing and easy to access?

Answered: 86 Skipped: 39

ANSWER CHOICES	RESPONSES	
Training and resources are existent and easily to access	33.72%	29
Trainings units and resources exist but need to be enlarged	44.19%	38
Trainings units and resources exist but are content wise mature and need update	12.79%	11
Entire new curricula and training units need to be set up to create new resources	10.47%	9
Other (please specify):	1.16%	1
Total Respondents: 86		

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