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Samantha Michaux, Tabea Link (Lead authors)

10 Tools to Enable the Innovation Potential of High-Tech Photonics SMEs

A guide for cluster managers and business developers to support technological innovation

RESPICE SME

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PHOTONICS PUBLIC PRIVATE PARTNERSHIP

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Steinbeis-Edition

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10 Tools to Enable the Innovation Potential of High-Tech Photonics SMEs. A guide for cluster managers and business developers to support technological innovation

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Paving the way to excellence – Innovation capacity building for photonics SMEs

Small and medium-sized enterprises (SMEs) are the engine of the European economy. In Europe, 23 million SMEs provide around 75 million jobs and represent 99 % of all enterprises. Addressing gaps in terms of access to skills or expertise, resources, infrastructure or technology nevertheless remains a necessity in order to sustain the ongoing positive development. It is therefore important to ensure that conditions and support tools are in place that allow SMEs across the EU to exploit their innovation potential to the fullest.

This is where cluster and network initiatives can come in to play an active role in connecting and bringing together the right stakeholders and in reducing the barriers for collaborative innovations. This not only applies to stakeholders from different industries but also to stakeholders from within the value chain (for example, end-users and developers, or science and industry).

Besides providing an ideal environment for SMEs to best innovate and grow, clusters and networks managers should support the ***Innovation Management*** of SMEs which is of paramount importance for reducing the time from idea creation to putting a product on the market and successfully turning innovative ideas into profitable ventures.

Due to its nature as a Key Enabling Technology (KET), Photonics is one of the most prominent drivers for the modernisation of Europe's industry, strengthening its competitiveness, creating new jobs and supporting growth for SMEs. Within this framework, the project **RespiceSME** was launched to **strengthen the role of clusters and networks** as facilitators by **reinforcing the innovation capacity and stimulating targeted collaborations of European Photonics SMEs in and beyond photonics.**

With its unique 3-dimensional approach, RespiceSME focused on *evaluating and stimulating the innovation potential* of high-tech photonics SMEs *(Dimension 1)*; enhancing the *global technological exploitation* of photonics innovations by *analys-*

ing different value chains relevant for high-tech photonics SMEs *(Dimension 2)*. The objective was to support the breakthrough of photonic products in non-photonic sectors such as Environment / Energy, Transport and Manufacturing and thereby, to enable the *penetration of new markets and / or new application areas close to markets*. RespiceSME also focused on creating a bridge over the 'Valley of Death' *(Dimension 3) to increase the competitiveness* of the European photonics sector by developing *Best Practices* for facilitating photonics SMEs' access to European and regional Research Technology Organisations. This was achieved by harnessing educational and training programmes aligned with the specific needs of SMEs, assessing regional innovative smart specialisation strategies and providing access to public and private financial supports.

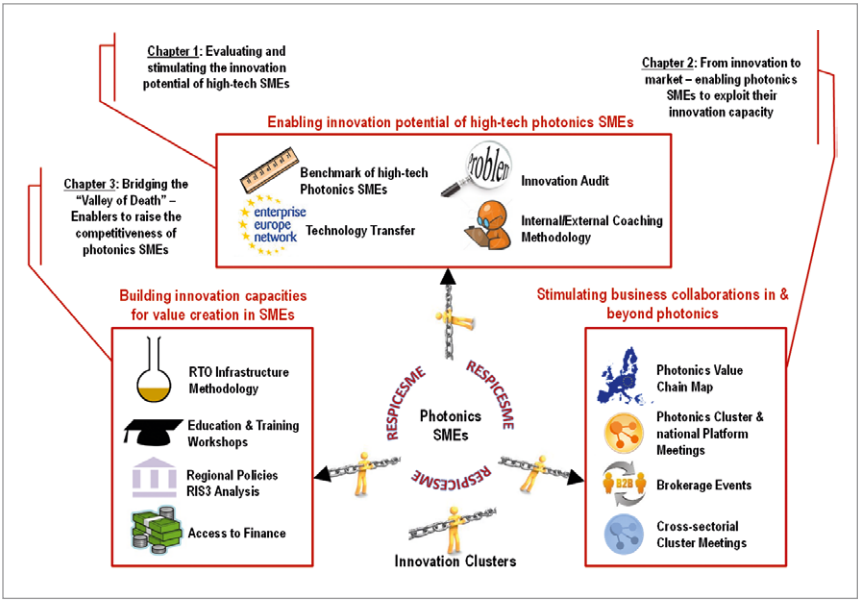


Figure 1: RespiceSME Toolbox (Source: Steinbeis 2i GmbH).

The handbook is targeted towards **cluster managers, business developers, network managers and corporate consultants** who seek to better understand the determining factors of innovation capability in high-tech Small and Medium-sized Enterprises (SMEs). It provides a set of indicators and tools to demonstrate how to

assess the innovative power of SMEs on the global as well as on the company level. With these practical instruments cluster managers may enhance their support for SMEs, allowing them to realise their innovation resources and to formulate an innovation strategy adapted to their needs.

Chapter 1: Evaluating and stimulating the innovation potential of high-tech SMEs

This chapter introduces the tools developed to evaluate and stimulate the innovation potential of high-tech SMEs. They can be utilised for benchmarking SMEs (e. g. cluster members) with regard to their innovation capability (Tool 1), for conducting a thorough analysis of innovation potential (Tool 2) and for finding the right strategic approach to innovation (Tool 3). Adding these tools to their portfolio of services, clusters will therefore improve and increase their competencies in supporting their SMEs in Innovation Management, strengthen the relationship to existing SMEs as well as generate new memberships.

Tool 1: Benchmark of high-tech SMEs – the PAPRIKA Method

Why benchmarking innovativeness?

It is common knowledge that innovativeness[1] is a key asset in today's global competition and that high-tech SMEs have a large share in it. In Silicon Valley, as well as in its European counterparts, SMEs are taking the lead, advancing technological developments and realising their potential by bringing new and highly-innovative products to the market. High-tech companies are drivers of innovation and, having the example of Silicon Valley in mind, are often key contributors to the 'innovation capital' of an entire region.

For cluster managers and business developers alike it therefore should be of interest to know about the 'innovation capital' of the high-tech SMEs they are working with since it tells them a lot, not only about their competitiveness, but also of the cluster and region.

1 When speaking of 'innovativeness' we genuinely mean the capability of a company to generate new products or solutions, involving novel and innovative technologies or methods

A cluster manager or business developer naturally cannot induce innovativeness, but can help to stimulate and unleash a company's innovation potential. A comparative analysis, so-called **benchmarking**, which looks at the grade of innovativeness found in cluster's member companies, can provide orientation to this end. In this way, cluster managers may acquire an overview of the strengths and needs their cluster's companies have. It can furthermore help to determine which SMEs actually make the best use of their innovation capabilities and should be addressed by measures to further stimulate these capabilities. Also, a repeated innovation benchmarking can help cluster managers with assessing the effectiveness of measures employed.

In RespiceSME, for example, the innovation benchmarking was used to generate a ranking list of SMEs with high innovation capabilities which were then considered for an innovation audit on individual company level.

Standard benchmarking tools rarely focus on innovativeness/innovation potential alone. High-tech companies need to have the ability to innovate as it is paramount for sustainable success on the market. The RespiceSME project decided to concentrate on innovation capabilities and to propose a benchmarking method, specifically tailored to cluster managers who are assessing multiple companies with different profiles. The method suggested by RespiceSME for innovation benchmarking is easy to apply and does not require a lot of additional time or resources – which is an advantage for cluster managers, having limited time for undertaking such analyses.

The following sections provide guidelines on how to conduct a **benchmarking** based on the **PAPRIKA method**, explained by taking the example of the RespiceSME project.

General introduction into the method

The PAPRIKA (Potentially All Pairwise RanKings of all possible Alternatives) method[2] is an innovative method for **scoring multi-attribute value models** to support multi-criteria decision making. It was developed by a team of researchers at the University of Otago (New Zealand) and has been recognised in several innovation awards.

2 P Hansen & F Ombler (2008), "A new method for scoring multi-attribute value models using pairwise rankings of alternatives", Journal of Multi-Criteria Decision Analysis 15, 87-107.

The PAPRIKA method allows decision-makers to look at different options of choice and compare them systematically, taking into account multiple objectives or criteria. The method helps to gauge the relative importance of criteria or attributes and to rank options / alternatives accordingly. It is especially suited towards complex decision situations that involve a number of alternatives that need to be considered.

The basic principle of the PAPRIKA method is thereby to limit the number of preference choices that have to be conducted in order to keep the decision procedure as simple as possible. Preference values are established through the pairwise ranking of only two hypothetical alternatives, involving a trade-off. Each choice option is defined by only two criteria to keep deciding between alternatives simple and intuitive for decision-makers. Also corollaries implied by previous ranking decisions are identified and discarded. This procedure is usually performed by software programmes such as 1000minds3 (www.1000minds.com) that apply the PAPRIKA method principle.

On the basis of the principles of the PAPRIKA method, RespiceSME developed a practical approach for ranking the innovativeness of high-tech (photonics) SMEs[4], which can be easily adopted and applied by managers of any high-tech cluster or anyone in a business development capacity.

Using the PAPRIKA method for benchmarking high-tech companies based on their innovativeness (explained by considering the example of RespiceSME)

Applying the PAPRIKA method for a benchmarking of innovative high-tech SMEs requires first clarifying which indicators shall be taken into consideration when gauging innovation potential. At the first glance it seems impossible to ascertain how much innovation potential a company really unlocks, especially from the outside view of a cluster manager.

3 RespiceSME acquired a license for using the 1000minds software for applying the PAPRIKA method in the framework of RespiceSME.

4 Since RespiceSME has been a project on photonics, the ranking criteria were originally established having photonics' companies in mind. However, considering the general notion of the criteria, they may be applied to any other technology field.

However, for mere benchmarking purposes, it is not necessary to have a detailed set of company data. The goal of the benchmarking, as proposed by RespiceSME, is to generate a **first overview on existing innovation assets or practices**. The benchmarking is not intended to deliver a qualitative inside-evaluation of innovation potential (this will be dealt within the next chapter).

For this purpose RespiceSME therefore recommends applying a pragmatic approach, which does not require a lengthy and cumbersome collection of company data through questionnaires, but relies on publicly available data.

The data considered for the RespiceSME benchmarking of photonics SMEs consisted of general figures like **founding year, turnover, number of employees**, which are publicly available as well as a **description of the main products and application markets**, which had been extracted from LinkedIn. This data was further consolidated with the information gained from individual company web pages and secondary sources.

From this pool of publically available data three criteria were identified by RespiceSME as being most significant for benchmarking the innovation potential of a company.

Innovation potential benchmarking criteria:

- Main type of company's activity
- Number of patents
- Company size

Regarding the **company's main type of activit**y, RespiceSME applied a classification that categorises companies' activities according to their position in the value chain (sales, services, contract research, component development, system development – listed from the lowest ranked to the highest). Activities that obviously involve less innovative practices such as sales or services were gauged lower than activities requiring them, such as system development.

For the **second criteria**, taking into account the **number of patents** and / or patent applications of a company, RespiceSME estimated the numbers, using the global patent aggregation portal (www.patentinspiration.com). The most common ranges of patent numbers (1–10, 11–20, 21–50, 51–100, above 100) were then identified; high numbers were associated with a strong innovative power.

The **third and last criteria** captured the **SMEs' size**, from start-up, over micro, small to medium sized enterprises. Here the factor growth was deemed to indicate, whether a SME possessed of higher or lower innovation capabilities. It is recognised that many small and very small enterprises are highly innovative, however, as the capacities of a company to pursue innovations also depend on the human resources available, it was decided to include the size of the company into the benchmarking.

Besides these criteria three additional factors were considered, namely the **company age** (number of years since incorporation), **turnover** (in MEUR) and a **specific application market** (a text description). Although these factors generally refer to both competitiveness and innovation potential of a company, they were included to complement the analysis.

In RespiceSME the three main criteria identified for the innovation benchmarking were then ranked by applying the PAPRIKA method, implemented on 1000minds.com[5]. To this end, all photonics cluster managers involved in RespiceSME had to answer a series of computer-generated questions, which required choosing between two hypothetical alternatives defined on two criteria at a time and involving a trade-off. By doing so, preference values for each previously identified criterion in comparison with the other were established.

The procedure resulted in the following criterion weightings:

5 RespiceSME acquired a license for using the 1000minds software for applying the PAPRIKA method in the framework of RespiceSME.

Criterion	Criterion weightings (sum to 1)	Level	Single criterion score (0–100)
Main type of activity	0.536	Sales	0.0
		Services	16.2
		Contract research	29.7
		Components	62.2
		Systems	100.0
SME status	0.246	Start-up	0.0
		Micro	29.4
		Small	35.3
		Medium	100.0
Number of patents	0.217	1–10	0.0
		11–20	6.7
		21–50	26.7
		51–100	86.7
		101–	100.0

Table 1: Normalized criterion weightings and single criterion scores (Source: LITEK).

This table summarises the values established by the RespiceSME consortium for benchmarking photonics SMEs according to their innovation capacity. As shown, the main type of activity was considered being the most significant indicator of innovation. This value scheme was used to score the photonics SMEs of each cluster region included in the RespiceSME project.

Outside of the RespiceSME context the weightings of the criterion may be adjusted. The great advantage of the PAPRIKA method is that it can be applied to any context and preference values always depend on the outlook of the person(s) conducting the benchmarking. Therefore, even if taking the same criteria as suggested by RespiceSME for benchmarking the innovativeness of a certain group of companies/SMEs, there is leeway to change the emphasis.

Tool 2: Innovation Audits

The innovation audits, as proposed by RespiceSME, aim at **evaluating the innovation potential of high-tech photonics SMEs at the company level**. The audits' approach is to assess a company's innovation capabilities and to formulate, on basis of the results, tailor-made recommendations on how to improve and enhance them.

The tool is not recommended to be applied by a company itself, as the proper assessment and evaluation require the assistance and supervision of an auditor in one-on-one meetings. Originally, the tool was conceived within the RespiceSME project with the global outlook to provide a framework for cluster managers and business developers, who take an interest in offering innovation services to their clients. *Innovation audits could be offered e. g. to high-tech companies, which were among the top ranked in the innovation potential benchmarking (see tool 1).*

The concept of the innovation audits is mainly based on the Potential Innovation Index (PII) by Boly[6], which has been adapted to the specific context of high-tech photonics SMEs. Taking into account the theoretical foundations of the PII, which are presented in the following sections, RespiceSME has developed a questionnaire for assessing the individual innovation potential of high-tech photonics SMEs.

The innovation audit questionnaire allows examining a company's performance and capacity in seven fields of innovation practices, e. g. in **competence management**, and determining on this basis the company's overall level of innovation potential. Due to the mostly quantitative set-up of the questionnaire, the tool can be easily employed by business developers and cluster managers for conducting a quantitative assessment of corporate assets and shortcomings concerning innovation practices. With participating in an innovation audit the company, on the other hand, receives valuable information about where they should take up measures or improve mechanisms of innovation management.

6 Boly et al., Evaluating innovative processes in French firms: Methodological proposition for firm innovation capacity evaluation, Research Policy 43 (2014) 608–622.

The Potential Innovation Index – an instrument to illustrate innovation potential

For the benchmarking of high-tech photonics SMEs' innovation potential, criteria relating to the innovation output of a company (e. g. number of patents) rather than revealing the state of *internal* innovation practices of a company were examined.

Assessing a company's individual innovation potential requires a deeper understanding of what constitutes innovation capacity metrics on the company level in case of high-tech (photonics) firms. Literature has provided a number of definitions of how to comprehend innovation capacity. Szeto, for example, defines **Innovation capacity** as the *continuous improvement of the overall capabilities and resources that the firm possesses for exploring and exploiting opportunities to develop new products to meet market needs*[7].

Research has sought to develop instruments to identify resources and capabilities linked to innovation capacity and to measure innovation potential on the company level. Reviewing the literature on this topic one concept, **the Potential Innovation Index**, stood out in particular, as it grasps the context of innovation in high-tech SMEs most comprehensively, while proposing a quantitative method to gauge the individual innovation potential level of a company.

The model of the Potential Innovation Index was introduced and further developed by Boly, Corona, Assiélou and the larger team of researchers from ERPI (Équipe de Recherche sur les Processus Innovatifs) at the University of Lorraine. It proposes a general referential framework of internal innovative practices for innovative companies.[8] The original framework consists of a list of **six main areas for innovation practice**, namely: 1) Creativity and concept generation, 2) New product development, 3) Human resources management, 4) Technological strategy, 5) Project management and 6) Data and knowledge management. Boly has further expanded the methodology by increasing the number of the innovation practice

7 Szeto, E., 2000. Innovation capacity: working towards a mechanism for improving innovation within an inter-organizational network. The TQM Magazine 12 (2),149–157.

8 Daniel Galvez, Mauricio Camargo, Julio Rodriguez, Laure Morel, PII- Potential Innovation Index: a Tool to Benchmark Innovation Capabilities in International Context, J. Technol. Manag. Innov. 2013, Volume 8, Issue 4, 36–45.

areas to 15, including design, project management, integrated strategy, project portfolio management, suitable organisation, innovation process improvement, competences management, moral support, knowledge management, competitive technology intelligence, network management, collective learning, ideas and creativity, R&D activities and customer relation management[9].

To evaluate a company's performance in these fields, each aspect is usually covered by three questions, which are in turn evaluated on a Likert scale with proposed weightings for each group of criteria. The questions' design is of mere quantitative nature, since Boly's assumption is that innovative companies develop all or any innovation practices with more or less relevance and in a formal or informal manner. From the degree of development of these practices the innovation capacity of a company and its mastery level of the innovation process can be determined. Hence, instead of trying to qualitatively evaluate the level of each innovation practice aspect (the process which is always prone to a subjective treatment of the observables) Boly proposes to measure the practices either by noting their existence or their absence, thus providing the basis for a more robust model using quantitative data as an output.

The Potential Innovation Index for high-tech photonics SMEs as proposed by RespiceSME

While adopting Boly's proposed Potential Innovation Index methodology, the RespiceSME consortium has narrowed down the innovation practices to **7 areas** which, having consulted with the industry experts, identified as the most suitable to capture the innovative potential of high-tech photonics SMEs. This was done by collecting the core characteristics of the key-performing SMEs. The list of characteristics and the corresponding questions, covering individual innovation practices, are presented in the table below.

In distinction to the main areas for innovation practice defined by Boly, RespiceSME has added one additional area, reflecting the **value chain of a company**. The area was included to reflect the challenge of photonics SMEs to take up a strategic

9 Boly et al., Evaluating innovative processes in French firms: Methodological proposition for firm innovation capacity evaluation, Research Policy 43 (2014) 608–622.

position in the value chain. As photonics is a technology which has a wide variety of applications (as has any key enabling technology) companies tend to engage in too many value chains, instead of concentrating on strengthening one line of action and focusing on core competences. Drawing on a large base of experience in business development, the assumption of RespiceSME is that in order to strategically exploit its innovation potential a company must analyse and identify the (sections of the) value chains, which have the greatest potential for innovation and development. This is a challenge, not only to photonics SMEs, but in fact to any high-tech SMEs using key enabling technologies.

The characteristics stated in the table below thus do not apply exclusively to photonics SMEs. On the contrary, adopting the larger and general scope of Boly's criteria, they can also be applied for assessing the innovation potential of other high-tech SMEs.

Innovation practice area	Issues relevant for high-tech SMEs	Aspects to be analysed in the PII survey
Ideas, creation and creativity	Formalise and streamline the idea generation for new R&D activities and planned products in specific, highly specialised areas; use the brainpower scattered across different functions	▪ Ideas collection from R&D and marketing staff ▪ Creativity groups ▪ Formalised procedures to collect ideas within the company ▪ Meetings dedicated to idea generation involving staff from R&D and marketing functions ▪ Dedicated resources to keep track of existing and new ideas ▪ Formalised assessment process to evaluate new ideas

»

Design and new product	Adapt practices, often introduced by external facilitators and experts, to design new products according to the set of rules in a highly complex and often customized product pipeline, which is difficult to replicate or scale-up especially in smaller companies working on customised solutions	▪ Monitoring of new product development activities take place ▪ Regular reviews of tasks of all project teams and managers ▪ Use of facilitator groups or individual ▪ Use of formalised design methodologies or tools for new product development ▪ In-house availability of prototyping facilities (such as a laboratory or a test bed) ▪ Implementation of quality and assurance processes
Competences management	Improve the skill base in the company while keeping a track of what skills could be required within a short-term period (given the fact that often the skills needed are extremely specific and their supply on the market is limited).	▪ Technological training on a regular basis ▪ Staff employment strategies according to skills needed for future projects ▪ Mapping of individual competences for use in innovation management ▪ Formation of cross-functional teams to perform project-driven activities ▪ Function of a human resource manager
Competitive technology intelligence	Keep an eye on the latest technological developments by incentivizing staff to gather and share information, collecting data in a structured manner and using the internal organizational structures to transform these bits of information into potential leads.	▪ The process for technology intelligence gathering ▪ Incentives to actively participate in the technology intelligence gathering ▪ Data collection methodologies and tools for the market survey ▪ Meetings to transform collected information into innovation projects ▪ Planning and preparation of visits (exhibitions, trade shows etc.) in advance
Project management	Keep on track with delivering projects while making sure that the project management process is flexible and adaptive to the changing demands of the customer and includes the risk mitigation measures in the case of highly customized solutions which have a strong service element attached.	▪ Availability of regular progress reports for each project ▪ Availability of well-defined planning boards available for tracking project progress ▪ Availability of an initial reference frame established for each project (objectives, responsibilities, budgets) ▪ Continuous resource monitoring (materials, financial, personnel) assigned to each project ▪ Project management and / or task tracking software

»

Knowledge management	Implement internal systems backed up by knowledge management processes in order to make available sensitive information for a safe retrieval and further use without jeopardizing the know-how by revealing it to externals. Hence, the big question is what to make available and how, and what levels of access should be introduced.	▪ Dedicated system or tool for recording know-how and re-use of previous knowledge ▪ Processing of (codification, classification) before storing ▪ Implementation of procedures for creating and maintaining and securing intellectual property ▪ A regular staff appraisal procedure at an individual or team level ▪ Knowledge management tools such as centralised intranet portals or repositories
Value chain analysis	Need to identify the value chains in order to better position oneself within the market space and create a more sustainable business model, which is challenging given the fact that photonics is a general purpose technology which has a wide variety of applications, so the company involvement in the value chains tends to be overstretched with a lack of a strategic depth. Hence, the need to have in-house capacities to constantly analyse different value chains and make strategic adjustments accordingly.	▪ A clear understanding of the value chain which encompasses products, processes, or service ▪ Analysis of the contributors (research partners, suppliers, advisors) that help you provide product, process, or service ▪ Identification of the different stakeholders who could most effectively exploit, apply or extract value from your product, process, or service? ▪ Recognition of the technology readiness levels of the various elements of the value chain in which a specific product or process contributes ▪ A systematic approach to identify what part of the value chain has the greatest potential for innovation or development

Table 2: Table Potential Innovation Index as adapted by RespiceSME (Source: LITEK).

The RespiceSME Innovation Audit Questionnaire – Guidelines for conducting and evaluating an Innovation Audit

RespiceSME developed a questionnaire in order to evaluate the proposed Potential Innovation Index (PII), comprising a series of closed questions on the innovation practices relevant to (photonics) SMEs. Each innovation practice area, illustrated in the PII, comprises of up to six question blocks. For example, questions on the innovation practice area 'Design and new product development' examine the involvement and organization of employees in product development, whether

methodologies or tools are used to this end, and if lab facilities are available. The aim of the questionnaire is to measure for every innovation practice area the capabilities and resources available at the company level.

Some aspects covered by the questionnaire only a company's top management has insights in, it is therefore recommended to conduct the survey with at least one executive manager / senior manager. For comparing different perspectives it can add further insights into companies by enabling executives as well as employees with managerial responsibilities to fill out the questionnaire. Ideally the cluster manager / business developer in charge of the innovation audit assists the firm with filling-out the questionnaire in a dedicated meeting. This ensures a clear and correct understanding of the queried factors in the questionnaire and allows for discussion and clarification of questions. It also enables the innovation auditor to get a first-hand insight into the company's innovation capabilities and possible problems.

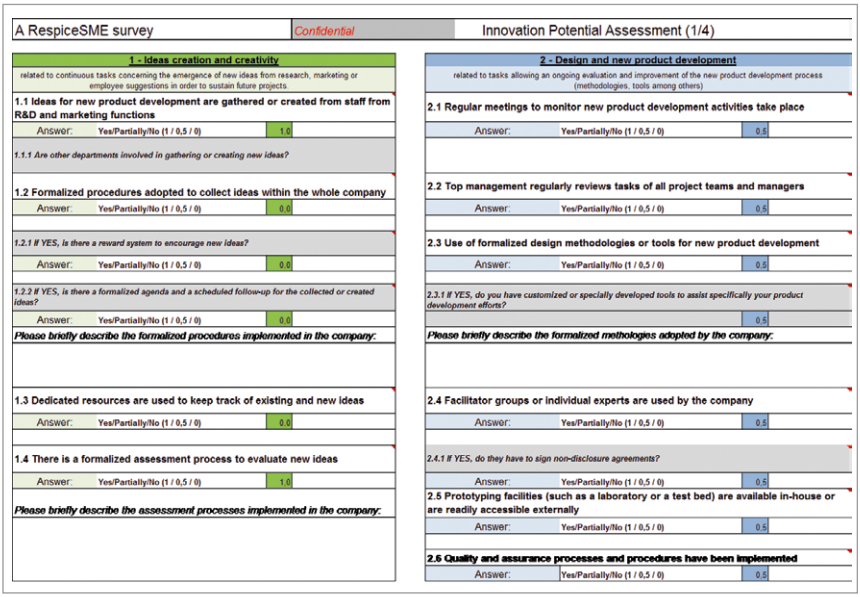
A large part of possible answers are limited to; yes, partially and no. Answers given can be scored and weighted using both standard and harmonic averages. In the RespiceSME innovation audits positive answers were gauged with 1 point, whereas a negative answer yielded 0 points. The simple composition of questions makes filling-out the questionnaire fairly easy. Answering the quantitative questions also should not be very time-consuming; a maximum of 20–30 minutes should be foreseen for the overall questionnaire. This is an important argument for business executives, who usually do not have a lot of time at their disposal.

However, the section "value chain analysis" also contains open questions that are directly linked with another tool that has been developed by Dr. Gerard O'Connor, lecturer at the University of Galway[10], for the purposes of RespiceSME. This additional tool, which necessitates a more comprehensive response, will be presented in detail in chapter 2 of this handbook.

10 http://www.nuigalway.ie/faculties_departments/physics/staff_pages/g_oconnor/

Excerpt of the RespiceSME Innovation Audit Questionnaire

The complete questionnaire can be downloaded from http://www.respice-sme.eu/respicesme-toolbox/tools/



A RespiceSME survey | Confidential | Innovation Potential Assessment (1/4)

1 - Ideas creation and creativity

related to continuous tasks concerning the emergence of new ideas from research, marketing or employee suggestions in order to sustain future projects

1.1 Ideas for new product development are gathered or created from staff from R&D and marketing functions
Answer: Yes/Partially/No (1 / 0,5 / 0) 1.0

1.1.1 Are other departments involved in gathering or creating new ideas?

1.2 Formalized procedures adopted to collect ideas within the whole company
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.0

1.2.1 If YES, is there a reward system to encourage new ideas?
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.0

1.2.2 If YES, is there a formalized agenda and a scheduled follow-up for the collected or created ideas?
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.0

Please briefly describe the formalized procedures implemented in the company:

1.3 Dedicated resources are used to keep track of existing and new ideas
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.0

1.4 There is a formalized assessment process to evaluate new ideas
Answer: Yes/Partially/No (1 / 0,5 / 0) 1.0

Please briefly describe the assessment processes implemented in the company:

2 - Design and new product development

related to tasks allowing an ongoing evaluation and improvement of the new product development process (methodologies, tools among others)

2.1 Regular meetings to monitor new product development activities take place
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.5

2.2 Top management regularly reviews tasks of all project teams and managers
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.5

2.3 Use of formalized design methodologies or tools for new product development
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.5

2.3.1 If YES, do you have customized or specially developed tools to assist specifically your product development efforts?
0.5

Please briefly describe the formalized methologies adopted by the company:

2.4 Facilitator groups or individual experts are used by the company
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.5

2.4.1 If YES, do they have to sign non-disclosure agreements?
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.5

2.5 Prototyping facilities (such as a laboratory or a test bed) are available in-house or are readily accessible externally
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.5

2.6 Quality and assurance processes and procedures have been implemented
Answer: Yes/Partially/No (1 / 0,5 / 0) 0.5

Figure 2: Excerpt of RespiceSME Innovation Audit Questionnaire (Source: LITEK).

Translating the Potential Innovation Index into practice – Report & recommendations on the innovation audit

Integral part and parcel of the innovation audits is the evaluation of the questionnaire's results including recommendations on how and in which innovation practice areas actions should be taken up or improved.

The innovation audit thereby reflects the results of the company's self-assessment regarding the innovation practice areas by providing **In-depth analysis of the innovation capacity** indicators related to the 7 dimensions of the RespiceSME audit: (1 – Ideas creation and creativity; 2 – Design and new product develop-

ment; 3 – Competence management; 4 – Competitive technology intelligence; 5 – Project management; 6 – Knowledge management; 7 – Value chain analysis).

It is recommended that different score levels for each field are illustrated in a potential star graph (see below).

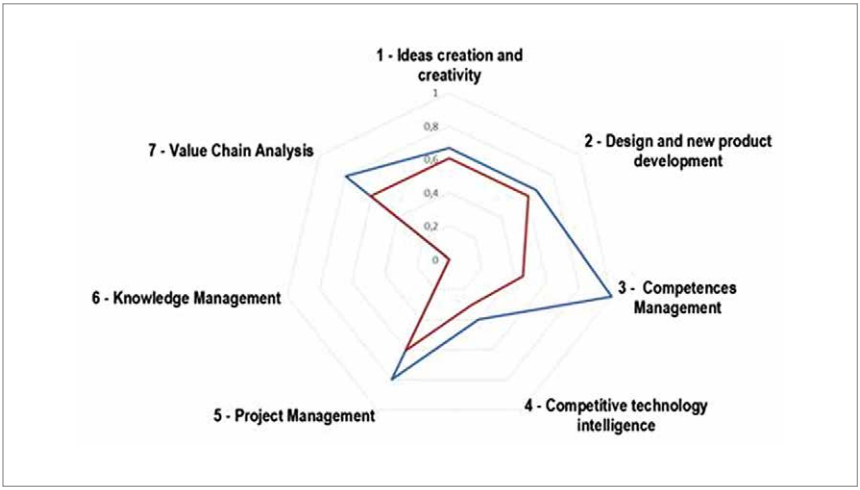


Figure 3: Potential Star Graph (Source: LITEK).

The potential star graph demonstrates which innovation practice areas the company has high assets in and in which it has shortcomings according to the questionnaire responses.

It also highlights how perspectives regarding the company's innovation practices might differ depending on the respondents' position in the company (e. g. comparing the view of an executive manager (blue line) with a technical project leader (red line). This may reveal weak points regarding internal communication or the overall structure of innovation processes in the company. These are issues which should be discussed in a follow up meeting with the company to discuss the outcomes of the innovation audit.

If the innovation audit was conducted on the basis of a prior benchmarking, including competitors of the audited company, the company's positioning within that benchmarking might be discussed as well. However, the results of the innovation audit questionnaire usually provide a more complete and complex picture of the company's strengths and weaknesses.

On the basis of the audit results, the cluster manager should develop a set of recommendations for the company to be implemented. These recommendations will address the identified weaknesses of the company and suggest solutions to overcome such weaknesses.

Lessons Learnt – The RespiceSME Innovation audits

In the framework of RespiceSME 32 innovation audits have been conducted with clusters' SMEs of the RespiceSME consortium. Insights, relating to the practical implications of the questionnaire organisation as well as the outcome of the audits are gathered below.

1) The audit questionnaire is not dedicated to micro-enterprises or start-ups

When auditing micro SMEs and start-ups, RespiceSME partners realised that most sections of the questionnaire do not apply to very small structures, which lack independent departments, formalized procedures of knowledge management or product development or which simply do not use formalized creativity methods or tools. This did not present a major difficulty as the concerned partners went through the sections and mainly focused on the sections that were relevant for the company. The only case where this might be an issue is when using the innovation audit results to benchmark companies, as smaller companies will consistently score lower than their larger counterpart. In RespiceSME it was thus decided to not benchmark the companies at a European scale. ***For smaller companies a benchmarking at the local and/or regional level (not European) is usually more interesting;*** they want to see how they are doing in relation to others within a particular ecosystem or the industry sector.

»

2) C-level executive are most dedicated for innovation audits

C-level executive or board members are most dedicated to answer the questions of the audits since they are mainly dealing with strategic issues. In some case, members of staff who were focused on the technical delivery of products seemed to display a greater scepticism about the impact of the audit tool than those in sales or at C-level. Furthermore, some companies are not part of a managed industry cluster and have not been exposed to this type of intervention in the past. They possibly feel that this is a waste of time for the company who should be focusing on "Lean Manufacturing" practices which have been at the forefront of industrial practices in some countries (e.g. Ireland).

3) Lack of resources to improve internal processes

SMEs on the whole agree with the results provided by the audit and justify their lower score by the lack of resources necessary to improve internal processes. They also perceive a gap between the results of the audit and a concrete action plan allowing them to improve their performance with a precise evaluation of the necessary efforts and guarantee of the results. In other terms, they are expecting some concrete recommendations on actions to be implemented. This is why the cluster manager should prepare some recommendations in accordance with the analysis of the audit that can be discussed with the SME during a follow up meeting.

Tool 3: Strategy workshop for the development of a Business Innovation Strategy

The strategy workshop tool is targeted at companies, which are interested in stepping up their efforts in innovation management through the **development of a coherent Business Innovation Strategy.**

The strategy workshops have been conceived by the RespiceSME partners while following-up on the innovation audits conducted within the project (see tool 2). The partners drew from the feedback of audited photonics companies that a mere reflection and analysis of the audit results was not enough, but a concrete action plan is needed to implement recommendations on how to improve innovation practices.

Ideally, the innovation audit and the strategy workshop are both part of an overall coaching process provided by the cluster manager or business developer to respective companies. As demonstrated in the graph below such a coaching could comprise a 1st 'strategy workshop', including the self-evaluation of innovation potential through the innovation audit questionnaire, and a 2nd workshop for formulating a final action plan.

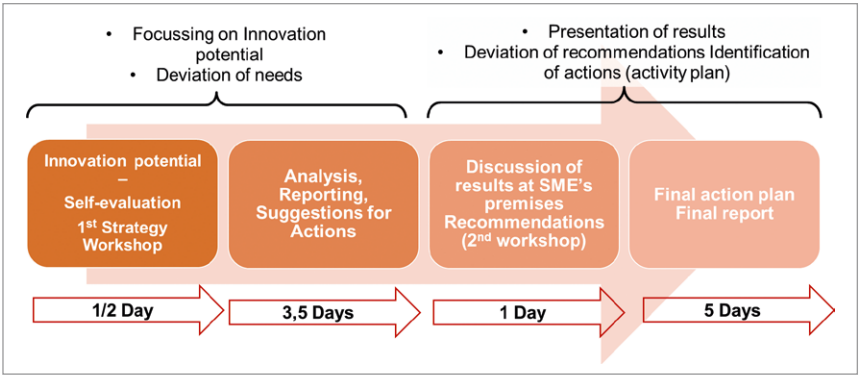


Figure 4: Innovation Coaching Timeline (Source: Steinbeis 2i GmbH).

Approach

The **goal of the strategy workshop** is to **support companies in formulating a coherent business innovation strategy,** adapted to their needs. A tailor-made business innovation strategy shall provide companies with a clear roadmap how to introduce and establish successful innovation management schemes in their corporate environment.

Innovation management, as understood here, subsumes the organisation of innovation practices and procedures undertaken in a company.

More precisely, carrying out innovation management means:

- To **consciously organise** the development of innovations (innovative products, services, etc.) within the company
- By **responding to external** (business criteria) and **internal** (organisational criteria) opportunities and use its creativity to introduce new ideas, processes or products.

The innovation management cycle, as depicted in Figure 5, provides orientation concerning how to build up and consciously organise innovation development procedures within a company. Starting with the formulation of a strategy and the collection and management of ideas the cycle ideally ends with concrete results obtained from the innovation development, which are in turn subject of evaluation and further optimization. The cycle ergo outlines the necessary steps of innovation management – a routine, which to establish should be one outcome of the strategy workshops for participating companies.

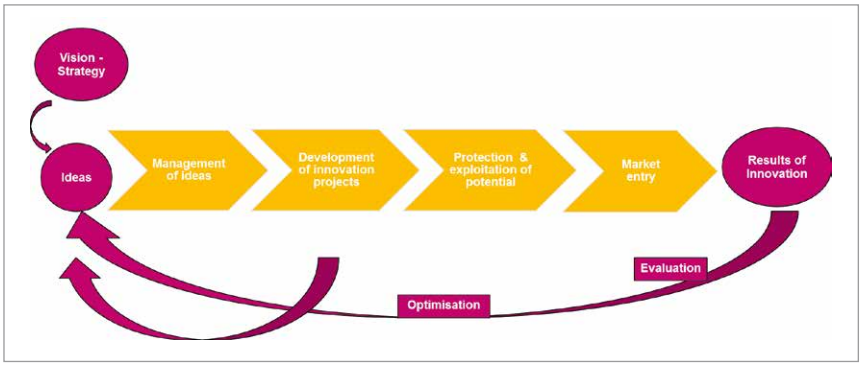


Figure 5: The Innovation Management Cycle (Source: Steinbeis 2i GmbH).

Here the strategy workshop can help to initiate the first step of the innovation management cycle, the creation (or gathering) of ideas. The concept of the workshop comprises of several units dedicated to the analysis of external factors, such as current market trends, which might influence or inspire a company's innovation development.

Moreover, the strategy workshop can provide a framework for the company to review its internal assets and shortcomings, not only regarding the management of innovation procedures, but also regarding the results of innovation. This kind of evaluation in turn can serve as a basis for installing new or optimised schemes of innovation management.

Last but not least a **final report on the strategy workshop** should summarize the insights gathered from the assessment of both internal and external factors relevant to the company's innovation management and provide a clearly outlined business innovation strategy for the company.

The following section outlines the **workshop steps** and provides recommendations on how to implement them.

Overall structure

1. Assessment of internal factors: Business life cycle; vision; PII; Strengths & Weaknesses
2. Analysis of external factors: Trends; Positioning of products; Product life cycle; Technology portfolio; new business fields; Opportunities & Threats; Stakeholder Analysis
3. Summary of recommendations and action plan

Strategy workshop steps

Assessment of internal factors relevant for innovation management

In order to effectively execute an innovation management cycle a company first needs to be aware of assets and shortcomings related to its existent innovation procedures. Therefore, the first part of the strategy workshop, as conceived by RespiceSME, concentrates on assessing the **internal factors** related to the company's innovation management.

This comprises:

- Analysis of the business life cycle;
- Providing an overview of the current situation of the company regarding its innovation management (Potential Innovation Index – Innovation Audit questionnaire, see tool 2);
- Identifying the Strengths and Weaknesses of the company as part of a SWOT analysis.

1.1 Business life cycle assessment: Current status and Vision

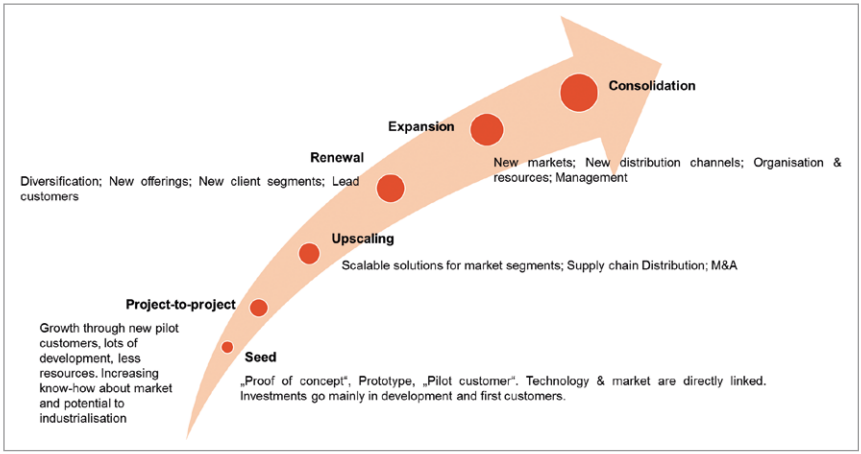


Figure 6: Business Life Cycle Assessment (Source: Steinbeis 2i GmbH).

Change is a constant in business life. There are different stages of business development each having its own challenges and opportunities. Building a successful business which thrives on the market requires frequent validation of goals set and adaptation of business approaches in response to current challenges. During business growth it might be necessary to shift the focus, e.g. change the market orientation, target new customer groups or look for novel sources of funding.

When leading a business – whether it be a start-up, SME or company – it is important to be aware of its position in the business life cycle.

Seed stage	The seed stage is when the business is just a thought or an idea. The challenge is to overcome the challenge of market acceptance and pursue one niche opportunity.
Start-up stage **Project-to-Project**	The business is born and now exists legally. Products or services are in production and first contracts with customers are ongoing. The challenge is to keep a good control on the cash flow in order to guaranty the financial viability of the business.
Growth stage **Scaling up**	Your business has made it through the toddler years and is now a child. Revenues and customers are increasing with many new opportunities and issues. Profits are strong, but competition is surfacing.
Establishment stage **Renewal**	Your business has now matured into a thriving company with a place in the market and loyal customers. Sales growth is not explosive but manageable. Business life has become daily routine. It is far too easy to rest on your laurels during this life stage. The company should thus focus on improvement and productivity.
Expansion stage	This life cycle is characterized by a new period of growth into new markets and distribution channels. This stage is often the choice of the business owner to gain a larger market share and find new revenue and profit channels.
Maturity stage **Consolidation**	Year over year sales and profits tend to be stable, however competition remains fierce. Eventually sales start to fall off and a decision is needed whether to expand or exit the company. The company should look for new opportunities and business ventures. Cutting costs and finding ways to sustain cash flow are vital for the mature stage.

Table 3: Table Business Life Cycle Stages (Source: Steinbeis 2i GmbH, adapted from http://www.justintimemanagement.com/en/The-7-stages-of-business-life-cycle).

As soon as the business life cycle stage has been established, it is important to **define the vision** of the company that will lead to the establishment of the objectives for the new business innovation strategy.

1.2 PII Self-Assessment – Innovation Audit questionnaire

Ideally, a strategy workshop follows-up on an innovation audit, which already provided information on the status of innovation practices within the company. If this is not the case, the strategy workshop should begin with an introduction to the Potential Innovation Index (as described in Tool 2) and filling-out the innovation audit questionnaire.

1.3 SWOT Analysis

Classic SWOT analyses look at Strengths and Weaknesses of a company, assessing their effect on the company's global competitiveness, while also outlining possible Opportunities and Threats. In the framework of a strategy workshop designated to examine a company's innovation management the SWOT analysis first should emphasize on interpreting the Strengths and Weaknesses (S&W) identified during the self-assessment based on the Potential Innovation Index frame, using the innovation audit questionnaire (tool 2).

However, the goal of the S&W analysis is to go beyond the insights revealed through the Potential Innovation Index, which mostly gauges if innovation practices are existent in different areas or not. The additional S&W assessment should scrutinize the strategic positioning and overall success of the company on the market, factors that are not explicitly conveyed through the PII questionnaire.

To assess these factors, although of rather global nature, is important as they reveal whether and how the company's competitive position is reflected inside the company and if this is linked to some form of innovation management, e. g. if new products have been developed coincidently or following dedicated R&D processes. Also, reviewing weaknesses of the company is important to understand how project failures are evaluated and if results are fed back in the company's (innovation) management cycle.

Below **exemplary questions** are gathered which can serve as a basis to assess strengths and weaknesses.

Strengths

- What are the special competitive advantages of the company?
- What are its most successful products?
- Which are successful markets for the company's products?
- Which clients are the most valuable for the company's products?

- What are the competitive advantages of the company's technology?
- Which successful actions have been implemented in the last 2 years?
- On which strengths can the company rely on in the near future?

Weaknesses

- What are the disadvantages of the company in competition?
- What are the disadvantages of the company's technology?
- Which were product flops?
- Which measures failed in the last two years?

Analysis of external factors to the company

In order to generate an effective business innovation strategy, it is not enough to only analyse the internal factors. Taking into account **current needs** and **demands of the market** as well as **trends and opportunities** in the process of innovation development is of key importance. This kind of market screening supports ideas creation by identifying gap segments, market niches. It may also put on the map new customer groups or stakeholders for cooperation, which have not been considered yet by the company. The reflection of market developments per se and in relation to the company's own assets can help with formulating strategic mid- and long-term goals for the business. In particular, the analysis of external factors shall ensure innovation developments are not errant, but thrive on the market, being placed strategically in the right segment at the right time.

The cluster manager or business developer, conducting the strategy workshop, should therefore cover the review and analysis of following external factors together with the company:

- Analysis of trends, markets, products, services & technologies
- Positioning of products / services on the market
- Positioning of products / services along the product life cycle

- Identification of new activity fields
- Analysis of Opportunities & Threats

2.1 Trends analysis

The trends analysis should cover the industries the company is active in and identify relevant developments, whilst also taking into account trends and tendencies on the macro level, which might influence the company's activities.

In preparation of the trend analysis the cluster manager implementing the strategy workshop may conduct a **brief pre-screening of trends** in the industry fields relevant to the company, especially if he or she is not familiar with the fields.

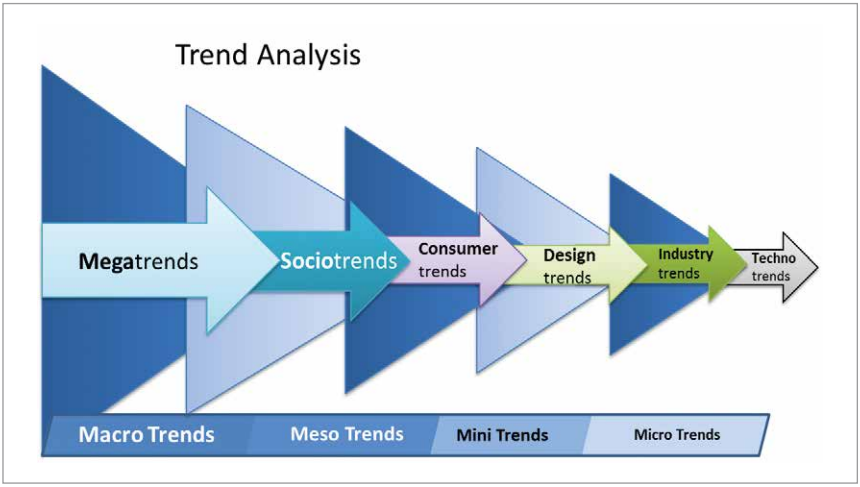


Figure 7: Trend Structure Analysis (Source: Steinbeis 2i GmbH).

The following classification of trends can serve as a guideline for the analysis:

Megatrends are significant, long-term and global changes to society and consumption: for example, globalisation and health are strong megatrends of recent years.

Social-cultural Trends can be defined as any type of activity that is participated in by society as a whole. Trends can be long-lasting or short-lived (e. g. Facebook, Twitter, etc.)

Consumer trends are dominant set of ideals and beliefs that motivate a society in a particular period in time (e. g. modernism)

Micro trends: Styles in design for a particular consumers group

Industry trends: Developments in a particular industrial field

Techno trends: Technology trends

2.2 Analysis of positioning of products – Growth-Share Matrix

Besides analysing future trends, it is also important to have a look at the company's **units' current position on the market and future perspectives**. This kind of market analysis, to classify the market success of different business units and to assess their share of the company's profit, is an established tool of business development. Its aim is to **highlight business areas of strategic importance** and / or with great potential as well as business areas with less promising prospects.

In the context of the strategy workshop the market analysis can help a company to identify areas where innovation actions should be stepped-up and where they should not be further pursued, given their potential value for profit is low. Since resources for innovation development are naturally limited, it is essential, especially for smaller companies, to focus on business units of strategic importance.

The classic market analysis[11] differentiates between **cash cows, dead dogs, questions marks** and **rising stars**, when assessing a company's units according to their value for profit and market share.

11 See Kumar, D., 2010. Enterprise Growth Strategy: Vision, Planning and Execution. Routledge Publishing.

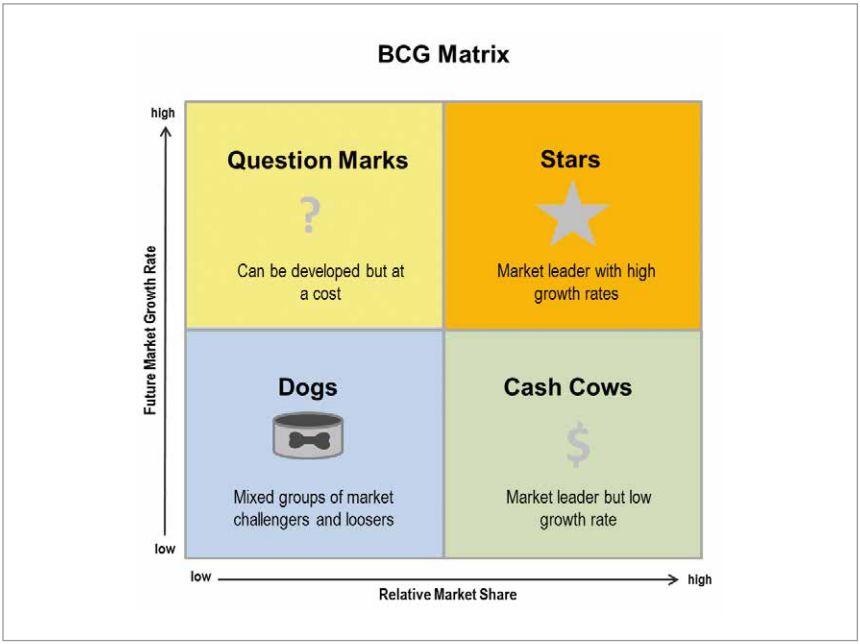


Figure 8: BCG Matrix (Source: Steinbeis 2i GmbH).

Cash cows are units with high market share in a slow-growing industry.

Dead Dogs are units with low market share in a mature, slow-growing industry.

Question marks are growing rapidly and thus consume large amounts of cash, but because they have low market shares they do not generate much cash. Question marks must be analysed carefully in order to determine whether they are worth the investment required to grow market share.

Rising Stars are units with a high market share in a fast-growing industry. The hope is that *stars* become the next *cash cows*.

2.3 Product Life Cycle Analysis

The objective of the product life cycle analysis[12] is to **assess each product of a company according to its technology readiness, level of revenue** and **performance / longevity on the market**. In the context of innovation management categorizing products in this way can serve as a basis for discussions, whether measures on innovation development should be intensified or neglected regarding a specific product.

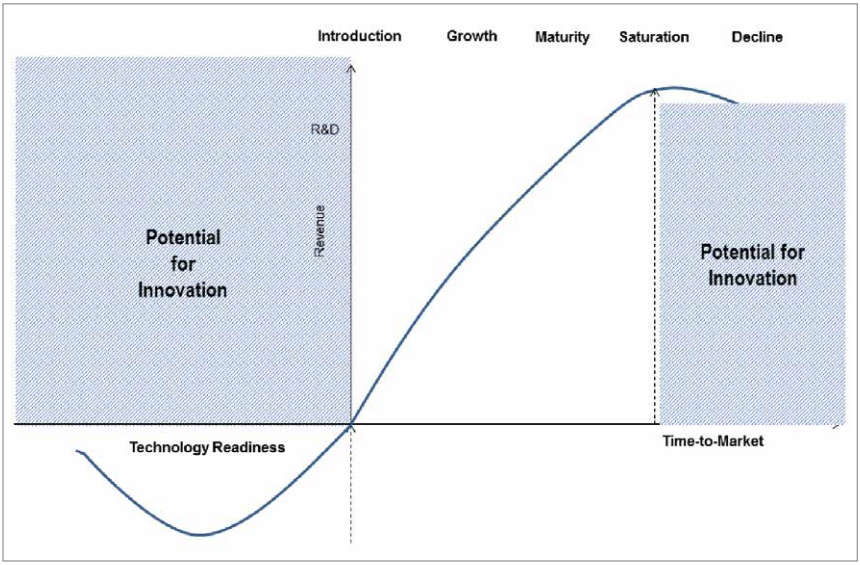


Figure 9: Product Life Cycle Analysis (Source: Steinbeis 2i GmbH).

A recently introduced product, for instance, may still require further research and development, whereas products which have been on the market for years, necessitate optimization and the input of new technological solutions or should be abandoned. In principle, the product life cycle analysis should highlight which products are of strategic relevance for the company.

12 See Day, G., 1981. The product life cycle: Analysis and applications issues", Journal of Marketing, vol 45, pp 60–67.

The RespiceSME approach to conduct the product life cycle analysis is to let the company name its products and place them on the graph depicted in Figure 9. If the company has several products, the coach should then propose to prioritize the products by giving 3 points per product (priority list). Discussions on further developments and measures to be pursued should focus on the product(s) with the most points.

2.4 Technology Portfolio Analysis

This analysis, developed by Werner Pfeiffer[13], aims at identifying the potential for investment in particular technologies, relevant product and production technologies according to dissection criteria (e. g. systems, sub-systems, component groups, elements, processes).

The approach is to examine together with the company, which technologies could potentially create additional benefit and how they could be integrated into the company (knowledge-transfer). The graph depicted in Figure 10 provides a a model of how to gauge technologies according to their relative attractiveness for the company, whilst also considering available resources for transfer / absorption.

In order to assess the factors **attractiveness** and **resources** the following questions should be addressed to the company:

- *Which technologies / processes do you integrate in your products / services?*
- *What are the actual technologies used? (Basis[1], Key Enabling[2], Leading[3], Emergent[4])?*
- *Which technology can be outsourced? (Potential for Open Innovation)*
- *What technologies are of key relevance to your portfolio of products?*
- *In which areas do you have strong technology know-how? (patent; out-licensing)*
- *Which resources are available in-house?*

13 Pfeiffer W., Dögl R., 1990. Das Technologie-Portfolio-Konzept zur Beherrschung der Schnittstelle Technik und Unternehmensstrategie. In: Hahn D., Taylor B. (eds) Strategische Unternehmungsplanung / Strategische Unternehmungsführung. Physica, Heidelberg.

In general, this exercise should provide orientation to the company, whether to invest internally or outsource the know-how integration ("Open Innovation").

The **Technology Attractiveness** describes the economic and technological advantages which can be achieved strategically through further development in a particular field.

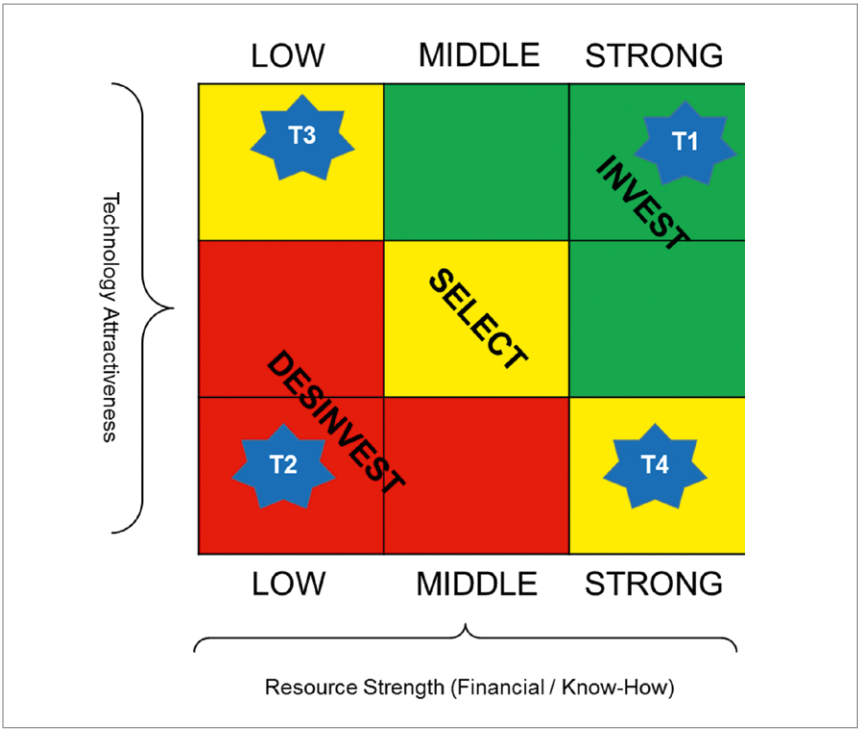


Figure 10: Technology Portfolio Analysis after Werner Pfeiffer (Source: Steinbeis 2i GmbH).

With the dimension of **Resource Strength**, the *financial resources* on one hand, and the *know-how resources* on the other hand, necessary for the realisation of the technology potential, are taken into consideration. Whether a certain technology is already available in the enterprise and how the company's technological know-

how ranks in comparison with competitors, are also important aspects, which should be covered in this context.

The investment fields (Green): indicate high technology attractive-ness is coupled with high resource strength (T1) → the technology thus is worthwhile for investment. The company should invest in this technology in order to strengthen the competitive position in economically attractive application fields.

The disinvestment field (Red): Low technology attractiveness and low resource strength (T2) → the company should not invest in this technology.

The selection fields (Yellow): Two options:

- High technology attractiveness with low resource strength (T3) → 2 possibilities of actions: 1. Exit because low resources or 2. Extension with high investment to get the necessary development stage.
- High resource strength with low technology attractiveness (T4) → this option could present a high risk of dysfunctional investment and personal resources. The further development of technologies that build the basis of numerous products and generate high income is directly related to the R&D budget while the know-how building in new technologies comes up short.

2.5 Identification of new business fields

You want to make your company more innovative? But you don't know how to do it with your regular portfolio of products? Or you developed several innovations and you would like to know which characteristics do they present in relation to market and groups of customers? You would also like to know how risky the innovations in your portfolio are? The following tool is a mix of the *BCG matrix*, a growth – share matrix which ranks products on the basis of their relative market shares and growth rates, and the product – market matrix, *Ansoff Matrix*[14], which analyses ways to grow via existing and future products in established and new markets.

14 https://www.mindtools.com/pages/article/newTMC_90.htm

The following version of the matrix is used to **identify potential new business fields** for the company, taking into account the technologies singled out during the *Technology Portfolio Analysis*.

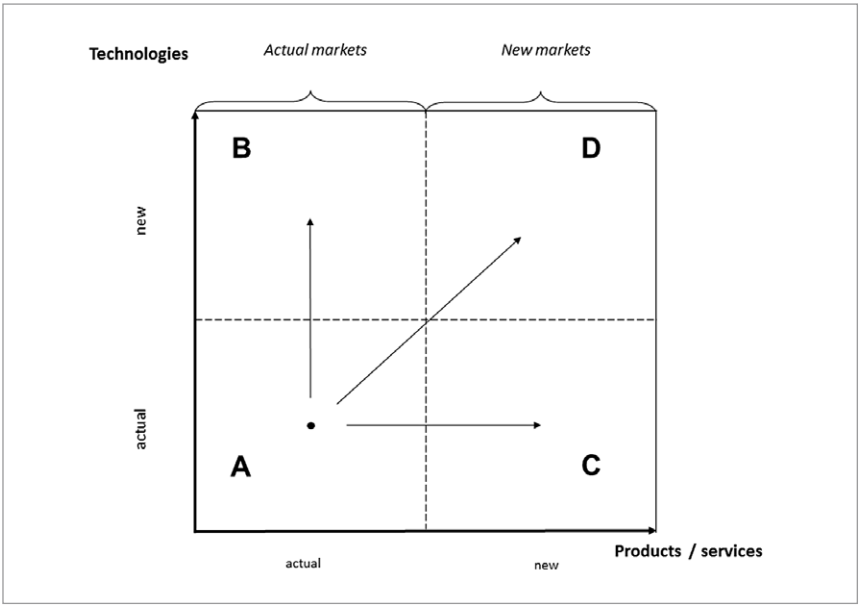


Figure 11: Product – Technology Matrix (Source: Steinbeis 2i GmbH).

The four fields of the matrix relate to:

A: Actual product / actual technology: This is the starting point of the analysis.

B: Actual product / new technology: This field relies on one actual product that is renewed by integrating a new technology. The level of risk here is relatively low because the company remains on the same market.

C: New product / actual technology: This field relies on the development of a new product by integrating an actual technology already used by the company. The level of risk is here medium because the company enters a new market with a new product using existing technology.

D: New product / new technology: This field relies on the development of a new product by integrating a new technology. The level of risk here is relatively high because the company enters a completely new market with a new product and using a new technology.

The matrix can be used in two ways: first by mapping existing products and secondly, by considering possible new products that could be developed by integrating a new technology. At this stage, the R&D portfolio of the company can be used to find ideas for new products.

The following questions should be taken into consideration together with the company:

- *How could the company improve its chosen products with new (e. g. leading edge or emergent) technologies or services for existing markets?*
- *How could they produce new products with existing technology for new markets?*
- *How could the company produce new products with new technologies for (niche) markets?*

2.6 Analysis of Opportunities & Threats (SW O & T)

The aim to analyse Opportunities & Threats is to carve out the company's disposition regarding larger market and societal trends. The analysis should also serve to wrap-up results obtained through the previous analyses on trends, markets, products and technologies with the aim to contextualise them within macro-level developments.

For the analysis of Opportunities & Threats the following questions should be taken into consideration:

Opportunities

- Are there new markets, technologies, materials, applications relevant for the company?

- Which social, political, demographic, life style changes may influence the company's disposition?

Threats

- Are there new technologies, substitutes and / or other reasons, threatening the company's competitiveness?
- What are the prospective risks from legislation, social, demographic, life style changes?
- What are the prospective customer needs, which cannot be satisfied?

2.7 Stakeholder Analysis

The stakeholder analysis is the last step of the strategy workshop. Its purpose is to **illustrate the company's existing partnerships** and to **identify new collaboration opportunities**. To this end, the company should map its partnerships with stakeholders such as suppliers, end-users / customers, competitors and non-photonics partners of further application fields (e. g. automotive, smart manufacturing, etc.). A stakeholder map, as shown in the graph below, can help with conducting the analysis and serves to illustrate different stakeholder groups.

Concerning the company's innovation management, it is important to depict possible partners for innovation collaboration, e. g. for European research and development projects. Taking up on the results of the stakeholder analysis, for instance, a partnership request could be disseminated through the Enterprise Europe Network (see tool 6).

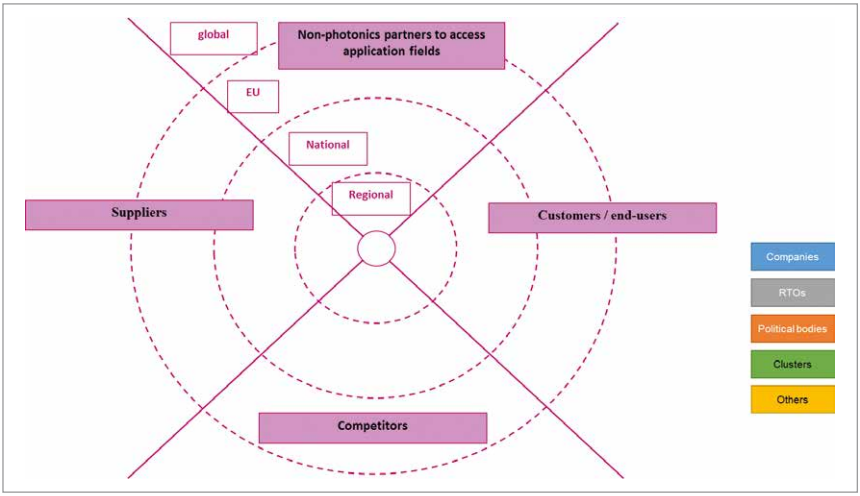


Figure 12: Partner Radar (Source: Steinbeis 2i GmbH).

Summary and analysis of results

After the workshop, the cluster manager / business developer or coach, who conducted the strategy workshop should:

- Prepare a **report** to be submitted to the company; containing the summary of the outcomes of the strategy workshop and recommendations for actions;
- Set up the 2nd meeting (max. 2 hours) for discussion of the action plan; this final meeting focuses on recommendations on external factors, management & strategy, organisational factors & promotors (internal personal resources) and internal innovation processes.
- Define concrete measures for implementation and discuss in the 2nd meeting which the company wants to focus their efforts on.

Some examples of recommendations expressed during the workshops of RespiceSME:

- Weakness in idea creation → building creativity groups
- Weakness in design & new product → Use of formalized design methodologies or tools for new product development
- Weakness in competence management → Formation of cross-functional teams to perform project-driven activities
- Weakness in competitive technology intelligence → Use of tools for market survey or participate in more trade shows
- Weakness in project management → Availability of well-defined planning board for tracking project process
- Weakness in knowledge management → Organisation of meetings between senior and junior employees to ensure the transfer of knowledge

Chapter 2: From innovation to market – enabling photonics SMEs to exploit their innovation capacity

How can photonics SMEs exploit their innovation potential better and penetrate new markets? The tools included in this chapter provide hands-on methods to answer this question. Tool 4 presents the Value Chain Analysis, a methodology developed within RespiceSME for preparing the successful market penetration of new products. Putting the focus on the specific innovative product or service the Value Chain Analysis examines factors (Stakeholders, Technology Readiness Levels (TRLs) and Innovation Potential) relevant to market uptake. Tool 5 and tool 6 outlines approaches on how to stimulate cross-sectoral and transnational business collaborations. Introducing novel matchmaking instruments both tools aim at supporting cluster managers with facilitating fruitful and sustainable exchanges between photonics and non-photonics SMEs.

Tool 4: Assessing opportunities for photonics in a non-photonics fields – The RespiceSME Value Chain Analysis

Tool 4 of the RespiceSME toolbox is focused on the development / strategic positioning of an early stage Photonics product concept. The Value Chain Analysis[15] tool is based on three key concepts for product and company assessment: **Stakeholder Mapping, Technology Readiness Levels (TRLs), and Innovation Potential Assessment.** The tool focuses on a new Product or Service and is of particular benefit for those that are targeting a new market. The method involves defining and scoring key factors crucial for success at a very early stage while aligning systematic elements essential for growth. Numerical values are assigned to im-

15 © Dr. Gerard O'Connor – NCLA / Laser Labs, School of Physics, National University of Ireland – Galway.

portant properties, and scores are compiled to indicate where a company should consider targeting their efforts.

The analysis involves five basic stages: 1. Identify the Product, 2. Identify the Stakeholders, 3. Assess Technology Readiness Levels, 4. Assess the Innovation Potential, and 5. Develop the System Model.

Step 1: Identify the Product

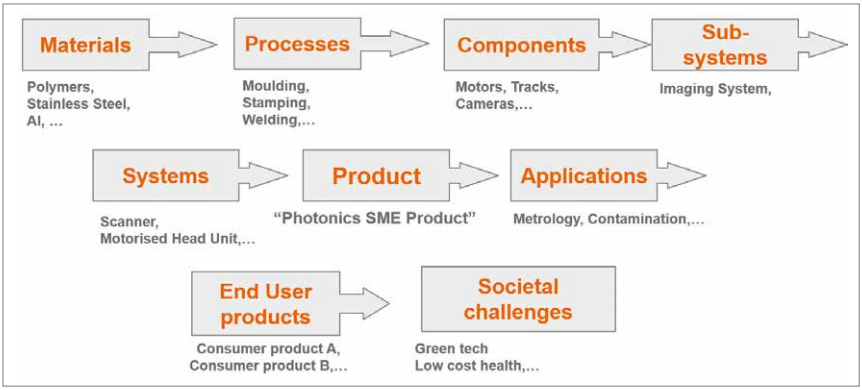


Figure 13: Product Types (Source: NUI Galway).

The **Product** referred to here can take several forms. Depending on the nature of the company it may be an **idea**, an **expertise**, a **service**, or a **physical product**. The key at this stage is to get a **very deep understanding of what the Product is**: how how it fits within the expertise of the proposers, how it fits within the identity of the company and how the Product fits into the market.

Starting from the level of the Product, the cluster manager tries to extract **how and why** the Product can meet or exceed expectations when used in specific **Applications**, for specific **End Users**, when addressing specific **Societal Challenges**. In the meantime, the Product is being analysed in terms of Technology Readiness Level (**TRL**), Innovation Potential and where it lies on the **'S-curve'** associated with the **uptake of technologies** that seeks to explain how, why, and at what rate new ideas and technology spread.

Step 2: Stakeholder Analysis

Once the product has been carefully designed and understood we begin the process of identifying **who might use the Product**. Specifically, we first focus on the **buyer side** of the value chain focussing on Applications, End Users, and the Societal Challenges to form the basis of a **Keyword 'tree'** that will have the Product at its core.

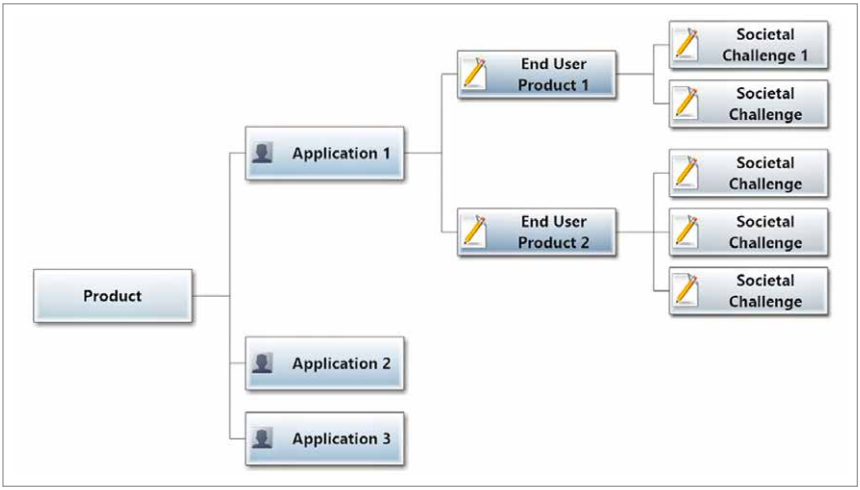


Figure 14: Keyword tree for product applications (Source: NUI Galway).

In order to target **potential customers** based on a specific industry, region, market, or sector that is of interest, the cluster manager can use a so-called **Custom Search Engine (CSE)** like the one proposed by Google (cse.google.com) which enables to create a search engine to be included into a website. The engine can be configured to search both web pages and images.

On completion of the stakeholder assessment on the buyer side, the analysis for the **supplier side** of the value chain is then in focus; as this is central to the companies' competitiveness a significant trust is required prior to disclosing the technologies. Once a stakeholder has been captured a series of questions are posed to assess some basic qualities which contribute to a **'Stakeholder Relevance Score'**; e. g.

- Is the Stakeholder aligned with the SME?
- Will the Stakeholder's growth and development help the SME and vice versa?
- Is the relation with the Stakeholder conflicted? Are they involved in competition? Likely to usurp the SME themselves?
- Are they engageable? Is there an easy path to initiating relationship through e. g. cluster membership, etc. between the Stakeholder and the SME?
- Can ongoing connections be easily leveraged?

Stakeholders are then validated by the generation of a simple **Value Proposition**.

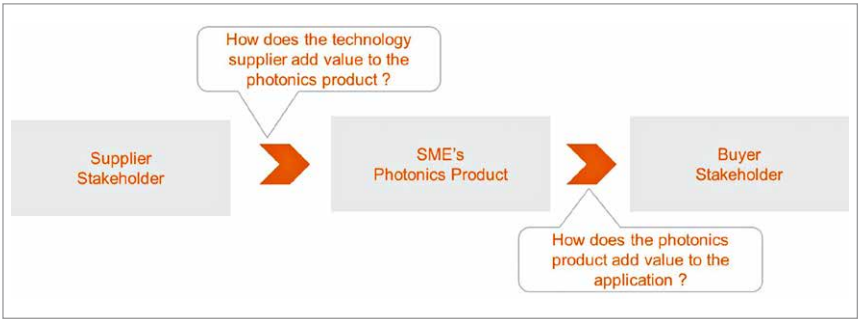


Figure 15: Stakeholders' specific value proposition (Source: NUI Galway).

Step 3: Assess Technology Readiness Levels

Technology Readiness Levels (TRLs) are estimated based on the Value Proposition connecting the Stakeholders identified in step 2. TRLs are useful here to show which stakeholders can support the **risk** of using the proposed product and identify and prioritise **next research actions**. The TRL for the application (or end-user product) is estimated based on whatever information gleaned about the company from web-based or industry sources. At this stage, the cluster manager carrying out the <value chain analysis is required to provide his "Best Guess" of the TRL based on the value proposition. On the **buyer side** of the value chain, the Value Chain Analysis gives **highest priority to stakeholders** that would use the Product at a **mid to upper range TRLs (5–8)** as they represent the best balance between

risk and potential growth. On the **supplier side** of the value chain, the value chain analysis gives the **highest priorities to technologies** for which the **TRLs are at the uppermost** part of the scale.

TRL	Definition	Description
9 – Proven	Actual system operated over full range, in final form.	No further development required / possible ?
8 - Qualified	Actual system completed & qualified through test & demonstration.	End of true system development ? Who qualified and tested the system?
7 – Demo operational environment	Full-scale, prototype system operated in relevant environment.	Actual prototype represents full scale system? Compare relevant to actual environment.
6 – Demo in relevant environment	Pilot engineering scale system validated in relevant environment.	Is prototype beyond lab-scale? Does tested demonstrate high readiness?
5 – Validated in relevant environment	Laboratory scale system, concept validated in relevant /simulated environment.	Are technology components integrated in high fidelity system that match final application in almost all respects ?
4 – Validated in laboratory	Component & or system validation in simulated laboratory environment	Are basic components integrated in low fidelity system? Has ad-hoc testing been completed ?
3 – Proof of concept	Analytical & experimental critical function shown in proof of concept.	Is active research & development initiated? Do preliminary results exist ?
2 – Concept formulated	Technology concept formulated. No proof or analysis	Have basic principles been observed? Is speculative application identified ?
1 – Basic principle observed	Principles observed & reported. Study of technologies basic properties.	Have ideas for translation of scientific research to applied R&D been completed ?

Figure 16: RespiceSME's TRL assessment (Source: NUI Galway).

Please note that a **low score** is a bad outcome as stakeholders are supposed to use the Product in an advanced state and that **too high a score** is also bad because fully developed TRL limit the potential for Growth.

Step 4: Asses the Innovation Potential

The Innovation Potential in this context identifies the **most impactful path** of the Product to be successful or innovative in its sector. RespiceSME has developed an Innovation Potential score that assesses several key measures both "Market" and the "Technical" attributes of the Product. These indicators have been gathered from a broad range of economic theories that all support scalable growth and appropriate timing.

Innovation Potential Level	Definition	Description
9 –Transformative	Potential to redefine the market	Has the potential to be a market leading innovation that creates and defines a new category of product/service.
8 - Compelling	High potential for success	Has the potential to be a market leading innovation
7 – Empowering	A competitive innovation	Plays well to the strengths of the company, has a strong possibility of success.
6 – Advanced	Could be successful under the right conditions	A solid advancement that has some limitations in the technical field, the market field or both
5 – Has Potential	Worth pursuing but needs refinement	Could be a worthwhile effort if additional advancement can be made in the innovation potential
4 – Unresourceful	Makes poor use of resources	Requires significant development in both market and technical fields
3 - Risky	Low chance of success	Requires reconsideration of market and technical positioning
2 – Incomplete	Needs major development/reconsideration	Requires significant redevelopment of concept in both market and technical fields, therefore both risky and low potential
1 – Insufficient	Not currently Possible or worthwhile	Does not fulfil the basic criteria for success

Figure 17: Innovation Potential Level (Source: NUI Galway).

The Innovation Potential index is applied to assess the Value Proposition offered by each stakeholder to give a general indication of **how likely they would benefit from using the Product**. The Innovation Potential is also scored numerically and contributes to an overall scoring of different stakeholders in the value chain.

The aggregated scores for stakeholder relevance, technology readiness and innovation potential are compiled for all the Buyer Stakeholders identified for each Application, End User, and Societal Challenge from Step 2. At the end, a compiled score for the Product Application is being generated which can help to guide the development of the product concept in a specific field.

Step 5: Develop the System Model

The **'System Model'**[16] originates from the work of Shtein & Shteyn – *Scalable Innovation* and outlines the key elements that must be in place for **scalability of a product in line with the S-curve of adoption**. The System Model is a 'blueprint' that shows how all the elements necessary for scalable growth for a product concept can be assembled in a specific system.

This 'blueprint' is used in this final stage as a framework within which the **top ranked stakeholders** can be placed to establish an **integrated system** for the

16 Eugene Shteyn, Max Shtein. Scalable Innovation: A Guide for Inventors, Entrepreneurs, and IP Professionals. June 4, 2013 by CRC Press.

product concept. It is proposed that only integrated systems have the potential for sustainable scalable growth along the S-curve. The result of this is a model for the entire system around the Product that is based on the **inputs of the user** and the **Applications of the Product. Gaps in the System Model** represent areas of concern where a **key stakeholder is missing**; resolving these gaps requires a further iteration of the value chain analysis.

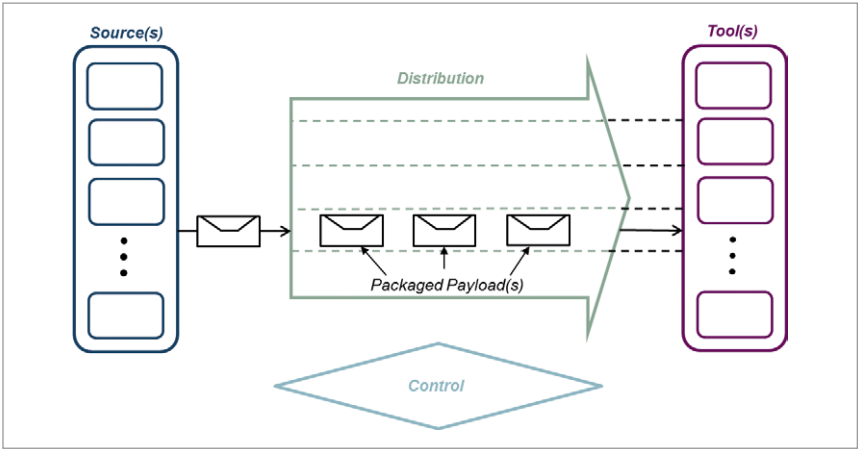


Figure 18: System Model (Source: NUI Galway).

The System Model is composed by the following elements:

- **Tool** – the key functionality of the product concept
- **Source** – the source of materials, energy, information used by product
- **Distribution** – the channels by which sources are delivered to tool.
- **Package payloads** – discrete packets of materials, energy & information
- **Control** – orchestrates interactions between elements in the product
- **Interfaces** – integral to system connectivity and product completeness

The scalability of a product should be in line with the S-curve of adoption and the System Model enables the growth of a product on the S-Curve.

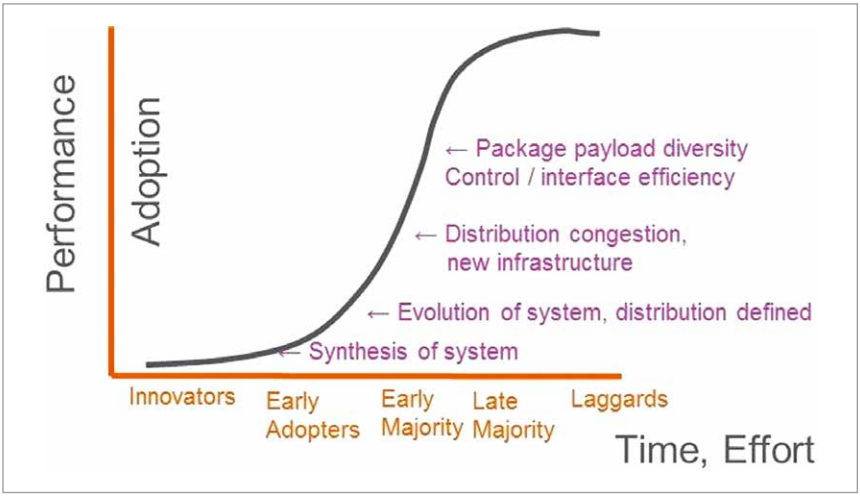


Figure 19: S-Curve of adoption (Source: NUI Galway).

Some examples of System Models:

Example 1: Light Bulb

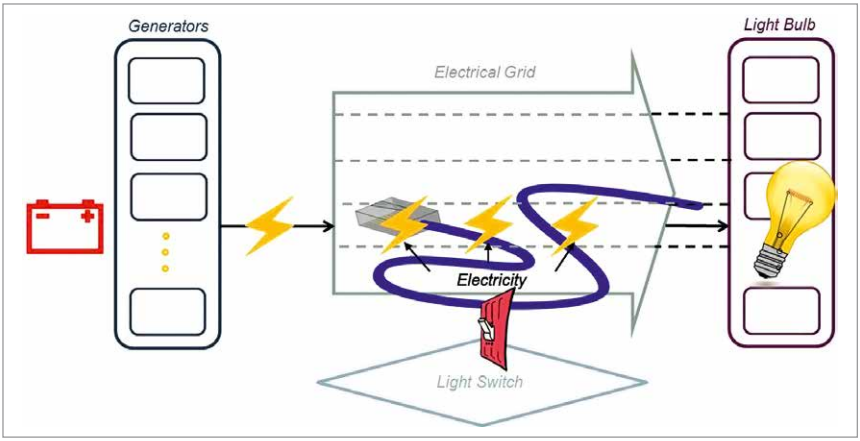


Figure 20: System Model for Light Bulb (Source: NUI Galway).

Example 2: iPhone

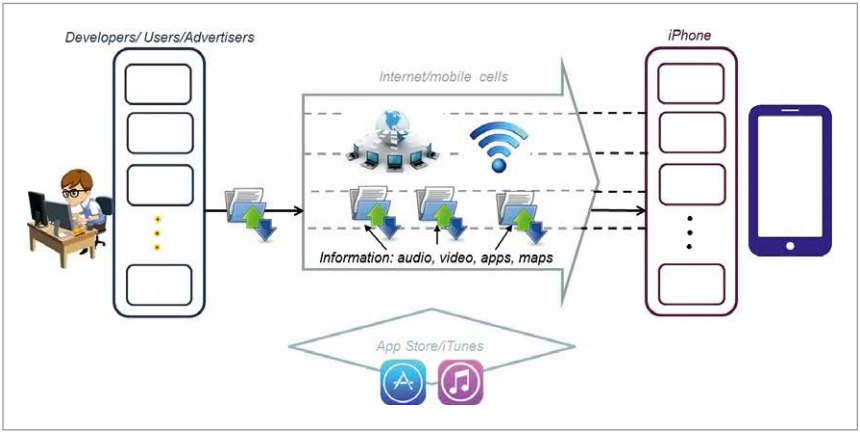


Figure 21: System model for iPhone (Source: NUI Galway).

Iterative Process

The result from the first round of Value Chain Analysis (VCA) will give the User a **broad overview of the potential for the Product in a number of diverse applications**. The Stakeholder scores and the regional / sector based searches provide an overview of all products potential that can be determined. For a finer comparison between potential Applications the VCA can be performed again, focusing in on the highest potential Application and the subsequent End Users and Societal Challenges. In fact, the entire process can be repeated on an ongoing basis to give continued guidance for Product direction.

Once a Product direction has been settled on by the user the process can be applied to the Upstream / Supplier side of the value chain to give a panoramic snapshot of what the highest potential version of the new Product would look like.

RespiceSME Case Studies

Following the initial inception and development of the Value Chain Analysis tool, four individual case studies were undertaken in order that the tool be tested in the field and refined in terms of both content and delivery technique. These case studies were preceded by an Innovation Audit (tool 2), and were accompanied by bilateral Non-Disclosure agreements.

The case studies were to look at the application of the tool for Photonics companies applying a new product/service to: 1) Manufacturing, 2) Energy/Environment, 3) Transport, and 4) Photonics:

1) Manufacturing

A Value Chain Analysis (VCA) was undertaken for a company whose primary business is the design and manufacture of laser workstations for research and manufacturing environments. The company specialized in micro-scale machining and deposition primarily for the microelectronic and photovoltaic industries. The company had been approached by a perspective 'client' seeking a hybridized manufacturing system for the Medical Device industry. The company had no previous experience in this field and was seeking some input in exploring the implications for them in both the technical requirements and commercial potential of this new sector.

Following a Value Chain Analysis, the company determined that this opportunity was worthwhile in pursuing and the VCA was used to determine both technical features of the product that would be suited to the sector, as well as in discussions with the client on how best to market their new capacities.

2) Energy/Environment

The company is a specialist in the supply and termination of fibre optic cable and accessories primarily to the communications industry. They are seeking opportunities to diversify which do not require a significant investment. A VCA was sought to explore opportunities for developing sales channels in alternative industries. The initial focus was for connectorised fibre optic cables but additional opportunities were explored that leveraged the company's core competences.

The goal of this VCA was to aid the company in identifying opportunities to diversify their target market. They were able to focus on the regional strengths and identified a significant number of potential stakeholders in the main local business sector. They were able to selectively target the stakeholders that were at an early stage in product development who would be most open to incorporation of the company's Product.

»

3) Transport

A company specializing in the production of light emitting diodes for lighting and metrology applications is seeking an opportunity to leverage their expertise in diodes and diode lasers to diversify into a new field of application: automotive Lidar. A Value Chain Analysis was undertaken to explore where the potential top markets for this might lie and to identify the primary stakeholders in the target regions

Ultimately the lack of a clear commitment to the sharing of technical information had a negative effect on the VCA. Significant sections of methodology were rendered obsolete by poor Product definition. The analysis was successful however in illuminating the sector to the company. There was observed to be a large number of potential competitors in each region and it was ultimately judged that the automotive Lidar industry was too competitive and alternative opportunities were to be explored. A VCA focusing on the core competences of the company would be helpful in identifying which sectors to pursue for diversification.

4) Photonics

RespiceSME engaged with an early stage spin off company based around a technical breakthrough in the photonic machining of brittle substrates. The technology and its implications were still in the early stages of exploration and a Value Chain Analysis was undertaken to fully explore the market opportunities that this tech would represent. An analysis was undertaken looking at the full value chain: first the downstream or buyer side was explored and following the insights gained the upstream or supplier side was developed to gain a better insight into the early stage development needed.

The company was successful in securing developmental funding as a direct result of the improved market awareness and product positioning enabled by the VCA. The company would be advised to repeat the VCA process at this stage to reassess direction and changing market environments.

Summary

An important element of the case study process has been the continual evolution and refinement of both the VCA tool and the process of delivering the best results for the company. Delivering a successful value chain analysis can be a lengthy process but through practice it becomes more innate and streamlined. Company specific issues and general difficulties have been used to refine the Tool and Process.

Tool 5: Stimulating cross-sectorial and international business collaborations

Leveraging the cross-sectoral potential of Photonics

As a key enabling technology Photonics can provide disruptive innovation not only to traditional application fields such as Manufacturing, but also to many other industrial sectors. The development of autonomous driving concepts, for instance, relies significantly on LiDAR and other Photonics technology. Nevertheless, in particular small suppliers of Photonics products are not aware of their cross-sectoral exploitation potential. In turn SMEs in other sectors often do not know of the added-value Photonics could provide to their business or have difficulties to find partnerships for transferring external technologies or know-how. An objective of the RespiceSME project therefore was to bring together Photonics and non-photonics stakeholders to support cross-sectoral collaboration. To this end, the RespiceSME consortium organised several cross-sectoral workshops and developed a matchmaking methodology.

Mapping collaboration potential – The RespiceSME matchmaking methodology

The concept for the cross-sectoral workshops was based on the identification of concrete collaboration opportunities between stakeholders (i.e. SMEs, R&D groups, Tech transfer centres) with different know-how and / or from different sectors and countries, but which are engaged in the same value chains.[17]

The methodology's approach is to position stakeholders on a large map, depicting each step of a value chain of a specific sector. The aim is to draw potential links between SMEs and R&D bodies, which are active in different segments of the value chain. This mapping exercise can either be done by stakeholders present in the event or by cluster managers, who represent SMEs / stakeholders of a particular region and have the mandate to represent them. The overall objective should be

17 The methodology is thus best applied, when implemented by several cluster managers, which bring together clients from matching sectors.

to leverage (international) collaboration by using sub-ordinated business associations and clusters as multipliers. Hence, the participation of cluster managers or business consultants in the mapping session is a prerequisite. The evaluation of the interactive mapping session is then undertaken jointly by the cluster managers or representative of other regional business entities. They are responsible for establishing the contact between SMEs matched during the session.

The methodology is divided into 3 parts:

- **Preparation** of materials and information for participants
- **Mapping** session
- **Follow-up matchmaking** actions

Preparation of materials and information for participants

Although the mapping session is the core part of the methodology, the importance of preparing the session should not be disregarded. Since the aim is to generate matching actions between participants, it is essential that the mapping does not only convey names, but also some key figures of participating entities. Information like name of company, country of origin, technologies developed and sectors of activity are necessary to have an initial idea if a match between two parties could be of mutual benefit. RespiceSME therefore suggests preparing cards with this information before the actual mapping session, drawing on the inputs received from cluster managers (who provided information of their SMEs and organisations) or delivered by SMEs upon registration. During the mapping session these so-called **'Collaboration Cards'** are being being placed on wall posters or maps developed for the session.

Preparation of maps for mapping sessions

The maps first and foremost should depict the value chain(s) concerned in the matchmaking. For example, RespiceSME defined a **value chain**, which includes all kind of **stakeholders**, from **idea creation and research to market** and which can be used as model: *R&D* | *Technology Transfer* | *Components manufacturing* |

modules manufacturing | Systems manufacturing | Engineering & Integration | Distribution

This abstract classification basically can be applied to any sector. Adjustments or specifications can be inserted, depending on the sector concerned and the overall focus of the event. The poster developed for the RespiceSME's mapping sessions on collaborations in the automotive sector (see graph below) may serve as an illustration of how the structure and design of such a poster / map might look.

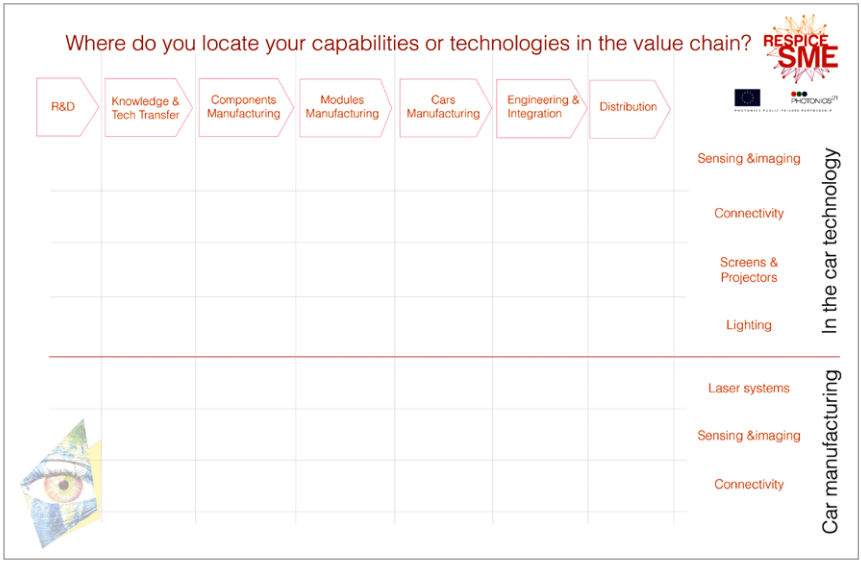


Figure 22: Mapping Session – Value Chain (Source: SECPhO).

For this particular mapping session RespiceSME used a chart divided by two axes; One axis, depicting the value chain and the other axis, depicting different types of photonics technologies, which were further sub-divided by areas of application (i.e. 2 areas for the automotive sector: "technology applied in the car" and ,"in the manufacturing process"). Setting-up a poster, ergo map with a different focus technology to photonics, certainly requires adjustment of the categories and possibly also a revised structuring of the value chain steps.

Moreover, posters that comprise other areas relevant for the matchmaking could be added; for example a poster featuring a more detailed categorization of technology types.

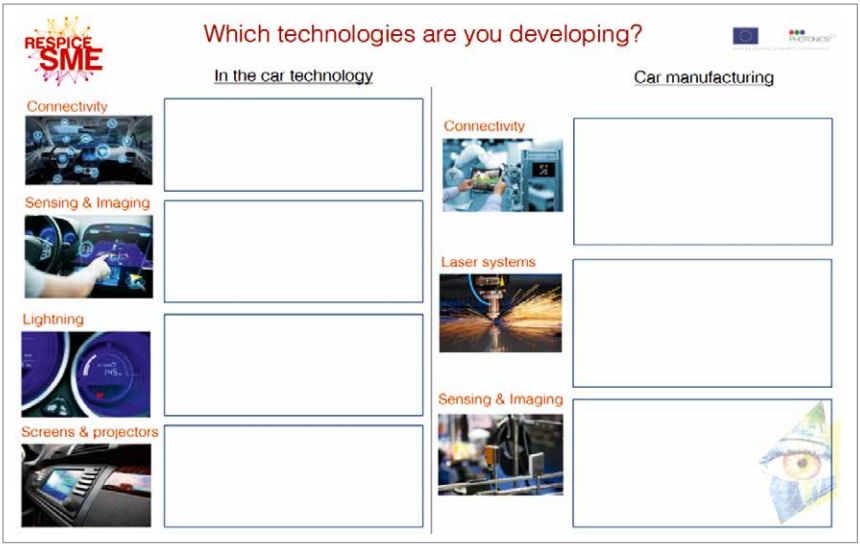


Figure 23: Mapping Session – Technology Fields (Source: SECPhO).

Also posters on the geographic localisation of a company's main markets and on markets / countries they would like to enter could reveal relevant insights for the matchmaking.

Figure 24: Mapping Session – Target Markets (Source: SECPhO).

Follow-up matchmaking actions

Once the mapping session is concluded, the follow-up should be taken up by the cluster managers of the mapping session.

This task involves 4 steps:

1. Analysing the maps in order to identify possible matchings between SMEs and / or other stakeholders along the value chain, e. g. matching stakeholders active in technology transfer with manufacturers and manufacturers with integrators and distributors.
   3 types of possible connections can be identified:
   - *Technology transfer connections*: These are connections between technology centres and manufacturers at different levels (components, modules and systems).
   - *Integration connections*: These are connections between companies dedicated to engineering and integration of systems in the industry and manufacturers at different levels (components, modules and systems).

- *Sales connections*: These are connections between companies dedicated to sales and distribution and manufacturers at different levels (components, modules and systems).

It is recommended to do the matching of participants by consulting all cluster managers / business consultants involved in the organisation of the mapping session. The information on matched partners should be shared with all organisers in order to coordinate and ensure a smooth implementation of step 2.

2. Requesting SMEs or other stakeholders which are involved in a matching opportunity to detail their profile, using Business and Technology profiles (see tool 6). Depending on the type of collaboration they seek, they may choose between filling out a Business and Technology Offer or Request or a Partner Search Request for a collaborative Research or Pilot project. The filling-out of the profiles ideally should be coordinated and supported by a cluster manager / business consultant responsible for the stakeholders' region of origin.

3. Establishing contact between partners identified for a possible cooperation match through the exchange of profiles prepared in step 2. Here again, it is best to facilitate the exchange of profiles through cluster managers / business consultants concerned.

4. Following-up on results of the matchmaking action. This step aims at evaluating the impact of the mapping sessions. It requires the organisers of the event to follow up the collaboration partners identified during the mapping session two to three months later and to inquire if the cooperation has been realised yet.

In contrast to classic matchmaking approaches, which usually bring together only stakeholders with an initial interest in cooperating with each other, this is an opportunity to open up new avenues for possible partnerships. Nevertheless, the success of the mapping sessions, of course, relies on the willingness of identified partners to actually cooperate. Here the role of the cluster managers or business consultants as mediators is of particular significance.

The RespiceSME case

For the cross-sectoral cluster meeting organised in the RespiceSME project, the organisers established 3 value chains for the mapping sessions:

Map 1. Value Chain of Photonic technologies applied to Energy & Environment

The aim of this map was to identify the possible links of collaboration between cluster members, mainly SMEs, in different areas of the chosen markets: Energy & Environment. The selected areas were:

- Energy efficiency
- Biomass
- Biogas
- Photovoltaic technology
- Wind Power
- Safety, maintenance & energy rehabilitation
- Drinking water quality
- Industrial water quality

Map 2. Value Chain of Photonic technologies applied to Transport

In this case, the purpose was the same but considering photonics technologies that can be applied both to manufacturing vehicles and to be used inside the vehicles. They were divided into two types of end markets:

SMART MOBILITY & CONNECTED TRANSPORT
- Sensing & Imaging
- Connectivity
- Screens & projectors
- Advanced Lighting

CAR, TRAIN, AIRPLANE MANUFACTURING
- Laser Systems
- Sensing & Imaging
- Connectivity

Map 3. Value Chain of Photonic technologies applied to Manufacturing

The last map looked at photonics technologies applied to manufacturing. In this case, the decision was made to narrow the focus of the value chain towards different types of applications in manufacturing. The selected applications were:

- Automation
- Quality Control
- Laser cutting & welding
- Additive manufacturing & 3D printing
- Computer vision & augmented reality
- Metrology & inspection
- Chemical analysis
- Micromachining & nanofabrication

Tool 6: Technology / Business / Knowledge Transfer – Brokerage Events and Business & Technology profiles

SMEs often fail to recognise that collaboration may enhance their business proposition or help them to overcome a challenge in their business. Collaboration has been shown to enhance many factors in business: *Profitability; Sales growth; Profit growth; Enhanced customer satisfaction; Productivity; Product quality; Product development rate and innovation.*

Advances in Information and Communications Technologies have paved the way for businesses to be far more global in operation and markets. Demands on internal responsibilities, keeping on top of orders and organisational responsibilities often mean that many SMEs struggle to find the time to actively look for partners or attend trade shows to see where mutual interests may lie.

The tools for Technology Transfer used within RespiceSME were trialled to assess which offered the best collaboration opportunities across the EU and which would appeal more to busy SMEs. The tools implemented were:

- Collaboration Corner
- Structured presentation with keynote speakers and 1-1 sessions
- Business & technology profiles online & dissemination with partners

Collaboration Corner

Time is too precious for SMEs to be able to dedicate the time to send staff to physically attend all relevant trade shows and events.

The 'Collaboration Corner' is a useful tool for providing collaborative opportunities and business exposure to contacts without the need for travel. Essentially companies submit a profile and have it displayed on a board at an event and follow up connections are made by the organisers after the event.

Figure 25: Collaboration corner format (Source: KTN).

The ideal requirements

1. Utilise a booth at a trade show, or exhibition space or a dedicated corner of an event which has good footfall and visibility in order to get maximum impact in delegates attending being able to see and browse profiles;

2. Use several poster boards to hold each profile and a receptacle to be placed underneath each profile to allow delegates at the show / conference / event to leave a business card to be connected to the profile after the event.

3. Create a template for contacts to use so that it creates a consistent format for delegates to be able to browse relevant sections more easily. The template used for RespiceSME is shown below but can be adapted depending on brokerage requirements.

4. Make the connections to each profile after the event and follow-up the introductions a few weeks later to see if any successful outcomes have emerged.

5. Further dissemination of profiles can be achieved after the event by sending profiles to known contacts that might be interested in the profile.

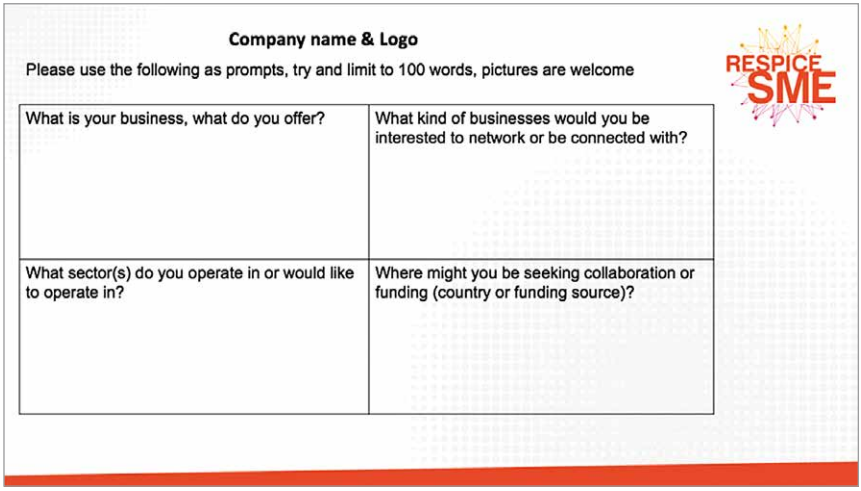


Figure 26: Matchmaking Contact Template (Source: KTN).

Top tips from RespiceSME case

- Do not display profiles too low on the board as they won't be read!
- Number each profile and number business cards in the receptacles at the end of the session or at the end of each day to avoid confusion and ease follow up and metrics;
- Focussing a collaboration corner around a particular funding call or topic has been shown to yield optimum results.

Structured presentation with keynote speakers and 1-1 sessions

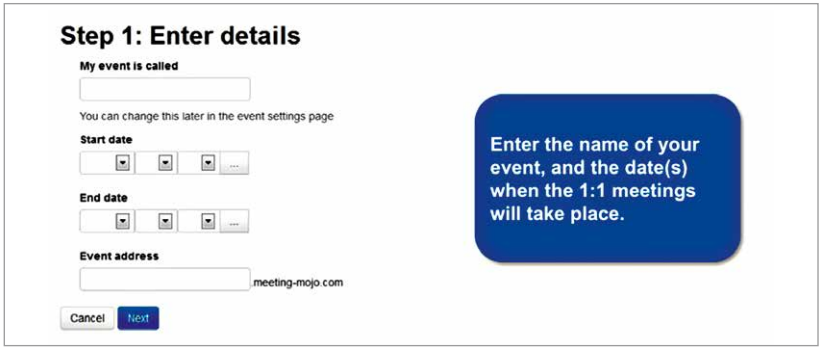
Structured presentation sessions in trade shows are renowned for creating an opportunity for questions and partnerships. Locating a new topic within a trade show that has cross sectoral opportunities can offer additionality for targeting partnerships with potential end users, particularly for enabling and emerging technology applications.

The ideal requirements

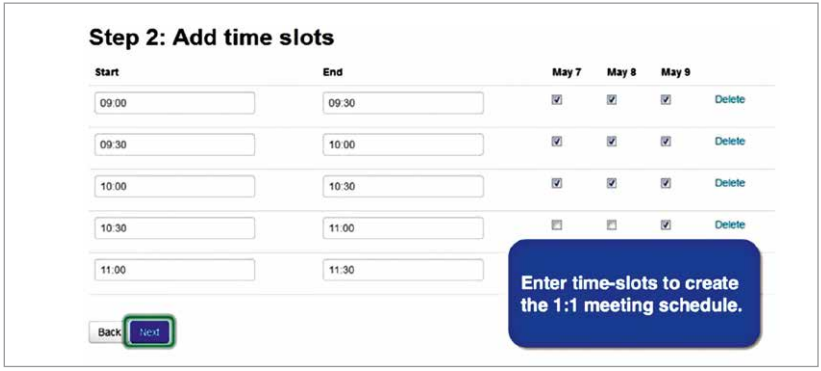
1. Target a trade show which has potential for cross sectoral benefits and that it is possible to structure a speaking session with presentations demonstrating application and innovation in the sector.

2. Set up an online brokerage registration site for speakers and delegates to book 1-1 sessions ahead of the event. An example of brokerage registration is meeting mojo (http://www.meeting-mojo.com), which is easy to use and to set up and enables event attendees to pre-arrange business partnering meetings online. It is versatile enough to slot into conference, exhibition or brokerage event formats.

Step 1 – Create event details



Step 2 – Add timings for each session



Step 3 – Add location options for meetings

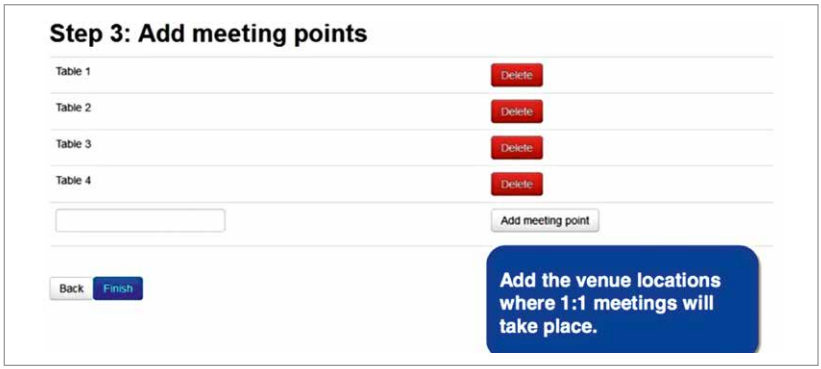


Figure 27: Meeting Mojo Setup Process (Source: http://www.meeting-mojo.com/).

At this point the setup is complete and the meeting mojo can be made live. It is also possible to import a list of potential delegates or to send the link for mojo to a wide database of contacts.
A more detailed overview of how to set up meeting mojo can be found here http://info.meeting-mojo.com/mm_slideshow.pdf

3. Establish an area for 1-1 sessions outside of the presentation area where booked meetings can take place;

4. Establish a rota for the 1-1 sessions and display booked slots for each table to ensure that participants know to vacate the table in time for the next booking.

Top tips from RespiceSME case

- Make sure that the conference or trade show is not running its own brokerage session as this might impact on 1-1 sessions take up at the event;
- Explore all types of online brokerage tools and assess which one fits best, there are many different online tools available at varying costs and ease of use;
- Plan brokerage well ahead of structured presentation session to enhance potential uptake.

Business & Technology profiles online & dissemination with partners

A further very valuable tool for Technology Transfer is provided by the European Network 'Enterprise Europe Network' (EEN) which provides a global profile database, 'Merlin' (http://een.ec.europa.eu/tools/), with more than **12.000 profiles for technology, business and R&D offers and requests**. This database is being used to identify and find suitable collaboration opportunities across Europe.

The database is accessible for free. Subscription to receive alerts on new requests and offers is anytime possible.

Types of partnering opportunities

To better match the expectations of the SMEs, 3 different types of profiles have been elaborated:

1. **Technology Offer vs. Business Offer**
   - A *Technology Offer* is used when a company has a technology or expertise to sell to or share with another company.
   - A *Business Offer* is used when a company intends to expand its business and is looking for partners by offering its business expertise or products to others.
2. **Technology Request vs. Business Request**
   - A *Technology Request* is used when a company is looking to partner with another company to fulfil a need or expertise.
   - A *Business Request* is used when a company intends to expand its business and is looking for partners by requesting for particular types of business partners / products.

3. Cooperation for Research & Development (H2020 projects)

This type of profile is used when a company is looking for a partnering opportunity or funding for a research project.

The ideal requirements

1. Use a template such as EEN or adopt the ones used under RespiceSME (http://respice-sme.eu/respicesme-toolbox/business-technology-profiles/) to help SMEs to create profiles with offers or requests for partnerships;
2. Use networks to disseminate profiles;
3. Use a website to locate all profiles.

Top tips from RespiceSME case

- Use newsletters to promote profiles to partners and networking organisations to further disseminate profiles;
- Work with existing contacts to gain initial profiles;
- Promote success stories to contacts to show the benefits of collaboration.

Chapter 3: Bridging the "Valley of Death" – Enablers to raise the competitiveness of photonics SMEs

Access to research, skilled personal and finance are fundamental for the lasting success of SMEs. Especially for start-ups a lack of sufficient access to these resources poses a serious threat to business operations. To equip cluster managers with instruments and advice to help start-ups to overcome the symbolic "Valley of Death" of dried-up resources and to provide them as well as established SMEs with useful innovation support RespiceSME developed a package of tools. Tool 7 outlines how to facilitate access to Research and Technology Organisations (RTOs) for SMEs. Delivering approaches on how to establish fruitful connections between Industry and Academia, ensuring innovation is put at the centre of education in photonics and SMEs as well as students benefit from mutual exchange is the main emphasis of tool 8. In tool 9 and 10 the focus is on access to finance. Tool 9 outlines the Regional Smart Specialization Process (RIS3) and explains how cluster managers may use the process to effectively advocate for policy support of photonics (or of other high-tech sectors). Tool 10 provides an overview of public and private financing and funding opportunities for SMEs.

Tool 7: Research as a resource for innovation building – Methodology for easy access to Research and Technology Organisations (RTOs) and SMEs

A significant factor for the innovative capacity of competent and competitive SMEs is the access to state-of-the-art know-how and research infrastructures. Such access is instrumental in the development of new products, processes and services; it can enrich an SME's technology and product portfolio and correspondingly increase market penetration and turnover. However, targeted Research and Devel-

opment (R&D) activities, covering the whole value chain of the products / services developed are costly to maintain and lengthy to develop for an SME. Thus, in most cases, companies, and in particular SMEs, lack the necessary funds and personnel to support a specialised or fully functional R&D department. This may have severe consequences on product commercialisation and company growth, and impede their ability to adapt to the constantly changing demands of the market and address Europe's major societal challenges.

On the other hand, Europe has a large number of very successful Research and Technology Organisations (RTOs) that effectively focus their research on Key Enabling Technologies including Photonics. However, in most cases only academics have access to these research efforts and a wide gap exists between the work of RTOs and SMEs needing relevant technological support. RTOs often, unfortunately, lack the needed resources in terms of personnel and business plan development to adapt and offer their high impact know-how to SMEs and others for supporting them in reaching the market, while keeping related risks low.

Therefore a pairing between these two entities (RTOs and SMEs) on the basis of a common agenda of know-how transfer would indeed be beneficial for both parties involved. In specific regions or regarding certain RTOs such a pairing has been realised with many successful emerging benefits. However, overall and throughout Europe the access of SMEs to RTOs needs to be further enabled and reinforced.

The RespiceSME consortium examined the main obstacles impeding the access of photonics SMEs to RTOs. On basis of the analysis' results, RespiceSME formulated a methodology aimed at helping SMEs and RTOs alike in finding new avenues for cooperation.

Approach

The two main players in SME-RTO collaboration obviously are SMEs in the role of the "facility seeker" and RTOs in the role of the "facility provider". In many cases the two sides can have quite a different view on the characteristics of their collaboration, e. g. concerning communication protocols, the desired outcome,

the obstacles that impede it and eventually also on possible solutions to overcome them. Here cluster managers or business consultants can play a significant role as mediators between the two parties.

As a first step, building the basis for extending and strengthening RTO-SME collaboration, it is important to gather the views of both parties in order to determine current conditions, to identify liaison points and, most importantly, to highlight good practices. The actions adopted within RespiceSME (schematically depicted in Figure 28 below) thus involved the collection of input from SMEs and RTOs through questionnaires and expert interviews conducted by the RespiceSME partners.

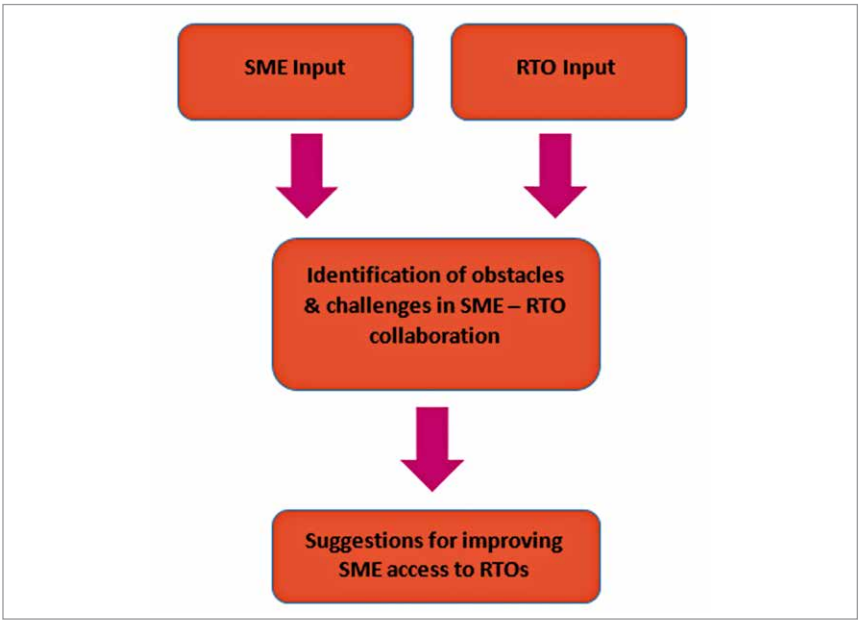


Figure 28: Methodology development approach (Source: FORTH).

The ***questionnaire*** developed by RespiceSME addresses SMEs and focuses on three aspects: the **type of assistance** required by the SME, an **assessment of previous experience** of access to a RTO and requirements for **potential future involvement** of the SME with RTOs.

Interviews with RTOs allow enquiring on the **availability of their facilities and expertise for SMEs**. The list of questions conceived by RespiceSME is addressed to RTO director / senior personnel and concerns issues such as **specific policies** and **funding schemes** to facilitate SME access as well as major **benefits and hindrances** emerging from the collaboration. Furthermore, the handling of **sensitive issues** such as IP Rights management, technology disclosure agreements and conflict of interest are discussed.

The RespiceSME RTO questionnaire, provided below, shall serve serve cluster managers or business consultants as a general guide on how to facilitate a short discussion with the RTO director / representative on RTO-SME collaboration. The questionnaire must not be handled like interview questions to be answered one by one.

Questionnaire:

1. Does your organisation's mission foresee facility access for photonic industrial users? If so, are there predefined policies encouraging collaboration with industry? Please mention any specific policies or mechanisms within your organisation encouraging this goal, while being specifically focused on the access of Photonics SMEs.

2. When establishing collaboration with Photonics SMEs, which of the two parties is most likely responsible for the first contact? Does your organisation facilitate specific enquiry channels or promotion protocols to foster such interactions?

3. Please name up to three major benefits for your organization arising from providing access to Photonics SMEs. Describe, accordingly, incurring barriers that emerge from this type of access facilitation.

4. Photonics SMEs seek access to an RTO mainly for one of the following reasons: contractors, acquiring Intellectual Property, know how transfer, infrastructure access, training and certification1. Please indicate which of the above services are provided by your organisation and comment on whether a specific

type of access is considered more beneficial and productive for your organisation and / or the SME.

5. Please provide an indicative ratio figure of collaboration with returning SME users versus access for first time users. Do you establish long term collaborations with SMEs that have accessed your facilities?

6. Please offer a statistical estimation of the successful outcome of SME-RTO collaboration. Can you comment on and if possible quantify the impact of SME-RTO collaboration on the SME's performance on issues such as patenting, new product development and growth?

7. How does your organisation handle sensitive issues that may occur within such a type of interaction, e. g. IP Rights management (forward and backward know-how definition), technology disclosure agreements and conflict of interest?

8. What are the main funding schemes that enable access of Photonics SMEs to your RTO? From your experience please describe the impact of facility fees in the access of industrial users in your organisation. Do you adopt alternative funding policies for easing the access of SMEs to your facility premises?

9. Can you describe in brief, major hurdles that may impede the access of SMEs to RTOs? Please provide any general comments / thoughts on how to further assist SMEs access to RTOs.

Proposed measures to assist SME access to RTOs

On the basis of the answers collected within RespiceSME the following aspects were identified as hindering a closer cooperation between RTOs and SMEs:

- Lack of information
  - Lack of detailed, accurate information on RTO competences
  - Difficulty to engage with an RTO from a different sector

- Communication barriers
  - Collaboration mostly takes place with RTOs located in SMEs' region / country, they are oblivious of valuable expertise available in pan-European level
  - Lack of common rhythm / mentality
  - RTOs favour collaboration with large scale companies
- Limited availability of tools
  - IP handling issues
  - Lack of funding
  - Collaboration mainly for low TRLs far from commercialization

Based on the obstacles identified above, RespiceSME developed a **roadmap to improve SME access to RTOs**, involving three main actions as depicted in figure 29. In the context of RespiceSME these actions were targeted at photonics RTOs and SMEs. However, given that RTO-SME collaboration is not only relevant for innovation in photonics, but also for other areas, where new product development is strongly linked to research, the roadmap applies for other contexts, too.

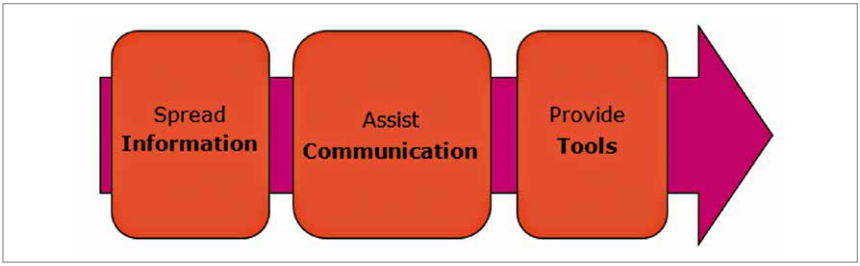


Figure 29: Methodology to facilitate SME access to RTOs (Source: FORTH).

The following recommendations concern first and foremost measures to be implemented by RTOs and / or SMEs. Nevertheless, cluster managers and business consultants can provide support in many of the aspects described below, in particular through acting as mediators between SMEs and RTOs.

Spread Information

RTO competence database

A web based, user friendly database of competences of European RTOs is required. The database should be addressed to an SME audience and include short and to the point information on the expertise, facilities and services each RTO can provide. The information requires regularly updating by the RTOs, while additional information such as contact persons and funding options should also be included.

Such an RTO competence database could be generated and / or coordinated by a cluster or regional business hub. Even if resources are not available for the maintenance of such a database, clusters could provide the necessary platform, e. g. on their online portal. Generally, cluster managers, given that they usually dispose of a large network, can play an important role in scouting cooperation opportunities and facilitating the exchange between RTOs and SMEs.

The RespiceSME consortium collected information on the RTOs active in partners' countries. Comprising more than 450 RTOs, the list primarily covers the photonics sector, but includes RTOs from other sectors where photonics penetrates or find end-users such as transport, energy/environment and manufacturing as well. It can be downloaded from the RespiceSME website: http://www.respice-sme.eu/respicesme-toolbox/tools/

RTOs services dissemination and SME access point

RTOs should actively disseminate their expertise, facilities and services through available information channels including newsletters, social media and events with industry participation (exhibitions, fairs etc.). Furthermore, each RTO should have a **SME access point** that can act as a first contact, efficiently handling SME enquiries and forwarding service seekers to the corresponding expert. Additionally, the access point should be responsible for keeping in touch with SME clients and execute a well-defined feedback process to identify good practices but also problems within previous collaborations.

Organisation of events for raising Awareness (open days for industry) at a pan-European level

A very successful initiative at a pan European level is the *European Researchers' night*[18] that is organised on the same date each year in research institutions across Europe. The aim is to motivate and inspire the youth to enjoy, understand and pursue science and technology by connecting with outstanding scientists and learning about breakthrough innovations. A similar event organised by RTOs with SME / industrial representatives as target audience and different content could render equal success. An **open day for industry** in institutions all around Europe at a predetermined date could become a yearly tradition, allowing for fruitful discussions and exchange of ideas between RTOs and SMEs.

Assist Communication

Personnel exchange / training

Intense interaction between RTO and SME representatives can help synchronise their activities and build trust in each other. This can be achieved via **study visits,** through which RTOs and SMEs have the opportunity to present their expertise and requirements. Furthermore, **training of personnel** within the premises of the opposite party can educate RTO representatives in business aspects and provide SME representatives with new skills required to deploy innovative technologies. Overall, personnel exchange can deepen cooperative relations and provide individuals with valuable experience.

Regional Photonics RTO team as emissary to European / other sector RTOs

It is clearly documented that a regional focus exists in the SME-RTO collaboration, which in many cases has resulted in the establishment of long term partnerships where the two parties understand and trust each other. In order to facilitate the access of SMEs to RTOs across Europe, a **regional RTO team** could act as an

18 https://ec.europa.eu/research/mariecurieactions/about/european-researchers-night_en

emissary to RTOs from other sectors on behalf of a SME. Such a regional RTO team could be attached to a cluster or local business hub, for example. The team should have a good knowledge of the regional SMEs and at the same time have the know-how, networks of stakeholders and communication channels to initiate discussions with other photonics / non photonics RTOs for solving a particular problem faced by a SME requesting its service. The output could be much more productive rather than the SME trying to establish collaborations on its own. An added benefit in establishing such a practise would be a boost in collaboration among different RTOs, especially from different sectors which is in many cases a prerequisite, especially for projects at higher Technology Readiness Levels (TRLs).

Provide Tools

Independent advisory services to SMEs

In many cases, SMEs acknowledge the need for external assistance in their product / service development process. However, they can be reluctant to proceed due to unfamiliarity with the requirements of such a process and in fear of the risk involved. An **independent advisory service** could assist SMEs in executing a tested and validated business model for collaboration. The advisory team could provide **valuable assistance** in issues such as assessment of new technologies; identifying the best suited RTO; evaluate the investment budget and potential risks; advice on IP handling and moderate initial meetings to facilitate a smooth evolution of the collaboration.

Funding tools

The access of SMEs to RTOs strongly relies on access to finance. A number of SME specific European funding calls have been proven very successful; however additional targeted actions are required aiming specifically at SME-RTO collaboration. Good Best Practices are the **One-stop-shop projects** (e. g. ACTPHAST[19],

19 http://www.actphast.eu/

Smarter-SI[20], NFFA Europe[21], ePIXfab[22]) funded under European Funding Programme Horizon 2020 and previous Research and Innovation programmes. These types of projects address many of the challenges in the SME-RTO collaboration and have proven to result in successful partnerships. The endorsement of similar additional actions covering a wide range of application fields and also including RTOs from different sectors could be instrumental in the promotion of SME-RTO collaboration. Furthermore, funding tools aiming to facilitate collaboration between a SME in a less developed region with a RTO in a more developed region and vice versa can contribute in eliminating region specific discrepancies. Finally, the endorsement at European level of a similar scheme to the **innovation voucher** available in some countries could facilitate access of SMEs to top level services and infrastructures regardless of their geographic location.

Promote and reward good practices in RTO-SME collaboration

Access of SMEs to RTOs has been in many cases extremely beneficial for both parties involved. The identification and advertising of such collaborations can greatly encourage other SME / RTOs to overcome any initial hesitation and assume partnerships. It can also act as a guide on the required steps and attitude in fostering such an alliance and handing any obstacles that exist. Such publicity would also be advantageous for the SME and RTO involved, while the establishment of a **reward / prize** can act as an incentive towards further actions.

20 https://www.smart-systems-integration.org/smarter-si/
21 http://www.nffa.eu/
22 http://epixfab.eu/

Tool 8: Human capital as resource – Aligning education with innovation

Access to skilled personnel through photonics education and training programmes

In photonics, just as in any other (high-tech) area, access to skilled personnel is of key importance for companies seeking to maintain and grow their innovative potential. A sound education in photonics not only ensures employees excel at executing their job, but also are able to keep track of current technological developments and implement new ideas.

One objective of RespiceSME was thus to examine the skills photonics SMEs seek in employees and to assess how educational curricula can satisfy their demands. On basis of the project findings, RespiceSME collected examples, which can serve as guidelines for Academia, Industry and related stakeholders. The following approach is embedded into the context of photonics, but can be also applied in other fields, considering their general agenda of promoting a stronger linkage of education with innovation.

Industry expectations regarding employees' skills

RespiceSME conducted a survey on the expectations of the industry regarding skills and knowledge of their (future) employees. The aim was not only to determine which skills are of primary importance to industry, but to look for models and solutions how to better integrate the learning of these skills in academic and corporate trainings.

The survey contained the following questions:

1. *Which type of education do the employees in your company have or is needed in your company?*
2. *Which kind of knowledge do you think is important?*
3. *What skills do you think are important?*

The results of the survey showed that besides photonics fundamentals, knowledge in optical metrology, fibre optics, laser technology, etc. entrepreneurs also considered knowledge on product development to be very important. Moreover, self-management and organisational skills are ranked very high, as demonstrated in the graphs below.

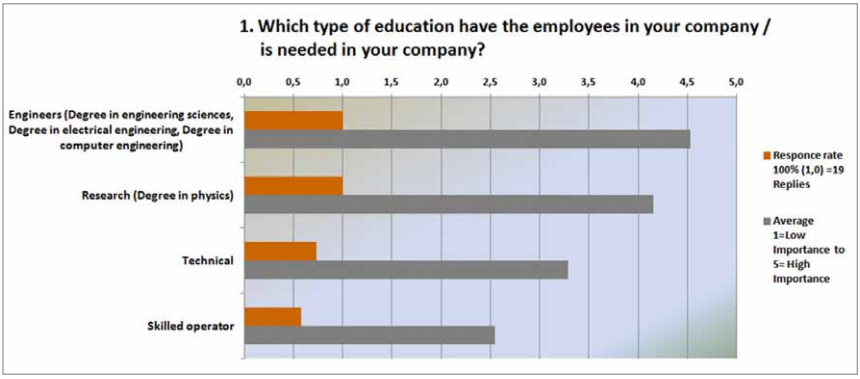


Figure 30: Type of education sought by employers (Source: PhotonicSweden).

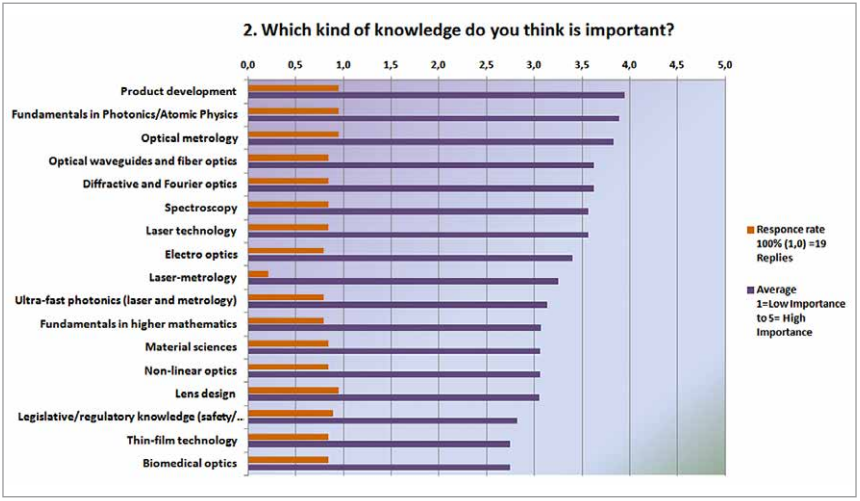


Figure 31: Knowledge considered important by employers (Source: PhotonicSweden).

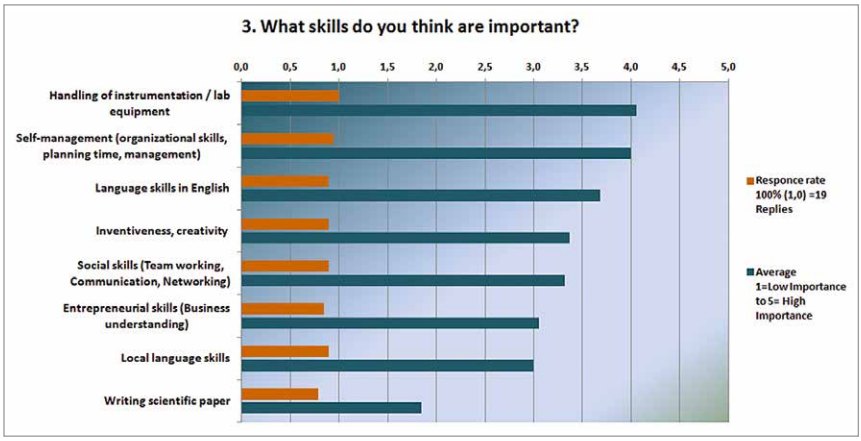


Figure 32: Skills rendered important by employers (Source: PhotonicSweden).

Entrepreneurship training programmes

Another line of action in RespiceSME was to identify successful initiatives from universities or companies regarding 'innovation training'. Concepts of integrating innovation practices into the academic curricula were "in the focus as well as the establishment of fruitful exchanges with companies". To this end, RespiceSME invited representatives from Industry and Academia to present their approach on "Aligning education with innovation" in a workshop dedicated to this topic.

The workshop discussed tools and measures, which are used for establishing and / or improving the interaction between Academia and Industry.

One Best Practice example presented was for universities to offer special **entrepreneurship courses** to technology students and have representatives from industry as guest speakers. Another interesting approach fosters the **integration of successful entrepreneurs into the university ecosystem** through offering graduates the possibility to get a **free coaching by a business angel**.

Study visits to companies for graduate students organised by local photonics cluster are another example of best practice in the realm of innovation education.

The aim of the programme is to familiarise the students with the demands of industry before they graduate, while showing employment opportunities in the region. Similar innovation concepts can be found throughout Europe. It should be highlighted that some of these programmes have not been exclusively established by universities or companies bilaterally, but through the initiative and mediation of a cluster. As a hub for companies and institutions of secondary educations alike, the role of regional networks in facilitating educational partnerships is significant.

More good practice examples of programmes, aligning successfully education with innovation can be discovered on the RespiceSME website[23].

Database of education programmes – Access to skilled personnel through photonics education and training programmes

Given to their size, which often corresponds with a rather low public profile, SMEs have sometimes difficulties finding suitable personnel with a specialisation in photonics. Also, they often lack resources for identifying relevant training opportunities for their staff.

In order to facilitate the access for SMEs to skilled personnel RespiceSME elaborated a brochure of current photonics courses, to be downloaded on the RespiceSME website www.respice-sme.eu/respicesme-toolbox/tools/.

SMEs can use the brochure to find universities and institutes to collaborate with, e. g. for posting job offers and recruiting potential employees among graduates. Students in turn can use the brochure to find suitable education and training programmes in photonics. The brochure contains courses for the following countries: France, Germany, Greece, Ireland, Spain, Lithuania, UK, Austria and Sweden[24]; and information on the city of location, programme focus, certificates, bachelor masters and doctoral degrees.

23 www.respice-sme.eu/news-events/news/news/best-practices-of-academic-innovation-support-programmes-presented-at-the-respicesme-workshop-on-al/

24 The brochure developed within RespiceSME builds upon the overview of Masters and PhD programmes in Photonics produced within the EU Horizon2020 project "Photonics4All".

**Best Practice of RespiceSME –
Workshop for aligning education with innovation**

The activities undertaken in RespiceSME have shown that there is a real need for bringing together different players active in the field of education and innovation. The organisation of common activities, like the workshop on "Aligning education with innovation" helps to establish new collaborations of Industry and Academia representatives who otherwise would not meet. Furthermore, successful initiatives of spreading innovation knowledge and skills already established at universities as well as in companies have been demonstrated. These initiatives can serve as guideline examples for initiating innovation trainings and cooperation among Academia and Industry. Regional networks such as clusters or business associations can play a significant role in initiating collaboration and facilitating workshops or common projects in this regard.

Tool 9: Policy support for innovation

This tool outlines the support schemes of European Regional Policies targeted at bolstering the innovation potential of SMEs. Analysing the process of policy formulation, the tool aims to provide guidelines for cluster managers and business consultants on how to advocate effectively for political support of (photonics) SMEs. Examples of selected countries are presented, which can serve as Best Practice for positively impacting regional policies in favour of SMEs. Especially for high-tech technologies like photonics political support is essential, since large investments are needed for high-risk innovation. Clusters may not be able to provide financial support, but they can act as influencers on the political level. Moreover they can help SMEs in finding the adequate funding programme and assist in the application process. The tool, therefore, also touches upon how to provide guidance for SMEs, so they can benefit from regional policy.

National / Regional Innovation Strategies for Smart Specialisation (RIS3)

The basis for political support of innovation in the framework of the European Regional Strategy is the so-called RIS3 process. The Regional Innovation Strategies for Smart Specialisation (RIS3) are part of the 'Europe 2020' Growth Strategy of

the European Union[25]. RIS3 are integrated, place-based economic transformation agendas with sound monitoring and evaluation systems. They draw on empirical evidence, targeting technologies and specialisations, which are main drivers of the economy in the respective country or region. The key targets of the RIS3 strategies are:

- to focus policy support and investments on key national / regional priorities, challenges and needs for knowledge-based development;
- to build on each country's / region's strengths, competitive advantages and potential for excellence;
- to support technological as well as practice-oriented innovation and to stimulate private sector investment;
- to get stakeholders fully involved and to encourage innovation and experimentation.

Moreover, Smart Specialisation Strategies shall ensure a more efficient use of the European Structural Investment Funds (ESIF). European Member States' Regions can only benefit from ESIF financing, if they draft a Smart Specialisation Strategy and pass the RIS3 process. The aim is to set out a roadmap for strengthening national or regional assets and capabilities and to concentrate resources on a limited set of research and innovation priorities. Thus, the strategy has to be based on a SWOT analysis, outlining measures to stimulate research, technology and development in areas the region excels in.

Besides the results of the SWOT analysis, also insights on the state of the region's innovation policy gathered in an entrepreneurial discovery process (EDP) flow into the strategy. The EDP brings together participants from different backgrounds (policy, business, academia, etc.) with the goal to initiate a bottom-up process of cross-disciplinary discovery and sharing of information on innovation policy, while identifying potential new activities and opportunities. It is then the task of policymakers to assess outcomes and ways to facilitate the realisation of this potential in the coming years.

25 http://ec.europa.eu/regional_policy/sources/docgener/informat/2014/smart_specialisation_en.pdf

Encouraging the inclusive participation of all key stakeholders from a certain region, the EDP is a rare opportunity for cluster managers to take part in the formulation of future RIS3 priorities and to influence the focus of regional innovation policy. As the RIS3 determines the allocation of funding in a region, it should be of outmost importance for clusters to get involved in the EDP or to provide strategic support to SMEs represented in the EDP.

Best Practice: French Cluster OpticsValley

Concerning the involvement of SMEs and clusters in the RIS3 process, the French cluster OpticsValley can serve as best practice example. OpticsValley issued a policy paper on Photonics in the Paris Region in summer 2016. The cluster thereupon was invited to take part in four working groups set up by the Paris Region with the aim to review and contribute to the region's innovation policy and R&D strategy. Since photonics was not identified as a sector of major interest in the Parisian R&D strategy, OpticsValley offered to manage a strategic committee to work on the redefinition of the R&D strategy of the region. One of the cluster's successes within this regional lobbying was to obtain a one-stop-shop for photonics at the regional council (Conseil Régional d'Île de France).

Finally, OpticsValley coordinated a project funded under the European Regional Development Fund (ERDF) in 2016 and 2017, providing financial support to SMEs in the photonics sector. On a national level, the cluster is working on a roadmap for manufacturing and is setting up working groups with representative companies from this sector.

The RIS3 process is an opportunity for photonics SMEs and photonics clusters to assume a strategic position in their region and get access to European regional policy funding. However, since the process is very complex and time consuming, especially smaller SMEs avoid being involved in the process. Photonics clusters along with RTOs and policy makers should thus support them in this process, ensuring that smart specialisation strategies are implemented for maximum economic development.

Moreover, the experience in France provides a Best Practice example for regions in which photonics are not an explicit RIS3 priority area by showing the potential of light technologies and their numerous application markets. This has led to a closer cooperation with the regional representative authority, which is now more aware

of the photonics industry potential, and more willing to consider photonics in regional funding schemes.

It is thus highly recommended for any cluster aiming to support the SMEs of their region to be involved in the RIS3 process from the very beginning and to keep involved in the process via working groups and panels. Furthermore, European cluster projects can help to share knowledge of the specific regional smart specialisation strategies and support cluster managers, SMEs and policy makers in joint activities.

Tool 10: Access to finance

The lack of sufficient financing can be a major drawback for innovation projects. SMEs especially do not often have necessary resources at their disposal for developing and testing novel technologies or products, which is usually costly and involves high risks. When discussing how to enable the innovation potential of SMEs, access to finance is therefore a topic of great importance.

In the framework of RespiceSME's work with SMEs it was observed that smaller companies often were not aware of **public and private funding and financing opportunities**.

The aim of this tool is therefore to provide an overview of European funding and private equity opportunities, which SMEs and cluster managers may use as guidance, when looking for financing or when consulting clients.

Private financing and funding opportunities

Private equity provides for interesting financing opportunities for SMEs. Especially start-ups and SMEs seeking investments for an innovation or expansion of their activities can benefit from private capital. Private investing is typically effectuated with a long-term interest in the company's development yielding at higher returns. In turn investors acquire holdings of the company's shares. Private equity investors

include institutions such as banks and pension funds, but also wealthy individuals (business angels). Apart from classic private financing instruments crowdfunding platforms are another opportunity to raise capital for innovations.

The following list provides an overview of the manifold private financing and funding opportunities, so SMEs and cluster managers may identify the most appropriate source of funding according to the current needs and future development strategy.

Crowdfunding: Crowdfunding implies to raise funds from a community of investors or from individual donors.

Types of crowdfunding:

- Reward-based crowdfunding
- Presale crowdfunding
- Equity crowdfunding
- Crowdlending / peer-to-peer lending

Amounts of Investment: Average < 10 k€ can go up to 500 k€

Honour loan: The honour loan is a loan that aims to help entrepreneurs who do not have enough personal financial contributions to support the creation of their business. A loan without interest rate, nor guarantee or personal deposit from the entrepreneur is usually awarded by local or national (networking) organizations / associations of entrepreneurs.

Amounts of Investment: Mainly < 10 k€ can go up to 100 k€

Incubator fund / accelerator: Funds from incubators and accelerators (or related national R&D funds, such as French Tech in France) which are either public, private or a combination of both and support companies in business maturation. Funds that come from incubators and accelerators offset by acquiring a stake in the capital of the company, or by repayable advance.

Amounts of Investment: Mainly < 50 k€ can go up to 300 k€

Business Angel: A Business Angel is a physical person who invests a part of his assets in an innovative company (start-up) and who, in addition to his / her money, offers his / her skills, experience, network and time to the benefit of entrepreneurs. In turn business angels receive equity stakes.

Amounts of Investment: Mainly 20 – 50 k€ can go up to M€

Venture Capital: Venture capital subsumes investments in unlisted companies that require equity capital. Venture capital funds acquire equity stakes.

Amounts of Investment: 150 k€ – 10 M€

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Family Office: A Family Office is an organization of persons in the service of one or more families, offering advice to families in the exclusive service of their patrimonial interests. Compensation through equity stake. **Amounts of Investment:** from 150 k€
Bond Financing: A bond is a debt investment in which an investor loans money to an entity (such as an SME) which borrows the funds for a defined period of time at a variable or fixed interest rate. **Amounts of Investment:** from 150 k€
European Investment Fund: The EIF supports Europe's SMEs by improving their access to finance through a wide range of selected financial intermediaries. To this end, it designs, promotes and implements equity and debt financial instruments which specifically target SMEs.

Table 4: Overview Financing Opportunities for SMEs (Source: Opticsvalley).

The following tables provide further information related to the investments presented above in terms of company type and stage of development required, actions funded, range and impact, as well as helpful tips for each private funding category.

Private financing opportunities	**Kinds of investment**			**Type of actions funded**					**Type of companies**	
Crowdfunding	Seed	Post-creation	Development	Equipment, accomodation	R&D	Commercialization (internat.)	Recruitment	Day to day	Early stage SMEs	Other SMEs
	✓	✓			✓	✓			✓	
Honour loan	✓	✓		✓	✓				✓	
Incubator fund / accelerator	✓				✓	✓	✓		✓	
	✓				✓	✓	✓		✓	
Business Angels	✓	✓	✓	✓	✓	✓			✓	✓
Venture Capital	✓	✓	✓		✓	✓			✓	✓
Corporate Venture Capital	✓	✓	✓		✓	✓			✓	✓
Family Office			✓					✓		✓
Bond Financing			✓					✓		✓

Table 5: Private Financing Opportunities (Source: Opticsvalley).

Private financing opportunities	Cumulativeness	Leverage	Temporality		Network impact	Tips & Advices
	Cumulative with other private financing opportunities	**This funding attracts other kinds of private financing**	**(Exit strategy) Short term (< 3 years)**	**(Exit strategy) Long term (> 3 years)**	**The investor is able to connect the company to its ecosystem (access to skills, address book, …)**	
Crowd-funding	Cumulative with other types of private financing, excluding investments in capital (BA, VC,…) for „Equity crowdfunding"	Crowdfunding provides leverage (positive signal about the existence of a market) for raising funds from business angels or venture capitalists			Crowdfunding investors do not take an active part in the company's strategy	Crowdfunding is mainly adapted to B2C companies and award-based crowdfunding is interesting if there is an environmental or health care added value proposition
Honour loan	Cumulative with other types of private financing	Obtaining a honour loan entails leverage to obtain additional bank financing, as well as a credibility effect by convincing a jury composed of professionals			Organization that give honour loans believe in the project and may take an active part in the company's strategy	It is important for companies to be well aware of the opportunities offered by the organizations / association of entrepreneurs, or even cluster
Incubator fund / accelerator	Contestable cumulativeness with other types of private financing in case of equity financing	Good credibility effect, but rather low incentive for other kind of private financing because of equity financing		✓	The business of incubators is to accompany companies towards the maturation of their business and technology by „opening doors"	It is important to rely on network effects
	See above	See above			A business angel typically helps to connect companies to its business ecosystem	It is important to choose business angels that know very well the industrial sector the company belongs to
Venture capital	See above	See above		✓	Venture capitalists help to connect start-ups to its business ecosystem	VCs are generally specialized in one or several industrial sectors, but also in terms of level of maturation of the companies they invest in. It is important to choose one that fits with companies' fundamentals
Corporate venture capital	See above	See above		✓	Corporate venture capitalists help to connect start-ups to the business of its own companie(s)	Such investment brings credibility to the start-up project
Family Office	Good cumulativeness with other types of private financing	No use	✓	✓	No use	Family Office do not invest regarding the project, but regarding the financial leverage
Bond financing	Good cumulativeness with other types of private financing	No use		✓	No use	

Table 6: Private Financing Opportunities – Characteristics (Source: Opticsvalley).

Facilitating access to national / regional funding for SMEs

Cluster managers play a significant role in influencing regional funding policy in favour of SMEs. As mediators between businesses and authorities and as policy experts, they facilitate the access of SMEs to public funding schemes by providing relevant information and support.

National / Regional financial support can come from central government, regional authorities or from both sides. Funding schemes can vary in the particular regions, but most countries in Europe have a large spectrum of financial support for SMEs.

To assist SMEs in finding suitable funding programmes the list of regional support schemes should also distinguish between different types of supporting organisations, e. g. Ministries, Chambers of Commerce or Non-Governmental-Organisations. Different organisations offer different programmes to support innovative SMEs, such as:

- funding programmes;
- internationalization programmes;
- special programmes for clusters / photonics clusters;
- or special programmes to support activities in the field of human resources.

For every programme the general funding conditions for SMEs should be examined closely, since they can differ from the conditions for RTOs or bigger enterprises. Some organizations also offer special programmes dedicated to SMEs only. Besides common research and development activities, some special accompanying programmes might be offered to support innovation activities of SMEs.

Best Practice[26] case of RespiceSME:
Germany – funding opportunities for SMEs

Germany features a high bandwidth of funding schemes which are divided into national and regional funding schemes in the different federal states.

On the **national level**, most support for (photonics) SMEs is provided by the Federal Ministry of Education & Research and the Federal Ministry for Economic Affairs & Energy. Both ministries have their own funding programmes with a broad variety of measures. The most important funding programmes for (photonics) SMEs are:

- Support to innovative projects and ideas in research through targeted funding programmes (e. g. "photonics research" www.photonikforschung.de);
- Funding for projects in a wide spectrum of research areas; there is a broad range of funding available covering basic research in natural sciences, environmentally friendly sustainable development, new technologies, information and communication technologies, the life sciences, work design, structural research funding at institutions of higher education to innovation support and technology transfer.
- Research funding targeted to projects of cutting-edge research in SMEs, e. g. KMU-Innovativ: Priority for Cutting-Edge Research in SMEs www.kmu-innovativ.de;
- Special programmes for the new Laender of Germany (former states of East Germany);
- Central Innovation Programme ZIM (basic programme for market-oriented technology funding);
- German Accelerator Tech (supports high-potential German technology start-ups).

On a **regional level** (States of Germany) a broad variety of institutions offering financial support and consultancy to SMEs exists. Examples from the state of Baden-Wuerttemberg are:

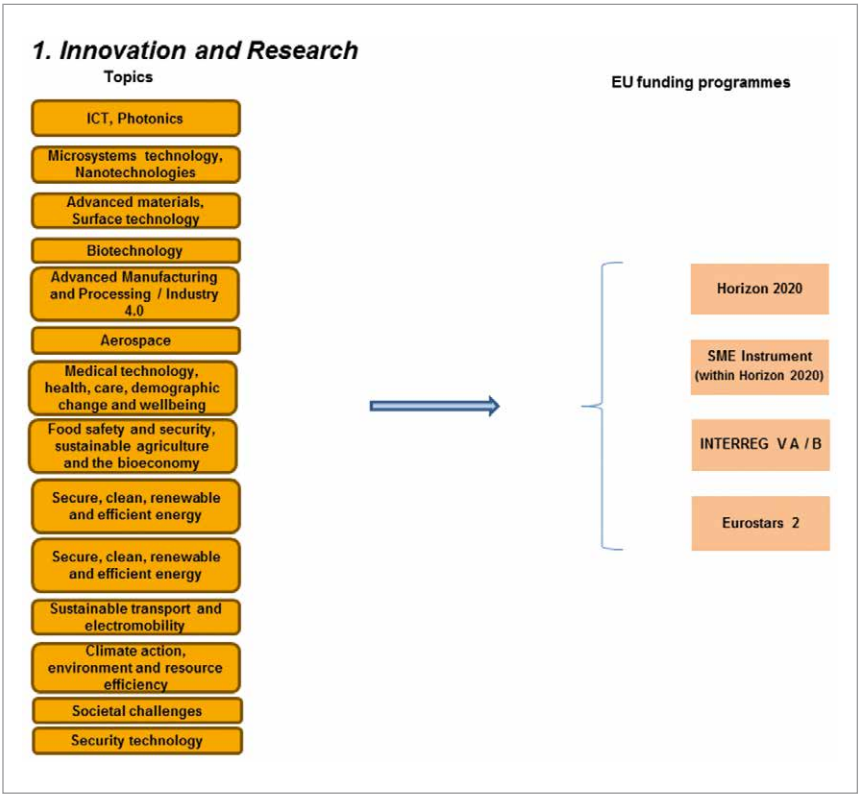
- State Ministries (e. g. Ministerium für Wirtschaft, Arbeit und Wohnungsbau)
- State Agencies: Umwelttechnik BW, eMobil BW GmbH, BIOPRO Baden-Württemberg GmbH
- Chambers of Commerce
- Steinbeis Network
- Networks: Allianz Industie 4.0, microTEC SW, Photonics BW
- Innovation Angels: promotion of SME research projects
- Clusterportal BW: support of clusters / networks

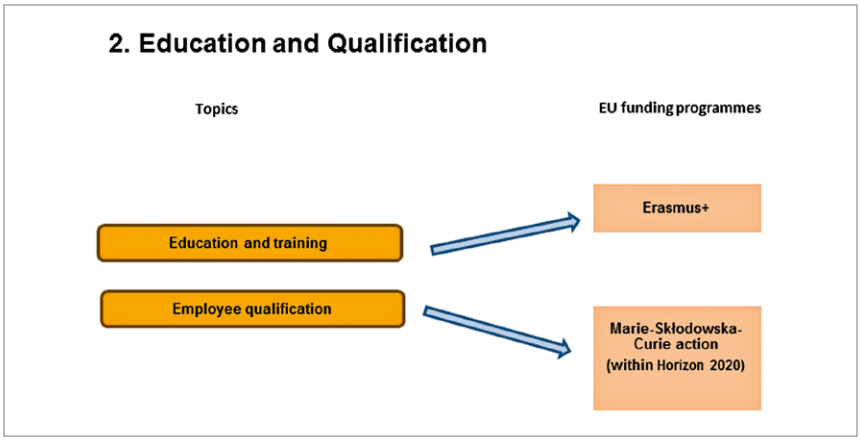
26 For an overview of regional funding programmes and policy support schemes in Austria, France, Germany, Greece, Ireland, Lithuania, Spain, Sweden and United Kingdom which were identified during RespiceSME please see http://www.respice-sme.eu/fileadmin/cms/Deliverables/Deliverable_3.5_Best_practices_catalogue_for_regional_policy_support.pdf

Funding programmes of the European Union with relevance for Photonics and Key Enabling Technologies

The European Union provides funding opportunities for SMEs seeking to finance innovation and research projects or support for employee qualification or for business growth, transnational cooperation and internationalisation. The following tables deliver an overview of topics covered by European funding schemes. The overview is completed by descriptions of the most relevant programmes for photonics stakeholders.

Overview of European funding opportunities for high-tech (photonics) SMEs





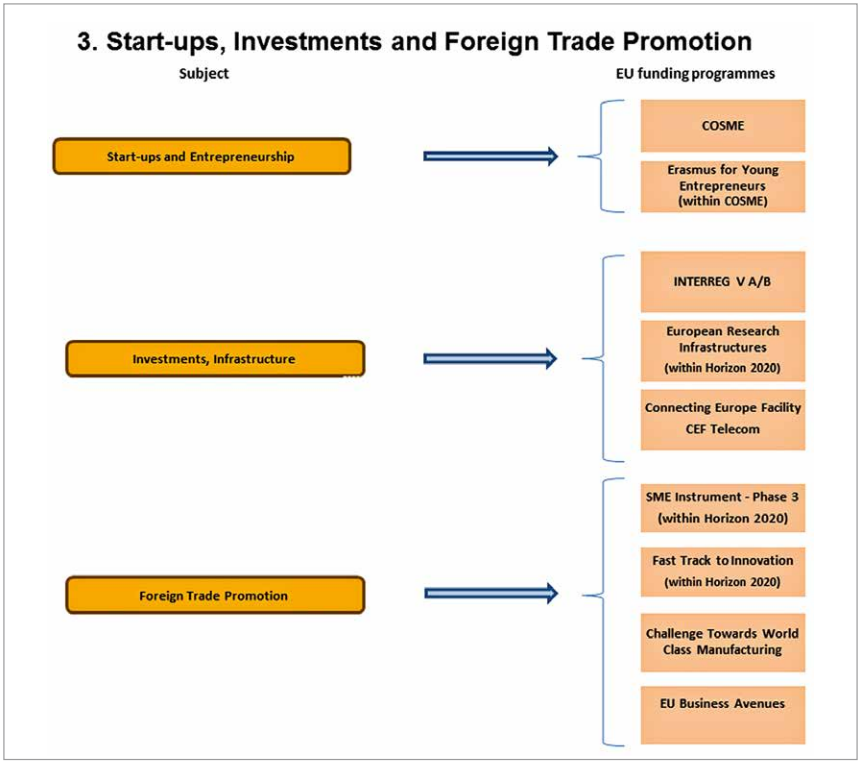


Figure 33: Destination panel of EU-funding (Source: Steinbeis 2i GmbH, Table adapted from EU-Förderlotse, ed. by Ministerium für Finanzen und Wirtschaft Baden-Württemberg in cooperation with S2i).

Horizon 2020

Horizon 2020[27] is the EU Framework Programme for Research and Innovation and part of the Innovation Union, a Europe 2020 flagship initiative aimed at boosting Europe's competitiveness. Its central goal is to drive economic growth and create jobs in Europe by financing innovations facilitating the transfer of research to market. Horizon 2020 supports transnational research projects with an emphasis on excellent science, industrial leadership and tackling societal challenges. These are also the topics of the main lines of funding.

The programme is open to everyone. The approach is to accelerate the market uptake of innovations and achieve results faster. For Key Enabling Technologies (KET), such as photonics, the programme holds many opportunities since a high level of innovation is a pre-requisite for projects implemented under this programme.

SME Instrument

This European funding programme is addressed to Small and Medium sized Enterprises (SME) developing breakthrough innovations with a market-creating potential.

The SME instrument[28] is part of the European Innovation Council pilot (EIC pilot) and provides € 1.6 billion in funding over the period 2018–2020. The scheme, available for SMEs exclusively, has no thematic focus. The main emphasis is on innovation with high potential for commercialization and internationalisation boosting growth and job creation.

The SME instrument is built around in 3 phases:

Phase 1 – Feasibility assessment

Funding is directed to projects exploring and assessing the technical feasibility and commercial potential of an innovation. The objective is to support the launch of a

27 Based on information provided on https://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020
28 Based on information provided on http://ec.europa.eu/programmes/horizon2020/en/h2020-section/sme-instrument

new product, service or process on the market. Subject to funding could be risk assessments, design or market studies and intellectual property exploration. Funded projects receive a lump sum of € 50.000 (per project, not per participating SME).

Phase 2 – Innovation project

In Phase 2 funding is reserved to highly-innovative projects featuring a sound and strategic business plan. Activities linked to product development such as prototyping, miniaturisation, scaling-up, design and performance verification receive financial support of up to € 2.5 million.

Phase 3 – Business acceleration

Following-up on the results obtained in phase 1 and 2 support provided in phase 3 is concentrated on business acceleration services and includes assistance for developing investment readiness, for linking with private investors and customers through brokerage activities and events and for applying for further EU risk finance. Phase 3 does not include any monetary funding only consulting services provided by experts engaged by the European Commission.

Fast Track to Innovation

The Fast Track to Innovation (FTI)[29] provides funding for bottom-up proposals for **close-to-market innovation** activities in any area of technology or application. This thematic openness – combined with the possibility for all kinds of innovation actors (SME, large enterprise, R&D, academic) to work together and deliver innovation onto the market and / or into society – is set to nurture trans-disciplinary and cross-sectoral cooperation.

29 Based on information provided on https://ec.europa.eu/programmes/horizon2020/en/h2020-section/fast-track-innovation-pilot

The FTI's aim is to:

- reduce time from idea to market;
- stimulate the participation of first-time applicants to EU research and innovation funding; and
- increase private sector investment in research and innovation.

Proposals for funding must be submitted by consortia comprising between three and five legal entities established in at least three different EU Member States or countries associated to Horizon 2020. Actions are to be 'business-driven' because they are intended to give breakthrough innovation ideas the last push before shaking up the market. Substantial industry involvement in FTI actions is mandatory to ensure quick market take-up ('quick' meaning within a three-year period after the start of the FTI-action). This industry involvement implies:

- either the allocation of at least 60 % of the budget to industry participants in the consortium;
- or the presence of a minimum number of two industry participants in a consortium of three or four partners, or of three industry participants in a consortium of five partners.

INTERREG

Interreg[30] is the funding instrument of the European Territorial Cooperation (ETC), which pursues joint actions and policy exchanges between national, regional and local actors from different Member States. There are three types of cooperation supported in Interreg: cross-border (Interreg A), transnational (Interreg B) and interregional (Interreg C, mainly targeted to public authorities). The budget of the fifth programming period of Interreg (2014–2020) amounts to 10.1 billion EUR, which are invested in over 100 cooperation programmes between regions and territorial, social and economic partners.

30 Based on information provided on http://ec.europa.eu/regional_policy/en/policy/cooperation/european-territorial/

The thematic focus of Interreg is based on the 11 investment priorities of the EU's regional policy:

- Information and Communication technologies
- Competitiveness of SMEs
- Low-carbon economy
- Combating climate change
- Environment and resource efficiency
- Sustainable transport
- Employment and Mobility
- Social inclusion
- Better education, training
- Better public administration

Eurostars 2

In the framework of Eurostars[31] innovative projects of international scale receive funding for the development of rapidly marketable innovative products, processes and services. The goal is to support SMEs with a strong profile in research and development in leveraging innovations that positively impact and improve the daily lives of people around the world. Eurostars provides for opportunities, specifically tailored to SMEs, to leverage international cooperation, share expertise and benefit from an international exchange of knowledge. In the 2014–2020 period a total public budget of € 1.14 billion has been allocated to Eurostars, which is a joint programme between EUREKA and the European Commission, co-funded from the national budgets of 36 participating states and partner countries (including non-European countries such as Canada and South Korea).

31 Based on information provided on https://www.eurostars-eureka.eu/

Overview of key European funding programmes

Key data	Horizon 2020	SME Instrument	INTERREG V A / B	Eurostars 2
Project duration	2–4 years	Phase 1: 6 months Phase 2: 1–2 years	Interreg V A: 1–5 years Interreg V B: 2–3 years	Average 29 months; max. 3 years
Number of partners required	8–14 partners from 6–8 countries	Single applicants or collaborations eligible	Interreg V A: 3–6 partners from 2–4 countries Interreg V B: 5–12 partners from 5–6 countries	3–4 partners from 2–3 countries; partners should represent min. 2 Eurostars countries
Funding rate	70–100 %	Phase 1: 50.000 EUR (lump sum) Phase 2: 70%	Interreg V A: 50–70% Interreg V B: 60–85 %	50–100%
Project budget	Average 2–6 MEUR	Phase 1: min. 50.000 EUR, plus 30% injection of own resources Phase 2: 1–3 MEUR	Interreg V A: Average 0,5–3 MEUR, projects involving investments are eligible too Interreg V B: Average 2–4 MEUR, only small investments possible	No specification; average 1.4 MEUR
Calls for proposals	Calls are published one time per year per line of funding	Submission of proposals possible at any time, up to 4 cut-off dates per year	Interreg V A: Submission at any time Interreg V B: Publication once per year per cooperation area	Submission of proposals possible at any time, 2 cut-off dates per year
Time to prepare a proposal	6–12 months	3–6 months	6–12 months	4–6 months

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Topics / funding lines	▪ Excellent science, e. g. Future and Emerging Technologies (FET); ▪ industrial leadership, e. g. advanced manufacturing; ▪ societal challenges, e. g. health and well-being	No predefined topics; three phase, progressive funding	See 11 priority areas of EU regional policy	No predefined topics
Activities eligible for funding	▪ R&D projects on Horizon 2020 topics ▪ Demonstration projects ▪ Coordination and support actions	▪ Phase 1: Feasibility assessment ▪ Phase 2: Innovation projects, from demonstration, prototyping to implementation on the market	Interreg V A: ▪ R&D projects ▪ Technology / Knowledge transfer ▪ Sustainable partnerships and networking ▪ Cross-border initiatives and actions (sustainable tourism, projects on energy-efficiency etc.) ▪ Fund for micro projects Interreg V B: ▪ Transfer of knowledge and creation of competence hubs ▪ Sustainable partnerships and networking ▪ Pilot investments ▪ Collaborative development of standards and strategies	▪ R&D projects in all areas, including prototyping

Table 7: Table Overview of key EU Funding Opportunities (Source: Steinbeis 2i GmbH, Table adapted from EU-Förderlotse, ed. by Ministerium für Finanzen und Wirtschaft Baden-Württemberg in cooperation with S2i).

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Description of RespiceSME Consortium

Foundation for Research and Technology Hellas – FORTH

FORTH-IESL is a major research organization in Greece with a strong international and national presence, with a mission to pursue high quality basic and applied research along a broad scientific area. The Institute of Electronic Structure and Laser (IESL) centres its research activities in the fields of Lasers and Applications, Materials Science, Microelectronics and Devices and Theoretical-Computational Physics achieving excellence in several of the above while laying the grounds for a competitive presence in others. Basic and applied researches as well as technological innovation projects are carried out in the overhead fields, with financial support from national and EU research programs.

FORTH-IESL has been a key participant of the Access to Research Infrastructures programme (since 1990 as a Laser facility and now as a facility in Cultural Heritage and Soft Matter as well) and is currently also a member of the Extreme Light Infrastructure (ELI) consortium. With support from the EC, the institute provides educational-training opportunities to doctoral students from European countries, within the Marie-Curie training scheme. Also, FORTH-IESL has been collaborator and co-founder of several spin-off companies focused in the fields of biomedical optics and laser material processing.

FORTH-IESL holds one stakeholder position in Photonics21 Board of Stakeholders (BoS), being one of the founding organisations of the Platform, while members of its Research Staff have been heavily involved into the activities of the Platform. Along with other keyrole national players, FORTH-IESL initiated the establishment of a similar thematic platform for Photonics in National Level in Greece (PhotonicsGR) and currently participates in the executive board of this National Platform.

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Knowledge Transfer Network Limited

Knowledge Transfer Network

The Knowledge Transfer Network (KTN) was established to foster better collaboration between science, creativity and business, the KTN has specialist teams covering all sectors across the economy. The KTN has helped thousands of businesses secure funding to drive innovation and supports them through their business cycle to see the investment turn into success.

KTN is a highly networked community that is extensively involved in UK innovation and wealth creation and one of its roles is to be an independent and influential voice of the electronics, sensors and photonics community to the EU, UK Central government, Innovate UK, Research Councils and whatever other organisations it is relevant to engage with. Through its Photonics group the KTN works in partnership with the UK's photonics clusters and develops initiatives and programmes to stimulate innovation and growth in UK photonics.

The KTN delivers many events in the UK and also on an international level and is keen to be involved in projects that allow opportunities to foster new collaborations to spark innovation and business growth.

Working with large and small companies, government agencies and research organisations, with tech hubs and start-ups, public funding bodies, VCs and private investors, KTN has built a unique network that helps enterprising people and companies reach the full potential of their innovative capabilities.

Established by Innovate UK to build better links between science, creativity and business, the Knowledge Transfer Network has specialist teams covering all significant sectors of the economy, from defence and aerospace to the creative industries, the built environment to biotechnology and robotics. Our expertise in connecting sectors, disciplines and skills with the right collaborations and business approach is what helps unlock the tremendous hidden value in people and companies.

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Laser & Engineering Technologies Cluster – LITEK

LASER & ENGINEERING
TECHNOLOGIES CLUSTER

The Public entity "Science and Technology Park of Institute of Physics" (FIMTP) is the managing organisation of the Laser and Engineering Technology Cluster (LITEK) formed through the joint efforts of high-tech companies and researchers. FIMPT was established in 2010 by the Centre for Physical Sciences and Technology (CPST), the largest state scientific research institution in Lithuania carrying out fundamental research and technological development in the fields of laser technologies, optoelectronics, nuclear physics, organic chemistry, bio and nanotechnologies, electrochemical material science, functional materials, electronics.

The aim of FIMPT is to act as a technology transfer facilitator between CPST and the laser industry. LITEK companies specializes in manufacturing and development of scientific lasers & systems, industrial lasers, optoelectronics, laser optics, ultrafast optics, optical components, opto-mechanical components, nonlinear and laser crystals, industrial workstations for mass and small batch production with short pulse solid state and fibre lasers, workstations for research and development with nano and pico second solid state lasers, customized state-of-the-art systems for scientific research with pico and femto second lasers, laser micro machining units for Micro machining laboratories.

LITEK companies also provide services of laser materials processing technology, development, deployment and expertise, consultation lasers in the manufacturing process, optical coating design and characterization services, custom development for optical components, metal processing, three-dimensional parametric design of components, compounds, mechanisms.

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National University of Ireland, Galway

NUI Galway, founded in 1845, has a distinguished track record of achievement in research, in teaching and contribution to society. The University with its 17,000 students and 2,000 staff makes impactful contributions internationally, nationally, and to the Connacht Ulster region in Ireland. The University is ranked 280th in the Times Higher Education world rankings. The University focuses on multidisciplinary research programmes, and has extensive collaborations with industrial partners.

The photonics community at NUI Galway has approximately 50 researchers engaged in photonics research, including 30 photonics PhD candidates and 20+ postdoctoral researchers in the School of Physics spread across research themes of Applied Optics, Biophotonics, Imaging, Remote Sensing and Laser-based Manufacturing. The Centre for Photonics & Imaging coordinates this activity at NUI Galway, integrating activities across fundamental science, education, applied research, technology transfer and industrial training. The key objective is the discovery of new science and the development of core intellectual property, carefully managed by the University, in close collaboration with SME and multinational industries. The impact of the photonics community in Galway is demonstrated by the 811 cited documents, including 424 peer-reviewed journal articles, and more recently in the last five years, by the 32 peer-reviewed journal articles published per year generating more than one thousand citations per year.

The National Centre for Laser Applications (NCLA) is part of the Centre for Applied Photonics and Imaging and is focussed on the area of advanced laser materials processing. The NCLA conducts internationally recognised research, commercialises proprietary research activity, trains graduate engineers and scientists and promotes laser-based production to national and international industry. The NCLA works closely with Irish and European academic and industrial partners on projects spanning graduate education, fundamental research, applied technology development and technology transfer.

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OptecNet Deutschland e.V.

optecnet DEUTSCHLAND | Innovationsnetze Optische Technologien

OptecNet Deutschland e.V. is the association of the German Regional Innovation Networks for Optical Technologies: Photonics BW, Optence, OptoNet, OptecBB, Bayern photonics, PhotonicNet, and HansePhotonik.

The German Innovation Networks for Optical Technologies unite more than 500 members: companies, research and education institutions, technology transfer agencies, business development companies, investors and public-law corporations. Their common aim is to support the development, the application, and the promotion of Optical Technologies as key enabling technologies and establish links between industry, science and politics and to promote innovation.

OptecNet supports the regional innovation networks and their members in establishing international contacts and business relations, e.g. by organizing partnering events, delegation trips and joint stands at trade shows abroad.

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Opticsvalley

Created in 1999, Opticsvalley (OV) is the Paris-Region's network in the fields of Optics, Electronics and Software & high-tech. Today, Opticsvalley, with a staff of 16 employees, develops support actions for its' 200+ members: SMEs, large corporations and research labs.

Through its network animation (over 12000 contacts in enterprises, labs, academic institutions, etc.), information dissemination and support activities, Opticsvalley promotes innovation and contributes to the Paris-Region's economic development. It has developed a specific employment exchange support open to industry and research in the high-tech fields, particularly of optics.

OV also provides individual support to SMEs and their development projects, with a tailor-made service & methodology offering analysis, concerted evaluations and action plans. Thanks to this strategic position, Opticsvalley supports partnership and strategic development initiatives for companies and research laboratories in the Paris region, enabling them to work effectively at a European level.

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Photonics Austria

Founded in November 2013, Photonics Austria represents the Austrian interests in Photonics. Main focus of Photonics Austria is to establish networking and co-operation between business, research and training in the field of Photonics.

Within the network that led to the founding of PHOTONICS AUSTRIA 55 organisations are involved. These organisations include all relevant Universities in Austria, RTOs, Industry, the ministry and intermediaries like the Austrian research funding organisation. In the business sector there are a number of large organisations represented like Zumtobel Lighting GmbH, Swarowski Optik KG or Fronius International GmbH as well as SMEs.

The network holds meetings in different locations all over Austria where specific photonic topics are discussed. Besides, these more technical topics meetings also cover relevant input from the European Union or Photonics21 in regards to Horizon2020 or Smart Specialisation. This is covered by the representative of the Austrian Federal Ministry of Transport, Innovation and Technology within Photonics Austria who also represents Austria within the Photonics21Mirror Group. This link with the Austrian Federal Ministry of Transport, Innovation and Technology also opens up the possibility to participate in the development of the national research funding programs and therefore to strengthen the input of the national photonics industry.

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PhotonicSweden

PhotonicSweden
The Swedish Technology Platform in Optics and Photonics

PhotonicSweden (PS) is the national platform for the Swedish photonics. It is an economic association which is a not for profit organisation. It was founded in 2011 by merging the activities of an association of companies called Swedoptronics with the networking activities of the Swedish Optical Society (SOS). PS manages as well the operational business of the SOS. PS has built working groups mirroring the ones of Photonics21. PS currently has 110 personal members and 50 company members out of which five are universities and research institutes.

PhotonicSweden aims at:

- Being the voice of the Swedish Photonics towards the Public, the Government and foreign and European organizations.
- Formulating national R&I agendas in Photonics.
- Increasing the collaboration between photonics industry, academia and institutes.
- PhotonicSweden shall catalyze fruitful cooperation between companies, universities, and institutes in the field of optics and photonics in Sweden and across the national borders.
- PhotonicSweden shall be a natural partner for Swedish and European funders and investors for product development and research.
- PhotonicSweden shall contribute to a healthy regrowth of engineers in optics and photonics.
- PhotonicSweden shall increase the awareness among the general public and politicians of the strategic importance of optics and photonics for the future of Sweden.

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SECPhO – Light Technologies Cluster

SECPhO (Southern European Cluster in Photonics and Optics) was founded in 2009 in Terrassa (Barcelona), Spain. The cluster brings together companies, innovation centers and research groups in the photonics and optics sector in Spain. Currently, it is comprised by more than 60 members. The mission of the cluster is to facilitate and improve the competitiveness of the Spanish Optics and Photonics sector by reaching major growth and profitability. SECPhO's main objectives are:

- To foster innovation in the field of photonic and optic technologies;
- To generate business opportunities for companies;
- To provide technology centres and research groups with access to projects.

SECPhO has yearly experience and is contributing in innovation generation where main actors are SMEs. This experience was gathered through organization of cross-sectorial innovation workshops nationally and internationally with market oriented clusters like: railway, food packaging, olive oil, wine cork, wine industry, rubber industry, automotive, agricultural machinery, aerospace and others. An original methodology of SECPhO Innovation Workshops helps to create new consortia for national and European funding programs for new product development.

Besides that, SECPhO is a partner in OASIS FP7 CSA project, that opens access of biophotonics research facilities to SMEs and fosters new projects. As one of the areas of interest of RespiceSME project is the applicationof photonics in health, SECPhO will bridge activities and contacts between the two initiatives.

Finally, SECPhO is a coordinator of the European Strategic Cluster Partnership ¨FoodPackLab¨ where besides photonics, clusters from packaging and food sectors are involved with an aim to help the consortium›s SMEs to expand their markets in 3rd countries.

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RespiceSME Coordinator

Steinbeis 2i GmbH

Steinbeis 2i GmbH (S2i) was founded in 2016 as a 100 % spin-off of Steinbeis-Europa-Zentrum (SEZ). SEZ is a not for profit organisation within Steinbeis Innovation gGmbH (SIG). The spin-off Steinbeis 2i GmbH has taken over all staff members and competences from SEZ, so that the over 25 years' experience of SEZ and the senior expertise of its staff in building innovation capacities in SME and supporting cross-border research and technology transfer is fully guaranteed and now executed by Steinbeis 2i.

S2i's acts as:

- Member of the Enterprise Europe Network (EEN) since 2008 with close to 600 participating organisations in over 50 countries, and is a reliable and experienced partner in the network for European technology transfer, promotion of exploitable European research results and innovation capacity building.
- The regional Contact Point for Small and Medium-sized Enterprises in Baden-Württemberg, Germany.
- A provider for Baden-Württemberg's Universities of Applied Science with information on European support programmes and supports them in formulating proposals and implementing European projects on behalf of the Ministry of Research, Science and the Arts Baden-Württemberg.

S2i's core competences are:

- Companies, universities and research organisations are supported in submitting and implementing cross-border innovation projects, by identifying and selecting appropriate funding and innovation programmes as well as taking steps to internationalise and enter European markets.

- Assistance in the exploitation of research results, to promote trans-national technology transfer, to stimulate and support the innovation process in industrial companies and to provide professional training.
- Advice for policy makers and administrations on regional futures scenarios, on innovation and cluster policy issues and accompany knowledge exchange at the European level.
- Expert knowledge on communication and dissemination of research and innovation projects and their results.
- Facilitating networking among innovation actors, e. g. through the professional and competent organisation of European conferences and events

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Europe's high-tech Small and Medium-sized Enterprises (SMEs) have a large share in developing smart products in the field of photonics and other Key Enabling Technologies (KETs). They are one of the backbones of Europe's economic power, yet despite great innovation potential they often lack management skills and cross-sectoral market insights to leverage their products on the market.

The EU funded project RespiceSME addressed these needs and developed a toolbox to boost the innovativeness and competitiveness of high-tech photonics SMEs. The tools were conceived to support cluster managers and business developers in consulting SMEs on business strategy.

This handbook provides a practice-oriented description of these tools outlining implementation guidelines on:

- Evaluating the innovation potential of high-tech SMEs
- Delivering support and advice to SMEs for improving corporate innovation management and formulating a strategy for innovation
- Enabling high-tech SMEs to exploit their potential and put novel products succesfully on the market v
- Bolstering the competitiveness of SMEs by initiating transnational and cross-sectoral cooperation

To illustrate tools and methods the handbook also presents best practices collected in the framework of the RespiceSME project.

All templates and tools are available online:
http://www.respice-sme.eu/respicesme-toolbox/the-respicesme-handbook/

"Cluster managers can have a significant role in leveraging the innovation potential of SMEs. The tools presented in this handbook are aimed at supporting their work."

Samantha Michaux, RespiceSME coordinator

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