



MAKING RESEARCH AND INNOVATION WORK FOR SMES IN THE FOOD AND DRINK SECTOR

Joint Chapter of the European Technology Platform 'Food for Life', the European Collaboration of the National Food Technology Platforms, and the European Federation of Food Science and Technology on Implementation Actions for the SMEs of the Food and Drink Sector



Contents

1. Role and Characteristics of SMEs in the Food and Drink Sector	2
2. Obstacles for Food and Drink SMEs to Engage in R&I	4
3. Potential Approaches to Overcome R&I Hurdles	5
3.1. Customer/consumer knowledge.....	6
3.2. Financial and funding instruments and tools.....	6
3.3. Human resource development and knowledge acquisition	7
3.4. Networking and collaborations.....	7
3.5. Facilities, tools and services	7
3.6. Systematic exploration and adoption of knowledge and solutions from other disciplines	8
4. Targeted Actions for Food and Drink SMEs	8
a. Make consumer, social and business sciences accessible to SMEs.....	9
b. Provide funding and financial tools tailored to SMEs.....	10
c. Create synergies between start-ups and SMEs	12
d. Exploit complementarities with other disciplines	13
e. Accelerate the diffusion of solutions to SMEs, and create access to enabling facilities, tools and services.....	14
f. Develop human resources through enhanced knowledge transfer and training programs for SMEs.....	17
5. Impact Stories.....	20
6. Monitoring Approaches	22
7. List of Recommendations	22
8. List of Contributors	26

1. Role and Characteristics of SMEs in the Food and Drink Sector

FoodDrinkEurope has published annual statistics¹ that show that about 99.1% of all food companies are small or medium sized enterprises (SMEs). Roughly 78% of them are being categorized as “Micro-SMEs”, meaning that they employ on average less than 3 people. Even if all larger European Food SMEs are included, the average number of employees is still low, i.e. all food and drink SMEs together employ individually on average about 9 people. Nevertheless, due to the extremely large number of food and drink SMEs in Europe (about 285.000), they employ in total as many as 2.8 Mio. workers which makes them one of the largest employers in the European manufacturing sector. Food and drink SMEs are therefore of great economic importance and due to their diversity have a large potential to develop and test novel solutions that could benefit many European citizens.

A consequence of the very small company size is that they largely operate in local and regional markets, i.e. they often do not have a national or Europe-wide presence. Unlike other manufacturing sectors (e.g. ICT) they often do not have personnel that has a strong scientific background and, in many instances, they can only operate effectively in their national language. The proportion of technology-adopting enterprises, i.e. SMEs that are willing to implement existing and already tested technologies but are reluctant to explore new and emerging ones, is around 20%. More worrisome, the percentage of SMEs that do not engage in any formal R&I activities is around 70%². This leaves only about 10% of SMEs that are carrying out innovative and research-fuelled activities. In comparison, the willingness of food SMEs and farmers producing food to carry out risky innovation activities is lower than in any other the high tech and emerging industry sectors, because of a conservative attitude versus their customers. This means that in essence, much of the creative potential in the sector is currently not realized, and special actions tailored to food and drink SMEs’ needs are therefore urgently needed to improve the situation.

There are some exceptions though. In some areas, food and drink SMEs are quite dynamic and able to implement incremental improvements, e.g. in the area of raw materials and ingredients, formulation, processing, portioning and packaging. There are three groups of sector SMEs in which innovative activities are carried out:

- a) **Food manufacturers**, whose aim of innovation is to produce food with new or

¹ [FoodDrinkEurope Data and Trends of the EU Food and Drink Industry \(2016\)](#)

² [EURAB ‘SMEs and ERA. Report and Recommendations’ \(2004\)](#)

improved properties and augmented services, increased benefits (increased food safety, sustainability, ethical aspects, better consumer/customer information, supporting healthy diet, etc.), and/or with more efficient use of resources at lower costs. They typically need input from knowledge and solution providers to implement their innovative ideas, and often require support in the identification of key hurdles and obstacles that endanger a successful commercialisation and market launch. Access to innovation management advice and financial support for innovation is also often lacking.

- b) **Solution and service providers**, including ingredient and packaging manufacturers and suppliers of technical support, whose strength it is to create innovative ideas for customer to address consumers' needs and desires. They need reliable food manufacturing partners for developing and testing the first food applications in an area, and for demonstrating successful cases that will then foster further application developments by "followers", that is food businesses that have been convinced by the success concluding then that an investment has acceptable risks. Here too, innovation management advice and financial support for innovation is often necessary.
- c) **Technology providers**, who develop and provide specific technologies that can be used in the production of foods by others. This category includes equipment manufacturers, communication and marketing agents, and also enterprises from the digital technology area. This third group is not always included, but is essential for innovations that should be adopted in the industry. It should be noted though that the involvement of digital technology companies and advanced manufacturing solution providers at the present is not a systematic one, and is often driven only by a desire to save costs. The possibility of using digital technologies to implement changes in the existing business model is only rarely fully realized.

In general, the innovation behaviour of each of these three groups is different. While food manufacturing SMEs are usually more 'conventional', their innovation activity is rather incremental than radical, and less visible. Knowledge and solution providers see innovation as an element of their core business, and they often carry out more radical innovations. They also innovate more frequently.

To achieve a real change in the food system, especially the innovation capacity of the 'conventional' SME food businesses must therefore be enhanced, since they represent a significant part of the food supply system providing European consumers with food

solutions. In particular, creating networking opportunities between these different types of SMEs would enhance the innovation potential of SMEs since their approach is complementary rather than competitive. Regional networks, such as the European collaboration of National Food Technology Platforms (NFTPs), are conducting campaigns at local level to improve these connections.

2. Obstacles for Food and Drink SMEs to Engage in R&I

Because of above described the nature of food and drink SMEs, it is often very difficult for them to react to new overarching developments that permeate the entire sector such as for example the increasing digitization of the food system or the ongoing restructuring of the supply chain with new business models emerging in the process.

Recent surveys on barriers to innovation in food SMEs conducted in the TRADEIT³ and TRUEFOOD⁴ projects suggested that the major barriers as seen by the companies were:

- Lack of time to carry out adequate innovation activities;
- Difficulties of getting access to finance for innovation activities; and activities incurring high cost compared to the available limited resources;
- An unsuitable size (often too large) and a high cost of purchasing new processing equipment needed to deliver product innovations;
- Problems in creating adequate production and distribution networks, and in entering retail spaces;
- A low innovation awareness due to a lack of information on emerging technologies, services, materials, and new consumer solutions;
- Lack of business and management skills needed to simultaneously carry out innovation activities on top of ongoing operations;
- Scepticism and unease regarding non-traditional business models e.g. those based on complementary networks;
- Emotional, cultural and language barriers;
- Fear of losing customers, often associated with a lack of customer responsiveness;

³ [TRADEIT Project](#) (Grant No. 613776). Deliverable 6.5

⁴ [TRUEFOOD Project](#) (Grant No. 16264). Final report

- Fear of losing workers (human resource losses);
- Legal barriers, and lack of knowledge of legal frameworks.

In principle, the small size of companies should allow them to be flexible and able to react quickly to changes. After all, the size of most SMEs in the food and drink sector is similar to that of start-ups. Start-ups represent a specific group of businesses, whose innovation behaviour is closer to the solution and service providers. They have the concept of an innovative product, process or service responding to customers' needs on the market. They are typically small organisations with limited assets who are looking for users and investors, and aim to develop a business models which can be scaled-up rapidly. They can be the source of innovative ideas, business concepts and business models. However, the fact that they are often funded by venture capital allows them to initially operate without cost coverage, which is they only have to become profitable at a later time. They are then however expected to return multiples of the initial investment by scaling up quickly.

In contrast to start-ups, SMEs are under pressure to be profitable at all times. They therefore often lack the resources (personnel, equipment, financial) that could temporarily be used to carry out new developments. Often this prevents them from engaging in activities that are not directly related to the ongoing business. Moreover, the need to constantly stay profitable hampers risk taking thereby putting SMEs at a substantial disadvantage when compared to start-ups.

3. Potential Approaches to Overcome R&I Hurdles

When considering the above-listed obstacles, it is important to note that SMEs are not uniform in their innovation behaviour and thus in their needs (see section 1). This applies, in general, to SMEs operating in all sectors. There are however "Technology Pioneers" (Innovators) amongst SMEs, but their percentage is often lower than 3%. This is a group that not only uses new knowledge, solutions and technologies at an early stage but also develops new applications and techniques using their own research and development capacities. They act in parts of their operations like a start-up, however using mostly their own capital to fund a new venture. Interestingly, high-tech start-ups have cutting-edge technologies in-house, but lack the manufacturing capabilities and/or distribution channels to turn this technology into a successful and profitable business with scale economies. This is an advantage that SMEs have over start-ups.

They already have access to markets, manufacturing equipment and distribution channels. It is thus worth looking at what factors can contribute to the success of both SMEs and start-ups, and draw then recommendations for actions from it.

3.1. Customer/consumer knowledge

Enterprises, especially small ones, need to be well aware of needs and wants of their customers and end-consumer base. A loss or lack of trust can prove fatal, since the consumer base is small. Often, SMEs occupy successfully specific niches that are however static in size. A shift to other niches would often require for a completely different business model to be established. Due to shortage in resources and in-house skills and the reluctance in taking risky behaviours, this however, is an extremely difficult task for SMEs to do. Thus programs targeted towards mapping changes in wants and needs of consumers are crucial. This is a bit in contrast to start-ups that have no customer base yet, but are quite aware of who they wish to target and what their end consumer wants and desires are. This is because business concepts are vetted and investments are made based on a rigorous assessment of growth potential.

3.2. Financial and funding instruments and tools

Having funds available is a critical prerequisite for R&I activities. Investments are needed because profit will only be generated at a later time. Therefore, access to information about opportunities for funding R&I is required, and this information must be compact and readily available to prevent information overload (i.e. too much information, difficult to digest). Funds, private and public, must be available and easily accessible. This applies to the bureaucracy of the system in which one applies for funding, as well as the reporting procedures, which must be simple and not too complex. Moreover, the size of the funds must be sufficient to allow for the innovation activities to be carried out, otherwise the investment may be lost since the activity cannot be carried out to their consequential end. The sufficiency of funds is often a problem when the funds come from within the organization itself. If provided by the public funding system, then there are often firm caps on the amount that can be obtained. Moreover, these investments need to be managed flexibly, i.e. the money must be transferred when needed and made available on time with the ability to shift uses when required. Lastly, there must be a familiarity with IPR and ownership issues, and this often requires knowledge of national or international law as well as internal rules of operation.

3.3. Human resource development and knowledge acquisition

A skilled, motivated and sufficiently large human resource pool is essential in ensuring economic success of a company. For start-ups, it is often experience and practical knowledge that is lacking, while in SMEs, new and emerging knowledge is missing. Moreover, in SMEs, workers may be resistant to change established (and often so far successful) procedures and approaches. Training programs that effectively raise awareness of new technologies and innovations without hampering ongoing operations are therefore crucial for entrepreneurs and their collaborators. Moreover recruitment of well-educated workers (such as M.Sc. and Ph.D. graduates) may be difficult due to limitations in employment benefits and compensations. For start-ups, the problem is often in the growth phase, where new personnel has to be brought in quickly. These high risk environments may therefore similarly experience difficulties in attracting and employing well-educated workers. Moreover, in both environments, changes in personnel can prove to be very disruptive since the smaller “cultural units” are often tightly knit resisting integration and open exchanges.

3.4. Networking and collaborations

Both SMEs and start-ups must have mechanisms in place that allow them to successfully enter and maintain markets. Due to their small size, this may be very difficult to do on their own. Thus partnerships and collaborations are needed. This can for example be done through collaboration agreements with non-competitor companies that act in adjacent spaces. When it comes to the adoption and development of new technologies, services or products, a collaboration with Institutions of Higher Learning (e.g. Universities and Research Centres) and Industry Technical Centres may be needed. Here, a rapid identification and selection of a specific expertise within the partner institution is needed. Moreover, the contact point in the higher learning institution or technical centre must have a good understanding of SMEs’ needs and possibly practical experience in working in the industry so that the collaboration creates true win-win scenarios.

3.5. Facilities, tools and services

When both SMEs and start-ups want to carry out new R&I activities, require facilities as well as access to tools. Provision of these facilities and tools alone are however not sufficient because both are not easy to operate by non-experts. As such, these should either be designed with simplicity, clarity and compatibility in mind, or have the option to be done in a service-type mode. In the latter case though, knowledge on operations

should be transferred so that no dependency is later generated. The service type support for the use of experimental and testing facilities of prototypes of new solutions and tools is particularly important when these solution are adapted from other disciplines. These facilities should be able to handle food material in way which meets the perishable nature of the raw materials and finished products, the food hygiene requirements including cleaning and sanitisation. At cross-disciplinary facilities the service staff from the non-food sectors should have some understanding of the basic needs and requirements of the food industry.

3.6. Systematic exploration and adoption of knowledge and solutions from other disciplines

The food industry is one of those sectors in which the innovation comes mostly from the application of the knowledge and solutions from the supplying sectors. This is caused mainly by resistance of the consumers to such developments which change the nature of the food itself at molecular or sub-molecular level and also by the difficulty in protecting the IPR of those innovative ideas which are based solely on the ingredients, composition, and/or market access channels of the food. The innovations based on the knowledge and solutions of other disciplines can result in more acceptable innovations if their acceptability by the consumers is checked at an early stage. These innovative solutions can also be protected better. Thus, a cross-disciplinary approach can result in more breakthrough innovations in the food sector.

The above outlined factors for success of SMEs in the research and innovation space lead to a number of SME-specific actions that must be taken to ensure that the food system in its entirety - and not just a select few players - transforms and advances.

4. Targeted Actions for Food and Drink SMEs

The disruptive, novel research and the new types of technology described in detailed in the Strategic Research and Innovation Agenda of the ETP 'Food for Life' and the Implementation Action Plan presented herein will have a beneficial impact on all food and drink companies, no matter their size. This is because food and drink SMEs are exposed to the same global trends and challenges as any other members of the food value chain. Nevertheless, considering the big changes taking place in the area where food and drink businesses operate, and the aforementioned particularities of the sector, we think that it is important that SMEs are brought into the R&I cycle in a manner

tailored to their needs. While their thematic needs are very similar to those of large companies, their interest and priorities are strongly influenced and controlled by their limited resources and their specific business and innovation culture and affected by the vulnerability of their business, as also shown in the TRAF00N project⁵. For instance, SMEs need assistance on issues of product formulation/re-formulation if they are to adequately impact or improve the health related aspects of their products. Hence, research based innovation activities that require less resources and enable faster implementation and return on investment (e.g. from TRL 5 and above) are typically more relevant and applicable for food and drink SMEs, than those that need more resources, investment, a long return time and more complex knowledge beyond their core competence. In this scenario, SMEs usually prefer to follow successful examples and learn from each other⁶. In the following sections we therefore suggest a number of vertical actions that would enable SMEs to better exploit the full potential that R&I offers.

a. Make consumer, social and business sciences accessible to SMEs

The enablers and barriers for innovation in SMEs are often related to the organizational structures and established ways that actors in SMEs apply when developing a product or service. In order to find more innovative mind-sets and solutions to possible barriers within SMEs and their networks, social scientists can actively support both SMEs' participation in projects and further aid the integration of new research findings in their daily activities. In many cases innovation-related issues are only partly linked to new knowledge or technical solutions. The other part of the problem relates to the ability to apply the knowledge and make the required changes in current behaviour patterns in the organization, such as changing the approach to innovation from reactive to proactive and growth-seeking. Most food and drink SMEs lack in-house expertise in aspects that go beyond direct marketing efforts. This statement often applies also to understanding the consumer behaviour in the food domain, which is the core market for most SMEs. Hence, a significant part of the training activities targeting SMEs should include a better understanding of how social sciences in general and especially market analysis can support their innovation activities. One option to achieve this would be to give incentives to SMEs to hire young people educated in social sciences for a period of time (e.g. social science interns). Social sciences can also help in identifying the

⁵ [TRAF00N project](#) (Grant No. 613912). Final Report

⁶ [European Collaboration of the National Food Technology Platforms. Strategic Research and Innovation Agenda \(SRIA\) for fostering innovation and knowledge transfer to SMEs, farmers and other national food businesses \(2017\)](#)

differences in the innovation attitude and innovation behaviour of different segments of SMEs thereby bringing about a change in attitude within SMEs. This could be done by innovation support counselling and coaching to assist different types of SMEs based on their needs and preference to induce changes in intrinsic innovation behaviour to more actively exploit their own innovation capacities and to tackle internal barriers of innovation.

The above are examples of how social sciences could feed into and improve the R&I processes in SMEs of the food sector. In order to foster a systematic dialogue between the two communities, a clear description of the capabilities and enabling functions of social sciences should be offered to food sector users, while a collection of the problems, needs of food businesses related to consumer behaviour, motivation of food business related to innovation and to other areas of the social sciences should be accessible to the social scientists. This dialogue could be facilitated by networks already established at the European and National level, such as the ETP 'Food for Life' or the NFTP.

b. Provide funding and financial tools tailored to SMEs

If the very large European food and drink SME sector is to innovate and grow, whether in production, turnover and employment, suitable financial support structures and tools urgently need to be developed. It is probable that the same model may not suit the whole of Europe and therefore structures appropriate to the local ethos and using the local language need to be established. In whatever format, these structures will need to provide access not only to scientific innovation ideas in an understandable form, educate or assist the individual SME with the business management skills needed to undertake an innovative expansion, but they also need to provide access to the necessary finance to then implement.

New financial initiatives are clearly necessary to facilitate innovative expansion of SMEs as currently tools do not really allow SMEs to take risks. Some of the advantages of financial tools for start-ups, which allow for much more risk to be taken, should therefore also be made available to existing SMEs. These tools have the advantage that they include assessments of new business models in terms of market and growth potential. However, the existing tools often are geared towards funding disruptive and not incremental innovations. A differentiated innovation funding scheme is therefore needed that can target different segments of SMEs/farmers and fit their innovation behaviour and risk-taking capacity. Public co-funding of bottom-up projects is needed

to leverage some of the risk, bringing collective research and collective services into the fold, especially in the initial, often still pre-competitive phase. This should then be followed by access to risk finance and shared technical facilities in the close-to-market phase. By the time of the large diversity and frequent changes of the funding schemes policy makers should monitor whether appropriate funding schemes are available for all steps of the innovation process seamlessly both at European and national level.

In case a tool has been evaluated and found to be successful due to SMEs using it frequently to grow their business, then it is crucial to keep them. A persistent problem is the varying nature, attitude and availability funds. It is strongly recommend that the financial tools used at the European level are stable and do not change. To date there have not only been changes from one Framework Programme to the next, but also within a framework program. On the national level, new programs have been created but their funding is subject to annual appropriations. For SMEs this makes it very difficult to become familiar with them. Flexible, fast, simpler financial tools at both national and European level are needed that are not bound to fixed deadlines could foster SME participation in R&I programmes. Vice versa, there should be fiscal incentives for classical R&I actors such as Universities and Research Institutions to engage in such activities.

A series of training modules for SMEs, assessed and/or adjusted at regional level, could provide the needed business skills for the appropriate personnel in small food SMEs. SMEs have to improve their understanding about the full range of financing instruments they can access depending on the respective financial need scenario. More importantly the vetting process for allowing access to financing should be designed such that it becomes a learning and improvement process facilitating an innovation and not simply granting or denying it. While bank financing will continue to be crucial for the SME sector, there is a broad concern that credit constraints will simply become "the new normal" for SMEs and entrepreneurs. It is therefore necessary to broaden the range of financing instruments available to SMEs and entrepreneurs, in order to enable them to continue to play their role in investment, growth, innovation and employment⁷.

Involving potential funding from investors from other sectors, should be explored, which may see an exploitation potential in food related services and products applicable in the food industry.

⁷ [OECD \(2015\) New Approaches to SME and Entrepreneurship Financing: Broadening the Range of Instruments](#)

c. Create synergies between start-ups and SMEs

Start-ups can be a source for innovative products, processes or service concepts that can be used by food-manufacturing SMEs. However, the majority of SMEs are not familiar with the concept of modern innovation promoting tools, such as incubators, living-labs, etc. and therefore there is a need to bridge the gap. The lack of trust and the fear of losing valuable intellectual property from the start-ups side and the fear of risks associated with the application of radical innovation concepts for the SME side can represent a significant barrier for their collaboration. Also the mutual perception of start-ups and SMEs in the food sector is often one of potential competitors on the food market in turn making collaboration difficult. However, there are many benefits that could be reaped from a structured interaction. Start-ups have in many cases vetted business models and a good understanding of changes in the sector. They however lack a customer base and manufacturing capabilities. In turn, SMEs have experience, access to local markets, and have production capabilities. A successful collaboration requires that competences are strictly complementary to avoid that the two partners operate independently in the same market. This requires a very deliberate matchmaking process that creates teams where there is no feeling of dealing with a potential competitor on the market. Specific platforms and matchmaking events are needed to facilitate this. There, food processing SMEs can be made aware of the innovative concepts of start-ups from the solution and technical input providing sectors and in parallel solution-provider SMEs may be made aware of the innovative concepts of food start-ups, who can be their first partners for developing new solutions of application of already available solutions, for the specific needs of the food businesses. If food SMEs were to describe their problems and needs for solutions from other disciplines in satisfactory details, but in a concise way, and if these were to be collected into a confidential database together with solutions and technical input providers from other disciplines describe the innovative concepts and their enabling functions, then a targeted matching process could be carried out in full confidentiality. This would require a neutral brokerage in which the parties have confidence. For example, a collection of national intermediaries having given assurances of confidentiality could serve as a facilitating agents. As an example, the inclusion of start-ups in the NFTP could help develop synergies with traditional food SMEs. On a less formal level, the national and European Student Competition Ecotrophelia⁸ demonstrates that a good practice model can successfully bring together start-ups and young entrepreneurs and SMEs, with applicants bringing innovative ideas into a concept, prototype and basic

⁸ [Ecotrophelia Europe](#)

business plan without incurring risking loss of intellectual property.

d. Exploit complementarities with other disciplines

The enabling functions of new, advanced solutions from other disciplines, such as ICT, advanced manufacturing, material science, genetics, social science, etc. is currently not fully taken advantage by SMEs in the food and drink sector. There is a lack of a concise go-to place tailored to the needs of SMEs to obtain this new knowledge. Programs must go beyond information provisioning, and offer small modular educational programs collected in easily accessible inventories that can be provided to the users' community. To rationally populate this inventory a process must be put in place that collects problems and challenges that food and drink SMEs have, and match that to the various enabling functions to translate them into viable food system solutions. This would lead to a sector-specific knowledge scouting process that could then be combined with a subsequent design of educational concepts that can be easily "consumed" by food and drink SMEs. A constant dialogue between users' and solution providers' communities would ensure that the repository is kept updated to allow new enabling functions of new solutions to be incorporated in the day-to-day operations of SMEs⁹.

In order to create complementarities and shared interest and combine knowledge from different disciplines with food system intrinsic ones, the networking structures already in place can play an important role. NFTP's and national intermediaries, EFFoST, innovation clusters, national innovation networks, membership-based food industry research organisations, technical centres and innovation-supporting organisations can significantly support the access to information, knowledge, solutions, and data from the food sector and from the other disciplines and subsequently transfer knowledge¹⁰. All these organisations involve different stakeholders not only in the food sector but also in related supplying sectors. The upcoming implementation of the Food2030 policy could play a key facilitating role by bringing these actors together and grouping them in thematic working and research teams. In the future, there should be a mandatory task in R&I projects to convert non-competitive information into a clear, understandable, user-friendly, concise educational formats focused on the aspects of benefits and practical applicability. The knowledge providers participating in these networks can significantly contribute to creating awareness on new results and solutions. A subsequent dissemination by intermediaries or suppliers is crucial, and here

⁹ NFTP's SRIA (2017)

¹⁰ Adapted from NFTP's SRIA (2017)

a consideration of national or regional needs (e.g. languages, cultures) is important. To do this, existing organizations may want to consider to widen their membership to not only be disciplinary focused, but rather include members that can address sector requirements.

The application of a systems approach to food provision, as outlined in the ETP 'Food for Life' Strategic Research and Innovation Agenda 2017¹¹ and the Food2030¹² vision of a future food system including circular value chain management concepts to access complementary resources, capabilities and competences of value chain partners, requires new facilitation instruments that combine the knowledge of the food sector with other disciplines for joint interest and benefits. Dialogue and collaboration between primary and secondary producers guided directly by consumer needs and wants is of particular importance. For example, the development of new sources and raw materials is often only slowly taking place since secondary producers are not able to articulate their needs to a fragmented small farmer network. Therefore there is a significant potential, which has not yet been exploited properly in the systematic collaboration of food processing SMEs and farmers producing foods on exchanging information on their needs, constraints of their technologies, capacities, factors influencing the quality of their products and on systematic strive for combining their complementary resources, capabilities, competences for mutual benefits. Specific advantages could be achieved in better serving local food supply needs and for positioning in niche markets, with added value premium products (e.g. traditional foods and foods with specific new properties and benefits, local and new recipe foods, premium quality foods, etc.). SMEs and farmers producing foods must better identify the areas of innovation where they have a common interest. The bottom up approach of the European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI), Rural Development Programmes and European Regional Development Fund can be used for strengthening the innovation through national and regional operational groups involving local farmers and food processors leading to a permeation of the system approach to food supply and provision.

e. Accelerate the diffusion of solutions to SMEs, and create access to enabling facilities, tools and services

Collectively-shared cost coverage of knowledge transfer, access to innovation facilities, tools and services, and facilitation of participation in collective research projects by

¹¹ [European Technology Platform 'Food for Life'. Strategic Research and Innovation Agenda \(2016\)](#)

¹² [FOOD 2030 High-level Conference background document \(2016\)](#)

national networks, membership-based industry food research organisations, clusters, and NFTPs are catalysers of open innovation and promote a multi-stakeholder approach¹³. National or regional intermediaries, innovation facilitators, and innovation service providers based on industry-focused local networks are ideally suited to contact SMEs at national and regional level. They could carry out personal visits as well as consultations, and help the members of the networks through advice or by organizing experimentations and small batch productions at nearby facilities. All of these services should be provided locally taking cultural and language barriers into account.

To that purpose, mediator/facilitator organisations must be established at national level in order to assist SMEs in finding the appropriate solutions and to identify partners to develop consortia and to apply for National and European funds. For instance, the TRUEFOOD project designated and trained Techno-Scientific Mediators, locally-based and supported by several National Food and Drink Federations¹⁴. The facilitator organizations can then also provide consulting in a confidential space, and address IPR issues which arise in a collaboration between industry and academia. A tool that continuously collects SMEs needs and presents existing solutions can help to achieve this. The development of industry best practice guides, and inventories of successful cases can help SMEs understand the application opportunities, benefits and principles of application of new methods and reduce their risks of failure. A cooperative-type approach to the establishment of small demonstrator or product manufacturing facilities would go a long way in helping both SMEs and start-ups to overcome innovation hurdles. The joint use of such facilities could simultaneously promote networking between the different actors.

The concept of the Future Internet PPP (FI-PPP) will be also beneficial for accelerating the diffusion of solutions to SMEs. The FI-PPP is aimed at accelerating the development and adoption of Future Internet Technologies, advancing the EU market for smart infrastructures, increasing the effectiveness of a digital-driven business process. It brings together demand and supply sides in a platform and involves users early in the R&I process. Combined with the facilities outlined above, this would allow for new digital approaches to be integrated in food design and production processes. Moreover, this could be provided to many users (SMEs) allowing for multi-partner validations of solutions. It involves a three-phase approach consisting of:

1. defining the technological foundation and creating use- case projects (on agri-

¹³ NFTPs SRIA (2017)

¹⁴ TRUEFOOD Project (Grant No. 16264). Final report

- food chain/SmartAgriFood), defining and developing the Enabling Functions of Key Enabling Technologies, making inventories of available (public) infrastructure, and provision of integrated programme support for better governance and dissemination;
2. developing a large number of locally-available, scalable pilots and platforms (on agrifood and logistics to test and improve these Key Enabling Functions and making them more user-friendly);
 3. focusing on entrepreneurs, start-ups, SMEs: expanding use cases through applications, services; applying Accelerator Projects, where the project partners develop calls for small applications with a limited amount of public co-funding for solution providers and users jointly (30-150 000 Euros/project for 31 projects at the end of the FI – PPP in one accelerator project); providing mentoring support to the projects on the applications including assistance in developing business models, dissemination, involving investors; monitoring the performance of the supported small projects, etc. and disseminating the results to a wide audience.

In addition, collective research/marketing and collective supply chain management activities reduce the barriers represented by relatively high costs for SMEs. Collective research in the pre-competitive phase of innovation is an efficient tool for involving those SMEs into a shared cost research, which have less intensive innovation activities and which do not have research capabilities on their own. Though a shared-cost collective research they can benefit from the collective learning from each other, besides the lower costs. Collective research can serve as a first step to involve SMEs into R&I activities, to understand the concepts and potential of application of new methods, and prepare the confidential close to market innovation projects¹⁵.

Typical activities in collective research include:

- Development / improvement of the methods;
- Development of proof to concept knowledge;
- Explore new techniques and areas with high risk of failure;
- Preparation of technical norms, standards and best practice guidelines;
- Search for improved processes and materials of wide application in the industry;
- Integrate social sciences expertise on finding the best solutions for supporting SMEs innovation activities;
- Development of efficient and pervasive technology transfer tools.

¹⁵ NFTP's SRIA (2017)

f. Develop human resources through enhanced knowledge transfer and training programs for SMEs

In a rapidly changing world, and effective knowledge transfer is crucial to continuously developing one's own human resource pool. To date, knowledge providers such as Universities and Research Institutes focus on educating tomorrow's human resource pool, but often fail to provide targeted programs that allow professionals to maintain a current state of knowledge. This is also because educational key performance indicators are not "human resource centric", but rather measure traditional student performance indicators such as e.g. application or graduation numbers. In SMEs however, where turnover of personnel may be low, a diffusion of new knowledge by the uptake of graduates that come fresh out of schools may not be a viable option. Rather, specific educational instruments need to be available that allow for a rapid pick-up of relevant knowledge (in whatever scientific discipline) by existing SME employees. This knowledge must be delivered in a way that workers that had gained their initial theoretical knowledge some time ago can integrate the new set easily and put it to practical use. The offerings must also take into account the limited time that employees have at their disposal. The use of local language and educational forms (e.g. flipped classrooms) that makes the science readily understandable employing commonly-used terms rather than those of any scientific discipline is therefore most appropriate to the task. Small but certifiable modules are needed that can be taken flexibly. This should be supported by the provision of open experimental and pilot plant facilities and services with skilled staff for food applications to operate these facilities of knowledge and technology providers for hire, or as contracted services. Enabling access to specific living labs with the purpose of advancing food application design, and shared-cost, joint test facilities for new machinery and industrial manufacturing elements such as sensors, process control systems, or robotics would also increase the participation of SME in R&I activities and make progress towards the 'Food Factory of the Future' and the food producing 'Farm of Tomorrow'¹⁶.

Such programs must be designed with sustainability and long-term existence in mind. The nonlinear nature of the application of research based solutions makes exploitation of new research results and solutions difficult. Typically, a market uptake of results and solutions from research and development may easily take up to 10-20 years. As such, consistency in educational support programs is crucial. Consistency is also needed because SMEs/farmers need to have trust in the knowledge provider, and this takes

¹⁶ NFTP's SRIA (2017)

time to develop. Generally, the number of knowledge providers or suppliers that are trusted and that are able to provide practical solutions, meeting the needs of the business at reasonable cost, within an expected, reasonable time is low. Educational national and EU policies should therefore provide incentives for the development of more non-traditional programmes that couple a knowledge need identification process with a knowledge provision one to prevent that the matching process is incidental and may take several years.

The services of intermediaries mentioned in previous sections can make the exploitation process more effective. They will also be relevant for collecting users' needs, problems of the food industry SMEs on a targeted area and match them with the available knowledge and solutions, structuring the new knowledge, enabling functions, lessons learned into inventories and collection of successful examples, in an open innovation environment. These networks create awareness, facilitate matching of problems/users and solutions and solution providers. This matching process is shown on Figure 1. Personal visits of innovation facilitators of the intermediaries can significantly increase the efficiency of the support, as shown in previous EU research projects (e.g. TRUEFOOD, TRADEIT, TRAF00N). The matching should be followed by adoption of the solution to the specific problem; testing, adjustment and evaluation of the tailored solutions, evaluation of the market opportunities and feasibility studies before practical implementation and exploitation can take place.

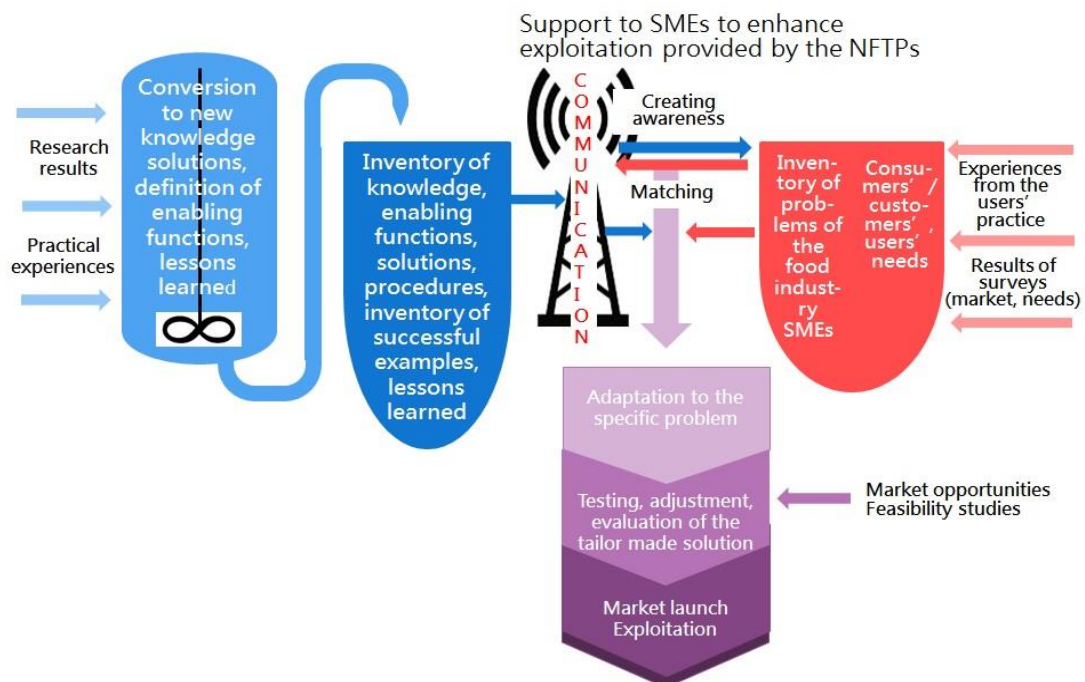


Fig. 1. Process of exploitation of the knowledge solutions – supporting tools.

New approaches should be explored for the dialogue with SMEs, farmers producing food and other national stakeholders of food research and innovation through the combination of conventional methods – personal contacts, networking with new enabling functions of digital methods and collaborative tools, improving the technology transfer and entrepreneurship. Finally, methods of operating multi-stakeholder platforms for research and innovation projects – ensuring the sound balance of involvement of stakeholders and protecting IPR shall be developed. The suggested actions and the target group for each are summarised in Table 1.

Table 1. Necessary trainings for actors involved into fostering of innovations of SMEs. (¹Intermediaries, ²Researchers, + denotes involvement)

		SMEs	Inter.¹	Res.²
Innovation	Managing/coaching innovation, projects	+	+	+
	Commercialisation of R+D outputs and/or supporting commercialisation	+	+	+
	Business skills, resource management	+		
	Technical subjects / eco-solutions	+	+	
Knowledge transfer	Knowledge and information management	+	+	+
	Training techniques, flipped classroom, soft skills		+	
	Technology transfer techniques		+	+
	Collective research, networking techniques with industry	+	+	
	Technology auditing		+	

	Communication, negotiation with industry		+	+
	Protection of intellectual properties		+	+
Research culture	Main steps and requirements of innovation		+	+
	Operation of food business / SMEs		+	+
Financial and business development	Business planning: - Presentation of business plans and negotiation skills - Finance management - Securing finance	+	+	+
Marketing	Marketing management and consumer insight	+	+	+
Resource management	Food Chain management	+	+	+

5. Impact Stories

"Can you imagine?"

You have a great idea for a new food product that could help your SME become more competitive. You shared this idea with a network of experts, who give you advice on how to make it possible and access to their open experimental and pilot plant facilities. You profit from your inventing allowing your SME to grow.

"Can you imagine?"

You work in a SME serving developing new food machinery. At a Matchmaking Event with SMEs and Start-ups you met this young entrepreneur working on turning food waste into edible utilities (straws, cutlery). You see an opportunity for new machinery to be developed and team up. A few years later your sales flourish.

"Can you imagine?"

You are a food and drink SME and have heard about this new digital revolution in the food and drink sector. You want to explore the potential of this digital revolution for your business. Through a new European instrument you are able to have access to open experimental and pilot plant facilities and services with skilled staff to operate these facilities. Through this initial use, you gain access to a whole range of new knowledge and solution providers for hire or as contracted services such as ICT Living Labs, advanced manufacturing solutions, research infrastructure for the Food Factory of the Future.

"Can you imagine?"

A new social science intern program has allowed you to take in a marketing student on a temporary basis. After a few months in your enterprise, the student suggests a new innovative solution scenario for consumers on making local food supply more attractive in a specific touristic area. You see a market potential for this and begin to develop prototype products. These become a great success making you scale up your production quickly.

"Can you imagine?"

You are a food and drink SME and have heard about this new healthy food revolutionary trend in the food and drink sector. You want to explore the potential of this new organic ingredient in a new recipe. Through your National Food Technology Platform you may know the procedures and rules about health claims. With the help of the Technology provider, you'll check the feasibility, structure, texture, colours and taste you may introduce, and pilot plant facilities and services with skilled staff to operate connected with the University will give you some tech options (antioxidants, water action, atmosphere, packaging material...). With the help of a socio economic research infrastructure you may know better unit prices and competitors positioning.

6. Monitoring Approaches

The budget invested in European and National programmes for research and innovation can seem high if we compare it with the direct economic benefit generated from the R&I programmes, but there are other criteria such as competitiveness, social and local benefits that need to be included in the assessment of the impact. Thus, it would be necessary to adopt specific KPIs for the evaluation of the project performance (e.g. increase of a company turnover through the development of new products, creation of new jobs, number of produced patents, etc.) that will reveal the real economic and social benefit generated from each euro spent for research at national and European level. In order to have a clear picture of the achievements of each project, this evaluation must be continuous and extended for at least 5 years after the end date of the project. In addition, the evaluators' lists at National and European level have to be enriched from experts coming from small businesses as well. Industry must cooperate to get results from research funding.

7. List of Recommendations

Make consumer and social sciences accessible to SMEs

- To design training activities targeting SMEs on understanding and applying consumer and market analysis into their innovation activities.
- To provide incentives for SMEs to hire young people educated in consumer and social sciences to support their innovation activities.
- To offer counselling and coaching services to SMEs to expand and actively exploit their own innovation capacities.
- To establish and maintain a bi-directional dialogue based on a clear description of the capabilities and enabling functions of social sciences and the real needs of food sector users.

Provide funding and financial tools tailored to SMEs

- To create specific financial tools dedicated to SMEs that are flexible, stable, fast and not bound to fixed deadlines.
- To ensure the stability of successful funding schemes that allow SMEs to take more risks, cover all steps of the innovation process seamlessly and are differentiated to meet the different innovation behaviour and risk-taking capacity of diverse segments of SMEs. This should include public co-funding of bottom-up projects and collective research.
- To design complementary funding schemes at the national and European level.
- To enrich the database of the project proposals evaluators with people coming from industry.
- To develop training modules and easily accessible and understandable information that enable SMEs to understand the full range of the financing instruments. Adequate intermediaries that can provide SMEs with all the necessary information for the existing opportunities.
- To provide fiscal and tax incentives for SMEs to develop R&I activities and to hire staff with experience in project management.

Create synergies between start-ups and SMEs

- To organise platforms and matchmaking events that facilitate the collaboration between start-ups and SMEs with complementary competences.
- To provide easily understandable information to SMEs about innovative start-ups among users' and solution providers' communities.
- To establish neutral, trusted intermediaries at the national level who can match the problems and needs from SMEs with enabling concepts of service providers from other disciplines.

Exploit complementarities with other disciplines

- To collect the problems and challenges of food and drink SMEs and the enabling functions of other disciplines, making use of the networking structures already in place.
- To design small modular educational programs, gathered in easily accessible inventories that are kept up-to-date by maintaining a constant dialogue between users' and solution providers' communities.
- To establish a mandatory task for publicly funded R&I projects to convert non-competitive information into a clear, understandable, user-friendly, concise educational formats focused on the aspects of benefits and practical applicability.
- To ensure an appropriate knowledge dissemination by intermediaries or suppliers, taking into consideration national and regional needs (e.g. language, culture).
- To design new facilitation instruments that combine the knowledge of the food sector with other disciplines for joint interest and benefits.

Accelerate the diffusion of enabling solutions to SMEs, and create access to enabling facilities, tools and services

- To establish mediator/facilitator organisations at national level who assist SMEs to find the appropriate solutions and to identify partners for jointly applying for National and European funds.
- To develop industry best-practice guides and inventories of successful cases to help SMEs understand the opportunities, benefits and principles of application of new methods.
- To exploit successful approaches for knowledge transfer to SMEs coming from other sectors of activity (e.g. FI-PPP).
- To facilitate collective research, marketing and chain management activities to help reduce the financial barrier for SMEs.

Develop human resources through enhanced knowledge transfer and training programs for SMEs

- To design knowledge transfer instruments that deliver information in each local language and in a form that makes the science readily understandable and uses commonly-used terms.
- To create open experimental and pilot plant facilities and services with skilled staff for food applications for hire, or as contracted services.
- To establish intermediaries to make the exploitation process more effective. They will also be relevant for collecting users' needs, problems of the food industry SMEs on a targeted area and match them with the available knowledge and solutions.
- To foster the dialogue with SMEs, farmers producing food and other stakeholders relevant in R&I for the food sector, by combining conventional methods with new digital and collaborative tools.
- To implement new methods of operating multi-stakeholder platforms for R&I ensure a sound balance of stakeholders and protect IPR.
- To design financial tools that support SMEs to hire staff with strong research background and capable to develop R&I projects
- To train the existing staff of SMEs in skills necessary for all the steps of the R&I process.
- To provide financial and tax incentives to SMEs to create R&I departments
- To facilitate staff mobility programmes (especially from Universities to SMEs and reversely, temporary placement of industry staff to research organisations).

8. List of Contributors

This chapter has been written by a group of experts from the European Technology Platform 'Food for Life', the European Collaboration of the National Food Technology Platforms (NFTPs), and the European Federation of Food Science & Technology (EFFoST):

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