Study on the effectiveness of public innovation support for SMEs in Europe

Final Report

Written by CSES, CSIL, PROGNOS, KMUForschung
March 2021

EUROPEAN COMMISSION

Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
Directorate D — Networks & Governance
Unit D.2 —: Industrial forum, alliances, clusters
Contact: Crispin Waymouth

E-mail: *GROW-D2@ec.europa.eu*; Crispin.waymouth@ec.europa.eu

European Commission
B-1049 Brussels

Study on the effectiveness of public innovation support for SMEs in Europe

Final Report

Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
Directorate D — Networks & Governance

March 2021 EN

PDF	ISBN: 978-92-9460-562-7	doi: 10.2826/7745	Catalogue number: EA-04-21-094-EN-N

Luxembourg: Publications Office of the European Union, 2021

TABLE OF CONTENTS

Executive summary

The **overall aim** of this study was to gather evidence to determine whether the situation regarding the effectiveness of the delivery of public innovation support in Europe has improved since the consultation of 2009.[1] To this end, the **specific objectives** of the study were to provide an understanding of: the main factors hampering innovation in SMEs, particularly in light of the recent technology and market developments in certain sectors and countries; the forms of innovation support received by SMEs; the level of satisfaction of SMEs regarding the support received; gaps in existing SME innovation support; and, the effectiveness and impact of the INNOSUP actions funded under H2020. The study considered the wide range of instruments (direct and indirect) supporting innovation in SMEs at European, national and regional levels.

To address these objectives, a **methodology** consisting of the following elements was developed: a review of literature on innovation in SMEs in Europe; a programme of interviews including stakeholders in SME innovation and SMEs; a public consultation (on-line survey); and, an in-depth evaluation of six INNOSUP actions, using the theory-based impact evaluation approach.

The study provided an **overview of Europe's heterogeneous SME** population by number, size distribution, member state and sector. Building on the literature review the various **barriers SMEs face** with regards to innovation were reviewed, namely: financing difficulties; shortage of, and difficulties in the recruitment of qualified, skilled staff; less experience and limited internal know-how on how to manage innovation processes effectively and efficiently (organisational barriers); lack of market knowledge; bureaucratic hurdles; smaller network of partners or lack of access to relevant actors with comprehensive R&D knowledge; knowledge and technological transfer; and, market power. Barriers could be external, over which there is little control, or internal, where some control is possible. Barriers are dynamic in the sense that overcoming one may lead to constraint by another; and barriers tend to come in clusters and interact with each other, rather than operate one-by-one.

The research suggested that a useful way to understand **how SMEs innovate** is to distinguish between two modes of innovation: one based on R&D, generating new scientific knowledge (STI), requiring finance between the research and its revenue-generating outcome; the other based on learning by doing and interacting with others in the industry (DUI).[2] Different modes of innovation are confronted by different barriers, and appropriate policy responses need to be designed to deal with the barriers in question. An overview **of the evolving EU policy responses to SME innovation** challenges was set out, culminating in the recent comprehensive communication on *An SME strategy for a sustainable and digital Europe.*

Policy instruments deployed in Europe to support innovation were then discussed, as informed by the findings of the literature review: grants; soft loans, loan guarantees and capital support schemes; skill development or knowledge transfer instruments; technology and innovation advisory services; collaboration and networking instruments; clusters/ science and technology parks; public procurement and government regulation; and, innovation system.

Recent trends and how they might affect SME innovation were outlined: the COVID-19 pandemic; the European Green Deal; the digital transition; and, the development of the 'platform economy'. These were further addressed in the consultation.

[1] European Commission (2009). Making public support for innovation in the EU more effective, Lessons learned from a public consultation for action at Community level. Commission Staff Working Document SEC(2009)1197 of 09.09.2009

[2] 'Zimmermann and Thoma (2019); Interactive learning or R&D: How do small and medium-sized enterprises generate innovations?', KfW Research, Focus on Economics, No. 264, 28 August 2019. See also Zimmermann and Thoma (2016) and Thoma, J. and Zimmermann, V. (2019); 'Non-R&D, interactive learning and economic performance: Revisiting innovation in small and medium enterprises', ifh Working Paper No. 17/2019:

The public consultation consisted of two web-based anonymous surveys, one of European SMEs and the other of innovation support intermediaries active at regional, national and European level. The questionnaires partially overlapped those used in the 2009 consultation to ensure some comparability with the previous results. The surveys collected 2,176 responses from SMEs and 498 from intermediaries related to the specific objectives of the study as set out above. Survey respondents tended to be more from innovative than non-innovative sectors. Responses were analysed using econometric techniques and Bayesian Network Analysis.

The main findings of the survey analysis can be summarised as follows. **European SMEs still face barriers in innovation,** although those in Southern and Eastern Europe face more challenges than those in Northern and Central Europe. These barriers to innovation originate from both traditional and new emerging trends. However, the perception of obstacles to innovation varies considerably by type of SME.

Micro enterprises throughout Europe see the lack of funds as the primary obstacle to innovation. For them, the lack of funds is strongly connected with other barriers such as the lack of information on funding opportunities, which in turn is associated with the lack of information on new technologies and regulations, and lack of access to research results, including patents, and skills and awareness of emerging innovation trends. The lower probability of accessing financial resources leads to lower satisfaction among micro enterprises with the public support received, as compared to other enterprises. Conversely, **when micro enterprises benefit from public financial support, they experience a higher added value** than other enterprises.

Small and medium-sized enterprises consider the financial barrier important but less so than access to skills, their primary concern. Small enterprises have difficulties in acquiring specific skills externally due to their limited networks. The BNA highlights that medium-sized firms, often already conducting research activities, suffer from the lack of in-house skills for their business development and the qualified staff that need to be integrated into their organisation. **Small and medium firms are more likely to benefit from public support than micro-enterprises, in both financial and non-financial forms. This contributes to increasing their innovations**.

Newly established firms (including start-ups and gazelles), like micro-enterprises, have wide-ranging needs. However, new firms **do not perceive the newly emerging trends identified as important barriers to innovation,** as it is likely that they are themselves often operating in these areas. Our analysis shows that public financial support has generally accelerated the introduction of innovation in this type of firm.

The level of **SMEs' satisfaction about a specific type of public support received is strongly linked with other typologies of support**. SMEs that benefit from financial support are also more likely to receive support to get more information about financial and non-financial opportunities, support to access skills and incubation, networking support, and so on. Financial support is often provided in a package with other forms of support.[3].

The study undertook an **in-depth and horizontal evaluation of INNOSUP actions**. The theories of change of six INNOSUP actions was reconstructed and their effectiveness tested with the empirical evidence from monitoring and (if available) data on each INNOSUP action, from interviews with SMEs and intermediary organisations and from relevant findings from the on-line survey. The actions were assessed in terms of their relevance, effectiveness, efficiency, coherence and EU added value.

3 Note the conclusions of CSES et al (2020) 'Evaluation of Support Services for would-be Entrepreneurs and Newly Established Businesses' which pointed to a significant gap in support provision for enterprises not geared to rapid growth and/or not located in metropolitan areas.

With regards to **relevance**, the six INNOSUP actions were found to correspond to the needs of beneficiaries and the innovation barriers they face throughout Europe. In terms of **effectiveness, *c**ontexts*** in which the actions were launched were found to play a role in terms of the geographic area (member states) in question, as well as for example absorptive capacity of beneficiaries (e.g. size, growth rate, age); and *mechanisms* employed have worked well overall. *Outcomes* have been the result of the interplay between contexts and mechanisms. *Short term outcomes* (applications) reflect the geographic context; *medium-term outcomes*, while not yet possible to assess fully, reflect mainly incremental improvements or adaptations of existing products and services, in line with programme objectives, as well as some positive network effects. At this stage the scale of effects are limited, given the funding and duration of projects. With regards to *longer term outcomes*, small budgets and the nature of the programmes as pilots mean that they might not be expected to achieve significant long-term results. Mechanisms were identified that contribute to **efficiency** and in particular 'cascade funding' and the 'lump sum' approaches were appreciated by beneficiaries. With regards to **coherence**, all the INNOSUP actions created synergies with other EU and national programmes. In terms of **EU added value,** there were no alternative funding opportunities for some of the INNOSUP actions, and the cross border elements were considered particularly valuable.

Policy recommendations flowing from the analysis were to: improve the visibility of INNOSUP actions and dissemination of related information; increase and improve the level of involvement and participation of intermediaries, especially from EU-13 countries; expand the use of the cascade mechanism and the possibility to mix support instruments; establish and improve monitoring mechanisms; and, establish more structured follow-up mechanisms.

Turning to the **overall findings of the study**, the research, found that among the range of barriers to innovation faced by SMEs, SMEs and intermediaries consider **financial barriers to be the most important.** Other challenges related to internationalisation, or regulations, etc. remain highly relevant, although the impact of barriers is dependent on contingent factors such as the firm size, age, stage in life cycle, sector, geographical location, etc. With regards to recent trends, SMEs in Eastern and Southern Europe are particularly concerned by challenges related to digitalisation and green innovation. **Effectiveness** of support tends to be context dependent, and long term effects of programmes make it hard to make overall generalisations in this respect. However, the survey indicates that SMEs' level of satisfaction compared to the 2009 findings has improved, and the great majority (85%) of SMEs considered public support received as essential for them to undertake their innovation activities compared to the situation in 2009 (47%). **Efficiency** of programmes varies, depending on contexts and mechanisms as mentioned above regarding the INNOSUP case studies. A need was identified to fast track procedures and better target initiatives to SMEs, as well as possibly combining different support initiatives. **EU-added value** is considered positive and tends to come from financial, internationalisation, staff acquisition and networking support. As in the case of the specific INNOSUP studies, EU programmes are considered **coherent** with those at national and regional level, although there is scope for improvement.

Looking to the future, we put forward the following **recommendations:** diversify the cohort of SMEs receiving innovation support; ensure that the barriers to innovation identified are addressed by public support instruments; identify targets of support and tailor instruments aimed at the targets accordingly; enable the combination of support instruments and initiatives; design future-proof initiatives to deal with emerging market, technological and economic challenges; expand the involvement of intermediaries and innovate experts in service provision; simplify and harmonise procedures when possible; and, increase the visibility and improve dissemination of and access to EU innovation support measures.

Synthèse

L'**objectif global** de cette étude visait à recueuillir des éléments permettant de déterminer si la situation en ce qui concerne l'efficacité de l'aide publique à l'innovation en Europe s'est améliorée depuis la consultation de 2009.[4] À cette fin, les **objectifs spécifiques** de l'étude étaient de comprendre : les principaux facteurs entravant l'innovation dans les PME, compte tenu notamment de l'évolution récente des technologies et des marchés dans certains secteurs et Etats membres ; les formes de soutien à l'innovation reçues par les PME ; le niveau de satisfaction des PME à l'égard du soutien reçu ; les lacunes dans le soutien à l'innovation en faveur des PME; et enfin, l'efficacité et l'impact des actions INNOSUP financées dans le cadre de Horizon 2020. L'étude a examinée le large éventail d'instruments (directs et indirects) de soutien à l'innovation dans les PME aux niveaux européen, national et régional.

Pour atteindre ces objectifs, une **méthodologie** a été élaborée et est composée des éléments suivants : une revue de la littérature sur l'innovation dans les PME en Europe ; un programme d'entretiens avec des acteurs de l'innovation dans les PME et avec les PME ; une consultation publique (enquête en ligne) ; ainsi qu'une évaluation approfondie de six actions INNOSUP, en utilisant l'approche théorique fondée sur l'évaluation d'impact.

Cette étude offre un **aperçu de la diversité des PME européennes**, en fonction de leur nombre, secteur, taille, et État membre dans lequel elles se situent. Sur la base de la revue de la littérature, les divers **obstacles rencontrés par les PME** en matière d'innovation ont été passés en revue, à savoir : les difficultés de financement ; la pénurie et les difficultés de recrutement de personnel compétent et qualifié; le manque d'expérience et de savoir-faire interne sur la manière de gérer les processus d'innovation de manière efficace et efficiente (obstacles organisationnels) ; le manque de connaissance du marché ; les lourdeurs administratives; les réseaux restreints de partenaires ou le manque d'accès aux acteurs compétents dans le domaine de la R&D ; le transfert de connaissances et de technologies ; et enfin, le pouvoir du marché. Les obstacles peuvent être internes ou externes, et donc, difficilement contrôlables. De plus, les obstacles sont dynamiques dans la mesure où leur suppression peut entraîner l'apparition d'autres obstacles. Par ailleurs, ces obstacles ont tendance à être groupés et à interagir les uns avec les autres, plutôt que de façon indépendante.

La recherche sur l'innovation dans les PME suggèreque pour comprendre **comment les PME innovent**, il est utile de distinguer deux modes d'innovation : l'un fondé sur la R&D, qui génère de nouvelles connaissances scientifiques et qui nécessite un financement entre la recherche et son résultat générateur de revenus ; l'autre, fondé sur l'apprentissage par la pratique et l'interaction avec d'autres acteurs de l'industrie.[5] Ces différents modes d'innovation sont confrontés à des obstacles distincts. Il est par conséquent nécessaire d'élaborer des réponses politiques appropriées pour les surmonter. Un aperçu **de l'évolution des réponses politiques de l'UE aux défis de l'innovation** dans les PME est présenté, et inclut la communication récente intitulée *Une stratégie axée sur les PME pour une Europe durable et numérique*.

Les instruments déployés en Europe à l'appui de l'innovation ont été examinés, sur la base des conclusions de la revue de la littérature : les subventions, les prêts à taux réduit, les garanties de prêts et les programmes de soutien financier ; les instruments de

[4] Commission européenne (2009). Making public support for innovation in the EU more effective, Lessons learned from a public consultation for action at Community level. Document de travail du personnel de la Commission SEC(2009)1197 du 09/09/2009.

[5] 'Zimmermann and Thoma (2019) ; « Interactive learning or R&D: How do small and medium-sized enterprises generate innovations? », KfW Research, Focus on Economics, No. 264, 28 août 2019. Voir aussi Zimmermann et Thoma (2016) et Thoma, J. et Zimmermann, V. (2019) ; « Non-R&D, interactive learning and economic performance: Revisiting innovation in small and medium enterprises », document de travail ifh Nº 17/2019 :

développement des compétences ou de transfert des connaissances ; les services-conseils en matière de technologie et d'innovation ; les instruments de collaboration et de mise en réseau; clusters/ parcs scientifiques et technologiques ; les marchés publics et la réglementation gouvernementale ; et le système d'innovation.

Les **tendances récentes,** ainsi que la manière dont elles pourraient avoir une incidence sur l'innovation, ont été présentées : la pandémie de la COVID-19 ; le Pacte vert pour l'Europe ; la transition numérique ; et le développement de « l'économie des plateformes ». Ces questions ont été abordées plus en détail lors de la consultation.

La consultation publique a été realisée via deux enquêtes anonymes en ligne : l'une adressée aux PME européennes et l'autre aux intermédiaires du soutien à l'innovation actifs à l'échelle régional, national et européen. Les questionnaires recoupaient en partie ceux utilisés lors de la consultation de 2009 afin de s'assurer d'une certaine comparabilité des résultats. Les enquêtes ont recueilli 2 176 réponses de la part de PME et 498 de la part d'intermédiaires. Les répondants à l'enquête étaient majoritairement issus de secteurs innovants. Les réponses ont été analysées à l'aide de techniques économétriques et d'analyses *bayésiennes*.

Les principales conclusions de l'analyse de l'enquête peuvent être résumées comme suit : **les PME européennes rencontrent toujours des obstacles à l'innovation.** Il est à noter que ces obstacles sont plus importants en Europe du sud et de l'est qu'en Europe du nord et en Europe centrale. Ces obstacles à l'innovation proviennent à la fois de tendances traditionnelles ainsi que de tendances émergentes. Toutefois, la perception des obstacles à l'innovation varie considérablement d'un type de PME à un autre.

Partout en Europe, les microentreprises considèrent le manque de financement comme l'obstacle principal à l'innovation. Pour elles, le manque de financement est fortement lié à d'autres obstacles, tels que le manque d'information sur les opportunités de financement, qui à son tour est associé au manque d'information sur les nouvelles technologies et les réglementations. S'ajoute à cela le manque d'accès aux résultats de recherche, y compris aux brevets, ainsi qu'aux compétences à la sensibilisation aux nouvelles tendances en matière d'innovation. La probabilité plus faible d'accéder aux ressources financières se traduit par une moindre satisfaction des micro-entreprises à l'égard de l'aide publique reçue, par rapport aux autres entreprises. Inversement, **lorsque les microentreprises bénéficient d'un soutien financier public, elles connaissent une valeur ajoutée supérieure** à celle d'autres entreprises.

Les petites et moyennes entreprises considèrent que l'obstacle financier est important, mais dans une moindre mesure que l'accès aux compétences, qui constitue leur principale préoccupation. Les petites entreprises éprouvent des difficultés à acquérir des compétences spécifiques en externe en raison de leurs réseaux limités. L'analyse par réseau bayésien souligne que les entreprises de taille moyenne, souvent déjà actives dans le domaine de la recherche, souffrent d'un manque de compétences internes pour leur développement commercial. **Les petites et moyennes entreprises sont plus susceptibles de bénéficier d'un soutien public que les microentreprises, tant sous des formes financières que non financières. Cela contribue à accroître leurs innovations.**

Les entreprises nouvellement créées (notamment les start-up et les gazelles), tout comme les microentreprises, ont des besoins très variés. Toutefois, les nouvelles entreprises **ne perçoivent pas les nouvelles tendances comme des obstacles importants à l'innovation**, en raison du fait qu'elles opèrent déjà parfois dans ces domaines. Le soutien financier public accélère d'une manière générale l'introduction de l'innovation dans ce type d'entreprise.

Le niveau de **satisfaction des PME à l'égard d'un type spécifique d'aide publique reçue est étroitement lié à d'autres types de soutien.** Les PME qui bénéficient d'un soutien

financier sont également plus susceptibles de recevoir un appui pour accéder à plus d'information sur les opportunités financières et non financières, aux compétences et aux pépinières de talents, à la mise en réseau, etc. Le soutien financier s'accompagne souvent d'un ensemble d'autres formes de soutien.[6]

L'étude a également effectué à **une évaluation approfondie et horizontale des actions INNOSUP.** Les théories du changement de six actions INNOSUP ont été reconstruites. Leur efficacité a été testée à l'aide des données empiriques provenant du suivi et (le cas échéant) des données relatives à chaque action INNOSUP, d'entretiens avec des PME et des organisations intermédiaires et des résultats pertinents de l'enquête en ligne. Les actions ont été évaluées sous l'angle de leur pertinence, efficacité, efficience, cohérence et valeur ajoutée européenne.

En ce qui concerne la **pertinence**, il a été constaté que les six actions INNOSUP correspondaient aux besoins des bénéficiaires et *addressaient* les obstacles à l'innovation auxquels ils sont confrontés dans toute l'Europe. En termes d'**efficacité**, les éléments de contexte suivants ont eu un rôle déterminant : la zone géographique concernée (États membres), la capacité d'absorption des bénéficiaires (par exemple taille, taux de croissance, âge). Dans l'ensemble, les *mécanismes* employés ont bien fonctionné. *L*es *résultats* sont le fruit de l'interaction entre les éléments de contexte et les mécanismes. *Les résultats à court terme* (applications) reflètent le contexte géographique ; *les résultats à moyen terme*, bien qu'il ne soit pas possible de les évaluer complètement, reflètent principalement les améliorations ou les adaptations progressives des produits ou services existants, conformément aux objectifs du programme, ainsi que certains effets positifs du la mise en réseau. À ce stade, l'ampleur des effets est limitée, compte tenu du financement et de la durée des projets. S'agissant des *résultats à plus long terme*, les budgets modestes et la nature des programmes pilotes signifient qu'ils risquent de ne pas produire des résultats significatifs à long terme. Certains mécanismes contribuent à l'**efficacité**, en particulier, les approches de « financement en cascade » et de « montant forfaitaire » particulièrement appréciés des bénéficiaires. En ce qui concerne la **cohérence**, toutes les actions INNOSUP ont créé des synergies avec d'autres programmes nationaux et de l'UE. Pour ce qui est de la **valeur ajoutée européenne**, il n'existait pas d'autres possibilités de financement pour certaines des actions INNOSUP, et les éléments transfrontaliers ont été jugés particulièrement précieux.

Le travail d'analyse a permis de formuler les recommandations suivantes : améliorer la visibilité des actions INNOSUP et la dissémination des informations connexes ; augmenter et améliorer le niveau d'engagement et de participation des intermédiaires, en particulier des pays de l'UE-13; étendre l'utilisation du mécanisme de financement en cascade et la possibilité de combiner les instruments de soutien ; établir et améliorer les mécanismes de suivi ; et mettre en place des mécanismes de suivi plus structurés.

En ce qui concerne les **conclusions générales de l'étude**, il s'est avéré que parmi les obstacles à l'innovation rencontrés par les PME, les obstacles financiers **sont considérés comme les plus importants** par les PME et leurs intermédiaires. D'autres défis, notamment ceux liés à l'internationalisation ou aux réglementations demeurent présents. L'incidence des obstacles dépend de facteurs contingents comme la taille de l'entreprise, son âge, l'étape de son cycle de vie, son secteur, sa situation géographique, etc. En ce qui concerne les tendances récentes, les PME d'Europe du sud et de l'est sont particulièrement préoccupées par les défis liés à la numérisation et à l'innovation verte. **L'efficacité** de l'aide tend à dépendre du contexte, et les effets à long terme des programmes rendent difficile les généralisations globales à cet égard. Toutefois, l'enquête indique que le niveau de satisfaction des PME s'est amélioré par rapport aux résultats de 2009, et qu'une plus grande

6 Voir les conclusions du CSES et al (2020) « Evaluation of Support Services for would-be Entrepreneurs and Newly Established Businesses » qui montraient un écart important dans l'offre d'appui aux entreprises non axées sur une croissance rapide et/ou non situées dans des zones métropolitaines.

part de PME (85 %) considèret l'aide publique reçue comme essentielle pour entreprendre des activités d'innovation, comparé à la situation en 2009 (47 %). **L'efficience** des programmes varie en fonction des contextes et des mécanismes évoqués ci-dessus en ce qui concerne les études de cas d'INNOSUP. Les besoins suivants ont été identifiés : des procédures accélérées, des initiatives calibrées ciblant davantage les PME, et éventuellement un panachage des différentes initiatives de soutien. **La valeur ajoutée européenne** est jugée comme *étant* positive. Elle provient principalement du soutien financier, à l'internationalisation, à l'acquisition de personnel et du soutien à la mise en réseau. Comme dans le cas des études INNOSUP spécifiques, les programmes de l'UE sont jugés cohérents avec ceux au niveau national et régional, bien que des améliorations soient possibles.

Pour l'avenir, les **recommandations suivantes** sont *proposées* : diversifier la population de PME bénéficiant d'un soutien à l'innovation ; veiller à ce que les obstacles à l'innovation recensés soient levés par des instruments de soutien public; déterminer les objectifs de l'aide et adapter les instruments visant à atteindre ces objectifs en conséquence ; permettre la combinaison d'instruments et d'initiatives de soutien ; concevoir des initiatives à l'épreuve du temps pour faire face aux nouveaux défis technologiques et économiques; accroître l'engagement des intermédiaires et des experts de l'innovation dans la prestation de services ; simplifier et harmoniser les procédures lorsque c'est possible ; accroître la visibilité et améliorer la diffusion et l'accès aux mesures de soutien à l'innovation de l'UE.

Zusammenfassung

Das **Gesamtziel** dieser Studie war es, Erkenntnisse zu sammeln und folglich festzustellen, ob sich die Effektivität der öffentlichen Innovationsförderung in Europa seit der Konsultation im Jahr 2009 verbessert hat.[7] Hierbei sollten in der Studie folgende **spezifische Ziele** verfolgt werden: Ermittlung der größten Hürden für Innovation in KMU, insbesondere angesichts jüngster technologischer und Marktentwicklungen in gewissen Branchen und Ländern; Informationen zu den Formen der Innovationsförderung, die KMU erhalten; Ermittlung des Zufriedenheitsgrads der KMU mit der erhaltenen Förderung; Ermittlung von Lücken in der bestehenden Innovationsförderung für KMU und die der Effektivität und der Wirkung der INNOSUP Aktionen, finanziert unter H2020. Die Studie untersuchte das breite Spektrum der (direkten und indirekten) Instrumente, die Innovation in KMU auf europäischer, nationaler und regionaler Ebene fördern.

Um diese Ziele zu erreichen, wurde eine **Methodologie** entwickelt, die **sich** aus folgenden Elementen zusammensetzte: eine Literaturstudie zum Thema Innovation bei KMU in Europa; ein Interviewprogramm mit Interessenträgern aus den Bereichen KMUInnovation und KMU; eine öffentliche Konsultation (Online- Umfrage); und eine eingehende Bewertung von sechs INNOSUP-Aktionen anhand des theoriebasierten Ansatzes der Folgenabschätzung.

Die Studie bot einen **Überblick der heterogenen KMU Europas** nach Anzahl, Größenverteilung, Mitgliedstaat und Branche. Aufbauend auf die Literaturstudie wurden die verschiedenen **Innovationshemmnisse** beleuchtet, mit welchen sich **KMU konfrontiert** sehen, nämlich: Finanzierungsschwierigkeiten; Mangel an und Schwierigkeiten bei der Rekrutierung von Fachkräften; weniger Erfahrung und begrenzte, interne Expertise zum effektiven und effizienten Management von Innovationsprozessen (organisatorische Hürden); Mangel an Marktkenntnissen; bürokratische Hemmnisse; kleineres Partnernetzwerk oder mangelnder Zugang zu relevanten Akteuren mit umfassender FuE-Expertise; Wissens- und Technologietransfer; und Marktstärke. Hürden können extern sein, in welchem Fall über sie wenig Kontrolle besteht, oder intern, wobei ein gewisses Maß an Kontrolle möglich ist. Hürden sind dynamisch, sodass das Meistern einer wiederum zu Beschränkungen durch eine andere führen kann; Hürden treten meist in Gruppen auf und interagieren, statt sich einzeln zu präsentieren.

Laut Studie sollte man zum Verständnis der Art und Weise, **wie KMU innovieren**, zwischen zwei Innovationsmodellen unterscheiden: das erste basiert auf F&E, das zu neuen wissenschaftlichen Erkenntnissen (STI) führt und zwischen der Forschung und ihrem gewinnbringenden Ergebnis Finanzierung benötigt; und das zweite basiert auf Praxislernen („Learning by doing“) und Interaktion mit anderen Industrieakteuren (DUI).[8] Die verschiedenen Innovationsmodi kommen je nach unterschiedlichen Hindernissen zum Tragen, sodass geeignete politische Maßnahmen konzipiert werden müssen, um mit den jeweiligen Hürden umzugehen. Ein Überblick über die sich weiterentwickelnden politischen Ansätze der EU **bezüglich der Innovationshemmnisse der KMU** wurde vorgestellt, der mit der aktuellen, umfassenden Kommunikation über *Eine KMU Strategie für ein nachhaltiges und digitales Europa* abgeschlossen wurde.

Anschließend wurden **politische Instrumente**, die in Europa zur Innovationsförderung eingesetzt werden, erörtert, basierend auf Erkenntnissen aus der Literaturstudie: Zuschüsse, zinsvergünstigte Darlehen und Darlehensgarantien und Kapitalinstrumente; Instrumente zur

[7] Europäische Kommission (2009). Making public support for innovation in the EU more effective, Lessons learned from a public consultation for action at Community level. Arbeitspapier der Kommissionsdienststellen SEC(2009)1197 vom 09.09.2009

[8] „Zimmermann und Thoma (2019); Interactive learning or R&D: How do small and medium-sized enterprises generate innovations?“, KfW Research, Focus on Economics, Nr. 264, 28. August 2019. Siehe auch Zimmermann und Thoma (2016) und Thoma, J. und Zimmermann, V. (2019); „Non-R&D, interactive learning and economic performance: Revisiting innovation in small and medium enterprises“, ifh Arbeitspapier Nr. 17/2019:

Kompetenzentwicklung oder zum Wissenstransfer; Beratungsdienste bezüglich Technologie und Innovation; Instrumente zur Kooperation und Vernetzung; Cluster/Wissenschafts- und Technologieparks; öffentliche Auftragsvergabe und staatliche Regulierung; und das Innovationssystem.

Aktuelle Trends und ihr möglicher Einfluss auf KMU wurden geschildert: die COVID-19 Pandemie; der Europäische Green Deal; die digitale Wende; und die Entwicklung der „Plattform-Wirtschaft". Diese wurden in der Konsultation weiter beshandelt.

Die öffentliche Konsultation bestand aus zwei anonymen Online-Umfragen, eine unter europäischen KMU und die zweite unter regionalen, nationalen und europäischen Akteuren der Innovationsförderung. . Die Fragebögen entsprachen zum Teil denen der Konsultation aus dem Jahr 2009, um ein gewisses Maß an Vergleichbarkeit mit den vorherigen Ergebnissen zu gewährleisten. Bei den Umfragen wurden 2176 Antworten von KMU und 498 von Innovations-Vermittlern zu den spezifischen Zielen der Studie, die bereits erläutert wurden, erhalten. Die Umfrageteilnehmer stammten eher aus innovativen als aus nicht-innovativen Sektoren. Antworten wurden mit ökonometrischen Techniken und der Bayesscher Netzwerk-Analyse ausgewertet.

Die Haupterkenntnisse der Umfrageauswertung können wie folgt zusammengefasst werden. **Europäische KMU sehen sich weiterhin mit Innovationshürden konfrontiert,** wobei jene in Süd- und Osteuropa größere Herausforderungen als ihre Pendants in Nord- und Mitteleuropa zu meistern haben. Diese Innovationshürden ergeben sich sowohl aus traditionellen als auch neu entstehenden Trends. Die Wahrnehmung der Innovationshemmnisse unterscheidet sich jedoch deutlich je nach Art der KMU.

Kleinstunternehmen in ganz Europa sehen den Mangel an Finanzmitteln als größte Innovationshürde. Für sie sind die fehlenden Geldmittel eng mit anderen Hürden verbunden, wie mangelnde Informationen über Finanzierungsmöglichkeiten, was wiederrum mit einem Mangel an Informationen über neue Technologien und Regulierungen zusammenhängt, sowie fehlendem Zugang zu Forschungsergebnissen, einschließlich Patenten, und Kompetenzen und Wissen über neue Innovationstrends. Die geringere Wahrscheinlichkeit, Zugang zu Finanzmitteln zu erhalten, führt unter Kleinstunternehmen auch zu einer geringeren Zufriedenheit mit der erhaltenen öffentlichen Unterstützung, verglichen mit anderen Unternehmen. Im Gegensatz dazu, **wenn Kleinstunternehmen von einer öffentlichen finanziellen Unterstützung profitieren**, **dann sehen sie darin einen größeren Mehrwert,** als andere Unternehmen.

Kleine und mittlere Unternehmen halten finanzielle Hürden für wichtig, aber weniger als den Zugang zu Fachkräften, was sie vorrangig beschäftigt. Kleine Unternehmen haben aufgrund ihrer begrenzten Vernetzung Schwierigkeiten, externe spezifische Kompetenzen zu erwerben. Die BNA beleuchtet, dass Mittelständler, die oftmals bereits Forschungsaktivitäten durchführen, unter einem Mangel an internen Kompetenzen für die Unternehmensentwicklung leiden, wie auch unter einem Mangel an qualifizierten Personal, das in ihre Organisation integriert werden muss,. **Kleine und mittlere Unternehmen profitieren eher von öffentlicher Unterstützung als Kleinstunternehmen, sowohl in finanzieller und nicht-finanzieller Form. Das trägt zur Steigerung ihrer Innovationen bei.**

Neu gegründete Unternehmen (einschließlich Start-Ups und Gazellen) haben wie Kleinstunternehmen breitgefächerte Bedürfnisse. Neue Unternehmen **betrachten jedoch die neu entstehend Trends nicht als wichtige Innovationshemmnisse**, da sie häufig selbst in diesen Bereichen aktiv sind. Unsere Analyse hat gezeigt, dass öffentliche finanzielle Unterstützung in diese Art von Unternehmen das Innovationsaufkommen generell beschleunigt hat.

Die **Zufriedenheit der KMU mit einer bestimmten Art öffentlicher Unterstützung hängt**

unmittelbar mit anderen Unterstützungstypologien zusammen. KMU, die von finanziellen Beihilfen profitieren, erhalten auch eher Unterstützung zu Informationen über finanzielle und nicht-finanzielle Angebote, ebenso wie Unterstützung zum Zugang zu Kompetenzen und Gründerzentren, Vernetzung usw. Finanzielle Unterstützung wird häufig in einem Bündel mit anderen Unterstützungsformen geboten.[9].

Die Studie führte eine **eingehende und horizontale Bewertung von INNOSUP- Aktionen** durch. Die Theorien des Wandels von sechs INNOSUP-Aktionen wurden rekonstruiert und ihre Effektivität anhand empirischer Erkenntnisse aus der Überwachung und (sofern verfügbar) Daten über jede INNOSUP-Aktion getestet. Es wurden zu diesem Zweck auch Interviews mit KMU und Innovationsvermittler und relevante Ergebnisse der Online-Umfragen herangezogen. Die Aktionen wurden auf ihre Relevanz, Effektivität, Effizienz, Kohärenz und ihren EU-Mehrwert bewertet.

Bezüglich ihrer **Relevanz** wurde festgestellt, dass die sechs INNOSUP-Aktionen den Bedürfnissen ihrer Empfänger und den Innovationshemmnissen, mit denen sie in ganz Europa konfrontiert sind, entsprechen. Im Hinblick auf die **Effektivität** ergab sich, dass der *Kontext*, in dem die Aktionen umgesetzt wurden, eine wichtige Rolle spielte, zum Beispiel bezüglich der jeweiligen Geografie (Mitgliedstaaten), sowie zur Absorptionskapazität der Empfänger (z.B. Größe, Wachstumsrate, Alter). Die angewendeten *Mechanismen* haben insgesamt gut funktioniert. *Ergebnisse* sind aus dem Zusammenspiel von Kontexten und Mechanismen entstanden. *Kurzfristige Ergebnisse* (Anwendungen) reflektieren den geografischen Kontext; *mittelfristige Ergebnisse*, obwohl sie noch nicht voll bewertet werden können, reflektieren überwiegend inkrementelle Verbesserungen oder Anpassungen bestehender Produkte und Dienstleistungen, im Einklang mit den Programmzielen, sowie einige positive Netzwerkeffekte. Zu diesem Zeitpunkt ist der Umfang der Auswirkungen aufgrund der Finanzierung und der Laufzeit der Projekte begrenzt. Was *längerfristige Ergebnisse* betrifft, so bedeuten kleine Budgets und die Art der Programme in Form von Pilotprojekten, dass man sich von ihnen evtl. keine signifikanten langfristigen Ergebnisse versprechen dürfte. Es wurden Mechanismen identifiziert, die zur **Effizienz** beitragen, und die Empfänger schätzten, allen voran das sog. „cascade funding“ (Finanzhilfen an Dritte) und der „Ansatz zu Pauschalbeträg“. Was die **Kohärenz** betrifft, so haben alle INNOSUP-Aktionen Synergien mit anderen EU- und nationalen Programmen geschaffen. Bezüglich des **EU-Mehrwerts** gab es keine alternativen Finanzierungsmöglichkeiten für manche INNOSUP-Aktionen und die grenzüberschreitenden Elemente galten als besonders wertvoll.

Politikempfehlungen entstehend aus der Analyse waren die folgenden: Verbesserung derSichtbarkeit der INNOSUP-Aktionen und der Verbreitung entsprechender Informationen; eine gesteigerte und verbesserte Einbindung und Beteiligung der Innovationsvermittler, insbesondere aus den EU-13 Ländern; Erweiterung des Einsatzes des „Cascade-Mechanismus“ und Erweiterung der Möglichkeit, Unterstützungsinstrumente zu kombinieren; Verbesserung von Überwachungsmechanismen und Einrichtung von strukturierteren Follow-up Mechanismen..

Wendet man sich den **Gesamterkenntnissen der Studie** zu, so hat die Studie ergeben, dass unter den Innovationshemmnissen, mit welchen sich KUM konfrontiert sehen, KMU und Innovationsvermittler **finanzielle Hürden als die wichtigsten ansehen.**. Andere Herausforderungen im Zusammenhang mit Internationalisierung oder Regulierung usw. bleiben höchst relevant, auch wenn die Auswirkung von Hindernissen immer auch von anderen Faktoren wie Unternehmensgröße, -alter, Entwicklungsstadium, Branche, geographischer Lage usw. abhängt. Was aktuelle Trends betrifft, so sind KMU in Ost- und Südeuropa besonders von Herausforderungen im Zusammenhang mit der Digitalisierung

9 Beachten Sie die Schlussfolgerung von CSES et al (2020) „Evaluation of Support Services for would-be Entrepreneurs and Newly Established Businesses“, die auf eine signifikante Unterstützungslücke für Unternehmen hinwies, die nicht auf schnelles Wachstum abzielen bzw. nicht in Ballungsräumen angesiedelt sind.

und grünen Innovationen betroffen. **Effektivität** von Unterstützung hängt meist vom Kontext ab und langfristige Wirkungen von Programmen erschweren pauschalere Aussagen in diesem Hinblick. Dennoch zeigt die Umfrage, dass sich die Zufriedenheit von KMU verglichen mit den Ergebnissen von 2009 verbessert hat. Die große Mehrheit (85 %) der KMU hält die öffentliche Unterstützung, von der sie profitieren, für entscheidend, um ihre Innovationstätigkeit auszuführen, im Vergleich mit der Situation aus dem Jahr 2009 (47 %). **Effizienz** von Programmen variiert je nach Kontext und Mechanismen, wie bereits bezüglich der INNOSUP-Fallstudien erwähnt wurde. Es wurden auch festgestellt, dass beschleunigte Verfahren, besser auf KMU zugeschnittene Maßnahmen, aber auch eine mögliche Kombination verschiedener Förderinitiativen erforderlich sind. Der **EU-Mehrwert** gilt als positiv und ergibt sich meist aus finanzieller Förderung, sowie aus Unterstützung zur, Internationalisierung, Personalakquise- und Vernetzung. Wie bei den spezifischen INNOSUP-Studien, gelten die EU-Programme als **kohärent** mit jenen auf nationaler und regionaler Ebene, wenn auch Verbesserungspotenzial besteht.

Mit Blick auf die Zukunft haben wir folgende **Empfehlungen** ausgesprochen: Diversifizierung der Kohorte von KMU, die Innovationsförderung erhalten, ; Sicherstellen, dass identifizierte Innovationshemmnisse mit öffentlichen Unterstützungsinstrumenten angegangen werden; Festlegung von Zielen für die Unterstützung und entsprechender Anpassung der auf die Ziele ausgerichteten Instrumente; Kombination von Unterstützungsinstrumenten und -initiativen ermöglichen; Entwicklung von zukunftssicheren Initiativen für aufstrebende Märkte, neu entstehende technologische und wirtschaftliche Herausforderungen; stärkere Einbeziehung von Innovationsvermittlern und Innovationsexperten bei der Erbringung von Dienstleistungen; Vereinfachung und Harmonisierung von Verfahren wo möglich; Erhöhung der Sichtbarkeit und Verbesserung der Verbreitung der Informationen und des Zugangs zu den Innovationsfördermaßnahmen.

1. Introduction and methodology

This introduction sets out the aim and objectives of the study and presents the methodological approach, the analytical framework adopted and the evidence used.

1.1 Aim and objectives of the study

According to the public consultation on the effectiveness of innovation support in Europe conducted by the European Commission in 2009[10] the vast majority of enterprises and intermediary organisations consulted believed that direct innovation support can overcome barriers to innovation. However, the consultation also found that many small and medium-sized enterprises ("SMEs")[11] were dissatisfied with the public support they had received.

The mid-term evaluation of Horizon 2020 and, specifically, of the Innovation in SME Actions (European Commission, 2017), suggested that the situation could have improved since 2009 thanks to "clear improvements in the availability of support and the interconnectedness of the system, between Agencies and the Enterprise Europe Network for example".

The **aim** of this study was to gather fresh evidence to determine whether the situation has improved or not. To this end, according to the terms of reference, this study was to provide a thorough understanding of:

- the main factors hampering innovation in SMEs, particularly in light of the recent technology and market developments in certain sectors and countries;
- the forms of innovation support received by SMEs;
- the level of satisfaction of SMEs regarding the support received;
- gaps in existing SME innovation support; and,
- the effectiveness and impact of the INNOSUP actions funded under H2020.

The study considered the wide range of instruments (direct and indirect) supporting innovation in SMEs at European, national and regional levels.

The **outputs** of the study are:

- insights into the most recent barriers to SMEs' innovation and SMEs' expectations as regards public innovation support with a view to contributing to evidence-based policy making; and,
- recommendations on how to make public innovation support more efficient and effective.

This report is **structured** as follows: after this introductory chapter, Chapter 2 sets the scene for the discussion which follows, by providing a short overview of the EU's SME landscape and findings from previous studies on the kinds of innovation barriers SMEs face and appropriate policies to support innovation. Chapter 3 brings together the main findings of this study concerning the most relevant barriers hampering innovation in SMEs, forms of innovation support received by SMEs in the years 2017-2019, the level of satisfaction with the support received and gaps/ scope for improvement in existing SME innovation support. Chapter 4 deals specifically with the evaluation of the selected INNOSUP actions. Chapter 5

[10] European Commission (2009). Making public support for innovation in the EU more effective, Lessons learned from a public consultation for action at Community level. Commission Staff Working Document SEC(2009)1197 of 09.09.2009
[11] As defined in the EU recommendation 2003/361.

concludes by providing a synthetic answer to the different research questions of the assessment framework, and puts forwards recommendations for the future.

1.2 Methodological approach

In order to address these objectives, the study team developed a methodology consisting of the following elements:

- a review of literature on innovation in SMEs in Europe;
- a programme of interviews including stakeholders in SME innovation and SMEs;
- a public consultation (on-line survey) of SMEs and innovation intermediaries; and, an
- in-depth evaluation of six INNOSUP actions, using the theory-based impact evaluation approach.

The overall study relied on a critical triangulation of the evidence gathered using these methodological tools. The consultation process and the analytical and reporting tasks were performed in accordance with the Commission Better Regulation Guidelines and Better Regulation Toolbox. [12]

The full literature review can be found in Annex A, but some specific findings are recalled in Chapter 2 and, to a minor extent, Chapter 3. The interview program included 31 SMEs and 37 stakeholders from the public and private sectors. Organisations interviewed are listed in Annex B.

The public consultation consisted of two web-based anonymous surveys, one addressed to European SMEs and the other to innovation support intermediaries, active at regional, national and European level (the questionnaires can be found in Annex C). The team designed the two questionnaires, which are partially in line with the consultation held on the same topic in 2009[13], in order to ensure some comparability with the previous results. The surveys ran from April 8, 2020 to June 26, 2020 and collected 2,176 responses from SMEs and 498 from intermediaries. More details about the sample frame are available in Annex D.

The in-depth and horizontal evaluation of INNOSUP actions is summarised in Chapter 4 of this report, and full individual evaluations are provided in a separate document as Annex E.

[12] 'Chapter VI Guidelines on evaluation (including fitness checks.

[13] European Commission (2009). Making public support for innovation in the EU more effective, Lessons learned from a public consultation for action at Community level. Commission Staff Working Document SEC(2009)1197 of 09.09.2009

2. Europe's SMEs and innovation policy

The aim of this chapter is to provide an overall context for the study. First, we provide a definition of SMEs and some key empirical data about Europe's population of SMEs. Then, we set out the kinds of challenges SMEs face with regards to innovation, and provide a typology of methods by which SMEs innovate, the types of barriers they face and what this implies for policy makers. After that, the rationale for intervention in support of innovation is set out and the EU policy response to SME challenges in innovation is outlined. Finally, some recent developments in the business environment of SMEs are presented that have, and are likely to continue to have in the future, an effect on their innovation and innovation activities.

2.1 SMEs in Europe, innovation barriers they face and how SMEs innovate

2.1.1 A profile of European SMEs

It is often said that 99.8% of all non-financial enterprises in the EU are SMEs. However, this is not strictly true. Over 99% of enterprises employ less than 250 persons, but the EU definition, as established by EU Recommendation 2003/361, refers to additional criteria which are set out in Table 1. In addition there is a further criterion which excludes enterprises with significant degrees of external ownership.

Table 1: The definition of Small and medium-sized enterprises (SMEs)[14]

Company category	Staff headcount	Turnover	or	Balance sheet total
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

Source: SME Performance Review, 2019.

The full definition is of some importance, especially in the context of innovation support. The 2012 Evaluation of the SME Definition, published by the Commission, estimates that up to 10% of enterprises with less than 250 people employed may not in fact be SMEs according to the full definition. These enterprises are not eligible for EU and national assistance provided to SMEs. The European Structural and Investment Funds and Horizon 2020, for instance, have both applied the full definition and excluded enterprises that do not fit the full definition from support measures.[15] And yet, many of these smaller enterprises are among the most dynamic and innovative in the economy – precisely the ones that policy might be expected to support[16].

However, there are considerable difficulties in generating data on SMEs using the full definition and in view of these difficulties this study has adopted the practice of the SME Performance Review and other analysis of simply referring to enterprises with less than 250 persons employed as 'SMEs'.

Enterprises employing less than 250 persons make a significant contribution to the non-financial business economy of the EU. In 2018 they generated €3,7137 billion of value

[14] As defined in the EU recommendation 2003/361 (there is a 54-page guide for using the SME definition).
[15] However, the ESIF allows funding for large enterprises, although only in a restricted way- when collaborating with SMEs
[16] The 2012 *Evaluation of the SME Definition* for DG Enterprise and Industry by CSES refers, for instance to the difficulties that smaller enterprises may encounter when they receive investment from venture capital funds. This can exclude them from SME status. For this and similar reasons, the European Investment Bank often now extends the availability of its schemes to 'mid caps', a category which includes enterprises of this kind.

added and employed 86.9 million people (see Table 2). They also accounted for some two thirds of overall employment and 58.3% of overall value added in the non-financial business economy. Micro firms were the most common size of firm, accounting for 93.0% of the total.

Table 2: European SMEs[17] key data (numbers–millions; employment–millions, value added-€billions) (EU-27)

	Micro	% Total	Small	% Total	Med	% Total	SMEs	% Total	Large	% Total	Total
Number of enterprises (millions)	21.4	93.3	1.3	5.6	0.2	0.9	22.9	99.8	0.04	0.2	22.9
Employment (millions)	39.7	31.3	25.8	20.4	21.5	16.9	86.9	68.6	39.8	31.4	126.7
Value added (€bn)	1,345.9	21.1	1,174.3	18.4	1,193.0	18.7	3,713.8	58.3	2,661.3	41.7	6,375.0

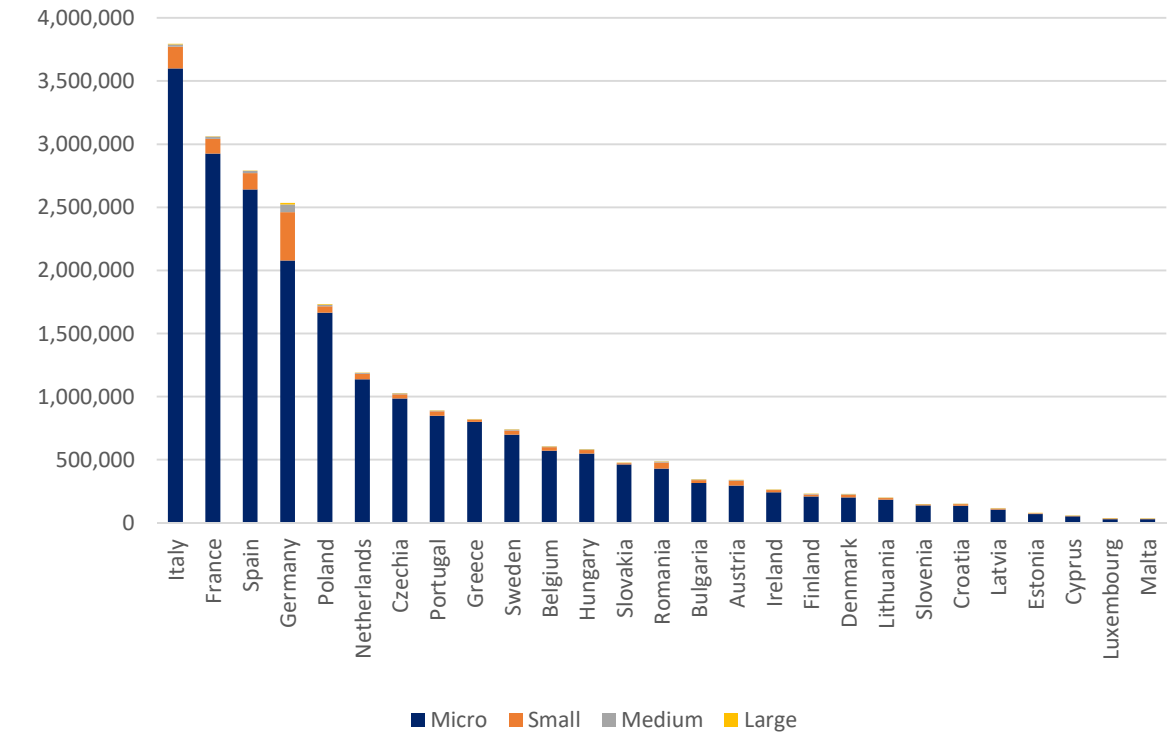
Source: SME Performance Review, 2019.

Table 2 suggests that, on 'average' (the arithmetic mean), each SME has approximately 4 employees.

Figure 1 provides some data about the number and location of SMEs throughout EU Member States, as well as the shares of different size categories of SMEs within Member States. This is important because, based on the assumption that smaller firms have more difficulties in innovating than larger ones, Member States with more, and proportionately more, smaller enterprises can be expected to face more challenges and, thus, may feel the need for more innovation support. For example, Italy has some 3.6 million microenterprises, almost double that of Germany's 2 million, even though the German economy is some 90% larger than that of Italy in terms of GDP.[18] This data provides some contextual background to be borne in mind when discussing the survey results in chapter 3.

[17] SME Performance Review, 2019
[18] SME Performance Review, 2019

Figure 1: Enterprises in the EU by number and size category



Source: SME Performance Review 2019.

Within the SME population (see Figure 2), the largest share of SMEs in terms of both number of enterprises and employment is active in the sector 'Wholesale and retail trade, repair of motor vehicles and motorcycles', followed by the sectors 'Manufacturing, Construction, Professional, scientific and technical services' and 'Accommodation and food activities'.

Figure 2: Top 15 SME industry sectors (NACE 2 Digit) by number of SMEs in 2019

Source: SME Performance Review 2019

2.1.2 Innovation challenges faced by SMEs

SMEs face certain **practical challenges** in their innovation activities. Due to their size and, linked to that, their distinctive structures (e.g. start-ups, mature, ownership, etc.), their sector of activity and location, SMEs pursue a wide range of innovation activities, and face a wide range of barriers to innovation. Frequently cited categories of obstacles to innovation in SMEs, as identified in the literature review (Annex A) and interview programme, are discussed in the following paragraphs:

- **Financing difficulties:** SMEs can face problems in access to external finance, in particular where riskier investments are involved. They face proportionately higher innovation costs and are therefore confronted with higher economic risk. Especially start-ups and smaller enterprises are affected by this constraint. Most studies on barriers to innovation for SMEs consider access to finance an important factor. The extent to which this is a barrier varies by firm age, firm size, research intensity, growth orientation (Zimmermann and Thoma, 2016) and often also location (Rimmer et. al. 2016, 2020;Holzl & Janger, 2014). In general, financial barriers are considered to be among the most important, if not the most important, barriers to innovation.
- **Shortage of, and difficulties in, the recruitment of qualified, skilled staff:** the importance of access to staff with specific skills varies over the life cycle of the enterprise and type of enterprise, but in general small and micro firms usually have less or no R&D labour force and face higher proportional costs in acquiring new specialists than larger enterprises. Studies from throughout European countries (e.g. Belitz & Lejpras 2016, Astor et al. 2016; Gardocka-Jalowiec & Wierzbicka 2019; and, Duarte et.al. 2017) confirm the importance of skills shortages as a barrier to innovation. According to Hölzl and Janger (2014) the deterring effect of skill barriers is highest in more technologically advanced countries. While studies found that a lack of qualified personnel is an important barrier to innovation, there are differences in the perception of the importance of this barrier between countries, economic sectors and the level of technology in the sector in question.
- **Less experience and limited internal know-how on how to manage innovation processes effectively and efficiently (organisational barriers).** This gap refers to matters such as enterprise strategy, structure, organisational culture and learning (Hueske and Guenther, 2015). These barriers may affect traditional handicraft enterprises or enterprises in low-tech sectors more often than in other SME segments (Huck-Fries et al. (2018) and may also reflect management failings (Orzes et.al. (2018). In some instances researchers also found a lack of willingness and lack of awareness of the need to innovate (Corchuelo and Mesias). Organisational barriers can also hamper efforts to establish more open innovation systems (Presenza (2015); Fiorentino, 2018; and Rossinin 2016). Overall, it is difficult to generalise about the role and importance of organisational barriers. The effect of such barriers varies by enterprise type, sector, age, location, etc., reflecting the heterogeneity of SMEs, and makes generalisations difficult. Because organisational barriers tend to be qualitative and difficult to assess, it is easy to underestimate their impact (Zimmermann and Thoma, 2016).
- **Lack of market knowledge:** This barrier has two aspects. One is that SMEs have less knowledge about customer needs and less knowledge about foreign markets, which hinders sales and exports from their area and internationalisation of their activities. The other aspect is that SMEs tend to be less familiar with and/ or aware of technologies that can be used to innovate, or do not know where to access such technologies. Several researchers have reported that lack of knowledge presents an obstacle to innovation (e.g. Duarte et al. 2017; Meijer et al. 2019, Deloitte et al. 2019), but others consider it minor compared to other barriers (Huck-Fries et al. 2018; Zwolinska-Ligaj and Adamowicz, 2018), although the extent to which it affects innovation varies by sector.

For example a report relating to the Dutch sustainable energy sector found that access to knowledge was an important issue (Meijer et al. 2019).

- **Bureaucratic hurdles:** Long administrative procedures and restrictive laws or regulations may constrain innovation processes in SMEs, especially in some sectors that are strongly regulated, such as the construction industry. Regulatory uncertainty and frequent changes may also have negative impacts. In this regard, for example, some French SMEs that were interviewed explained that, due to changes in how an enterprise 'in distress' was defined in financial legislation, start-ups can face major challenges in obtaining funding, until patents have been filed. Other bureaucratic hurdles include standards, which, while from one point of view may support innovation, require costly administrative work (Meijer et. al. 2019) and, once established, channel innovation towards a specific direction, limiting other options. SME representative organisations have argued that standards are used by large enterprise as a tool to limit competition by SMEs. In addition, in some countries there are bureaucratic barriers present with regard to managing intellectual property (IP). The need to pay bribes and the presence of corrupt practices can also inhibit innovation. State aid rules can also favour innovation activities or hamper them.
- SMEs usually have a **smaller network of partners** or lack access to relevant actors with comprehensive R&D knowledge. The importance of such barriers varies (Belitz and Lejpras (2016) between types of enterprise, between countries with different levels of technological development (Hölzl and Janger, 2014) and sectors (Pinget, 2016). There are also cultural factors in some areas and sectors that can make collaboration and advances towards open innovation challenging, which may lead to the adoption of alternative innovation strategies (Duarte et.al 2017; Fanelli 2018).
- **Knowledge and technological transfer:** SMEs may face greater challenges in adopting new technological trends (like for example digitalisation) or face stronger difficulties in the uptake and exploitation of new developments in specific sectors (like for example Building Information Modelling in the construction industry or the circular economy). With regards to **Intellectual property management,** SMEs have less resources and capabilities for the economic exploitation of IP rights.
- **Market power:** SMEs usually have less negotiating power vis-à-vis larger actors. As a consequence, they have to act as takers/ innovation adopters or adaptors rather than being able to pursue their own innovation agenda (Galia et al. 2015; Bozic & Rajh 2016). Long value chains can constrain their innovativeness (Meijer et.al. (2019). Customers may both drive and/or inhibit innovation ((Hueske & Guenther 2015). Markets dominated by established firms and uncertain demand for innovation, together with internal financial constraints, are cited as innovation barriers in French and Italian firms, as is the case of Portugal (Duarte et al. 2017). Other studies emphasising various aspects of market risk related to services sectors, manufacturing and Industry 4.0 include Spescha et al. (2018), Bozic and Rajh (2016) and Orzes et al. (2019).

The above-mentioned barriers can be further categorised as **external or internal barriers**. Internal barriers are linked to the internal resources and capabilities of SMEs (intellectual property management, access to skilled staff, managerial orientations, less R&D experience, etc.), whereas external barriers are based on the external structures or rules that apply to certain activities of SMEs, like restricted access to finance, bureaucratic hurdles, access to markets, competition, etc. Generally speaking, the view is that SMEs have more control over internal than external factors.

Barriers also tend to come in clusters, rather than on a one-by-one basis, as illustrated in the discussion above on how bureaucratic/ compliance factors can work together with financial factors to create a very challenging situation for high-tech start-ups.

A final point worth mentioning is that **barriers are also dynamic** (Debrand (2018). As one barrier is overcome, the enterprise might move into the domain of another, different barrier.

Box 1: Defining innovation: from Oslo 3 to Oslo 4

The Oslo Manual[19] (3rd edition – Oslo3) defines innovation as follows: 'An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations'.

This definition had expanded the idea of innovation beyond technological product and process (TPP) aspects, by including four types of innovation:

- *Product innovation*: introduction of a good or service that is new or significantly improved with respect to its characteristics or intended use;
- *Process innovation*: deployment of new or improved manufacturing and/or processing techniques within factories and/or delivery methods, to complement or replace existing systems and technologies (including significant changes in techniques, equipment and/or software);
- *Marketing innovation*: introduction of a new marketing concept, strategy or method, involving significant changes in product design or packaging, product placement, product promotion or pricing; and
- *Organisational innovation*: implementation of new organisational methods in the firm's business practices, workplace organisation or external relations, including but not restricted to structural change, procedural change, knowledge management and relations with parties external to the firm.

Reflecting the dynamic and evolving nature of the understanding of innovation, the OECD produced, in 2018, the fourth edition of the Oslo Manual on Guidelines for collecting, reporting and using data on innovation (Oslo4).[20] Oslo4 takes recently emerged trends into account. These include the presence of global value chains, the emergence of new information technologies, the influence of new business models and the growing importance of knowledge-based capital, as well as progress made in understanding innovation processes and their economic impact. The major change, in relation to Oslo3, in the definition of business innovation is the reduction in the complexity of the previous list-based definition with four types of innovations (product, process, organisational and marketing), to two main types:

- A *product innovation* is a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market.
- A *business process* innovation is a new or improved business process for one or more business functions that differs significantly from the firm's previous business processes and that has been brought into use by the firm.

For this study, the Oslo3 definition of innovation has been adopted, in order to ensure alignment and comparability with the 2009 Public Consultation. The study has also adopted the view that an innovation does not have to be completely original, in contrast to an 'invention'. This is in line with the definition of innovation used in the Community Innovation Survey.

[19] OECD/Eurostat (2005), Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, The Measurement of Scientific and Technological Activities, OECD Publishing, Paris

[20] OECD/Eurostat (2018), Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg.

2.1.3 How do SMEs innovate?

The heterogeneity of Europe's SME population is reflected in the ways in which they innovate. A useful approach to structuring how SMEs innovate is provided by Zimmermann and Thoma (2019).[21] This approach is reflected in interviews with SME industry associations carried out in the course of this study. The authors distinguish between two *modes of innovation.*

- One mode is based on R&D performed by dedicated departments or individuals within an enterprise generating new scientific knowledge. Where necessary, it is complemented by external partnerships or scientific organisations. This mode requires finance to cover the period between research and revenue, and can be called the 'Science, Technology and Innovation' (STI) mode.
- The second mode is based on experience, learning by doing, using and interacting (DUI). In this instance, informal processes of learning and understanding dominate. Innovations come from employees working together closely or the business environment through interaction with customers and suppliers – personal experience.

In practice enterprises do not fully work in either one or the other mode, but employ a blend of the two, the balance being determined by the type of enterprise they are and the barriers they face (see below).

According to the KfW SME Panel (based on analyses of in-house datasets), depending on how SMEs apply the innovation modes, three 'types' of innovators can be identified.

- 'Industry specific experts' who innovate on the basis of their practical industry-specific knowledge gained from suppliers, trade fairs, and trade publications. They do little R&D and do not prioritise innovation. They operate mainly in DUI mode.
- 'Sales market-oriented' innovators are very active in innovation but do little R&D and their main source of innovation is their customers. They also learn internally and are predominantly DUI but also have some STI skills.
- 'Combined STI and DUI innovators' primarily employ R&D and the STI mode and combine that with knowledge from the external environment and robust internal management procedures (error management).

A group that uses STI exclusively was not identified. While of course a typology is never perfect, it provides a useful framework from which to look a**t** innovation on a wide scale, across the landscape of SMEs.

2.1.4 A typology of SMEs in terms of barriers to innovation and implications for support services

In order to further characterise innovation in SMEs, and given that a major focus of this study was on barriers to innovation, it was of interest to consider an approach (Zimmermann and Thoma: 2016)[22] to segmenting the SME population based on the barriers they face. This approach provided insights and useful data on types of barriers faced by different segments of SMEs and the implications for policy responses relevant for those segments.

[21] 'Interactive learning or R&D: How do small and medium-sized enterprises generate innovations?', KfW Research, Focus on Economics, No. 264, 28 August 2019. See also Zimmermann and Thoma (2016) and Thoma, J. and Zimmermann, V. (2019); 'Non-R&D, interactive learning and economic performance: Revisiting innovation in small and medium enterprises', ifh Working Paper No. 17/2019:

[22] Zimmermann, V. and Thoma, J. (2016); "SMEs face a wide range of barriers to innovation – support policy needs to be broad-based", KfW Research, Focus on Economics, No 130, 20 June 2016.

The authors segment SMEs in terms of the barriers they face (based on the Community Innovation Survey (CIS) defined barriers) and identify four broad clusters of enterprise types. These were enriched with data on size, sector, age and the innovation activities they undertake, all of which determine the types of barriers they will face as well as the intensity of those barriers. Each cluster faces a particular set of barriers to innovation, and, accordingly, requires different kinds of support. Financing problems affect primarily small and young SMEs and businesses pursuing growth strategies. Bureaucratic obstacles, in turn, mainly affect enterprises in the construction industry. For a further group, organisational and skills problems in combination with financing difficulties and high market risk are the most widespread barriers to innovation. These are often enterprises in traditional 'low-tech' sectors such as craft industries and businesses with a low level of profitability. These also often adopt incremental innovations. A small high-tech group where innovation is driven by R&D constitutes some 8-12% of the population.

In view of the heterogeneity of SMEs and the diversity and clustering of obstacles to innovation they are faced with, the authors suggest that innovation support for SMEs should be broad-based and comprise both financial and non-financial support. It is particularly in enterprises whose innovations are not based on their own R&D, but emerge primarily from the normal work process and through interaction with customers and suppliers, that the availability of skilled workers, organisational problems and lack of technological expertise constitute key obstacles to developing innovations (DUI –mode). Major building blocks for promoting innovation therefore include measures that aim to improve training and the upskilling of staff and provide support for the development of innovation management systems, and the transfer of scientific-technical knowledge as well as those promoting continuous improvements in the financing situation.

A typology with distinctions between four clusters is set out in table 3 below. Arguably, a similar segmentation approach could be undertaken for EU SMEs as a whole or on a country basis. These distinctions could then be further elaborated with data related to different innovation adoption rates within the segments.[23] [24] Our view is that this presents a useful approach that can be built upon for the future.

Table 3: A typology of SMEs and barriers to innovation

SMEs with a strong focus on R&D	SMEs facing innovation barriers in organisation and skills	SMEs facing strong financing barriers to innovation	SMEs facing bureaucratic barriers to innovation
Large and older SMEs R&D intensive manufacturing and knowledge-based services High profitability	Older companies Traditional low-tech sectors, construction Craft enterprises Low profitability Investment goals:	Young and small enterprises Less research and knowledge-intensive segments of the manufacturing and services sector Below-average	Older companies Construction High profitability Investment goals: rationalisation and cost reduction

[23] See for example the theory of diffusion of innovations, developed by Everett Rogers The Rogers model argues that the adopters of innovation go through specific hierarchy of responses to new technologies (innovators – 2.5%; early adopters – 13.5%; early majority – 34%; late majority – 34%; laggards 16%. http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories4.html

[24] Innovation theorists such as Geoffrey A. Moore have argued that the movement beyond the 'early adoption' and into the 'early majority' stage is the most challenging for any given innovation, as it requires a significant proportion of population to change behaviour. (1998) Crossing the Chasm: Marketing and Selling Technology Products to Mainstream Customers

SMEs with a strong focus on R&D	SMEs facing innovation barriers in organisation and skills	SMEs facing strong financing barriers to innovation	SMEs facing bureaucratic barriers to innovation
Investment goals: innovation and R&D Innovation goals: pioneering role	rationalisation and cost reduction Innovation goals: incremental	profitability Growth orientation	Innovation goals: incremental

Source: Zimmermann, V. and Thoma, J. (2016), op.cit.

For each segment the size of the sector (number of enterprises), employment, age and profitability are relevant and a targeted innovation support strategy can be designed, rolled out and evaluated along the lines, for example, of table 4 below.

Table 4: Policy approaches to promoting innovation in less R&D intensive SME segments

	Reducing financing obstacles	Reducing obstacles in the area of organisation and skills	Reducing bureaucratic barriers
Age of company	Young enterprises	Older enterprises	Older enterprises
Size of enterprise	Small	-	-
Economic sectors	Less research/ knowledge intensive sectors	Enterprises from traditional low-tech segments	Construction
Skilled crafts	-	Crafts enterprises	-
Strategic orientation	Enterprises with growth strategies	Incremental innovators	Incremental innovators

Source: Zimmermann, V. and Thoma, J. (2016), op.cit.

The challenge for SME innovation policy in Europe is then to ensure that all segments are appropriately served whether at EU, Member State, regional or national level, with the relevant instruments.

2.2 The policy response to SME innovation challenges

2.2.1 The rationale for public intervention

Classic market theory identifies some key arguments for intervention that are relevant with regards to innovation by SMEs. These are:

- **Information problems:** Insufficient (or incorrect) information (or information asymmetries) can lead to inefficient markets and resource allocation. This could be on the side of providers of finance and technological knowledge as well as that of the enterprises working to innovate. SMEs or individuals rarely have the resources to acquire all the knowledge needed to manage their innovations from start to end; and the business sector rarely has sufficient knowledge of the public sector to be able to access relevant knowledge efficiently. There is, for example, a role for a "trusted intermediary" (e.g. an innovation agency, or the Digital Innovation Hubs) to guide the SME and point

out various forms of support.

- **Co-ordination failures**: Coordination problems may prevent market participants from overcoming the above-mentioned barriers to innovation or their consequences. For example, there may be institutions with useful financial, technical or scientific knowledge for SMEs that want to innovate but the enterprises may not be aware of their existence – in this instance public sector intervention to bring the organisations together would be justified.
- **Externalities**: Positive externalities occur when benefits accrue to those not involved in a transaction. In the case of innovation – the positive externalities in terms of productivity or increased income, employment and welfare for society as a whole are well-known and therefore innovation at the individual enterprise level deserves support from the public purse.
- **Public goods and services**: Society as a whole benefit from increased innovation, but if everyone benefits and it is not possible to exclude anyone through the price system, it may not be possible or rational for an individual or single enterprise to incur the costs involved, and therefore it is sensible for the public sector to intervene.

2.2.2 The policy response

Public policy has responded to the challenges faced by SMEs when trying to innovate by increasing both financial and non-financial support. Public policy has also been driven by awareness of the global competition for leadership and both the necessity for and the benefits of being in the race.[25]

After 1992 the EC's industrial policy focused primarily on the internal market, Monetary Union and the emergence of the knowledge economy. The Lisbon Agenda of 2000 shifted the focus to competitiveness, knowledge, sustainable economic growth, jobs and cohesion, in short, to improving EU competitiveness. SMEs and entrepreneurship were seen as key to ensuring economic growth, innovation, job creation and social integration in the EU. To this end, the EC worked with Member States to create a small-business friendly environment – both for existing and new businesses.

SME specific policy started to take shape towards the end of the 1990's with the launch of instruments in support of innovation in 1998 (G&E) and in 2000 (MAP), followed by other instruments in subsequent MFFs and leading to COSME and InnovFin. The adoption of the **European Charter for Small Enterprises** by the 'General Affairs Council' and its approval by the EU Council at Fiera in 2000[26] was followed by a comprehensive SME policy with the implementation of the Small Business Act (SBA) in 2008 which became the framework and the basis for EU policy on SMEs. The SBA sets out ten principles which include measures intended to strengthen SMEs, from facilitating financing, better access to procurement procedures, and encouraging start-ups led by women.

The **Europe 2020 Strategy**, launched in 2010, includes seven Flagship Initiatives of which achieving **Innovation Union** is one. Since then (for the 2014-2020 MFF) a wide range of

[25] There are overviews of EU-level policy intervention in the fields of industrial and SME policy – also with regards to innovation, especially vis-a-vis the European Green Deal and the Digital Transition in other documents. See for example Smit,J.,Kreutzer,S.,Moeller, C and Carlberg, M. (2016); Industry 4.0, The European Parliament's Committee on Industry, Research and Energy (ITRE); and Smit,J., the Centre for Strategy and Evaluation Services LLP (2020); SME focus - Long-term strategy for the European industrial future, The European Parliament's Committee on Industry, Research and Energy (ITRE)

[26] European Commission, D G Enterprise (2000); The European Charter for Small Enterprises, (Annex III of the Presidency conclusions of the Santa Maria da Feira European Council, which took place on 19 and 20 June 2000) European Commission 25.6.2008 COM(2008) 394 final. "Think Small First" A "Small Business Act" for Europe {SEC(2008) 2101} {SEC(2008) 2102}

SME initiatives has been launched, many of which focused on innovation support.[27] In order to structure the delivery and management of several EU programmes on its behalf in the fields of SME support and innovation, environment, climate action, energy and maritime affairs, the EC set up the Executive Agency for Small and Medium-sized Enterprises (EASME).[28]

It needs to be emphasised that SME innovation policy during these years was also delivered **by national, regional and local governments**, sometimes in collaboration with the Structural Funds such as the ERDF. In order to improve coherence and effectiveness at these levels, regions were increasingly encouraged to develop Smart Specialisation Strategies.

In recent years, there has been an increased focus on industrial strategy within the EU. The EC launched *The New Industrial Policy Strategy* in 2017 as set out in the Communication on "Investing in a smart, innovative and sustainable industry - a renewed EU Industrial Policy Strategy. The policy identified six integrated and coherent pillars of action. While the pillars are in theory placed on an equal footing, some Commission officials, in practice, tend to categorise these as having two main thematic concerns – **digitalisation** and the **green economy**; and the four 'I's' – internal market, investments, innovation, internationalisation; and, the context of partnership.[29]

Box 2: The Digital Transition and innovation

In several major EU programmes over the past 10 years substantial funding was dedicated to support SMEs, enabling them to grasp opportunities from the digitalisation of their business processes, their products and services or their organisational methods. Major programmes and initiatives that specifically focussed on the digital transition were:[30]

- Digital Agenda for Europe (2010)[31],
- Digital Single Market Strategy and the Digital Single Market Program (DSM - 2015)[32],
- Digitising European Industry Initiative (DEI with DIHs and I4MS)[33] (2016),
- Digital Europe Programme 2021-2027 (DEP – 2020).[34]

The *Start-up and Scale-up initiative*, and the *Digital Innovation and Scale-up Initiative* are examples of specific initiatives that have been launched. Other examples include the *eIDAS*

[27] These include The Entrepreneurship 2020 Action Plan, information portals, the Competitiveness of Enterprises and SMEs (COSME) programme, the Digital Single Market (DSM) Programme, European Observatory for Clusters and Industrial Change and the European Cluster Collaboration Platform, European Fund for Strategic Investments (EFSI), European Investment Advisory Hub (EIAH), and the European Investment Project Portal (EIPP); Horizon 2020 and the many programmes it supports including the European Institute of Innovation and Technology and Future and Emerging Technologies (FET) and others.

[28] See Smit, S.J. (2020), above, for an overview of SME support programmes – the majority of these have had an innovation angle, as well as specifically covering the digital transition and the European green Deal.

[29] CSIL, University of Bari and CERPEM, University of Warsaw and EUROREG (2019), How to tackle challenges in a future-oriented EU industrial strategy? ITRE committee, European Parliament, Policy Department for Economic, Scientific and Quality of Life Policies, Directorate-General for Internal Policies, Sections 2-3

[30] See also: Smit, S.J. (2020), SME focus – Long-term strategy for the European industrial future, p.37-38 IPOL, European Parliament

[31] European Commission (2010), EUROPE 2020 A strategy for smart, sustainable and inclusive growth - COM(2010) 2020 final

[32] European Commission (2015), A Digital Single Market Strategy for Europe - COM(2015) 192 final

[33] European Commission (2016), Digitising European Industry Reaping the full benefits of a Digital Single Market – COM(2016) 180 final

[34] https://ec.europa.eu/digital-single-market/en/news/digital-europe-programme-proposed-eu75-billion-funding-2021-2027

SME study and communication campaign[35] and the solutions offered under CEF, available for reuse by SMEs, for free. This includes solutions such as electronic identification and electronic signature.[36]

In May 2019 the Council of the European Union called for a longer term approach - *An EU Industrial Policy Strategy: a Vision for 2030*, with the aim, among others, of improving the business environment for SMEs. The initiatives proposed have direct implications for innovation.[37] The Council emphasised the importance of SMEs for the competitiveness of the EU economy, together with continued access to global value chains, scaling-up, innovation and finance, through the SME Window of the InvestEU Programme, Horizon Europe and EIC instruments to support the structural transformation of industry. Clusters are identified as key tool for implementation as is the use of the new Interregional Innovation Investment Instrument under Cohesion Policy to develop EU value chains. In June 2019 a *Vision for Industry 2030* was published by the High Level Industrial Roundtable. This proposed a new European industrial model based on an integrated approach, increased innovation and technology take-up, transition to climate-neutral industry, strengthening global competitiveness and a focus on people, skills and values. In November 2019 the Commission published recommendations by a group of experts, the Strategic Forum on *Important Projects of Common European Interest,* to boost Europe's competitiveness and global leadership in six strategic and future-oriented industrial sectors: Connected, clean and autonomous vehicles; Hydrogen technologies and systems; Smart health; Industrial Internet of Things; Low-carbon industry; and Cybersecurity.

The new president of the EC published the *Political Guidelines for the next European Commission 2019-2024* which sets out a range of initiatives and policy measures supporting them. These integrate preceding policy statements of the Council and the Commission, and provide a greater focus by targeting six themes: a European Green Deal, an economy that works for people, a Europe fit for the digital age, a Europe protecting our European way of life, a stronger Europe in the world, and a new push for European democracy. The March 2020 Communication for *An SME strategy for a sustainable and digital Europe*[38] recognises the diversity of the SME population and SMEs' needs (not just growth/scale-up but also competitiveness, resilience and stability). Building on the existing SME policy framework, the objective is to considerably increase the number of SMEs engaging in the green and digital transition. The ultimate goal is to make Europe the most attractive place to start, grow and scale-up a new business. The text box below summarises some of the key policy elements. The policy is to be implemented through an EU-Member State delivery partnership, with strong collaboration between EU-national, regional and local levels, and the provision of a renewed mandate for the SME Envoys, along with the appointment of a high-level SME Envoy. There are also to be Strategic Entrepreneurship Ambassadors (from the private sector), and regular dialogue with the Regulatory Scrutiny Board by the Member States.

[35] https://op.europa.eu/nl/publication-detail/-/publication/712f9ce2-5042-11e9-a8ed-01aa75ed71a1/language-en/format-PDF/source-search
https://ec.europa.eu/digital-single-market/en/eidas-smes
[36] https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/CEF+Digital+Home
https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/digital+innovation+challenge
[37] Areas of interest are: identifying and developing additional key strategic value chains, further support to the Digitising European Industry and Artificial Intelligence strategy (supported by a European network of Digital Innovation Hubs) and the new Digital Europe Programme; support for the Commission's 'A Clean Planet for all' Communication and transition towards a climate-neutral and circular economy (making use of the EU Innovation Fund), and, the Circular Economy Action Plan.
[38] European Commission, Brussels, 10.3.2020 COM(2020) 103 final Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. An SME Strategy for a sustainable and digital Europe

Box 3 The three pillars of the 2020 SME strategy

In order to achieve its goals, the *SME strategy for a sustainable and digital Europe* adopts a comprehensive, horizontal approach but also targets specific needs. The strategy is based on *three pillars:*

- *Capacity building and support for the twin transitio*n, which includes: provision of dedicated Sustainability Advisors for the Enterprise Europe Network; support through the Energy Resource Efficiency Knowledge Centre (EREK); disruptive start-up funding through the European Innovation Council (EIC); increased openness to SMEs on the part of the European Institute of Innovation and Technology's (EIT) Knowledge and Innovation Communities (KICs); a network of up to 240 Digital Innovation Hubs (DIHs); fair access to data (see 4.2.2); an Intellectual Property Action Plan; Digital Crash Courses; an SME component in the Pact for Skills; and, support for the collaborative economy.
- *Reducing regulatory burdens and improving market access*, which includes: a Single Market Enforcement Task Force to minimise barriers in terms of regulations, standards, labels and administrative formalities; regulatory fitness screening; the 'one-in, one-out' principle; EU SME-envoy screening; launching an EU Start-up Nations Standard; Border Regions partnerships; providing a Single Digital Gateway; mutual recognition alliances; European Defence Fund, mapping RTOs and university capabilities; increasing space sector scale-ups; public procurement to lead markets and using 'SME-friendly' practices (regulatory sand boxes); a Business Transfer friendly environment; fairness in value chains – late payments monitoring and enforcement; open global markets (rule-based and SME chapters); support for Trade Defence Instruments – a Chief Trade Enforcement Officer; and, expanding Erasmus for Young Entrepreneurs.
- *Improved access to finance* by providing: continued support for access to a wide range of financing options; diversifying sources of finance - VC and non-EU; new EC risk-sharing with the private sector; an SME IPO Fund; support for Fintech; a review of state aid rules; a gender-SMART financing initiative; an EU Investment plan to support more than 1 million SMEs; through the InvestEU SME window – guarantees and VC, and encouraging leverage from other sources; and, measures to address geographical imbalances and skills issues.

The preceding overview is not complete but makes clear that a great deal has occurred since 2009 and there is a good deal of activity taking place at policy level with a view to both driving and supporting more innovation by SMEs.

2.2.3 Policy instruments

There is a lively on-going debate about the pros and cons, advantages and disadvantages, of direct as opposed to indirect approaches to the support of innovation by SMEs. The literature review (Annex A) presents the main arguments either way. In this section we provide a short summary regarding the key direct instruments that tend to come within the ambit of measures employed by the public sector in Europe in support of innovation in recent years (more details are available in Annex A, the Literature Review).

- **Grants**: Grants have been an important part of innovation support for SMEs in the EU for many years. A wide range of grant programmes exists. Generally, it appears that grants tend to support young SMEs with their R&D inputs. However, it is hard to generalise regarding effects over the longer term and on other types of enterprises (larger, older, etc.) as there is sometimes uncertainty about longer term outputs and impacts. Kaufmann et al. (2019) in an evaluation of the German ZIM programme suggest that more efforts could be made to address non-innovating firms and to make it easier for non-innovating firms to apply for funding.

- **Soft loans, loan guarantees and capital support schemes**: in view of the key role that access to finance plays as a barrier to SME innovation it is not surprising that many initiatives have been developed by the public sector to overcome finance barriers. The literature review considers findings of evaluations of a wide range of these schemes, including the French ANVAR programme, the Small Firms Loan Guarantee in the UK, the Czech START programme, and the Polish Technological Credit. These programmes tend to have positive effects overall.

  There is also increasing provision of alternative finance through seed capital, support of networks of Business Angels, and other forms of start-up capital. Financial institutions such as BPI and KfW, as well as the EIF and the EIB are making a substantial impact on provision of funding to this market. There is also a much better appreciation of the role of financial elements within innovation ecosystems.

- **Skill development or knowledge transfer instruments**: The level of skills in a country or region is largely the outcome of the educational system as a whole. However, SMEs often have specific skills needs that have not been met by the educational system, or they have problems because they cannot afford appropriate specialists and instruments. Coyne and Carlberg (2018) also found that frequently there was a failure to consider the significance of human resource inputs for innovation processes in the design of support measures. Innovation vouchers can be used to provide funding to enterprises in the form of a voucher to buy innovation services from knowledge providers, or to recruit an in-house innovation resource or innovation manager. In Austria such schemes have been found to provide positive results (Kaufmann et al. 2015; and, Handler 2018). Lombardy's scheme was assessed by Sala et al. (2016) who found both positive and negative effects; but in Slovakia, Bondareva et al. (2017) found that there was little interest in the scheme.

- **Technology and innovation advisory services**: SMEs usually face obstacles to adopting new technologies due to a lack of knowledge and skilled specialists within the business but also due to the potentially high costs and poor availability of consultancy services. Advisory services aim to help SMEs overcome those barriers by provision of advice to help resolve their problems. Different typologies of such services exist and Shapira and Youtie (2016) have concluded from an evaluation of such services in the US, Canada and the UK, that firms generally benefit from these services.

- **Collaboration and networking instruments**: Funding of networks, partnerships or collaborations is usually part of public innovation support. The rationale for fostering collaborative activity between firms and public innovation support institutions (e.g. universities or research centres) is to improve the innovativeness of business communities and to increase the social return from public investments in science organisations via the transfer of knowledge from research organisations and the use of this knowledge by market-oriented organisations (Cunningham & Gök 2016). Typical collaboration instruments include: collaborative research centres, centres of competence, centres of excellence, or knowledge exchange projects. A good number of studies have found that these networks have positive impacts (e.g. Chai and Shih, 2016 with regards to the Danish National Advanced Technology Foundation; O'Keene et al. 2016 with regards to VINNOVA; and, Cottica, 2017 with regards to the agro-food sector in Italy).

- **Clusters/ science and technology parks**: Clusters have been important instruments of industrial policy for some decades and have gone through various transformations and permutations in the process. At present, the concept of clusters is controversial and there are ongoing conceptual and empirical debates which have generated a range of cluster typologies (Uyarra & Ramlogan 2016). Member States have implemented cluster strategies in different ways. A number of evaluations of clusters that have been carried out have found positive effects (e.g. Aranguren et al. 2014; Rothgang et al. 2017; and,

Engel et al. 2019). However, a study by Uyarra and Ramlogan (2016) of 17 cluster evaluations found no clear evidence of innovation impacts. Increasingly, there has been a broader discussion, beyond clusters, of innovation or entrepreneurial ecosystems (Mercan and Göktaş, 2011; CSES et al 2019). The role of science and technology parks as separate institutions has also been questioned (OECD 2011), and these two types of organisations are increasingly seen as contributing through their roles in a wider innovation ecosystem rather than as stand-alone institutions.

- **Public procurement and government regulation**: In view of the role of the public sector as a buyer of goods and services it can through its purchasing procedures and standards have an important effect on innovation. This can be through pre-commercial procurement (PCP) which might support innovative companies by providing a pilot and potential launch customer; as well as public procurement of innovation (PPI) to acquire innovative products that already exist in the marketplace (Uyarra 2016). A further option is public procurement with contracted innovation (PPCI). Several studies have been undertaken to assess the impacts of such initiatives on innovation. In Germany a PPCI scheme was found to have had a positive impact (Czarnitzki et al. 2018), the evaluation of the British SBIR programme (Connell 2017) also identified positive impacts; as did Cordero Machado (2019) in a study of PPI in Spain.
- **The innovation system**: While not strictly speaking a 'direct instrument', the increased structuring of innovation systems at EU, national (Legait, et. al. 2015; Zecchini 2016), and regional levels (Picard; Pillon 2015a, b) has been a feature of European innovation policy in recent years.

2.3 Recent trends and developments – challenges for SME innovation policy

In this sub-section we set out some key contextual / policy factors affecting innovation by SMEs that have recently emerged.

- **The COVID-19 pandemic:** The COVID-19 pandemic has had a significant impact on innovation in SMEs (in particular on digitalisation), and will continue to have an on-going impact in coming years. From one point of view, the pandemic has had a very positive impact on innovation – it has led to the invention of new ways of communication and the introduction of more flexible business modes – or the wider adoption and enhancement of ways of communication with no personal contact that were already in existence. It has also stimulated developments in transport (logistics), education, and many other areas. At the same time, it has meant that research projects have had to be postponed or even cancelled as businesses fail and value chains change to such an extent that the innovations being developed are no longer appropriate or called for.
- **The European Green Deal (EGD):** The EGD was launched on 11 December 2019. It is highly ambitious and is *de facto* the prime new economic growth policy agenda for Europe. It includes an increased EU climate ambition with a European 'Climate Law' to enshrine the 2050 climate neutrality objective in legislation. It envisages a transformation of how Europe produces and the largest component of the EGD will be the New Circular Economy Action Plan (NCAP). As such, it will have a major impact on innovation as enterprises are forced to adjust to new standards, but will also create some regulatory uncertainty and will have cost implications, – which can have a negative impact on innovation
- **The Digital transition (DT):** Digital transition has been an on-going theme of the EU's industrial policy, and like the EGD was given a fillip in the new political agenda of the Commission, where the aim to achieve Digital Transition and technological sovereignty was spelled out through a series of specific initiatives. These give rise to wide-ranging

opportunities for innovation by SMEs, including those developing joint standards for 5G-networks, the legislation for Artificial Intelligence (AI) and the plans for investing in AI through multi-annual financial frameworks; a new Digital Services Act; in addition, there is the creation of a Joint Cyber Unit (for information sharing and better protection); promotion of the adoption of eIDAS solutions by SMEs; realising the European Education Area by 2025; and, updating the Digital Education Action Plan (see text box 2).

- **The platform economy:** Linked to digital transition there is the development of the platform economy, with major innovations and new ways of doing things. This includes diverse sectors and activities, with a wide range of implications including a redefinition of the basis for competition. For example, in the area of short term accommodation for tourism, domestic rentals compete with traditional hotels. This has consequences for the retail sector, as high streets lose shops and traditional stores close down. While there are many opportunities, SMEs also complain that when using external platforms, they often do not have access to their customer data, which means they cannot develop new innovative methods to approach them and remain competitive. In other sectors, such as the automotive industry, where providers of repair products and services include many SMEs, there are also issues that constrain innovation[39]. At the other end of the spectrum, in financial services, FinTech is innovating rapidly and providing efficient solutions in areas such as supply chain finance for SMEs that can circumvent constraints related to using providers from regulated markets.[40]

[39] SMEunited (2019); Manifesto for fair digitalisation opportunities

[40] VVA (assisted by CSES) (2020: Study on Supply Chain Finance, DG FISMA

3. The effectiveness of innovation support for SMEs in Europe

This chapter brings together the main findings of the research related to the relevance and effectiveness (and efficiency) of public innovation support for SMEs in Europe. The chapter draws on the results from the literature review, the interview programme and the survey of SMEs.

3.1 Introduction

The main focus of the chapter is on the following themes as indicated in the terms of reference with a view to providing insights on:

- the main factors hampering innovation in SMEs, especially in light of the recent technology and market developments in certain sectors and countries;
- the forms of innovation support received by SMEs;
- the level of satisfaction on the part of SMEs regarding the support received;
- gaps in existing SME innovation support;

This chapter presents answers to these questions based on the results from the public consultation of SMEs and intermediaries on the effectiveness of public innovation support in Europe. The public consultation consisted of two web-based and anonymous surveys, one addressed to European SMEs and the other one to innovation support intermediaries, active at regional, national and European levels (the questionnaires can be found in Annex B). The team designed the two questionnaires based on a consultation held on the same topic in 2009[41], in order to ensure comparability with the previous results. Both questionnaires were available in Czech, English, French, German, Hungarian, Italian, Polish, Portuguese and Spanish. The surveys ran from the 8th of April to the 26th of June 2020 and collected **2,176 responses from SMEs and 498 from intermediaries**.[42] The table below gives an overview of the key features of the SMEs participating in the survey. More details on the sample of respondents to the SME and intermediaries' surveys, as well as a comparison of the sample with the SME population in the EU in 2019 are included in Annex D. Whereas the geographical distribution of respondents is in line with that of the SME population in 2019, the distribution by size and sector is slightly different, as micro-enterprises and enterprises operating in less innovative sectors (especially in services and construction sectors) are under-represented. Nonetheless, it was not deemed necessary for the purposes of this study to adjust the sample of respondents and all the responses received were taken into account in the analysis.

Table 5. Key features of the SMEs participating in the survey

	Variable	N. of respondents	% of respondents
Respondents by geographic origin	EU	2004	93%
	Extra EU	156	0.7%
	No answer	16	

[41] European Commission (2009). Making public support for innovation in the EU more effective, Lessons learned from a public consultation for action at Community level. Commission Staff Working Document SEC(2009)1197 of 09.09.2009

[42] Considering the number of direct invitations sent to possible participants to either of the surveys, the response rate was around 7.5%.

	Variable	N. of respondents	% of respondents
Respondents by size	Micro	1447	67%
	Small	554	26%
	Medium	153	7%
	Large	11	1%
	No answer	11	
Respondents by sector	Construction	78	4%
	Manufacturing	837	39%
	Services	1230	57%
	No answer	31	
Respondents by age	Enterprises established after 1 January 2014	1005	47%
	Enterprises established before 1 January 2014	1146	53%
Respondents by turnover growth rate in the previous 3 years	Below 0%	337	16%
	0-10%	1027	48%
	10-20%	338	16%
	Over 20%	452	21%
	No answer	22	16%
Respondents having or not introduced innovation in previous 3 years	Having introduced innovation in previous 3 years	2046	94%
	Not having introduced innovation in previous 3 years	122	6%
	No answer	8	
Respondents having received or not public innovation support in the previous 3 years	Having received public innovation support in the previous 3 years	1589	74%
	Not having received public innovation support in the previous 3 years	556	26%
	Do not know / No answer	19	

Source: Authors' elaboration of survey to SMEs and intermediaries' results. Statistics on the EU SME population are from the SME Performance Review 2019.

Statistical and econometric techniques were used to analyse the survey responses. More specifically, econometric models and Bayesian Network Analyses[43] were used to shed light on all the possible correlations and interlinkages between variables and look more deeply into the effectiveness and the role of public innovation support for SMEs in Europe. More details about the survey methodology and sample frame are available in Annexes C and D respectively.

In addition, telephone and online interviews were carried out with 31 SMEs and 37 stakeholder organisations to better contextualise the surveys' results and enrich the report

[43] Bayesian Network Analysis was used by CSIL in other recent studies to model causal relationships between survey responses. The methodology is presented in the paper by Giffoni, F., Salini, S. and Sirtori, E., 2018. Evaluating business support measures: The Bayesian Network approach. Evaluation, 24(2), pp.133-152. https://doi.org/10.1177/1356389018767179

with some anecdotal evidence that can help explain the surveys' results. Relevant elements of the literature review have also been integrated into this chapter.

One key characteristic of the consultation was that **innovative SMEs tended to participate in the survey more than non-innovative ones**. This was mainly for two reasons: first, the survey primarily reached past applicants to INNOSUP actions and the SME Instrument, since they received a direct invitation to participate in it[44]. Secondly, innovation intermediary organisations helped disseminate the survey through their networks, which typically target enterprises interested in innovation. The fact that more innovative sectors are over-represented (e.g. IT, chemical, pharmaceutical, R&D sectors) while less innovative sectors, especially in construction and services, are under-represented confirms that respondents to the survey were usually more innovation oriented. As a result, our survey gives particularly valuable insights into the opinions and behaviours of innovative SMEs in Europe. At the same time, however, the sample is also composed of SMEs operating in non-innovative sectors which have not recently introduced any innovation and have not received any form of public support for innovation. The comparison between the two groups was then part of our analysis and the results highlight any significant difference that emerged between them.

3.2 Presentation of results by theme

3.2.1 Main factors hampering innovation in SMEs

Beginning with the types of barrier identified in the literature review, the survey investigated the level of importance assigned to each barrier by SMEs and intermediaries. In the following sections the survey results on the various barriers are set out and at the end of the sub-section, points identified that did not come up in the survey are mentioned.

As in 2009, **the lack of financing support for RDI activities was considered by far the main barrier to innovation**, **with 85% of SMEs** thinking that it is an important or very important obstacle.[45] In addition to and reinforcing this result, the results show that the second and third barriers by importance, as indicated by the SMEs, also concerned access to finance, namely *the lack of sufficient links with finance providers* and *the lack of information on financing possibilities*. The lack of support for **internationalisation** is considered an important obstacle by half of the SMEs, as well as the lack of certain **regulatory requirements** for new innovative products or services. By contrast, less than one-third of SMEs deem the lack of support to acquire innovation-related **skills** (e.g. digital skills, management skills, skills for service and organisational innovation) as important barriers.

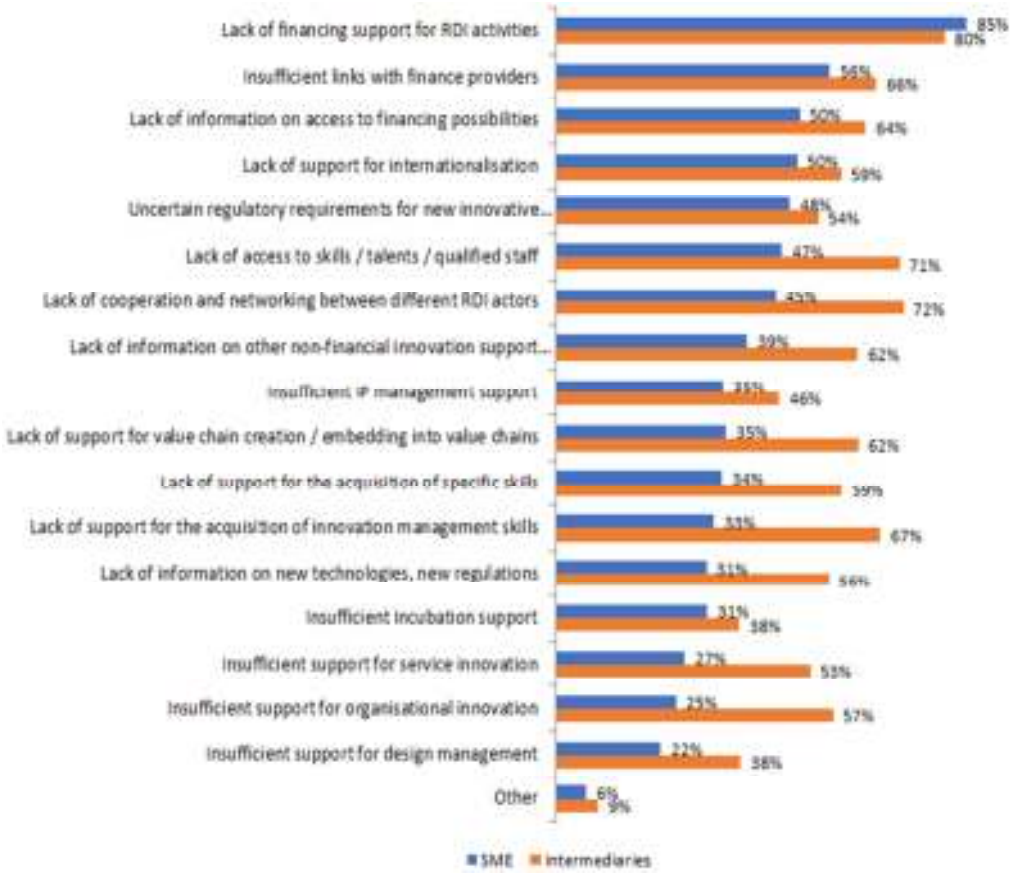
Whilst confirming that obstacles linked to access to finance are considered the most important for innovation in SMEs, **intermediaries'** opinion on the relevance of the other barriers differs from that of the SMEs. Intermediaries consider, indeed, the lack of support for networking with other RDI actors, and the lack of support to acquire skills from outside or to develop skills in-house as more important obstacles.[46]

It is worth mentioning here that our results concerning the importance of financing support might have been influenced by the peculiar contextual conditions in which the survey took place (at the beginning of the COVID-19 pandemic).[47] A similar trend is indeed registered by

[44] 55% of respondents received a direct invitation.
[45] In 2009, 69% of respondents addressed it as highly important.
[46] For example, more than 70% of intermediaries addressed as important obstacles the lack of cooperation and networking between different RDI actors (vs 45% of SMEs) and the lack of access to qualified staff (vs 47% of SMEs).
[47] Compared to the 2016 Community Innovation Survey (CIS), our results seem to indicate the lack of financing support as a more important barrier to innovation. However, the differences in the sample composition should be taken into account (e.g. there are no micro-enterprises responding to the CIS. Moreover, in the CIS the "lack of financing" question is fragmented in four

the 2019 - 2020 SAFE-survey[48] that was run in the same period and which highlights how SMEs' expectations about the future availability of external finance have fallen significantly as a consequence of the expected impact of the COVID-19 pandemic.

Figure 3. Share of SMEs and intermediaries considering each barrier important or very important



Source: Authors' elaboration of survey to SMEs and intermediaries' results.
A total of 2,164 SMEs and 495 intermediaries answered this question.

A further point worth mentioning is that the various barriers are not independent of each other. An enterprise that lacks finance may also experience challenges in finding and paying for specialist staff, or acquiring innovation management skills. An owner/manager of a small Italian enterprise, or the 'meister' of a German craft SME struggles to multitask effectively and hence to look for information and support with regards to finance while at the same time facing production, sales and management challenges. In one survey conducted in 2018 for the Federation of Small Business,[49] which asked slightly different questions than ours, and took a different perspective, among those considering innovation, the top three barriers to innovation were identified as: 'I do not find the time' (43%); 'I lack staff or skilled employees' (37%); and, 'I cannot decide whether it is worth the effort' (27%). With regard to these three factors, the survey suggests that decision-making is a core component of effective leadership and management, and therefore it can be argued that the top three barriers to further innovation are all related to 'management or leadership-related' functions.

different barriers, namely: (i) lack of internal finance for innovation, (ii) lack of credit or private equity, (iii) innovation costs too high, (iv) difficulties in obtaining government grants or subsidies for innovation.

48 The Survey on the Access to Finance of Enterprises is carried out by the European Central Bank and provides information on the latest developments in the financial situation of enterprises, their need for and perceived availability of external financing. More information is available at: https://www.ecb.europa.eu/stats/ecb_surveys/safe/html/index.en.html

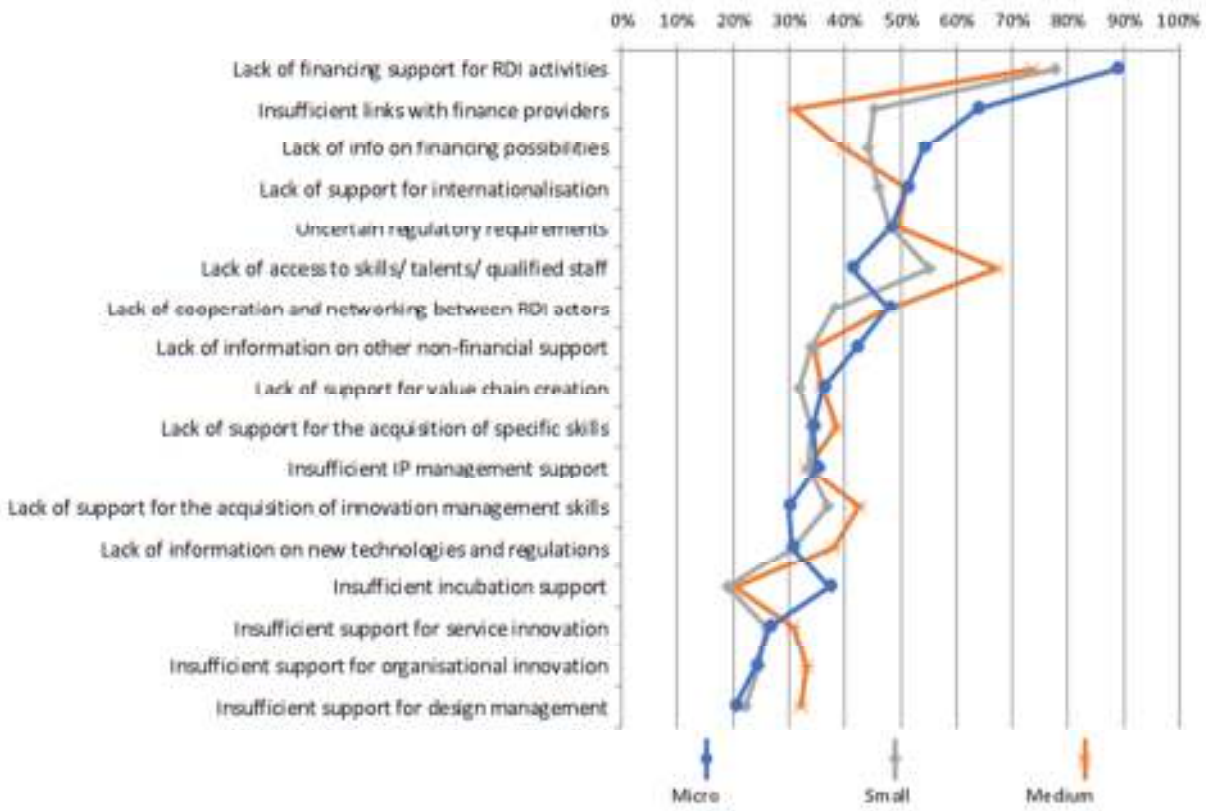
[49] Federation of Small Business (FSB) (2018); Spotlight on innovation. How government can unlock small business productivity, Table 3.6

Our analysis of the survey results suggests that the characteristics of the SMEs in the sample (e.g., their size, sector, geographic position, tendency to innovate, whether they have received public support or not, etc.) affect the importance assigned to certain barriers. For instance, as shown in Figure 44, whilst micro enterprises value receiving financing support highly and also establishing links with finance providers[50] and having access to information on support possibilities, medium enterprises in contrast see the lack of qualified staff and skills as a more important obstacle to innovation.

Access to financial support and to information seem to be the primary obstacles that might prevent "inexperienced" SMEs (smaller, newer, those that have not recently undertaken any innovation activity) from innovating. Instead, established and bigger enterprises, which have more economic resources, and usually also better access to finance, are more interested in support for acquiring innovation skills and engaging qualified staff.[51]

As emerged from some interviews, for a small or medium sized craft manufacturing enterprise that buys a new machine that embodies new technology, that can make products faster or cheaper, the challenge would be more to find a skilled employee than can work with the machinery, than accessing the finance to purchase the machine.

Figure 4. Share of SME respondents considering the barrier important or very important, by size



Source: Authors' elaboration of survey to SMEs' results
A total of 2,164 SMEs answered this question.

50 A study by CSES and Panteia for DG Enterprise and Industry found that the smaller an enterprise, the harder it will be for it to obtain external funding (Evaluation of Market Practices and Policies on SME Rating).

51 The results of the econometric analysis leading to this finding are displayed in the table below and are further discussed in the following paragraphs.

As regards the **link between the perceived barrier and the (public) support received**, respondent SMEs that have received financial support or awareness-raising support are less likely to indicate the financial barrier and the lack of information about innovation possibilities as obstacles to innovation. This may point to the **effectiveness of public intervention in mitigating those barriers**. Moreover, SMEs that have received financial support are less likely to see the lack of information on financial support, the lack of support for incubation and for networking (including with finance providers) as important. This might be explained by a series of interrelated causes:

- Past beneficiaries of public funds are usually better informed than other SMEs (they were of course aware of the support possibilities to be able to apply);
- Past beneficiaries of public funds had probably already consolidated their business; thus they need less incubation support;
- Past beneficiaries of public funds are less interested in links with finance providers since, first, they have already received financial support and, second, public financial support functions *per se* as a leverage to attract private investments. In this regard, Becker (2015) notices that the "additionality effect" is especially prevalent for small firms, "which are more likely to experience external financial constraints."[52]

The following paragraphs investigate the heterogeneity of responses for the main categories of barrier[53]. An overview of the econometric analysis results is provided in Annex C.

Although , the **lack of financing support is primarily relevant for newly established and micro enterprises,** which are the SME categories with less financial resources available,[54] accessing finance is also an important barrier to innovation for i) **high-growth SMEs**, i.e. SMEs with an average annual growth in turnover greater than 10% per annum over the previous three years, ii) SMEs that had invested a significant share of their budget in innovation activities in the previous three years (2017-2019) and iii) SMEs that consider their innovation as radical. The common theme in relation to both newly established and micro enterprises and those in the categories just listed is the uncertainty of the situation they face, since the types of enterprise just referred to often aim to develop ground-breaking innovations and these require a considerable amount of resources. In addition, there may be uncertain outcomes which can put most financial institutions off from funding them.

On the other hand, the probability of indicating a lack of funds as a barrier is lower for those SMEs already financially supported than for peers that have not received any public financial support.[55] This is corroborated by the fact that the higher the share of public funds received (out of total R&I expenditure), the lower the probability of indicating the lack of money as an obstacle to innovation. The interviews with SMEs confirm that it is often the case that once they have been successful in obtaining support, they tend to find it easier to obtain more.

[52] B. Becker, *Public R&D policies and private R&R investment: a survey of the empirical evidence*, "Journal of Economic Surveys" (2015) Vol. 29, No. 5, pp. 917–942.
[53] Our econometric analysis has regrouped the different barriers into 6 barrier categories, according to the pathway of responses given by SMEs, namely: 1)Lack of financing support for RDI activities, 2)Lack of support for internationalisation, 3) Lack of information on financial support, 4) Lack of information on non-financial support possibilities, on new technologies and new regulations, 5) Lack of support to acquire skills from outside, 6) Lack of support to develop skills in-house (including innovation management skills, skills for design, service and organisational innovation), 7) Lack of support for incubation activities, 8) Lack of support for networking and cooperation with other actors, including support to establish linkages with finance providers.
[54] The share of enterprises considering the lack of financing support as an important or very important barrier is: 90% of newly-established enterprises vs 80% of long established enterprises; 89% of micro-enterprises vs 74% of medium enterprises.
[55] The share of enterprises considering the lack of financing support as an important or very important barrier is 82%% of enterprises which have received financial support vs 90% of enterprises which have not received financial support.

In contrast to other barriers, the lack of financing support is considered equally relevant by SMEs throughout the EU. However, **SMEs based in Southern and Eastern EU tend to see other barriers** (e.g. concerning the access to information, the support for internationalisation, for skills' acquisition, incubation and networking) **as more important than SMEs in North-continental EU (i.e.** Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Lithuania, Luxembourg, Netherlands, Sweden, United Kingdom), thus suggesting that they have more difficulties in doing innovation in general.[56] This may be related to the characteristics of the innovation systems in such areas.

As mentioned above, the **lack of information**, especially on financing possibilities, is seen as a more important obstacle by enterprises with less experience or resources, such as micro and newly established enterprises, and respondents with a lower share of innovation expenditure in turnover. SMEs operating in less innovative sectors are more likely to maintain that lack of information on the market, new technologies and new regulation hamper their innovation activities. By contrast, as discussed above, the information barrier is less important for enterprises which have already received financial support or support aimed to raise awareness on support possibilities.

The **lack of support for internationalisation** hampers innovation activities, especially according to high-growth enterprises and SMEs whose innovation is based on research activities.[57] These two groups of enterprises might indeed be more interested in selling their innovative services/ products abroad than other SMEs. This is confirmed by evidence collected during the interviews. For instance, according to managers of an innovative scale-up company based in Germany, the main obstacle for this type of firm is bridging the gap between innovation and the market. In this regard, both intermediaries and SMEs interviewed mentioned the cost of managing IP as a considerable obstacle to operating on international markets. In fact, once a new product or services have been developed, IP management becomes essential for the innovation to be successful on the market. Monitoring regulatory and market developments, as well as the costs for patent translation fees in different EU Member States represent a significant burden for SMEs that aim to export the innovation to international markets.

SMEs for which lack of support for internationalisation is a particularly severe barrier might also be 'born global' businesses that operate in specific niches where they depend on multi-country markets to generate break-even turnover and profit. Hence, they would be more likely to be interested in this type of support.

Similarly, the **lack of incubation** support and of networking (especially with finance providers) is more relevant for micro and newly established enterprises, which are at an early stage of business.[58] Furthermore, a lower share of innovation expenses as a percentage of turnover is associated with higher importance given to the lack of incubation support.

Although the **lack of support to acquire or develop in-house skills** is regarded as less problematic by SMEs, medium-sized enterprises tend to ascribe more importance to both these factors (compared to small and micro enterprises). For example, 67% of medium-sized enterprises consider the lack of access to qualified staff and talents is an important barrier, whereas only 41% of micro enterprises have the same opinion. Moreover, the lack of

[56] This is in line with the country profiles elaborated by the Innovation Scoreboard. Available at: https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en.

[57] The share of enterprises considering the lack of support for internationalisation as an important or very important barrier is 49% of high-growth enterprises vs 45% of non-high-growth enterprises (considering enterprises with the same size) and 51% of enterprises with research-based innovation activities vs 41% of enterprises with not research-based innovation activities.

[58] The share of enterprises considering the lack of incubation support as an important or very important barrier is: 37% of micro-enterprises vs 20% of medium enterprises; 36% of newly-established enterprises vs 27% of long established enterprises.

support to develop skills in-house (e.g. innovation management skills, skills for service or organisational innovation) is a particularly relevant obstacle for enterprises with a low share of innovation expenditure as a percentage of turnover and which do not base their innovation on research, and also for those carrying out incremental innovation. These might be enterprises operating in the DUI innovation mode. Finally, SMEs in the services sector declared that their innovation is harmed by the insufficient support for skills acquisition (especially for service innovation) more often than enterprises in the manufacturing sector.[59]

The **business and innovation culture and mentality** in certain sectors and regions is another possible barrier to innovation, as highlighted by some interviews. In less developed regions it is more likely SMEs are found that are still at the pre-innovation stage. These types of firm do not see yet the value of innovation and therefore have not yet started their 'innovation journey'. In some parts of the EU, family-owned businesses can be seen to constrain innovation – whereas a different perspective is that with the change of hands within the family there is often an opportunity to innovate on a large scale. On this issue, however, there are conflicting opinions. Some believe that family businesses can be more innovative than public and large companies, because they can be more flexible and less constrained in decision making.

In addition to the typical barriers to innovation identified and explored in the literature, the survey explored the perceptions of SMEs and intermediaries of the **impact of recent or emerging technology, economic and market developments on innovation**, asking whether these could constitute a barrier to innovation. The majority of enterprises pointed to the **emergence of players with large market power and the increasing complexity of products and services** as important barriers to innovation. Intermediaries, on the other hand, pointed to the faster innovation cycles, the complexity and the global dimension of the value chains and the increasing emphasis on digitalization as the main barriers to innovation caused by the latest megatrends. The increasing emphasis on digitalisation, on green sustainable innovation and on open innovation are considered important challenges to innovation by one-third of SMEs responding to the survey (of any size), whilst around half of the intermediaries sees them as hampering innovation. We should explain that whilst digitalisation is considered to be an important opportunity by many SMEs, it also entails great costs and risks to them, in particular in more traditional sectors. Factors related to market power may also play a role - for example to the extent that digital data relating to machines and their operators are owned by large enterprises, e.g. in the automotive industry, but also with other electro-mechanical equipment. Such market dynamics could make SMEs very dependent on the data owners and restrict their ability to develop new innovations based on the use of the data in question.

Among enterprises, those working in the services sector (especially in innovative sectors) are particularly concerned with the large market power accumulated by a few players, while long-established SMEs are more likely to think that more difficult access to international markets (as a consequence of Brexit and trade tensions) will negatively impact on their innovation activities. This opinion is shared by 45% of respondents established before 2014. Interestingly, enterprises which have undertaken research-based and incremental innovation point more to innovation complexity since they might be more familiar with the transformations taking place in the market.

With the exception of the difficulties related to market access, which are equally perceived by SMEs in all EU countries, **SMEs in Eastern and Southern EU** (i.e. in Cyprus, Greece, Italy, Malta, Portugal, Spain, Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania,

[59] The share of enterprises considering the insufficient service innovation support as an important or very important barrier is: 31% of SMEs in the services sector vs 19% of SMEs in the manufacturing sector.

Slovakia, Slovenia) are more likely than SMEs in North-continental EU to **see emerging trends as obstacles to innovation, especially as far as digitalisation and new green policies** are concerned.[60] The different attitude towards digitalisation reflects the disparities in terms of current digital performance in the EU, with countries in North-continental EU better positioned than the others.[61] Other groups of SMEs particularly concerned with increasing digitalisation are those operating in non-innovative sectors. Interviews with intermediaries seem to confirm this result. In fact, some of them reported that digitalisation will represent a significant challenge as it entails major changes in the firm's business model. Thus, it may be particularly hard for SMEs that are more reluctant to undertake business and process innovation, namely smaller firms active in East and Southern EU.

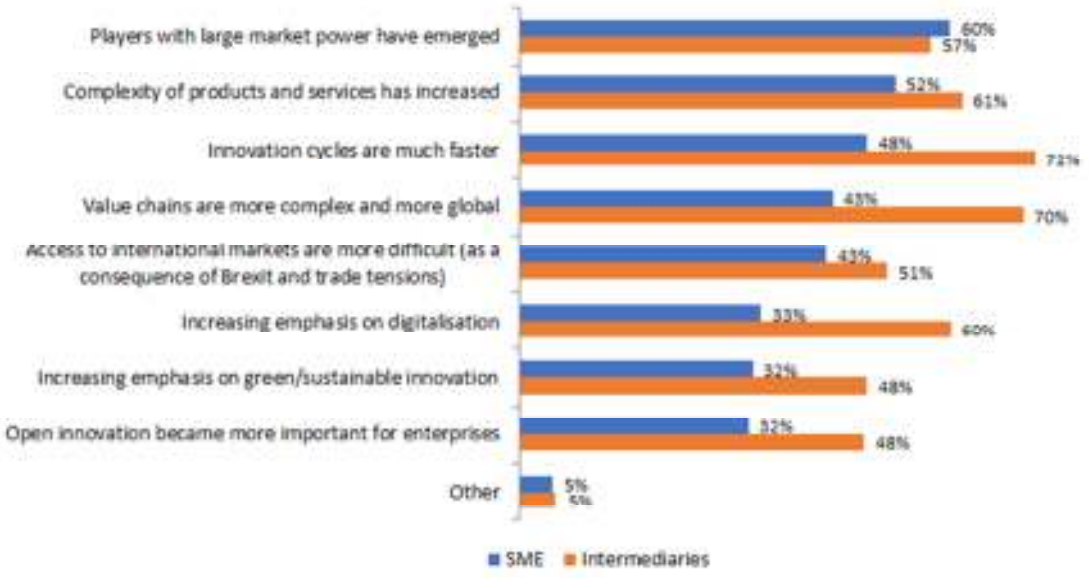
A key issue highlighted by both the literature review and the interview programme relates to the **access to and ownership of digital data**. This has some implications for the data or ICT platforms developed and owned by large enterprises, since these enterprises accumulate grant them huge market power with their use and this poses entry barriers for smaller firms and can constrain their innovative activities.

SMEs also face significant challenges with regards to the green and digital transitions, as evidenced in a recent report for the European Parliament.[62] The green transition creates considerable uncertainty for SMEs as well as potentially significant cost commitments that can constrain innovation, except possibly in the form of 'forced innovation' which enterprises have to undertake to comply with legislation. The plastics sector provides one example, and the digital transition also creates uncertainty for SMEs in that changing the business model might mean a loss of control by existing owner/ managers (who become dependent on technologists) and vulnerability to highly destructive risks such as cyberattacks, or data loss, all of which has been labelled the 'dark side' of digitalisation.[63]

A further challenge, when compared to USA and Chinese companies, was identified by SMEs during the interviews, as well as by some public sector organisations involved in SME innovation. This concerns the lack of scale and support with regards to public sector purchasing, e.g. when compared to the US Department of Defence as a pilot customer. Few public sector buying organisations in Europe have policies to support innovation (e.g. along the lines of Start-Up Amsterdam). In addition, the current pandemic crisis may be having a strong impact on business innovation activities. According to the intermediaries interviewed, the expected **impact of COVID-19** on innovative firms is mixed. On the one hand, it is expected to slow down investment in innovation, since many SMEs are facing extremely hard business and economic challenges which put at risk their presence on the market. However, some intermediaries also believe that the crisis may also have positive impacts on innovation because it is forcing enterprises to adapt their business models and their organisation to a new paradigm.

[60] The share of enterprises considering the increasing digitalisation as an important or very important barrier is: 28% of SMEs in North-continental EU, 38% of SMEs in Southern EU, 40% of SMEs in Eastern EU.
The share of enterprises considering the increasing emphasis on green policies as an important or very important barrier is: 27% of SMEs in North-continental EU, 37% of SMEs in Southern EU, 36% of SMEs in Eastern EU.
[61] See, for instance, the scoring of the Digital Economy and Society Index (DESI): https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi.
[62] Smit,S.J. and Centre for Strategy and Evaluation Services (2020); op.cit.
[63] De Lemos, B. (2019) ; The Dark Side of Digital Transformation: 8 Emerging Digital Risks, RSA

Figure 5. Share of SMEs and intermediaries thinking that recent developments will constitute an important or very important barrier to innovation



Source: Authors' elaboration of survey to SMEs and intermediaries' results.
A total of 2,150 SMEs and 496 intermediaries answered this question.

3.2.2 Type of innovation introduced

94% (out of 2168) of SMEs in our sample introduced at least one form of innovation in the last three years (2017-2019), especially in the form of new or significantly improved products (65% of SMEs) and services (26%). Other types of innovation, such as process innovation, organisational methods, logistics, delivery and distribution processes and new business models represent a residual share and were introduced by a minority of respondent SMEs (Figure 6, orange bars).

A comparison with the 2009 survey shows that, despite the fact that the share of innovative SMEs sampled is the same (94%), there are significant differences in the distribution of respondents according to the type of innovation introduced. Figure 6 illustrates that in the 2020 consultation, the percentage of SMEs that have introduced new or significantly improved products is 13% higher than in the 2009 (65% vs 52%); conversely, only 26% of respondents in the 2020 survey introduced new or significantly improved services as compared to 48% in 2009. This piece of evidence is particularly important, considering that the share of micro enterprises responding to the survey in 2020 is higher than the one in 2009 (67% vs 45%). Moreover, there is a significant difference between 2020 and 2009 when looking at the other form of innovation, particularly at processes, organisational and other business models.[64]

[64]The Team also made a comparison with the evidence from the Community Innovation Survey (2016). This study corresponds with CIS in that small and medium firms in Italy and Germany mainly introduced new or significantly improved products as a form of innovation, followed by new services in this study and by new processes in the CIS. It was not possible to go further because of significant differences between the CIS and the survey launched for the purpose of this study. They primarily concern the firms' size and their geographical distribution as well as the type of innovation investigated.

Figure 6. Share of respondents in 2009 and in 2020 introducing any form of innovation activities in the previous three years

Source: Authors' elaboration of survey results and results of the 2009 public consultation

While our sample includes a large share of innovative firms, the econometric and descriptive data analyses allow us to understand better the factors that play a role in determining the how innovation is introduced and the type of innovation developed. More specifically, we used econometric analysis in the form of logistic regression models to statistically test the probability of introducing a specific type of innovation as a function of the SMEs' characteristics and, in this case, of the type of support received. Annex C.3.3 presents in detail the results of this exercise which are summarised below.

SMEs introducing innovations in the form of **new or significantly improved products are concentrated in the North-Continental EU Member States**,[65] **where they are active in innovative manufacturing sectors.** These firms are also characterised by a significant turnover growth rate. According to the evidence collected, product innovations are, in general, the result of considerable investment in innovation and research activities. In particular, investment in innovation is significantly high for firms producing computer, electronic and optical devices, as well as chemical, pharmaceutical and bio-technology products and for firms active in the mechanic sector. Moreover, among SMEs surveyed, those introducing new products tend to consider their innovations to be radical, especially firms that are active in the transport and energy sectors.[66]

Firms based in North-continental EU countries also show a higher probability of introducing innovative services (together with SMEs active in the Eastern EU Member States) in contrast to SMEs in South Europe. The evidence seems to suggest that in Southern EU there are more factors hampering innovation in the services sectors. An analysis of the barriers faced by SMEs in southern EU suggests that the main obstacles to the implementation of innovative services are the financing of innovations, including the lack of financing support, an absence of links with finance providers and a lack of information on access to financing possibilities. Beyond geographical aspects, significant turnover growth

[65] Please, see the country categories identified by the European innovation scoreboard: https://ec.europa.eu/growth/sites/growth/files/eis2020_leader_map-01.png

[66] In order to provide a more detailed picture of the results concerning the manufacturing industry, which is composed by a large variety of sectors, these figures have been obtained by breaking down data collected on manufacturing firms according to the sub-sector of operation (question A3.2. "In which sector are you active?"), their investment in innovation (question B3. "In general, how would you consider your innovation activity?") and their perception of the innovation introduced (question B4. "Approximately how much did your company spend in 2019 on all your innovation activities?").

rates and a consolidated level of activity on the market (reflected by the fact that the firms were established before 2014) seem to be important conditions for introducing new or significantly improved services.

Similarly to product and services innovations, **firms operating in Northern and Continental EU are also more likely to introduce process innovations, new business and marketing models and new logistics and organisational methods** than enterprises from other geographical areas. Results obtained suggest that these types of innovation, which are perceived to be radical, seem to be a prerogative of medium-sized enterprises, active on international markets, which in general have the resources required to transform their business structure. This evidence seems to be in line with the literature. For instance, Cohen and Klepper (1996)[67] showed that the share of process R&D undertaken by firms increases with the firm size, since larger firms are able to apply the results and spread the costs over a greater output. Consistently with the results above, Fritsch and Meschede (2001)[68], in a study focused on German enterprises, found that small enterprises devote more resources to developing product innovations rather than to innovative processes.

Beyond SMEs' characteristics, we asked whether receiving public support is likely to increase the probability of introducing an innovation. In general, we found that **firms that had received public support are positively associated with the implementation of innovations**. In particular, the share of innovative SMEs is higher among firms which have benefited from public support (97%) as compared to the rest of the sample (86%). This result seems to be aligned with evidence collected in the literature review showing how public R&D subsidies[69] succeed in stimulating private R&D expenditure. Furthermore, results show that **different forms of innovation require a different type of public support.** For instance, while financial support seems to be positively associated with any type of innovation, the probability of introducing new products is increased when the firm receives support for the acquisition of specific skills or internationalisation. On the other hand, firms providing services seem to have more diversified support needs, e.g. for consulting and training schemes (such as support for the identification of innovation potential, raising awareness of support possibilities and fostering technology knowledge transfer).

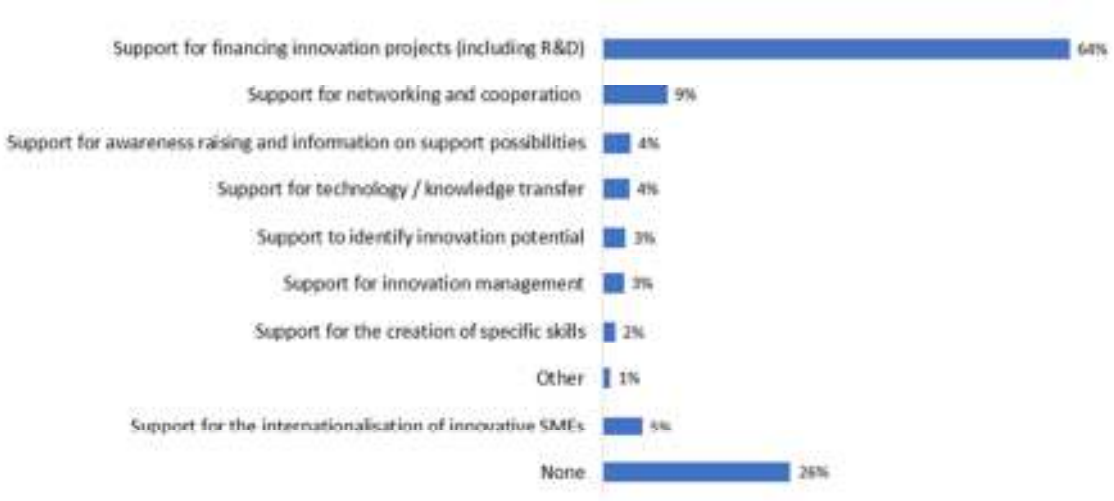
3.2.3 Forms of innovation support received by SMEs

The majority of SMEs surveyed (74% of 2164) received some kind of public innovation support in the previous three years (2017-2019). In particular, 64% of respondents received support to finance innovation projects (including R&D). As far as the use of other forms of innovation support is concerned (e.g. networking and cooperation between actors, awareness-raising and information on support possibilities and for technology and knowledge transfer), the 2020 survey reveals that less than 10% of respondent SMEs have benefitted from them.

During the period 2017-2019, the most widely used **forms of support** were grants (43%), tax incentives (15%) and loans (12%). The 2020 survey also reveals that the main **sources of public funds** in support of innovation came from national governments (37%), followed by European funds (34%), and regional/federal authorities (23%).

[67] W.M Cohen and S. Klepper (1996). Firm size and the nature of innovation within industries: The case of process and product R&D. Review of Economics and Statistics 78: 232–43.
[68] M. Fritsch and M. Meschede (2001). Product Innovation, Process Innovation, and Size. Review of Industrial Organization volume 19, pages335–350.
[69] In this respect, it is important to note that grants are the most widely used instrument to support SMEs in the sample.

Figure 7. Distribution of respondents according to the type of innovation support received in the previous three years



Source: Authors' elaboration of survey to SMEs' results

When **comparing the above figures with the results of the 2009 consultation**, we observe that the share of firms which received financial support for innovation is significantly higher (64% against 49%). Conversely, the share of firms which received other types of support is half of the percentage registered in 2009. At the same time, we observed that whereas in 2009 only 17% of firms received a share of public funds out of the total expenditure on innovation greater than 25%, in 2020 these SMEs represented 36% of the sample.

In order to highlight the **factors determining the probability of receiving public support for innovation and detect the type of support provided**, the study team performed an econometric analysis the results of which are synthesised in the paragraphs below (see Annex C.3.3). This analysis tests the probability of receiving a specific type of public support for innovation depending on the SMEs' characteristics, the type of innovation introduced and type of barrier faced by the SME.

In general, **SMEs in North-continental EU countries have a higher probability of receiving public support**, of both financial and non-financial kinds. Moreover, SMEs established in North-continental and Southern EU Member States are more likely than SMEs in Eastern Member States to receive financial support,, the most widely used form of support for innovation.

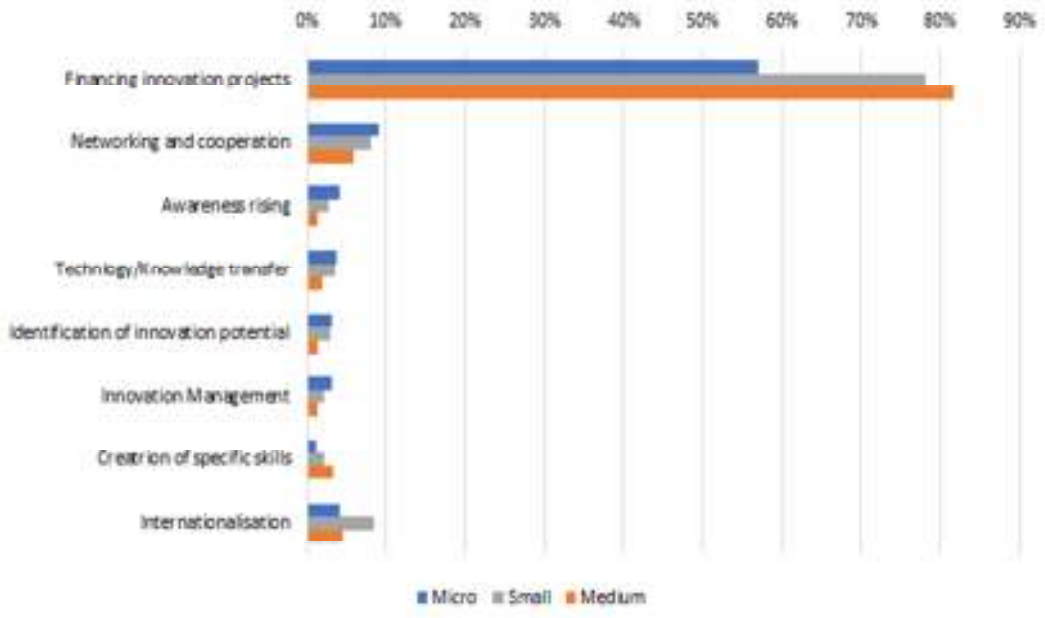
Public support to innovation, in particular financial support, has been concentrated in small and medium sized enterprises active in manufacturing sectors, especially firms investing a significant share of their turnover in innovation and implementing research-based solutions. Breaking down the above results, we observe that the main target of public financial support is firms operating in technology and knowledge-intensive sectors of manufacturing, such as the sectors of space and robotics, mechanical, manufacturing materials and computer and electronic devices.[70] These would be firms operating to a significant extent in the Science-Technology-Innovation (STI) mode.

[70] In order to shed more light on the results concerning the manufacturing industry, which is composed of many different sub-sectors, these results have been obtained breaking down data collected on manufacturing SMEs according to the different sub-sectors and the type of public support received.

Moreover, the analysis shows that firms developing new or significantly improved products also have a higher probability of receiving financing support for innovation.

Conversely, **receiving public support appears to be more challenging for start-ups and micro enterprises**. Whereas respectively 83% and 88% of small and medium sized enterprises in the sample have received public support for innovation, this share is significantly lower for micro enterprises (less than 70%). This gap becomes even larger if we consider support for financing innovation projects (only 57% against around 80% for other types of firm).

Figure 8. Share of surveyed SMEs according to the kind of public innovation support received, by size



Source: Authors' elaboration of survey to SMEs' results

The above figure is particularly relevant if we consider that, as highlighted in the sections above, a lack of financing support, together with missing links with providers of finance, are considered to be the main barriers to innovation for micro enterprises. In particular, we observe that for micro enterprises, public support is crucial to financing innovation projects. When asked about the added value of public support, more than 50% of micro enterprises surveyed reported that they would not have been able to complete innovation projects without public support schemes. It is important to remember here a finding of the literature review. Masiak C. et al. (2017)[71] discovered that state subsidies seem to be more often used by small and medium-sized enterprises and less by micro firms. In the authors' opinion, this result may be either due to the specific structure of these subsidy initiatives, which does not fit the requirements of micro firms or to the fact that micro firms lack an awareness of government support programmes. The survey results are consistent with this finding. They show that firms which have not received any public support are also those which have declared high financial barriers, which have limited information on access to financing possibilities and experience barriers to cooperation and networking, and these are generally micro enterprises.

[71] Masiak, C., Moritz, A., Lang, F. (2017). Financing Patterns of European SMEs Revisited: An Updated Empirical Taxonomy and Determinants of SME Financing Clusters. Working Paper 2017/40, EIF Research & Market Analysis. Retrieved.

Public support schemes tailored to micro enterprises would increase their absorption capacity. In fact, different micro firms who were interviewed highlighted their lack of the internal resources required to undertake a complex application process for public financial support for innovation. Entrepreneurs interviewed have reported that, despite having a high technical capacity to develop innovation projects, they lack sufficient skills such as design and project management, including how to define an innovation strategy and a strategy to obtain public support. However, these aspects are specifically assessed in the evaluation of applications, since they are important in determining the success of a project.In order to overcome these difficulties, one solution may be to rely on external consultancy but these services are generally unaffordable for smaller enterprises. According to the interviewees, the significant amount of time and financial resources required to complete the application processes and the risk of an unsuccessful application due to high competition, especially from larger firms, often prevents smaller businesses from applying for these public support schemes.

Survey results also showed that **a higher share of newly established micro and small enterprises have benefited from other support services (such as consultancy advice and technical assistance)** as compared to larger firms, which have, in general, more resources and capacity to implement innovation projects or internal services including, for instance, specific units dedicated to innovation.

The **survey of intermediaries** revealed that, while only less than 35% of intermediaries provided financial support for innovation projects, they seem to have more a more pronounced bridging and consulting role. In fact, the great majority of them provided support for networking and cooperation between actors (84%) and support in the form of awareness-raising and information on support possibilities (74%). In particular, the former type of support would perfectly match the need of micro enterprises which, as illustrated in the sections above, stressed the relevance of networking barriers, especially because their innovation activity is challenged by insufficient links with finance providers. As regards the main obstacle to innovation identified by medium firms, only 40% of intermediaries support firms in the creation of specific skills.

Less than 10% of intermediaries surveyed specifically target micro enterprises in the provision of support to increase cooperation and networking. Similarly, the share of intermediaries targeting medium sized firms with support for the development of specific skills is particularly low. These results suggest a possible mismatch between the type of support provided by the intermediaries and the needs faced by specific types of enterprises.

At the same time, 50% of intermediaries reported that they are in the process of introducing new support measures. According to 54% of them, these new measures will increase the support of high-growth firms. This is well aligned with the need of this type of firms which evaluated as extremely important the support received: 65% of them reported that they would not have been able to implement innovation activities without public support schemes.

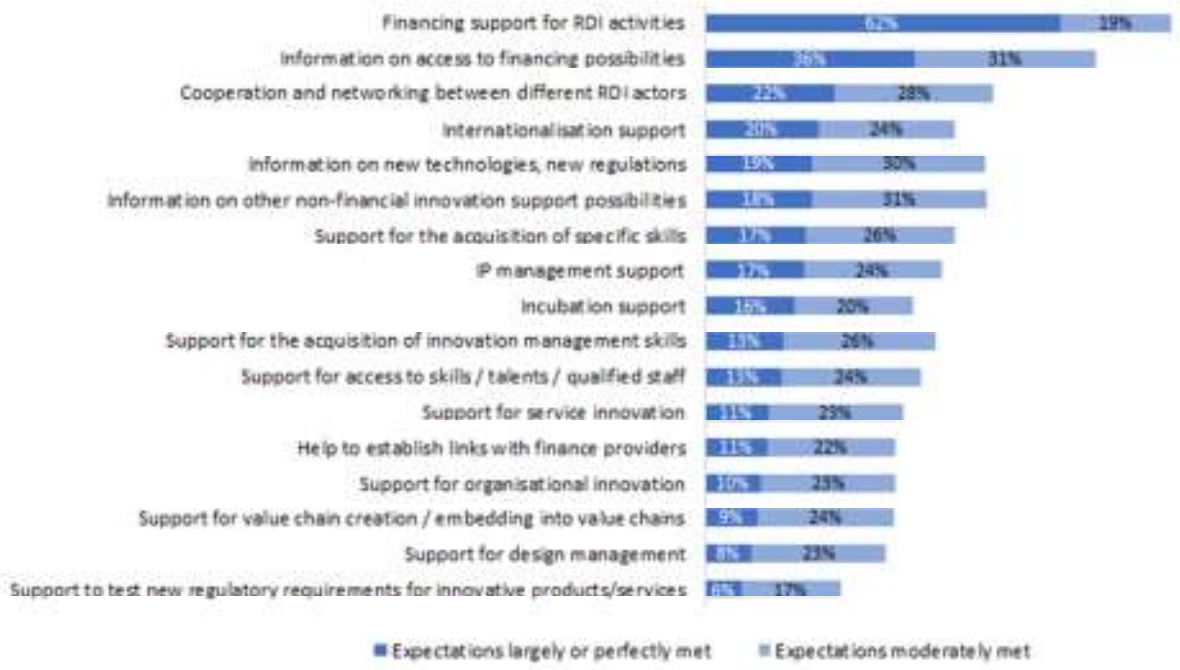
3.2.4 SMEs' level of satisfaction with the support received

The **overall perception of satisfaction** on the part of beneficiaries with public innovation support **is mixed.** When asked to assess the extent to which the public support they received met their expectations, SMEs showed a **low level of satisfaction**[72] **for all** types of support initiative, **except for two,** namely: **financing support for R&D activities and receiving information about financing possibilities**. Nonetheless, **the level of**

[72] We consider a low level of satisfaction when the % of respondents stating that the support perfectly or largely met their expectations is smaller than the % of respondents stating that the support did not meet or weakly met their expectations.

satisfaction of enterprises has improved compared to 2009 for all the innovation support measures investigated. [73]

Figure 9: SMEs' satisfaction with the support received



Source: Authors' elaboration of survey to SMEs results.
A total of 1,587 SMEs answered this question.

Moreover, if the sample is restricted to the SMEs which have received a particular type of support in the previous three years, their expectations were mostly met also with reference to internationalisation support, support for cooperation and networking between different RDI actors, design management support and information support on other non-financial innovation support possibilities. Cossequently, **the relatively lower degree of satisfaction could well have been influenced by not having received that type of support recently**. For example, micro enterprises, which have received less financing support compared to the other size categories[74], are the least satisfied with it.[75] Similarly, newly established SMEs are less satisfied than SMEs established before 2014, which are more likely to have received financial support.[76] The econometric analysis has confirmed that **enterprises which have received financial support are indeed more satisfied, not only with the financial support but also with other types of support** such as support to have access to information and skills, incubation support and support for networking with other actors (it may be of course that these forms of support are linked in overall support packages). In this regard, the higher the share of public funds received out of total R&I expenditure, the more satisfied SMEs are, not only with the financial support, but also with the support received to have access to information and to encourage networking.

[73] More SMEs stated that the support received had met their expectations in particular as regards financing support measures (from 34% in 2009 to 62% in 2020) and support to awareness raising and information on support possibilities (from 21% in 2009 to 36% in 2020).
[74] See paragraph above on the type of support received.
[75] The share of enterprises whose expectations were perfectly or largely met with regard to financial support is: 56.4% among micro-enterprises, 71.6% among small enterprises and 67.9% among medium enterprises.
[76] The share of enterprises whose expectations were perfectly or largely met with regard to financial support is: 65.6% among enterprises established before 2014, 56.5% among enterprises established after 2014.

Whereas more than 65% of SMEs in North-continental EU and Eastern EU are largely satisfied with the financial support received, SMEs in Southern EU are less so, with 56.5% of them declaring that they are satisfied.

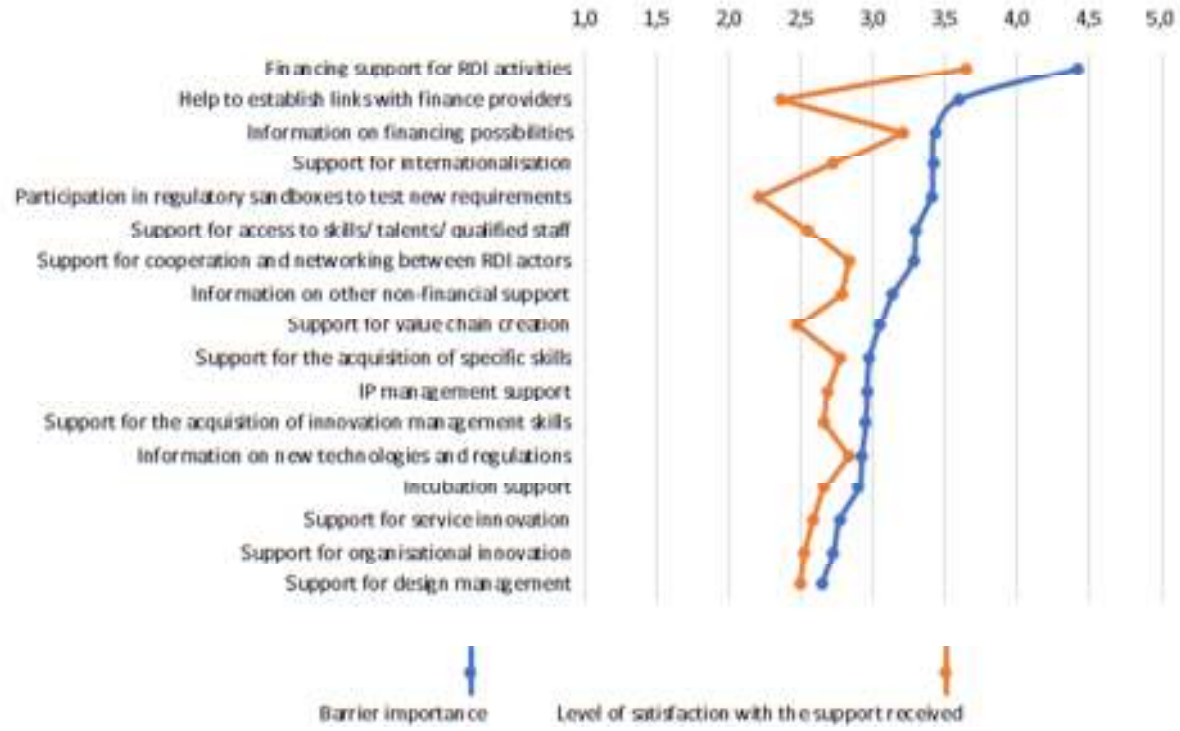
When it comes to satisfaction with the support for acquiring new skills (either from outside or by developing them in-house), on average less than 15% of respondents declared that they were largely or fully satisfied with it. However, respondents from Southern and Eastern EU are slightly more satisfied than respondents from Northern EU, especially as far as skills for service innovation and innovation management are concerned.[77] Respondents active in non-innovative sectors tend to be more satisfied than other SMEs with the support to develop skills in-house. Furthermore, newly established SMEs have a more positive opinion of the support received for IP management skills and for the acquisition of specific skills[78].

Although the general level of satisfaction is quite low, **the SME categories that need more incubation support** (namely, smaller and newer enterprises) **are slightly more satisfied with it than the others**. Incubation support also better met the expectations of SMEs active in non-innovative sectors than in innovative sectors. It is worth mentioning here that, differently from the rest of the sample, **gazelles**[79] tend to be more satisfied with the support received for incubation, internationalisation and the acquisition of specific skills. In this regard, it is worth mentioning that intermediaries responding to our survey and offering these types of services explicitly target innovative SMEs and scale-ups.

With some exceptions, the level of satisfaction for a specific type of support is correlated with the perceived importance of the corresponding barrier (see Figure below).[80] **This means that SMEs are more satisfied with public support when it tackles more important barriers to innovation**.

[77] The share of enterprises whose expectations were fully or largely met with regard to the acquisition of service innovation skills is: 8.8% of SMEs in North-continental EU, 13% of SMEs in Southern EU, 15.2% of SMEs in Eastern EU. With regard to the acquisition of innovation management skills it is: : 11.1% of SMEs in North-continental EU, 15.7% of SMEs in Southern EU, 16% of SMEs in Eastern EU.
[78] The share of satisfied SMEs for IP management is: 13.9% of SMEs established before 2014 vs 20.9% of SMEs established before 2014. The share of satisfied SMEs for the acquisition of specific skills is: 13.7% of SMEs established before 2014 vs 21.7% of SMEs established before 2014.
[79] Defined as enterprises that are up to five years old with average annualised growth (turnover or employment) greater than 10% per annum, over a three year period (Eurostat definition).
[80] Corr. Value: 0.76.

Figure 10: SMEs' average opinion on the importance of a barrier and their average level of satisfaction with the support received



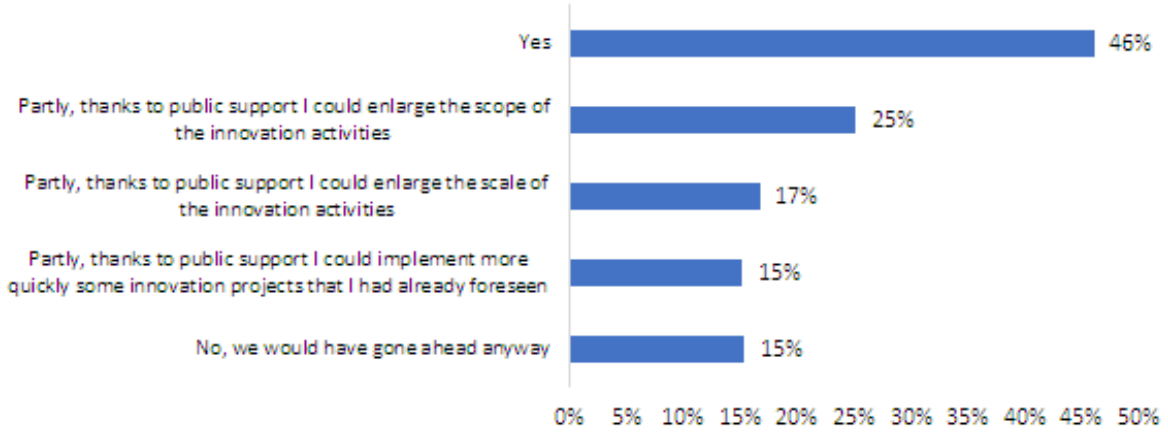
Source: Authors' elaboration of survey to SMEs' results.

SMEs benefitting directly from EU support expressed a higher level of satisfaction compared to those which have received support from the national or regional level.[81] On the one hand, the EU support to innovation better matches the SMEs' expectations especially in terms of financing support, facilitation of internationalisation, acquisition of skills and qualified staff from outside, and stimulus to cooperation and networking between different RDI actors. This result is confirmed by evidence collected in the interviews, where interviewees reported how EU initiatives, such as the EEN, are extremely valuable initiatives to stimulate innovation through the building of a network to exchange views between innovation actors across Europe. On the other hand, there is higher satisfaction with the support provided at the regional level that aimes to raise awareness- and with incubation services.

Although the degree of satisfaction varies depending on the type of support, **the great majority of SMEs surveyed** (85% of respondents) **considered the public support received as essential to undertake their innovation activity**. In particular, 43% of these enterprises reported that they would not have been able to complete their investment without public support. At the same time, for 12% of SMEs surveyed public support has accelerated the time needed to complete the investment. Public support enabled an increase in the scope and the scale of the innovation activity of 18% and 8% of respondents, respectively. A **comparison with the results of the previous consultation** reveals that only 15% of respondents declared that they would have been able to undertake the same innovation activity without public support, compared to 53% in 2009.

[81] It should be noted that respondents were aware that the survey was commissioned by the European Commission. Whether this information may have affected the response behaviour of the surveyed stakeholders cannot be assessed.

Figure 11: Respondents' perception about the added value of public support received when asked whether their innovation would not have been developed or introduced without this support.



Source: Authors' elaboration of survey to SMEs' results
A total of 1,419 SMEs answered this question. Multiple answers were possible.

The econometric analysis shows that **financing support and support for cooperation and networking** are more likely to provide higher added value, whereas the support schemes for internationalisation provide less added value (see Annex C.3.4).

Public support for innovation was particularly important for SMEs which benefitted the most from these schemes, namely **firms operating in the manufacturing sector and enterprises in North-continental EU**. For instance, almost 55% of these SMEs reported that they would not have been able to complete the investment in innovation without public support. This result seems to suggest that public support turned out to be an effective instrument to support innovation in the sectors and geographical areas where these schemes have been implemented, particularly when coordinated at national and EU level.

However, public support is not only considered crucial by its main beneficiaries. For instance, **micro enterprises see public support as a fundamental instrument to overcome financial barriers** to innovation and the lack of cooperation and networking between innovation actors. In fact, when asked about the added value of public support, more than 50% of micro enterprises surveyed reported that they are not in a position to complete innovation projects without public support schemes. On the other hand, **small and medium sized enterprises, and enterprises devoting a significant share of their turnover to innovation**, are more likely to declare that the public support had a partial added value, as it **allows them to enlarge the scope** of their innovation activities, by making more funds available and reinforcing technology and knowledge transfers. In particular, the public support was effective in helping enterprises to overcome challenges arising from the increasing complexity in in developing innovation (such as increasing complexity of products, global value chains, and faster innovation cycles), enabling them to expand their areas of innovation while exploring new possibilities. At the same time, public support enabled **start-ups and enterprises in innovative sectors** of the economy to reduce the time needed to complete their innovation activity.

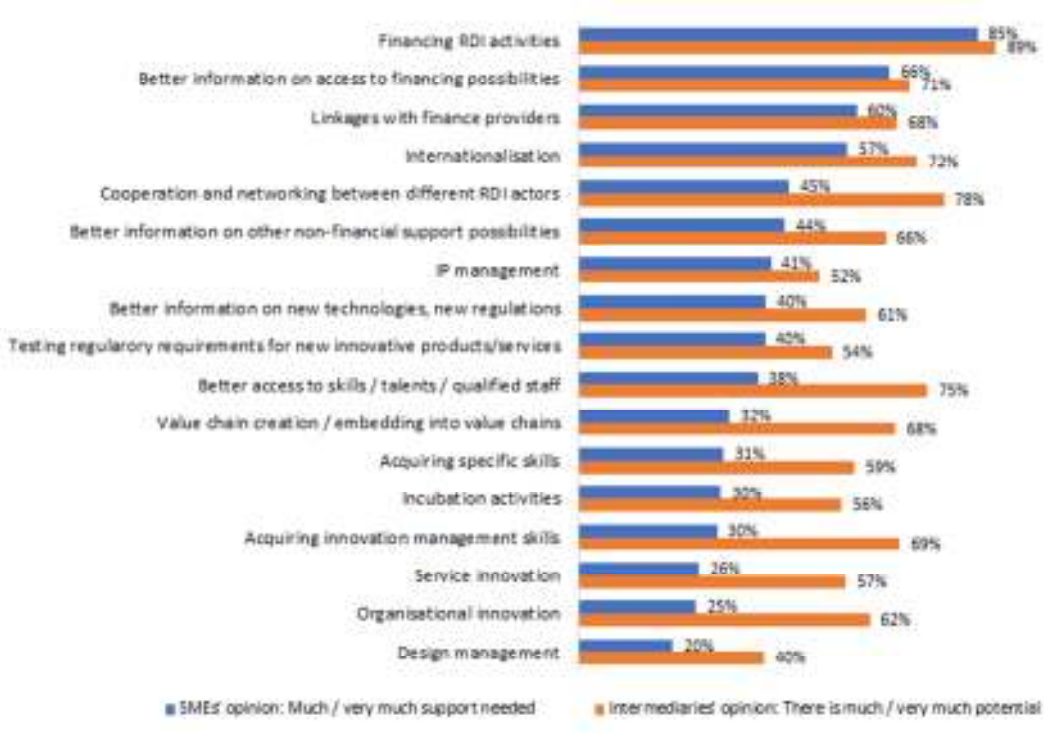
Despite the positive opinion on the added value of the support received, when asked about the **added value of selected EU support initiatives**, the survey suggests a low level of familiarity among SMEs with EU initiatives such as InnovFin, the European Cluster Collaboration Platform (ECCP), the COSME Loan Guarantee Facility, Startup Europe and the international IPR Helpdesks. The Enterprise Europe Network (EEN) is the best known initiative (although 38% of respondents from Eastern Europe still do not know it). The respondents' opinions on the added value of the EEN are mixed: according to 26% of the

SMEs its added value is high or very high; in contrast, the added value is limited or very limited for 25% of them. Intermediaries are instead more aware of the EU initiatives and have a positive opinion of their added value. Nonetheless, **only 21% of intermediaries** consider that the EU support measures are easily understandable by the stakeholders.

3.2.5 Gaps in existing SME innovation support

SMEs declared they would need better public support for the following types of initiatives: **support aimed to improve their access to finance, awareness-raising about financing possibilities, cooperation and networking with other actors, and internationalisation**. More SMEs think that little or very little support is needed when it comes to acquiring design management, innovation management and other skills, carrying out service or organisational innovation, receiving incubation services or entering new value chains. This result could be explained by two possible reasons: on the one hand, it is possible that SMEs underestimate the importance of these forms of public support to address the barriers hampering innovation; on the other hand, SMEs may consider the currently existing level of service provision already adequate.

Figure 12: Share of SMEs thinking that much or very much support is still needed vs % of intermediaries thinking that there is much or very much potential for that type of support



Source: Authors' elaboration of survey to SMEs results.
The total number of respondents ranges from 1,900 and 2,016 SMEs and 465 to 479 intermediaries.

In general, **there is an alignment between the perceived importance of a certain barrier and the request for more support in that area**. This relationship is confirmed when differences among SME' groups, sizes, sectors etc. are taken into account. It also means that **the variables that explain divergences in opinion about the gaps to be filled are the same ones that explain divergences in opinion about the barriers' importance**. For instance, newly established and micro enterprises seek more financing support, more

support to obtain information on financing possibilities[82] and more support to establish links with finance providers. These firms are also those declaring a higher need for more incubation support. On the other hand, medium enterprises tend to ask for more support for acquiring new skills (both from outside or through in-house development). At the same time, **the call for more support is not related to the level of satisfaction of certain groups of SMEs**.

The study team has also calculated the existing gap between the importance given to a certain barrier and the extent to which the enterprises' expectations for the corresponding type of support are met. Although the gap is still significant for certain types of support (e.g., for the support to help establish links with finance providers or for internationalisation), the econometric analysis pointed to the **efficacy of public support in reducing the gap** between the barrier importance and the level of satisfaction. In particular, providing funds for RDI activities contributes to reducing the financial gap and the gap on information on financing possibilities: the higher the share of public funds received, the narrower these two gaps tend to be.

Box 4: Support gaps identified in the course of the interviews with SMEs

In the course of the interview programme two additional points of interest related to gaps in support were mentioned:

- Several SMEs indicated that for them a key gap was that between the development of the product and service and its commercialisation: the final step in the innovation process. By this no VC funding is meant, for example, but commercialisation and sales expertise (sales and business development) that can lead to the product or service being sold and generating revenue for the enterprise.

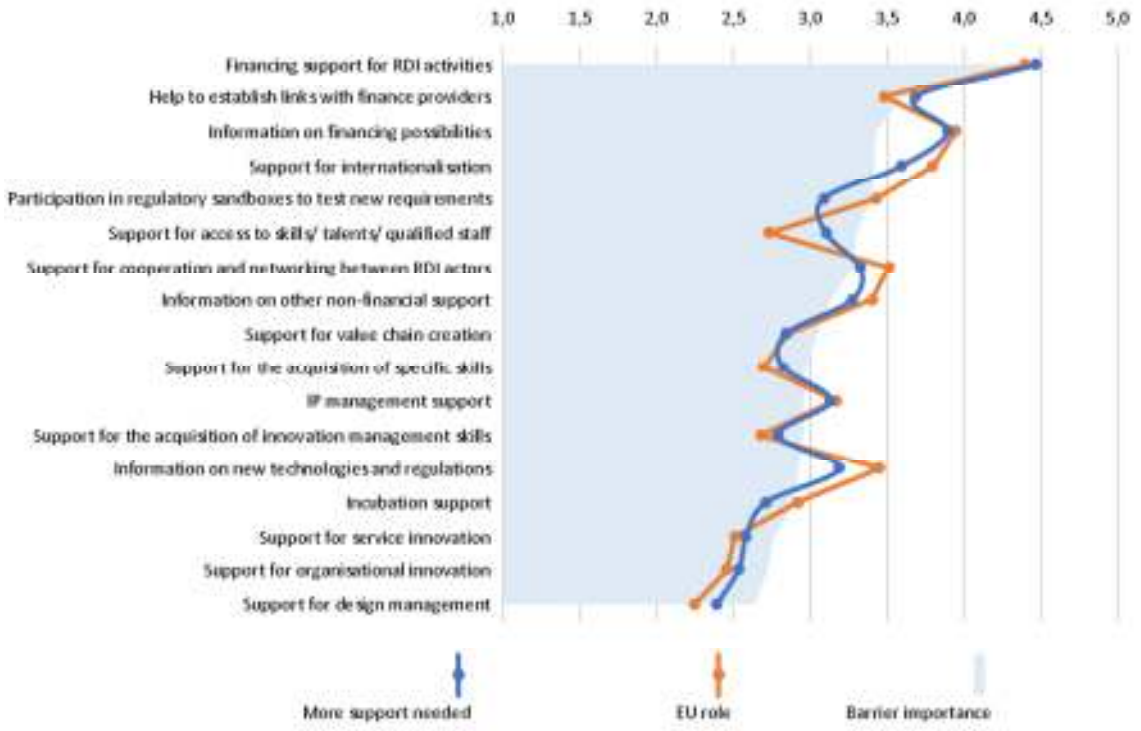
- The question was raised as to whether public innovation support might be too much targeted at new enterprises and start-ups and not enough at older and more established medium-sized enterprises.

Both SMEs and intermediaries indicated that they expect the EU to have a relevant role in providing this additional support, especially with regard to providing financing support, making relevant information available, encouraging internationalisation and cooperation among innovation actors. Some differences between innovative and non-innovative enterprises can be highlighted: non-innovative SMEs recognised a greater role for the EU in providing incubation support, support to acquire qualified staff and skills and to receive information on non-financial possibilities. More innovative SMEs, instead, highlighted the role of the EU in internationalisation support.

When it comes to the role the EU should have, the geographic area to which the SME belongs seems to be a key driver: **a larger share of enterprises in North-continental EU assigned a limited or very limited role to the EU in providing different types of support**.

[82] 65% of micro-enterprises sought much or very much support to establish links with finance providers vs 27% of medium enterprises.

Figure 13. SMEs' average opinion on the barrier importance, the amount of support that would be needed in the future and the role the EU should have in offering that support



Source: Authors' elaboration of survey to SMEs' results

As far as the providers of innovation support are concerned, the majority of SMEs expect better innovation support from innovation and development agencies. At the same time, around 40% of respondents maintain that the innovation support provided directly by the EU, the national or regional government should be improved. In general, **public actors, at EU, national or regional level, are seen as being most responsible for offering better support** for innovation, followed by universities and research centres. Among the private providers, SMEs seem to appreciate the support from investors and venture capital organisations. Less than 20% of respondents called for more support from other types of private organisation (e.g. business organisations, Chambers of Commerce, incubators, development banks).

When it comes to the possible ways in which public innovation support could be made more effective, all the possible improvements listed in the survey questionnaire were considered important or highly important by at least 42% of SME respondents. However, **introducing fast-track procedures for administration and evaluation of projects remains the favourite way to provide support more effectively** according to more than 80% of SMEs[83] and intermediaries. Evidence collected during the interviews confirms this result and highlights the significant impact of cumbersome procedures on SMEs' innovation activities. In fact, among the most critical points in improving the application processes for public support, SMEs pointed to the need to streamline the administrative requirements and reduce the time taken to obtain the results of the application process. According to the interviewees, this aspect plays a crucial role for smaller firms given their business structure. In fact, burdensome administrative requirements lead firms to resort to consultancy services to complete the application process and manage the grant. However, in most of the cases it

[83] SMEs indicating this option were 83% in 2009.

has been reported that these services are particularly expensive and use up resources which could be instead devoted to in-house innovation activities. Interviewees suggested that as much as 5-10% of total grant money might go to professional application writers.

Another finding emerging from the survey results concerns the need to **target** public support more effectively **on enterprises with high-growth potential**. This need is raised especially by small and medium enterprises, innovative and high-growth enterprises, and enterprises operating in the service sectors. Additionally, some entrepreneurs and managers interviewed reported that in most cases, EU schemes that support innovation are often too competitive, since they aim to address different types of firm operating in many different sectors. Designing programs which focus instead on a few economic sectors or are targeted at specific types of SME would increase the chances of smaller business to receive public supportby.

More collaboration between enterprises, Research and Technology Organisations (RTOs), and digital innovation hubs is considered necessary to improve the effectiveness of innovation support measures. This should be complemented by more integrated innovation support schemes involving different actors at the same time.

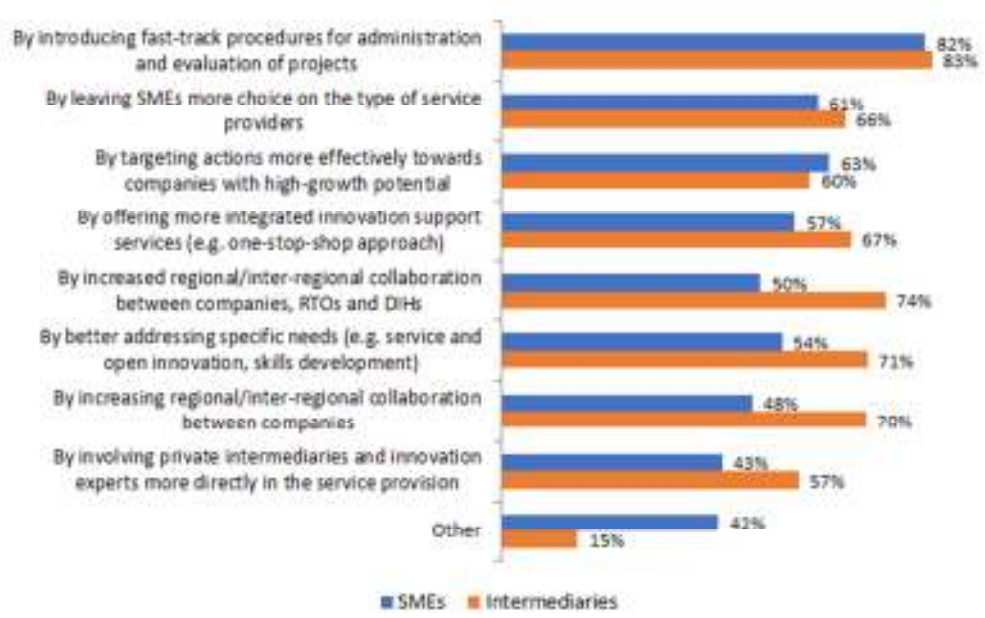
Box 5: The role of large enterprises in supporting SME innovation

In the course of the interview programme several SMEs and intermediaries discussed the role that large enterprises might play in SME innovation support ecosystems. While some views were negative, others were more positive, and it appeared that the matter is quite nuanced and requires careful attention and management.

SMEs in the services sector valued more than SMEs in manufacturing the option to better address specific needs (e.g. service and open innovation, skills development) and of having more integrated innovation support services (e.g. a one-stop-shop approach).

The recent survey results do not significantly differ from the results of the 2009 consultation on this point. One point of divergence relates to opinion on the need to involve private intermediaries and innovation experts more directly in the service provision: this view is shared by 43% of respondents in 2020 as compared to 63% in 2009.

Figure 14. SMEs and intermediaries' opinion on how public support could be provided more effectively (High or very high importance)



Source: Authors' elaboration of survey to SMEs and intermediaries' results
A total of 2,061 SMEs and 492 intermediaries answered this question

3.3 Synthesis of the survey results

In this section we summarise the main results of the analysis, by combining information related to the specific themes discussed in Section 3.2. To support the identification of the main messages and of underlying patterns in the survey data, we rely on the results of the econometric analysis and of the Bayesian Network Analysis (BNA - see Annex C.4 for more details). The BNA is a method based on probability inference that is used to model causal relationships between variables. It combines graphical map analysis with statistical analysis to estimate and visualise the conditional independence and dependence relationships among variables. We processed the survey data with BN analysis algorithms to express in probabilistic terms the dependency relations among variables, while allowing multiple relations among them to be observed.

The main findings of the analysis are summarised as follows.

- **There are still barriers hampering SMEs' innovation in Europe**. In general, SMEs in Southern and Eastern Europe seem to face higher innovation challenges compared to SMEs in Northern and Central Europe. These barriers originate from both traditional barriers to innovation and new emerging trends. However, the perception of obstacles to innovation varies considerably by type of SME.
    - **Micro enterprises see the lack of funds as the primary obstacle to innovation. For them, the lack of funds is strongly connected with other barriers**, such as the lack of information on funding opportunities, which in turn is associated with the lack of information on new technologies and regulations, and lack of access to research results, including patents, and skills and awareness of emerging innovation trends. This holds true regardless of the geographic area these firms are based in, the sector in which they operate, or the type of innovation they introduced (e.g. in products or services). The lower probability of accessing financial resources and the poor links with financial providers translate into a lower satisfaction for micro enterprises with the public support received, as compared to small and medium

enterprises. Because of the high financial needs expressed by micro enterprises, **when these enterprises benefit from the public (financial) support, they experience a higher added value** than small and medium enterprises.

- **Small and medium-sized enterprises consider the financial barrier important,** but less so than **micro enterprises. Access to skills is their primary concern.** While small enterprises have difficulties in acquiring specific skills from outside (e.g. the labour market) due to their limited networks and levels of cooperation with other actors, the BNA highlights that medium size firms, often already conducting research activities, operating in the manufacturing sector, and located in North-continental Europe, suffer from the lack of in-house skills for their business development and the qualified staff that need to be integrated into their organisation. **Small and medium firms are more likely to benefit from public support than micro-enterprises, in both financial and non-financial forms. This contributes to increasing their chance of introducing any type of innovation** (whether this is new products or services, or innovation in production processes and organisational methods) and therefore addresses the innovation market failures these firms face.
- Beyond the paths followed by micro firms on one side, and small and medium enterprises on the other one, it is interesting to look at the **newly established firms**, which also includes start-ups and gazelles. Like micro firms, their needs range from financial support and information on funding opportunities, to incubation support, cooperation and networking between different RDI actors, and support for technology transfer. In contrast, new firms **do not perceive the newly emerging trends**, like the existence of players with large market power, the increasing complexity of innovative and "green" products and services, and the digitalisation trend **as important barriers to innovation.** It is likely that they are themselves often operating in these areas. As far as public support is concerned, our analysis shows that public financial support has generally accelerated the introduction of innovation in this type of firm.

- Although financial support seems to be perceived as the most effective form of support by SMEs, it is only one tool to address innovation needs. The analysis also highlights the effectiveness of other forms of public innovation support. Specifically, two pathways can be investigated:
  - the first one concerns financial support. **Financial support is generally associated with a higher level of satisfaction in beneficiary SMEs and a perceived higher added value**. Financial public resources are often absorbed by research-based SMEs, i.e. those which invest more money for innovation (as a share of their turnover) and introduce "hard" innovation, such as radically new products and services. As previously mentioned, these SMEs are more likely to be small and medium (not micro) enterprises based in North-continental rather than in Southern or Eastern Europe and are active in the manufacturing sector.
  - the second path refers to the **other forms of support**, including support for acquiring specific skills, knowledge and technology transfers, networking and cooperation, awareness-raising, and others types of support. While still effective against innovation barriers and in addressing SMEs' needs, the analysis points to lower satisfaction and perceived added value by SMEs than with respect to financial support. For instance, the access to specific skills and knowledge and technology transfers have helped SMEs enlarge the scope of their innovation activities, while awareness raising support, networking and cooperation, and support for identifying innovation potential have met the SMEs' expectations only in terms of information needs. SMEs operating in the services sector tend to benefit the most from this type of support measures.
- The last point we want to emphasise is the existence of a **path dependence on public**

support. The level of SMEs' satisfaction about a specific type of public support received is strongly linked with other typologies of support. The analysis indicates that SMEs that benefit from financial support are also more likely to receive support to get more information about financial and non-financial opportunities, support to access skills and incubation, networking support, and so on. Financial support is often provided in a package with other forms of support. While the greater absorptive capacity by specific groups of SMEs may increase the effectiveness of the public innovation support for those specific groups or geographical areas where the support is concentrated, this may leave behind other types of SME (e.g. micro) and EU peripheral areas, which experience more difficulty in accessing public support initiatives[84].

[84] Note the conclusions of CSES et al (2020) 'Evaluation of Support Services for would-be Entrepreneurs and Newly Established Businesses' which pointed to a significant gap in support provision for enterprises not geared to rapid growth and/or not located in metropolitan areas.

4. Evaluation of INNOSUP actions funded under Horizon 2020

This chapter investigates the impact of the INNOSUP actions. It is based on a horizontal reading of the case studies, which focused on each INNOSUP action, included in Annex E, and assesses their relevance, effectiveness, efficiency, coherence and EU added value. The theories of change of six INNOSUP actions has been reconstructed and their effectiveness tested with the empirical evidence from monitoring and (if available) data on each INNOSUP action, from interviews with SMEs and intermediary organisations and from relevant findings from the on-line survey.

The chapter is structured as follows: Section 4.1 provides background information on the six selected actions, Sections 4.2 (Methodology) and 0 (Comparative analysis) scrutinise similarities and differences between the selected six INNOSUP case studies. Section 4.4 concludes with policy recommendations.

4.1 General information on the six selected case studies

The Horizon 2020 Work Programme "Innovation in SMEs" (INNOSUP) aims to test new approaches to better innovation support for relevant actors across Europe. It consists of innovation-support measures designed to provide opportunities to Member States and regions to enhance their services to SMEs through collaboration, peer-learning, and testing new approaches that facilitate SMEs' access to customers, capital and competencies; the latter especially in the domains of business, innovation and intellectual asset management. Its ultimate goal is hence to help strengthen the dynamism and the resilience of the SME innovation ecosystem in Europe, though INNOSUP Actions generally operate as pilots to test out particular approaches. **Calls are, generally, directed to intermediaries that nurture and support innovative SMEs**, such as innovation agencies, industrial clusters, and innovation associations of different kinds and from different sectors. **Some of the calls are also directly targeted at SMEs (final beneficiaries),** while others are intended to support existing European innovation-support schemes (e.g. the Enterprise Europe Network).

Out of the 26 calls, **six INNOSUP Actions** were selected for case studies, providing an **in-depth analysis.** The selection reflects the variety of the calls with regards to the amount of resources allocated (money allocated per topic) and the duration of the Action. The clear focus is on "Coordination and Support Actions" (CSAs) and the somewhat smaller group of "Innovation Actions" (IAs). Five out of six case studies are CSAs while one belongs to the IAs. Furthermore, high-volume multi-annual actions related to IPR and social innovation were part of the sample. The six selected INNOSUP Actions are to an extent a reflection of the whole sample of INNOSUP Actions. Survey results regarding the entire sample have shown that beneficiary SMEs are mainly micro (60%) and are active both in manufacturing (46%) and services (54%). Concerning the geographical distribution of the beneficiaries, the majority of beneficiaries are located in North-Continental EU and in Southern EU with more than 75% of SMEs based in EU15.

Table 6 provides an overview of the six different case studies, including the number of calls, the total budget and the numbers of direct and final beneficiaries (if applicable). It can be seen that the budget for the Cluster facilitated projects for new industrial value chains (INNOSUP-01-2014-2015, 2016-2017 and 2018-2020) accounts for considerably more than all the other actions together. In the following paragraphs, further information on the rationales and specific objectives of each Action are given.

Table 6: General information about selected INNOSUP Actions

INNOSUP Action	Type of Action	Barrier/market failure	Number of calls / type of call / Call year	Total Budget (EUR)	Number of direct beneficiaries	Number of final beneficiaries
IPR Helpdesk	Coordination and support action (CSA)	Lack or inefficiency of IPR protection	One call / single-stage / 2014	**4,000,000**	One consortium (three members)	Estimated amount of registered users: 13,700 Estimated amount of persons trained: 4,350
European SME Innovation Associate – pilot	Coordination and support action (CSA)	Lack of human capital for innovation	Three calls / single-stage / 2016/19/20	**15,700,000**	108 financed projects (Proposals for the 2020 call under evaluation)	-
SMEs for social innovation – Challenge platform	Coordination and support action (CSA)	Imperfect information on innovation opportunities	One call / single-stage / 2016	**3,500,000**	One consortium (three members)	81 'solution providers' funded
Cluster facilitated projects for new industrial value chains	Innovation action (IA)	Coordination and network failures	Six calls / two-stage / 2015/16/17/18/19/20	**107,200,000**	18 consortia (consisting of a total of 204 partners and 18 coordinators)	1006 SMEs that received financial support 1372 SMEs that received non-financial support
Peer learning of innovation agencies	Coordination and support action (CSA)	Imperfect information on innovation opportunities	Three calls /multiple-cut-off	**3,420,000**	188 consortia	-
Technology services to accelerate the uptake of advanced manufacturing technologies for clean production by manufacturing SMEs	Coordination and support action (CSA)	Limited capacity to absorb spill-over effects	2016/2017	**4,900,000**	21 initial consortia members	40 granted projects

Source: Authors.

4.1.1 Technology services to accelerate the uptake of advanced manufacturing technologies for clean production by manufacturing SMEs (INNOSUP-03-2017)

The INNOSUP Action "Technology services to accelerate the uptake of advanced manufacturing technologies for clean production by manufacturing SMEs" is a coordination and support action (CSA) which was funded under the H2020 WP 2016-2017. The Pan-European network established by the Action gives access to clean technologies for manufacturing enterprises in the field of key enabling technologies (KET)[85]. By setting up a one-stop-shop access for manufacturing SMEs, cross-border services and facilities aim to provide support to SMEs that are lacking resources and/or **competencies to integrate innovative advanced manufacturing technologies**. The **objective** of the Action is to **enable cleaner production processes through KETs in SMEs**. The first and only call was launched in 2016.

The Action provides the selected consortium with a grant that funds 100% of their project. The Action granted in total EUR 4.9 million to the selected KET4CleanProduction, consortium of twelve members led by the Steinbeis2i GmbH as project coordinator. The duration of the Action is three years - from 2018 to 2021. During the implementation, the services provided by the consortium were characterized by their high flexibility and rapidity and their responsiveness to the pace of innovation and SME requirements. A pilot phase to test the activities took place between 2018 and 2020. As a part of the service activities of the consortium, **lump sum grants (EUR 50,000 per project) were provided** to final beneficiaries by the intermediary consortium. The lump sum is offered to SMEs to integrate innovative clean manufacturing processes into their production processes and must be used for specific technology services.[86] The application process and selection of the SMEs were defined by the selected consortium in their proposal. The Actions aimed to attract a significant number of new SME users of innovative advanced manufacturing technologies in the manufacturing sector, leading to a significant and quantifiable increase in their productivity, environmental performance and/or in their market shares, as a result of increased quality and the innovativeness of products.

The outcomes of the case study show that the Action is an effective support tool for the better coordination of KET Technology Centres, EENs and SMEs at the European level. The data on consortia that had received grants provide evidence that SMEs coming mostly from EU13 had been supported by KET TCs coming mostly from EU15 countries. Thus, the rationale of the Action, which is based on knowledge transfer from countries with more developed KETs, seems to have been followed. Success stories published on the KET4CP website and interviews with KET TCs and SMEs also provide evidence that SMEs had improved their production processes with the support of technology services. Moreover, the cooperation between SMEs and the KET TCs continued in some cases even after the end of the micro-grant. However, it is not possible to assess to which degree the Action will have medium- and long-term effects.

4.1.2 er learning of innovation agencies (INNOSUP-05-2014-2015, 2016-2017, 2018-2020)

The INNOSUP Action "Peer learning of innovation agencies" is a coordination and support action (CSA) which has been funded under the H2020 WP 2014-2015, 2016-2017 and

[85] Key enabling technologies embrace six technologies which are micro and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials, photonics, and advanced manufacturing technologies. KETs aim to increase industrial innovation addressing societal challenges and creating advanced and sustainable economies.

[86] Services can be e.g. prototyping, testing, pilot production, engineering, training and advice. The services are provided by chosen technology centres specialised in a specific KET field.

2018-2020. In recent years, the European Union has supported the exchange of "best practice" among innovation agencies (IAs) e.g. through the Competitiveness and Innovation Framework Programme and mutual policy learning. However, it remains a challenging endeavour to establish and improve innovation support programmes for SMEs and to transfer good practice in SME innovation support. Consequently, the Action **aims to support national and regional innovation agencies in undertaking peer learning activities more frequently** and to develop new approaches for more effective innovation support to SMEs. According to the "INNO-Partnering Forum" (IPF)[87], learning activities must meet certain criteria to be successful. In general, the activities must be demand-driven which means that agencies should only launch a peer learning process if it is necessary to revise their existing programmes. Moreover, the activity needs to be guided by a secretariat or an animation structure and the learning process should be based on pre-defined methodologies.[88] Two methodologies had been developed in that respect by the IPF as permanent learning frameworks for IAs engaged in SME support:

- A "quality management system in innovation agencies" implemented through a peer review system based on the EFQM methodology.[89]
- A "twinning advanced methodology" that combines elements of traditional peer reviews and twinning in small learning groups of interested agencies.[90]

Since 2014, three different WPs were in force with several cut-off dates for each WP. The last cut-off date was in October 2020. The total budget of the Action for all the WPs is EUR 3.42 million. In practice, the Action provides small lump-sum grants of either EUR 15,000 or EUR 50,000 to national and regional innovation agencies engaged in peer learning, to help them use the learning methodologies mentioned.

The main findings of the case study confirm that the Action is an effective support tool for IAs seeking to improve their services via peer learning activities in the short term. The main effect is the reviewing of services provided and their improvement. However, the degree to which the Action will support IAs in improving their service in the medium- and long-term is uncertain as monitoring data with regards to these outcomes are lacking (e.g. data on the use of the final deliverable, the Design Option Paper, by third parties) and no funding was provided for follow-up activities.

87 The INNO-Partnering Forum (IPF) was a project of the European Commission (DG Enterprise and Industry) for the period 2009–2012. Its objective was to explore and develop synergies between public innovation agencies in Europe. The consortium then proposed new approaches to innovation support for SMEs and tested new approaches to service delivery to enhance innovation mechanisms.

88 EURADA (2019): Peer Learning for Innovation Agencies. Available at: http://www.eurada.org/peer-learning-for-innovation-agencies/ Last access on 03.08.2020.

89 The EFQM methodology can be used as a tool to develop and deliver better innovation support. It supports users in defining and implementing a consistent innovation strategy. Besides, it can be used as a tool for self-assessment (e.g. by measuring the organisation's performance) and for external assessments (e.g. if a consortium of agencies plans to start a joint learning and benchmarking process based on reciprocal assessments). See for details https://ec.europa.eu/easme/sites/easme-site/files/Paper-EFQM-framework-Innovation-Agencies.pdf

90 The idea of the "Twinning advanced" methodology is that agencies review their own- and third-party practices within a consortium. The tool can support the draft of new instruments or topics. Moreover, existing instruments can be reviewed to redesign the service with the focus on synergies between European, national and regional support. By working with other agencies, common problems regarding implementation, monitoring or impact assessment can be tackled. See for details https://ec.europa.eu/easme/sites/easme-site/files/Paper-Twinning-advanced-methodology.pdf

4.1.3 The European Intellectual Property Rights (IPR) Helpdesk (INNOSUP-02-2014)

The INNOSUP Action "IPR Helpdesk" is a Coordination and Support Action (CSA) funded under the H2020 Work Programme 2014-2015[91] and building on the previous European IPR Helpdesk that had operated since 1998. As explained in the WP, "Small firms and research organisations face a challenge in adequately managing, diffusing and valorising Intellectual Property Rights (IPR) due to limited knowledge and resources"[92]. Limited knowledge refers not only to the concept of protecting Intellectual Property (IP) but also to understanding how intellectual assets can be used strategically to extract value from them. Consequently, the IPR Helpdesk supported with this Action was meant to **provide support in the management, diffusion and valorisation of technologies and other intellectual assets**, and in bringing technologies to the market.

This goal is pursued by improving the knowledge and capacity of the target groups and by establishing support services and cooperation structures with intermediaries. In practice, the Action consisted of granting EUR 4 million to a consortium, selected through a call for proposals, which has been in charge of running the IPR Helpdesk for four years, from 1 January 2015 to 31 December 2018. The target groups expected to make use of the Helpdesk and, ultimately, to benefit from the Action were: i) European SMEs, especially those operating cross-country (e.g. exporting products to other states or involved in transnational partnership agreements) and ii) candidates and participants in EU-funded projects (e.g. SMEs, academic institutions, research centres and individual researchers). Other EU innovation stakeholders (e.g. members of the Enterprise Europe Network – EEN and business organisations at the EU level) were also expected to benefit from the Action.

The main findings of the evaluation show that the Action was successful in achieving the objectives established in the call as regards short and medium-term effects. The way the Action was designed, comprising awareness raising activities and cooperation with stakeholders, has increased its effectiveness since it has enhanced the visibility of the Helpdesk among target groups and has created mechanisms of policy feedback, which in turn, have improved the Helpdesk itself. In particular, a more structured collaboration with the EEN has contributed to extending the Helpdesk's outreach and to improving the assistance provided to target groups in the Member States. However, there is not enough evidence on whether the Helpdesk is an effective tool in producing wider and long-term impacts in terms of business growth, internationalisation and improved competitiveness for SMEs.

4.1.4 The European SME Innovation Associate - pilot (INNOSUP-02-2016; INNOSUP-02-2019-2020)

The European SME Innovation Associate - pilot (hereafter SME IA) is an experimental innovation capacity-building action launched for the first time in 2016. A total of three calls were organised. The Action aimed to **support SMEs that experience difficulties in recruiting the relevant skills for a particular innovation idea** at the national level, either because the required skills are not available or not affordable.

The Action provided the selected SMEs with a grant that funds 100% of the salary of a newly employed highly skilled researcher, the so-called "Innovation Associate", for one year. During the contract period, the Associate's task is to participate in the exploration of the

[91] European Commission, Horizon 2020 Work Programme 2014 – 2015, 7. Innovation in small and medium-sized enterprises (SMEs), European Commission Decision C (2015)2453 of 17 April 2015.

[92] Ibidem.

potential of an innovative idea within the SME and to turn it into an innovation project. Also, the grant funds the Associate's participation in a core training programme on industrial innovation and business innovation management organised by the European Commission, and another training programme organised by the host SME and tailored to its specific needs.

The objective of the Action was to inspire SMEs, by showing that an idea can be transformed into innovation strategies and subsequent research and innovation projects, once the SMEs have access to the right skills. In general, the Action wanted to contribute to improving the capacity of SMEs to manage the innovation process effectively, and hence to enhance the innovation capacity of European SMEs, and to inspire similar initiatives at the national and regional level.

The main findings of the evaluation were that the Action is regarded as an effective tool to support the innovation capacity of SMEs. Indeed, the great majority of SMEs surveyed in 2020 are satisfied with the implementation of the Action (including the financial support) while 25% of the SMEs surveyed by Carsa et al (2019) attribute an improvement of their innovation management process to the Action, which is not negligible for a policy experiment. The main effect of this pilot Action is that it helps SMEs access networks of academics, experts, and highly-skilled professionals as well as to gain new skills. The degree to which the pilot action will be scaled up and replicated at either national or European level is still uncertain. The initiative was also seen to complement Marie Skłodowska-Curie Actions effectively. The effectiveness of the SME IA, including the training programme, is however questioned by some start-ups and high growth SMEs, which follow different organisational and innovation management logics that are relevant for more structured SMEs.

4.1.5 SMEs for social innovation – Challenge platform - pilot (INNOSUP-04-2016)

The coordination and support Action 'SMEs for social innovation – Challenge platform' aimed to promote the opportunities of social innovation to SMEs. This was based on the fact that social innovators/enterprises oftentimes lack support. At the same time, it allowed SMEs to discover new business opportunities. To achieve this, this Action provided social innovators with the opportunity to upload their social challenge onto an online platform, then to find SMEs that would be willing to join in on this specific social innovation project. This Action was part of the WP 2016-2017 and consisted of one call with an overall budget of EUR 3.5 million.

According to the WP, the design of an online 'challenge platform' was required as the first step of this Action. This could be used as a 'marketplace', both for the demand side (social innovators/challenge owners seeking solutions) and the supply side (SMEs willing to engage in social innovation – 'solution providers'). Furthermore, it included a funding mechanism to provide the newly found partners with financial support of up to EUR 50,000 to allow for testing of the feasibility and potential of the project, as well as to start its execution.

The objectives of this Action were **to get more SMEs involved in the field of social innovation, create new products and find new business models**. Besides that, the Action was expected to provide more social challenges with solutions and to increase the number of business intermediaries and incubators in the field of social innovation.[93]

[93] European Commission, Horizon 2020 Work Programme 2016 – 2017, 7. Innovation in small and medium-sized enterprises (SMEs), European Commission Decision C (2015)2453 of 17 April 2015.

The main findings of the evaluation are that the action is an effective support tool to connect SMEs to social innovators and to make SMEs more aware of social innovation. However, the degree to which the action has positive effects in the medium- and long-term remains uncertain. This is because the Action has a relatively short project duration and further monitoring data is so far non-existent. The budget was used efficiently, the challenge coordinators built upon their network to create synergies and used this to involve local nodes in different countries to reach out to stakeholders. However, it was suggested in some instances that the relatively low budget, overall and for participants, and the lack of a follow-up have negatively affected the achievement of medium- and long-term effects.

4.1.6 Cluster facilitated projects for new value chains (INNOSUP-01-2014-2015), (INNOSUP-01-2016-2017), (INNOSUP-01-2018-2020)

The innovation Action 'Cluster facilitated projects for new value chains' has the objective to provide innovation support to SMEs through intermediaries. Specifically, it is supposed to enhance SMEs' capabilities to create new industrial value chains promoting the development of emerging industries in Europe, by using a cross-sectoral and cross-border approach. The Action has been part of WPs 2014-2015, 2016-2017, as well as 2018-2020 and has consisted of five calls in total (one in 2014-2015, two each in the other periods). The Action is characterised by its thematic heterogeneity as the 18 projects that have been selected so far cover a wide range of different topics and industries. Its main mechanism has been cascade funding that has been used to support SMEs.

The projects that are conducted under this Action are managed by expert organisations (intermediaries, working under a consortium agreement) consisting mostly of clusters, other network organisations, research organisations and in a few cases, SMEs[94]. At least 75% of the total budget must be allocated to SMEs that are either a partner in the consortium or final beneficiaries, through direct financial support (for instance vouchers, prizes, grants), direct innovation support services (coaching, mentoring) or other measures. The Action follows a systematic approach[95]. It aims to address specific problems and needs in an outcome-and user-driven process by bringing different actors together to test different solutions in real-life conditions and by using potential synergies with other European funding programmes (ESIF, COSME etc.) and regional/national funds.

The initial objective of this Action was to provide funding to SMEs either through direct financial support and/or support services in order **to help with implementing projects related to key enabling technologies (KETs) and emerging industries**, notably those driven by cross-sectoral collaboration. Further, new connections between SMEs are to be created in order to work on cross-sectoral topics. In the medium- and long-term the Action aims to incentivise the development of new products and services and, ultimately, have a positive impact on the EU's global competitiveness by enhancing the development of emerging industries.

The evaluation shows that this Action has been effective for certain countries. Through the five calls, a significant number of projects were initiated (18) and a high number of SMEs were supported. New products and services have been developed as a result and others

[94] SMEs can participate in this action as partners in the consortium or be supported as final beneficiaries

[95] A systemic approach includes the following: Adopting a solution-/outcome-driven approach, involvement of cluster organisations and/or SME intermediaries as facilitators, strategic selection of partners, and sectors from which SMEs are to be targeted, close links with regional policy and other activities and investments, a combination of different support instruments and tools. For more information on this approach, please see for instance: European Commission (2012): The smart guide for service innovation, p.15-17. or specifically related to the INNOSUP-1 programme: European Commission (2019): H2020 Programme 2018-2020 - For a better innovation support to SMEs. *INNOSUP-01-2018-2020 Background Note Version 1.2.* Available at: https://op.europa.eu/en/publication-detail/-/publication/0cc79ba3-98ec-478f-a0b1-3e4e37bbf7d7. Last access on 11.09.2020.

successfully adapted by applying new technologies. Survey data show the high satisfaction of SMEs; out of 13 beneficiary SMEs surveyed, more than half of the sample (7 of them) were satisfied or very satisfied with the results of this INNOSUP Action. Nevertheless, the effects of the Action have been far more pronounced in EU15 countries (especially in Spain, France, Italy and Germany) than elsewhere. Apart from that, policymakers, participating intermediaries and SMEs recognize that the transnational component is a major added-value of this Action. Intermediary organisations and SMEs alike have valued this factor highly. Additionally, a major strong point of this Action has been the flexibility with which the consortia could design their respective projects (funding calls) and combine different support mechanisms.

4.2 Methodology of horizontal analysis

The following section will merge/integrate the outcomes of the individual six INNOSUP case studies to analyse and classify the overall results. Based on these merged results from individual theory-based evaluations of the INNOSUP case studies, the effectiveness of public support for SME innovation within the INNOSUP programme will be assessed in terms of the evaluation criteria of **effectiveness, relevance, EU added value, coherence, and efficiency** indicated by the Commission Better Regulation Guidelines. In that regard, the challenge is that a wide range of INNOSUP Actions exist with differing aims, different intervention logics and different direct beneficiaries, and this makes it challenging to draw up a one-size fits all evaluative framework. The conclusions that can be drawn in respect of the effectiveness of such interventions are likely to reflect the complexity of the intervention types themselves. However, core recommendations for the further development of the INNOSUP programme can be derived in the end by taking the particularities of each Action into account.

4.3 General findings on the INNOSUP actions

4.3.1 Effectiveness

Effectiveness relates to the progress that has been achieved towards meeting the objectives of public innovation support. To accurately evaluate the effectiveness of the six chosen cases studies, one must take into account each action's specificities with regards to the interplay of mechanisms and context factors. For this purpose, this part assesses the effectiveness of the different actions in terms of the following factors which characterise the theory-based impact evaluation approach:

- In which contexts the intervention works and does not work, and why?
- What are the main mechanisms by which we expect the intervention to work?
- If the intervention works, what outcomes do we see?

Context-related factors are all the influencing aspects that are not part of the programme or the intervention itself but that interact, influence, modify, facilitate or hinder the mechanisms of the intervention and its effectiveness, such as the socio-economic environment or the organisational context. **Mechanisms** are the combination of resources offered by the intervention under study, the processes by which the intervention is implemented and the response to the intervention by stakeholders/beneficiaries. The combination of reasoning and resources is what enables a programme to work. **Outcomes** (short-, medium-, long-term) refer to the results (generated change) of a programme. Multiple mechanisms have different effects on different subjects in different situations, and can thus produce a variety of outcomes.

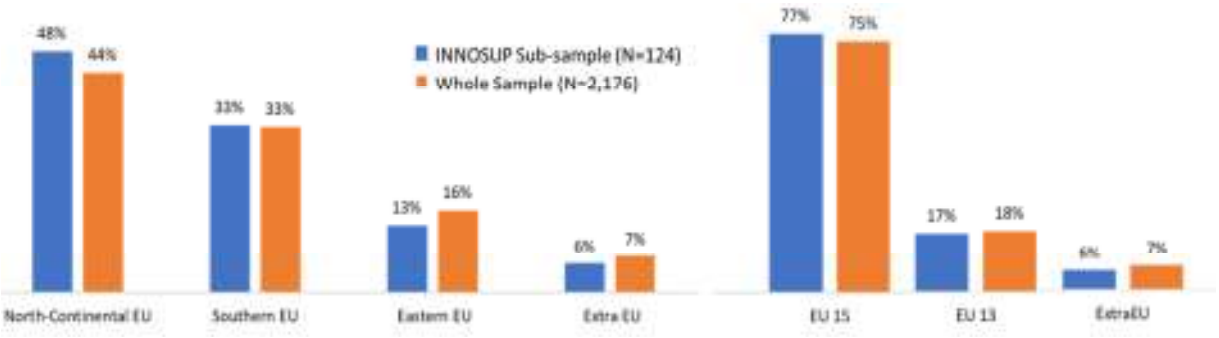
Contexts that impact the functioning of interventions

As indicated by the numbers of the participants in the survey of both direct (intermediaries) and final (SME) beneficiaries in Figure 15 below, the share of stakeholders from EU15 countries is overall significantly higher than that of actors from EU13 countries. This geographic component is also reflected in the six INNOSUP Actions that have been investigated in-depth. In five of these, the geographic location of direct or final beneficiaries was identified as a factor that has influenced specific mechanisms of the respective programmes and thus, impacted on the outcome. In all of these, it was found that the results (number of applicants, beneficiaries, etc.) were generally more positive when applicants and beneficiaries came from EU15 countries and rather less positive for applicants and beneficiaries from EU13 countries. One explanation seems particularly related to the direct beneficiaries. In some of the INNOSUP Actions, direct beneficiaries have a role as some sort of intermediary (for instance clusters) and are intended to improve the outreach of the Action to final beneficiaries. However, **the average performance of these intermediaries**, both in terms of their ability to become involved in winning consortia and in terms of their capacity to reach out to SMEs in cases where they are part of successful consortia, **appears to be weaker in EU13 countries than in EU15 countries**. Consequently, as fewer intermediaries from EU13 countries are involved (or have smaller networks), less outreach to final beneficiaries (SMEs) is generated in these regions/countries.

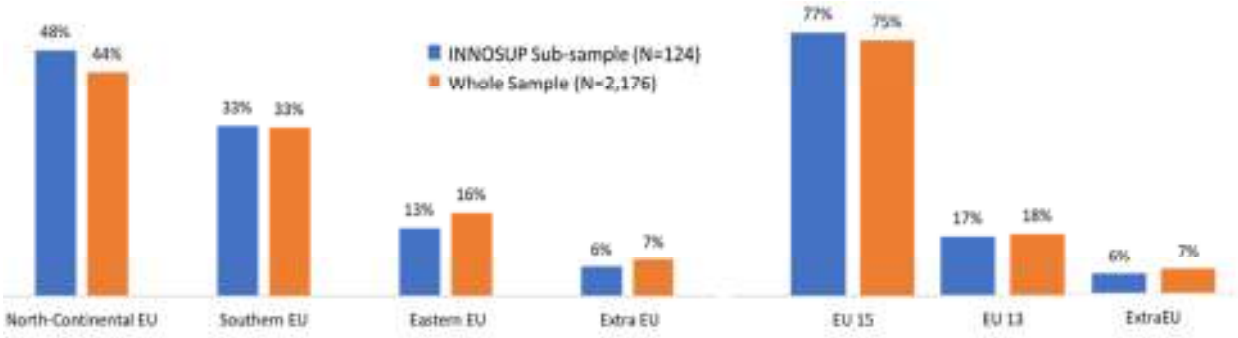
Beyond the geographical factor, a good number of other contextual impacts have been identified as influencing the respective outcomes, but less significantly. One of these is related to the **varying absorptive capacity and abilities of SMEs**. On the one hand, this means that the degree of openness of SMEs to applying for support programmes addressing new technologies differs but also that the capacity of some SMEs (for instance in terms of human resources available) has determined stronger or weaker outcomes. In this respect, the **size of the final beneficiaries** (for instance micro-enterprises) or other characteristics such as the speed of growth (gazelles) or the extent to which enterprises have been recently-established (start-ups) have been identified as relevant context factors impacting on the outcomes in individual programmes. In one example in particular (Action SME Innovation Associate), gazelles and start-ups considered the design and implementation of the initiative was not suitable to their approach, characterised by rapid technological change. On the other hand, more structured/established SMEs with less dependence on frontier technology viewed the design and implementation as rather positive.

Figure 15: Geographical distribution of INNOSUP beneficiaries vs the whole survey sample

Panel A: SMEs



Panel B: Intermediaries

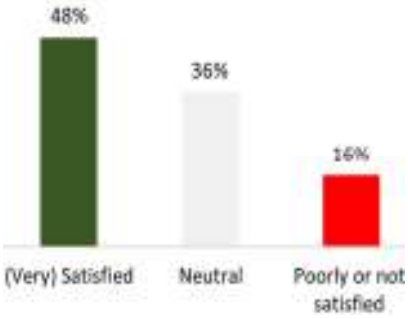
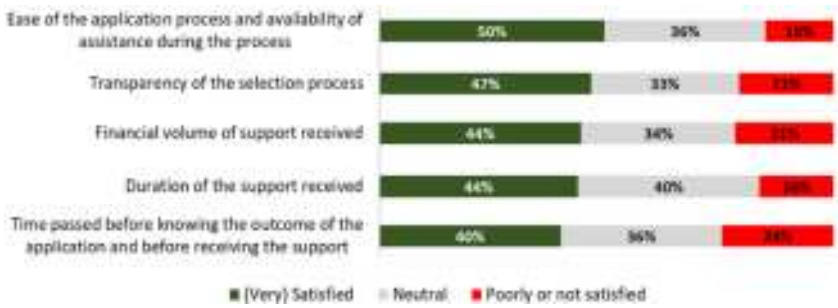
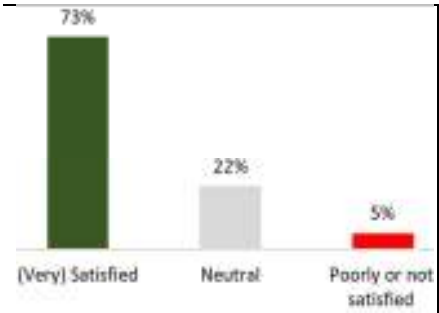
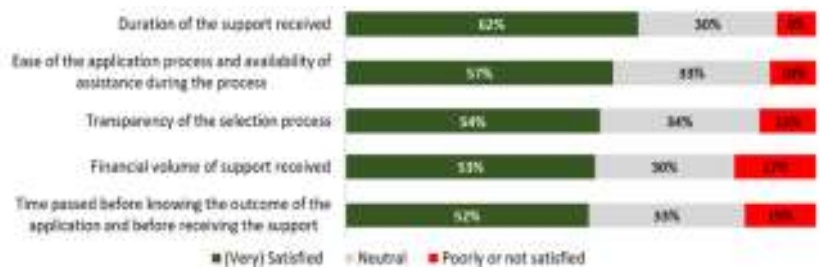


Source: authors' elaboration. Statistical differences between the sub-sample of INNOSUP beneficiary SMEs and the whole sample were assessed by using a Pearson's chi-square tests. All the tests do not reject the null hypothesis of the similarity of distributions. ***EU15*** *includes (N of beneficiary SMEs in brackets): AT (4), BE (3), DK (3), FI (1), FR (3), DE (17), GR (6), IE (3), IT (4), LU (0), NL (9), PT(4), ES (24), SE (3), UK (9).* ***EU13*** *includes: BG (0), HR (1), CY(1), CZ (3), EE (0), HU (2), LV (0), LT(3), MT (1), PL (7), RO (1), SI(0),SK (2).* ***North-Continental EU includes****: AT, BE, DK, EE, FI; FR, DE, IE, LV, LT, LU, NL, SE, UK.* ***Southern EU includes****: CY, GR, IT, MT, PT, ES.* ***Eastern EU includes****: BG, HR, CZ, HU, PL, RO, SI, SK.*

Mechanisms that work well

Since each of the six Actions includes a different mix of specific mechanisms that vary by topic or by the type of action (one action is an Innovation Action - IA, five are Coordination and support actions – CSA), a comparison is only feasible on a more aggregate level, namely in terms of financial support, selection process, ease of application and duration. Overall, it can be said the **mechanisms have worked rather well when looking at the satisfaction rates of SMEs and intermediaries with the different kinds of instrument** (see Figure 16).

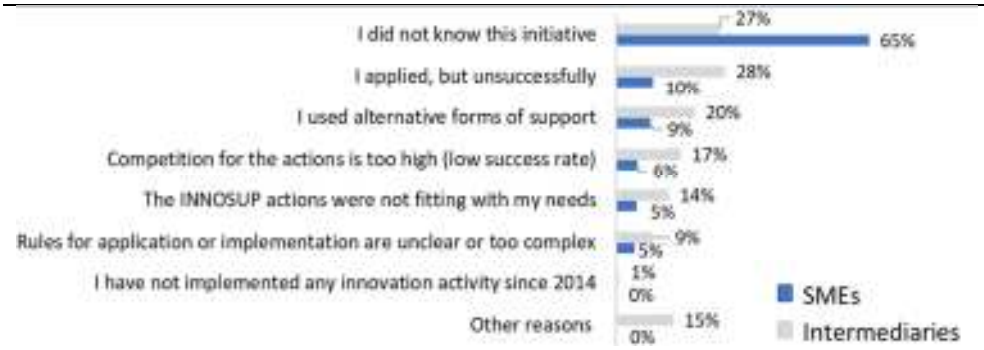
Figure 16: INNOSUP Actions: general satisfaction and satisfaction linked to specific items

To what extent are you satisfied with the results attained by the INNOSUP Action(s)?	To what extent are you satisfied with the following issues regarding your application to the INNOSUP Action(s)?
Panel A: SMEs	
	
Panel B: Intermediaries	
	

Source: authors' elaboration.

With regards to the application procedures (to the European Commission by direct beneficiaries), it can be said that these have been perceived as **straight-forward and simple** by applicants. The same can be said for the application procedures of final beneficiaries (SMEs) and direct beneficiaries (consortia of intermediaries). In one example (INNOSUP-1) a two-stage application procedure has been in place. This has been perceived to be particularly positive, since it allowed applicants to refine their approach after the first step, which was relatively helpful in the light of the complexity of the topics and the mix of different funding support instruments. In connection with the application procedure, **the selection process and its transparency are seen as positive** by intermediaries and to a lesser extent by SMEs, though even here they are still predominantly regarded as positive. However, application and selection are seen as **relatively competitive, and it has been particularly difficult to be successfully involved for non-established organisations** (for instance from EU13 countries, as shown above). Additionally, as Figure 17 shows, the lack of awareness on the part of SMEs appears to be a central barrier to applying to the Actions. 65% of the respondents to the survey stated that they were not aware of the initiatives.

Figure 17: Reasons for not applying to any INNOSUP action

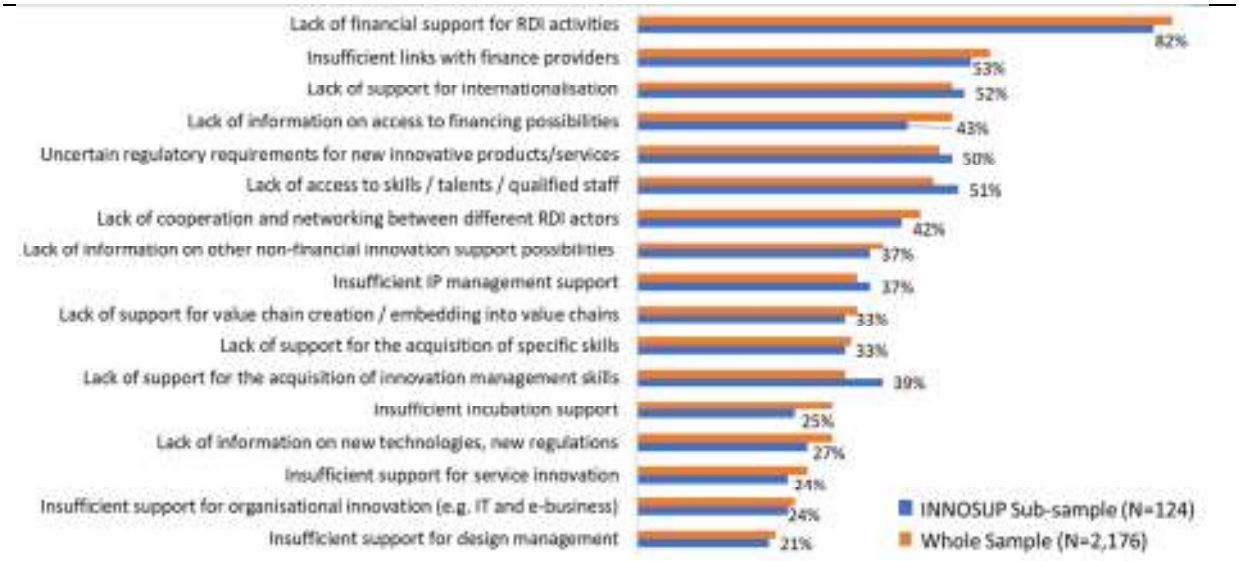


Note: Number of respondents: SMEs = 1,570; Intermediaries = 256.
Source: authors' elaboration.

The duration of the Actions varies significantly between 6 and 36 months. It appears that **shorter project durations have made it more difficult to achieve medium- and long term outcomes.** Also, in some Actions in which intermediaries are involved, it was indicated that the respective intermediary consortia need some time to get established, to get to know each other and to organise themselves internally, hence longer project durations would have been preferred in order to allow consortia to better organise themselves internally. Regarding the range of support instruments, it can be said that when possible, **a flexible combination of support instruments has been appreciated and has been beneficial**, for instance, a combination of financial support, training and investor meetings. Of all the support instruments used, **financial support has been seen as the most appealing and useful for SMEs**. This is in line with the evidence on the main barriers to innovation as shown in Figure 18. The same results show that over half of Action beneficiaries found lack of access to skills/talents/qualified staff to be a barrier and a third referred to lack of support for the acquisition of specific skills, pointing to the significance of human resource developments in innovation implementation. In general, training and other 'soft measures' are much valued, though their effectiveness seems to vary, depending on the topic and in some instances (so this cannot be generalised) on the size of the SME being trained. It was mentioned that sometimes smaller enterprises could not attend training due to limited dedicated resources (in terms of human and financial resources). The cascade funding that has been used in four of the six Actions has been a **valuable instrument in reducing administrative burdens** (see next section on efficiency for more detailed information) in this context.

Other, action-specific mechanisms, for instance, matchings between social entrepreneurs and SMEs (INNOSUP-4-16) were seen as creative ways to engage SMEs. The medium- and long-term effects cannot however be finally assessed, due to limited and varying data availability.

Figure 18: Barriers to innovation for INNOSUP beneficiary SMEs vs the whole survey sample



Source: authors' elaboration.

Outcomes

The outcomes of each Action result from the interplay of the chosen mix of mechanisms with the relevant contextual factors. As described above, both components have varied, depending on the scope and the objective of the respective action. In the following, a differentiation is made between short-, medium-, and long-term outcomes.

Short-term outcomes: With regards to the **number of applicants**, a distinction should be made between the applications by the direct beneficiaries (in four out of six cases these are intermediaries) and the final beneficiaries (SMEs). The number of applications by direct beneficiaries has varied and depended to a large extent on the respective topic. Whereas relatively broad actions, such as the INNOSUP-01 Action (cluster facilitated value chains) have seen a large number of consortia applying for each call, a relatively smaller number have applied for more topic-specific actions such as INNOSUP-04-16 (social innovation), which also had a smaller budget. The involvement of intermediaries, which have in some instances been network organisations such as clusters, has contributed to the satisfying number of SMEs that applied, even though it also contributed to the geographic concentration on certain regions (see the part on context factors). While the number of SMEs applying has been high, it still shows that the INNOSUP Actions need more promotion. 65% of the SMEs that participated in the survey (n=1,570) stated that they did not apply to an INNOSUP Action because they were not aware of them (see point above under mechanisms). Concerning the final beneficiaries, all actions reached their specific targets with regards to the **number of final beneficiaries** that were selected and funded. However, in line with the findings on the contextual factors and also the number of applicants, there has been a significant variation between countries which has led to an imbalance in funding volume.

Medium-term outcomes: Even though not completely measurable at this point for all Actions, the varying involvement of intermediaries has been a significant factor with regards to the medium- and long-term outcomes, as these develop. Apart from that and in line with the survey results, the case studies have shown that the INNOSUP Programmes have

mainly led to innovation in products and services in SMEs (Figure 18). The case studies illustrate that these mainly stemmed from **incremental improvement or adaptions rather than entirely new products and services**, in line with the key objectives of the programmes. Most of the INNOSUP Actions selected can present several good practice examples in which these incremental improvements have led to more medium-term effects, as follow up investment was secured and partnerships were concluded on the basis of the actions (for instance Innosup-04-2016 'SMEs for social innovation'). With regards to other network effects, some evidence shows that one of the actions has led to a longer-lasting involvement of some SMEs with cluster organisations. Overall, the evidence with regards to medium-term effects (e.g. new products, lasting collaborations), is still insufficient to make a final statement, since some Actions have not ended. However, it can be indicated that the scale of the effects has been limited, which is to be expected, given the amount of funding and the duration of projects (see mechanisms).

Long-term outcomes: With regards to the intended long-term outcomes, it should be said that the budgets have been rather small in four out of the six Actions in comparison with the relatively ambitious targets that are outlined in the work programmes. Furthermore given that the actions were of a pilot kind, in general, perhaps they should not be expected to have significant long-term results. Actions would need to be consolidated and continued in order to achieve these longer-term objectives. In general, though, it is shown that the **outcomes are stronger when projects are of longer duration and /or when actions were repeatedly part of the respective work programmes.** The latter feature has led to more and better data on outcomes but has also strengthened the programmes' structures and led to policy learning (see for instance INNOSUP-01).

Figure 19: Type of innovation introduced by INNOSUP beneficiary SMEs vs the whole survey sample

Source: authors' elaboration. Percentages refer to INNOSUP beneficiaries (blue bars). Statistical differences in the perceived barriers and the type of innovation introduced between the sub-sample of INNOSUP beneficiary SMEs and the whole sample were assessed by using a Pearson's chi-square tests. In both cases the tests do not reject the null hypothesis of the similarity of distributions.

4.3.2 Relevance

The success of innovation support measures strongly depends on matching the objectives of innovation support measures and the services provided with the needs and challenges identified by intermediaries and SMEs. Consequently, the horizontal analysis of the INNOSUP case studies aims to assess if the objectives of the Actions have corresponded to the needs and problems faced in developing innovation. The **characteristics and objectives** of the six INNOSUP Actions assessed are diverse with regards to their duration, their specific target groups, the type of funding and the amount of the financial support available. This diversity corresponds to the rationale of the INNOSUP programmes in testing new approaches in pilot actions and in tackling different barriers to innovation.

All in all, **the six INNOSUP case studies confirm that the different Actions corresponded to the needs of beneficiaries and the barriers they face in innovation.** The Actions tackled different needs and challenges on the part of SMEs and their capability to generate innovation, arising from market failures such as lack of knowledge and information about KETs, the high dissatisfaction rate of SMEs with public innovation support programmes, gaps in the social return and the innovation competencies of SMEs and their awareness of existing European-level support schemes. The results of the survey results shown in Figure 16 are in line with these findings. INNOSUP survey participants perceived the lack of financial support (82%), insufficient links with financial providers (53%) and lack of support for internationalisation (52%) as the main barriers to innovation. All INNOSUP Actions supported internationalisation by including a cross-border approach which was put into practice in different ways e.g. through cross-border initiatives of clusters or KET centres, the activities of innovation agencies in learning from their peers in different countries or newly created platforms dedicated to different topics like IPR or innovative digital and technological industrial value chains in the bio-food, forestry, and environment sectors. In addition to the cross-border approach, some of the Actions also emphasised a cross-sectoral approach (for instance INNOSUP -01), and this was regarded as beneficial and relevant for tackling market failures in the context of key enabling technologies.

Taking together the selected INNOSUP actions, the programme is relevant in all EU Member States since the needs of SMEs are somewhat comparable. Given that there is an innovation gap between the EU15 and EU13, the challenges might differ in scale and scope but the issues remain the same. The INNOSUP actions are therefore considered to be relevant for the entire EU.

4.3.3 EU added value

The INNOSUP case studies considered EU added value which refers to the **value resulting from EU interventions** that is additional to the value that would have resulted from interventions initiated at regional or national levels by both public authorities and the private sector. As a guiding principle for all EU funding initiatives, all the INNOSUP Actions assessed followed this principle, in order to increase the effects of European innovation support measures.

As far as some of the INNOSUP Actions are concerned, **no substitute funding opportunities** exist and the INNOSUP funding therefore closes a funding gap. This fact can be considered to be one of the main added value contributions by the EU (INNOSUP-05-2014-2015, 2016-2017, 2018-2020 and INNOSUP-02-2014). Another element of EU added value seems to be the cross-border approach of all INNOSUP Actions. In the context of EU Science, Technology and Innovation Actions, the boosting of international cooperation is often considered to be the main EU added value. A report of the European Commission (2014) emphasizes that the EU loses ground in technology development compared to other economies because it lacks critical mass and strategic cooperation across the national

borders.[96] The rationale of the INNOSUP Actions is to address this challenge. By focusing on the cross-border cooperation of different stakeholders in the European innovation ecosystem, **the case studies confirm that the international exchange of knowledge and ideas is the main EU added value that could not have resulted from actions at national, regional or local levels**.

Depending on the rationale of each INNOSUP Action, cross-border cooperation facilitated e.g. the **networking of stakeholders** (INNOSUP-01, INNOSUP-04-2016, INNOSUP-05-2014-2015, 2016-2017, 2018-2020), the **establishing of critical mass in different industrial fields** (INNOSUP-03-2017 and INNOSUP-01) or the **fostering of mutual learning and exchange** (INNOSUP-05-2014-2015, 2016-2017, 2018-2020). Consequently, INNOSUP Actions provided access to new networks or supported the creation of new networks. In this context, an added value of the Actions was the **linkage to other EU initiatives** such as INNOSUP-01 with the European Cluster Cooperation Platform.

Other advantages that stemmed from the cross-border cooperation were the exchange of best practice by different stakeholders, the harmonization of processes within the EU and the improved coordination of innovation actions with national actions. Stakeholders interviewed often described the learning process of the cross-border actions as a helpful and enriching experience, extending knowledge and creating broader networks / critical mass. All these outcomes would have not been achieved by national or regional measures.

4.3.4 Coherence

The INNOSUP case studies also considered the **policy mix of the various instruments** making up the INNOSUP Actions and how well they worked internally and with other national or regional interventions. To achieve the objectives of the EU policy mix, a variety of different instruments can be used, such as regulatory tools that set rules for social and market interactions, financial tools that provide specific incentives and soft tools which are characterised as voluntary and non-coercive (e.g. recommendations). By focusing on the coherence of the policy mix and its instruments, the INNOSUP Actions can create synergies within the Research Framework Programme as well as with national, European and international levels.

The findings of the case studies confirm that **all INNOSUP Actions created synergies with other EU or national programmes** not least because of their (implicit) linkage to different actions of the Research Framework and H2020 WPs. While some INNOSUP Actions are also linked to specific funding programmes such as the ESI Funds (INNOSUP-01, INNOSUP-03-2017) most of INNOSUP Actions have a link to other Horizon 2020 Work Programmes. In addition, some of the Actions involved intermediaries that are based on EU initiatives themselves, such as the Enterprise Europe Network. This also helped to increase the coherence of EU actions.

Due to the variety of instruments and the issues addressed by INNOSUP Actions, the **coherence with other European or national programmes and initiatives** varies depending on each INNOSUP Action. For instance, INNOSUP-03-2017 has a linkage to the bio-based joint undertaking which also focuses on KETs and the INNOSUP-02-2014 has established synergies with other international IPR Helpdesks as well as other EU bodies that are dealing with IP, like EUIPO or EPO. The focus of INNOSUP-01 is mainly on industrial competitiveness and emerging industries and linkages to other European initiatives such as

[96] European Commission (2014): European Added Value of EU Science, Technology and Innovation actions and EU-Member State Partnership in international cooperation. Available under: https://ec.europa.eu/research/iscp/pdf/publications/Final_European_Added_Value_inco_MainReport.pdf. Last access on 26/10/2020.

the European Cluster Collaboration platform. A strong interlinkage therefore exists with the ESI Funds. In addition to this, INNOSUP-04-2016 has synergies with other EU policies such as the European Social Innovation Competition. The INNOSUP-02-2016-2019-2020 also confirms synergies with other INNOSUP Actions and the COSME programme.

4.3.5 Efficiency

Underlying effectiveness is the question of **efficiency**. The INNOSUP case studies identified factors driving costs and benefits of the public funding support and how these factors relate to the different INNOSUP Actions and their instruments. Depending on how public innovation support is approached and conducted, it can have a significant influence on outcomes, making it necessary to consider whether other choices (e.g. as demonstrated in the different Member States) achieved the same benefits at less cost (or greater benefits at the same cost).

The Framework Programme for Research and Innovation (2014-2020) introduced **cascade funding**. The main objective of the new funding method was to simplify administrative procedures and to ease the application process for EU-funded projects. In four out of six INNOSUP case studies evaluated, the funding was distributed as cascade funding. According to the 'cascade funding' approach, the EC selects a consortium responsible to the EC and this in turn provides the financial support to final beneficiaries. Consequently, no financial or legal validation is necessary by the EC. The newly introduced cascade funding approach also had a significant impact on the **application processes**, which were generally judged in all of the INNOSUP case studies to be simple and straightforward. Due to this cascade approach, final beneficiaries confirmed in most of the cases that they benefitted from a simplified application process with a decreased workload and regular cut-off dates. These changes were appreciated by the majority of final beneficiaries interviewed.

The way in which the **financial support** was allocated and how much was awarded depended on the individual characteristics of each INNOSUP Action. The funding rate for CSA Actions was 100% and 70% for IA Actions. The INNOSUP case studies and the different interviews confirmed that both direct and final beneficiaries were satisfied with the new funding scheme, since it has reduced their administrative tasks and beneficiaries were able to focus on the implementation of the project. The overall level of efficiency in the INNOSUP Actions is judged as good. In particular, **the cascade funding and lump sum approach was appreciated by beneficiaries interviewed**. Besides the way in which the financial support was allocated, the funding amount was crucial for the successful implementation of projects. The total allocated budget ranged from of EUR 1 million per call (INNOSUP-05-2014-2015, 2016-2017, 2018-2020) up to EUR 107.2 million (INNOSUP-1).[97] Evaluations referred to in the INNOSUP case studies confirm that the budgets allocated were adequate to carry out the activities required. Therefore, the budget was proportional to the achievements of each action. Nevertheless, the amount was in some cases judged to be sufficient but limited (**INNOSUP-05-2014-2015, 2016-2017, 2018-2020)**. Even if it had no impact on the final outcomes of the action, further budget would have helped additional implementation, according to stakeholders interviewed.

[97] The indicated budget is the total amount per call. The respective budget was then further divided within the call among various final and direct beneficiaries.

4.4 Overarching policy recommendations on INNOSUP Actions

The individual evaluations on each INNOSUP action include action-specific recommendations (see Annex E). In this section we highlight some **recommendations for the future** that can be regarded as being of a more general nature and as relevant for more than one Action analysed:

- **Visibility of INNOSUP Actions and the dissemination of information**: The visibility of the INNOSUP Actions seems to vary significantly. However, studies show that visibility and systematic communication and dissemination of information are crucial to attract applicants and to promote follow-up of success stories. Despite the existence of dedicated websites, potential INNOSUP beneficiaries often lack information about funding opportunities (INNOSUP-03-2017 and INNOSUP-02-2014). The increased involvement of third parties e.g. through cluster or network associations could help the European Commission and intermediary structures to better disseminate information about calls and promote the programme especially in the EU-13 and non-EU countries (INNOSUP-05-2014-2015, 2016-2017, 2018-2020).
- **Involvement of intermediaries:** In the funding period of 2014 – 2020, it was observed that a higher number of final beneficiaries (SMEs) from EU-15 countries participated and benefited from the INNOSUP Actions. Amongst other things, this is because there are fewer intermediaries (direct beneficiaries) from EU13 countries that apply and get selected, leading to a weaker outreach to SMEs in these countries. Thus, improving the participation rate of intermediaries in these countries could be an efficient way to achieve a better geographical balance. Consequently, a greater focus should be on engaging intermediaries from countries with a lower participation rate in order to attract a higher number of e.g. Helpdesk users (INNOSUP-02-2014), challenge owners and solution providers (INNOSUP-04-2016) and engage with SMEs seeking new clean production processes (INNOSUP-03-2017) in the future. Other than that, it is recommended that the involvement of intermediaries in different actions should continue and even be extended, since this has been shown to be an efficient instrument for achieving a wider reach to SMEs, leading to more applicants and in general a higher rate of SMEs that know about these programmes. These points regarding the involvement of intermediaries would ensure that the contextual factors that have been identified are better taken into account.
- **Funding mechanism:** The newly introduced cascade funding method with its flexible lump sum approach that significantly decreased the administrative burden was appreciated by direct and final beneficiaries according to evaluations referred to in the individual case studies. In this context, the possibility to mix different support instruments (vouchers, trainings, etc.) has been appreciated and should be continued. Here, direct financial support (supplemented by other support actions) should be emphasized as this is seen by SMEs and intermediaries as the most valuable form of support.
- **Establishment and improvement of monitoring mechanisms:** In the 2014-2020 programming period, the individual INNOSUP Actions were characterized by a high degree of flexibility. While this flexibility was mostly appreciated with regards to financing and administrative workload, the monitoring of projects results and their follow-up could have been better structured allowing the results achieved to be captured. To better measure medium- and especially long-term effects, it will be important to put more emphasis on monitoring. This is already done in certain actions, especially those that have been part of multiple work programmes but it could also be stressed in one-time programmes or pilots to collect more thorough information with regards to the mid- and long-term effects.
- **Establishment of a follow up mechanisms:** To make even more efficient use of the funding, it is recommended that more emphasis is put on structured follow-up

mechanisms. All case studies, but in particular those with a shorter project duration, had beneficiaries state that a follow-up would send a stronger signal that this Action is not a one-off instrument. Potentially, this could consist of a structured event with a particular focus on follow-up investment or a presentation on other potential EU funding programmes. Overall, this could increase the sustainability of the actions and potentially increase the chance of longer-lasting collaborations between actors.

5. Conclusions and recommendations to improve innovation support at European level

This concluding chapter provides a synthesis of the key findings of the study and some reflections and recommendations for the ongoing discussion of the post-2020 period about how to improve the EU support for SME innovation.

5.1 Key findings on public innovation support for SMEs

Building on the findings from the study's literature review, survey, case studies and interviews, we present here the overarching insights into the most recently experienced barriers to SME innovation, the impact of existing public innovation support for SMEs and SMEs' expectations regarding public innovation support. We do so by following the structure of the evaluation criteria recommended by the Better Evaluation Guidelines.

5.1.1 Relevance – What are the main barriers to SMEs' innovation and to what extent do existing public innovation support measures address those barriers? Which gaps still remain?

Relevance relates to assessing to what extent public innovation support measures addressed the main factors hampering innovation in SMEs. As illustrated in Chapter 2 and discussed in the literature, **multiple types of barrier affect innovation activities** in SMEs: i) financial barriers, ii) lack of skills / qualified personnel, iii) bureaucratic barriers, laws, standards and regulations and difficulties in managing IP, iv) lack of external partners and possibilities of collaboration (e.g. between science and businesses), v) barriers related to the organisational level, vi) lack of knowledge (e.g. about technologies, market information, etc.), vii) market constraints (e.g. markets dominated by established enterprises, no or uncertain demand). According to the evidence collected in this study and presented in Chapter 3, among these obstacles, **the financial barrier is the one considered most important** today by SMEs and intermediaries. This is supported by the findings from the literature, which distinguishes two aspects; the cost of an innovation activity, which is related to the availability of SMEs' financial resources, and the access to external sources of finance, which is related to the possibilities of receiving public financial support as well as to the SME's relations with finance providers. The recent economic crisis and great uncertainty triggered by the COVID-19 pandemic may have affected the perceptions of enterprises, increased the concerns about the future and their need for financial support over any other type of support.

Other barriers deemed particularly relevant by SMEs are the lack of support for **internationalisation** and the lack of **certain regulatory requirements** for new innovative products or services. Innovation intermediaries pointed to the lack of support for **networking** with other RDI actors, and the lack of support to acquire **skills** from outside or to develop skills in-house as key obstacles to innovation for SMEs. The main barriers that were identified through the literature review and the survey are reflected in the work programmes of the INNOSUP Actions, which mostly include elements to support internationalisation and to address a lack of financial resources.

In addition to the typical barriers to innovation identified and explored in the literature, the study also considered the **impact of recent or emerging technologies and economic and market developments on innovation**. SMEs are concerned with the emergence of players with large market power (e.g. in the ICT sector) and the increasing complexity of products and services and faster innovation cycles. SMEs in Eastern and Southern EU are particularly concerned by the ongoing digitalisation and green innovation challenges. Even if representing significant business opportunities in the long-term, they require changes in their

business models and high financial investments. Programmes such as the INNOSUP-1 are seen as particularly relevant in this regard, since emerging technologies are their main focus.

The literature review, the results of our survey and to an extent the results from the INNOSUP case studies, indicate that the **SMEs' perception of the different barriers varies considerably depending on certain factors** such as the age of a firm, its size, its stage in the life cycle, and the sector in which it operates. Furthermore, factors related to the organisational level (e.g. the willingness to innovate or if the firm has already conducted innovation projects) and other contextual factors, for instance the geographical context as in certain INNOSUP actions, all affect the SMEs' views. In particular, the survey's results suggested that more "inexperienced" SMEs (smaller, newer, those that have not recently undertaken any innovation activity) are more concerned with having access to financial support and to information about support possibilities, whereas established and bigger enterprises are more interested in support for developing innovation skills or to attract qualified staff. The lack of support for internationalisation hampers innovation activities, especially according to enterprises that might be more interested in selling their innovative services/products abroad than other SMEs (i.e. high-growth 'born global' enterprises and SMEs whose innovation is based on research activities). Similarly, the lack of incubation support and of networking (especially with finance providers) is more relevant for micro and newly established enterprises, which are at an early stage of business.

In contrast, having already received public support (especially financial support and awareness raising support) positively affects the SME's perception of the obstacles to innovation, meaning that the **support received actually addressed those barriers**. The literature review identified appropriate instruments to address each of the main barriers to innovation. Nonetheless, the in-depth analysis of the INNOSUP actions showed that both SMEs and intermediaries recognised that there is potential for better and more targeted public support, in particular in areas where the barriers are perceived as more important, namely: in support aiming to improve SMEs' access to finance for micro enterprises, where more clarity about financing possibilities is required, in cooperation and networking with other actors, and with internationalisation. It should be noted here that barriers also do not impact SMEs individually but collectively.

The interview programme and some of the literature suggest that an area of support that may be underprovided for is that of addressing the needs of SMEs primarily operating in the innovation by experience, learning by doing, using and interacting (DUI) mode.

5.1.2 Effectiveness – Can innovation support received by SMEs be considered effective? What is their level of satisfaction? Which factors determine the effectiveness and satisfaction?

Effectiveness relates to the progress made towards achieving the objectives of public innovation support. Although the strategic objective is clear – using public support to address the market and systemic failures constraining innovation in SMEs, thereby releasing their full innovation potential and maximising positive externalities from innovation – a very wide range of delivery institutions exists, each one with a range of policies and programmes and with specific objectives. Intervention logics of the different support initiatives may differ, as well as the direct and indirect beneficiaries targeted, with programmes being delivered at different levels (e.g. EU, national, regional, local) and to different target segments of the SME population. This, as well as the fact that long-term effects might only be visible after some years, makes it challenging to draw up general conclusions about their effectiveness.

In general, as the theory-based impact evaluation of six INNOSUP actions shows, the effectiveness of public innovation support appears to be **context-dependent**, i.e. at least affected by country and/ or beneficiaries' characteristics. In this context, the INNOSUP Actions seem indeed to work **better in the EU15** countries than in the EU13 countries, especially when the direct beneficiary of the Action is supposed to act as an intermediary to improve the outreach of the Action. This is also highlighted in the respective literature, according to which innovation outcomes of the instruments vary depending on the design and implementation of the instrument itself as well as on the context in which it is implemented. Factors like the size and age of the beneficiary, its economic sector, organisational structure and innovation management may also affect the support outcomes (as confirmed by the survey's results). In light of this, several studies suggested that the **support instruments need to be tailored** as much as possible to the type of firm (micro/small/medium/large, firms with growth potential, etc.), their needs (financial support, advisory services, etc.) and their willingness and capability to innovate.

Overall, the survey's results on the level of satisfaction of SMEs with the support received are mixed. When asked to assess the extent to which the public support they received met their expectations, SMEs showed a moderate level of satisfaction for all types of support initiatives. Satisfaction was higher with two forms of support: financial support and support to acquire information about financing possibilities. These two correspond to the highest barriers to innovation perceived by SMEs. In general, the SMEs' **level of satisfaction has improved compared to 2009** for all the innovation support measures investigated. The great majority of SMEs surveyed (85%) considered the public support received as essential to undertake their innovation activity (compared to 47% in 2009). For 43% of SMEs surveyed, public support represented the key driver to embark on innovation activities; for 38% of SMEs, public support had the effect of accelerating innovation (i.e., implementing the innovation project earlier or faster than expected), or increasing the size and scope of the innovation project. It was also the case that SMEs that had experienced some kind of support tended to rate the services more highly than those that had not.

The findings from the survey are well reflected in the functioning of the different mechanisms that are illustrated in the **INNOSUP actions**. Applicants and beneficiaries are particularly **satisfied with the volume and form of financial support** received, the **transparency** of the selection process, **easiness and duration** of the application process. A key benefit that was illustrated through the INNOSUP-1 action has been the value of the combination of support instruments (for instance pairing training offers with financial support). However, one key **barrier to the effectiveness of the INNOSUP Actions is the low level of awareness** among SMEs about the Actions' existence. With regards to medium- and long-term effects (e.g. new products, lasting collaborations), it can be indicated that the amount of funding the duration of projects and often their nature as pilot projects are likely to result in limited effects. In general, it is shown that the outcomes are **stronger when projects have a longer duration** and/or when the same Action is repeated over time and remains available for a longer time.

5.1.3 EU Added value – What's the value of EU innovation support initiatives, compared to national and regional measures?

As illustrated in Chapter 3, the EU, national governments and regional and local authorities concur in providing public funds in support of innovation. Although all of them offer a wide range of types of support, SMEs appreciated the EU support (compared to that offered by other government levels), especially in terms of **financial support**, facilitation of **internationalisation**, acquisition of **skills** and qualified staff from outside, and stimulus to **cooperation and networking** between different RDI actors and across borders. These are also the areas in which both SMEs and intermediaries indicated that they expect the EU to have a relevant and stronger role in the future.

The EU added value, however, seems to vary depending on the geographic area to which the SME belongs. SMEs in North-continental countries expect a more limited role from the EU. This may depend on the stronger innovation system present in these countries and on the fact that there are national, regional and local initiatives which can substitute the EU support. On the other hand, as also underlined in the literature, national or local initiatives in countries without a favourable environment for innovation activity and an innovation system based on the interaction between the main stakeholders produce modest effects. In these cases, the added value of the EU support is perceived as stronger by SMEs. The main added value of the EU support consists in favouring the **exchange of knowledge and ideas between different stakeholders and across borders** through the creation of networks. In general, it emerges that the **INNOSUP actions were complementary and not overlapping** with any already existing national or regional measure (see also the section on Coherence below), thus pointing to positive added value from the EU intervention. A particular good practice can be drawn from the INNOSUP-1 action, in which intermediary organisations (clusters) benefited by building lasting cross-border/cross-sectoral collaborations with other clusters and also benefit in this context from other EU measures such as ESIF funding or platforms such as the ECCP.

When asked about the perceived added value of some specific EU initiatives, such as the INNOSUP actions, the Enterprise Europe Network, the COSME Loan Guarantee Facility, the European Cluster Collaboration Platform or others, the majority of innovation intermediaries consider these initiatives to be of moderate or high added value. SMEs generally consider these initiatives as less important, largely due to **their low level of familiarity** with such initiatives.

5.1.4 Coherence – What is the level of coherence between the various SME innovation support initiatives?

The EU innovation support actions were conceived under the umbrella of the EU 2020 Strategy. Although the various initiatives were disseminated across larger programmes not specifically aimed at SMEs, they all **contributed to the overarching aim of fostering innovation** in the EU. By creating an Executive Agency for Small and Medium-sized Enterprises (EASME) stronger coherence among a wide range of initiatives was ensured.

According to the evidence collected through the survey and a more in-depth analysis of INNOSUP actions, the various initiatives can be considered **complementary** insofar as they provide different forms of support, from financing support to the creation of innovation clusters, and/or use different instruments (e.g. grants, loans or guarantees). Different support initiatives are available to address the diverse barriers faced by SMEs. **Innovation intermediaries play a stronger role in providing non-financial support** (e.g. networking, knowledge transfer, support to identify innovation potential, training etc.), while public agencies at national and regional level and the EU institutions are relatively more involved in the provision of financial support. Moreover, **the EU has a stronger role to play in favouring cross-border cooperation** in any form, whether it is support to cluster collaboration for new value chain creation (like with the INNOSUP-01 action), or support for the international mobility of researchers (INNOSUP-02) or the establishment of a pan-European network to favour the access to new technologies for cleaner production processes (INNOSUP-03). The INNOSUP evaluations show that no similar national or regional initiatives exist.

Moreover, the INNOSUP case studies confirmed that **all INNOSUP Actions created synergies with other relevant EU or national programmes** in the specific thematic area of different Actions. More differentiation in the target groups may further improve the complementarity of the actions.

When it comes to external coherence with other EU programmes, there is a political will to reconcile EU innovation support actions with the new Commission's priorities, especially the European Green Deal and the European Digital Strategy, as reflected in the Commission's communication "An SME strategy for a sustainable and digital Europe". This is also coherent with the need raised by SMEs to receive **more support to embark on the green and digital transition**. This is an increasingly important source of concern for SMEs, particularly those located in the Southern and Eastern countries of the EU, where innovation capabilities are relatively more limited and a lack of access to finance is considered a stronger barrier.

5.1.5 Efficiency – Are benefits of public support for SME innovation proportional to costs? What factors drive efficiency?

In order to assess the efficiency of an intervention, the costs and benefits accrued to the different stakeholders should be considered. However, the resources allocated to each support initiative vary considerably, and the effects produced do not necessarily depend on the amount of resources dedicated to it, but on design, implementation and contextual factors, as previously discussed. The evaluation of six INNOSUP actions indicates that their overall level of efficiency is good. The **budgets allocated were considered generally sufficient** to carry out the activities planned. In some cases, the budget was considered tight, but this did not have any impact on the outputs achieved.

This study also provided indications about the factors driving these costs/ benefits. **Application, selection and funding procedures** were highlighted as the key factors in this regard. Whereas the **cascade funding and the lump sum** approach adopted by the INNOSUP Actions increased their efficiency by reducing the burden on beneficiaries, applicants to other EU innovation support instruments generally found the application and selection procedure still quite complex and inefficient, requiring them to invest substantial resources and time. Confirming this observation, when asked about how public innovation support services could be provided more effectively, both SMEs and intermediaries responding to the survey indicated a need to introduce **fast-track procedures** for administration and evaluation of projects. **Better targeting** of support initiatives could also increase the efficiency of public support for the beneficiary SMEs.

Another key aspect undermining the efficiency of the EU public innovation support is the dispersion of information and funding across multiple initiatives with different names, application and evaluation rules. Limited awareness of available support measures is indicated as one of the main barriers to innovation by many of the SMEs surveyed. In this regard, a **one-stop-shop approach** is deemed useful by both SMEs and intermediaries to reduce time and efforts when trying to access public support measures.

Finally, the possibility of coordinating and **combining various support initiatives**, including at different levels of government, is considered an important driver to increasing the efficiency of the overall innovation support system.

5.2 Recommendations for the future

Starting from the findings of our study, we have elaborated a set of recommendations to improve the EU public innovation support. Detailed recommendations regarding the INNOSUP Actions are presented in Chapter 4 (overarching) and in Annex E (action-specific).

1) **Take actions to diversify the cohort of SMEs receiving public innovation support**. Our study has shown that public support tends to be concentrated in the

already more innovative countries (in the EU Old Member States of Northern and Continental Europe[98]) and in small and medium enterprises, for rapid-growth enterprises and for the advantage of SMEs operating in more innovative sectors (i.e. technology and knowledge-intensive sectors in manufacturing). To avoid deepening the gap between leaders and laggards in the long run, public innovation support measures should more strongly aim for innovation diffusion – notably concerning digitalisation and new technologies – and at a better geographical diversification of the beneficiary SMEs.

2) **Make sure that all the different barriers to SME innovation identified are addressed by public support instruments**. In particular, more support should be dedicated to financing RDI activities in micro-enterprises (including innovative smart-ups), increasing awareness about financing possibilities, especially among newly established SMEs, reinforcing cooperation and networking among RDI actors. Newly emerging needs related to the digital and green transition should also be specifically addressed by public support measures. The literature review also indicates that the role of managerial and 'soft' support, for example in the craft sector and for SMEs that favour a DUI innovation method (i.e. innovation and learning by doing, using and interacting) should not be overlooked.

3) **Clearly identify the targets of the different initiatives and tailor innovation support measures to the needs of specific types of SME**, taking their characteristics into account in the design of the actions, in terms of specific objectives, leading to a combination of appropriate support instruments and the most suitable application and evaluation procedures and programme management. At the same care needs to be taken to avoid a proliferation of instruments and programme titles that simply confuses the market.

4) **Ensure the combination of different support instruments** as well as various support initiatives, including at different levels of government, so as to increase the coherence, effectiveness and efficiency of the support. An integrated and coherent one-stop-shop approach for all the innovation support initiatives for SMEs should be adopted at all levels.

5) **Design future-proof support initiatives** that help SMEs address the emerging market, technological and economic challenges. As intermediaries seem to be more aware of these trends than SMEs, they might have a role in raising awareness and helping SMEs to adjust to the latest developments. For this reason, SME support also needs to be seen in the light of the various EU cluster initiatives and other collaborative activities that will continue to play an essential role in disseminating support and information to SMEs. This holds especially true for complex technologies and organisational adjustments required around themes such as the green deal (especially with regards to the New Circular Economy Action Plan) and the digital transition. More innovation support to accompany the green and digital transition should be available for SMEs in less innovative sectors, especially in Southern and Eastern EU.

6) **Expand the involvement of intermediaries and innovation experts in service provision**, especially in actions aimed at stimulating networking and cooperation among actors and support their increasing professionalisation. Related to the prior point, intermediaries can indeed play a key role in reaching out to SMEs and in the

[98] I.e. Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Lithuania, Luxembourg, Netherlands, Sweden, United Kingdom.

creation of favourable ecosystems. The role of intermediaries to provide financial support, in addition to non-financial support services could be reinforced.

7) **Simplify and harmonise**, when possible, the application procedure to EU support initiatives, taking into account the amount of resources available for target groups. When possible, consider adopting a cascade funding approach similar to that of some INNOSUP Actions.

8) **Increase the visibility** and improve the access to information about EU innovation support possibilities (including the INNOSUP Actions) through systematic communication activities targeting newly-established and micro-enterprises. The involvement of third parties can help to disseminate information.

Annex A: Literature review

A.1 Introduction

Unsurprisingly, the literature surrounding the evaluation of the effectiveness of public innovation support is voluminous, rich and complex, and appears to be increasingly so, with contributions from academia, government and the private sector. This heterogeneity reflects the diversity of the subjects of the research: small and medium-sized enterprises (SMEs) and their innovation activities, and precludes any simple, unequivocal generalisations.

This literature review aims to provide a comprehensive overview of the subject; however, given the huge number of studies on the one hand, and the specificity in terms of time, space and particularity of many of the issues and instruments involved, it does not claim to be complete. Where further details are sought on specific areas, these can usually be identified in the literature referred to in the relevant sections or sub-sections.

This document is structured as follows: first there is a short methodological section which sets out the approach adopted to identifying literature, followed by the definitions used for the key terms 'innovation' and 'barriers'. Then there is a review of the literature relating to barriers, instruments and effectiveness, with a synthesis at the end.

It is clear that many factors influence the level of innovation performance of SMEs. These include the effects of the work of public education institutions, the effectiveness of partnerships between research organisations and firms, the business environment (e.g. access to capital, economic growth), the digital infrastructure, market and competition laws, regulations and standards (e.g. for the protection of intellectual property) as well as cultural factors like the entrepreneurial spirit in the population.

For SMEs, their small size can significantly hamper their innovation and development potential. The innovation and growth challenges faced by SMEs are manifold: market failures, including limited access to resources such as finance, information (including about support instruments) and human capital; the high costs of innovation; lack of incentives facilitating cooperation or supporting partner search between actors; organisational constraints such as lack of time, quality and forward-looking ownership and management; and limited ability to shape the external environment, yet having a high dependence on it. Public support for innovation at European, national and regional levels aims to overcome such barriers.

In the European context and especially that of the **Europe 2020 strategy**, innovation is seen as a way to achieve smart, sustainable and inclusive growth. Innovation is considered essential to preserve and improve Europe's competitiveness and its ability to create jobs and to tackle societal challenges (European Commission, 2014). For that reason, the Innovation Union initiative – as part of the Europe 2020 strategy – aims to improve Europe's capacity to innovate.

The European Commission monitors the innovation performance in EU countries (and some non-EU countries) by means of specific indicators on a yearly basis. The **European Innovation Scoreboard** provides a comparative analysis of those indicators, and assesses relative strengths and weaknesses of national innovation systems to help countries identify areas for improvement[99]. The innovation scoreboard ranks countries according to their average performance scores, with the top-performers categorized as "innovation leaders", followed by "strong innovators", "moderate innovators" and "modest innovators". The

[99] See: https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en , 06.07.2020

countries' performance is assessed over several dimensions: framework conditions, investments, innovation activities and impacts[100]. The 2020 report[101] shows that overall performance has improved for most EU member states since 2012 and that the EU has a performance lead over countries like India, Russia, Brazil, China as well as the US but lags behind in terms of innovation performance when compared to Japan, Australia, Canada and South Korea. The report also shows differences in innovation performance between countries in the EU and this is detailed in the dimensions mentioned and their sub-dimensions.

When comparing countries over time in terms of their innovation performance as assessed by the Innovation Scoreboard, the Nordic countries Sweden, Finland and Denmark often score very highly and are among the innovation leaders, and western European countries are often categorised as strong innovators or some as innovation leaders. Most southern and eastern European countries (with notable exceptions depending on the year of the assessment) tend to be assigned to the groups moderate and modest innovators. However, countries' innovation scores change over time, and consequently their group assignment. The methodology used (e.g. the indicators chosen to calculate the innovations scores), which has changed over time, has also led to changes in the rank and the overall performance score of countries.

Source: European Innovation Scoreboard 2020, available at: https://ec.europa.eu/growth/sites/growth/files/eis2020_leader_map-01.png

[100] For a full list of relevant areas in the measurement framework see the European Innovation Scoreboard reports available at: https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en , 06.07.2020

[101] Hollanders, Hugo (2020): European Innovation Scoreboard 2020. Prepared as part of the European Innovation Scoreboard (EIS) project. Publications Office of the European Union. Luxembourg.

Results from the **Innobarometer 2016** – EU business innovation trends report[102] (TNS Political & Social), which is based on survey responses from more than 14.000 companies, shows that 67 % of the companies in the EU-28 have introduced at least one innovation between January 2013 and February 2016 (p.4), but results differ between countries. The Innobarometer and the European Innovation Scoreboard both measure innovation activities, but each uses different methodological tools[103]. Therefore, the reports show different results. In the Innobarometer 2016 the share of firms that reported the introduction of at least one innovation is high in Denmark (81 %) but quite low in the other Nordic countries - Finland (54 %) and Sweden (52%). Among the EU-28, the share of firms that report the introduction of at least one innovation is only lower in Estonia (50 %). In contrast to the results from the European Innovation Scoreboard, a high share of firms in Slovenia (74 %), Czechia (73 %), and Romania (72 %) reported having introduced at least one innovation between 2013 and 2016 (p.9).

According to results based on the Community Innovation Survey[104] 2016 the share of innovative enterprises was highest in Belgium (68 %), Portugal (67 %) and Finland (65 %). The EU-28 average was 51 %, the lowest shares of enterprises with innovation activities were found to be in Romania (10 %), Poland (22 %) and Bulgaria (27 %)[105].

As a conclusion, the assessment of innovation performance depends to a great deal on the specific research focus and the methods applied, and different foci and methods used may lead to considerably different results.

A.2 Methodology

The selection of literature was guided by three research questions:

- What are the main **barriers to innovation** in SMEs in Europe?
- Which **instruments** and programmes targeting innovation in SMEs exist and
- what evidence can be found in the literature regarding the **effectiveness** of these instruments?

The literature review provide information that allows a mapping of policy instruments supporting innovation in SMEs at regional, national and EU levels. From the identified barriers to innovation and the instruments targeting innovation we derive a working typology to analyse the effectiveness of public support to innovation in SMEs in the current EU context.

To identify relevant literature we formulated specific search terms, which were then fed into the search engines and literature databases. The search terms selected were:

[102] TNS Political & Social (2016): Innobarometer 2016 – EU business innovation trends. Flash Eurobarometer 433. European Commission.

[103] For example, the Innobarometer relies on its own survey data (survey year: 2016), and questions about new or improved goods and services were asked separately. The European Innovation Scoreboard uses data from the OECD (source year: 2016) and the dimension “Innovation activities” is comprised of eight different indicators, of which only two measure the share of SME (indicator measures only SME’s performance in comparison to the Innobarometer, where all firms were surveyed) that have introduced product, process, marketing or organisational innovations.

[104] The Community Innovation Survey is a survey of innovation activity in enterprises carried out with two years’ frequency by EU member states. (https://ec.europa.eu/eurostat/web/microdata/community-innovation-survey, 06.07.2020)

[105] https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190312-1 , 16.07.2020

- (SME OR SMEs) AND (“barriers to innovation" OR "challenges to innovation" OR "factors hampering innovation" OR "obstacles to innovation" OR "innovation barriers")
- (SMEs OR SME) AND innovation AND (policy OR instruments OR policies OR "public procurement" OR “R&D grants” OR “R&D subsidies” OR R&D "tax incentive" OR "venture capital" OR funds OR voucher OR loan) AND (effect OR impact OR efficiency OR effectiveness)

We used Scopus and Web of Science[106] to search for scientific articles, the OECD Library and the SIPER database developed by the Manchester Institute of Innovation Research to search for policy papers as well as evaluations in the EU countries. In these databases most documents identified were in English. To include literature from other languages as well we, we conducted a search in google scholar with a translation of the search terms into French, German, Italian and Spanish respectively. As google scholar has a limit set for the characters used in search requests, we had to shorten the second search term accordingly (by specifying fewer instruments and fewer words related to the effects of the instruments). To reduce the number of matches (which at this point amounted to several thousand overall) we further added time constraints (2015-2020 for google and 2010-2020 for Scopus and Web of Science) as well as geographical restrictions (we focused only on the EU-28 countries, Switzerland and Norway) Overall, the search resulted in more than 1.000 documents. The number of documents to be analysed was further reduced manually. The research team screened the documents’ titles and abstracts and excluded those that we deemed as non-relevant for our study. Ultimately, we classified 149 documents in English, 27 in German, 26 in Italian, 28 in French and 68 in Spanish as relevant for our analysis. Some documents, which on closer examination were not relevant for the purpose of this study, were excluded after the search was completed. Ultimately, the following types of documents were included in the analysis: articles, conference papers, book chapters, government reports, consultants’ reports and Master/ PhD theses.

A.3 Definitions

In this section we provide definitions of what we understand by some of the key terms we use in this document: innovation, innovation barriers, effectiveness, and SMEs

A.3.1 Innovation

In the context of the organisation, innovation is something newly created or something existing, which is improved or modified (Hueske and Guenther 2015). According to the Oslo Manual (OECD/ Eurostat 2018), a business innovation is ‘a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm’ (OECD, 2018, p.20). Innovations can be further classified according to the type of innovation (product innovation, business process innovation, novelty (disruptive or radical innovations, new to firm, new to firms market, new to world), and according to impacts (potential to transform market, improve competitiveness) (OECD 2018).

The Oslo Manual 2018 distinguishes between three types of innovative firms: innovative firms, innovation-active firms and non-innovative firms. (OECD 2018, p.81) A slightly different approach distinguishes between R&D intensive and less R&D intensive segments of the economy and between enterprises that conduct internal R&D and those that do not. Firms with R&D departments develop innovations that are based on (internal) scientific

[106] In addition, we also used the library of the University of Vienna to search for documents that could supplement the search via Scopus and Web of Science.

research. In less intensive R&D segments innovations are often based on experience and on skills that are related to certain fields of applications (therefore innovations are more likely to be incremental than disruptive and are focused on solutions for specific problems). Therefore, a distinction can be made between SMEs that operate in a Science, Technology, Innovation (STI) mode, and SMEs that operate in a "Learning by doing, using and interacting (DUI) mode (Zimmermann & Thomä 2016). Another approach is to categorize firms according to their willingness to innovate. Based on answers to the CIS questionnaire, Blanchard et.al. (2012) distinguish between firms that are willing to innovate and firms that are not willing to innovate.

While on the face of it, innovation might be relatively straightforward to define, in some contexts it is more nuanced. For example, when reviewing the impacts of the REACH Regulation on innovation (Centre for Strategy and Evaluation Services 2015, 2012a and 2012b), it was found that enterprises were forced to substitute chemical substances that had been identified as Substances of Very High Concern (SVHCs) for others even though the substances substituted might not be as effective as the ones discarded. Does this qualify as innovation?

Innovations can have a wider impact on society and might sometimes even change people's behaviour in the end. The term 'social innovation' refers to innovations that are focused on social objectives as opposed to the definitions above, which are focused more on technological aspects. (Anderson et al., 2015, p.1[107]). Although there are different definitions of social innovation, the term usually refers to new forms of practices that are performed by people to achieve a certain goal[108]. The European Commission defines social innovations as "new ideas that meet social needs, create social relationships and form new collaborations. These innovations can be products, services or models addressing unmet needs more effectively".

https://ec.europa.eu/growth/industry/policy/innovation/social_en , 13.07.2020

A.3.2 Barriers to innovation

Barriers to innovation can be defined as "factors which impede, delay or completely block innovation" (Hueske & Guenther 2015, Bergmann and Volery 2016, p.42, Gardocka-Jalowiec and Wierzbicka 2019). Which barriers are relevant for a specific firm also depends on whether a firm is already engaged in innovation activities. D'Este et al. (2012) propose to distinguish between two types of innovation barrier: 'revealed' and 'deterring' barriers. While barriers to innovation may reveal themselves during a firm's innovation process, other firms may abandon their innovation activities due to deterring barriers (Hvolkova et.al. 2019). Firms may be affected by one or more innovation barriers, depending on various firm characteristics (like for example size, age, access to financial resources and others). Barriers can emerge on various levels, e.g. firm environment, organizational, group level, and individual level (Hueske & Guenther 2015). The most common distinction in the literature is between internal and external barriers to innovation. (Hvolkova et.al. 2019, Duarte et.al. 2019, Hueske & Guenther 2015, Gardocka-Jalowiec & Wierzbicka 2019) Firms can directly influence internal factors, which are related to the organizational and individual level (Gardocka- Jalowiec & Wierzbicka 2019), but firms, especially SMEs, are usually not able to influence external factors directly. External factors include barriers caused by the market, government or other environmental factors (Gardocka- Jalowiec & Wierzbicka 2019). Hadjimanolis (2003) proposes a distinction between general, relative, objective, and

[107] Anderson, Tara; Curtis, Andrew; Witting, Claudia (2015): Definition and Theory in Social Innovation. The theory of social innovation and international approaches. ZSI Discussion Papers. Nr. 33. Centre for Social Innovation. Vienna.

[108] For an overview of different definitions see for example in Anderson et al., 2015, p.6-9

perceptual barriers General barriers are those that affect all firms regardless of sector, while relative barriers are rather sector specific. Objective barriers are barriers that are indeed present while perceptual barriers depend on the firm's subjective point of view. (Bozic & Rajh, 2016, p.4). Further approaches can be found as well (Gardocka-Jalowiec & Wierzbicka 2019), depending on the theoretical background of the researchers.

In this study, we will not take into consideration the different theoretical approaches that guide researchers in their scientific investigation of barriers to innovation. Our scope is on highlighting the different innovation barriers described by researchers while following a more practical approach. What follows is a review of the obstacles to innovation and factors that are associated with a certain obstacle, or factors that may affect the influence/strength of these obstacles.

A.3.3 Effectiveness

The overall rationale underlying the implementation of public innovation support instruments is based on the concepts of market and systemic failures. Market failure is related to specific barriers such as for example market domination by competitors, information asymmetries between actors in the market, or the diffusion of knowledge acquired by innovation activities that may lead to an underinvestment in R&D&I activities. From this point of view, interventions that lead to a better allocation of resources can help to overcome market failure. The concept of systemic failure focuses more on the efficiency of the innovation system as a whole, on the business environment, on processes, and on networks and links between actors. This broad concept includes topics such as the innovators' capabilities to adapt to changes in the system, the optimization of information flow within the system, the regulatory framework, consumer demand, the availability of human resources, etc. Targeting systemic failures may require a broader range of public support instruments, as there are more approaches that could lead to better innovation results. (European Commission 2009[109])

Although public support for R&D accounts for only a small share of overall R&D spending on innovation, efficient implementation of public support instruments is crucial to minimize suboptimal results of interventions. A report from 2009 (European Commission 2009[109]) emphasises that all policy interventions need to be based on a clear policy rationale and respond to the needs of innovative enterprises.

According to the Better Regulation Guidelines,[110] effectiveness of policy intervention relates to the progress made towards achieving the objectives of the intervention and looking for evidence of why, whether or how these changes are linked to the intervention. This includes identifying and understanding the factors driving or hindering progress and how they are linked (or not) to the EU intervention.

In practice, as will be seen, the various studies and evaluations that are to be examined have considered effectiveness from many different angles and each study has its own indicators. However, a common distinction that will be observed is between effects in terms of input additionality (such as an increase in R&D activity) and the longer-term effects on outputs, including new products and processes and ultimately effects on turnover, employment, productivity and profitability.

[109] European Commission (2009): Making Public Support for Innovation in the EU More Effective: Lessons Learned from a Public Consultation for Action at Community Level. Publications Office of the European Union. Luxembourg.

[110] https://ec.europa.eu/info/sites/info/files/better-regulation-guidelines-evaluation-fitness-checks.pdf, p.59

A.4 Barriers to innovation

The following table provides an overview of barriers to innovation identified in the literature. The first column shows the identified barrier to innovation, the second column shows the regions that the studies shown in column three have investigated. Not all of the studies formulated hypotheses and most studies, although describing the barriers of innovation considered from a more general point of view, did not explicitly explain those barriers in detail.

Table 7: Overview of barriers to innovation

Barrier to innovation	Region(s) covered in studies	Source(s)
Financial barriers (sometimes further specified, e.g. external and internal)	27 EU countries, 18 EU countries, Bulgaria, Croatia, France, Germany, Poland, Spain, Sweden, Eastern European countries, Portugal, Italy, Austria, Netherlands, Slovakia	Marin et.al. (2014), Hölzl & Janger (2014), Petrova (2019), Bozic & Rajh (2016), Blanchard et.al. (2013), Zimmermann (2016) , Belitz & Lejpras (2016), Zwolinska-Ligaj & Adamowicz (2018), Backman & Wallin (2018), Botric & Bozic (2017), Duarte et.al. (2017), Hall et.al. (2016), Hueske & Guenther (2015), Ozes et.al. (2018), Meijer et.al. (2019), Gardocka-Jalowiec & Wierzbicka (2019), Hvolkova et.al. (2019)
Lack of skills / qualified personnel	Germany, Slovakia, Croatia, 18 EU countries, Poland, Bulgaria, France, Germany, Portugal, Austria, Italy, Slovakia	Zimmermann (2016), Lesakova et.al. (2017), Bozic & Rajh (2016), Hölzl & Janger (2014), Zwolinska-Ligaj & Adamowicz (2018), Petrova (2019), Blanchard et.al. (2013), Belitz & Lejpras (2016), Duarte et.al. (2017), Hall et.al. 2016, Hueske & Guenther (2015), Ozes et.al. (2018), Gardocka-Jalowiec & Wierzbicka (2019), Hvolkova et.al. (2019) Coyne and Carlberg (2018)
Bureaucratic barriers, laws, standards and regulations, corruption, access to IP	Germany, Slovakia, Austria, Italy, Poland	Zimmermann & Thomä (2016), Belitz & Lejpras (2016), Lesakova et.al. (2017), Hueske & Guenther (2015), Ozes et.al. (2018), Gardocka-Jalowiec & Wierzbicka (2019), Rammer et.al. (2016)
Lack of external partners, possibilities of collaboration (e.g. between science and businesses)	Germany, 18 EU countries, Poland, France, Bulgaria, Slovakia, Portugal, Austria, Italy, Spain, Slovakia	Lesakova et.al. (2017), Belitz & Lejpras (2016), Hölzl & Janger (2014), Zwolinska-Ligaj & Adamowicz (2018), Blanchard et.al. (2013), Petrova (2019), Duarte et.al. (2017), Hueske & Guenther (2015), Ozes et.al. (2018), Gardocka-Jalowiec & Wierzbicka (2019), Hvolkova et.al. (2019)
Barriers related to the organizational level (e.g. firm management, firm	Germany, Slovakia, France, Portugal, Austria, Italy, Spain, Netherlands	Belitz & Lejpras (2016), Lesakova et.al. (2017), Blanchard et.al. (2013), Duarte et.al. (2017), Hueske & Guenther (2015), Orzes et.al. (2018), Meijer et.al.

Barrier to innovation	Region(s) covered in studies	Source(s)
innovation strategy, firm (prior) innovation activities), ownership e.g. family)		(2019)
Lack of knowledge (e.g. about technologies, market information, etc.)	27 EU countries, Slovakia, 18 EU countries, Germany, Poland, Bulgaria, France, Portugal, Austria, Italy, Netherlands, Slovakia	Marin et.al. (2014), Lesakova et.al. (2017), Hölzl & Janger (2014), Belitz & Lejpras (2016), Zwolinska-Ligaj & Adamowicz (2018), Petrova (2019), Blanchard et.al. (2013), Duarte et.al. (2017), Hall et.al. 2016, Hueske & Guenther (2015), Ozes et.al. (2018), Meijer et.al. (2019), Hvolkova et.al. (2019)
Market constraints (e.g. market dominated by established enterprises, no or uncertain demand)	Croatia, France, Poland, Germany, 27 EU countries, Germany, Portugal, Netherlands, Poland, Slovakia	Bozic & Rajh (2016), Blanchard et.al. (2013), Zwolinska-Ligaj & Adamowicz (2018), Belitz & Lejpras (2016), Marin et.al. (2014), Belitz & Lejpras (2016),. Duarte et.al. (2017), Hueske & Guenther (2015), Meijer et.al. (2019), Gardocka-Jalowiec & Wierzbicka (2019), Hvolkova et.al. (2019)

Source: Austrian Institute for SME Research, Centre for Strategy and Evaluation Services 2020

It is important to note that **barriers to innovation are not always regarded as harmful** to SMEs. As Hall et.al. (2015) point out, financing constraints could also lead to a selection of the more efficient innovation projects in firms (p.2). In the case of public financial support what comes to mind is an inhibiting of an unintended crowding-out effect, firms using public support instead of their own financial resources (internal and/ or external) for financing innovation projects (which they may have conducted in any case).

It is also worth indicating that the **relationship between barriers and initiatives to remove them is dynamic**. Debrand (2018), looking at the behaviour of French firms from the plastics sector, found that while strategies were being put in place to remove barriers, that created a new situation which in itself created new barriers.

Some of the empirical studies used data from the **Community Innovation Survey** (CIS) that include questions that refer to specific innovation barriers. The CIS questionnaire has changed over time, which means that the survey has focused on different barriers depending on the year it was conducted. For **Germany,** Rammer et.al. (2020) compiled a list of eleven barriers that were frequently included in the national CIS survey between 1996 and 2014. These barriers to innovation are: costs too high, risk too high, lack of adequate financing, lack of qualified personnel, insufficient demand/ customer acceptance, laws and regulations, organisational difficulties in the firm, lengthy administrative procedures, internal resistance, lack of market information, lack of technological innovation (p.57). It should be noted therefore that as the dependence of some of the empirical studies reviewed rely on the CIS data, the coverage of the relevant barriers varies depending on the time of the survey and the countries analysed. A good number of the studies are sector-based and refer to specific geographical areas – for example rural business in a specific region. Overall, the literature found on barriers to innovation lacks meta-analyses, and fewer studies are found when compared to the literature on innovation support instruments.

The following discussion describes barriers to innovation in detail to the extent that the studies mentioned provide information about them.

A.4.1 Financial barriers

Access to finance is essential for the implementation of innovation projects and consideration should be given to the **cost** of a project and **conditions attached to finance** as well as the overall **availability of finance**, either **internally or externally.** External sources of financing can for example be investors that provide funds for innovation projects, while internal sources can be the firm's owners' capital, retained profits or R&D budgets (Hueske & Guenther 2015, Hvolkova et.al. 2019). With regard to external sources, public sources like government grants or tax credits are distinguished from sources like bank loans or other debt contracts (Belitz & Lejpras 2016). A good deal of research has been carried out regarding the financing challenges faced by innovative enterprises and SMEs **at different stages of the project cycle** (including investigation for example of the so-called 'valleys of death'). (Osawa and Miyazaki (2006), Ford, Koutsky and Spiwak (2007) and Johnson (1966).

Most studies consider the problems of financing innovation projects in one form or another. In Duarte et.al. (2017) lack of funds within the enterprise, lack of access to finance from outside the enterprise and innovation costs are among the economic factors that may hamper innovation (p.249). Belitz & Lejpras (2016) point out that internal resources for R&D financing take a higher share on average than external resources for R&D financing among subsidized SMEs in Germany (p.250). In a study reviewing seven papers by different researchers, Hall et.al. (2015) conclude that **European firms** are negatively affected by unwarranted financial constraints, especially the more technology intensive and smaller ones (p.10). As Botric & Bozic (2017) show, innovative firms perceive access to finance to be a larger problem than non-innovative firms, although they found differences between countries (in some countries non-innovators perceive greater difficulties). Results in Galia et.al. (2015) show that the most frequently perceived obstacles to innovation in **French and Italian** firms are related to internal financial constraints and innovation costs.

For **Germany**, (Zimmermann & Thomä 2016) showed that German SMEs facing financing problems are more likely to have the following characteristics: young and small firms, less research- and knowledge intensive, below-average profitability, growth orientation. (p.3) According to Lesakova et.al. (2017), financial barriers like the high cost of innovation and lack of financial resources are among the main barriers to innovation in **Slovakian** SMEs. (p.332) and Zwolinska-Ligaj & Adamowicz (2018) as well as Gardocka-Jalowiec & Wierzbicka (2019) found similar results for **Poland**. Arvanitis et.al. (2017, (p.84f), Bergmann & Volery (2016, p.42) and Spescha et.al. (2018, p.24) report that high the costs of innovation projects are the main barrier to innovation for **Swiss** SMEs. Rammer et.al. (2016, 2020) report for the years 2006, 2010 and 2014 that high economic risk and high innovation costs are the most common innovation barriers in SMEs located in the **western German** regions, and a lack of equity capital was the most frequent barrier in SMEs located in the **eastern German** regions in 2006 and 2010. For eastern Germany, the situation changed in 2014, when high risk and high costs also became the most important obstacle to innovation. Similarly, Astor et.al. (2016) report that high risk and high costs of innovation projects as well as internal financing are among the main barriers to innovation in **German SMEs**, and Brink et.al. (2018) report that lack of equity capital and lack of access to debt capital are important obstacles to innovation for **German ICT firms** (p.23) When comparing **18 EU countries**, Hölzl & Janger (2014) *found financial barriers to be of importance in countries that are less advanced technologically, while in countries that are more advanced other types of barrier related to knowledge become more important* (p.10). Research by Achleitner, Braun,

Behrens and Lange (2019) has emphasised the importance for innovation of developing the growth finance ecosystem.

Overall, financial barriers are among the most important or are even the most important obstacle to innovation. Two main aspects of financial barriers to innovation can be distinguished: The first is the **cost** of an innovation activity, which is related to the availability of SMEs' financial resources. The second aspect is **access to external sources** of finance, which is related to the market environment of the SME (e.g. possibility of equity and debt financing). Both aspects are influenced by the risk of an innovation project, which may limit the options for conducting a project. *Influencing factors seem to be the size of a firm, the age of a firm, its financial status, the knowledge-intensity of the sector, and the region and country in which it operates*.

A.4.2 Lack of skills

Lack of skills means that a firm does not have access to the specific skills required (mostly in the form of personnel) to conduct innovation projects and implement the results. Several studies point out that the supply of skilled personnel is a rather strong barrier for SMEs in **Germany** (Belitz & Lejpras 2016, Astor et al. 2016), **Poland** (Gardocka-Jalowiec & Wierzbicka 2019), **Portugal** (Duarte et.al. 2017) and many **EU countries in general** (Hölzl and Janger 2014). Hölzl and Janger (2014) showed in their study based on data from 18 EU-countries that *"across innovator types, the learning and deterring effect of skill barriers is highest in the group of technologically advanced countries"* (p.29). In the case of **Portugal**, lack of qualified personnel is a factor negatively correlated to undertaking innovation activities in SMEs (Duarte et.al. 2017, p.258). Gardocka-Jalowiec and Wierzbicka (2019) reports results for **Poland**, where lack of qualified personnel is an important barrier (p.220). Meijer et.al. (2019) report that for the **Dutch sustainable energy** sector that a time consuming search for skilled employees slows down the development process of innovations (p.119). Lack of qualified personnel is among the main barriers to innovation in **German SMEs**. For the period 2012-2014, one third of German SMEs report that they were hampered in the implementation of innovation projects, one fifth of the SMEs experienced delays and half of the SMEs have abandoned innovation projects due to lack of qualified personnel. (Astor et al. 2016, p.26, Rammer et.al. 2016, p.104, Rammer 2017, p.69). Lack of skills was also reported to be the main barrier to innovation in **German SMEs in the ICT sector**, both for R&D conducting firms and firms without internal R&D capacities. (Brink et.al. 2018) For **Swiss** firms however, Arvanitis et al. (2017) report that a lack of qualified personnel is not among the main difficulties for firms that want to innovate.

A study by **Danish Industry** (2018) among its members on the importance of innovation and digitalisation showed that 7 out of 10 firms use innovation to give them a competitive edge; it also highlighted that major barriers to improving the level of innovation is a lack of management time (74%) and a lack of personnel with the right skills (51%). Similar conclusions were reached by the **Swedish innovation agency**, Vinnova, in a 2016 study of Digitalisation which concluded that a key challenge was the availability of competent staff with the right qualifications. It was suggested that qualified personnel could become a bottleneck for Swedish industry due to the low level of interest in science among Swedish teenagers and a fall in the competitiveness of the Swedish educational system in recent years compared to other countries.

Results from the **Innobarometer 2016** (TNS Political & Social 2016) also show that lack of human resources was one of the most mentioned problems (among others) in the process of commercialisation of innovative goods and services. *The most mentioned skills that could help to improve and kick-start a firm's innovation activities are marketing, financial and technical*. (p.4f).

In a study of innovation support measures across Europe, Coyne and Carlberg (2018) found that a lack of consideration for the human resource inputs into innovation processes was a frequent feature of support measure design and there was a corresponding lack of consideration given to this aspect of innovation in evaluations of measures. Given the widely-held view that while Europe performs relatively well internationally in generating ideas, but fails to follow up their commercialisation successfully, it is surprising that this flaw in measure design persists.

Most studies found that a lack of qualified personnel is an important barrier to innovation, but differences in the perception of the importance of this barrier can be observed between countries as well as economic sectors and the level of technology in the sector in question.

A.4.3 Bureaucratic barriers

Bureaucratic barriers, laws, standards and regulations, but also corruption, plus access to IP are hurdles to innovation for SMEs. Regulations and laws set by the state may restrict innovation activities, but regulations and laws may also stimulate innovation (e.g. by setting compulsory standards) (Hueske & Guenther 2015). For example, Blind (2016) mentions some aspects of standards, that have positive impacts on innovation (p.426). Standards limit technological development options therefore channelling the development of a critical mass of a specific technology. They provide the basis for subsequent generations of innovation, and can help to build trust in new technologies, as they are often an unknown risk to health and safety. Administrative work in the firm required to comply with regulations in the innovation process is another obstacle to innovation, while state regulations are perceived as an external barrier hampering innovation projects. (Meijer et.al. 2019).

Hueske and Guenther (2015) found in their literature review that studies reported **regulatory constraint, unstable legislation or no strict legislation (p. 129) as barriers to innovation**. According to Lesakova et.al. (2017), the majority of **Slovakian SMEs** see **bureaucracy and corruption as well as inappropriate state support** as a main hurdle for innovation activities. Similarly, Hvolkova et.al. (2019) found that SMEs in **Slovakia** perceive unsuitable state innovation policy to be an important barrier to innovation, which means that according to the Slovakian SMEs surveyed, the national innovation policy in 2017 was perceived as unsupportive by 47 % of the medium, 25 % of the micro and 15 % of the small enterprises. Also, more than half of the enterprises reported the perceived quality of state innovation policy as negative (p.62f). Zimmermann and Thomä (2016) show that firms facing bureaucratic barriers to innovation in **Germany** more frequently have the following characteristics: they are older firms, firms in the construction segment, they have a high level of profitability, and their investment goals are rationalisation, cost reduction and incremental innovation. Three out of ten German ICT firms report bureaucratic hurdles as a barrier to innovation, according to Brink (2018, p.24).

Rammer et.al. (2016) report **some bureaucratic obstacles** like laws, regulations, long administrative and approval procedures, and standards / norms as well as lack of access to IP to be of relevance for **German SMEs**. They are mostly less frequently encountered however, than other barriers (p. 104). Also, Gardocka-Jalowiec and Wierzbicka (2019) consider bureaucratic obstacles among other factors that hamper innovation, but found them less important than financial barriers in **Poland**.

Although **intellectual property rights** are important as a resource for some of the innovative European SMEs, only Hall et.al. (2015) and Rammer et al. (2016) provide information about SMEs' opinions on IP management as a specific barrier to innovation. In **German SMEs**, barriers related to the protection of intellectual property rights are less frequently reported than other barriers to innovation (Rammer et.al. 2016). In their literature

review, Hall et al. (2015) found a study where researchers describe the role of patent applications: patent applications could facilitate access to finance for SMEs due to a signalling effect with respect to external investors (p. 8).

The importance of bureaucratic barriers, laws and regulations differs between countries. In some countries, it is perceived as a very important barrier, while in others countries only a small share of SMEs perceive it as an important obstacle to innovation. It is important to notice, however, that laws and regulations can also stimulate innovation activities (for example for environmental technologies).

A.4.5 Lack of cooperation partners

Lack of cooperation partners includes both a **lack of other firms** willing to work on an innovation project and a lack of access to **research institutions** that could help the innovative firm with specific knowledge, research capacities and other resources. While some authors regard the lack of collaboration opportunities as one of the stronger barriers to innovation (Hölzl & Janger 2014), others (Zwolinska-Ligaj & Adamowicz 2018, Belitz & Lejpras 2016, Duarte et al. 2017) found the difficulties of finding collaborative partners to be of lesser importance than other barriers (like lack of financial resources, innovation costs, or no demand for innovation). Zwolinska-Ligaj and Adamowicz (2018), Belitz and Lejpras (2016) investigated the opinion of **German SMEs r**egarding access to universities and research institutions but it turned out that only a very small portion of German SMEs perceive it as an unfavourable condition. In Hölzl and Janger (2014) the lack of suitable innovation partners is among others one of the stronger obstacles in countries with a generally higher level of technological development (countries which are closer to the technological frontier). In the case of **Portugal** (Duarte et.al 2017), **difficulties in finding cooperation partners** are considered as an obstacle, but other factors like lack of internal funding or high innovation costs are stronger reasons for SMEs to abandon their innovation projects (p.259). Among other barriers and supposedly not as important as financial barriers for SMEs is the obstacle of finding cooperation partners in Poland (Gardocka-Jalowiec & Wierzbicka 2019 p.220). Rammer et al. (2017) report a lack of cooperation partners as a barrier less frequently encountered in **German** firms between 2014 and 2016 than other barriers to innovation (p.70). In a study concerning **Slovakian SMEs, unwillingness of universities to cooperate** is among the barriers with the lowest significance (Hvolkova et al, 2019, p.60).

Fanelli (2-018) looked at **innovation processes in rural SMEs in Molise** (Italy) and found a high level of awareness among their managers of the importance of technical innovation, but they prefer to buy new technology and processes rather than to invest in R&D and/ or partner with other enterprises in the supply chain and collaborate with networks to stimulate innovation. It was also mentioned that a lack of finance contributed to the unwillingness to do the in-house innovation.

Again, the p**erception of the importance of the lack of cooperation partners differs between countries and sector**s, and it is not always clear whether this is because co-operation is already quite good in some countries, as indicated for instance in the European Innovation Scoreboard (European Commission 2019), or because enterprises are not aware of its significance. There is some evidence that the level of technological development in countries influences the perception of this barrier: SMEs in more developed countries report lack of cooperation partners as a more important barrier than SMEs in countries that are further away from the technological frontier (although sector specific characteristic may also be of importance in this respect).

A.4.6 Organisational barriers

In their literature review of 188 studies, Hueske and Guenther (2015) found studies that relate barriers to innovation to t**he strategy, structure, resources, size and to the culture or organisational learning** of a firm respectively (p.131). Firms may lack a strategy for innovation; they may consider other goals than innovation of higher priority. Internal processes or rules may hamper innovation; firms may lack internal resources like money, time or staff. Firms may promote a culture that does not encourage innovative activities. All these factors hamper innovation on the organisational level. Other factors that are relevant and may be located at the group level or the individual level are for example leadership style, team climate, manager and employee abilities among others. (Hueske & Guenther 2015)

Rammer et.al. (2016) point out, that some **German SMEs** based on data from 2006 and 2010 regard **organisational problems and internal resistance** as a barrier to innovation (p.104). According to Huck-Fries et al. (2018), organisational barriers (lack of compatibility with routine and business processes) hamper the adoption of mobility related service innovations in **German craft SMEs**. Orzes et.al. (2018) report that cultural barriers like lack of cooperation between departments or lack of vision on the part of management may also be obstacles to innovation among SMEs (p.1350). Based on survey data from Switzerland, it seems that knowledge problems related the organisational level are only minor difficulties for **Swiss SMEs** when compared to other innovation barriers. (Spescha et.al. 2018, p.24) **Culture and communication** may also emerge as a problem when different firms or partners are involved in an innovation project (Meijer et al. 2019); this may therefore moderate the positive effects of cooperation.

Corchuelo and Mesias analysed perceived barriers in the agro-food industry in Extremadura (Spain) and found **lack of willingness to innovate and lack of awareness of the need to innovate** within the organisation to be important barriers to innovation, which would require personalised support from public sector to overcome. Avellaneda-Rivera (2019) also identifies a **lack of motivation** as a barrier for eco-innovation in traditional sectors, such as food, and develops a taxonomy of handicaps. They see development of **open innovation** strategies by SMEs and proactive search for new knowledge as the way out of the problem.

In a qualitative study looking at how **ten Italian wine SMEs organise themselves to sustain open innovation,** Presenza (2015) found barriers that hinder the adoption of the open innovation model: cultural and organizational differences among partners; and the lack of knowledge, resources and competencies. The findings suggested that open innovation could not yet be seen as a defined strategy but was more like a set of fragmented initiatives in embryonic form with several barriers that hinder development.

In a study on **open innovation practices in Italian SMEs**, Fiorentino (2018) found that the main challenge facing SMEs is to balance the trade-off between the need to protect and strengthen the firm's own innovation, know-how and competencies on which its competitive advantage is based with the requirement to open up to the external environment to maximise benefits coming from there. Barriers identified in this process were the absence of **required managerial skills** to open up and deal with the related processes (retaining competitive advantages) and **not becoming too dependent on the external environment** and thereby losing the firm's competitive strengths. Other barriers identified were having to interact with other business cultures; heavy bureaucratisation by the public sector; and, resource constraints on carrying out innovation.

Furthermore, Arranz and de Arro (2016) use data from the Technological Innovation Panel (PITEC) from 2012 to show that **Spanish SMEs** in manufacturing and services are **reluctant to co-operate technologically** and enter into agreements to solve problems and

operational barriers such as innovation costs and lack of financing, among others. The difficulty in finding partners is also a determining factor in establishing technology cooperation agreements.

A review of governance, internationalisation and **innovation in family businesses in Italy** (D'Allura and Faraci, 2018) pointed out that there was a substantial gap in studies of innovative behaviour in family firms. They looked at the influence of the family on company innovative processes and characterised three kinds of behaviour: family centred, market centred and investor centred. While they found there was often a long term strategic vision in a family firm which made innovation easier, tradition and an orientation towards sticking what the firm knows best countered this and work against innovation. Rossinin (2016) identified the various gaps in organisational culture that could impede innovation in Italian companies.

The role of organisational barriers to innovation is difficult to assess. One the on hand, with respect to the importance of innovation activities from a firm's perspective, organisational barriers can have a strong influence. On the other hand, barriers like culture and communication seem to be of less importance than other barriers to innovation. But it is difficult to generalise, given the heterogeneity of SMEs.

A.4.7 Lack of knowledge

Lack of knowledge includes the two most frequently encountered barriers to innovation in the reviewed studies: **lack of information regarding the target market and lack of knowledge about a required technology for an innovation activity**. Duarte et al. (2017) found that lack of information on technology and lack of information on markets are among the obstacles to innovation in **Portuguese SMEs.** Lack of knowledge was a relevant barrier for **German SMEs** in the years 2006 and 2010, although only a minority of 10-15% of SMEs reported a lack of market information and a lack of technological information as a barrier. According to Huck-Fries et al. (2018), the complexity of knowledge and the complexity of investments in infrastructure hamper the adoption of mobility related service innovations in German craft SMEs. For example, with relation to IT the complexity of investments in infrastructure covers a set of interrelated factors: the cost of new IT for SMEs, the applicability of IT (e.g. smartphones in locations without or bad wireless reception) and the usability of IT (that is how easy or difficult it is to use the new technology for employees). Lack of technological knowledge may be a sector specific barrier. Meijer et al. (2019) report that for the **Dutch sustainable energy** sector lack of technological knowledge, especially among entrepreneurs, hampers the development of complex innovations. Lack of awareness is also a factor, as found in a study on how to increase uptake of the electronic identification eID and trust services by SMEs in the EU (Deloitte et al. 2019),

Other studies however report a lack of knowledge to be among the less important barriers to innovation. For the **Lubin province, Poland**, Zwolinska-Ligaj and Adamowicz (2018) found that barriers related to limited access to knowledge in the innovation process are not very important when compared to financial barriers. Based on survey data, it seems that knowledge problems related to a lack of information are only minor difficulties **for Swiss SMEs** compared to other innovation barriers (Spescha et al. 2018, p.24). Also, Hvolkova et al. (2019) report for **Slovakia** that a lack of information about new technologies is among the barriers with the lowest significance (p.60). Similarly, Bozic and Rajh (2016) consider it an encouraging result that based on answers in their survey data **Croatian SMEs** do not face problems when it comes to learning and knowledge creation.

Lack of knowledge is an important barrier to innovation, but there are differences between countries as well as sectors with regard to its importance. However, generally it does not appear as wide ranging and critical a factor as for example access to finance.

A.4.8 Market constraints

Market constraints that hamper innovation activities include a market dominated by established firms (Galia et al. 2015), market size and its saturation and regulation (Bozic & Rajh 2016), and uncertain demand for innovative goods and services (Duarte et al. 2017, Meijer et al. 2019). Meijer et.al. (2019) also point out that a long value chain may hamper innovation for an innovator positioned at the beginning of the chain, especially when the innovation turns out to be not very user-friendly in the end. Hueske and Guenther (2015) note that it also depends on whether competitors are seen as a barrier to innovation or not (p.128). On the one hand, they can be seen as drivers of innovation by setting a new standard for other firms. On the other hand, innovations that are easy for competitors to copy may act as an innovation barrier. The role of customers appears to be ambiguous as well. Through their demand for innovative products and services, customers can be drivers of innovation, but they can also be an obstacle if they do not demand innovations. (Hueske & Guenther 2015, p.128f)

Galia et al. (2015) point out that markets dominated by established firms and uncertain demand for innovation, together with internal financial constraints, are very frequently cited as innovation barriers in **French and Italian** firms. Markets dominated by established enterprises and uncertain demand for innovative goods or services are also among the market constraints to innovation in **Portugal** (Duarte et al. 2017). In the case of green product innovations, Stucki et al. (2019) report a lack of customer demand at a given price range ("Low willingness to pay") as well as high commercial uncertainty as a barrier to innovation (p.1259). According to Rammer et al. (2016) and based on the German innovation survey, market constraints are a relevant barrier for a minority of German SMEs in terms of market domination by established companies and more frequently in terms of lack of demand for innovation (p.104). High market risks and a long amortisation period are among the top four most reported innovation barriers in **Swiss** industry and service firms in 2014-2016. (Spescha et al. 2018) Bozic and Rajh (2016) found that market constraints are a wide-spread barrier to innovation both for manufacturing and service firms. Regarding industry 4.0 technology, market constraints, especially uncertain returns of investments are an obstacle to investment. (Orzes et al. 2019)

Ultimately, SMEs strive to exploit the results of their innovation activities, but market constraints can be considered of an important barrier to innovation. Again, differences between countries and sectors are observed. However, other factors, especially on the demand side (customers) and the general competitive environment are more important for this type of barrier.

A.4.9 Further remarks, sector and other specific studies

There are other barriers that researchers reported in studies but could not be categorised according to the barriers identified so far. These include barriers related to public funding, and barriers related to specific technologies or specific sectors. Belitz and Lejpras (2016) report that lack of public support is an important barrier to innovation for only a small portion of subsidised SMEs in Germany. Bozic and Rajh (2016) found that SMEs in Croatia perceive state support as one of the more serious constraints in their innovation activates (p. 322). Hvolkova et al. (2019) note that especially small and micro enterprises perceived unsuitable innovation policy as an important barrier in Slovakia (p.61).

In some sectors like **manufacturing**, specific technologies may be more complex (like Industry 4.0 related innovations) and require more technological development (e.g. communications standards) to be implemented (Ozres et.al. 2018).

Some sector specific studies are mentioned elsewhere in relation to specific barriers (e.g. agro-industry in ES). One sector study dealing with a range of barriers in a low to medium tech (LMT) environment relates to **the hotel industry in Spain**. Gil Corbalán (2015) compared barriers in the Spanish hotel sector to those in other LMT sectors, such as transport and commerce, and found that in the hotel sector there is often not a belief that there is a demand or need for technological innovation. There is more of a concentration on marketing or organisational innovation, where cost is seen as a major inhibiting factor. Knowledge is also seen as a major barrier in organisational innovation.

In a study of barriers to innovation in **family businesses in Spain**, Mancheno Ricuarte (2019) found that market conditions and financial constraints have a particularly strong impact, and that family businesses are less oriented towards technological innovations and more to incremental innovation. Family businesses have a superior capacity to innovate compared to non-family businesses, due to the family character of ownership and decision-making. A paper by Iglesias-Sanchez et al. (2015) discusses innovation in family firms and identifies both barriers and facilitators, and factor analysis is applied to measure the weight of each component.

A.4.10 Factors influencing perception of barriers to innovation in SMEs

As well as barriers that objectively pose difficulties for SMEs, there are also considerations stemming from how firms interact with these barriers. This can often depend on characteristics of the enterprise, such as its **size, the sector** in which it operates **and the age** of the firm and these are often considered in the literature when comparing the nature and extent of innovation activities among firms. (Duarte et al. 2017) For example, according to the Innobarometer 2016 (TNS Political & Social 2016), larger companies (in terms of employment as well as turnover) are more likely than smaller ones to have introduced at least one innovation, and retail and manufacturing companies are more likely to have implemented innovative practices than industry or services (p. 10).

(Duarte et.al. 2017) Hall et.al. (2015) note that whether financial barriers influence innovation activities depend on **characteristics like size, age or R&D financing strategies**. (p.2). SMEs (especially younger ones) tend to have more difficulties in acquiring financial resources than larger firms. SMEs tend to have both fewer internal resources and less access to external resources (Hall et al. 2015, Galia et al. 2015). Hueske and Guenther (2015) however come to the conclusion that in empirical literature there can be found hints that both small and large enterprises face barriers to innovation (p.131). Botric and Bozic (2017) in contrast report that firms being part of a larger enterprise or enterprises, which have been established as a joint venture, have less difficulties regarding access to finance.

The relationship between **age and innovation** is also complex. Backman and Wallin (2018) for example report a **u-shape relationship** in the case of firms experiencing difficulties in accessing external financial capital for innovation in Sweden, with both young and old firms experiencing difficulties. Platero Jaime (2014) studied innovation in microenterprises in Spain and found that **environmental barriers** were less important for them than for larger enterprises. For microenterprises he found that cultural, organisational and financial aspects properly explain the innovative behaviour of microenterprises, and he looked in particular at the negative effect that **the age of the entrepreneur** might have on the innovative capacity of the firm. He found that a negative relationship could be moderated or even become positive with use of ICT, diversification strategies and CSR initiatives.

Innovation activity, R&D activity and R&D expenses are also relevant for the perception of certain barriers (Duarte et al. 2017, Hölzl & Janger 2014). In a pooled sample of CIS data from 18 countries Hölzl and Janger (2014) found that the **deterring effect of barriers is**

stronger than the learning effect, "meaning that deterred non-innovators are more likely to assess barriers to innovation as being important than innovative firms." (p.24)

Differences in the perception of barriers to innovation between sectors are reported in Hölzl and Janger (2013), Rammer (2017), Bergmann and Volery (2016) and Marin et al. (2014), the latter with regard to eco-innovations. For example, in Hölzl et.al. (2014) manufacturing firms report a higher impact of barriers to innovation than non-manufacturing firms (p.24). Bergmann and Volery (2016) also identified differences between sectors: high costs and a long amortisation period were reported in capital-intensive sectors (Food, Chemistry, Pharmacy), while firms in the ICT sector emphasised barriers related to personnel costs and lack of financial resources.

Pinget (2016) looked at how companies innovate for positive environment impact and sustainable development and identified specific **barriers to environmental innovation for SMEs**. Her research produced three key findings: '(1) Environmentally innovative SMEs perceive more barriers, in more intense and numerous ways, compared to other innovative or non-innovative SMEs; (2) Environmentally innovative SMEs utilize more external knowledge sources than other SMEs; (3) and SMEs, like large firms, can adopt environmental innovations proactively because they possess certain capacities. The findings point to public policy and managerial recommendations for more widespread and more effective environmental innovation in SMEs.

The **perception of innovation as a high-tech and R&D intense activity** can also have a negative effect on innovative activity. (Iglesias Sanchez et al. 2017) In a review of barriers and facilitators of innovation among a sample of 114 companies from Southern Spain, based on Exploratory Factoral Analyses, an insufficient level of management skill is seen as the key barrier. Innovation is associated with R&D and high tech rather than improving competitiveness. This puts management teams off from undertaking innovation initiatives.

Geographical/ locational factors also play a role; firstly, there are differences between countries or group of countries shown in most studies that compare two or more countries. This is, among other considerations, due to different laws, regulations, competitive environments, state support systems, etc. But geographical factors could influence innovation also on a more regional scale. Backman and Wallin (2018) show that proximity to a bank branch as well as density of local bank branches in a region is a factor that influences access to financial capital for innovations in **Sweden**.

A.4.11 Summary

In general, it is difficult to find statements about which barriers are relevant for all SMEs. In fact, a common theme in the studies considered in this section is that barriers and their perception vary considerably depending on factors such as the age of a firm, its stage in the life cycle, its size and the sector in which it operates. Furthermore, the perception of barriers depends greatly on factors related to the organisational level (e.g., the willingness to innovate or if the firm has already conducted innovation projects) and other contextual factors (like sector or country specific characteristics). Consequently, barriers to innovation for a pharmaceutical start-up may differ quite considerably from barriers to innovation for a large construction firm.

Some researchers use methods of clustering SMEs according to certain characteristics (age, size, sector, innovation activities, etc.) to better account for those differences between groups of SMEs. (Lesakova et al. 2017, Belitz & Lejpras 2016, Marin et al. 2014) Ultimately, what sort of barriers are relevant depends on the individual SME and its economic environment. For example, Marin et.al. (2014) show for firms active in eco-innovations that

some obstacles like market barriers are relevant to all firms, while the relevance of obstacles like cost barriers depend more on the specific type of firm (p.28).

With respect to the significance of specific types of barriers, evidence on the importance of financial barriers to innovation is strongest, although that may be because it is easiest to quantify. It is quite clear that an innovation project in most cases will not be carried out without the financial resources needed for its development. The role of other barriers is more difficult to assess. There appears, however, to be a clear indication that human resource aspects of innovation are an area of difficulty with problems of accessing appropriate skills and a lack of attention to their importance in innovation processes. Similarly, problems in access to knowledge sources and in developing partnerships with other firms and knowledge institutions appear to be of significance, in some countries, at least. Even in the case of financial barriers, and more so regarding other types of barrier, associated with factors like size, age, sector, region and country, what SMEs perceive can be an important barrier to innovation. Another conclusion is that there is a difference in the perception of barriers to innovation between innovative companies and non-innovators, especially if the latter are not willing to innovate.

A.5 Instruments

Public support for innovation at European, national and regional levels aims to overcome innovation barriers. A distinction can be made between **supply-side and demand-side instruments**. The aim of both instruments is to improve the conditions of innovation stakeholders that suffer from market or systemic failures. Supply-side instruments target the resource pool that firms need for their innovation activities and therefore try to push innovation activities, while demand-side instruments aim to improve demand for innovative products and services. An underlying assumption is that more R&D drives more innovation and more innovations will lead to firms that are more competitive and this will drive job creation. (Laredo et al. 2016, p19)

Further distinctions, constituting a **typology of innovation support**, were developed by Edler et al. (2012). This typology focuses on seven major innovation policy goals to distinguish between types of innovation intervention:

- increasing research and development investment
- augmenting skills
- enabling access to expertise
- strengthening system-wide capabilities and exploiting complementarities
- enhancing innovation demand
- improving frameworks for innovation, including regulation and standards
- facilitating exchange and dialogue about innovation.

These distinctions will be apparent in the following discussion, although other research has made use of distinctions based more on the operational characteristics of the instruments or other considerations. Coyne and Carlberg (2018), for instance distinguished between a more detailed range of instruments designed to support individual enterprises, including those that aim to build managerial capacity within enterprises, secondly, measures supporting groups of enterprises and promoting the development of relations with partners in various ways and a third category of measures providing the general conditions for individual enterprises to innovate and thrive. Those include, on the one hand, awareness-raising actions and the

promotion of open innovation and, on the other, procurement for innovation initiatives and strategic approaches promoting whole sectors, such as smart specialisation strategies.

Since some of these categories relate to developments that have only become relatively widespread recently, it has not always been possible to identify evidence on their performance, but it is worthwhile mentioning them, because they illustrate the way that innovation support is developing dynamically in the current period and also becoming more complex. In particular, there is a growing tendency for packages of support to be provided, combining different elements to ensure that all aspects of innovation are covered and at the same time a growing interdependence between measures and between the agencies that provide them. This is most evident in the growth of innovation ecosystems that will be considered subsequently, but it is not confined to them. The overlap between support for SMEs and support for innovation is a case in point. Centre for Strategy and Evaluation Services et al (2020) consider support services for would-be entrepreneurs and newly established businesses and discuss the strong tendency for SME support to be concentrated on enterprises with the potential for rapid growth, but it also points to the structuring of support around a series of core support services, providing advice, training and access to finance and the interdependence of all the types of support provided.

A.5.1 Direct funding (grants)

There are numerous arguments in favour of direct subsidies: firms need incentives for innovation activities due to the high risk, costs, unsure outcome and potential spillover effects of innovation projects. Direct funding instruments could prevent underinvestment in firm's innovation activities, as they grant firms financial support and therefore reduce the extent of financial if the innovation project fails. Furthermore, direct support could help firms to maintain their leading position in terms of technology, increase their exports to foreign markets or help them to catch-up with foreign firms in their own country. Small firms especially may need support, as they might be too small to conduct (costly) innovation projects or lack the specific knowledge required, or are not be able to access appropriate funding. Furthermore, mission-oriented-programmes can target innovations in public or collective goods that may otherwise be neglected by market-oriented actors. (Cunningham et al. 2016)

The general intervention logic of direct funding instruments is: the government provides certain inputs (grants, subsidised loans, equity financing) to firms that stimulate certain outputs (R&D investment, acquisition of new technology, etc.) and supports the creation of innovations that lead to growth in sales, productivity, employment and other benefits for the firms as well as the economy in the long-run. (Cunningham et al. 2016)

Aiello et al. (2019) report that firms receiving public support for innovation register a significantly higher level of R&D expenditure in absolute terms and in terms of R&D intensity, expressed as the ratio between R&D expenditure and sales. Analyses seem to indicate a very substantial increase in R&D spending, thus confirming that public support for R&D affects the quantity of innovative inputs. However, the authors find that public support does not add benefits to patent activities. The effect of publicly funded R&D is statistically similar to that of private R&D but with some evidence of a negative differential in terms of the number of patents. Furthermore, the authors managed to show that subsidies push R&D expenditure more than tax credits and the effect on the probability of patenting is null for both types of policies. Overall, public policies based on subsidies seem to increase R&D expenditure, but not the innovation output.

Radicic and Pugh (2017) analysed the effect of **national and European R&D programmes** (using subsidies as their main policy instrument) on SMEs' innovativeness. Based on survey

data from SMEs covering 28 European countries and the period 2005-2010, the authors use propensity score matching to estimate the average treatment on the treated effect, that is the effect of national and European R&D programmes on firms that participated in support programmes versus firms that did not participate. The effects are measured in terms of R&D employment, R&D expenditure, patents and innovative sales. The authors compared firms that participated either in national programmes, in European programmes, or in both, with firms that did not participate in any programme. The authors conclude that national as well as European R&D programmes are effective in increasing SMEs' R&D expenditure when the SMEs access only one of the two or both in some combination, as compared to firms that did not participate in any programme. However, compared to national programmes, EU support is more effective in raising R&D expenditure, while for R&D employment, the joint participation in both national and European programmes is more effective than the participation in either national or European ones on their own. Overall, the authors state that their evidence seems to suggest that EU support in isolation promotes innovation inputs but not innovation outputs, as the respective estimate is negative in terms of patent application and innovative sales when compared to firms that did not receive EU support. Still, they also state that they did not acknowledge additional treatments or treatment effects through other instruments such as innovation vouchers.

Bellucci et al. (2019) analysed **two subsidy programmes**, one targeted at individual firms and one targeted at collaborative research projects, at the regional level in Italy using a matched difference-in-difference approach. Compared to firms not applying for grants in the regional programme, they found evidence of input additionally in firms applying for the individual programme. The researchers found positive effects on R&D expenditure, employment, tangible investments, firm profitability and patents. The results of their analysis of the collaborative programme show additional effects regarding R&D expenditure, employment, and profitability when compared to non-applying firms.

Mariani and Mealli (2017) analysed the effects of a **regional subsidy programme in Italy**. SMEs who received subsidies showed an increase in graduate employees, R&D personnel and in R&D investment. The programme did not increase outputs of firms (IPRs, turnover) and has not enhanced the propensity of SMEs to cooperate with firms or universities. However, the authors point to some data limitations: they could no analyse the economic performance of the firms in a longer-term perspective.

Norek (2017) analyses the efficiency of the **Innovative Economy Operational Programme in Poland**. The programme was financed by the EU and national funds between 2006 and 2013 and the total value of investment under this programme was € 10.18 bn. Despite the amounts of financial support, Poland still ranked below the average of the 28 EU countries in the European Innovation Scoreboard in 2016. Based on a survey of 400 Polish SMEs, the author measured the return on innovation investment of firms. He concluded that there was no statistically significant difference between SMEs that received EU funds and SMEs that did not receive EU funds in terms of return on innovation investment.

RAZUM is an **innovation subsidy programme** targeted at **SMEs in Croatia**. Radas and Anic (2013) evaluated the effect of the programme on its participants. They found out that the subsidies provided adjusted the scale of the project (which otherwise would not have been conducted or would have been conducted at smaller scale). The majority of SMEs that received a grant also increased their R&D intensity and hired new employees.

In another paper, Radas et al. (2014) investigate the effects of **direct grants and tax incentives** on SMEs. When compared to a control group, they found additionality effects on R&D orientation, on some aspects of innovation output and effects on firm's absorptive capacity. However, firms that received only direct funding did not much differ from firms that

used both direct funding and tax incentives in terms of their output. The authors suggest that subsidies may be the primary instrument for SMEs to increase innovation activities. Furthermore, the authors suggest that an effective public instrument may not only reduce R&D costs but also drive organizational transformation of SMEs.

Results of the evaluation of the **German ZIM programme** (Kaufmann et al. 2019) indicate a positive effect on R&D inputs on the firm level, i.e. R&D expenditure, employment in R&D and intensity of R&D employment. However, effects were observed primarily in firms that are already conducting R&D, only a small portion of firms start new R&D activities due to the incentives provided by the ZIM programme. This is interesting, as the programme itself is targeted at SMEs that are less experienced in R&D, and the programme management has taken measures to lower the entry barrier with regard to administrative burdens for applicants. This result may indicate the limited range of direct funding programmes. However, the authors conclude that more efforts could be undertaken to address the non-innovating firms through some changes in the programme and making it easier for non-innovating firms to apply for funding.

Czarnitzki and Delanote (2015) analyse the effects of R&D **subsidies on young SMEs in Germany**. Their results reveal that the treatment effects on independent new technology-based firms (NTBFs) are actually highest, as usually presumed by policy makers. Thus, this study not only supports the “common choice” to give a preferential treatment to small, young and independent firms active in high-tech sectors, but also provide evidence that previous estimates of innovation policy impacts might have been partly misleading since usually no distinction between preferential firm profiles in policy schemes have been made. In general, their results reveal that full crowding-out with regard to public funding can be rejected for all firm types studied. However, the authors note that their results might not necessarily hold for other countries within the European community.

Bedu and Vanderstocken (2019) have analysed the effectiveness of regional funding for R&D in the French region **Aquitaine**. According to their analysis, public action (including regional, national and supranational support) has a positive impact on the resources that subsidised companies use in their R&D activities (especially the growth of R&D staff numbers and private R&D spending). Their findings also show that the effectiveness of public R&D support relies on the joint interventions of regional, national and supranational authorities. Apparently, non-regional support fosters the hiring of R&D personnel but not that of non-R&D staff members in contrast to regional intervention. Overall, the authors’ findings identify regional subsidies as being positively associated with an increase of SMEs’ private R&D spending. However, a solely regional intervention is not likely to be sufficient to increase the resources that subsidised SMEs allocate to their R&D processes significantly. Their results indicate that public subsidies not only have a beneficial effect on companies’ R&D, but also on their development. This is confirmed by the regional subsidies’ positive and significant impact on companies’ total staff numbers. Regional R&D subsidies have a positive impact on SMEs’ total assets. Bedu and Vanderstocken (2019) conclude that regional subsidies are particularly effective when they help the region’s innovative SMEs to expand and develop. Their study also shows that the quasi-automatic (or less selective) aid allocation process used in Aquitaine can be very effective especially when SMEs are involved.

A.5.2 Indirect funding (tax incentives)

The rationale underlying indirect funding schemes is basically the same as the rationale underlying direct funding: to compensate for potential losses of investments in R&D due to the uncertainty of results, and promoting possible spill-overs of the results of R&D to other firms. Tax incentive schemes can also be used by more firms than direct funding

instruments. It should be noted, however, that tax incentives can only be used by authorities that have taxation powers over corporate income or profits and therefore do not apply at a European level and frequently not at a regional level.

An important point is that tax incentives can also compensate for financial barriers due to asymmetries of information, that inhibit financial institutions from supporting business R&D (Laredo et al 2016). Asymmetries of information could also occur with direct public support of innovation, as the government or a public body implementing a funding scheme usually evaluates the funding proposals of firms and has to make decisions about which projects to support. Radicic et al (2014) report results that suggest that firms being selected for programme participation actually benefit less than would randomly selected firms, which could be interpreted as existing information asymmetries in funding selection processes.

Similarly to direct funding, there exist different tax schemes with different design features. Laredo et al. (2016) distinguish between the type of incentive, the approach (volume vs. increment based[111]), the definition of eligible operations (e.g. cost of R&D personnel or also R&D capital), the generosity of the tax credit, the beneficiaries, the rules of credit consumption and the duration.

An OECD report[112] (2020) analysed 39 countries in which tax incentives for R&D exist. The report distinguishes between five types of tax incentive schemes: R&D tax credit, tax allowance, payroll withholding tax, social security contribution (SSC) and accelerated depreciation of R&D capital. The following table gives an overview of the European countries analysed in the report and their R&D tax scheme as well as the tax scheme design (volume based or incremental rate[113]):

Table 8: Overview of R&D tax incentive instruments in selected OECD countries

Country	Tax incentive scheme	Scheme desgin	Special SME rate/refund options
Austria	Tax credit and tax allowance	Volume-based and incremental	none
Belgium	Tax credit, payroll withhold tax credit, accelerated depreciation for R&D capital, tax allowance	Volume-based	none
Croatia	Tax allowance	Volume-based	none
Czech Republic	Tax allowance	Volume-based and incremental	none
Denmark	Tax credit, tax allowance, accelerated depreciation for	Volume-based	none

[111] The difference between volume-based and incremental tax credits is, that in volume-based schemes tax incentives may apply to all qualified R&D expenditures, while in incremental-based schemes tax incentives may only apply to an additional amount of R&D expenditures above a certain base amount. (OECD Business and Finance Outlook, 2016, p.122)

[112] OECD (2020): OECD Compendium of information on R&D tax incentices, 2019. https://www.oecd.org/sti/rd-tax-stats-compendium.pdf , 16.07.2020

[113] Further design features may be relevant depending on how the instrument is implemented in a country, e.g. different rates for basic, industrial, and experimental research respectively, thresholds and ceilings, and other design characteristics. See: https://www.oecd.org/sti/rd-tax-stats-compendium.pdf , 09.07.2020

Country	Tax incentive scheme	Scheme desgin	Special SME rate/refund options
	R&D capital		
France	Tax credit, Social security contribution (SSC) reduction, accelerated depreciation for R&D capital	Volume-based	Yes, special refund options for SME in the tax credit instrument, and SSC reduction for SME only
Greece	Tax allowance	Volume-based	None
Hungary	Tax credit, two tax allowance instruments, Social security contribution (SSC) reduction	Volume-based	Yes, special tax credit rates for SMEs
Ireland	Tax credit, Accelerated depreciation for R&D capital	Volume-based	None
Italy	Tax credit	Incremental	None
Lithuania	Tax allowance, accelerated depreciation for R&D capital assets	Volume-based	None
Malta	Tax allowance	Volume-based	None
Netherlands	Social security contribution (SSC) reduction/payroll tax reduction[114]	Volume-based	Yes, but only for start-ups
Norway	Tax credit	Volume-based	Yes, slightly higher deduction rate applies for SMEs
Poland	Two tax allowance instruments, accelerated depreciation for R&D capital	Volume-based	None
Portugal	Tax credit	Volume based and incremental	Yes, special rates may apply if certain conditions are met
Romania	Tax allowance, accelerated depreciation for R&D capital assets	Volume-based	None
Slovak Republic	Two tax allowance instruments	Volume-based	None
Slovenia	Tax allowance	Volume-based	None

[114] The OECD report categorizes the WSBO as a SSC reduction scheme, the Netherlands Enterprise Agency named it “tax credit for R&D”: https://english.rvo.nl/subsidies-programmes/wbso , 09.07.2020 In practice, the scheme reduces the payroll tax burden of firms. (WBSO Manual, available at: https://english.rvo.nl/sites/default/files/2020/06/Manual_WBSO_2020.pdf , 09.07.2020)

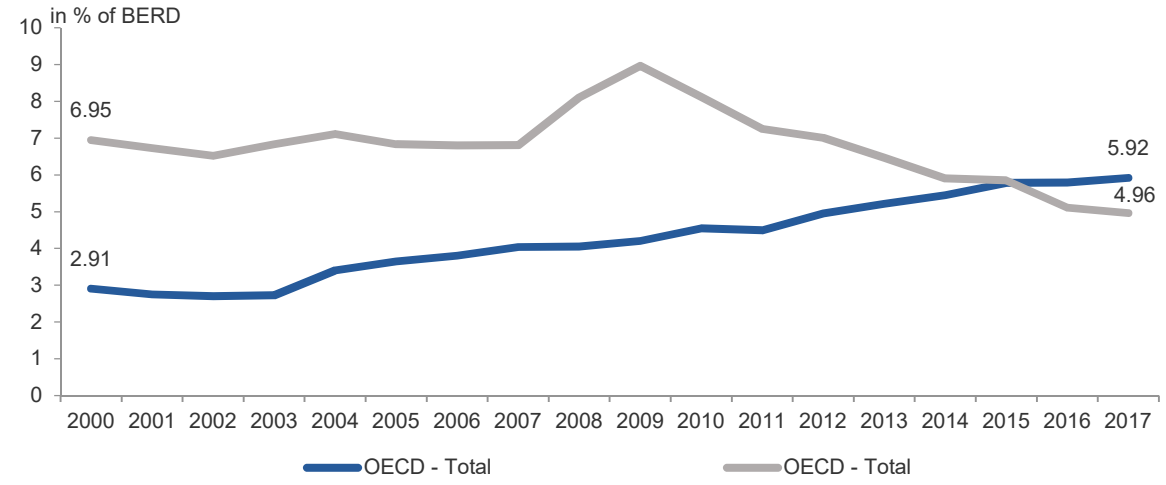
Country	Tax incentive scheme	Scheme desgin	Special SME rate/refund options
Spain	Tax credit, payroll withholding tax credit, accelerated depreciation for R&D capital	Volume-based and incremental	None
Sweden	SSC exemption	Volume-based	None
United Kingdom	Tax credit, tax allowance, accelerated depreciation for R&D capital	Volume-based	Yes, only SME[115] can claim tax allowance but cannot apply for tax credit.

Source: OECD Compendium of information on R&D tax incentives, 2019, available at: https://www.oecd.org/sti/rd-tax-stats-compendium.pdf , Austrian Institute for SME Research

The 22 European OECD countries in Table 8 use a mix of different tax incentive instruments: 14 countries implemented R&D tax allowance instruments, 11 countries use R&D tax credits, nine countries allow for accelerated depreciation for R&D capital and four countries use a social security reduction or payroll withholding tax credit instrument. The vast majority of countries implemented a volume-based design, only three countries use an incremental design in addition to a volume-based one, and one country (Italy) uses an incremental tax scheme design only. In six countries, for some of the instruments special rates or refund options for SMEs may apply.

In comparison to direct R&D funding, the share of indirect funding of business expenditure for R&D (BERD) in OECD countries increased between 2000 and 2017 as shown in the graph below.

Figure 20: Indirect and direct government support for R&D as percentage of business expenditure on R&D (BERD) in OECD countries, 2000 - 2017



Source: Estimates as shown in the OECD database on R&D tax expenditure and direct government funding of BERD, https://stats.oecd.org/Index.aspx?DataSetCode=RDTAX, Date of data retrieval: 09.07.2020, Austrian Institute for SME Research

[115] A different SME definition as the one in this report is used in the tax allowance and tax credit instruments, see: https://www.oecd.org/sti/rd-tax-stats-compendium.pdf, p.238 (09.07.2020)

The amount of direct government financed business expenditure on R&D as a share of all BERD declined from 6.95 % in 2000 to 4.96 % in 2017 in OECD countries. The amount of indirect government support through R&D tax incentives increased during the same period from 2.91 % to 5.92 % of all BERD in OECD countries. The importance of indirect R&D funding instruments in terms of financial support for R&D increased over time when compared to direct R&D funding instruments, which steadily declined since 2009 with regard to their share on BERD.

The OECD's (2020) on-going microBeRD project has produced some initial results that are relevant in this context. The project applies a "distributed" approach to the empirical analysis of business R&D micro-data to investigate the structure, distribution and concentration of business R&D and sources of R&D funding across countries and models the incidence and impact of public support for business R&D. Findings reported for the first phase (2016-2019) focus on input additionality. The findings indicate a gross incremental ratio of 1.4 for tax incentives, with a larger effect on experimental development than on basic and applied research. The R&D tax incentives also increase the level of human resources dedicated to R&D. There is a similar level of input additionality of 1.4 for direct government R&D funding measures. Direct measures appear to favour research. The report points out that there is a substantial level of heterogeneity in input additionality across countries, which means that when designing support measures, the specific contextual aspects of the intervention logic need to be born in mind for the beneficiaries in question.

A difference between grants and tax relief is that the latter depends on the extent of tax liability and may not be relevant, if for instance, a firm is not making a profit. In addition, they may be claimed only after the firm's R&D funds are spent/disbursed, limiting the usefulness of these instruments in case of financial constraints (which may be more common in small enterprises). Therefore, access to finance is an important factor that may limit the effectiveness of tax incentives. (Radas et al. 2014, p.14f) Radas et al. (2014) suggest that grants may be better suited for large innovative projects with possibly smaller returns, while tax incentives could better support more routine projects (p.15).

A further distinction when compared to grants or other direct support instruments is that tax incentives cannot be directed towards projects or areas with high social returns. Tax incentives may also have less impact on firms' decisions to start new R&D activities, and firms may rather favour projects that generate short-term profits over projects that require long-term investments in R&D but might result in larger spillover effects. (David & Hall, 2000)

Empirical research on the effects of tax incentives for R&D typically come to the conclusion that they have a positive effect on corporate R&D investments, since they increase the amount of R&D carried out by each company, and lower its marginal costs. Castellacci and Mee Lei (2015) in their meta-regression analysis conclude that "sectors matter". Micro-econometric studies that have focused on high-tech industries have obtained a smaller estimated effect of R&D tax credits. This effect is however stronger and more visible in countries that have (or had) an incremental scheme, such as the US, Japan and France. Furthermore, their results also indicate that the additionality effect of R&D tax credits is stronger for SMEs and for firms in the service sectors. Altogether, the authors suggest that R&D tax credits seem to have stronger benefits for enterprises with low R&D intensity than for highly R&D intensive firms in technologically advanced sectors. In other words, this policy scheme – particularly if designed as an incremental system – favours the process of catching up of firms lagging behind the technological frontier rather than pushing the country's frontier further. The overall benefits of R&D tax incentives depend on the interplay of three related factors: (1) the total incremental effect of tax credits in a given industry; (2) their productivity effects in the same industry; (3) the spill-over effects to all other industries.

Analysing several **tax incentive regimes in Europe**, Bergner (2017) concludes that in the case of R&D tax incentives (as in the general case of tax incentives for SMEs), policymakers should avoid the size criteria (SME) and instead implement absolute caps, so as not to distort the decision making of entrepreneurs.

Appelt et al. (2019) found a positive effect of tax incentives on input additionality in **OECD countries**. The authors point out that direct instruments are better suited to target activities, firms and areas where higher additionality and spill-over could be expected but one has to take into consideration that direct instruments usually come at the expense of higher administration costs and higher compliance costs for firms. Tax incentives are more easily implemented than direct support in terms of compliance with competition and trade rules. Estimations based on R&D incrementality ratios suggest that tax incentives are associated with an increase in business R&D spending but involve some degree of crowding out (p.8). Therefore, an optimal policy mix will likely require a combination of both direct and indirect support instruments (p.47).

Busom et al. (2011) analysed **Spanish CIS Data** and examined under which conditions firms use either direct funding, tax incentives, or both. The authors conclude that direct support may encourage firms that face financial constraints to invest more in R&D. Tax incentives on the other hand may encourage firms that do not face financial constraints to invest more in their R&D activities. (p.22) Related to the Spanish context and based on survey data collected in 2002, Corchuelo and Martinez-Ros (2009) found that large firms that are already active innovators and can guarantee the viability of innovation projects are more likely to use tax incentives than small firms. Tax incentives are also more effective when used by large firms rather than SMEs. The authors conclude that tax incentives are only effective in high-medium tech sectors and large firms.

In a review of **applications for R&D&I incentives** in Spain, Martinez-Ros (2016) found that for the year of 2008, the main reasons for not applying were that for companies already active in R&D&I the level of expense contribution was small and involved a long time delay; and, the concept of expense in the regulation was not always the same as that required by enterprises. The conclusion of the study was that the low level of applications was not due to lack of awareness, ignorance or ambiguity in the legislation which made it hard to understand.

Testa and Szkuta (2018) found that **tax incentives and grants are complementary** in terms of their impact on firm's growth and innovation activities in the case of young innovative firms with growth potential. The authors suggest the following policy implication: R&D grants stimulate firms for the growth phase and help attract follow up funding (signalling effect especially for equity). In terms of achieving a longer lasting effect, they suggest that financial measures should be coupled with complementary services (e.g. networking, advice). The authors also suggest, that selection mechanisms built on milestones should be used more often, as they show very positive results (p.4).

In the evaluation report of the **Austrian R&D tax scheme** ("Forschungsprämie") Ecker et al. (2017) point out that the tax scheme has a mid to low incentive effect in terms of the R&D input and behaviour of firms, and that R&D intensity has a greater impact on input additionality and behavioural additionality than firm size. The Austrian R&D tax scheme supports firms that already conduct R&D: these firms increase their R&D activities, while there is little incentive for firms that are not active in R&D to start new R&D projects (p.75f, p.98ff). Some of the firms surveyed stated that the tax scheme was an important factor in outsourcing some of their R&D activities to firm locations in Austria (p.104). This is an example of how tax schemes can influence the competitiveness of regions on a global scale. However, as Laredo et al. (2016, p.50) note, in the long term, and as more and more

countries start to adapt their tax schemes, this could turn out to be a zero-sum game, and leave the government with less income from taxes overall without increasing or less effectively increasing private R&D expenditure on a global scale.

Benedictow et al[116]. (2018) evaluated the **Norwegian SkatteFUNN tax incentive scheme** in terms of its effects on input, output, outcome and impact between 2002 and 2015. The authors found that for each unit of tax allowance, companies invest NOK 2,07 more in R&D than non-subsidised companies, but the effect has been decreasing since the introduction of SkatteFUNN and is 1,15 for the period 2014/2015. SMEs and large companies benefit to a similar extent, but the ratio is significantly higher for small projects than for larger ones. SkatteFUNN has a positive effect on the likelihood to create innovations, but does not increase labour productivity. The appropriateness of funding is rated as particularly good for small R&D projects, otherwise hardly any differences to direct research funding can be identified. When including measures that identify incorrectly declared R&D expenditures however, the cost-benefit ratio decreases below 1 for every unit of tax allowance.

The evaluation of the *Wet ter Bevordering van Speur- en Ontwikkelingswerk*[117] (**WBSO) in Netherlands** between 2011 and 2017 (Coyne and Carlberg, 2018, Annex II; de Boer et al. 2019[118]) concluded that the WBSO increased the R&D wage payroll as well as the share of sales of innovative products and labour productivity in subsidised firms. For the programme as a whole, there is an average increase in the R&D wage payroll of EUR 720 million per year over the period 2011-2017, although only around 25 % can be accounted for as input additionality. According to the companies surveyed, about 50% of the WBSO is spent on additional R&D activities. Overall, behavioural additionality is highest among small enterprises.

In their evaluation report of the **R&D tax credit in the UK**, Fowkes et al[119]. (2015) suggest that the tax credit increases the R&D expenditure of its beneficiaries: for each pound of tax forgone, R&D expenditure increases between 1.53 and 2.35 pounds. Similarly, Acheson et al[120]. (2016) found quite strong additionality effects for the **tax credit scheme in Ireland**: For every Euro of tax forgone, the subsidised firms invested Euro 2.4 in R&D. The tax credit accounts for about 60 % of the total business R&D invested between 2009 and 2014, and effects are weaker for young firms than for established ones. However, as all firms are entitled to avail of a tax credit for R&D and considering a “deadweight” of 40 %, partial crowding out may occur, as some companies might replace their own financing with public financing. The authors conclude that overall, the Irish R&D tax credit increases private R&D expenditures to a reasonable degree, but there may be scope to increase the cost-benefit-ratio of the instrument.

A special case of an indirect funding instrument is the **patent box**. A patent box is an income-based tax reduction on profits that result from immaterial assets like patents or other intellectual property rights. (Mohnen et al.[121], 2016, p.1). As other forms of tax preferences for the process of commercialisation of products and services resulting from R&D activities

[116] Benedictow, Andreas; Bjoru, Emil Cappelen; Eggen, Fernanda Winger; Norberg-Schulz, Marthe; Rybalka, Marina; Rotnes, Rolf (2018): Evaluation of SkatteFUNN. Ministry of Finance. Oslo.

[117] Law in support of Research and Development

[118] De Boer, Pieter; Faber, Dionne; Gielen, Maartje; van Dorsser, Sam de Hass; den Hertog, Pim; Janssen, Matthijs; Vankan, Arthur; Verspagen, Bart (2019): Evaluation Dutch R&D tax credit scheme (WBSO) 2011-2017. Assignment by the Ministry of Economic Affairs and Climate Policy. Utrecht.

[119] Fowkes, Rigmor Kringelholt; Sousa, Joao; Duncan, Neil (2015): Evaluation of Research and Development Tax Credit. HM Revenue and Customs. London.

[120] Acheson, Jean; Malone, Rory (2016): Economic Evaluation of the R&D Tax Credit. Department of Finance. Dublin.

[121] Mohnen, Pierre; Vankan, Arthur; Verspagen, Bart (2016): Evaluating the Innovation Box Tax Policy Instrument in the Netherlands, 2007-2013. UNU-Merit. Maastricht.

emerged, other terms like “IP boxes” or “innovation boxes” have been used to refer to a wider range of similar instruments (Lester & Warda[122], 2018, p.3). First introduced in the 1970s, patent boxes or similar instruments have been established in many OECD countries since then, but a large number of countries implemented that instrument only after 2007 (Lester & Warda, 2018, p.3, Alstadsaeter[123] et al., 2018, p. 137).

As firms may shift their taxable income to a country providing income tax reduction, but might not conduct R&D at that location, the OECD recommended that both the R&D and the income from its commercialisation should be located in the same jurisdiction (“nexus requirement”) if firms apply for patent box tax reductions. (Lester & Warda, 2018, p.3) Lester and Wade (2018) assess income-based tax incentives as less attractive for risk-averse firms, as the tax benefit of R&D comes into effect only during the commercialisation phase. Therefore, the incentive is less strong compared to tax reduction based on R&D expenditure for start-ups and SMEs that conduct risky innovation projects. Larger firms and multinational enterprises however, may increase the commercialisation of its innovation activities in order to benefit from patent boxes. As with other indirect funding instruments, patent boxes may also intensify tax competition between countries.

A.5.3 Other direct financial instruments

Grants and tax incentives are two types of direct public support for innovation. Other instruments to facilitate access to finance for R&D include for example **low interest loans** or **loan guarantees** and Cunningham et al. (2016) list three more types of direct funding: **Soft loans**, **government loan guarantees, government support to seed capital, business angel networks and early-stage venture capital funds** (p.60). Some of these instruments may be implemented in a way that requires the recipient to reimburse some of the financial assistance received after some time. Thus funds get repaid and can then be invested again, which not only increases the available funds over time, but may also increase the efficiency of these instruments, since the funding organisation has an interest in the returns on its investments. Depending on the instruments in question, support usually has to be paid back by the recipient only when the funded projects are successful. The downside of these instruments is that successful firms have to reserve funds that could be invested in other activities for paying back the assistance received. With regard to equity capital investments, the firms’ owners may lose some control over business decisions, which can have positive (in case of supportive advice and input experience) but also negative effects (in case of poor business experience of shareholders). Some programmes may also combine different direct instruments, e.g. grants combined with soft loans. According to a report of the ex-post evaluation on Cohesion policy programmes 2007-2013 (European Commission 2016[124]) , almost half of the analysed operating programmes used grants as support instrument, but these were also often (22 % of all instruments) implemented in more complex forms of support, like a combination of grants with technical assistance and consulting services or grants with loans (p.12).

With regard to soft loan schemes the authors report evaluation results of a **French programme** (soft loan scheme of the French innovation agency ANVAR) that showed good additionality effects, where 75% of the enterprises receiving the loan would not have realised the project in the same way or would not have done it at all without the loan. An evaluation of

[122] Lester, John; Warda, Jacek (2018): An international comparison of tax assistance for R&D: 2017 update and extension to patent boxes. SPP Research Paper. Volume 11:13. The School of Public Policy Publications. University of Calgary.

[123] Altstadsater, Annette; Barrios, Salvador; Nicodeme, Gaetan; Skonieczna, Agnieszka Maria; Vezzani, Antonio (2018): Patent boxes design, patents location, and local R&D. Economic Policy January 2018. Pp.131-177.

[124] European Commission (2016): Support to SMEs – Increasing Research and Innovation in SMEs and SME Development. Final Report Work Package 2. Ex post evaluation of Cohesion Policy programmes 2007-2013, focusing on the European Regional Development Fund (ERDF) and the Cohesion Fund (CF). Brussels.

the Small Firms Loan Guarantee **(SFLG) in the UK** showed only moderate additionality (less than half of recipients probably/definitely would not have achieved similar results without the loan guarantee) (p.63).

When analysing the **Czech programme START** (active between 2007 and 2011) which supported new entrepreneurs through zero interest soft loans and credit guarantees, Dvoulety (2017) found no positive impact by the programme on firm's performance. As the firms supported performed worse than the control group in terms of return on assets as well as sales, the author suggests a negative impact of the programme on firm's financial performance, although the author states two limitations of the study, namely missing data and that the control group was not applicants rejected for the programme. The negative effect could be due to adverse selection and moral hazard if firms started taking greater risks than they normally do which may increase the probability of failure (p.11). Also, if the funding requirements are too generous, then some firms might get funded to a greater extent than they need to which would not improve their performace. Therefore there should be careful consideration in the design and implementation of a loan instrument, otherwise the instrument looses its effectiveness by selecting firms that are less effective and less innovative.

Florio et al. (2018) analysed the **Polish "Technological Credit"** programme, which was co-funded by the EU and aimed to support SMEs that were planning to invest in technology and had already been granted a bank loan. The Technological Credit was actually a grant given to Polish SMEs, but was only given as a substitute for a part of the commercial bank loan. Although the effects of the programme were generally positive in terms of firms' investment in technology, the main beneficiaries of the instrument were the financially sounder and more internationalised SMEs. Therefore, the core driver of adopting new technology for participants of the programme was having access to foreign markets (p.2154). The authors conclude that the programme is not well suited to fostering innovation in fragile and more domestically oriented SMEs (p.2132).

A study with data from **Spanish firms** (CIS data for the period 2002-2005 of both SMEs and large firms) (Huergo et al. 2015) shows that public low interest loans have a positive impact on firms' R&D investments, and the effect is larger for SMEs than for large firms, and larger for manufacturing firms than for service firms. Furthermore, the authors find a positive effect of investing in R&D in the previous year on investing in R&D in the current year.

In a study comparing different loan and grant instruments (on national and EU level) that **Spanish firms** used between 2002 and 2005, Huergo and Moreno (2017) found that public subsidies increase the probability of conducting R&D activities, with grants having a greater impact than loans. For the observed period, European grants had the greatest impact compared to national grants and national loans. The impact of public aid was higher in SMEs compared to large firms, and participation in more than one programme had a higher effect than the use of only one programme. In the case of large firms, the authors could not rule out the existence of crowding-out effects when both loans and grants were used (p.1209).

Szukuta et al[125] (2017) analysed academic literature and policy evaluation studies on the impact of public support through **equity instruments**, focusing specifically at young innovative companies with growth potential. As young, high growth innovative enterprises usually lack internal resources for financing, they depend to a greater degree on external sources for financing than established bigger firms do. By making equity capital available,

[125] Szkuta, K.; Stamenov, B.; Ianshyna, A. (2017): Improving access to finance for young innovative enterprises with growth potential: evidence of impact on firms' outputs. Part 1 Equity instruments: lessons learned from policy evaluations. Publications Office of the European Union. Luxembourg.

the investors receive a share of ownership in the company. Equity instruments usually aim at filling gaps of financing in the growth phase of companies (e.g. through the provision of venture capital). Three types of public policy equity instruments can be distinguished: the direct provision of venture capital through public venture capital funds (1), the indirect provision of venture capital either through public funds invested in private venture capital funds (2) or government backed loans/guarantees for private financial intermediaries (funds or banks) to finance venture capital (3). (p.5ff). Based on their literature review, the authors found out that high-growth potential firms expand their innovation activities more than those that have not received support in the form of equity. The impact of equity via venture capital funding seems to be primarily an indirect one (access to networks, partners, etc.), with a greater impact on the commercialisation of innovations than the innovation process itself. (p.29) As venture capital investors gain a share of ownership in the company, they usually have an expertise in the field of a funded firm's activities and depending on the relationship between investor and investee could also provide non-financial support such as advise or access to networks. With regard to the design and implementation of public equity instruments, the authors suggest that a syndication of funds with a leading role of the private sector may deliver better results than government funds only. Also, equity instruments should aim at intervening both at the early and growth stages, should deliver added value services (e.g. coaching and networking), should have flexible geographical boundaries and provide larger size funds and should extend the indicators of success beyond leverage effect, exits, and fund profitability. (p.4)

Other financial instruments address the **need for capital, especially of firms in the start-up and growth stages** (Osawa & Miyazaki 2006, Ford et al. 2007, Johnson 1966). Venture capital is especially important for firms in the growth stage and later stages, that is after the first investments in start-up (possibly using seed and/ or business angel funding), and a product or service is market-ready, when the start-up is in need of further financial support to expand and scale up their business idea. Firms in Europe are at a disadvantage compared to firms in USA or Asia, since venture capital investments in the USA or Asia are four times higher than in Europe. Differences are visible especially with regards to the venture capital investments in the later stage, where median investments in firms are 1.6 times higher in the USA and 3.7 times higher in Asia than in the Europe. (Achleitner et al., 2019, p.12f)

Gottschalk et al. (2016) evaluated a **German venture-capital-support programme ("INVEST")** and although they could not come to a conclusion regarding its effectiveness in terms of innovation output due to the early stage of the programme, they provided arguments for the implementation of such a scheme. First, the market of venture capital in Germany is still relatively small, and second the literature provides evidence of market failure due to information asymmetries in the venture capital market, making it difficult especially for firms in the early growth stage to acquire financial capital.

Overall, Europe's market for alternative sources for finance is less developed than the market in the US, where the average venture capital fund size in 2018 was € 174 Mio compared to € 35 Mio in the EU, and where € 46 billion of total venture capital funds were raised compared to a total of € 4 billion in the EU (Correia et al., 2020[126], p.530f). In 2017, bank loans have the highest share on external investment finance in the EU when compared to other sources[127], but there are considerable differences between countries: while the share of bank loans is higher than 80 % in Cyprus and Greece, the share of bank loans is lower than 30 % in Latvia, Estonia and Ireland. (Correia et al, 2020, p.529)

[126] Correia, Ana; Martino, Roberto; Rovet, Julien: (2020): Framework conditions. In European Commission (Ed.): SCIENCE, RESEARCH AND INNOVATION PERFORMANCE OF THE EU 2020. A fair, green and digital Europe. Brussels.

[127] Other sources: newly issued bonds, leasing or hire purchase, loans from family/friends/business partners, newly issued equity, factoring/invoice discounting, grants, other terms of bank finance and others.

A.5.6 Skill development and knowledge transfer instruments

Skilled personnel and qualified employees are the foundation of innovation. They create and share knowledge and promote its diffusion. However, the availability of skills is affected by market failure, as actors find it difficult to estimate the return on investment in education and training. (Jones & Grimshaw 2016, p.109). Furthermore, technological change leads to a permanent pressure for the adoption of new forms of certain skills, e.g. digital skills.

Innovation vouchers are used to allocate funding to enterprises in the form of a voucher to buy innovation services from knowledge providers, or to recruit an in-house innovation resource or innovation manager. The company pays the researchers, consultants or employees, which in turn is reimbursed by the public issuer. Innovation vouchers facilitate SMEs' access to external knowledge while avoiding bureaucratic delivery problems and explicitly address the relative weaknesses of SMEs in hiring innovation specialists and R&D staff. They can then build their own R&D expertise and capabilities. National and regional bodies issue innovation vouchers. While they have been primarily used to address technological development, the second generation of innovation vouchers addresses innovation in a broader sense. One of their main success factors is their relative simplicity and low cost of procedures. Factors potentially limiting their effectiveness include the definition of services linked to objectives, the qualification of service providers and the threshold for the maximum support to be granted. (OECD 2011)

In **Austria**, firms can apply for a voucher to fund R&D&I related services from research organisations. Before 2018, two voucher programmes with different levels of funding existed. The evaluation of these innovation voucher programmes in Austria showed that the majority of the firms that use the programmes are newcomers (have not conducted R&D or innovation projects before) and about 25% of the newcomers conducted follow-up innovation or R&D projects. Another result was that the participating firms in the programmes created lasting networks with research organisations that otherwise would not have been created, and that the vouchers enabled firms to implement projects or accelerated the implementation of projects. (Handler 2018, p.2) Similarly, in an earlier evaluation of the Austrian innovation voucher scheme, Kaufmann et al. (2015) conclude that the vouchers have produced a significant change in innovation behaviour or behavioural additionality with regard to continued R&D or innovation activities as well as increased R&D expenditures.

In their analysis of two innovation voucher programmes in **Italy's Lombardy region,** Sala et al. (2016) found that innovation vouchers were primarily used by SMEs that already spent time and financial resources on innovation activities and seem to be less effective for SMEs less acquainted with innovation. In some cases, the voucher forced SMEs to adopt a more structured approach to innovation and reduced the time-to-market; in other cases, follow-up projects set up with private resources were launched. According to their research, innovation vouchers increase the overall competitiveness of local SMEs.

In a study analysing the use of innovation vouchers in **Slovakia**, Bondareva et al. (2017) note that there is little interest in this instrument among SMEs, which the authors attribute to the low awareness rate and the low level of financial support provided by the vouchers.

A review of the Rete Technologico Aziendale (RTA) programme by Federlazio which was aimed at helping SMEs to **assess and improve their innovation culture and management systems** in a way that supports innovation found that the programme was working and should be continued with.

A.5.7 Technology and innovation advisory services

Shapira and Youtie[128] (2016) reviewed literature that analysed the impact of technology and innovation **advisory services**. Innovation advisory services may also be associated with advisory services for business operations. SMEs usually face obstacles to adopting new technologies due to a lack of knowledge and skilled specialists but also due to the potentially high costs and poor availability of consultancy services.

Advisory services aim to increase SMEs' abilities to overcome such obstacles by providing direct technological information and additional services helping enterprises to improve their business activities and processes (e.g. on how to improve management competences, supply chains, training, quality improvement (e.g. ISO certifications), marketing and export assistance, etc.) These services may help SMEs catch up with larger firms in terms of their productivity. Another important part of advisory services is signposting to other specialised service providers (e.g. refering to other experts, but also to public and private funding opportunities) and/or access to networks and partners that could provide additional support or could otherwise be helpful for innovation activities (e.g. as collaboration partners in R&D projects). Technology and innovation advisory services usually position themselves among other advisory services in a country and target already established firms that focus more on incremental innovation or new to the firm innovations than new to the market or disruptive innovations. The rationale lies in the process of adopting and upgrading technology and innovation processes in SMEs rather than in developing something completely new.

Shapira and Youtie (2016) identify **three types of advisory service**: The first type consists of a decentralized network of field agents that provide advisory services with an orientation towards application rather than research. This type can be found in the UK and also the US. The second type of advisory service provides a wide range of technology-oriented business services to its clients: Besides technology and innovation advice, this may include venture start-up assistance, funding, technology transfer and other services. The Industrial Research and Assistance Program in Canada is an example of this type of advisory service. The third type are applied technology centres that are engaged in research and technology projects together with firms and which may also provide advisory services to firms. The German Fraunhofer Institutes, the Carnot Centres in France, the Catapult Centres in UK and the Japanese Public Industrial Technology Research Institutes are examples of this type. In addition to these major types, other forms of innovation services exist. In the US and the UK some universities provide technology and advisory services to small firms, but other public, private and non-profit organisations may also be involved in the provision of such services, depending on the respective country. Provision of advisory services by experts on site not only facilitates the transfer of tacit knowledge but also helps to build trust that may then also lower potential reservations in relation to other third party service providers.

Based on an in-depth review of **evaluations of advisory services in Canada, the UK and the US** Shapira and Youtie (2016) conclude that participating firms generally benefit from these services, e.g. in terms of cost reduction, improved quality, improved environmental performance, higher productivity and new product development and innovation. As public investments via these instruments are comparably low, the net benefits of advisory services are also modest, although broader effects and spill-overs as a result of these services are difficult to estimate. Negative effects, for example on private consultancy services, have not been found, as private services are often involved in the provision of these government-supported services. There is a trade-off between the amount of firms that receive services,

[128] Shapira, Philip; Youtie, Jan (2016): The impact of technology and innovation advisory services. In: Edler, Jakob; Cunningham, Paul; Gök, Abdullah; Shapira, Philip (ed.); Handbook of Innovation Policy Impact. Edward Elgar Publishing. Celtenham, UK. Northampton, MA, USA.

and the depth and time of service quality provided. The more intense the service, the more likely are positive results, but the fewer firms can be supported, as customised consultancy takes more time and resources. Therefore, initial (public) support services may be complemented with reference to more specialized (private) service providers. Furthermore, if the advisory process follows best practice examples (e.g. considering the outreach of measures undertaken, staff capability, firms' long-term engagement, organisational structure and networks), the likelihood of positive results in terms of the programme's effectiveness increases.

In contrast to other instruments in this review that usually target firms, **initiatives to improve entrepreneurship** target individuals. The aim is to increase the performance as well as the number of entrepreneurial actors in the society. Entrepreneurship encompasses distinctive individual values and attitudes as well as certain skills. However, value concepts and knowledge do not necessarily lead to action, therefore practical application based on experience as well as an entrepreneurship-friendly environment are also important factors influencing the number and performance of entrepreneurs in countries. Rigby and Ramlogan[129] (2016) distinguish between three broad types of entrepreneurship schemes:

- Schemes to promote cultural and behavioural change: these refer to support instruments like entrepreneurship education in schools - the target group is very broad and usually consists of pupils or students of different age groups
- Schemes to provide information/business coaching: these include advisory services, training and awareness raising, some of which are targeted towards specific types of businesses and/or SMEs. Also included is business coaching, which is targeted more to the specific needs of the entrepreneur, and takes place on a relationship like basis between coach and entrepreneur and usually covers a certain period.
- Multi-instrument schemes: those schemes combine different initiatives, e.g. coaching activities with skills development and access to finance. The schemes can be subdivided in location-based (on-site) initiatives and initiatives that run for a certain time but are not linked to a certain location (off-site). Entrepreneurship policy programmes that combine instruments and target SMEs in a specific country are an example of off-site multi-instrument schemes whereas incubators are an example of a multi-instrument scheme that is based at one specific location.

All these schemes are characterized by diversity in terms of design, which makes it difficult to generalise regarding studies and evaluations of specific entrepreneurship instruments. All these measures however target the entrepreneurial skills of a variety of people or self-employed persons and influence the innovative capabilities of firms more indirectly than specific advisory services. Rigby and Ramlogan (2016) emphasise the methodological challenges of measuring the effects of entrepreneurship instruments and report mixed results (in terms of employment status, firm survival rate, sales growth, etc.) from different studies and evaluations of entrepreneurship support instrument schemes, with results depending on the methods used, the instrument investigated and its context of implementation (e.g. centralised, regional, implemented by various different actors or one superordinate body, etc.).

[129] Rigby, John; Ramlogan, Ronnie: The impact and effectiveness of entrepreneurship policy. In: Edler, Jakob; Cunningham, Paul; Gök, Abdullah; Shapira, Philip (ed.); Handbook of Innovation Policy Impact. Edward Elgar Publishing. Celtenham, UK. Northampton, MA, USA.

A.5.8 Collaboration and network instruments

Funding of networks and partnerships or collaborations is usually not a separate policy instrument but an inherent part of public innovation support. The following section focusses on the network/collaboration effect rather than the financial aspect of support.

The underlying rationale for fostering collaborative activity between firms and also public innovation support institutions (e.g. universities or research centres) is twofold: first, to improve the innovativeness of business communities and, second, to increase the social return from public investments in science organisations via the transfer of knowledge from research organisations and the use of this knowledge by market-oriented organisations. (Cunningham & Gök 2016, p.243) The reason for an intervention is that the flow of knowledge in innovation systems (especially between business and science) can usually be improved. The role of government support in the creation of networks therefore could be to act as a coordinator and administrator to encourage knowledge sharing between actors. Links between actors in a network may be arranged in different ways, on a more formal basis (e.g. via contractual agreements) or more loosely coupled and informally, where the knowledge exchange often takes place on an informal level. (Cunningham & Ramlogan 2016, p.283f)

Furthermore, collaboration from the perspective of the firm can have many benefits: to collaborate with suppliers could result in lower cost and improved product quality. Collaboration with customers and competitors could contribute to serving customer needs better, improved commercial success, enhanced innovation productivity through economies of scale, and may lead to greater access of domestic or foreign markets. (Cunningham & Gök 2016, p.239) Further reasons for firm-firm collaborations are: saving transaction costs where there are incomplete contracts, attaining economies of scale and scope, using networks as a way to increase synergy, efficiency and power, assessing complementary resources, creating and exploiting high-risk situations and decreasing R&D costs by pooling risks and co-opting competition (p.240). The reasons for science-industry cooperation are similar, but tend to be asymmetric, as firms try to get access to research knowledge, research infrastructure and research services while research institutions tend to seek the economic exploitation of research results or to get access to practical experience and to develop career pathways for students (p.240). Cunningham and Gök (2016) state four mechanisms and sources that underlie industry-research linkages: informal contacts and spin-outs from university departments, research performed by universities on behalf of the industry, property-led initiatives in the form of science parks, the commercial exploitation of university research through the management and licensing of intellectual property rights (IPRs). (p.241)

Different kinds of collaboration instruments can be distinguished, for example between research centres and collaborative and knowledge exchange research projects. **Collaborative research centres** can take the form of **Centres of Competence**, on which Higher Education Institutions (HEIs) collaborate with industrial partners, and **centres of excellence,** which are less industry driven and focus more on building a critical mass of competitive research. Collaborative research projects are typically co-financed by public grants and involve one or more business partners and one or more public research institutions. **Knowledge exchange projects** on the other hand are support measures for specific innovation projects. They are typically much smaller in scale and their flexibility makes them more attractive to SMEs. (Cunningham & Bök 2016, S.245)

In their study of academic–industry partnerships supported by the **Danish National Advanced Technology Foundation**, Chai and Shih (2016) show a significant, strong and increasing effect on academic engagement of SMEs collaborating activity as measured by

the number of peer-reviewed publications. Overall, the evidence shows that the effect of academic–industry partnership funding on co-publication activities of SMEs is particularly strong and progressively increases throughout the 5 years period after funding. Moreover, the longer firms participate in these academic–industry partnerships, the more they co-author with academics. The authors also produce evidence suggesting that for young firms there is a strong impact of academic–industry partnership funding on participating firms' granted patents filed up to 3 years after funding. Firms participating in larger projects show that academic–industry partnership funding strongly impacts the firms' R&D activities measured in publications and granted patents throughout the years after funding.

Similar experiences are found **in Sweden**, where since 1995 the Vinnova innovation agency has funded a number of competence research centres that build bridges between science and industry and create excellent academic research environments with active and persistent businesses participation. An evaluation of these VINN Competence Centres (O'Keene et al. 2016) found that they have strengthened the national innovation system by creating links between academic research groups, industrial R&D and public sector actors and have generated very good long-term results for participating companies in the form of new products, new processes and improved financial results and increased competitiveness.

Cottica (2017) reviewed the **role of business networks** as an instrument for the development of the **agro-food sector in Italy.** Networks are seen as of a particular importance as an instrument in Italy given the very high share of micro-enterprises in the Italian economy, the fragmentation between them and their reduced negotiation power while facing increasing international competition. Cottica developed a generic typology of such networks and found that the new collaboration contract provided for by the legislator (D.L. 5/2009) was a valuable tool for supporting development. A case study on 'Il buon gusto Veneto' was put forward as an example.

A study by de Martino (et.al.) (2017) of drivers of innovation in 122 agro-food SMEs from the Campania region in Italy found that three different **clusters of innovation modes** could be identified: innovative collaborators; innovative non-collaborators; and, non-innovators. It was suggested that dissemination of best practices by the innovative collaborators would help the other two groups to increase their innovative activities.

Idevaia and Resce carried out a **qualitative review of some institutions aimed at supporting transition to industry 4.0 in Italy,** including Competence Centres and Punti di Impresa digitale, while focusing on Digital Innovation Hubs. This was done in the context of the national Italian digitalisation plan and EU initiatives in support of digitalisation. They found that the cultural changes required among SMEs were as great a challenge – if not greater than – the purely technological challenges. They also point out that the Digital Innovation Hubs still faced a major challenge in helping to bring about changes in working patterns, skills and training that would lead to a networking culture as required by digitalisation and Industry 4.0.

The **importance of collaboration**, especially for growth companies is also highlighted by Achleitner et al. (2019). Growth companies can benefit from learning effects with regard to the application of their technology, as well as from joint projects or orders from established companies. Established firms on the other hand can benefit from cooperation with start-ups by getting access to new technologies and accelerating their own technological transformation (p.18).

A review of the **impact of the Triple Helix and innovation challenges in Spain**, referring to the 2007-2013 period, by Luengo-Valderrey (2018), found that SMEs were becoming more open to innovation from outside the organisation. In this respect, there was a gradual

increase in the importance of the university axis as compared to that of industry. However, above all, it was necessary for public agencies/ institutions to make an effort to ensure that SMEs lose their fear and suspicion of everything that may come from them, so that SMEs may, in turn be better served with information and access to finance. What was required is the creation of sectoral or thematic groupings to oversee integration of the three axes of the Triple Helix. Such groupings have been successful in regional spaces such as the Basque Country.

Feser and Proeger (2015) used a qualitative approach to describe **problems of SMEs cooperating** with various knowledge-intensive business services (KIBS). They found strong information asymmetries, distrust and uncertainty about the effects of using external expertise in the cooperation between SMEs and KIBS. The authors suggest that policy makers in regional innovation systems should establish structures that could provide impartial provision of information to strengthen mutual trust between firms. They suggest institutions like regional chambers or chambers of commerce could eventually play that role, as firms perceive these institutions as neutral (p.19f).

Nepelski and Piroli (2017) analyse the performance of collaborative research projects funded by the **European Commission** (FP7 ICT research projects). The authors distinguish between homogenous partnerships (two organisations of the same type) and heterogeneous partnerships (two organisations of different types, e.g. firm and university, SME and large firm). The results of their study show that the composition of innovation partnerships in publicly funded projects has an impact on the innovation potential of the research projects: the innovative potential of homogenous groups (firm-firm cooperation) is likely to be higher than the potential of heterogeneous groups (p.629). As the authors found no effects of project funding or duration on the potential of innovation, they conclude that the characteristics of a consortium are more important than the level of R&D input in explaining its innovative performance (p.629).

According to Cunningham and Bök (2016), the literature focuses mainly on goal achievement - if certain initiatives succeed in encouraging collaboration. The actual collaboration process on the other hand is rarely investigated in detail, making it difficult to define which attributes of the policy instruments work and which do not (p.269f). They conclude that **future evaluations of programmes should focus more on the behavioural change** induced by the collaboration process and the intangible outcomes generated, as well as better document the unanticipated outcomes of collaboration processes. Long-term assessment of outcomes and the measurement of causality are issues that are of importance for innovation programmes in general (p.273).

Networks can be viewed from different angles, and different types of networks are proposed in the literature. For example, they can be categorised by the type of actor in a network of an organisation (e.g. supplier, users, competitors, research organisation), or the underlying feature or reason of forming a network (knowledge networks, regional and national network, instrument networks, science-industry networks, strategic networks, etc.). (Cunningham & Ramlogan 2016, p.287)

According to Caloffi et al. (2014), innovation **policies focusing on the establishment of (regional) networks** of firms, universities and research organisations as well as intermediaries (not necessarily through joint R&D projects) **affect the SMEs' relational patterns**, pushing them to collaborate—often in a stable way—with a variety of other organisations. This effect is stronger if the participation in a support measure is repeated. Sectoral heterogeneity had a negative effect on the probability of forming relationships in the network consolidation stage: once the policy constraints were removed, firms resumed cooperation with partners that were most similar to them, and who were presumably useful

in achieving their innovation objectives. The results also highlight an interesting aspect of firm–university relationships, which policymakers in many European regions are very interested in supporting: only some types of intermediaries—those specialised in providing innovation-related services—were able to encourage the development of university– industry relationships. Co-location in the same province (often in the same cluster), increased the likelihood of collaborating. Therefore, imposing certain requirements on the characteristics of networks to be funded within a policy programme could encourage the adoption of certain behaviours that are considered desirable, but only to a limited extent.

A.5.9 Clusters/Science and technology parks

Clusters usually consist of interconnected organisations that operate in a particular field and are located in a geographical region. Most cluster definitions therefore include a degree of specialisation, co-location and scale or critical mass in the cluster. However, the concept of clusters is controversial and there are ongoing conceptual and empirical debates. As a result, there exist various cluster typologies. (Uyarra & Ramlogan 2016, p.198)

The economic rationale underlying cluster formation is built on **advantages arising from geographical proximity,** like better access to employees, knowledge spillovers, local access to material and components from intermediate industries, finance, marketing and business services, reduced transport costs and favourable market conditions. On the other hand, negative effects for firms in clusters may be the threat of lock-ins, the inability to adapt, greater vulnerability to external shocks, congestion and competition effects, property price rises and increases in labour costs. (Uyarra & Ramlogan 2016, p.198f)

Aranguren et al. (2014) show that **cluster policy does have positive effects** on firms that are associated with clusters supported through public funding. Firms in clusters demonstrate superior levels and growth of productivity, and appear more likely to have obtained quality certificates and to have invested in R&D. However, an econometric analysis revealed that there is only weak evidence that the cluster policy has had a positive impact on firm-level productivity.

Rothgang et al. (2017) found that the **Leading Edge Cluster Competition (LECC) in Germany** lead to positive regional impulses from the LECC, such as enhanced regional R&D activity. The authors also found that the programme increased the R&D expenditure of the firms and promoted additional SME activities. The authors state that the following factors influence the success of cluster initiatives: clusters need to have a critical mass of existing technological and innovation potential, an assertive cluster organisation represented by cluster managers is indispensable, internal factors like joint activities within the organisation and a regional exchange between cluster stakeholders are important as are environmental factors. The latter could – in the case of severe technological problems or a change in market conditions – even render the objectives of a cluster organisation obsolete. Geographic proximity on the other hand could be interpreted more pragmatically in consideration of today's transportation and communication technologies.

Public funding of enterprises' R&D activities in the context of funding clusters seems to **benefit SMEs particularly** as Engel et al. (2019) have concluded from their analyses of the German leading-edge cluster competition (LECC). SMEs gained access to already existent R&D networks when they joined the cluster initiative. Overall, the LECC significantly increased R&D expenditures with no evidence for crowding out. Compared to R&D funding outside of the cluster, funding of organisations within the LECC apparently leads to a higher increase in some R&D related measures (e.g. external R&D as a share of turnover).

In its 2011 publication on policy instruments for regional innovation (OECD 2011), **the OECD** lists **science and technology parks as especially relevant**. Science and technology parks are defined as physical infrastructure, often accompanied by a range of services, where enterprises and research institutions are co-located. The generic term includes a wide range of typologies (Wei Keit et al. 2019), and Borreguero Figols (2015) has developed a method to understand innovative behaviour of firms in science parks. The rationale behind these parks is that science and research lead to economic growth through the creation of new technology-based firms (NTBFs) and commercialisation of research. Science and technology parks capitalise on proximity to enhance knowledge flows among tenants. Regional authorities invest in parks for regional restructuring purposes; national governments focus more on technology development and foreign investment attraction. In the OECD publication (2011) the authors have observed a trend of convergence between science and technology parks and cluster initiatives. It is important to notice however, that both concepts are not mutually exclusive, and a comparison between the two concepts on the basis of their characteristics may show more similarities than differences. Taking this into account, "there has been some convergence between science and technology parks and clusters with a thematic focus around regional high-technology clusters" (OECD 2011, p.200). For example, as Salvador et al. (2013) point out, innovation clusters include enterprises that may also be hosted in a science park (p.2). This means different initiatives that cluster firms according to their region, sector or technology intensity may overlap each other. Firms in innovation clusters that have been promoted by the European regional policy generally need to be co-located in a geographic region, as would be the case in science and technology parks (Salvador 2013, p.9). When comparing firms located in a science park with firms located in both the science park and a regional cluster located in Italy, the authors suggest that both initiatives can complement each other in terms of cognitive, organisational and institutional proximity. Geographical proximity, which is mainly satisfied in the science park however, is of importance for the creation of social links (p.19).

However, **evaluations shed doubt on the additionality of science and technology parks (OECD, 2011, p.201)**. Effects of parks on firms located in the park (as compared to firms located outside) are ambiguous. Although parks can lead to employment and sales growth in firms located in the parks in some cases, they do not always lead to positive effects. For example, there may be a selection bias in firms that tend to locate in a park, or the effects in terms of regional engagement of universities are visible but rather small. A challenge is to achieve a good balance between economic development and technology transfer objectives of the park (focus on high-technology industry versus commercial viability of the property development). Conflicting objectives and unclear objectives complicate evaluations and there is frequently a problem with evaluations as they are not able to assess the full effects of an intervention over an appropriate time period.

Clusters, as stated in the **OECD's 2011 report on instruments for regional innovation** (OECD 2011) are geographical concentrations of a critical mass of economic actors and other organisations, specialised in a common field of activity, and contributing to the innovation and competitiveness of its members and the territory they are located in. Clusters often include networks. New approaches in regional, industrial and technology policies have provided rationales for cluster policy that go beyond the market failure rationales of technology policies and combine the interactive element of the innovation process with a market-oriented approach to new forms of industrial policy. With regard to their effectiveness, researchers have identified a mismatch between what firms and institutions consider as the most relevant policy areas. For example, governments may support the creation of networks in a cluster, but pay less attention to the importance of entrepreneurial firms in the initial stage of cluster development. Another reason for a failure of cluster initiatives may be weak programme execution or the subsidising of declining firms (Anic et al., p.2230). On the other hand, there may also be differences in the desired objectives of

clusters among its members. For example, as a survey among members of **13 competitiveness clusters in Croatia** show, three groups of members could be identified: lobby-oriented members, networking-oriented members and innovation-oriented members. While all members perceived the performance of their clusters on average as rather poor, networking-oriented members as well as innovation-oriented members perceived the performance worse than lobby-oriented members (p.2239ff).

In addition, there is a wide variety of factors potentially **limiting positive effects,** such as poor targeting; inappropriate policies due to high-tech myopia; danger of lock-in due to excessive specialisation; lack of private sector engagement; weak policy co-ordination; and difficulty in adjusting policy to needs over time. Furthermore, many clusters seem to rely on public funding beyond their seed stage for success while private participation in funding is required to ensure that clusters remain business-driven initiatives.

Uyarra and Ramlogan (2016) collected evidence from **17 cluster programmes evaluations**. They found the following effects of clusters: the clusters evaluated operate at different geographic levels (district, city, regional or national programmes) and have different initiatives (single or groups) and different levels of technology (low-high) as well as different time horizons. They therefore paint a rather heterogeneous picture and making it difficult to draw clear conclusions. However, in a number of cases the clusters succeeded in mobilising resources and actors as well as advancing the innovation potential of the target regions and sectors. Also, many clusters provide additional support services that can be helpful especially for SMEs. An increase in collaborations which might not have occurred without the cluster is reported in a number of evaluations, and some strong additional networking effects have been identified. However, in some of the evaluated cluster programmes this was not the case (p.225). The authors also found that a key feature of clusters is the competence of cluster managers that facilitate the engagement of cluster members, particularly firms. High technology clusters seem to attract more private sector funding than traditional industry clusters. No clear evidence is reported in terms of an impact on innovation outcomes (p.226).

Métailler (2015) found that in a **French high-tech pole of competitiveness** (pôle OPTITEC), application of the 'version 2.0' management strategy required working at enterprise support in a wider sense than purely on the basis of an engineering and technology approach but also necessitated development of competences in the SMEs being supported. This was best achieved through implementing Knowledge Management systems in the SMEs in question.

In **Denmark** where clusters and innovation networks form an important part of the Government's business development strategy, a study surveying 888 businesses involved in clusters/networks (Uddannelses- og Forskningsministeriet 2017) showed that it had led over half of them, especially the medium-sized ones, to create innovative products, services or processes. Collaboration in a cluster was considered to raise the general knowledge and technology level of the sector in question and was also seen by many as an important factor in attracting an increased flow of capital to the sector. Over a quarter said it had led to a growth in turnover.

Increasingly, there has been a broader discussion, beyond clusters, **of innovation or entrepreneurial ecosystems,** though the extent to which the concept is different from that of a cluster has been debated. Using a metaphor from ecology, it is suggested that after originating in Silicon Valley, there have been a growing number of locations where a supportive environment has been created, which is intensely knowledge-driven and facilitates the growth and development of entrepreneurial activity. These ecosystems operate through the interaction of the multiple agents, public and private, that allow access

to knowledge resources and research environments, but also bring in providers of finance and business management and rely on intensive networking. (CSES et al 2019) In order to assess the absorptive capacity of SMEs embedded in collaborative innovation networks, Benhayoun-Sadafiyine (2017) developed a grid to assess their degree of maturity and innovation readiness, which could be for value for design and management of network activities.

Mercan and Göktaş (2011) examine the role of **clusters within innovation ecosystems** and conclude that the strength of university-industry collaboration is the most important dimension of the ecosystem, but others are less sure about whether the concept is coherent. Oh, D-S et al. (2016) warn that innovation ecosystem is not yet a clearly defined concept, much less a theory and that the idea carries pitfalls, notably its over-emphasis on market forces, and its flawed analogy to natural ecosystems. Similarly Autio and Thomas (2014) warn that the terminology is largely to be found in practitioner literature, with little treatment in academic journals but they believe that the concept is rather more than a loosely defined and versatile metaphor, since it describes 'evolutionary features of the interactions between individuals, their relationships with innovative activities and their relations with the environment in which they operate' and provides insight into the management of innovation in evolving networks of interconnected actors organised around a focal firm or platform. Nonetheless, there are still research gaps and Autio and Thomas (2014) point to the need to better understand value-creation dynamics within ecosystems and control and management mechanisms.

Boquet and Mothe (2015) found that the governance structure of a cluster can increase the dynamic absorptive capacity of member companies. Through a longitudinal qualitative study of members of the governance of a French SME cluster, they show the key role of both direct involvement of the governance structure in individual and collective actions, and indirect involvement as an intermediary between firms and relevant expertise. The 'intermediated' management model of knowledge has important managerial implications. Specialist (publicly) funded training of cluster managers could have useful results.

Carpanese (2016) looked at the contribution of H2020 to innovation and investments in research, new technologies, etc. and presented two cases studies of how this worked in Sweden and Catalonia. In particular, the role of Smart Specialisation in the H2020 was spelled out in terms of motives, initiatives and instruments as well as processes to realise the objectives of Smart Specialisation strategies. He asks what the implications are for Italy and an innovative region such as the Veneto.

It should be noted that **conventional support systems** can be a significant element in ecosystems, but it is important to recognise that they operate across a broader field with active private sector involvement in their networks and significant links to higher education and research facilities. In order to develop ecosystems, it is therefore necessary to emphasise the development of supportive environments that underpin entrepreneurial growth, while taking local conditions into account, and being built from the ground up rather than being imposed from above. In this context (OECD 2014) rather than trying to 'create something from nothing', policymakers should build up from existing foundations.

A.5.10 Innovation systems

Although an innovation system as such is not strictly speaking an instrument in support of innovation, there is an increasing emphasis in research on the importance of the context in which support instrument is provided for the efficacy of the instrument in question. A key aspect of this is the innovation system – which could be regional, national or even international (see Coyne and Carlberg).

Picard reviewed the evolution of regional innovation policy as an instrument into intelligent specialisation (RIS3) in Franche-Comté against the background of weaknesses identified in regional SMEs and their external environment. The review demonstrated how the evaluation of actions from the RIS (e.g. Rally-novbg, post incubation, platforme ateliers-ingenieurs, chèques Innovation, Minnov and Innovabilis) led to the adoption to RIS3. There is also more knowledge developing regarding how to identify the innovation capability of SMEs with a view to increasing effectiveness and efficiency of interactions with them and how regions or poles of excellence should collaborate to that end (Pillon 2015a,b).

A report on innovation in France (Legait, et. al. 2015) found that there were obstacles within the French innovation system over the preceding twenty years had made it more difficult to understand and more complex for enterprises to negotiate. According to the report the French innovation system compared unfavourably with that of the USA, the UK, Germany and Israel. The report identified the following factors as barriers to the development of France's innovation system: the lack of professionalism and responsiveness of public actors, the lack of understanding of innovation project needs, negotiations tended to be drawn out over too long a period, too may entities were involved in negotiations, there were issues related to IP and how to value IP, and the mobility of researchers. The report made several recommendations including: use of innovation vouchers for SMEs; designation, within public research structures, of industrial liaison officers; increasing the visibility and readability of public research, with a new interface supplementing the internet tool; and, grouping of "small" calls to public projects.

It is important to bear in mind that policies should have **sufficient impetus to make an impact, and be co-ordinated**. Thus, Zecchini (2016) argued that despite many support measures implemented by the Italian government during preceding years, innovation performance remained modest. The main reason for this was seen as the **absence of an innovation system based on intense interaction between the main stakeholders in a favourable environment** for innovation activity. In addition, there are also several barriers including regarding the supply of and demand for innovation, its diffusion across firms, and policy governance. A structural factor hindering innovation was the predominance of micro and small enterprises in the economy, combined with their 'traditional' specialization model and some aversion to improving competitiveness trough R&D. In response, Zecchini argues, public intervention was spread out in a wide range of measures with relatively small financial backing and lacking a fully-fledged strategy focused on the main barriers.

A.5.11 Public procurement and government regulation

Public procurement can be an instrument to boost demand for innovation and overcome barriers related to the commercialisation of innovations, and therefore complement supply-side instruments like subsidies. Public procurement can be related to a range of activities, starting with the procurement of solutions that do not (yet) exist (**pre-commercial procurement – PCP**), to the procurement of goods and services that already exist in the market place but that are new for the procuring organisation (**public procurement of innovation – PPI**). (Uyarra 2016, p.359) The public sector can directly increase demand by procuring innovations, but can also facilitate diffusion by setting standards through procurement and therefore stimulating demand indirectly. In the case of PCP, the state can also directly support the creation of new technologies and prototypes of products and services, which will be used either by the state itself or by private actors. Also, as PCP usually includes R&D activities, it seems to be more of a hybrid with characteristics of both supply-side and demand-side instruments. (Rigby 2016, p.383)

Public procurement supports SMEs allowing them to overcome the costs of innovation by providing financial support (especially via PCP) and can further increase market demand (via

direct procurement and setting standards) and the possibility of getting access to finance (signalling effect for potential investors). The use of public procurement to foster innovation has become more and more popular. Chicot (2017) identified a range of market failures PPI could overcome and the most appropriate policy instruments to deal with them. Different countries apply very distinctive ways to utilise public procurement for innovation (in SMEs). According to Appelt and Galindo-Rueda (2016, p.6) the OECD countries spent on average 13 % of their GPD on public procurement in 2013, which shows a high potential market volume for innovation procurement. In 2010-2012, 14 % to 36 % of enterprises in procurement activities in the EU and some OECD countries reported having to undertake an innovation activity as part of a public procurement contract. An example of a highly innovative public procurement programme that supports innovation and start-ups is the **Start-up in Residence Program** that started in Amsterdam and is spreading throughout the Netherlands (Coyne and Carlberg, 2018, Annex II, p. 245).

Public Procurement with Contracted Innovation (PPCI) leads to positive impacts in **German** firms (Czarnitzki et al. 2018): Firms that made a contract for the procurement of an innovation showed an additional turnover of new products and services worth € 13 billion in 2012. This increase is based on innovations that can be regarded as incremental rather than radical. Therefore, public procurement, when compared to supply-side instruments, can be seen as more of a top-down instrument, and it seems to be more suited to inducing technological diffusion for technological upgrading (p.23).

With respect to the **US Small Business Innovation Research** (SBIR) programme, Rigby (2016) concludes that its net impacts on innovation in terms of growth, sales, patenting and scientific publications are still uncertain, and it is not clear if the programme is effective in dealing with market failures (399f). The pattern of returns to the programme are typical of programmes that focus on the early stage of the innovation process, with small returns in many instances, many cases of no returns due to lack of commercialisation and few cases of very significant returns (p.399).

Following the 2017 evaluation of the **British SBIR programme** (Connell 2017), public procurement contracts (contracts to develop innovative products that address unmet public sector needs) have had a positive impact on enterprise revenues. SBIR contracts have also triggered the creation of successful new firms, enabled more established SMEs to develop and launch new products and led to significant amounts of equity investment being raised in some of the enterprises funded.

Uyarra (2016) reviews the evaluation literature on PPI instruments and concludes that more effort is needed to understand these instruments in terms of their logic, design and objectives, as their characteristics differ considerably from supply-side instruments. Additionally better metrics and methodologies are needed to better assess and trace the impact of PPI instruments. Cordero Machado (2019) analysed the efficiency of PPI in Spain and found that it had a positive impact throughout its implementation life cycle. However, the evaluation of the efficiency of this type of purchasing is not systematised and he developed a measurement framework to that end.

In the economic literature, regulations can also be considered a demand-side instrument. The effect of regulations on innovation depends on the extent of compliance cost and on the incentive effect to develop innovation (for example, environmental regulations that cause additional costs but also support the creation of environmental technologies). Additionally, regulations can have a diffusion effect, if they speed up the dissemination and adoption of innovations. (Blind, 2016, p.453f) Empirical studies provide evidence that compliance uncertainty is negatively related to innovation, as the returns on investment in innovations for firms also become more uncertain. Performance standards or regulations that promote more

complete market information (e.g. by reducing the information asymmetry on the consumer-side) can foster innovations. While economic regulations (like competition laws, market entry regulation or price regulations) have ambivalent impacts on innovation, the effects of social regulations (like environmental regulations) tend to be positive (p.474).

Some examples of the **effects of regulation on innovation** in the EU context can be mentioned. One of the aims of the REACH Regulation was to encourage innovation, yet several reports (Centre for Strategy and Evaluation Services 2015, 2012a and 2012b) found no significant evidence of new products being developed in response to the regulation. The studies did however highlight specific aspects related to the definition of innovation in that context, and also found that a significant new service sector was generated to support enterprises in REACH-related issues. But the extent to which that could be considered 'innovation' is disputable. Another instance relates to the implementation of e-invoicing in Italy in response to Directive 2014/55/EU of the European Parliament and of the Council of 16 April 2014 on electronic invoicing in public procurement. This resulted in a major change of practices in Italy as all relevant firms had to implement the required innovations in their administrative systems (Zavani and Di Toma, 2012).

Finally, in this broader context there should be reference to the arguments of Mariana Mazzucato (2013, 2018), relating to state investments in R&D, the importance of recognising the interplay of state and private inputs and the need to develop a mission-oriented approach that drives collaboration across different industries and bodies in both the private and public sectors and respond to societal challenges. The approach advocated means the adoption of a 'market shaping' framework rather than the more traditional and passive 'market fixing' orientation that has dominated policy making previously.

A.5.12 Behavioural insights – an emerging field

The use of behavioural insights as an instrument to support innovation has only emerged as a policy instrument in recent years. The OECD **defines 'behavioural insights'** (BIs) as 'an inductive approach to policy making that combines insights from psychology, cognitive science, and social science with empirically-tested results to discover how humans actually make choices"[130]. Insights derived from the behavioural and social sciences, including, for example, decision-making, neuroscience, organisational and group behaviour, are being applied by governments with the aim of making public policies work better. According to the JRC[131], there is a **growing recognition of the role** that BIs can play in delivering more targeted and policy solutions by focusing on how people actually make choices.

From the point of view of this study and public support for innovation in SMEs, the BI approach means that in addition to the macro/ innovation system approach; the meso- or industry level approach; and, the enterprise focused micro approach to innovation support; there is another dimension which focuses on innovation behaviour (Potts and Morrison nd:

[130] https://www.oecd.org/gov/regulatory-policy/behavioural-insights.htm#:~:text=Behavioural%20Insights%20(noun)%3A%20An,how%20humans%20actually%20make%20choices.

[131] Joana Sousa Lourenço, Emanuele Ciriolo, Sara Rafael Almeida, and Xavier Troussard; Behavioural insights applied to policy: European Report 2016. EUR 27726 EN; doi:10.2760/903938

11-12).[132] The problem can often be identified as removing the structural and psychological barriers to ensuring that intentions are translated into behaviour.[133]

For example, a report (Wu and Broughton 2019) for BEIS looked into the reasons for the low-take up of proven technologies and management practices by SMEs to determine what was restraining SMEs from taking them up. They found at least four behavioural barriers impede the adoption of existing technologies and management practices: overconfidence; expectation errors; mind sets unconducive to profit growth; and, information gaps, complexity, and scarce mental resources (Wu and Broughton 2019:13). Countering these, they identified several behavioural enablers that facilitate the adoption of existing technologies and management practices. These are: peer and network effects; mind sets conducive to profit growth; salience of benefits; and moments of change (Wu and Broughton 2019:16). The aim of a BI-driven innovation policy would be to encourage behaviours in support of innovation and to counter behavioural barriers to innovation. The WATIFY programme could be considered an example of such an approach.[134]

A.5.13 Summary

The following table tries to consider to what extent certain instruments may be appropriate for addressing specific barriers to innovation. The first column lists the barriers, the second column shows some challenges that are related to the barriers. The third column shows which instruments may be aimed at addressing the barriers. However, some instruments may address many barriers, like for example grants may be implemented to address financial barriers and knowledge barriers or market barriers. Therefore, a specific programme may differ from our classification. Whether an instrument addresses a certain barrier however tells us nothing about its effectiveness, which we look into in the next section of this review.

Table 9: Barriers, challenges and instruments aimed at addressing the barriers

Barrier to innovation	Challenges	Instruments addressing the barrier
Financial barriers	Firms that are more affected are: young and small, technologically intensive, less research and knowledge intensive firms, below-average-profitability.	Direct and indirect public support, other financial support instruments (loans, guarantees, equity, venture capital funds), clusters (signalling effect for investors)
Lack of skills / qualified personnel	Skills gaps/ shortages, affordability of specialised skills, problems with the education/ training system, certain economic sectors are more affected	Direct public support, skills development, support, training, coaching and personal/ management development and advice services, knowledge transfer, clusters

[132] Potts, J. and Morrison, K. nd. Nudging Innovation - Fifth generation innovation, behavioural constraints, and the role of creative business – considerations for the NESTA innovation vouchers pilot, NESTA

[133] Gifford, R., Lacroix, K., & Chen, A. (2018). 7 Understanding responses to climate change: Psychological barriers to mitigation and a new theory of behavioral choice. In S. Clayton & C. Manning (Eds.), Psychology and Climate Change (pp. 161 183). Academic Press. https://doi.org/https:// doi.org/10.1016/B978 0 12 813130 5.00006 0

[134] https://ec.europa.eu/growth/tools-databases/dem/watify/

Barrier to innovation	Challenges	Instruments addressing the barrier
Bureaucratic barriers, laws, standards and regulations, corruption, access to IP	Related to economic sector, affected by innovation policy, level of bureaucracy (and corruption) in countries, type of innovation (IP)	Innovation friendly laws and regulation, regulatory transparency, regulatory scrutiny (e.g. SMETest), SME focused innovation policy/ support
Lack of external partners, possibilities of collaboration	Level of trust between enterprises and between public/ privatesectors, level of technological development in industry and country	Collaboration and network instruments, clusters, digital innovation hubs
Barriers related to the organisational level	Managerial willingness to innovate, resistance of employees, firm structure, culture and internal communication	Skill development and knowledge transfer; support services; collaboration and network instruments, clusters, digital innovation hubs
Lack of knowledge	Technological complexity, costs, risks in implementation, infrastructure (e.g. IT), training level of employees	Skill development and knowledge transfer, vouchjers, collaboration and knoiwleledge sharing.
Market constraints	Laws and regulations, market acces, customer demand, competitors, market dominance, external/ export markets	Public procurement, government regulations, direct public support programmes, anti-monoploy pro-competitive legislation

Source: Austrian Institute for SME Research and CSES

A.6 Effectiveness

Many studies and evaluations provide evidence of the effectiveness of specific programmes. However, the effectiveness of instruments is difficult to assess, as instruments are usually directed towards certain goals in a specific national or regional environment. Effectiveness in the long-term is also difficult to measure. Innovation projects may take several years before the outcome in the form of a product, service or process is visible, and even longer before the effects on a firm's productivity, profitability and growth are apparent. In the meantime, a wide range of external factors may also have come into play affecting impacts. Therefore, different measures for the effectiveness of public support instruments are reported depending on the level of impact and the time period covered by the investigation. At the firm-level, the effects of public support can be measured by the increase in firm's R&D expenditure, patents, innovation outcomes (new or improved products, services, processes), collaboration with other firms and/or research organisations, the uptake of innovation activities, etc. There is however little evidence of the success of these over time. Outputs can also be measured at the sectoral level of the targeted firms, i.e. as an increase in productivity, employment, turnover, competiveness, etc. Lastly, innovation support should optimally lead to an increase in welfare or help to overcome societal challenges.

An increase in R&D does not necessarily lead to innovations. However, the underlying assumption is that private firms conduct R&D to increase their innovation output at least in the long-term. Brink et al (2018) analysed **medium-large enterprises in Germany** (German "Mittelstand") and found that for realising product innovations R&D is the most important factor. However, the importance of R&D with regard to innovation differs between sectors and micro, small and medium-sized enterprises especially tend to innovate without conducting their own R&D. They mainly focus on incremental, process and non-

technological (e.g. marketing) innovation activities (p.26). Hence, by only looking at R&D expenditure, the actual number of innovators may be underestimated. In their review of direct support innovation instruments, Cunningham et al. (2016) point out, that some methodological challenges in measuring innovation still remain. Even if surveys specifically collect innovation data from firms, the data are based on respondents' opinions and this may lead to an overall bias towards positive innovation results (if respondents hope to get an advantage from stating positive innovation results). Furthermore, statements about prospective or potential additionality cannot be subject to verification (p.85).

In this section, we have structured our review using the work of Petrin (2017). We summarise her findings, which are based on a review of 188 studies published between 1960 and 2017, and add our own comments, mainly based on findings, derived from Edler et al. (2016) and further studies obtained through our own search for literature.

Petrin (2017) analysed studies from EU and OECD countries, plus studies from China and Taiwan, that investigated direct and indirect government support at the firm level and macroeconomic level. She analysed literature explicitly in search of evidence of the **effectiveness of different public support instruments**. She analysed the effects of direct and indirect instruments on the input, output and behavioural level of firms and their impact on welfare. Petrin (2017) noted that most studies analyse input additionality, for example an increase of R&D expenditure or R&D intensity on the firm level. Also, some (earlier) studies did not take measures to prevent methodological problems such as endogeneity (lack of comparable control groups), selection bias (only a certain group of firms, e.g. the most successful may be analysed) and non-observation of heterogeneity (e.g. unobserved variables that correlate with innovation outcomes). Petrin (2017) also points out, that "a substantial part of the differences in obtained results between studies can be explained by study characteristics", i.e. definitions of input and output variables, the econometric method used or the equations used for estimations (p.28). However, the more sophisticated econometric techniques are used, the more reliable the results become and the more positive the effects of public support for R&D and innovation, which generally points towards additionality effects of the instruments used, although the exact strength of the effect(s) are yet to be identified.

Edler et al. (2016) published a 'Handbook of innovation policy impact' which in turn is based on earlier work of the Manchester Institute of Innovation Research and their colleagues, who in 2012 published a 'Compendium of Evidence on the Effectiveness of Innovation Policy' (Edler et al. 2012), which at the time claimed to be one of the most comprehensive databases of empirical evidence on the effectiveness of innovation policies in the world. It is significant that the Compendium and the subsequent Handbook are explicitly set out to go beyond academic studies to examine evidence from evaluations and other policy-related documentation.

Both Petrin (2017) and Edler et al. (2016) studied a large amount of literature, which will help to contextualise our own findings, which are often based on empirical studies focusing on one programme in a specific country.

A.6.1 Input additionality

Direct instruments (grants)

The following studies and evaluations showed positive effects of grants on input additionality: Aiello et al. (2019) found positive effects of public R&D support on R&D expenditure **in Italian manufacturing SMEs.** Positive impacts on input additionality of a regional individual and collaborative programme in Italy are also reported in Belucci et al.

(2019), and the effects are greater for collaborative projects funded by the programme than for individual projects. Additional evidence from Italy is reported in Mariani and Mealli (2017): The authors found increases in input additionality in SMEs funded by a regional subsidy programme. When comparing **European R&D programmes**, Radicic and Pugh (2017) report positive effects from both EU programmes and national programmes (with higher effects for EU programmes) on R&D employment and R&D expenditure. Further positive evidence of the effectiveness of grants is found in Radas and Anic (2013) and Radas et al. (2014) for **SMEs in Croatia.** The evaluation of the **German ZIM programme** (Kaufmann et al. 2019) showed positive effects on R&D inputs of firms (R&D expenditure, R&D employment, and intensity of R&D employment). Czarnitzki and Delanote (2015) also report that crowding-out with regard to public R&D funding can be rejected for young SMEs in Germany. For **France,** Bedu and Vanderstocken (2019) analysed the effectiveness of regional funding for R&D **in Aquitaine** and found positive input effects on subsidised companies. In an OECD Working Paper Appelt et al. (2019) presented the results of an analysis carried out with data from the OECD R&D Tax Incentives Database. The authors investigate the link between government support of R&D (direct and tax support) and business R&D in **OECD member countries** over the period 2000-16. Overall, they found that the additionality of direct support might be on average slightly higher than for tax incentives.

The effectiveness of public direct support can be influenced by many different internal as well as external factors and depends greatly on the programme design. Some evidence of factors influencing the effectiveness of public support is found in: Cuckovic and Vuckovic (2018) who conclude that the empirical evidence suggests positive effects of participating **in EU-funded programmes** on SME's innovation activities. The researchers point out however, that the magnitude of this effect depends on firms' size, age, and industry competitiveness conditions, and on whether SMEs invest more in product or process innovations (p.119f). Other effects that possibly influence additionality effects are related to the firms' environment. For example, based on **German CIS Data** (years 2006-2010), Hud and Hussinger (2015) show in their study, that the crowding-out-effects of R&D subsidies might have occurred in the "crisis year" 2009, but in 2010 the firm's R&D investments returned to the levels before 2009. The authors speculate that firms may have shifted funds during the crisis "to other business areas, such as keeping their stock of employees" (p.1852). Radas and Anic (2013) suggest, that SMEs with better **R&D capability, better innovation capability and larger absorptive capacity** (in terms of knowledge acquisition, assimilation, transformation and exploitation) may be more likely to expand their R&D investment compared to other SMEs (p.82f).The effectiveness of subsidies seems to vary with regard to a number of characteristics. Aiello et al. (2019) show that for **SMEs in the Italian manufacturing** industries the effect of public support on firm R&D investments is stronger for micro and small firms than for medium-sized firms (measured both as amount and as a share of sales). This partially supports the argument that subsidies are most effective when the beneficiaries face greater financial constraints in financing innovation activity privately (which is supported in Cecere et al. 2018). The effect is also found to be higher when considering firms operating in sectors 3 and 4 of Pavitt's taxonomy (i.e. specialized suppliers, and science-based/high-tech firms relying on R&D) when compared to those belonging to sectors Pavitt 1 and 2 (i.e. supplier-dominated firms, and scale-intensive firms). If patents are considered to be a measure of research productivity, then Aiello et al. (2019) show that there is no relationship between firms' innovation performance and R&D subsidies or tax incentives for R&D.

Cunningham et al. (2016) review the **literature on direct innovation support** and conclude that the methods usually applied to evaluate the relevance and objectives of programmes face some limitations. However, most studies provide evidence that **programmes do have a positive impact on innovation projects in firms, especially in smaller firms**.

Consideration should be given to the implementation of programmes. First of all, firms that have already succeeded in programmes seem to be more successful when applying for grants, so programme managers have to be careful not to discriminate against newcomers. Another point is that there is a trade-off between the administrative burden for firms that apply for grants and the need of funding organisations to collect information and evaluate the outcome of their funding programmes. Last but not least, the **evidence regarding input, output and behavioural additionality remains inconclusive**. The authors suggest two strategies regarding programme implementation: one is to better address the target group(s) of programmes (with careful consideration of the risk of picking winners) and the other is that the implementation of a programme should consider not only the specific programme but also bear in mind the existing portfolio of different public interventions.

Petrin (2017) analysed meta-studies that investigated the **effectiveness of government subsidies on firms' R&D expenditure** and concludes that government subsidies may impact on R&D expenditure, but not always. However, studies from the past decade, which are based on more sophisticated methods (propensity score matching, difference-in-difference, etc.) support the hypothesis of crowding-in effects (p.10). Effects are stronger for SMEs than for large firms, and programmes that target specific sectors appear to perform worse than sector neutral programmes (p.8). Also, stronger effects were observed in years more affected by the recent financial crisis.

Most evidence points toward a **positive impact of R&D grants in terms of input additionality**. Firms using subsidies receive the grants after a competitive procedure and an ex-ante evaluation of the projects. Subsidies for R&D affect both the innovation input and output of their beneficiaries, but results for both levels may differ, even when looking at the same programme. A huge body of literature has investigated whether public R&D spending is a complement or a substitute for private R&D investment. Even though the early findings were mixed (David et al. 2000), the more recent contributions find that public R&D spending is primarily complementary and thus "additional" to private R&D, at least in the case of SMEs (Becker 2015), results that are also confirmed in Cunningham et al. (2016) and Petrin (2017), although Mazzucato (2013) offers a more radical interpretation, arguing that the state has a major role to play in delivering R&D investment.

Indirect instruments (tax incentives)

The evidence from studies with regard to the **effectiveness of tax incentives** is as follows: Appelt et al. (2019) report a positive impact of tax incentives on business R&D spending in their study based on data of OECD countries, but tax incentives also involve some degree of crowding out (p.8). Corchuelo and Martinez-Ros (2009) conclude that large firms benefit more from tax incentives than SMEs and that tax incentives are only effective in high-medium tech sectors and large firms. A mid to low incentive effect in terms of R&D input in firms is found in an evaluation report of the **Austrian R&D tax scheme** (Ecker et al. 2017). Based on a **literature review of 25 empirical studies**, Falck et al. (2019) report that tax incentives for R&D lead to an increase in R&D expenditure in firms, both in incremental-based and volume-based tax schemes.

Mohnen et al. (2016) evaluated the Innovation Box Tax Instrument in the Netherlands in the period from 2007 – 2013. The authors found a positive effect of the innovation box on firms' R&D activities. The cost-benefit-ratio however was slightly negative, which means that although additional R&D activities were undertaken by firms that used the innovation box, the benefit was lower than the amount of taxes forgone. (p.16)Based on **a literature review of studies from different countries**, Laredo et al. (2016) report input additionality (effect of one forgone unit of tax revenue) between 0.29 and 3.5 in the local currency, which means one unit of forgone tax leads to 0.29 - 3.5 units in the local currency of R&D expenditure

(p.26ff). The authors also point out that input additionality seems to diminish over time, and crowding out of private R&D can only be avoided for small firms (p.48).

Petrin (2017) points out that the results found in the literature are **difficult to compare**, as the effects of tax incentives vary depending on the data, estimation method and model specification. In cases where the instruments are effective, the elasticity of R&D expenditure with respect to the user cost of capital in the long run is found broadly to be below unity (p.20).

A.6.2 Output additionality

Direct support instruments

Testa and Szkuta (2018) found several **positive effects from R&D grants for young and innovative firms with growth perspective**: Based on a literature review conducted by the authors, beneficiaries of grants report an increase in employment (36-55%), an increase in both total sales (33%-92%) and share of innovative sales and also that the effect on sales growth persisted for several years. Between 29%-61% of the beneficiary firms were engaged in product or service innovation and the effects of R&D grants on young innovative firms are larger than the effects of both generic R&D grants and R&D subsidies (p.4). Grants that are targeted (with a technology focus) deliver better results for disruptive innovations, whereas generic grants are better suited for knowledge diffusion and deliver results that are new to the firm rather than new to the market. (Testa & Szkuta 2018)

By contrast, Aiello et al. (2019) find that **direct as well as indirect public support do not add benefits to patent activities.** Guisado-Gonzalez et al. (2018) conclude that granting R&D subsidies under the condition of cooperation with other firms does not produce significant increases in business productivity. The effects of national R&D programmes analysed by Radicic and Pugh (2017) showed no impact on firm innovation output, and European support programmes lead to crowding-out. Only the combination of both national and European programmes can eliminate the crowding-out effect on both patent activities and innovation sales. That companies using subsidies even obtain a lower number of patents compared to firms financing the R&D investments with private funds was also found in another study by Idea Consult (2010). According to Mariana and Mealli (2017) a regional subsidy programme **in Italy** did not increase outputs by SMEs (in terms of IPR and turnover). Norek (2017) also found no statistically significant difference between SMEs that received EU funds and SMEs that did not receive EU funds in terms of return on innovation investment in Poland. Positive effects on output additionality are reported in Bellucci et al. (2019) in terms of firm profitability and patents.

Also, Radas et al. (2014) found some positive effects of grants on innovation output of SMEs. Higher R&D outputs of subsidized firms are also reported in Czarnitzki and Delanote (2015), and Bedu and Vanderstocken (2019) find a positive impact of R&D subsidies on SMEs total assets and firm development.

Karhunen and Huovari (2015) show that **R&D subsidies have a negative effect on productivity after the subsidy is granted**. The productivity of treated firms catches up with that of unsubsidised firms five years after a subsidy is granted. Productivity decline is statistically significant in the industrial sector but not in the service sector. The decline in productivity after a subsidy decision is – according to the authors – reasonable because new R&D projects often begin by recruiting new employees or reallocating old employees (and other resources) from the daily business to the R&D project. The increase in the number of staff negatively affects productivity growth if there is no sufficient increase in value added at the same time. Furthermore, their results indicate that R&D subsidies have a relatively

steady, positive effect on employment growth but that the effect on value added is essentially zero; however, this effect might be realised with a significant lag. Firms that receive large subsidies experience (on average) greater productivity decline after the treatment year than firms that receive small subsidies. Overall, it appears that subsidised firms become more human capital intensive because of the subsidies.

Petrin (2017) concludes that **direct public subsidies may positively impact innovation outcomes at the firm level.** These may take the form of an increased number of patents, sales of new products and the introduction of new processes, but not always. A greater impact is generally found for SMEs. Effects in programmes that target a specific sector appear to be slightly worse than a neutral programme focus. A generalisation of the results is difficult since there are different definitions of innovation output used and the time covered in the studies varies. For some measures, their appropriateness can be questioned (e.g. are patents an adequate measure of innovation output?). For an adequate assessment of the impacts on output, information on outputs years after the completion of a R&D project may be necessary. Especially with regard to early stage R&D support, the impact of subsidies may take a long time to become visible and measureable (p.14).

Research by Acebo Moral (2018) looked at the effect of refundable innovation subsidies on the financial autonomy of the enterprise and found that this had decreased as a result of using subsidy and might mean that it would be harder to obtain external (market) funding.

Michaël (2017) investigated the impact of public subsidies for innovation on firms' export activity, focusing **on potential impact of R&D and innovation on strategy, particularly on export**. Particular attention was paid to the effect of innovation tax credits. The empirical methodology found that innovation support impacts the causal relationship between product innovation and export in the short term. This result was also observed when the analysis focused on the effect of tax incentives. Then, innovation subsidies impact the export activity of firms directly and simultaneously. This effect occurs for firms that have benefited only from tax incentives. However, benefiting from both direct and tax subsidies for innovation does not affect joint decisions regarding innovation and export. Finally, considering the central role of R&D investments revealed that the impact of innovation subsidies on exports is an extension of the effectiveness of innovation policies. These results lead to several policy recommendations that can be used to improve public support effectiveness for both innovation and export activities.

Regarding the impact on the macroeconomic level, the studies found in our literature review provide hardly any evidence. Petrin (2017) concludes that the effects on the macroeconomic level differ across different types of measures such as productivity, employment and firms' financial performance. Overall, positive effects on employment are more likely than on productivity (p.16). She also notes that the empirical evidence is limited since not enough studies have been conducted to allow for a conclusion.

Indirect public support instruments

Very little evidence of the effects **of tax incentives on innovation output additionality** is identified and **the results are mixed**. Testa and Szkuta (2018) found very limited evidence of the effects of tax incentives (increase in employment, increase in sales, and share of innovative sales) compared to R&D grants for young innovative firms (p.40). With regard to the special case of eco-innovations, Cecere et al. (2018) found that access to public funding or fiscal incentives has a significant and positive effect on the probability of developing innovations. Falck et al. (2019) found that especially SMEs and start-ups benefit from tax incentives (especially in terms of positive effects on the input level). The results are not clear with regard to if an increase in patents, market-ready innovations, employment or productivity occurred. The authors note that application processes for grants can result in the development of a market for private advisory services for Laredo et al. (2016) looked at the **reported effects of R& tax incentives in six studies**, providing some evidence of a positive impact on innovation output at the firm level, but results are ambiguous with regard to the type of innovation. Also, there is no clear evidence that tax incentives raise the productivity of firms. The authors point out that due to methodological limitations various studies are not able to reach a clear policy conclusion (p.30f).

Alstadsaeter et al. (2018) analysed the effect of patent boxes based on firm level data of the top 2.000 corporate R&D investors (mostly large firms) worldwide in 2000 – 2012. The authors found out, that in general patent boxes attract high-value patents with high earnings potential, but that they do not induce local innovation activities (p. 135). This means that multinational firms indeed shifted their patents to countries with patent boxes, but this happened primarily to reduce income taxes. The nexus requirement however could weaken this effect and increase local innovation activities. (p. 166f)

Petrin (2017) **summarises the effects of** R&D tax incentives on output additionality as follows: studies tend to find a positive impact on innovation outcome at firm level (specifically on patenting) while the impact on macroeconomic outcomes (productivity, employment, firm's competitiveness) is mixed. The magnitude of the impact tends to be stronger for SMEs and depends on the industry concerned (p.25).

In sum, **the evidence on output additionality is less clear than that on input additionality**. It is sometimes unclear whether additional spending as a result of public policy also improves innovation outcomes such as patent applications. Positive effects are reported to be more likely for SMEs than for large firms, and impacts on employment seem to be more frequent than impacts on productivity. Again, programme design matters. Compared to the measurement of input effects, the challenges are greater for the measurement of output effects, as impacts become visible only after a relatively long time has passed, and a wide range of factors internal and external to the enterprise may have changed in the meantime.

A.7 Behavioural additionality

Direct funding instruments

The report on increasing research and innovation in SMEs and SME development as part of the ex-post evaluation of the Cohesion Policy programmes (European Commission 2016) showed that although the programmes helped SMEs to increase their economic performance (turnover, profitability, exports), the support instruments also triggered changes in the way SMEs operate and initiated behavioural changes, which may take more time to materialise in an improved economic performance, and which may spread to other SMEs (for example within the same network) (p.14).

Some results point towards the **importance of programme design** when implementing direct support programmes that aim to increase SMEs' cooperation activities. R&D subsidies also affect SMEs cooperation activities as Guisado-Gonzalez et al. (2018) managed to show using the example of **Spanish manufacturing** enterprises. They showed that firms receiving R&D subsidies are more likely to establish cooperation agreements, even though such firms show a propensity to have lower absorptive capacity. For companies with a low absorptive capacity the results indicate that the relationship between R&D cooperation and R&D subsidies is substitutive, i.e. Spanish manufacturing enterprises embark on cooperation agreements that diminish their productivity levels. The additional funds that many of these firms receive for participating in public R&D funding programmes are insufficient to offset the costs incurred by their participation in the respective R&D cooperation agreements.

Other studies investigated whether changes in the internal management of R&D activities occurred due to the participation of SMEs in direct funding programmes. In their evaluation of the SME-specific measures of the **5th and 6th Framework Programmes for Research** (Idea Consult 2010), the authors mention an increase in the degree of R&D-formalisation among SMEs receiving R&D subsidies as measured by the availability of a yearly budget for R&D. Effective subsidy programmes can also drive the organisational transformation (that is, increase their absorptive capacity) of SMEs, as Radas et al. (2014) suggest based on results from a survey conducted in Croatia.

Other studies showed **less clear or no effects on behavioural additionality** of participants in grant programmes. Bellucci et al. (2019, p.229) point out, that the results of their study indicate a careful consideration of the regional context when implementing collaborative programmes and an in-depth understanding of the incentives for collaborative research projects. The researchers found hints of crowding-out of investments in tangible and intangible assets in the collaborative programme, casting some doubts on its overall input additionality (p.228). The results of another regional subsidy programme in Italy showed that participating SMEs showed no enhanced propensity by SMEs to cooperate with firms or universities. (Mariani & Mealli 2017).

Petrin (2017) reports that it is **difficult to draw a clear conclusion on the effects of government support on behavioural additionality** due to rather scarce empirical evidence and different definitions of behavioural additionality (e.g. measured as more collaborations, more challenging research, improved management, accelerated schedule, etc.), and often the measures that are used to evaluate output additionality are also used to measure behavioural additionality (p.17).

Indirect public support instruments

According to Petrin (2017) the very low number of studies and estimation problems means that it is difficult to come to a conclusion regarding the impact of indirect public support instruments on behavioural additionality.

An assessment by Martinez Martin et al. (2019) of the *Networks of Innovation* program which provided services for R&I activities aimed at improving the competitiveness of SMEs and business groups (delivered by the School of Industrial Organisation of the University of Rey Juan Carlos funded by the ERDF) found that, based on the estimation of a difference-in-differences model, it was possible to identify differential and positive impact of the Program on a synthetic indicator of business competitiveness. Alonso and Garcia Espejo found that technical training was a key factor in improving regional competitiveness systems in areas of low to medium technology.

A.8 Impact on welfare

A Eurofound study (Coyne & Carlberg 2018) analysed the effects of different innovation support measures in 10 EU-countries on employment. One key finding is that innovation support created some better quality jobs for highly skilled employees, although innovation measures do not generally aim to create employment as a main objective. Also, there is much less evidence of the working conditions in the created jobs or the sustainability of those jobs. The authors find evidence of the influence of the type of establishment (single, headquarter, site location), with single establishments being less likely to innovate. Some characteristics of the workforce also matter: firms with higher shares of older employees and fewer shares of female employees in relation to all employees are less likely to innovate. Another point that gets little attention in evaluations as well as in the policy design of innovation support measures is the development of skills and competences. Most measures have a strong technological bias, do not support the necessary adaptation of the workforce in enterprises, especially when it comes to exploiting innovative discoveries and often generate jobs and other employment effects largely as a by-product. The authors find positive effects on innovation activities in work organisation practices, employee involvement in decision making and training and pay schemes. The authors therefore conclude that there is a neglect of the human dimension in innovation policy.

Centre for Strategy and Evaluation Services et al (2020) comments on a finding that there has been an increasing tendency for support for firms launching enterprises to be concentrated either on firms with a potential for high growth or on individuals or groups of people in enterprises that suffer from social exclusion and disadvantage. While the latter measures are welcome from a social point of view and now often include the encouragement of social enterprise and support for rapid growth enterprises is likely to bring more obvious returns on investment, the study points out that there is a significant group of enterprises that are potentially productive that are finding it difficult to access support. This is especially the case since support for high growth enterprises is increasingly concentrated in metropolitan areas and neglecting those living in smaller towns or rural areas. This tendency also reflects a bias in favour of new technologies at the expense of traditional sectors, but also newly emerging service industries. It has important social implications.

Petrin (2017) points out that the evidence regarding the effects of government subsidies for innovation on welfare is very scarce. The available evidence however, suggests a positive effect of subsidies on the social rate of return, and that subsidies to research are the most welfare-increasing policies (p.18). Also, in the meta-analysis, it seems that the social return and welfare gains of tax incentives are positive.

A.9 Evidence of the effectiveness of other public support instruments

There is less evidence of the effectiveness of other financial instruments like soft loans, loan guarantees and government support to venture capital funds. Positive impact effects are reported from a **soft loan scheme in France**, **the Small Firms Loan Guarantee in the UK** (Cunningham et al. 2016), an adoption of a **grant programme ("Technological Credit") in Poland**, where grants were only given to SMEs as a substitute for part of a commercial bank loan (Florio et al. 2018), and from Spain, where Huergo et al. (2015) found positive impacts of public low interest loans on R&D investment in firms. Compared to direct funding, loans seem to be less effective however, with a greater impact in SMEs than in large firms (Huergo & Moreno 2017).

Compared to financial instruments, the **effect of instruments that aim to increase the development of skills and knowledge usually depends to a greater extent on changes in firm behaviour**. Some instruments like **innovation vouchers** require knowledge transfer

activities to be acquired to be able to participate in the programme. Only few studies exist that explicitly analyse the effects of training on innovation, although Centre for Strategy and Evaluation Services et al (2020) found that training is one of the three core and most extensive support services provided across Europe and beyond for new enterprises. This study also suggests that advice and mentoring services should also be regarded as a form of training, since the main aim of these services is to build up the core managerial capacities of client enterprises and entrepreneurs. Jones and Grimshaw (2016) found three key findings in their review of empirical studies that have implications for innovation policy: There appears to be a positive association between the level of expenditure on formal and informal training and performance at the organisational level. Organisations benefit by developing their innovation pool, and the skill composition of a firm's workforce is an important contributing factor (p.113). The authors also point out that in the literature there is a lack of theoretical and empirical analysis related to the multidimensional effects of the skill system on innovation (p.124).

Regarding the impact of **technology and innovation advisory services**, Shapira and Youtie (2016) found that based on a literature review those services provide positive effects on participating firms in terms of reduction in costs, improved quality, reduced waste and improved environmental performance, higher productivity, and new product development and innovation. The net benefits however, are relatively modest. Given the decision between whether to have a broad penetration of firms or fewer intensive services for specific firms, the authors tend to favour the latter strategy as intensity of services is associated with more positive firm benefits (p.185f). Although little evidence is available, the results overall suggest a positive impact on input, output and behavioural additionality. **The biggest challenge seems to be the design of skill development and knowledge transfer programmes, in particular with regard to their accessibility for SMEs with little experience in innovation**.

Collaboration often takes place while innovation projects are carried out or a collaborative arrangement may even be the precondition for applying for certain programmes. Some results have already been mentioned in previous chapters, e.g. collaborative programmes may show positive effects in terms of additionality. Firms may benefit from partnerships with regard to knowledge transfer and the implementation of new technologies (Achleitner et al. 2019). However overall there is **little evidence** of the effectiveness of collaboration in terms of input, output and behavioural additionality. Positive effects are reported from Chai & Shih (2016), who show that **funded academic-industry partnerships** positively affect the numbers of publications as well as the number of patents granted to SMEs. On the other hand, Nepelski and Piroli (2017) report that the **innovative potential of homogeneous consortia** (firm-firm cooperation) is likely to be higher than the innovative potential of heterogeneous consortia (firm-academic cooperation), and similar results are found in Caloffi et al. (2014). In the evaluation of the German ZIM programme, Kaufmann et al. (2019) show that with respect to cooperation projects and projects conducted in networks, the initial project ideas often originated from external sources (project partners, research institutions). Also, the **number of cooperation partners** in funded projects has a positive effect on knowledge transfer activities, possibly inducing further positive economic effects in the future. Networks supported by the programme also have a positive impact on collaborations between network participants: Although networks that form around a **ZIM-project** sometimes formally dissolve after the funding phase ends, more informally cooperative activities between the former network participants often remain intact. Cunningham and Ramlogan (2016) report quite remarkable positive effects from the **Innovation Network Denmark** on the innovation activities and innovation output of its participants.

An OECD study done in collaboration with the Danish Business Authority (2013) benchmarked programmes for High Growth Firms (HGFs) with special attention to business accelerator schemes. Key recommendations were that programmes for HGFs should not be sector-based since HGFs are found in any sector; they should provide a mixed offer of services where peer learning plays an important role; they should seek the collaboration of the private sector for implementation; and they should ensure the presence of entrepreneurial experience within the management of the programme.

Some clusters like the **Leading Edge Cluster Competition (LECC) in Germany** seem to have positive impacts on the level of regional R&D activity (Engel et al. 2019, Rothgang et al. 2017). Rothgang et al. (2017) however suggest that cluster funding is only advisable if the following factors are met: spatial agglomeration of relevant firms and public research organisations, technological breakthrough of the technologies addressed being expected in the foreseeable future, there is a critical mass of relevant innovation capacities, there is a strong commitment of the stakeholders to the cluster initiative and the technologies and industries addressed have a significant importance for the total economy. (p.18f). An OECD publication (2011) suggests that the impact of science parks as well as the impact of clusters on innovation is ambiguous. In their analysis of how geographical clustering of beneficiaries might affect the effectiveness of public innovation support programmes, Crass et al. (2019) also find evidence of a positive impact of R&D subsidies on SMEs' increase in R&D expenditure, and a negative impact on innovation output. Uyarra and Ramlogan (2016) report some positive effects of clusters in terms of resource mobilisation for innovation activities and an increase in collaborative and network activity. The authors conclude that the **effectiveness of clusters on innovation activities in SMEs is positively influenced by a competent cluster management**.

With respect to **demand-side instruments like public procurement for innovation**, the potential effects on innovation activities can be regarded as high due to the high volume spent in public procurement. The effects of public procurement on activities are not always clear. While the impact in the **USA (SBIR)** is uncertain, studies from **UK and Germany** suggest a positive impact on the innovation output of firms. However, as PPI instruments differ considerably from supply-side instruments, there is a need to better understand their logic and a need for better metrics and methodologies to assess their impact on SMEs. Regulations and laws also have the potential to induce innovation. Their effectiveness however depends on the relation between their incentive effect and their compliance cost. Regulations that foster market transparency and the dissemination of information can foster innovations, while the effects of economic laws on innovations are ambivalent.

One point worth mentioning is that identified by Maurel, et. al. (2016) who looked at the effect of implementing an innovation in an organisation on further innovation as a result of the initial innovation. They found that innovations once implemented have direct and indirect effects. In particular, they looked at organisational innovation in public enterprises and found that such innovation increased the capacity to innovate in the organisation.

A.10 Summary

The main challenge in assessing the effectiveness of public support instruments lies in how to treat the different results obtained for the various programmes investigated. While there are some positive impacts reported for all types of instrument, the exact effects of the instruments on innovation outcomes is often unclear. The reason for this is that there are various factors that influence the performance of instruments, starting with the design and implementation of an instrument in a specific regional, national or supranational context. Depending on the instrument, further factors like the size and age of an SME, its economic sector, organisational structure and innovation management may influence innovation

outcomes. Overall, SMEs usually perform better than large firms in terms of input and output additionality. Some instruments seem to perform better in addressing certain innovation barriers. However, this again depends to great extent on the specific implementation of the instruments. Comparing effects by type of incentive, subsidies push R&D expenditure more than tax credits. However, findings from empirical studies have not clearly identified which type of R&D support scheme is the most effective. There is evidence that the effectiveness is different for different countries, e.g. analyses in Norway seem to prefer tax incentives while subsidies were found to be superior in Spain. Other studies have shown that subsidies are generally more effective for SMEs than fiscal incentives while both types of intervention can be complementary (and especially those companies using both instruments tend to perform better than e.g. companies using only tax cuts). However, grants and fiscal incentives are not substitutable: grants are more attractive for enterprises that have trouble in accessing funding (which often are SMEs), while tax incentives are sometimes preferred by firms with R&D experience.

Although it is very difficult to make general assumptions about the effectiveness of instruments, some key points should be considered that could help boost effectiveness (many of the following points are also mentioned in European Commission 2016):

- The more sensitive SMEs are towards innovation activities and the more tailored the instruments towards the specific needs of SMEs, the higher its effectiveness in terms of outcomes (input, output and behavioural change).
- A mix of different support instruments can be used more flexibly and address various needs in a more effective way, e.g. the funding of risky projects via grants and the funding of less risky projects via loans. Therefore, a mix of instruments or a combination of various instruments may lead to better results in terms of their effectiveness than one single intervention measure.
- Instruments that set stimuli during a period may lead to better results, especially in terms of (long-term) behavioural changes of SMEs.
- Result-oriented instruments may lead to better SME performance and therefore higher effectiveness
- Intermediaries (chambers of commerce, cluster manager, etc.) may increase the effectiveness of instruments or are even essential for an effective implementation of an instrument.

A trade-off situation may occur, where a few SMEs may benefit from the intensive support of specialised (and more effective) support instruments, or many SMEs may benefit from less specialised (and less effective) support instruments. However, the deciding factor seems to be not so much the number of SMEs reached, but how well an instrument fits the SMEs' needs and its specific ecosystem. Last but not least, the societal impact of support instruments should be taken into consideration. As the report on Science, Research and Innovation Performance of the EU 2020 (Correia et al[135] 2020) shows, there is a significant gap between innovative frontier firms and less or non-innovative laggards in terms of their labour productivity growth (p.110). A focus on supporting the most willing and most capable firms may create very innovative firms in the end, but may widen the gap between leaders and laggards in the long run, which may lead to an increase in inequality (e.g. in terms of wages, flow of skilled workers to the most innovative). On the other hand, overly extensive support for less innovative firms may lead to inefficiencies in the market and lower

[135] Correia, Ana; Martino, Roberto, Ravet, Julien (2020): Productivity, structural change and business dynamism. In European Commission (Ed.): SCIENCE, RESEARCH AND INNOVATION PERFORMANCE OF THE EU 2020. A fair, green and digital Europe. Brussels.

productivity growth. As start-ups and new firms may also operate on lower levels of productivity until they grow and catch-up in terms of efficiency (Calligaris et al. 2020[136], p. 610), innovation diffusion –with regard to digitalisation and new technologies – is important to support those firms and to increase competitiveness and prevent a monopoly-like market concentration of well-established actors. Factors that positively influence the diffusion of innovation and help SMEs to catch up are for example good financing opportunities (lower interest rate spread between SME and large firms) and direct government funding that fosters R&D and enhances knowledge transfer and absorptive capacities of firms. (Calligaris, 2020, p.636)

Many of the studies have emphasised that the effectiveness of support very much depends on the nature of the target enterprises, which suggests that support instruments need to be tailored well for the type of firm (large, SME, firms with growth potential, etc.), their needs (financial support, advisory services, etc.) and willingness and capability to innovate in order to increase their effectiveness. Therefore, such instruments should complement other measures and contextual structures such as for example legislation, efficiently working financial systems, and education and training systems. (Calligaris et al., 2020, p.626)

The following table summarises the findings of the effectiveness on the input, output and behavioural level. While there is plenty evidence for direct and indirect instruments, results for other types of instrument are less often reported, therefore a distinction between the different output levels does not seem reasonable.

Table 10: Evidence on the effectiveness of instruments and influencing factors

Instruments	Input additionality on firm level	Output additionality on firm level and macroeconomic output additionality	Behavioural additionality and welfare	Influencing factors affecting effectiveness
Direct funding	Overall, results of most studies point towards a positive influence of direct support instruments on input additionality.	The evidence on output additionality is inconclusive. Positive effects seem to be stronger for employment than for productivity. The results on patent activities are not clear and seem to depend more on additional factors like firm size and programme	No clear conclusion can be drawn as for the effects of direct support instruments on behavioural additionality. Some results suggest a positive effect of knowledge transfer in collaborative innovation projects; however, some studies find no	Firm size, firm age, industry competitiveness, type of innovations (product, service, process), organisational structure and characteristics of SME, economic sector , environmental factors, programme design

[136] Calligaris, Sara; Criscuolo, Chiara; Gonne, Nicolas; Verlhac, Rudy; Organisation for Economic Co-operation and Development (OECD); D'Adamo, Gaetano; Directorate-General for Economic and Financial Affairs,

European Commission; Ravet, Julien; Directorate-General for Research and Innovation, European Commission (2020): The bottom also matters: policies for productivity catch-up in the digital economy. In European Commission (Ed.): SCIENCE, RESEARCH AND INNOVATION PERFORMANCE OF THE EU 2020. A fair, green and digital Europe. Brussels.

Instruments	Input additionality on firm level	Output additionality on firm level and macroeconomic output additionality	Behavioural additionality and welfare	Influencing factors affecting effectiveness
		design.	effects at all.	
Indirect funding	Studies tend to find positive effects, however the results are less clear compared to direct support measures. Crowding-out of private R&D seem more likely to occur in large firms than in SMEs	Studies find some evidence on positive effects on outputs on the firm level, effects for SME seem to be stronger than for large firms. Reports on the impact on macroeconomic outcomes show mixed results.	No conclusion can be drawn based on the available studies with respect to behavioural additionality. Studies show positive effects on welfare.	Instrument design, economic sector of the firm, competitors, size of the firm, financial situation of SME
Other Instruments	**Input, output and behavioural additionality**			**Influencing factors affecting effectiveness**
Other financial instruments	Input additionality seems to be positive in most cases, but there is fewer evidence than for other predominantly financially oriented instruments. As for output additionality, there is little evidence and the results are mixed. The same is true for effects in terms of behavioural additionality. Generally positive evidence is provided for loan schemes than other financial support instruments in this category.			Programme design, firm size, financial situation of SMEs, sector, firm already active in R&D, level of implementation (EU, national, regional)
Skill development and knowledge instruments	There is only little evidence of the effectiveness, mainly on voucher programmes. This evidence suggests however a positive impact on additionality in general. Programme design and implementation is a key challenge, in particular with regard to programme accessibility for SMEs with little experience in innovation.			Programme design and scheme implementation (especially accessibility), characteristics of SMEs (e.g. propensity to innovate), skill level of employees and internal training schemes,

Instruments	Input additionality on firm level	Output additionality on firm level and macroeconomic output additionality	Behavioural additionality and welfare	Influencing factors affecting effectiveness
Collaboration and network instruments	There is great potential and a strong underlying rational in favour for instruments that foster collaboration between actors in an innovation system. However, there is only little empirical evidence on its effectiveness. The results tend to be positive, however, perhaps even more so than with other public support instruments, programme management, in particular with regard to innovation network programmes is a key factor for its success.			structure of private-business relations, type of collaboration (contractual or informal and firm-firm or firm-research organisation), network characteristics such as number of participants or structure (gatekeeper and broker positions), programme management (especially with regard to networks), trust between partners and commitment to network activities, geographic location
Clusters/Science and technology parks	While some researchers report positive effects of clusters on innovation activities, the effectiveness of clusters as well as science and technology seem to be more controversial than other support instruments. Similarly to innovation networks, cluster management is of great importance. Clusters and science and technology parks are also more prone to lock-in effects due to their boundaries.			critical mass (e.g. of technological and innovative potential), cluster type (high technology clusters are more successful), cluster management, joint cluster activities, environmental factors
Public procurement and government regulation	The overall effects in terms of innovation outputs are not clear. While the effects of the US SBIR programme are inconclusive, positive impacts on revenues, firm creation and investments in firms are reported from the evaluation of the British SBIR programme, and in terms of innovative sales turnover from PPCI in Germany. Regulations can be seen as both a barrier to as well as an incentive for innovation activities, and its effectiveness depends on the level of incentive in relation to the cost of compliance.			Type of procurement (PPI or PCP), management and innovation policy of the procuring bodies (e.g. level of risk aversion, political support), implementation (e.g. volume of procurements), legal framework, type of regulations (environmental, market-related, etc.)

Source: Austrian Institute for SME Research

A.11 Conclusions

The review of the literature on innovation support has shown that the barriers to innovation are reasonably well understood and that there is a growing amount of information on the various mechanisms by which innovation is supported and of evidence on the effectiveness of these mechanisms, although there are also still some important gaps in this last area. It has also underlined the diversity of the SME sector and the other relevant actors in the

innovation environment (including large enterprises) and pointed to the large scope for policy choices in terms of the objectives to be pursued, the targets of support, the instruments to be deployed and the means of their assessment.

As well as the differences in the size of firms supported and the related issue of the stage of their development (start-up, acceleration, maturity), there has been a growing tendency for measures to be directed at firms with a high growth potential or for measures to promote effective scaling-up of operations and creating market leaders. There are important questions about the consequences of such a policy focus, in terms of the social impacts and the overall impact on productivity within the economy.

Most measures aim to address barriers and other issues faced by SMEs and access to finance remains a predominant issue, but the review illustrates that there are diverse facets of this problem and also shows that there are other significant areas, including having the right skills to develop and exploit innovation, having access to knowledge sources and being able to work with other enterprises and research institutions.

The type of support instrument deployed is also becoming more complex. Considerable resources are devoted to providing grants, largely for R&D, or through tax incentives. However, there has been a growing provision in the form of advice and organisational support that has become increasingly complex and sophisticated and now includes the promotion of many interacting elements in innovation ecosystems, not least in the form of clusters.

Evidence on the effectiveness of measures is not always consistent and can be patchy. However, the weight of the evidence suggests that measures are effective overall and also points to features that are especially effective, including the good organisation of those implementing measures, such as cluster managers, and effective co-operation with innovation partners. The complementarity of support measures also appears to be a success factor.

A.12 Literature

Acebo Moral, D.E. (2018): Subvenciones a la innovación: Su reparto y efecto a corto plazo en los indicadores económico-financieros de las empresas, Facultad de Ciencias Económicas y Empresariales, Universidad de León (Grado en Administración y Dirección de Empresas)

Achleitner,A-K., Braun, R., Behrens, J.H., and Lange, T. (2019); Enhancing innovation in Germany by strengthening the growth finance ecosystem, An Acatech study.

Aiello, F., G. Albanese, und P. Piselli. 2019. „Good value for public money? The case of R&D policy“. Journal of Policy Modeling 41(6): 1057–76.

Al Bachawaty, E. (2015); Innovation et compétences : une analyse du comportement innovant de la firme française. Economies et finances. Université Toulouse le Mirail - Toulouse II, 2015. Français. ffNNT: 2015TOU20098ff. Doctoral dissertation.

Alstadsæter, A., Barrios, S., Nicodeme, G., Skonieczna, A. and Vezzani, A. (2015). Patent Boxes Design, Patent Location and Local R&D. Taxation Papers Working Paper, No. 57-2015 L uxembourg: Publications Office of the European Communities. http://ec.europa.eu/taxation_customs/resources/documents/taxation/gen_info/economic_analysis/tax_papers/taxation_paper_57.pdf

Anderson, Tara; Curtis, Andrew; Witting, Claudia (2015): Definition and Theory in Social Innovation. The theory of social innovation and international approaches. ZSI Discussion Papers. Nr. 33. Centre for Social Innovation. Vienna

Ángel Alonso, A., García Espejo, I. and Rodolfo Gutiérrez (2016); Aprendizaje interactivo en un contexto low-tech: formación profesional e innovación en el caso de Asturias, conference paper, June 2016

Anic, I-D., Corrocher, N., Morrison, A., Aralica, Z. (2019): The development of competitiveness clusters in Croatia: a survey-based analysis. European Planning Studies. 27:11. P.2227-2247. DOI: 10.1080/09654313.2019.1610726

Appelt, S., Galindo-Rueda, F., Gonzales Cabral, A.C. (2019): Measuring R&D tax support: Findings from the new OECD R&D Tax Incentives Database. OECD Science, Technology and Industry Working Papers. https://dx.doi.org/10.1787/d16e6072-en

Appelt, S., Galindo-Rueda, F. (2016): Measuring the Link between Public Procurement and Innovation. OECD Science, Technology and Industry Working Papers. DOI:https://doi.org/10.1787/5jlvc7sl1w7h-en

Aranguren, M. J., De La Maza, X., Parrilli, M. D., Vendrell-Herrero, F. and Wilson, J. R. 2014 Nested methodological approaches for cluster policy evaluation: an application to the Basque Country, Regional Studies 48(9):1547-62.

Arranz, N,&Fernandez de Arro, J.C. (2016); La cooperación en proyectos tecnológicos, ¿qué queda por hacer? Una aproximación desde el enfoque estratégico. Papeles de Economia Espanola

Arvanitis, Spyros, Florian Seliger, Andrin Spescha, Tobias Stucki, und Martin Wörter (2017): Die Innovationsleistung Schweizer Unternehmen im Zeitverlauf. KOF Analysen 2017, Nr. 1 77–87.

Astor, Michael, Christian Rammer, Cordula Klaus, und Georg Klose (2016) „Endbericht: Innovativer Mittelstand 2015-Herausforderungen, Trends und Handlungsempfehlungen für Wirtschaft und Politik“. ZEW-Gutachten und Forschungsberichte

Autio, E, Thomas, L. 2014 ‘Innovation Ecosystems: Implications for Innovation Management’, published in Dodgson, M, et al (Eds), The Oxford Handbook of Innovation Management, Oxford University Press.

Avellaneda-Rivera, L; Why not? Barriers to eco-innovation in the food sector in Spain, in Triguero, A. and Gonzalez-Moreno, A (eds) (2019); Research on Open-Innovation Strategies and Eco-Innovation in Agro-food industries, Chartridge books, Oxford

Backman, M., und T. Wallin (2018): „Access to banks and external capital acquisition: perceived innovation obstacles“. Annals of Regional Science 61, Nr. 1 161–87. https://doi.org/10.1007/s00168-018-0863-8.

Barbieri, L. (ed) (2017); Vertical Innovation. La vera natura dell’innovazione, goWare,Firenze

Becker, B. 2015. Public R&D policies and private R&D investment: A survey of the empirical evidence. Journal ofEconomic Surveys, 29(5), 917–942.

Bedu, N., and Vanderstocken, A. (2019). Do regional R&D subsidies foster innovative SMEs’ development: evidence from Aquitaine SMEs. European Planning Studies.

Belitz, H, und A Lejpras (2016): „Financing patterns of R&D in small and medium-sized enterprises and the perception of innovation barriers in Germany“. Sci. Public Policy 43 261. https://doi.org/10.1093/scipol/scv027.

Bellucci, Andrea, Luca Pennacchio, und Alberto Zazzaro. „Public R&D Subsidies: Collaborative versus Individual Place-Based Programs for SMEs“. Small Business Economics 52, Nr. 1 (Januar 2019): 213–40. https://doi.org/10.1007/s11187-018-0017-5.

Benhayoun-Sadafiyine, L. (2017); La capacité d'absorption des PMEs intégrées dans des réseaux d'innovation collaboratifs : évaluation à travers une grille de maturité. Gestion et management. Université Grenoble Alpes, 2017. Français. ffNNT : 2017GREAG002ff. fftel-01689138v2. Doctoral dissertation

Bergmann, Heiko, und Thierry Volery (2016) „Forschungs-und Innovationsaktivitäten von Klein-und Mittelunternehmen in der Schweiz. Studie im Rahmen des Berichtes ‚Forschung und Innovation in der Schweiz 2016 '. Teil C, Studie 1“.

Bergner, Sören. „Tax incentives for small and medium-sized enterprises - a misguided policy approach?“, 2017.

Blanchard, Pierre, Jean - Pierre Huiban, Antonio Musolesi, und Patrick Sevestre (2013): „Where there is a will, there is a way? Assessing the impact of obstacles to innovation“. Industrial and Corporate Change 22. 710. https://doi.org/10.1093/icc/dts027.

Blanchard, Pierre, Jean-Pierre Huiban, Antonio Musolesi, und Patrick Sevestre (2013): „Where There Is a Will, There Is a Way? Assessing the Impact of Obstacles to Innovation“. Industrial and Corporate Change 22, Nr. 3. 679–710. https://doi.org/10.1093/icc/dts027.

Bondareva, Irina, und Jana Plchova. „SUPPORT OF INNOVATION ACTIVITY OF SME AS A FACTOR OF COMPETITIVENESS GROWTH OF SLOVAK REPUBLIC“. In PROCEEDINGS OF THE 5TH INTERNATIONAL CONFERENCE INNOVATION MANAGEMENT, ENTREPRENEURSHIP AND SUSTAINABILITY (IMES 2017), herausgegeben von Dvoulety, O and Lukes, M and Misar, J, 48–60. Univ Econ, Fac Business Adm; Ctr Enterpreneurship; Univ Econ, Dept Entrepreneurship; Comenius Univ, Fac Management; Perm Natl Res Polytechn Univ, 2017.

Bocquet, R. & Mothe, C. (2015). Le rôle de la gouvernance des clusters dans les capacités dynamiques d'absorption des PME. Management international /International Management /Gestiòn Internacional, 19 (2), 171–188. https://doi.org/10.7202/1030394ar

Borreguero Figols, Jose, Maria (2015); Las empresas tecnologicas en el entorno de los parques cientificos: Taxonomia multidimensional', Tesis Doctoral, Universitat de Barcelona

Botrić, V., und L. Božić. „Access to finance: Innovative firms' perceptions in post-transition eu members“ (2017): E a M: Ekonomie a Management 20, Nr. 1 129–43. https://doi.org/10.15240/tul/001/2017-1-009.

Božić, Ljiljana, und Edo Rajh (2016): „The Factors Constraining Innovation Performance of SMEs in Croatia“. Economic Research-Ekonomska Istraživanja 29, Nr. 1 314–24. https://doi.org/10.1080/1331677X.2016.1168040.

Brink, Siegrun, Sebastian Nielen, und Eva May-Strobl (2018): „Innovationstätigkeit des nicht-forschenden Mittelstands“. IfM-Materialien. .

Busom, Isabel, Beatriz Corchuelo, und Ester Martínez Ros. „Tax Incentives and Direct Support for R&D : What Do Firms Use and Why?“, o. J., 31.

Caloffi, Annalisa, Federica Rossi, und Margherita Russo. 2015. ‘What Makes SMEs more Likely to Collaborate? Analysing the Role of Regional Innovation Policy’. EUROPEAN PLANNING STUDIES 23(7): 1245–64.

Carlone, F. (2018); Innovazione e digitalizzazione nel settore dello shipping, LUISS, Dipartimento di Impresa e Management, Cattedra Management dell’Innovazione

Carpanesi, C. (2016); Innovazione tecnologica e politiche regionali: la Smart Specialization Strategy dell’UE, Corso di Laurea magistrale in Economia e Gestione delle Aziende, Tesi di Laurea, Univesrita Ca’Foscari, Venezia

Castellacci, Fulvio, und Christine Mee Lie. 2015. ‘Do the effects of R&D tax credits vary across industries? A meta-regression analysis’. RESEARCH POLICY 44(4): 819–32.

Cecere, Grazia, Nicoletta Corrocher, und Maria Luisa Mancusi. 2020. „Financial constraints and public funding of eco-innovation: empirical evidence from European SMEs“. SMALL BUSINESS ECONOMICS 54(1): 285–302.

Centre for Strategy and Evaluation Services (2012) ‘The Evaluation of the SME Definition’, published by the European Commission

Centre for Strategy and Evaluation Services REACH innovation (2012a); Interim evaluation of the Functioning of the European Chemical market after the introduction of REACH, European Commission DG ENTR

Centre for Strategy and Evaluation Services (2012b); The Impact of the REACH regulation on the innovativeness of the EU chemical industry, European Commission, DGENTR

Centre for Strategy and Evaluation Services (2015); Monitoring Impacts of REACH on Innovation, Competitiveness, and SMEs, European Commission, DGGROW

Centre for Strategy and Evaluation Services (2017); Interim Evaluation of H2020 Financial Instruments, European Commission, DGRTD

Centre for Strategy and Evaluation Services et al (2020) ‘Evaluation of Support Services for would-be Entrepreneurs and Newly Established Businesses’, published by the European Commission

Chai, Sen, und Willy Shih. 2016. „Bridging science and technology through academic-industry partnerships“. RESEARCH POLICY 45(1): 148–58.

Chicot, J. (2016); Strategic use of public procurement for innovation: Rationales, instruments and Practices, Laboratoire d’économie appliquée de Grenoble, dans l'École doctorale de sciences économiques University of Grenoble. Doctoral dissertation,

Connell, D. 2017. Leveraging public procurement to grow the innovation economy. An independent review of the Small Business Research Initiative, London.

Cottica, G. (20176); Le reti di impresa come strumento di Sviluppo per il settore agroalimentare, Corso di Laurea Magistrale in Marketing e Comunicazione, Tesi di Laurea, Universita Ca’Foscari, Venezia

Coyne, M., Carlberg, M (2018): Employment effects of public innovation support measures. Working Paper - Labour Market Change, Eurofound.

Corchuelo, M Beatriz, und Ester Martínez-Ros, 'The Effects of Fiscal Incentives for R&D in Spain', o. J., 33.

Corchuelo, B. and F.Y. Mesias; Disposición a innovar y competitividad en la agroindustria Extremeña, ITEA (en prensa), Vol. xx, 1-16

Copenhagen Economics (2019) 'Undersøgelse af Vækstiværksættere' (*Analysis of Growth Entrepreneurs*) https://www.copenhageneconomics.com/dyn/resources/Publication/publicationPDF/9/479/1550813570/undersoegelse-af-vaekstivaerksaettere_07012019.pdf

Cordero Machado, J. (2019);Lla compra pública de innovación (cpi) en España. Análisis de la eficiencia en el ecosistema administración – empresa. Instituto Universitario General Gutiérrez Mellado, Trabajo fin de Máster

Crass, Dirk, Christian Rammer, und Birgit Aschhoff. 2019. „Geographical clustering and the effectiveness of public innovation programs". JOURNAL OF TECHNOLOGY TRANSFER 44(6, SI): 1784–1815.

Čučković, Nevenka, und Valentina Vučković. „EU R&D Funding as a Way of Incentivizing Innovation of SMEs: A Review of Impacts". Croatian Economic Survey 20, Nr. 2 (31. Januar 2019): 97–127. https://doi.org/10.15179/ces.20.2.4.

Cunningham, P, Gök, A., Laredo, P (2016): The impact of direct support to R&D and innovation in firms. In: Edler, J., Cunningham, P., Gök, A., Shapira, P (Ed.): Handbook of Innovation Policy Impact. Cheltenham. Northampton. pp. 54-108

Cunningham, P., Gök, A. (2016): The impact of innovation policy schemes for collaboration. In: Edler, J., Cunningham, P., Gök, A., Shapira, P (Ed.): Handbook of Innovation Policy Impact. Cheltenham. Northampton. pp. 239-279

Cunningham, P., Ramlogan, R. (2016): The impact of innovation networks. In: Edler, J., Cunningham, P., Gök, A., Shapira, P (Ed.): Handbook of Innovation Policy Impact. Cheltenham. Northampton. pp. 279-318

Czarnitzki, Dirk, and Delanote. J. 2015. R&D policies for young SMEs: input and output effects. Small Business Economics 45(3): 465–85.

D'Allura, G.M. and Faraci, R. (2018); Le imprese familiari. Governance, internazionalizzazione e innovazione, FrancoAngeli Open Access.

Dansk Industry, DI Analyse (2018) 'Der ligger store muligheder i innovation og digitalisering' (*There are important opportunities in innovation and digitalisation*). https://www.danskindustri.dk/arkiv/analyser/2018/11/der-ligger-store-muligheder-i-innovation-og-digitalisering/

De Martino, M., Magnotti, F, and L Santoro (2017); L'innovazione nelle piccole e medie imprese agroalimentari della Regione Campania, realizzato attraverso la partecipazione al progetto di ricerca Campus innovazione QUARC: "Qualità delle produzioni tipiche campane ed il suo territorio: approcci innovativi ed integrati per rafforzare la competitività del sistema Agroalimentare", in attuazione degli obiettivi operativi 2.1 e 2.2. del Programma Operativo FESR Campania 2007/2013.

D'Este, P., Iammarino, S., Savona, M., von Tunzelmann, N. (2012): What hampers innovation? Revealed barriers versus deterring barriers. Research Policy. Vol. 41. Issue 2. p.482-488

David, P. A., Hall, B., & Toole, A. (2000). Is public R&D a complement or substitute for private R&D? A review of the econometric evidence. Research Policy, 29(4-5), 497–529.

David, P.A. and B.H. Hall. 2000. Heart of Darkness: Modeling Public-Private Funding Interactions Inside the R&D Black Box, Research Policy 29, pp. 1165-1183.

Debrand,D. (2018); Les nouvelles stratégies d'innovation des firmes françaises de plasturgie, Revue d'économie industrielle 2018/4 (n° 164), pages 9 à 36

Deloitte, the Lisbon council (2019). eIDAS study on pilots for replication of multipliers: supporting the uptake of eIDAS services by SMEs. SMART 2016/0084. European Commission, Directorate-General of Communications Networks, Content & Technology.

Department of Finance (2016); Economic Evaluation of the R&D Tax Credit, Irish Government Economic and Evaluation Service, Dublin

Dobrinsky, R. (2019); European Innovation Partnerships: How Successful Have They Been in Promoting Innovation in the EU?, The Vienna Institute for International Economic Studies, Research Report 438

Duarte, Filipe A. P., Maria Jose Madeira, Dulcineia Catarina Moura, Joao Carvalho, und Jacinta Raquel Miguel Moreira (2017): „Barriers to innovation activities as determinants of ongoing activities or abandoned". INTERNATIONAL JOURNAL OF INNOVATION SCIENCE 9, Nr. 3 244–64. https://doi.org/10.1108/IJIS-01-2017-0006.

Dvouletý, Ondřej. „Effects of Soft Loans and Credit Guarantees on Performance of Supported Firms: Evidence from the Czech Public Programme START". Sustainability 9, Nr. 12 (10. Dezember 2017): 2293. https://doi.org/10.3390/su9122293.

Ecker, B., Fink, N., Sardadvar, S., Kaufmann, P., Sheikh, S., Wolf, L., Brandl, B., Loretz, S., Sellner, R. (2017): Evaluierung der Forschungsprämie gem. § 108c. EStG. WPZ Research Gmbh. KMU Forschung Austria. Vienna.

Edler, J. et al, 2012 'Compendium of Evidence on the Effectiveness of Innovation Policy' Manchester Institute of Innovation Research

Edler, J. et al, 2016 'Handbook of Innovation Policy Impact' Manchester Institute of Innovation Research

Engel, Dirk, Verena Eckl, und Michael Rothgang. 2019. „R&D funding and private R&D: empirical evidence of the impact of the leading-edge cluster competition". JOURNAL OF TECHNOLOGY TRANSFER 44(6, SI): 1720–43.

European Commission (2003) 'Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises' 2003/361/EC

European Commission (2019) 'The European Innovation Scoreboard' https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en

European Court of Auditors (2020); Special Report The SME Instrument in action: an effective and innovative programme facing challenges, Luxembourg

Falck, O., Fichtl, A., Lohse, T. (2019): Steuerliche Forschungsförderung: Wichtiger Impuls für F&E-Aktivitäten oder zu wenig zielgerichtet? Ifo Schnelldienst. Ifo Institut – Leibnitz-Institut für Wirtschaftsforschung an der Universität München. Vol. 72. Iss. 09. Pp. 3-25. http://hdl.handle.net/10419/198749

Fanelli, R.M. (2018); Rural small and medium enterprises development in Molise (italy), Europ. Countrys. · Vol. 10 · 2018 · No. 4 · p. 566-589

Federlazio, RTA & PMI, Federlazio & Camera di Commercio Roma

Fernández Sánchez, I. (2016); "Dificultades en la aplicación de las deducciones fiscales por actividades de I+D+i", Working Paper, Business Economic Series, WP. 16-03 ISSN 1989-8843, Universidad Carlos III de Madrid.

Feser, Daniel, und Till Proeger. „Knowledge-Intensive Business Services as Credence Goods - a Demand-Side Approach“, o. J., 26.

Fiorentino, V.F. (2018); Le pratiche di Open Innovation nelle Piccole e Medie Imprese: il caso italiano. Dipartimento di economia e gestione delle imprese Cattedra: Management dell'Innovazione, LUISS

Florio, Massimo, Aleksandra Parteka, und Emanuela Sirtori. 'The mechanisms of technological innovation in SMEs: a Bayesian network analysis of EU regional policy impact on Polish firms“. Technological and Economic Development of Economy 24, Nr. 5 (2018): 2131–60. https://doi.org/10.3846/tede.2018.6056.

Ford, G.S. Koutsky, T.M. & Spiwak, L.J. (2007), Discussion paper: a Valley of Death in the Innovation Sequence: An Economic Investigation, Phoenix Center for Advanced Legal & Economic Policy Studies

FORFÁS (2012); Evaluation of Enterprise Supports for Start-Ups & Entrepreneurship, Dublin

Frontline (2016); Evaluation of the Technology Innovation Development Award (TIDA) Programme Final Report for Science Foundation Ireland

Galia, Fabrice (2015) 'Obstacles to innovation and firms innovation profiles: are challenges different for policy makers?“, 90–96, https://doi.org/10.4995/ICBM.2015.1287.

Gallego-Roquelaure, V. and Ludivine Adla (2019); Manager l'innovation en PME: Focus sur la gestion des ressources humaines, Éditions EMS

Galossi, E and Teselli, A. (eds) (2012); Le piccolo e medie imprese al tempo della crisi, ediesse, Rome

Gardocka-Jałowiec, A., und K. Wierzbicka (2019) „Barriers to Creating Innovation in the Polish Economy in the Years 2012-2016“. Studies in Logic, Grammar and Rhetoric 59, Nr. 1. 211–25. https://doi.org/10.2478/slgr-2019-0038.

Gay, C.and Bérangère L. Szosta (2019); Innovation et créativité en PME: Enjeux, mutations et perspectives, ISTE editions, UK

Gil Corbalán, N. (2015); Análisis de la Influencia de las Barreras en la Adopción de Innovaciones en el Sector Servicios: El Caso de la Hostelería, Departamento de Organización de Empresas y Finanzas Universidad de Murcia, Tesis doctoral

Gottschalk, S., Egeln, J., Herrmann, F., Hupperts, S., Reuss, K., Köhler, M., Bersch, J., Wagner, S. (2016): Evaluation des Förderprogramms "INVEST – Zuschuss für Wagniskapital". Projetkbericht an das Bundesministerium für Wirtschaft und Energie (BMWi). ZEW. Mannheim.

Guisado-Gonzalez, Manuel, Jennifer Gonzalez-Blanco, Jose Luis Coca-Perez, und Manuel Guisado-Tato. 2018. „Assessing the relationship between R&D subsidy, R&D cooperation and absorptive capacity: an investigation on the manufacturing Spanish case". Journal of technology transfer 43(6): 1647–66.

Hadjimanolis, A. (2003): The barriers approach to innovation. In: Shavinina, L.V. (Editor): The International Handbook of Innovation. Elsevier Ltd. p.559-573

Hall, Bronwyn H, Pietro Moncada-Patern-Castello, Sandro Montresor, und Antonio Vezzani (2015): 'Financing constraints, R&D investments and innovative performances: new empirical evidence at the firm level for Europe'. Economics of Innovation and New Technology 25 196. https://doi.org/10.1080/10438599.2015.1076194.

Handler, R. (2018): Gemeinsame Evaluierung der Innovationsscheck-Programme. Fteval Journal for Research and Technology Policy Evaluation. Vol. 46. pp.60-63.

Hölzl, Werner, und Jürgen Janger (2014): 'Distance to the frontier and the perception of innovation barriers across European countries'. Research Policy 43 725. https://doi.org/10.1016/j.respol.2013.10.001.

Huck-Fries, Veronika, Christoph Pflügler, Manuel Wiesche, und Helmut Krcmar (2018): 'Innovationshemmnisse für kleine und mittlere Unternehmen'. In Management digitaler Plattformen, 297–312. Springer.

Hud, Martin, und Katrin Hussinger.' The Impact of R&D Subsidies during the Crisis'. Research Policy 44, Nr. 10 (Dezember 2015): 1844–55. https://doi.org/10.1016/j.respol.2015.06.003.

Huergo, Elena, und Lourdes Moreno. 'Subsidies or Loans? Evaluating the Impact of R&D Support Programmes'. Research Policy 46, Nr. 7 (September 2017): 1198–1214. https://doi.org/10.1016/j.respol.2017.05.006.

Huergo, Elena, Mayte Trenado, und Andrés Ubierna. 'The Impact of Public Support on Firm Propensity to Engage in R&D: Spanish Experience'. Technological Forecasting and Social Change 113 (Dezember 2016): 206–19. https://doi.org/10.1016/j.techfore.2015.05.011.

Hueske, Anne-Karen, und Edeltraud Guenther (2015): 'What hampers innovation? External stakeholders, the organization, groups and individuals: a systematic review of empirical barrier research'. Journal für Betriebswirtschaft 65. 148. https://doi.org/10.1007/s11301-014-0109-5.

Hvolkova, Lenka, Ladislav Klement, Vladimira Klementova, und Marcela Kovalova (2019): 'Barriers hindering innovations in small and medium-sized enterprises'. Journal of Competitiveness 11, Nr. 2 51–67. https://doi.org/10.7441/joc.2019.02.04.

Idea Consult (2010); Impact assessment of the SME-specific measures of the Fifth and Sixth Framework Programmes for Research on their SME target groups outsourcing research. Brussels.

Idevaia, V., and Resce, M. ; Ecosistemi territoriali 4.0: modelli e approcci per lo sviluppo del valore del lavoro e la circolazione delle competenze. AISRe – Associazione Italiana di Scienze Regionali XL Conferenza scientifica annual,Oltre la crisi, rinnovamento, ricostruzione e sviluppo dei territori

Iglesias Sánchez, P. P., Jambrino Maldonato, C. and De las heras, C. (2-017); La innovación en la Pyme: Barreras y facilitadores, Revista de Estudios Regionales, Nº 110, I.S.S.N.: 0213-7585 (2017), PP. 99-131

Iglesias Sánchez, P.P., Jambrino Maldonado, C., and Carlos De las Heras Pedrosa; Innovation and marketing: keys for competitiveness in family firms, Revista de Empresa Familiar, vol 5, no 1 (2015)

Indecon (2017); Interim Evaluation of Science Foundation Ireland Research Centres Programme Submitted to Science Foundation Ireland

Johnson, R. E.(1966), Technical Progress and Innovation, Oxford Econ. Papers, New Series 15, 160-161.

Jones, B., Grimshaw, D. (2016): The impact of skill formation policies on innovation. In: Edler, J., Cunningham, P., Gök, A., Shapira, P (Ed.): Handbook of Innovation Policy Impact. Cheltenham. Northampton. pp.108-129

Karhunen, Hannu, und Janne Huovari. 2015. „R&D subsidies and productivity in SMEs“. SMALL BUSINESS ECONOMICS 45(4): 805–23.

Kaufmann, P, Bittschi, B., Depner, H, Fischl, I, Kaufmann, J., Nindl, E., Ruhland, S., Sellner, R., Struß, V., Vollborth, T., Wolff von der Sahl, J. (2019): Evaluation des Zentralen Innovationsprogramms Mittelstand (ZIM). Richtlinie 2015. Endbericht. Austrian Institute for SME Research. Institute for Advanced Studies Vienna. RKW Kompetenzzentrum.

Kaufmann, P. Wolf, L. and Sheikh, S. 2015. Zwischenevaluierung des Programms Innovationsscheck Plus, Vienna.

Laredo, P., Köhler, C., Rammer, C. (2016): The impact of fiscal incentives for R&D. In: (Edler, J., Cunningham, P., Gök, A., Shapira, P (Ed.): Handbook of Innovation Policy Impact. Cheltenham. Northampton.

Legait, B., Renucci, A., Sikorav, J-L. (2015) Les relations entre les entreprises et la recherche publique. Lever les obstacles à l'innovation en France, Ministère de l'éducation nationale, de l'enseignement supérieur at a la recherché N. 2015-071/ Ministère de l'économie, de l'industrie, de l'énergie et des technologies, No 2014/19/CGE/SG.

Lesáková, Ľubica, Petra Gundová, Pavol Kráľ, und Andrea Ondrušová (2017): 'Innovation Leaders, Modest Innovators and Non-Innovative SMEs in Slovakia: Key Factors and Barriers of Innovation Activity'. Organizacija 50, Nr. 4. 325–38. https://doi.org/10.1515/orga-2017-0024.

Liabot Michaël (2017); Étude de l'impact des aides à l'innovation sur l'exportation des firmes, Thèse Pour obtenir le grade de Docteur de la Communauté, Université Grenoble Alpes

Loix, Marie. Les patent boxes : outil efficace pour stimuler l'innovation ou soumission à la pression internationale ?. Faculté de droit et de criminologie, Université catholique de Louvain, 2019. Prom.: Traversa,Edoardo. http://hdl.handle.net/2078.1/thesis:20369

Luengo-Valderrey, M.J., (2018); Repercusión de la Triple Helix y las Dificultades para Innovar en los Objetivos de Innovación: España, 2007-2013, Revista de Estudios Regionales, Nº 113, I.S.S.N.: 0213-7585 (2018), PP. 167-192

Mancheno Ricaurte, J.C. (2019); Innovación en la Empresa Familiar: Influencia de los Obstáculos, las Perspectivas Económicas y la Orientación Familiar. University of Murcia, International Doctoral School. Doctoral dissertation.

Mariani, Marco, und Fabrizia Mealli (2018): „The Effects of R&D Subsidies to Small and Medium-Sized Enterprises. Evidence from a Regional Program". Italian Economic Journal 4, Nr. 2. 249–81. https://doi.org/10.1007/s40797-017-0062-2.

Marin, Giovanni, Alberto Marzucchi, und Roberto Zoboli (2014): SMEs and Barriers to Eco-Innovation in EU: A Diverse Palette of Greens. INGENIO WORKING PAPER SERIES". Working Paper Series, o. J., 39.

Martinez Martin, I., Sanchez Galindo, M., Perez Lopez, C., and Rosa Santero Sanchez (2019); Evaluación del impacto del programa Redes de Innovación al Servicio de la Competitividad (RISC); implantación y el desarrollo de iniciativas de innovación y de transferencia tecnológia, Hacienda Pública Española / Review of Public Economics, 229-(2/2019): 59-86 © 2019, Instituto de Estudios Fiscales https://doi.org/10.7866/hpe-rpe.19.2.3

Mason C., Brown R. 2014 'Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship'

Maurel, C., Favoreu, C., Carassus, D. and Pierre Marin. Analyse des interdépendances entre les différentes catégories d'innovation organisationnelle publique. "Innovation et management public", Colloque de l'Association Internationale de Recherche en Management Public, Jun 2016, Poitiers, France.ffhal-02141971f

Mazzucato, M. 2013 'The Entrepreneurial State'

Mazzucato, M. 2018 'Mission-Oriented Research & Innovation in the EU', published by the European Commission

Meijer, L. L. J., J. C. C. M. Huijben, A. van Boxstael, und A. G. L. Romme (2019): „Barriers and drivers for technology commercialization by SMEs in the Dutch sustainable energy sector". RENEWABLE & SUSTAINABLE ENERGY REVIEWS 112. 114–26. https://doi.org/10.1016/j.rser.2019.05.050.

Mercan, B, Göktaş, D 2011 'Components of Innovation Ecosystems: A Cross-Country Study' International Research Journal of Finance and Economics Issue 76

Métailler, T. (2015); Une approche critique, en gestion des connaissances, du soutien à l'innovation par les compétences dans les pôles de compétitivité: le cas des PME en optique photonique du pôle OPTITEC, Aix-Marseille Université, UFR Economie et Gestion, Laboratoire d'Economie et de Sociologie du Travail – CNRS (UM7317). Thèse pour titre de Docteur en Sciences de Gestion

Mohnen, P., Vankan, A., and Bart Verspagen (2013); Evaluating the innovation box tax policy instrument in the Netherlands, 2007–13, Oxford Review of Economic Policy, Volume 33, Issue 1, 1 January 2017, Pages 141–156, https://doi.org/10.1093/oxrep/grw038

Mokaddem, S,; La résistance à l'innovation de service: Analyse appliquée dans le cadre du développement de l'écomobilité, Université Paris-Est, ESIEE Paris, Institut de Recherche en Gestion

Nepelski, Daniel, und Giuseppe Piroli (2018): „Organizational Diversity and Innovation Potential of EU-Funded Research Projects“. The Journal of Technology Transfer 43, Nr. 3: 615–39. https://doi.org/10.1007/s10961-017-9624-6.

Norek, T. (2017): Analysis of the efficiency of innovation projects supported by the EU funds – a case study of Polish SME companies. In Zbuchea, A.: Entrepreneurs. Entrepreneurship. Challenges and Opportunities in the 21st century. SNSPA, Faculty of Management. Bucharest.

OECD. 2002. „Public and Private Financing of Business R&D“. : 99–128.

OECD. 2011. „Policy Instruments for Regional Innovation“. : 187–270.

OECD (2013) Local Economic and Employment Development Programme with the Danish Business Authority, 'An international benchmarking analysis of public programmes for high-growth firms'. https://www.oecd.org/industry/high-growthreport.htm

OECD/Eurostat (2018), Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation,4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg. https://doi.org/10.1787/9789264304604-en

OECD (2020); The effects of R&D tax incentives and their role in the innovation policy mix: Findings from the OECD microBERD project, 2016-19, OECD Science, Technology and Industry policy papers September 2020 No. 92

Oh, D-S et al (2016); 'Innovation ecosystems: A critical examination' Technovation 54

O'Keene, Mary et al, VIinnova (2016) 'Third Evaluation of VINN Competence Centres' - Sweden
https://www.vinnova.se/contentassets/170ad0d9bd4e458c8bd7ca08ca3a7b41/vr_16_01t.pdf

Orzes, G., E. Rauch, S. Bednar, und R. Poklemba (2019): „Industry 4.0 Implementation Barriers in Small and Medium Sized Enterprises: A Focus Group Study“. In IEEE International Conference on Industrial Engineering and Engineering Management, 2019-December:1348–52. https://doi.org/10.1109/IEEM.2018.8607477.

Osawa,. Y. and K. Miyazaki, (2006); An Empirical Analysis of the Valley of Death: Large Scale R&D Project Performance in a Japanese Diversified Company, Asian Journal tech Inno, 14 (2), 93-116.

Petrin, T. (2017): A literature review on the impact and effectiveness of government support for R&D and innovation. Faculty of Economics. University of Ljubljana.

Petrova, Desislava (2019): 'Intelligent, innovative and sustainable industry in bulgaria – prospects and challenges'. Environment. Technologies. Resources. Proceedings of the International Scientific and Practical Conference 1. 210. https://doi.org/10.17770/etr2019vol1.4188.

Picard, F.; De la Stratégie Régionale d'Innovation à la Spécialisation Intelligente des Régions (RIS3) MCF-HDR en Sciences Economiques, Université de Technologie de Belfort-Montbéliard, IRTES-RECITS

Pillon, E. (2015a) ; Identifier et soutenir des pôles d'excellence partagés ou complémentaires. Lot de travail 2.2 Rapport final, Laboratoire de recherche IRISE

Pillon, E. (2015b); Analyse du niveau de maturite des pme en terme d'innovation, Laboratoire IRISE – CESI recherche, CONFERE'15 9 - 10 Juillet 2015, Lisbonne

Pinget, A (2016); Spécificités des déterminants des innovations environnementales: une approche appliquée aux PME, PhD Thesis, Gestion et management. Université Grenoble Alpes, 2016. Français. ffNNT : 2016GREAA023ff. fftel-01429671

Platero Jaime, M. (2014); Un estudio sobre el papel del microempresario, y los factores internos y estratégicos de la microempresa española: el efecto de la edad en la capacidad innovadora, Tesis Doctoral, Departamento de Organización de Empresas, Facultad de Ciencias Económicas y Empresariales, Universidad Complutense de Madrid

Presenza, A., (2015); L'Open Innovation nel contesto delle PMI vitivinicole, Rivista Piccola Impresa/Small Business - n. 3, anno 2015 doi: 10.14596/pisb.202

Radas, Sonja, Ivan-Damir Anić, Azra Tafro, und Vanja Wagner (2015). „The Effects of Public Support Schemes on Small and Medium Enterprises". Technovation 38. p. 15–30. https://doi.org/10.1016/j.technovation.2014.08.002.

Radas, Sonja, Anić, Ivan-Damir (2013) 'Evaluating Additionality of an Innovation Subsidy Program Targeted at SMEs: An Exploratory Study'. Croatian Economic Survey 15, Nr. 1. 28.

Radicic, Dragana, und Geoffrey Pugh. 2017. 'R&D Programmes, Policy Mix, and the European Paradox: Evidence from European SMEs'. Science and Public Policy 44: 512.

Radicic, Dragana, Geoffrey Pugh, Hugo Hollanders, und René Wintjes (2014): „The Impact of Innovation Support Programmes on SME Innovation in Traditional Manufacturing Industries: An Evaluation for Seven EU Regions". SSRN Electronic Journal, 1. https://doi.org/10.2139/ssrn.2438459.

Rammer, Christian (2017): Dokumentation zur Innovationserhebung 2017. ZEW. Mannheim.

Rammer, Christian, Sandra Gottschalk, Bettina Peters, Johannes Bersch, und Daniel Erdsiek (2016): „Die Rolle von KMU für Forschung und Innovation in Deutschland: Studie im Auftrag der Expertenkommission Forschung und Innovation". Studien zum deutschen Innovationssystem.

Rammer, Christian, Sandra Gottschalk, und Markus Trunschke (2020). „Innovationstätigkeit der Unternehmen in Ostdeutschland seit der Wiedervereinigung: Studie im Auftrag der Expertenkommission Forschung und Innovation". Studien zum deutschen Innovationssystem.

Rigby, J. (2016): The impact of pre-commercial procurement on innovation. . In: Edler, J., Cunningham, P., Gök, A., Shapira, P (Ed.): Handbook of Innovation Policy Impact. Cheltenham. Northampton. pp.382-403

Roper, S., & Hewitt-Dundas, N. (2016). The legacy of public subsidies for innovation: input, output and behavioural additionality effects. Enterprise Research Centre. https://www.enterpriseresearch.ac.uk/wpcontent/uploads/2016/04/Legacy-effects-of-innovation-policy-formatted.-No-21.pdf

Rossini, R. (2016); Cultura d'impresa e innovazione organizzativa, Dipartimento di Impresa e Management Cattedra di Economia e Gestione delle Imprese, LUISS

Rothgang, M., U. Cantner, J. Dehio, D. Engel, M. Fertig, H. Graf, S. Hinzmann (2017): „Cluster Policy: Insights from the German Leading Edge Cluster Competition". Journal of Open Innovation: Technology, Market, and Complexity 3, Nr. 1. 18. https://doi.org/10.1186/s40852-017-0064-1.

Sala, Alessandro, Paolo Landoni, und Roberto Verganti. 2016. „Small and Medium Enterprises collaborations with knowledge intensive services: an explorative analysis of the impact of innovation vouchers". R & D MANAGEMENT 46(1, SI): 291–302.

Salvador, E., Mariotti, I., Conicella, F. (2013): „Science Park or Innovation Cluster?" Similarities and differences in physical and virtual firms' agglomeration phenomena. International Journal of Entrepreneurial Behaviour & Research. Vol. 19. pp.656-674

Shapira, P, Youtie, J. (2016): The impact of technology and innovation advisory services. In: Edler, J., Cunningham, P., Gök, A., Shapira, P (Ed.): Handbook of Innovation Policy Impact. Cheltenham. Northampton. pp. 161-196

Spescha, Andrin, und Martin Wörter (2018): „Innovation in der Schweizer Privatwirtschaft". KOF und SBFI. Bern.

Stam, E., Spigel, B. 2016 Entrepreneurial Ecosystems

Stucki, Tobias (2019): „What hampers green product innovation: the effect of experience". Industry and Innovation 26. 1270. https://doi.org/10.1080/13662716.2019.1611417.

Technopolis (2017) Evaluation of Norwegian Innovation Clusters – international comparison through three case studies of cluster programs in Germany, Denmark and France.https://www.regjeringen.no/contentassets/377067362c2d4f5e87cd87063bce7a62/evaluation-of-norwegian-innovation-clusters_.pdf

Technopolis (2017); Evaluation of the SME instrument and the activities under Horizon 2020 Work Programme 'Innovation in SMEs', Final Report, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, and Directorate-General for Research and Innovation

Testa, G., and Szkuta, K., Improving access to finance for young innovative enterprises with growth potential: evidence of impact on firms' outputs. Part 2. R&D grant schemes: lessons learned from evaluations, EUR 28995 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79- 77241-2, doi:10.2760/706430, JRC109879.

Uddannelses- og Forskningsministeriet /Danish Ministry of Education and Research (2017) 'Effekter af virksomheders deltagelse i klynger og innovationsnetværk' (*Effects of enterprise participation in clusters and innovation networks'*) https://ufm.dk/publikationer/2017/filer/virksomhedseffekter-af-klynger-og-netvaerk-2016.pdf

Luxembourg, 2018, ISBN 978-92-79- 77241-2, doi:10.2760/706430, JRC109879.

Uyarra, E. (2016): The impact of public procurement of innovation. In: Edler, J., Cunningham, P., Gök, A., Shapira, P (Ed.): Handbook of Innovation Policy Impact. Cheltenham. Northampton. pp.355-382

Uyarra, E., Ramlogan, R. (2016): The impact of cluster policy on innovation. In: Edler, J., Cunningham, P., Gök, A., Shapira, P (Ed.): Handbook of Innovation Policy Impact. Cheltenham. Northampton. pp.196-239

Vinnova (2016) 'Digitalisering av Svensk Industri – Kartläggning av svenska styrkor och utmaningar' (*Digitalisation of Swedish Industry – Mapping of Swedish strengths and barriers*) https://strategiska.se/app/uploads/digitalisering-av-svensk-industri.pdf

Wei Keat BennyNg, Appel-Meulenbroek, R., Cloodt, M., and T. Arentze (2019); T*owards a segmentation of science parks: A typology study on science parks in Europe,* Research Policy, Volume 48, Issue 3, April 2019, Pages 719-732

Zavani, M. and Di Toma, P. (2012); L'Innovazione nei processi amministrativi delle PMI. Oportuita e voncoli della fatturazione elettronica, Franco Angeli, Milano

Zimmermann, V. and Thoma, J. (2019); 'Interactive learning or R&D: How do small and menium-sized enterpises generate innovations?', KfW Research, Focus on Economics, No. 264, 28 August 2019

Zimmermann, Volker, und Jörg Thomä (2016): „Innovationshemmnisse in KMU–vielfältige Hemmnisse sprechen für eine breit aufgestellte Förderpolitik". KfW Research, Fokus Volkswirtschaft, Nr. 130.

Zimmermann, V. and Thoma, J. (2016); "SMEs face a wide range of barriers to innovation – support policy needs to be broad-based", KfW Research, Focus on Economics, No 130, 20 June 2016

Zwolinska-Ligaj, Magdalena Anna, and Mieczyslaw Adamowicz (2018): 'Innovative Activity of Enterprises in the Peripheral Region', 433–41. https://doi.org/10.22616/ESRD.2018.050.

Annex B: Organisations Interviewed

Name	Type	Country	Sector
Business representative and support organisations (at EU level)			
SMEunited (UEAPME)	EU Industry Association	EU	Diverse
Orgalim	EU Industry Association	EU	High tech - Engineering
Eurochambres	EU Industry Association	EU	Diverse
Business representative organisations (at national and regional level)			
Zentralverband des Deutschen Handwerks ZDH	National Industry Association	DE	All - crafts
Confartigianatio	National Industry Association	IT	All - crafts
SEV, Hellenic Federation of Enterprises	National Industry Association	HE	All/ digitalisation
Polish Craft Association	National Industry Association	PL	All
Teknikföretagen - Teknik gör världen bättre	IndustryAssociation	SE	Engineering
Polish Regional Craft Chamber Poznan	IndustryAssociation	PL	All
EU funded networks, helpdesks and portals relevant for research, development and innovation in SMEs			
European Association of Development Agencies (EURADA)	EU Suport Organisation	EU	General
EIT Digital	EU Suport Organisation	CZ	Digital
European Institute of Innovation & Technology EIT	EU Suport Organisation	EU/HU	All
National or regional government authorities or agencies responsible for promoting SME innovation, in EU Member States and other COSME and H2020 third countries			
Bundesministerium für Digitalisierung und Wirtschaftsstandort	National Government	AT	General
National Research, Development and Innovation Office	National Government	HU	All
Forschungsförderungsgesellschaft Austria	National Government	AT	All
APRE (Agency for the Promotion of European Research)	National Government	IT	All
Veneto Innovazione Spa	Regional	IT	Diverse
Steinbeis-Europa-Zentrum	Regional	DE	Diverse
Center for University-Industry Cooperation (FIEK) in Gyor, Hungary	National	HU	Diverse
Ministry of Economic Development	National Government	IT	All
Cluster organisations			
Pôle de compétitivité Photonique et Hyperfréquences	Regional cluster	en Nouvelle-Aquitaine	Photonics
nanoprogress	Regional cluster	Pardibice CZ	Nano technologies
Business Innovation Centres (BICs)			
gate - Garchinger Technologie- und Gründerzentrum GmbH	Innovation Centre	PT	Space for innovation
National and regional promotional banks			
KfW	NPB with regional offices	DE	Diverse
BpiFrance	NPB with regional offices	FR	Diverse
Investors or Venture capital organisations (at EU, national or regional level) - 2			

Name	Type	Country	Sector
Invest Europe (old EVCA)	Investors/ VC	EU	Diverse
European Business Angels Network	Investors/ VC	EU	Diverse
Digital Innovation Hubs			
Santaka Artificial Intelligence DIH	DIH	LT	AI/ Digital
Pôle EMC2 Competitiveness cluster for innovation in production technologies	DIH	FR	Manufacturing Technologies
Others			
EASME	EU policy makers		SME
DG RTD	EU policy makers	EU	RTD
DG CONNECT/ DDG1.A.2	EU policy makers	EU	CNT -AI& Digital Tech & Systems Digi.Industry
EIB	EU financial organisations	EU	Diverse
EIF	EU financial organisations	EU	Diverse
DG GROW IP (DDG1 F.3)	EU policy makers	EU	All
DG GROW IP (DDG2 H.1)	EU policy makers	EU	All

Annex C: Survey Questionnaires and Econometric Analysis

C.1 Introduction

This methodological annex presents the detailed results of the targeted consultations with SMEs and intermediary organisations. It is structured as follows:

- Annex C2 includes the survey questionnaires and distribution of responses of each question;
- Annex C3 includes details on the econometric models used, and results obtained;
- Annex C4 includes the results of the Bayesian Network analysis, which has been used to validate the findings of the econometric analysis and shed more light on all the possible interlinkages between variables.

C.2 Survey questionnaires

C.2.1 Enterprises survey questionnaire

Section A – Company information

A1. How did you first hear about the survey?	
☐ From the Enterprise Europe Network (EEN)	☐ 12.47%
☐ From a business association	☐ 7.53%
☐ From EU information sources (e.g. EU web portals, networks and platform)	☐ 9.19%
☐ Through social networks (Linkedin, Twitter…)	☐ 2.03%
☐ From the European Commission or EASME (direct invitation)	☐ 55.10%
☐ Other – please specify	☐ 13.67%

A2. In which country is your company located?			
☐ Albania	☐ 0.14%	☐ Lithuania	☐ 0.56%
☐ Armenia	☐ 0%	☐ Lichtenstein	☐ 0%
☐ Austria	☐ 1.57%	☐ Luxembourg	☐ 0.14%
☐ Belgium	☐ 2.13%	☐ Malta	☐ 0.09%
☐ Bosnia and Herzegovina	☐ 0.05%	☐ Moldova	☐ 0.14%
☐ Bulgaria	☐ 1,06%	☐ Montenegro	☐ 0.09%
☐ Croatia	☐ 0.46%	☐ Netherlands	☐ 5.37%
☐ Cyprus	☐ 0.51%	☐ Northern Macedonia	☐ 0.19%
☐ Czech Republic	☐ 2.50%	☐ Norway	☐ 1.06%
☐ Denmark	☐ 0.88%	☐ Poland	☐ 5.79%
☐ Estonia	☐ 0.56%	☐ Portugal	☐ 2.36%
☐ Faroe Islands	☐ 0.05%	☐ Romania	☐ 1.48%
☐ Finland	☐ 1.16%	☐ Serbia	☐ 0.09%
☐ France	☐ 8.29%	☐ Slovakia	☐ 1.06%
☐ Georgia	☐ 0.09%	☐ Slovenia	☐ 0.93%
☐ Germany	☐ 8.80%	☐ Spain	☐ 12.50%
☐ Greece	☐ 3.06%	☐ Sweden	☐ 2.96%
☐ Hungary	☐ 2.92%	☐ Switzerland	☐ 1.67%
☐ Iceland	☐ 0.19%	☐ Turkey	☐ 1.34%
☐ Ireland	☐ 1.44%	☐ Ukraine	☐ 0.32%
☐ Israel	☐ 1.48%	☐ United Kingdom	☐ 9.77%
☐ Italy	☐ 14.31%	☐ Other (please specify)	☐ 0.32%
☐ Latvia	☐ 0.14%		

A3.1. In which industry does your company operate?	
☐ Manufacturing –> GO TO A3.2a	☐ 39.02%
☐ Services–> GO TO A3.2b	☐ 57.34%
☐ Construction (including civil engineering) –> SKIP QUESTION A.3.2 AND GO TO A4	☐ 3.64%

A3.2.a In which sector are you active? *(if more than one category applies, please choose the most characteristic one)* –> GO TO A4	
☐ Computer, electronic and optical products	☐ 16.77%

☐ Bio-technology and medical devices	☐ 11.34%
☐ Electrical equipment	☐ 10.86%
☐ Chemicals	☐ 9.65%
☐ Pharmaceuticals	☐ 7.12%
☐ Food and Beverage	☐ 6.39%
☐ Energy	☐ 6.03%
☐ Transport	☐ 5.07%
☐ Manufacturing of plastic, metal and other components	☐ 3.86%
☐ Machinery	☐ 2.90%
☐ Textile	☐ 2.05%
☐ Materials	☐ 1.57%
☐ Furniture	☐ 1.57%
☐ Water filtration	☐ 1.45%
☐ Mechanic	☐ 1.33%
☐ Agriculture	☐ 1.09%
☐ Waste treatment	☐ 1.09%
☐ Other (please specify)	☐ 9.89%
A3.2.b In which sector are you active? *(if more than one category applies, please choose the most characteristic one)* –> GO TO A4	
☐ IT and other information services	☐ 39.43%
☐ Scientific research and development	☐ 16.07%
☐ Other professional, scientific and technical activities	☐ 11.07%
☐ Energy	☐ 6.39%
☐ Environmental Services	☐ 5.98%
☐ Legal, accounting, management, architecture, engineering, technical testing and analysis activities	☐ 3.61%
☐ Healthcare	☐ 2.21%
☐ Financial and insurance services	☐ 2.05%
☐ Telecommunication	☐ 1.56%
☐ Accommodation, food and beverage services	☐ 1.31%
☐ Transport and Storage services	☐ 1.31%
☐ Entertainment production and services	☐ 1.23%
☐ Wholesale and retail trade	☐ 1.23%
☐ Education	☐ 1.15%
☐ Administrative and support service activities	☐ 0.98%
☐ Consultancy	☐ 0.74%
☐ Marketing	☐ 0.49%
☐ Real Estate	☐ 0.41%
☐ Other (please specify)	☐ 2.79%
A4. Was your company established after January 1st 2014?	
☐ Yes	☐ 46.72%
☐ No	☐ 53.28%
A5. Please indicate the turnover of your company in 2019	
☐ 0-2 million €	☐ 83.4%

☐ 2-10 million €	☐ 12.0%
☐ 10-50 million €	☐ 4.2%
☐ Over 50 million €	☐ 0.4%
A6. Please indicate the annual growth rate of your turnover during the last 3 years	
☐ Below 0%	☐ 15.65%
☐ 0-10%	☐ 47.68%
☐ 10-20%	☐ 15.69%
☐ Over 20%	☐ 20.98%
A7. Please indicate the number of staff employed in 2019	
☐ 0-9	☐ 66.84%
☐ 10-49	☐ 25.59%
☐ 50-249	☐ 7.07%
☐ More than 250	☐ 0.51%
A8. Please indicate the annual growth rate of staff employed during the last 3 years	
☐ Below 0%	☐ 16.87%
☐ 0-10%	☐ 49.79%
☐ 10-20%	☐ 13.64%
☐ Over 20%	☐ 19.69%

Section B – Information on innovation activities implemented

B1. Over the last 3 years, has your company introduced any forms of innovation? *(multiple answers possible)*	
☐ Yes, new or significantly improved products	☐ 65.41%
☐ Yes, new or significantly improved services	☐ 25.88%
☐ Yes, new or significantly improved processes for manufacturing goods or producing services	☐ 8.39%
☐ Yes, new or significantly improved organisational methods (e.g., change in management structure, work organisation or new methods of interaction with other companies)	☐ 1.89%
☐ Yes, a new business model or a new way of marketing your products/services	☐ 6.92%
☐ Yes, new or significantly improved logistics, delivery or distribution processes	☐ 1.43%
☐ Yes, other – please specify	☐ 2.35%
☐ No –> SKIP QUESTION B2, B3 AND B4 AND GO TO SECTION C	☐ 5.63%
B2. If your company has introduced any form of innovation over the last 3 years, was this based on research activities (carried out in-house or by/with other collaborating partners/ third parties)?	
☐ Yes	☐ 90.38%
☐ No	☐ 8.54%
☐ Do not know	☐ 1.08%
B3. In general, how would you consider your innovation activity?	
☐ Incremental	☐ 47.28%
☐ Disruptive	☐ 52.72%
B4. Approximately how much did your company spend in 2019 on all your innovation	

activities?	
☐ Below 100,000 €	☐ 42.74%
☐ 100,000 - 500,000 €	☐ 38.24%
☐ 500,000 - 1 million €	☐ 10.32%
☐ 1 million € - 5 million €	☐ 6.36%
☐ Over 5 million €	☐ 0.54%
☐ Do not know	☐ 1.81%

Section C – Barriers to innovation

C1. What are the factors hampering innovation activities in your company?
For each of the following statements listing the barriers to innovation, please indicate the level of importance.

	NOT IMPORTANT AT ALL	SLIGHTLY IMPORTANT	NEUTRAL	FAIRLY IMPORTANT	VERY IMPORTANT	DO NOT KNOW
Lack of financing support for R&D&I activities (grants, equity, guarantees, tax incentives)	1.94%	4.81%	7.54%	19.60%	65.09%	1.02%
Lack of information on access to financing possibilities	7.81%	14.83%	24.86%	28.23%	22.13%	2.13%
Lack of information on new technologies, new regulations	14.65%	20.19%	30.41%	20.33%	10.77%	3.65%
Lack of information on other non-financial innovation support possibilities & knowledge (support possibilities of clusters, knowledge on research results, patents)	9.57%	19.69%	27.68%	26.80%	12.66%	3.60%
Insufficient links with finance providers e.g. business angels, venture capital, development banks etc.	8.87%	11.74%	19.50%	25.51%	30.91%	3.47%
Lack of cooperation and networking between different R&D&I actors including support for technology transfer	9.89%	15.57%	25.09%	28.56%	16.87%	4.02%
Lack of access to skills / talents / qualified staff (e.g. with digital skills)	10.26%	16.45%	24.03%	26.85%	19.73%	2.68%
Lack of support for the acquisition of innovation management skills (e.g. for the development of an including innovation strategy)	13.96%	20.19%	29.02%	21.63%	10.95%	4.25%
Lack of support for the acquisition of specific skills (pitching skills, turning innovation projects investment ready, intercultural skills)	13.45%	19.82%	28.60%	24.26%	10.03%	3.84%

Insufficient IP management support (patents, copyrights, trademarks)	16.17%	19.32%	26.85%	21.58%	12.94%	3.14%
Insufficient support for design management	19.13%	21.53%	31.75%	16.87%	4.71%	6.01%
Insufficient support for service innovation	18.25%	20.29%	28.51%	18.39%	8.27%	6.28%
Insufficient support for organisational innovation including the use of IT and e-business	18.72%	21.49%	29.11%	16.73%	8.09%	5.87%
Lack of support for value chain creation / embedding into value chains	13.08%	16.64%	28.23%	22.92%	12.20%	6.93%
Insufficient incubation support	17.84%	18.16%	25.74%	17.88%	13.40%	6.98%
Lack of support for internationalisation (market intelligence, market conditions, matchings)	9.20%	14.83%	21.40%	26.71%	23.01%	4.85%
Uncertain regulatory requirements for new innovative products/services	10.63%	12.85%	23.66%	23.89%	24.31%	4.67%
Other	5.50%	0.79%	5.73%	0.74%	5.55%	81.70%

If other, please specify. [text box]

C2. In your opinion, do the following technology, economic and market developments constitute a barrier to innovation?

For each of the following statements listing possible barriers to innovation, please indicate the level of importance.

	NOT IMPORTANT AT ALL	SLIGHTLY IMPORTANT	NEUTRAL	FAIRLY IMPORTANT	VERY IMPORTANT	DO NOT KNOW
Players with large market power have emerged	7.40%	10.60%	19.53%	29.77%	30.05%	2.65%
Complexity of products and services has increased	8.05%	12.28%	25.16%	34.74%	17.44%	2.33%
Access to international markets is more difficult (as a consequence of Brexit and trade tensions)	11.30%	14.56%	28.09%	25.12%	17.44%	3.49%
Innovation cycles are much faster	9.40%	13.49%	26.00%	32.65%	15.63%	2.84%
Increasing emphasis on green/sustainable innovation	23.07%	15.67%	26.28%	17.12%	15.26%	2.60%
Increasing emphasis on digitalisation	24.00%	15.58%	24.09%	17.91%	15.58%	2.84%

Value chains are more complex and more global	10.56%	13.63%	27.58%	28.79%	14.70%	4.74%
Open innovation became more important for enterprises	15.35%	13.53%	31.02%	20.42%	11.35%	8.33%
Other	3.72%	0.65%	4.37%	0.74%	3.86%	86.65%

If other, please specify [text box]

Section D – Public support to innovation

D1. Over the last 3 years, what kind of public innovation support has your company received? *(multiple answers possible)*

☐ Support for financing innovation projects (including R&D)	☐ 64.00%
☐ Support for networking and cooperation between actors	☐ 8.73%
☐ Support for awareness raising and information on support possibilities	☐ 3.70%
☐ Support for technology / knowledge transfer	☐ 3.56%
☐ Support to identify innovation potential (information on market needs, market conditions, new regulations, new technology, etc.)	☐ 3.00%
☐ Support for innovation management (organisational management, IP management, design management)	☐ 2.82%
☐ Support for the creation of specific skills	☐ 1.62%
☐ Support for the internationalisation of innovative SMEs	☐ 5.31%
☐ Do not know	☐ 0.88%
☐ None → GO TO QUESTION E1	☐ 25.69%
☐ Other (please specify)	☐ 0.97%

D2. Over the last 3 years, which of the following instruments for innovation support has your company received or used? *(multiple answers possible)*

☐ Grants	☐ 43.21%
☐ Voucher schemes	☐ 5.83%
☐ Tax incentives	☐ 15.37%
☐ Loans	☐ 12.17%
☐ Equity finance	☐ 9.16%
☐ Guarantees	☐ 6.12%
☐ Support services (consultancy, advice, technical assistance)	☐ 6.12%
☐ Other (please specify)	☐ 2.02%

D3. Considering your overall expenditure on innovation over the last 3 years, what was the approximate share of public funds received out of the total?

☐ No public funds received → GO TO QUESTION D7	☐ 31.67%
☐ 0-10%	☐ 16.25%
☐ 10-25%	☐ 16.06%
☐ 25-50%	☐ 21.44%
☐ Over 50%	☐ 14.58%

D4. From what level of government did you receive support?

(multiple answers possible)	
☐ EU	☐ 47.73%
☐ National government	☐ 52.27%
☐ Regional government/ federal	☐ 31.89%
☐ Local (including city) government	☐ 8.62%
D5. Was the public support for any of your company's innovation projects such that the innovation would not have been developed or introduced without this support? *(multiple answers possible)*	
☐ Yes	☐ 46,10%
☐ No, we would have gone ahead anyway → GO TO QUESTION D7	☐ 15,35%
☐ Partly, thanks to public support I could enlarge the **scope** of the innovation activities	☐ 25,17%
☐ Partly, thanks to public support I could enlarge the **scale** of the innovation activities	☐ 17,76%
☐ Partly, thanks to public support I could implement **more quickly** some innovation projects that I had already foreseen	☐ 14,20%
If Yes or partly, please specify which public support scheme(s) it was, and how it helped Open comment	

D6. To what extent did the following innovation support you received meet your expectations?

	DID NOT MEET YOUR EXPECTATIONS AT ALL	WEAKLY MET YOUR EXPECTATIONS	MODERATELY MET YOUR EXPECTATIONS	LARGELY MET YOUR EXPECTATIONS	PERFECTLY MET YOUR EXPECTATIONS	NOT RELEVANT
Financing support for R&D&I activities (grants, equity, guarantees, tax incentives)	5.92%	9.26%	19.09%	39.89%	21.68%	4.16%
Information on access to financing possibilities	5.92%	12.29%	31.44%	30.12%	6.18%	14.05%
Information on new technologies, new regulations	7.06%	19.47%	29.99%	15.94%	2.65%	24.89%
Information on other non-financial innovation support possibilities & knowledge (support possibilities of clusters, knowledge on research results, patents)	8.13%	21.87%	30.56%	15.63%	2.77%	21.05%
Help to establish links with finance	18.21%	24.83%	22.05%	8.82%	2.02%	24.07%

providers e.g. business angels, venture capital, development banks etc.						
Cooperation and networking between different R&D&I actors including support for technology transfer	9.39%	22.05%	27.60%	17.52%	4.85%	18.59%
Support for access to skills / talents / qualified staff (e.g. with digital skills)	12.79%	23.13%	24.39%	10.59%	2.52%	26.59%
Support for the acquisition of innovation management skills (e.g. for the development of an including innovation strategy)	9.14%	20.98%	26.40%	11.09%	2.33%	30.06%
Support for the acquisition of specific skills (pitching skills, turning innovation projects investment ready, intercultural skills)	9.07%	19.41%	25.96%	13.61%	3.78%	28.17%
IP management support (patents, copyrights, trademarks)	11.72%	21.68%	23.88%	12.92%	4.16%	25.65%
Support for design management	10.84%	18.59%	23.38%	6.36%	1.64%	39.19%
Support for service innovation	9.96%	18.34%	23.44%	9.33%	1.64%	37.30%
Support for organisational innovation including the use of IT and e-business	11.47%	19.03%	23.31%	8.13%	1.58%	36.48%
Support for value chain creation / embedding into value chains	12.60%	20.42%	23.69%	7.18%	1.83%	34.28%
Incubation support	12.67%	18.34%	20.42%	10.52%	4.98%	33.08%
Support for	11.34%	22.31%	23.76%	15.06%	4.47%	23.06%

internationalisation (market intelligence, market conditions, matchings)						
Support to participate in regulatory sandboxes to test new regulatory requirements for innovative products /services	18.40%	20.16%	17.39%	4.66%	1.51%	37.87%
Other	2.45%	0.82%	2.39%	0.44%	0.57%	93.33%

If other, please specify. [text box]

D7. How would you evaluate the added value of the following EU support initiatives?

	VERY LIMITED	LIMITED	MODERATE	HIGH	VERY HIGH	DO NOT KNOW THIS INITIATIVE
Enterprise Europe Network (EEN)	11.35%	13.93%	20.74%	17.21%	9.33%	27.43%
International Intellectual Property Rights (IPR) SME helpdesks (e.g. China, ASEAN and Latin American IPR SME Helpdesk)	10.59%	11.98%	11.41%	6.18%	2.21%	57.63%
European Cluster Collaboration Platform (ECCP)	10.59%	10.03%	10.47%	4.73%	1.39%	62.80%
InnovFin	11.60%	9.27%	7.50%	3.91%	1.26%	66.46%
COSME Loan Guarantee Facility	13.49%	9.52%	8.32%	3.72%	1.45%	63.49%
Startup Europe	12.48%	10.09%	10.03%	6.31%	2.08%	59.02%
Other	2.65%	0.63%	1.58%	0.95%	1.83%	92.37%

If other, please specify. [text box]

Focus on Innosup actions

D8. Has your company benefitted from any INNOSUP action in the period 2014-2020? Please select which one(s).

Note: INNOSUP actions are initiatives funded by the H2020 programme since 2014, aimed at strengthening the ecosystem of innovation support to SMEs across the EU, at European, Member State and regional levels.

☐ Yes, IPorta 2	☐ 0.06%
☐ Yes, Support and improve the decision-making process of investors for financing high-growth potential innovative SMES	☐ 0.12%
☐ Yes, Professionalization of open innovation management in SMEs	☐ 0.06%
☐ Yes, Peer learning of innovation agencies	☐ 0.12%

☐ Yes, Supporting experimentation in innovation agencies	☐ 0.12%
☐ Yes, SMEs for social innovation – Challenge platform	☐ 0.25%
☐ Yes, Technology services to accelerate the uptake of advanced manufacturing technologies for clean production by manufacturing SMEs	☐ 0.25%
☐ Yes, Workplace innovation uptake by SMEs	☐ 0.25%
☐ Yes, Blockchain and distributed ledger technologies for SMEs	☐ 0.31%
☐ Yes, European Open Innovation network in advanced technologies	☐ 0.62%
☐ Yes, Innovating SMEs - segmentation along lifecycle and sectors (analytical research activity)	☐ 0.68%
☐ Yes, European label for innovation voucher programmes	☐ 0.68%
☐ Yes, Capitalising the full potential of online collaboration for SME innovation	☐ 0.74%
☐ Yes, Cluster facilitated projects for new value chains	☐ 0.87%
☐ Yes, Access to industrial technologies developed overseas	☐ 1.05%
☐ Yes, Community building and competence development for SME Instrument coaching	☐ 1.18%
☐ Yes, IPR helpdesk	☐ 1.30%
☐ Yes, Capacity-building for NCPs for SMEs and Access to Risk Finance under Horizon 2020	☐ 1.36%
☐ Yes, European SME innovation Associate - pilot	☐ 2.05%
☐ Do not know → Skip to question D9.1(b)	☐ 20.41%
☐ No, we have not benefitted from any INNOSUP actions in the 2014-2019 period → Skip to question D9.1(b)	☐ 71.90%

D8.1. To what extent are you satisfied with the following issues regarding your application to the INNOSUP action(s):

	NOT SATISFIED AT ALL	POORLY SATISFIED	NEUTRAL	SATISFIED	VERY SATISFIED
Ease of the application process and availability of assistance during the process	5.19%	9.63%	35.56%	34.07%	15.56%
Transparency of the selection process	9.63%	11.11%	32.59%	31.85%	14.81%
Time passed before knowing the outcome of the application and before receiving the support	5.93%	18.52%	35.56%	25.19%	14.81%
Financial volume of support received	10.37%	11.11%	34.07%	29.63%	14.81%
Duration of the support received	6.67%	9.63%	40.00%	28.89%	14.81%
Possibility to combine the EU support with other national/regional support instruments	10.37%	12.59%	45.93%	22.96%	8.15%

D8.2 To what extent are you satisfied with the results attained by the INNOSUP action(s)?

☐ Not satisfied at all	☐ 5.93%
☐ Poorly satisfied	☐ 10.37%
☐ Neutral	☐ 35.56%
☐ Satisfied	☐ 31.11%
☐ Very satisfied	☐ 17.04%

Please, add any comment on the Innosup action you were involved in [free text].

D8.1(b). Why didn't you apply for the INNOSUP action? *(more options are possible)*	
☐ I applied, but unsuccessfully	☐ 9.68%
☐ I did not know this initiative	☐ 65.41%
☐ I have not implemented any innovation activity since 2014	☐ 0.32%
☐ The INNOSUP actions were not fitting with my needs	☐ 5.35%
☐ Competition for the actions is too high (low success rate)	☐ 5.54%
☐ Rules for application or implementation are unclear or too complex	☐ 4.84%
☐ I used alternative forms of support	☐ 8.85%
☐ Other reasons (please specify)	☐ 0%

Section E – Suggestions for improvement

E1. For which types of activities would you need better support?

ON A SCALE 1-TO-5 HOW MUCH SUPPORT WOULD YOU NEED?
(1: NO SUPPORT NEEDED – 5: VERY MUCH SUPPORT NEEDED)

	VERY LITTLE SUPPORT	LITTLE SUPPORT	MODERATE SUPPORT	MUCH SUPPORT	VERY MUCH SUPPORT
Financing support for R&D&I activities (grants, equity, guarantees, tax incentives)	2.88%	3.08%	8.78%	14.93%	70.34%
Better information on access to financing possibilities	6.45%	7.46%	19.52%	22.54%	43.92%
Better information on new technologies, new regulations	13.03%	16.37%	30.53%	18.52%	21.50%
Better information on other non-financial innovation support possibilities & knowledge (support possibilities of clusters, knowledge on research results, patents)	12.02%	14.90%	28.83%	21.79%	22.35%
Linkages with finance providers e.g. business angels, venture capital, development banks etc.	11.45%	10.01%	18.89%	17.66%	41.89%
Cooperation and networking between different R&D&I actors including support for technology transfer	10.89%	14.21%	29.67%	21.89%	23.24%
Better access to skills / talents / qualified staff (e.g. with digital skills)	15.01%	17.30%	29.09%	18.65%	19.74%

Acquiring innovation management skills (e.g. for the development of an including innovation strategy)	21.24%	19.83%	29.20%	17.65%	11.97%
Acquiring specific skills (pitching skills, turning innovation projects investment ready, intercultural skills)	20.78%	20.52%	27.52%	17.49%	13.58%
IP management (patents, copyrights, trademarks)	17.47%	14.68%	26.61%	19.33%	21.86%
Design management	33.68%	20.84%	25.11%	12.11%	8.05%
Service innovation	30.13%	19.35%	24.45%	13.35%	12.51%
Organisational innovation including the use of IT and e-business	29.95%	21.95%	22.74%	14.32%	10.84%
Value chain creation / embedding into value chains	22.49%	17.29%	27.80%	17.92%	14.40%
Incubation activities	29.37%	16.26%	23.75%	14.21%	16.26%
Internationalisation (market intelligence, market conditions, matchings)	10.52%	9.69%	22.34%	24.47%	32.97%
Involvement in regulatory sandboxes to test new regulatory requirements for innovative products /services	18.87%	16.13%	25.04%	17.19%	22.77%
Other	49.39%	2.45%	13.06%	4.49%	29.39%

E1. For which types of activities would you need better support?

ON A SCALE 1-TO-5 HOW MUCH ROLE THE EU SHOULD HAVE IN OFFERING THIS SUPPORT? (1: NO ROLE AT ALL – 5: A VERY SIGNIFICANT ROLE)

	VERY LITTLE ROLE	LITTLE ROLE	MODERATE ROLE	SIGNIFICANT ROLE	VERY SIGNIFICANT ROLE
Financing support for R&D&I activities (grants, equity, guarantees, tax incentives)	2.67%	2.92%	12.32%	16.25%	65.85%
Better information on access to financing possibilities	6.40%	7.12%	18.67%	20.68%	47.14%
Better information on new technologies, new regulations	11.73%	12.51%	25.50%	18.85%	31.31%
Better information on other non-financial innovation support possibilities & knowledge (support possibilities of clusters, knowledge on research results, patents)	11.85%	12.84%	26.83%	19.89%	28.50%
Linkages with finance providers e.g. business angels, venture capital, development banks etc.	13.61%	11.47%	22.21%	18.14%	34.46%
Cooperation and networking between different R&D&I actors including support for technology	9.96%	11.85%	26.03%	21.02%	31.09%

transfer					
Better access to skills / talents / qualified staff (e.g. with digital skills)	24.41%	20.02%	27.63%	13.05%	14.74%
Acquiring innovation management skills (e.g. for the development of an including innovation strategy)	25.70%	19.38%	29.26%	12.21%	13.33%
Acquiring specific skills (pitching skills, turning innovation projects investment ready, intercultural skills)	26.45%	20.33%	25.23%	12.67%	15.17%
IP management (patents, copyrights, trademarks)	18.69%	14.27%	23.49%	18.27%	25.22%
Design management	38.57%	22.05%	22.32%	8.93%	7.85%
Service innovation	31.99%	20.01%	23.52%	11.07%	12.29%
Organisational innovation including the use of IT and e-business	33.41%	20.66%	23.94%	10.01%	11.83%
Value chain creation / embedding into value chains	23.58%	16.99%	26.63%	15.81%	16.88%
Incubation activities	25.60%	14.19%	23.78%	15.21%	21.16%
Internationalisation (market intelligence, market conditions, matchings)	10.31%	7.63%	17.78%	20.41%	43.87%
Involvement in regulatory sandboxes to test new regulatory requirements for innovative products /services	14.91%	11.85%	22.04%	17.32%	33.89%
Other	49.39%	2.45%	13.06%	4.49%	29.39%

If other, please specify. [text box]

E2. From which types of organisations would you expect an improvement in the quality of provided innovation support?

(please choose at most 3 options)

☐ Innovation and business development agencies in your country or region	☐ 55.12%
☐ Universities and research centres	☐ 28.87%
☐ Chambers of commerce and business associations	☐ 19.31%
☐ Incubators and science parks	☐ 16.59%
☐ Cluster organisations	☐ 11.21%
☐ Private consultancies	☐ 6.26%
☐ National or regional governments	☐ 36.63%
☐ Development banks	☐ 15.57%
☐ Investors or Venture capital organisations	☐ 27.85%
☐ Digital Innovation Hubs	☐ 8.54%
☐ Directly from the EU (e.g. the DGs)	☐ 39.93%
☐ Other	☐ 1.65%

If other, please specify. [text box]

E3. In your opinion, how could public innovation support services be provided more effectively (at the EU, national and regional levels)?	No importance	Low importance	Medium importance	High importance	Very high importance
By involving intermediaries (e.g. Chambers of Commerce and Industry, innovation agencies) and innovation experts more directly in the service provision	14.17%	14.65%	28.53%	29.94%	12.71%
By better addressing specific needs (service innovation, open innovation, skills development, others)	7.04%	9.70%	29.02%	36.20%	18.05%
By targeting actions more effectively towards companies with high-growth potential	7.18%	7.91%	21.54%	37.55%	25.81%
By introducing fast-track procedures for administration and evaluation of projects	3.30%	2.57%	12.28%	33.67%	48.18%
By leaving SMEs more choice on the type of service providers (e.g. through innovation vouchers)	5.77%	8.30%	24.84%	33.53%	27.56%
By offering more integrated innovation support services (e.g. one-stop-shop approach)	6.89%	9.41%	26.98%	32.75%	23.97%
By increased regional/inter-regional collaboration between companies	8.01%	13.93%	29.60%	30.86%	17.61%
By increased regional/inter-regional collaboration between companies and research and technology organisations (RTOs) and digital innovation hubs	9.56%	12.71%	27.75%	30.76%	19.21%
Other	37.61%	2.56%	17.95%	9.12%	32.76%

If other, please specify. [text box]

Section F – End of the survey

F1. Do you have any further comments?	Open question

F2. Would you like to participate in a follow-up interview?	☐ Yes ☐ No

If yes, please provide us with your email.	

Section G – Privacy policy

Thank you for completing the questionnaire!

Before closing, please **download the Data Protection note** below and confirm that you have read it.

[DPN to be downloaded]

xx) By clicking this box, I confirm I read the data protection notice.

C.2.1 Intermediaries survey questionnaire

Section A – Organisation information

A1. How did you first hear about the survey?	
☐ From the Enterprise Europe Network (EEN)	☐ 16.87%
☐ From a business association	☐ 6.22%
☐ From EU information sources (e.g. EU web portals. networks. and platforms)	☐ 5.02%
☐ Through social networks (LinkedIn. Twitter…)	☐ 7.03%
☐ From the European Commission or EASME (direct invitation)	☐ 46.79%
☐ Other – please specify	☐ 18.07%

A2. In which country is your institution/organisation located? *(multiple answers possible)*			
☐ Albania	☐ 0.63%	☐ Latvia	☐ 0.42%
☐ Armenia	☐ 1.48%	☐ Lithuania	☐ 2.11%
☐ Austria	☐ 4.65%	☐ Luxembourg	☐ 0.85%
☐ Belgium	☐ 6.55%	☐ Malta	☐ 0.42%
☐ Benin	☐ 0.21%	☐ Moldova	☐ 0.21%
☐ Bosnia and Herzegovina	☐ 0.21%	☐ Montenegro	☐ 0.21%
☐ Bulgaria	☐ 1.27%	☐ Netherlands	☐ 6.34%
☐ Croatia	☐ 1.90%	☐ Northern Macedonia	☐ 0.42%
☐ Cyprus	☐ 1.06%	☐ Norway	☐ 0.42%
☐ Czech Republic	☐ 3.81%	☐ Poland	☐ 5.29%
☐ Denmark	☐ 1.69%	☐ Portugal	☐ 2.96%
☐ Estonia	☐ 0.85%	☐ Romania	☐ 2.75%
☐ Finland	☐ 2.33%	☐ Serbia	☐ 1.06%
☐ France	☐ 10.57%	☐ Slovakia	☐ 1.90%
☐ Georgia	☐ 0.21%	☐ Slovenia	☐ 1.27%
☐ Germany	☐ 9.30%	☐ Spain	☐ 13.32%
☐ Greece	☐ 3.38%	☐ Sweden	☐ 1.69%
☐ Hungary	☐ 1.90%	☐ Switzerland	☐ 0.85%
☐ Iran	☐ 0.21%	☐ Tunisia	☐ 0.42%
☐ Ireland	☐ 1.69%	☐ Turkey	☐ 0.85%
☐ Israel	☐ 0.63%	☐ Ukraine	☐ 1.27%
☐ Italy	☐ 15.01%	☐ United Kingdom	☐ 2.33%

A3. What kind of institution / organisation do you represent?	
☐ Business representative and support organisation	☐ 16.90%
☐ Chamber of Commerce and Industry / Crafts	☐ 3.82%
☐ Cluster organisation	☐ 18.31%
☐ Incubator or science park	☐ 6.24%
☐ Higher education institution	☐ 5.84%
☐ Government / Ministry / Department	☐ 4.23%
☐ Public agency	☐ 10.26%
☐ Development/ promotional bank	☐ 0.60%
☐ Not-for-profit organisation / foundation	☐ 8.85%
☐ Research centre (public or private)	☐ 9.26%
☐ Investors or Business Angels or Venture capital organisations	☐ 2.01%
☐ Digital Innovation Hub	☐ 5.84%
☐ Other (please specify)	☐ 7.85%
A4. At what institutional level does your institution/organisation operate? *(multiple answers possible)*	
☐ Global	☐ 14.60%
☐ EU level	☐ 27.79%
☐ National level	☐ 27.18%
☐ Regional level	☐ 34.69%
☐ Local (incl. city) level	☐ 7.51%
☐ Others (please specif)	☐ 0.81%
A5. What kinds of activities fall under your institution's / organisation's responsibility? *(multiple answers possible)*	
☐ Provision of services to enterprises based on own budget	☐ 68.69%
☐ Implementation / management of publicly funded innovation programmes (through EU funds/national/regional funds)	☐ 68.08%
☐ Involvement in innovation policy formulation	☐ 48.28%
☐ Conducting policy analysis and evaluation	☐ 24.24%
☐ Supervision of funded innovation programmes	☐ 22.63%
☐ Other (please specify)	☐ 11.72%

Section B – Information on innovation support activities provided by your institution/ organisation

	B1. What type of innovation support does your institution / organisation provide? *(multiple answers possible)*
☐ Networking and cooperation between actors (business-to-business, research-to-business)	☐ 84.31%

☐ Awareness raising and information on support possibilities	☐ 74.04%
☐ Technology / knowledge transfer	☐ 63.38%
☐ Information on new regulations. new technologies	☐ 50.10%
☐ Innovation management (innovation potential identification/innovation audit design management and organisational innovation)	☐ 52.31%
☐ IP management	☐ 18.71%
☐ Support for incubation	☐ 33.20%
☐ Financing innovation projects (including R&D)	☐ 34.61%
☐ Consultation on access to finance	☐ 57.14%
☐ Cluster development	☐ 41.05%
☐ Development of specific skills (pitching skills. investment readiness support. intercultural skills. negotiating skills etc.)	☐ 41.65%
☐ Internationalisation support (market intelligence. market conditions/needs. matchings)	☐ 52.11%
☐ Other (please specify)	☐ 6.84%
☐ None → SKIP QUESTIONS B2. B3. B4. B5. B6 AND GO TO QUESTION C1.	☐ 0.80%

	B2. What is the annual budget of the innovation support schemes provided by your institution / organisation in 2019?
☐ Less than 1 million €	☐ 63.49%
☐ 1 – 5 million €	☐ 21.99%
☐ Over 5 million €	☐ 14.52%
	B3. Please specify the source of the budget of the innovation support schemes provided by your institution / organisation
☐ Only own resources	☐ 10.86%
☐ Mainly own resources	☐ 25.82%
☐ Only external resources	☐ 17.21%
☐ Mainly external resource	☐ 46.11%
	B3.1 If you are funded by external organisations. are these
☐ Public – EU level	☐ 26.37%
☐ Public – National level	☐ 19.78%
☐ Public – Regional level	☐ 18.68%
☐ Public – Local level	☐ 3.30%
☐ Private	☐ 11.81%

☐ Both private and public	☐ 20.05%
B4. Over the last year (2019). how many companies have benefited from innovation support provided by your institution / organisation?	Open question
	B5. Do you target any particular firm sizes (micro/ medium/ small)?
☐ Yes. Micro enterprises	☐ 10.00%
☐ Yes. Small enterprises	☐ 25.71%
☐ Yes. Medium enterprises	☐ 10.61%
☐ No	☐ 53.67%
	B6. Do you target any particular firm types (e.g. innovative start-ups/ traditional SMEs?)
☐ Yes	☐ 38.54%
☐ No	☐ 61.46%
If yes. which ones? [open question]	
	B7. Has your institution / organisation recently (over the last three years) introduced or is it about to introduce new innovation support measures?
☐ Yes → GO TO B7.1	☐ 49.49%
☐ No. existing measures work quite well → SKIP QUESTION B7.1. GO TO C1	☐ 9.09%
☐ No. but to optimise the impact of the support measures. they need to be coordinated better with those of other innovation support actors → SKIP QUESTION B7.1. GO TO C1	☐ 13.54%
☐ No. but we modified existing measures → SKIP QUESTION B7.1. GO TO C1	☐ 3.84%
☐ No. but we feel the need for it → SKIP QUESTION B7.1. GO TO C1	☐ 11.31%
☐ Not relevant → SKIP QUESTION B7.1. GO TO C1	☐ 12.73%
	B7.1. What do you expect from these new measures primarily? *(multiple answers possible)*
☐ To address new needs of innovative SMEs	☐ 75.41%
☐ To better promote innovation in general	☐ 65.98%
☐ To support specifically enterprises with high-growth potential	☐ 54.10%

☐ To increase the gross added value (GVA) in your region	☐ 31.97%
☐ To support non-innovative companies (e.g. in low tech sector)	☐ 29.92%
☐ To support specifically enterprises in the service sector	☐ 13.52%
☐ To reduce administrative burdens	☐ 18.85%
☐ Other	☐ 6.97%

If other, please specify. [text box]

Section C – Barriers to innovation

C1. What are the factors hampering innovation activities in your company?
For each of the following statements listing the barriers to innovation, please indicate the level of importance.

	NOT IMPORTANT AT ALL	SLIGHTLY IMPORTANT	NEUTRAL	FAIRLY IMPORTANT	VERY IMPORTANT	DO NOT KNOW
Lack of financing support for R&D&I activities (grants, equity, guarantees, tax incentives)	1.41%	7.27%	9.49%	25.86%	54.34%	1.62%
Lack of information on access to financing possibilities	1.82%	12.32%	20.20%	38.79%	25.05%	1.82%
Lack of information on new technologies, new regulations	2.22%	12.93%	24.24%	36.16%	20.20%	4.24%
Lack of information on other non-financial innovation support possibilities & knowledge (support possibilities of clusters, knowledge on research results, patents)	3.03%	10.51%	19.80%	39.80%	22.42%	4.44%
Insufficient links with finance providers e.g. business angels, venture capital, development banks etc.	2.42%	7.88%	17.17%	30.71%	35.35%	6.46%
Lack of cooperation and networking between different R&D&I actors including support for technology transfer	2.22%	6.46%	16.57%	36.77%	34.95%	3.03%
Lack of access to skills / talents / qualified staff (e.g. with digital skills)	2.42%	7.68%	15.15%	32.73%	38.18%	3.84%
Lack of support for the acquisition of innovation management skills (e.g. for the development of an including innovation strategy)	2.02%	9.09%	16.36%	39.80%	27.07%	5.66%
Lack of support for the acquisition of specific skills (pitching skills, turning innovation projects investment ready, intercultural skills)	3.03%	11.72%	20.40%	39.39%	19.60%	5.86%
Insufficient IP management support (patents, copyrights,	3.64%	13.74%	31.31%	31.31%	14.75%	5.25%

trademarks)						
Insufficient support for design management	2.83%	14.95%	34.75%	26.46%	11.72%	9.29%
Insufficient support for service innovation	1.62%	13.13%	26.06%	34.75%	17.78%	6.67%
Insufficient support for organisational innovation including the use of IT and e-business	2.63%	8.69%	23.43%	36.77%	20.40%	8.08%
Lack of support for value chain creation / embedding into value chains	1.01%	7.88%	19.80%	34.34%	28.08%	8.89%
Insufficient incubation support	4.65%	17.58%	30.91%	22.42%	15.35%	9.09%
Lack of support for internationalisation (market intelligence, market conditions, matchings)	1.62%	9.70%	23.03%	35.76%	23.03%	6.87%
Uncertain regulatory requirements for new innovative products/services	2.42%	12.12%	23.23%	29.09%	25.05%	8.08%
Other	1.62%	0.20%	4.44%	1.82%	6.87%	85.05%

If other, please specify. [text box]

C2. In your opinion, do the following technology, economic and market developments constitute a barrier to innovation?

For each of the following statements listing possible barriers to innovation, please indicate the level of importance.

	NOT IMPORTANT AT ALL	SLIGHTLY IMPORTANT	NEUTRAL	FAIRLY IMPORTANT	VERY IMPORTANT	DO NOT KNOW
Players with large market power have emerged	4.23%	12.90%	19.96%	34.68%	22.38%	5.85%
Complexity of products and services has increased	3.43%	11.09%	19.35%	38.71%	22.78%	4.64%
Access to international markets is more difficult (as a consequence of Brexit and trade tensions)	4.23%	13.10%	25.40%	32.86%	18.15%	6.25%
Innovation cycles are much faster	3.63%	5.65%	14.52%	40.12%	31.45%	4.64%
Increasing emphasis on green/sustainable innovation	11.69%	11.69%	22.58%	27.82%	20.36%	5.85%
Increasing emphasis on digitalisation	10.28%	9.68%	15.12%	26.41%	33.47%	5.04%
Value chains are more complex and more global	4.03%	6.45%	14.72%	37.30%	32.66%	4.84%
Open innovation became more important for enterprises	8.27%	7.86%	26.41%	27.62%	20.16%	9.68%
Other	2.02%	0.40%	3.02%	0.40%	4.64%	89.52%

If other, please specify. [text box]

C3. Please provide any additional comments you might have on the barriers to innovation faced today by SMEs. [free text]

Section D – Public support to innovation

D1. What do you think is the potential of the following innovation support measures to remove existing barriers to innovation? (i.e. address the most relevant barriers in an effective manner)
ON A SCALE 1-TO-5 HOW MUCH POTENTIAL DO YOU SEE FOR THE LISTED SUPPORT MEASURES?
(1: VERY LOW POTENTIAL –5: VERY HIGH POTENTIAL)

	VERY LITTLE SUPPORT	LITTLE SUPPORT	MODERATE SUPPORT	MUCH SUPPORT	VERY MUCH SUPPORT
Financing support for R&D&I activities (grants, equity, guarantees, tax incentives)	1.88%	1.04%	7.93%	17.54%	71.61%
Better information on access to financing possibilities	1.46%	6.89%	20.88%	30.69%	40.08%
Better information on new technologies, new regulations	1.68%	6.71%	30.19%	31.03%	30.40%
Better information on other non-financial innovation support possibilities & knowledge (support possibilities of clusters, knowledge on research results, patents)	2.52%	7.77%	23.95%	30.46%	35.29%
Linkages with finance providers e.g. business angels, venture capital, development banks etc.	3.58%	7.16%	21.05%	28.21%	39.79%
Cooperation and networking between different R&D&I actors including support for technology transfer	1.05%	4.43%	16.46%	27.85%	50.21%
Better access to skills / talents / qualified staff (e.g. with digital skills)	2.99%	7.69%	14.53%	30.13%	44.44%
Acquiring innovation management skills (e.g. for the development of an including innovation strategy)	2.33%	6.77%	22.20%	30.66%	38.05%
Acquiring specific skills (pitching skills, turning innovation projects investment ready, intercultural skills)	3.61%	9.98%	27.39%	31.00%	28.03%
IP management (patents, copyrights, trademarks)	4.26%	12.37%	31.34%	31.56%	20.04%
Design management	7.94%	16.09%	36.27%	25.97%	13.73%
Service innovation	5.96%	10.85%	25.96%	35.74%	21.49%
Organisational innovation including the use of IT and e-business	3.83%	8.09%	25.74%	35.11%	27.23%
Value chain creation / embedding into value chains	3.66%	4.73%	23.87%	37.20%	30.54%
Incubation activities	5.34%	12.39%	25.85%	31.84%	24.36%

Internationalisation (market intelligence, market conditions, matchings)	1.27%	5.10%	21.23%	29.30%	43.10%
Involvement in regulatory sandboxes to test new regulatory requirements for innovative products /services	4.10%	11.88%	29.59%	30.67%	23.54%
Other	26.42%	3.77%	11.32%	15.09%	39.62%

D1. What do you think is the potential of the following innovation support measures to remove existing barriers to innovation? (i.e. address the most relevant barriers in an effective manner)
ON A SCALE 1-TO-5 HOW MUCH ROLE THE EU SHOULD HAVE IN OFFERING THIS SUPPORT?
(1: NO ROLE AT ALL – 5: A VERY SIGNIFICANT ROLE)

	NO ROLE AT ALL	LITTLE ROLE	MODERATE ROLE	SIGNIFICANT ROLE	VERY SIGNIFICANT ROLE
Financing support for R&D&I activities (grants, equity, guarantees, tax incentives)	1.26%	2.31%	11.13%	16.39%	68.70%
Better information on access to financing possibilities	3.59%	8.86%	20.68%	25.53%	41.35%
Better information on new technologies, new regulations	4.03%	10.38%	26.69%	28.60%	30.08%
Better information on other non-financial innovation support possibilities & knowledge (support possibilities of clusters, knowledge on research results, patents)	5.96%	13.62%	27.02%	25.11%	28.09%
Linkages with finance providers e.g. business angels, venture capital, development banks etc.	8.94%	17.02%	26.81%	21.49%	25.74%
Cooperation and networking between different R&D&I actors including support for technology transfer	2.98%	8.09%	22.13%	26.60%	39.15%
Better access to skills / talents / qualified staff (e.g. with digital skills)	9.85%	13.28%	30.62%	23.55%	22.27%
Acquiring innovation management skills (e.g. for the development of an including innovation strategy)	8.92%	16.77%	29.51%	24.63%	19.75%
Acquiring specific skills (pitching skills, turning innovation projects investment ready, intercultural skills)	9.81%	20.04%	34.33%	20.68%	14.93%
IP management (patents, copyrights, trademarks)	8.55%	17.95%	33.12%	20.73%	19.23%
Design management	16.38%	26.29%	35.56%	13.79%	7.76%
Service innovation	12.61%	19.66%	29.06%	25.85%	12.61%
Organisational innovation including	10.23%	21.32%	27.72%	23.45%	17.06%

the use of IT and e-business					
Value chain creation / embedding into value chains	7.33%	12.72%	26.72%	25.65%	27.59%
Incubation activities	14.19%	17.20%	28.17%	23.23%	16.77%
Internationalisation (market intelligence, market conditions, matchings)	3.62%	5.32%	17.87%	29.36%	43.62%
Involvement in regulatory sandboxes to test new regulatory requirements for innovative products /services	5.39%	8.84%	23.06%	24.78%	37.50%
Other	30.19%	3.77%	16.98%	9.43%	35.85%

If other, please specify. [text box]

D2. To what extent are you familiar with EU measures in support of innovation?	
☐ Very familiar	☐ 33,75%
☐ Familiar with only the main support schemes	☐ 60,63%
☐ Not familiar at all	☐ 5,63%

D3. How would you evaluate the added value of the following EU support initiatives?

	VERY LIMITED	LIMITED	MODERATE	HIGH	VERY HIGH	DO NOT KNOW THIS INITIATIVE
Enterprise Europe Network (EEN)	5.06%	10.32%	25.51%	28.14%	23.48%	7.49%
International Intellectual Property Rights (IPR) SME helpdesks (e.g., China, ASEAN and Latin American IPR SME Helpdesk)	5.47%	10.32%	27.53%	19.84%	11.13%	25.71%
European Cluster Collaboration Platform (ECCP)	4.25%	13.77%	22.67%	25.51%	11.13%	22.67%
InnovFin	3.64%	13.56%	16.19%	21.46%	8.10%	37.04%
COSME Loan Guarantee Facility	5.06%	12.15%	20.24%	23.89%	10.73%	27.94%
Startup Europe	6.48%	10.53%	22.67%	20.65%	11.74%	27.94%
Other	2.13%	1.83%	2.74%	2.74%	6.10%	84.45%

Focus on Innosup actions

D4. Has your institution/organisation benefitted from any of the following INNOSUP actions? Please select which one(s).

Note: INNOSUP actions are initiatives funded by the H2020 programme since 2014, aimed at strengthening the ecosystem of innovation support to SMEs across the EU, at European, Member State and regional levels.

(multiple answers are possible)

☐ Yes, European label for innovation voucher programmes	☐ 1.66%
☐ Yes, Technology services to accelerate the uptake of advanced manufacturing	

technologies for clean production by manufacturing SMEs	1.24%
Yes, Support and improve the decision-making process of investors for financing high-growth potential innovative SMES	1.86%
Yes, European Open Innovation network in advanced technologies	2.28%
Yes, Blockchain and distributed ledger technologies for SMEs	1.24%
Yes, IPorta 2	1.24%
Yes, Workplace innovation uptake by SMEs	1.86%
Yes, Innovating SMEs - segmentation along lifecycle and sectors (analytical research activity)	1.86%
Yes, Professionalization of open innovation management in SMEs	1.86%
Yes, SMEs for social innovation – Challenge platform	1.45%
Yes, European SME innovation Associate - pilot	1.66%
Yes, Capitalising the full potential of online collaboration for SME innovation	2.48%
Yes, Supporting experimentation in innovation agencies	2.48%
Yes, Access to industrial technologies developed overseas	2.69%
Yes, Community building and competence development for SME Instrument coaching	4.14%
Yes, Capacity-building for NCPs for SMEs and Access to Risk Finance under Horizon 2020	6.00%
Yes, IPR helpdesk	5.18%
Yes, Peer learning of innovation agencies	6.63%
Yes, Cluster facilitated projects for new value chains	11.80%
No, we have not benefitted from any INNOSUP actions in the 2014-2019 period → SKIP QUESTION D6 AND GO TO E1	51.76%
Do not know→ SKIP QUESTION D6 AND GO TO E1	19.67%

D4.1(a). Why didn't you apply for the INNOSUP action? *(more options are possible)*	
I applied, but unsuccessfully	28.13%
I did not know this initiative	26.56%
I have not implemented any innovation activity since 2014	0.78%
The INNOSUP actions were not fitting with my needs	13.67%
Competition for the actions is too high (low success rate)	16.80%
Rules for application or implementation are unclear or too complex	9.38%
I used alternative forms of support	20.31%
Other reasons (please specify)	14.84%

D4.1(b). To what extent are you satisfied with the following issues regarding your application to the INNOSUP action(s):

	NOT SATISFIED AT ALL	POORLY SATISFIED	NEUTRAL	SATISFIED	VERY SATISFIED
Ease of the application process and availability of assistance during the process	1.52%	8.33%	33.33%	39.39%	17.42%
Transparency of the	3.01%	9.02%	33.08%	38.35%	15.79%

selection process					
Time passed before knowing the outcome of the application and before receiving the support	3.79%	11.36%	34.09%	37.12%	14.39%
Financial volume of support received	3.79%	13.64%	29.55%	38.64%	14.39%
Duration of the support received	2.27%	6.06%	29.55%	42.42%	19.70%
Possibility to combine the EU support with other national/regional support instruments	6.82%	13.64%	43.94%	24.24%	11.36%

D4.2 To what extent are you satisfied with the results attained by the INNOSUP action(s)?	
☐ Not Satisfied at All	☐ 0.77%
☐ Poorly Satisfied	☐ 4.62%
☐ Neutral	☐ 21.54%
☐ Satisfied	☐ 44.62%
☐ Very Satisfied	☐ 28.46%

Please, add any comment on the Innosup action you were involved in [free text].

D4.3 Do you have any data regarding results that you can share with the research team?	
☐ Yes	☐ 23.88%
☐ No	☐ 76.12%

Section E – Suggestions for improvement

E1. In your opinion, how could public innovation support services be provided more effectively (at the EU, national and regional levels)?

	No importance	Low importance	Medium importance	High importance	Very high importance
By involving intermediaries (e.g. Chambers of Commerce and Industry, innovation agencies) and innovation experts more directly in the service provision	5.89%	10.57%	26.22%	33.54%	23.78%
By better addressing specific needs (service innovation, open innovation, skills development, others)	2.85%	6.30%	20.12%	47.56%	23.17%
By targeting actions more effectively towards companies with high-growth	5.08%	8.74%	26.63%	38.41%	21.14%

potential					
By introducing fast-track procedures for administration and evaluation of projects	1.83%	3.66%	11.38%	36.99%	46.14%
By leaving SMEs more choice on the type of service providers (e.g. through innovation vouchers)	4.67%	7.11%	21.95%	39.84%	26.42%
By offering more integrated innovation support services (e.g. one-stop-shop approach)	4.88%	6.91%	20.73%	35.77%	31.71%
By increased regional/inter-regional collaboration between companies	3.66%	6.50%	19.51%	41.46%	28.86%
By increased regional/inter-regional collaboration between companies and research and technology organisations (RTOs) and digital innovation hubs	4.07%	5.28%	16.46%	34.35%	39.84%
Other	80.50%	0.00%	4.72%	2.52%	12.26%

If other, please specify. [text box]

E2. In your opinion, are EU support measures easily understandable by the stakeholders? Why?	
☐ Yes	☐ 21.34%
☐ No	☐ 62.80%
☐ Do not know	☐ 15.85%

Please explain the reasons of your answer. [free text]

E3. Would you be interested in collaborating with other European partners to develop and improve your tools and instruments in support of innovation?	
☐ Yes	☐ 87.93%
☐ No	☐ 2.66%
☐ Do not know	☐ 9.41%

Please explain the reasons of your answer. [free text]

Section F – End of the survey

F1. Do you have any further comments?	Open question

F2. Would you like to participate in a follow-up interview?	☐ Yes ☐ No

If yes, please provide us with your email.	

Section G – Privacy policy

Thank you for completing the questionnaire!

Before closing, please download the Data Protection note below and confirm that you have read it.

[DPN to be downloaded]

xx) By clicking this box, I confirm I read the data protection note.

C.3 Econometric analysis

We employed multivariate econometric analysis to study the relationships between a set of dependent variables (i.e. the variables that we want to explain) and a set of explanatory or independent variables (i.e. the factors driving the dependent variables). The dependent variables are related to the above five main topics to be analysed, i.e. the innovation barriers, the type of innovation, the form of support received, the SMEs' level of satisfaction and the gaps in existing innovation support. **These five sets of variables are treated as dependent variables in the econometric analysis** and each of them will be analysed as a function of specific explanatory variables to identify the SMEs' characteristics that more influence those outcome variables. Each set and the respective econometric model are described more extensively below.

The multivariate analysis permits to control for the characteristics of the respondent SMEs and to address the possible bias stemming from the peculiarities of the sample (for instance the fact that 95% of surveyed SMEs have already introduced some forms of innovation in the previous years).

C.3.1 The main factors hampering innovation in SMEs (Barriers)

The questionnaire targeted to SMEs asked them to indicate the importance of the factors hampering innovation activities among a list of 24 barriers. Column 1) through a five-point Likert scale as follows: "Not important at all"; "Slightly important"; "Neutral"; "Fairly important"; "Very important". The option "Do not know" was added as well. Numbers in parentheses report the percentage of SMEs that selected the options "Fairly important" or "Very important". For instance, 85% of surveyed SMEs (out of 2,176 respondents SMEs) perceive the lack of funds as an important barrier to innovation; while 50% has selected the barrier "Lack of support for internationalisation", etc.

While the questionnaire results are interesting in their own right, they need to be further elaborated for the econometric analysis. To transform original answers into useful input variables for the econometric analysis, the Team pre-treated the SMEs' responses considering three criteria:

- **The importance of the barrier as perceived by SMEs**. For instance, the lack of financial support was considered as a standalone barrier given its importance for SMEs;
- **The importance of the barriers from a policy viewpoint:** this is the case, for instance, of the barriers "Lack of support for internationalisation", the "Increasing emphasis on digitalisation", the "Increasing emphasis on green/sustainable innovation", and the "Insufficient incubation support", the latter important for new established firms. They reflect market trends/needs which is worth investigating on, therefore they are treated as stand-alone barriers.
- **The results from a principal component analysis (PCA)** through which the Team has grouped two or more barriers underlying the same concept based on responses given by the SMEs (see below).

For standalone barriers, the original variable on five-point Likert scale was transformed into a binary variable taking on the value of 1 if "Very" or "Fairly important" and the value of 0 if otherwise, Column 3).

As regards the other barriers, the Team applied the PCA to create groups of "homogeneous" barriers to innovation and condense the amount of information to be used in the econometric models. For example, and according to the SMEs' responses, the PCA indicates that the

barriers with ID 7, 8, 9 underlie the same concept regarding the lack of information on non-financial support as common barrier; hence we built a composite categorical variable "*Information barrier about non- financial support"* that synthesises all of them. This variable was built in a two-step approach: in the first step, the original five-point Likert scale answers to every single barrier were transformed into a binary variable by assigning the value of 1 if the single barrier was "Very" or "Fairly important" and 0 otherwise. In the second step, the *"Information barrier about non- financial support*" variable was obtained as the sum of the three binary items (each one reflecting the lack of info about a specific issue) and its value ranges from 0 to 3 (Column 3). The value of 0 means that no one of those single barriers was important for the respondent SME; in contrast, the value of 3 reflects the importance of all the items. Thus, the higher the value of this variable, the higher the number of the single barriers belonging to the group *"Information barrier about non- financial support"* the respondent SME indicated as important.

The same logic applies to all the other groups of barriers reported. Specifically, Column 1 shows the original barrier as reported in the questionnaire; Column 2 shows the label we attributed to the new outcome variables to be used as dependent variables into the econometric models, while Column 3 reports how the variable is coded.

Table 11. Innovation barriers as dependent variables in the econometric analysis

ID	*Barriers as investigated in the questionnaire* *(% of SMEs that selected very or fairly important)*	*Name of the dependent (outcome) variable as used in the econometric model*	*Dependent variable as used in the econometric model*
	Column 1	**Column 2**	**Column 3**
1	Lack of financing support for R&D&I activities **(85%)**	**Financial barrier**	**Binary variable:** 1 if very or fairly important; 0 Otherwise
2	Lack of support for internationalisation **(50%)**	**Internationalisation barrier**	**Binary variable:** 1 if very or fairly important; 0 Otherwise
3	Increasing emphasis on digitalisation **(33%)**	**Digitalisation barrier**	**Binary variable:** 1 if very or fairly important; 0 Otherwise
4	Insufficient incubation support **(31%)**	**Incubation support barrier**	**Binary variable:** 1 if very or fairly important; 0 Otherwise
5	Increasing emphasis on green/sustainable innovation **(32%)**	**Green and sustainable innovation**	**Binary variable:** 1 if very or fairly important; 0 Otherwise

ID	*Barriers as investigated in the questionnaire* *(% of SMEs that selected very or fairly important)*	*Name of the dependent (outcome) variable as used in the econometric model*	*Dependent variable as used in the econometric model*
	Column 1	**Column 2**	**Column 3**
6	Lack of information on access to financing possibilities **(50%)**	**Information on financial support**	**Binary variable:** 1 if very or fairly important; 0 Otherwise
7	Lack of information on other non-financial innovation support possibilities and knowledge **(39%)**	**Information barrier about non- financial support**	**Composite categorical variable** Min=0; Max= 3
8	Lack of information on new technologies, new regulations **(31%)**		
9	Uncertain regulatory requirements for new innovative products/services **(48%)**		
10	Lack of access to skills / talents / qualified staff **(47%)**	**Skills acquisition from outside**	**Composite categorical variable** Min=0; Max= 2
11	Lack of support for the acquisition of specific skills **(34%)**		
12	Lack of support for the acquisition of innovation management skills **(33%)**	**In-house skills for business development**	**Composite categorical variable** Min=0; Max= 5;
13	Insufficient support for design management **(22%)**		
14	Insufficient support for service innovation **(27%)**		
15	Insufficient support for organisational innovation including the use of IT and e-business **(25%)**		
16	Insufficient IP management support **(35%)**		
17	Lack of cooperation and networking between different R&D&I actors including tech transfer **(45%)**	**Networking and cooperation barrier**	**Composite categorical variable** Min=0; Max= 3;
18	Insufficient links with finance providers **(56%)**		
19	Lack of support for value chain creation / embedding into value chains **(35%)**		
20	Players with large market power have emerged **(60%)**	**Market access barrier**	**Composite categorical variable** Min=0; Max= 2;
21	Access to international markets are more difficult (as a consequence of Brexit and trade tensions)		

ID	*Barriers as investigated in the questionnaire* *(% of SMEs that selected very or fairly important)*	*Name of the dependent (outcome) variable as used in the econometric model*	*Dependent variable as used in the econometric model*
	Column 1	**Column 2**	**Column 3**
22	Complexity of products and services has increased **(52%)**	**Innovation complexity barrier**	**Composite categorical variable** Min=0; Max= 3;
23	Value chains are more complex and more global **(43%)**		
24	Innovation cycles are much faster **(48%)**		

Source: authors elaboration. The Barrier "Other (6%)" is not reported in the Table

In the case of dependent binary variables, the Team applied the binary **logistic econometric model** to investigate what are the factors determining the importance of that barrier for the SMEs (see Equation 1 below); in the case of dependent categorical variables, **the ordered logistic models** are used (see Equation 2).[137]

Logistic models allow us to estimate the probability of observing a specific outcome (dependent variable) given a set of potential explanatory/independent variables. For instance, if the dependent variable is the "*Financial barrier*", Eq. 1 estimates the probability of considering that barrier as important (i.e. = 1) given a set of SMEs' characteristics and other independent variables. Specifically, we can expect that being a micro enterprise increases the probability of perceiving the lack of funds as an important barrier to innovation as compared to small and medium enterprises, and so on.

$$Prob(Financial\ barrier = 1|X) = f(geo\ location, size, sector, type\ of\ SMEs, etc..) \quad (1)$$

When the dependent variable is a categorical variable with j possible values $(i = 0, \dots, J)$, then standard logistic models cannot be applied; therefore, the ordered logistic models are implemented. The latter explain what is the probability of observing the value j of the dependent variable given a set of SMEs' characteristics and other independent variables. For example, if our outcome variable is the "*Information barrier about non- financial support*", then the model estimates the probability of observing the values 0, 1, 2, 3 according to the set of explanatory factors.

$$Prob(Information\ barrier = j|X) = f(geo\ location, size, sector, type\ of\ SMEs, etc..) \quad (2)$$

The set of explanatory variables that the study team used to explain the importance of barriers to innovation included:

[137] See, for instance, Verbeek, M. (2008). A Guide to Modern Econometrics. John Wiley and Sons.

- Geographical factors (North-continental EU, Southern EU, Eastern EU, Extra EU);
- Sector (Manufacturing, services, innovative/non-innovative sector);
- Type of SMEs (micro, small, medium, innovative vs non innovative, high-growth, new vs old established firm, share of R&D expenses, research based);
- SMEs' innovativeness (being in innovative vs-non innovative sub-sectors, research based, share of R&D expenses on turnover, having introduced radical or incremental innovation);
- Type of public support received (see Section B.3.3 below).

In practice, 12 (ordered) logistic models were estimated, i.e. one for each dependent variable (barriers). Moreover, each model had different specifications, that is considering either the full set of explanatory variables or only a sub-set of them.[138]

Error! Reference source not found.and 13 below report the results of this exercise. The "+" symbol indicates that the corresponding variable positively influences the probability of selecting the barrier; in contrast, the sign "-" indicates a negative influence. *,**,*** indicates statistical significance at 10%, 5%, and 1% level respectively. The label "not significant" means no influence of the explanatory variable on the dependent one.

The fact that, in our analysis, several factors turned out to be non-significant might depend on several reasons. Endogeneity could be one of them. For example, having received support for internationalisation may induce some firms to declare that they do not face internationalisation barriers anymore; in contrast, other firms may have responded that they do face internationalisation barriers, and precisely for this reason they applied for (and obtained) internationalisation support. Including these two types of responses in the same model may generate non-significant coefficients. Endogeneity in survey-based data is a well-known issue, which in our study cannot be properly addressed. It would require, for instance, to conduct a proper counterfactual impact evaluation study.

Another reason for the absence of the statistical significance may lie in the aggregation of the original answers. For instance, while the type of public support "*Support for cooperation and networking*" does not influence the aggregate barrier "*Networking and cooperation*", it may instead have an effect on the single original answer "*Lack of cooperation and networking between different R&D&I actors including tech transfer*". The study team performed several robustness checks (not reported here) to reduce the risk that the transformation of the original answers into aggregated variables alter the main results of the econometric analysis.

[138] Specifically, each model (Column) represents the synthesis of several specifications including the full set of explanatory variables or only a subset of them. For instance, considering the Column "Financial" the positive and statistically significant effect of being a micro enterprise holds true both in partial specifications where only SME characteristics are inserted into the model and in more complete specifications where also the *Type of public support received* is jointly plugged into the same model. In order to accompany our estimation with a goodness-of-fit measure, the Count R-Squared is reported in the last row of each table. The Count R-Squared ranges from 0 to 1 and reports the number of records correctly predicted by that specification. For instance, a value of 0.60 indicated that 60% of the answers were correctly predicted by the model. It particular useful in our case because its interpretation is straightforward with respect to other goodness-of-fit measure used in case of OLS estimation such as Efron's or McFadden's R-squared, See for detail https://stats.idre.ucla.edu/other/mult-pkg/faq/general/faq-what-are-pseudo-r-squareds/

As another general remark, it should be considered that all the following tables report all the explanatory variable, including the full set of dummy variables, to facilitate the interpretation of the results also to readers who are less familiar with econometric models, and for the sake of completeness. When dummies are used, the reference category used in the econometric analysis is indicated by the superscript "a". For instance, the variable "*Sector*" was a dummy variable taking on the value of 1 for "*manufacturing*" and 0 for "*services"* and the latter was used a reference modality in the econometric analysis. Both of them are reported in the following tables: if they are both "not significant", this means that the firms operating in the manufacturing sector do not behave differently from those operating in the services sector with respect to dependent variable to be explained. In contrast, if the coefficient of the variable "*manufacturing*" is positive and statistically significant, this indicates that firms operating in the manufacturing sector have a positive effect on the dependent variable as compared to firms in the service sector (which shows the opposite negative sign).

Table 12. Probability of selecting that barrier according to SMEs' characteristics and type of public innovation support received

Explanatory factors		Barriers to innovation – Question C1: What are the factors hampering innovation activities in your company?							
		Financial	Internationalisation	Information on financial support	Information on non-financial support	Skills acquisition from outside	In-house skills for business development	Incubation	Networking and cooperation
SME characteristics									
Geographical factors	North-Continental EU[a]	not significant	- (***)	- (**)	- (***)	- (**)	- (***)	- (*)	- (**)
	Southern EU	not significant	+ (***)	- (**)	+ (***)	+ (**)	+ (***)	+ (*)	+ (**)
	Eastern EU	not significant	+ (***)	+ (**)	+ (***)	+ (**)	+ (***)	+ (*)	- (**)
	Extra EU	not significant	+ (***)	+ (**)	+ (***)	+ (**)	+ (***)	- (*)	+ (**)
Sector	Manufacturing	not significant	not significant	not significant	not significant	- (*)	- (*)	- (**)	not significant
	Services[a]	not significant	not significant	not significant	not significant	+ (*)	+ (*)	+ (**)	not significant
Size/type	Micro	+ (***)	not significant	+ (**)	not significant	- (***)	- (***)	+ (*)	+ (***)
	Small	- (***)	not significant	- (**)	not significant	- (*)	- (**)	- (*)	- (***)
	Medium[a]	- (***)	not significant	- (**)	not significant	+ (**)	+ (**)	- (*)	- (***)
	High-growth	+ (***)	+ (*)	not significa	not significa	not significa	+ (*)	not significa	+ (**)

Explanatory factors		Barriers to innovation – Question C1: What are the factors hampering innovation activities in your company?							
		Financial	Internationalisation	Information on financial support	Information on non-financial support	Skills acquisition from outside	In-house skills for business development	Incubation	Networking and cooperation
	firms			nt	nt	nt		nt	
	Non high-growth firms[a]	- (***)	- (*)	not significant	not significant	not significant	- (*)	not significant	- (**)
	Established after Jan 2014	+ (***)	not significant	+ (***)	not significant	not significant	not significant	+ (***)	+ (***)
	Established before Jan 2014[a]	- (***)	not significant	- (***)	not significant	not significant	not significant	- (***)	- (***)
SMEs Innovativeness	Being in an innovative sector	not significant	not significant	not significant	- (*)	not significant	- (*)	not significant	not significant
	Not being in an innovative sector[a]	not significant	not significant	not significant	+ (*)	not significant	+ (*)	not significant	not significant
	Research based	not significant	+ (**)	not significant	not significant	- (*)	- (*)	not significant	not significant
	Not research based[a]	not significant	- (**)	not significant	not significant	+ (*)	+ (*)	not significant	not significant
	High share of innovation expenditure on turnover	+ (*)	not significant	- (*)	- (**)	- (*)	- (**)	- (**)	not significant
	Low share of innovation expenditure on turnover[a]	- (*)	not significant	+ (*)	+ (**)	+ (*)	+ (**)	+ (**)	not significant
	Having introduced radical innovation	+ (**)	not significant	not significant	not significant	- (***)	- (***)	not significant	not significant
	Having introduced incremental innovation[a]	- (**)	not significant	not significant	not significant	+ (***)	+ (***)	not significant	not significant
Type of public support received									

Explanatory factors	Barriers to innovation – Question C1: What are the factors hampering innovation activities in your company?							
	Financial	Internationalisation	Information on financial support	Information on non-financial support	Skills acquisition from outside	In-house skills for business development	Incubation	Networking and cooperation
Financial support	- (***)	not significant	- (***)	not significant	not significant	not significant	- (***)	- (*)
Awareness raising support	not significant	not significant	- (*)	not significant	not significant	not significant	not significant	not significant
Support for specific skills	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Support for knowledge and tech transfer	not significant	not significant	not significant	not significant	not significant	- (*)	not significant	not significant
Innovation management support	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Support for identifying innovation potential	not significant	not significant	not significant	not significant	not significant	- (*)	not significant	not significant
Support for internationalisation	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Support for cooperation and networking	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Goodness-of-fit (Count R-Squared -%)	82.5%	58.6%	58.2%	52.0%	62.0%	59.0%	73.5%	55.1%

*Source: Authors' elaboration on SMEs survey data. "+" indicates that the corresponding variable positively influences the probability of selecting the barrier; in contrast, "-" indicates a negative influence. *,**,*** indicates statistical significance at 10%, 5%, and 1% level respectively. Constanta are not reported. Observations range from 1,986 to 1,864. The apex "a" identifies the reference category of dummy variables.*

Table 13. Probability of selecting that barrier (emerging trends) according to SMEs' characteristics and type of public innovation support received

Explanatory factors		Barriers to innovation – Question C2. In your opinion, do the following technology, economic and market developments constitute a barrier to innovation?			
		Market access	Innovation complexity	Digitalisation	Green and sustainable innovation
SME characteristics					
Geographical factors	North-Continental EU[a]	not significant	- (**)	- (***)	- (***)
	Southern EU	not significant	+ (**)	+ (***)	+ (***)

Explanatory factors		Barriers to innovation – Question C2. In your opinion, do the following technology, economic and market developments constitute a barrier to innovation?			
		Market access	Innovation complexity	Digitalisation	Green and sustainable innovation
	Eastern EU	not significant	+ (*)	+ (***)	+ (***)
	Extra EU	not significant	+ (**)	+ (***)	+ (***)
Sector	Manufacturing	- (*)	not significant	not significant	+ (***)
	Services[a]	+ (*)	not significant	not significant	- (***)
Size/type	Micro	not significant	not significant	not significant	not significant
	Small	not significant	not significant	not significant	not significant
	Medium[a]	not significant	not significant	not significant	not significant
	High-growth firms	- (*)	not significant	not significant	not significant
	Non high-growth firms[a]	+ (*)	not significant	not significant	not significant
	Established after Jan 2014	- (*)	- (*)	not significant	not significant
	Established before Jan 2014[a]	+ (*)	+ (*)	not significant	not significant
SMEs Innovativeness	Being in an innovative sector	+ (*)	not significant	- (**)	- (**)
	Not being in an innovative sector[a]	- (*)	not significant	+ (**)	+ (**)
	Research based	not significant	+ (*)	not significant	not significant
	Not research based [a]	not significant	- (*)	not significant	not significant
	High share of innovation expenditure on turnover	not significant	not significant	not significant	not significant
	Low share of innovation expenditure on turnover[a]	not significant	not significant	not significant	not significant
	Having introduced radical innovation	not significant	- (***)	- (***)	not significant
	Having introduced incremental innovation[a]	not significant	+ (***)	+ (***)	not significant

Explanatory factors	Barriers to innovation – Question C2. In your opinion, do the following technology, economic and market developments constitute a barrier to innovation?			
	Market access	Innovation complexity	Digitalisation	Green and sustainable innovation
Type of public support received				
Financial support	not significant	not significant	not significant	not significant
Awareness raising support	not significant	not significant	not significant	not significant
Support for specific skills	not significant	not significant	not significant	not significant
Support for knowledge and tech transfer	not significant	not significant	not significant	not significant
Innovation management support	not significant	not significant	not significant	not significant
Support for identifying innovation potential	not significant	not significant	not significant	not significant
Support for internationalisation	not significant	not significant	not significant	not significant
Support for cooperation and networking	not significant	not significant	not significant	not significant
Goodness-of-fit (Count R-Squared -%)	55.9%	63.0%	68.9%	68.2%

*Source: Authors' elaboration on SMEs survey data. "+" indicates that the corresponding variable positively influences the probability of selecting the barrier; in contrast, "-" indicates a negative influence. *,**,*** indicates statistical significance at 10%, 5%, and 1% level respectively. Constants are not reported. Observations range from 1,974 to 1,856. The apex "a" identifies the reference category of dummy variables.*

C.3.2 Type of innovation introduced by SMEs

The questionnaire asked SMEs what type of innovation they introduced during the past three years by offering the options listed in Table 14, Column 1.[139] As above, the percentage in parentheses shows that the great majority of the surveyed (65%) SMEs introduced new products, followed by those introduced services (26%). The other types of innovation were introduced by a residual share of SMEs. Similarly, the share of SMEs introducing more than one type of innovation (e.g. products and services) is negligible in our sample.
Accordingly, we defined three binary variables that capture the type of innovation introduced by SMEs (Table 14, Column 2 and 3).

In this case the logistic model allows us to investigate the probability of introducing a specific type of innovation as a function of the set of the following explanatory variables:

- Geographical factors (North-continental EU, Southern EU, Eastern EU, Extra EU);
- Sector (Manufacturing, services, innovative/non-innovative sector);
- Type of SMEs (micro, small, medium, innovative vs non innovative, high-growth, new vs old established firm, share of R&D expenses, research based);
- SMEs innovativeness (being in innovative vs-non innovative sub-sectors, research based, share of R&D expenses on turnover, having introduced radical or incremental innovation);
- Type of public support received (see Section C.3.3 below).

Table 14. Type of innovation as dependent variable in the econometric analysis

ID	*Type of innovation introduced as investigated in the questionnaire (% of SMEs)*	*Name of the dependent (outcome) variable as used in the econometric model*	*Dependent variable as used in the econometric model*
	Column 1	Column 2	Column 3
1	Yes, new or significantly improved **products (65%)**	**Products**	**Binary variable:** 1Yes; 0 Otherwise
2	Yes, new or significantly improved **services (26%)**	**Services**	**Binary variable:** 1Yes; 0 Otherwise
3	Yes, new or significantly improved **processes** for manufacturing goods or producing services **(8%)**	**Processes, organisational and business models.**	**Composite categorical variable** Min=0; Max= 4;
4	Yes, new or significantly improved **organisational methods** (e.g., change in management structure, work organisation or new methods of interaction with other companies) **(2%)**		
5	Yes, a new **business model** or a new way of marketing your products/services **(7%)**		
6	Yes, new or significantly **improved logistics**, delivery or distribution processes **(1%)**		

Source: authors elaboration.

The results of the analysis are reported in the Table below.

[139] See question B.1 of the questionnaire targeted to SMEs.

Table 15. Probability of introducing a certain type of innovation by SMEs'characteristics and type of public innovation support received

Explanatory factors		Type of innovation introduced – Question B1: Over the last 3 years, has your company introduced any of the following forms of innovation?		
		Products	**Services**	**Processes, business and marketing models, logistics and organisational methods**
SME characteristics				
Geographical factors	North-Continental EU[a]	+ (***)	+ (***)	+ (***)
	Southern EU	- (**)	- (***)	- (***)
	Eastern EU	- (*)	+ (***)	- (**)
	Extra EU	- (***)	- (***)	- (***)
Sector	Manufacturing	+(***)	- (***)	Not significant
	Services[a]	- (***)	+ (***)	Not significant
Size/type	Micro	Not significant	Not significant	- (***)
	Small	Not significant	Not significant	- (*)
	Medium[a]	Not significant	Not significant	+(***)
	High-growth firms	Not significant	+(**)	Not significant
	Non high-growth firms[a]	Not significant	- (**)	Not significant
	Established after Jan 2014	Not significant	- (*)	Not significant
	Established before Jan 2014[a]	Not significant	+(*)	Not significant
SMEs Innovativeness	Being in an innovative sector	+(*)	Not significant	- (*)
	Not being in an innovative sector[a]	- (*)	Not significant	+(*)
	Research based	+(***)	- (**)	Not significant

Explanatory factors		Type of innovation introduced – Question B1: Over the last 3 years, has your company introduced any of the following forms of innovation?		
		Products	**Services**	**Processes, business and marketing models, logistics and organisational methods**
	Not research based[a]	- (***)	+(**)	Not significant
	High share of innovation expenditure on turnover	+(***)	- (**)	Not significant
	Low share of innovation expenditure on turnover[a]	- (***)	+(**)	Not significant
	Having introduced radical innovation	+(**)	Not significant	- (**)
	Having introduced incremental innovation[a]	- (**)	Not significant	+(**)
Type of public support received				
Financial support		+(***)	+(**)	+(**)
Awareness raising support		Not significant	+(***)	Not significant
Support for specific skills		+(**)	Not significant	Not significant
Support for knowledge and tech transfer		Not significant	+(***)	+(***)
Innovation management support		Not significant	Not significant	Not significant
Support for identifying innovation potential		Not significant	+(***)	Not significant
Support for internationalisation		+(*)	+(**)	+(**)
Support for cooperation and networking		Not significant	+(***)	+(***)
Goodness-of-fit (Count R-Squared -%)		79.1%	78.6%	86.2%

*Source: Authors' elaboration on SMEs survey data. "+" indicates that the corresponding variable positively influences the probability of introducing the specific type of innovation; in contrast, "-" indicates a negative influence. *,**,*** indicates statistical significance at 10%, 5%, and 1% level respectively. Constants are not reported.*

Explanatory factors	Type of innovation introduced – Question B1: Over the last 3 years, has your company introduced any of the following forms of innovation?		
	Products	**Services**	**Processes, business and marketing models, logistics and organisational methods**

Observations range from 1,993 to 1,856. The apex "a" identifies the reference category of dummy variables.

C.3.3 The form of innovation support received by SMEs

The questionnaire asked SMEs whether in the three past years they received any form of public support, and in that case in which forms by distinguishing by the type of support listed in Table 16, Column 1.[140] Out of 2,176 surveyed SMEs, 64% received a financial support, 26% did not receive any support, and only a residual share of SMEs received other forms of support.

Accordingly, we created three dependent variables to be investigated (Table 16; Column 2, 3, 4):

- **Having received the support**: 1 if Yes; 0 if no support received.
- **Having received the financial support**: 1 if Yes; 0 otherwise
- **Having received other forms of public support:** 1 if Yes; 0 otherwise;

These three variables allow us to explain respectively: i) the probability of receiving any form of public support; ii) the probability of receiving the financial support, and iii) the probability of receiving any other support (except financial) according to a set of SMEs characteristics and other explanatory variables (see Table 17). Such a set of variables includes:

- Geographical factors (North-continental EU, Southern EU, Eastern EU, Extra EU);
- Sector (Manufacturing, services, innovative/non-innovative sector);
- Type of SMEs (micro, small, medium, innovative vs non innovative, high-growth, new vs old established firm, share of R&D expenses, research based);
- SMEs innovativeness (being in innovative vs-non innovative sub-sectors, research based, share of R&D expenses on turnover, having introduced radical or incremental innovation);
- Type of innovation introduced (see Section C.3.2 above);
- Type of barrier (as reported in Section C.3.1 above).

Table 16. Form of innovation support received as dependent variable in the econometric analysis

<table>
<tr><th rowspan="2">ID</th><th>Form of innovation support received in the last three years as investigated in the questionnaire

(% of SMEs)</th><th colspan="2">Name of the dependent (outcome) variable as used in the econometric model</th><th>Dependent variable as used in the econometric model</th></tr>
<tr><th>Column 1</th><th>Column 2</th><th>Column 3</th><th>Column 4</th></tr>
<tr><td>1</td><td>Support for financing innovation projects (including R&D) (64%)</td><td rowspan="3">Having received the support</td><td>Having received the financial support</td><td rowspan="3">Binary variable:

1 if Yes;

0 Otherwise</td></tr>
<tr><td>2</td><td>Support for networking and cooperation between actors (9%)</td><td rowspan="2">Having received other forms of public support</td></tr>
<tr><td>3</td><td>Support for awareness raising and information on support possibilities</td></tr>
</table>

[140] See question D.1 of the questionnaire targeted to SMEs.

ID	*Form of innovation support received in the last three years as investigated in the questionnaire (% of SMEs)*	*Name of the dependent (outcome) variable as used in the econometric model*		*Dependent variable as used in the econometric model*
	Column 1	**Column 2**	**Column 3**	**Column 4**
	(4%)			
4	Support for technology / knowledge transfer) **(4%)**			
5	Support to identify innovation potential (information on market needs, market conditions, new regulations, new technology, etc.) **(3%)**			
6	Support for innovation management (organisational management, IP management, design management) **(3%)**			
7	Support for the creation of specific skills **(2%)**			
8	Support for the internationalisation of innovative SMEs **(5%)**			
9	No support received **(26%)**			

Source: authors elaboration. The item "Other (1%)" and "Do not know" (less than 0.1%) are not reported in the Table.

Table 17. Forms of public support received according to the SMEs' characteristics, type of innovation introduced and barriers faced

Explanatory factors		Form of public support received – Question D1: Over the last three years, what kind of public innovation support has your company received?		
		Probability of receiving public support	Probability of receiving the financial public support	Probability of receiving other forms of public support
SME characteristics				
Geographical factors	North-Continental EU[a]	+(***)	+(*)	+(***)
	Southern EU	- (***)	+(*)	- (***)
	Eastern EU	- (*)	- (*)	- (***)
	Extra EU	- (**)	- (***)	- (***)
Sector	Manufacturing	+(***)	+(***)	+(***)
	Services[a]	- (***)	- (***)	- (***)
Size/type	Micro	- (**)	- (***)	+(*)
	Small	+(**)	+(***)	- (*)
	Medium[a]	+(**)	+(***)	- (*)
	High-growth firms	Not significant	Not significant	Not significant
	Non high-growth firms[a]	Not significant	Not significant	Not significant
	Established after Jan 2014	- (*)	- (***)	+(*)
	Established before Jan 2014[a]	+(*)	+(***)	- (*)
SMEs Innovativeness	Being in an innovative sector	Not significant	Not significant	Not significant

Explanatory factors		Form of public support received – Question D1: Over the last three years, what kind of public innovation support has your company received?		
		Probability of receiving public support	Probability of receiving the financial public support	Probability of receiving other forms of public support
	Not being in an innovative sector[a]	Not significant	Not significant	Not significant
	Research based	+(*)	+(**)	Not significant
	Not research based[a]	- (*)	- (**)	Not significant
	High share of innovation expenditure on turnover	+(***)	+(***)	- (**)
	Low share of innovation expenditure on turnover[a]	- (***)	- (***)	+(**)
	Having introduced radical innovation	Not significant	Not significant	Not significant
	Having introduced incremental innovation[a]	Not significant	Not significant	Not significant
Type of innovation introduced				
Products		+(**)	+(***)	+(***)
Services		Not significant	Not significant	+(***)
Processes		Not significant	Not significant	+(***)
Organisational methods		Not significant	Not significant	+(**)
Business models or marketing		Not significant	- (*)	+(***)
Logistics, delivery or distribution		Not significant	Not significant	Not significant

Explanatory factors	Form of public support received – Question D1: Over the last three years, what kind of public innovation support has your company received?		
	Probability of receiving public support	Probability of receiving the financial public support	Probability of receiving other forms of public support
Type of barrier			
Financial	- (***)	- (***)	Not significant
Internationalisation	Not significant	Not significant	Not significant
Digitalisation	- (*)	Not significant	+(**)
Incubation	- (***)	- (***)	Not significant
Financial information	- (***)	- (***)	Not significant
Other (non financial) information	Not significant	Not significant	Not significant
Lack of skills (acquisition from outside)	+(***)	+(***)	Not significant
Lack of in-house skills for business development	Not significant	Not significant	Not significant
Networking and cooperation	- (***)	- (***)	Not significant
Market access	Not significant	Not significant	Not significant
Innovation complexity	+(***)	+(***)	+(**)
Green and sustainable innovation	Not significant	Not significant	+(**)
Goodness-of-fit (Count R-Squared -%)	78.6%	74.6%	82.2%

*Source: Authors' elaboration on SMEs survey data. "+" indicates that the corresponding variable positively influences the probability of receiving the specific form of public support; in contrast, "-" indicates a negative influence. *,**,*** indicates statistical significance at 10%, 5%, and 1% level respectively. Constants are not reported. Observations*

Explanatory factors	Form of public support received – Question D1: Over the last three years, what kind of public innovation support has your company received?		
	Probability of receiving public support	Probability of receiving the financial public support	Probability of receiving other forms of public support

range from 1,869 to 1,856. The apex "a" identifies the reference category of dummy variables.

C.3.4 The SMEs' level of satisfaction with the support received

To investigate on the level of satisfaction of SMEs about the support received, the Team resorts to two set of questions:

- **Question D.6: To what extent did the following innovation support you received meet your expectations**? It was a five-point Likert scale question as follows: Did not meet your expectations at all"; "Weakly met your expectations"; "Moderately met your expectations"; "Largely met your expectations"; "Perfectly met your expectations". The option "Not relevant" was added as well. The satisfaction was asked about the typologies of support reported in Table 18, Column 1, which strictly mirror the typologies of barrier analysed in section C.3.1. 1,587 surveyed SMEs answered this question and the percentage of SMEs% that selected either the option "perfectly, largely, or moderately met the expectations" is shown in parentheses in Column 1.

  The rationale applied to construct the binary and the composite categorical variables is the same as the one applied in the case of barriers in section C.3.1.

  In this case the (ordered) logit models examine the probability of being satisfied according to the support received and other explanatory variables (see below). Econometric results are reported in Table 20.

- **Question D.5. It is a question on the added value of the support received** and specifically asks to what extent the innovation would not have been developed or introduced without the support. Different options of added value were investigated as reported in Table 19. For each option, a binary variable was constructed which takes on the value of 1 if that option was selected and 0 otherwise.

  In this case, the econometric analysis predicts the probability of selecting that option according to a set of selected variables. Results concerning the added value are reported in Table 21.

Whatever the question, the set of explanatory variables used were:

- Geographical factors (North-continental EU, Southern EU, Eastern EU, Extra EU);
- Sector (Manufacturing, services, innovative/non-innovative sector);
- Type of SMEs (micro, small, medium, innovative vs non innovative, high-growth, new vs old established firm, share of R&D expenses, research based);
- SMEs innovativeness (being in innovative vs-non innovative sub-sectors, research based, share of R&D expenses on turnover, having introduced radical or incremental innovation);
- Type of public support received (as reported in Section C.3.3);
- Share of public support received out of total R&D expenditure;
- Level of government of the public support received. i.e. European, National, Regional, Local (only for the added value);
- Type of barrier as reported in Section C.3.1 above (only for the added value).

Table 18. SMEs' level of satisfaction as dependent variable in the econometric analysis

ID	*Satisfaction about the innovation support as investigated in the questionnaire (% of SMEs that selected perfectly, largely, or moderately met the expectations)*	*Name of the dependent (outcome) variable as used in the econometric model*	*Dependent variable as used in the econometric model*
	Column 1	Column 2	Column 3
1	Financial support for R&D&I activities **(81%)**	**Financial support satisfaction**	**Binary variable:** 1 if perfectly, largely, or moderately met the expectations; 0 Otherwise
2	Support for internationalisation **(43%)**	**Internationalisation support satisfaction**	**Binary variable:** 1 if perfectly, largely, or moderately met the expectations; 0 Otherwise
3	Incubation support **(36%)**	**Incubation support satisfaction**	**Binary variable:** 1 if perfectly, largely, or moderately met the expectations; 0 Otherwise
4	Information on access to financing possibilities **(68%)**	**Information on financial support satisfaction**	**Binary variable:** 1 if perfectly, largely, or moderately met the expectations; 0 Otherwise
5	Information on other non-financial innovation support possibilities and knowledge **(49%)**	**Information on ono-financiala support satisfaction**	**Composite categorical variable** Min=0; Max= 3;
6	Information on new technologies, new regulations **(49%)**		
7	Support to participate in Regulatory sandboxes to test new regulatory requirements for innovative products /services **(24%)**		
8	Support to access to skills / talents / qualified staff **(37%)**	**Satisfaction about the support for the skills acquisition from outside**	**Composite categorical variable** Min=0; Max= 2
9	Support for the acquisition of specific skills **(43%)**		

ID	*Satisfaction about the innovation support as investigated in the questionnaire (% of SMEs that selected perfectly, largely, or moderately met the expectations)*	*Name of the dependent (outcome) variable as used in the econometric model*	*Dependent variable as used in the econometric model*
	Column 1	**Column 2**	**Column 3**
10	Support for the acquisition of innovation management skills (e.g. for the development of an including innovation strategy) **(40%)**	**Satisfaction about the support for in-house skills for business development**	**Composite categorical variable** Min=0; Max= 4
11	Support for design management **(31%)**		
12	Support for service innovation **(34%)**		
13	Support for organisational innovation including the use of IT and e-business **(33%)**		
14	IP management support **(41%)**		
15	Cooperation and networking between different R&D&I actors including tech transfer **(50%)**	**Networking and cooperation support satisfaction**	**Composite categorical variable** Min=0; Max= 3;
16	Help to establish links with finance providers **(33%)**		
17	Support for value chain creation / embedding into value chains **(33%)**		

Source: authors elaboration. The item "Other (3%)" is not reported in the Table

Table 19. Added value as dependent variable in the econometric analysis

ID	*Added value as investigated in the questionnaire (% of SMEs that selected the respective option; N = 1,577)*	*Name of the dependent (outcome) variable as used in the econometric model*	*Dependent variable as used in the econometric model*
	Column 1	**Column 2**	**Column 3**
1	**Total** added value – the innovation would not have been developed or introduced without the support **(45%)**	**Total added value**	**Binary variable:** 1 if Yes; 0 Otherwise
2	Partly, thanks to public support I could enlarge the **scope** of the innovation activities **(18%)**	**Partial added value - scope**	**Binary variable:** 1 if Yes; 0 Otherwise
3	Partly, thanks to public support I could enlarge the **scale** of the innovation activities **(8%)**	**Partial added value - scale**	**Binary variable:** 1 if Yes; 0 Otherwise
4	Partly, thanks to public support I could implement **more quickly** some innovation projects that I had already foreseen **(12%)**	**Partial added value - timing**	**Binary variable:** 1 if Yes; 0 Otherwise

Source: authors elaboration.

Table 20. SMEs' satisfaction about the type of support received according to SMEs' characteristics, type and share of public support received

Explanatory factors		Satisfaction of the support received – Question D6: To what extent did the following innovation support you received meet your expectations?							
		Financial	**Internationalisation**	**Information on financial support**	**Information on non-financial support**	**Skills acquisition from outside**	**In-house skills for business development**	**Incubation**	**Networking and cooperation**
SME characteristics									
Geographical factors	North-Continental EU[a]	+ (***)	not significant	+ (**)	- (**)	-(*)	-(***)	- (**)	not significant
	Southern EU	- (***)	not significant	- (**)	+ (**)	+(*)	+(***)	+ (**)	not significant
	Eastern EU	+ (***)	not significant	+ (**)	- (**)	+(*)	+(***)	- (**)	not significant
	Extra EU	- (***)	not significant	- (**)	+ (**)	+(*)	+(***)	+ (**)	not significant
Sector	Manufacturing	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
	Services[a]	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Size/type	Micro	-(*)	not significant	-(*)	not significant	not significant	not significant	+(***)	-(*)
	Small	+(*)	not significant	+(*)	not significant	not significant	not significant	+(***)	+(*)
	Medium[a]	+(*)	not significant	+(*)	not significant	not significant	not significant	-(***)	+(*)
	High-growth firms	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
	Non high-growth firms[a]	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant

Explanatory factors		Satisfaction of the support received – Question D6: To what extent did the following innovation support you received meet your expectations?							
		Financial	**Internationalisation**	**Information on financial support**	**Information on non-financial support**	**Skills acquisition from outside**	**In-house skills for business development**	**Incubation**	**Networking and cooperation**
	Established after Jan 2014	-(*)	not significant	not significant	not significant	+(**)	+(*)	+(***)	+(*)
	Established before Jan 2014[a]	+(*)	not significant	not significant	not significant	-(**)	-(*)	-(***)	-(*)
SMEs Innovativeness	Being in an innovative sector	not significant	-(*)	not significant	not significant	-(*)	not significant	-(*)	not significant
	Not being in an innovative sector[a]	not significant	+(*)	not significant	not significant	+(*)	not significant	+(*)	not significant
	Research based	+(**)	+(**)	+(**)	not significant	not significant	+(**)	not significant	not significant
	Not research based[a]	-(**)	-(**)	-(**)	not significant	not significant	-(**)	not significant	not significant
	High share of innovation expenditure on turnover	+(*)	not significant	not significant	not significant	not significant	not significant	not significant	not significant
	Low share of innovation expenditure on turnover[a]	-(*)	not significant	not significant	not significant	not significant	not significant	not significant	not significant
	Having introduced radical	-(***)	not significant	not significant	not significant	not significant	not significant	not significant	not significant

Explanatory factors		Satisfaction of the support received – Question D6: To what extent did the following innovation support you received meet your expectations?							
		Financial	**Internationalisation**	**Information on financial support**	**Information on non-financial support**	**Skills acquisition from outside**	**In-house skills for business development**	**Incubation**	**Networking and cooperation**
	innovation								
	Having introduced incremental innovation[a]	+(***)	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Type of public support received									
Financial support		+(***)	not significant	+(***)	+(***)	+(***)	+(**)	+(*)	+(***)
Awareness raising support		not significant	not significant	+(***)	+(*)	not significant	not significant	not significant	+(*)
Support for specific skills		not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Support for knowledge and tech transfer		not significant	not significant	not significant	not significant	+(***)	+(***)	not significant	+(*)
Innovation management support		not significant	not significant	not significant	+(***)	not significant	+(***)	not significant	not significant
Support for identifying innovation potential		not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Support for internationalisation		not significant	+(***)	not significant	not significant	not significant	not significant	not significant	not significant
Support for cooperation and networking		not significant	not significant	+(***)	+(*)	+(**)	not significant	not significant	+(***)
Share of public support received									

Explanatory factors	Satisfaction of the support received – Question D6: To what extent did the following innovation support you received meet your expectations?							
	Financial	**Internationalisation**	**Information on financial support**	**Information on non-financial support**	**Skills acquisition from outside**	**In-house skills for business development**	**Incubation**	**Networking and cooperation**
High share of public funds received out of total RDI expenditure	+ (***)	not significant	+ (***)	+ (***)	not significant	not significant	not significant	+(**)
Low share of public funds received out of total RDI expenditure	-(***)	not significant	-(***)	-(***)	not significant	not significant	not significant	-(**)
Goodness-of-fit (Count R-Squared -%)	65.0%	68.7%	70.9%	56.3%	60.6%	68.4%	68.6%	68.3%

*Source: Authors' elaboration on SMEs survey data. "+" indicates that the corresponding variable positively influences the probability of being satisfied about the type of public support received; in contrast, "-" indicates a negative influence. *,**,*** indicates statistical significance at 10%, 5%, and 1% level respectively. Constants are not reported. Observations range from 1,469 to 1,422. The apex "a" identifies the reference category of dummy variables.*

Table 21. Probability of experiencing the corresponding added value from the public support received as a function of SMEs' characteristics, type and share of public support received, level of government of the support and barrier faced.

Explanatory factors		Additionality of public support – Question D5: Was the public support for any of your company's innovation projects such that the innovation would not have been developed or introduced without this support?			
		Total added value	***Partial added value - scope***	***Partial added value - scale***	***Partial added value - timing***
SME characteristics					
Geographical factors	North-Continental EU[a]	+(***)	-(***)	+(**)	Not significant
	Southern EU	-(***)	-(***)	+(**)	Not significant
	Eastern EU	-(**)	+(***)	-(**)	Not significant

Explanatory factors		Additionality of public support – Question D5: Was the public support for any of your company's innovation projects such that the innovation would not have been developed or introduced without this support?			
		Total added value	***Partial added value - scope***	***Partial added value - scale***	***Partial added value - timing***
	Extra EU	-(***)	+(***)	-(**)	Not significant
Sector	Manufacturing	+(*)	Not significant	Not significant	Not significant
	Services[a]	-(*)	Not significant	Not significant	Not significant
Size/type	Micro	+(***)	-(*)	Not significant	Not significant
	Small	+(*)	+(*)	Not significant	Not significant
	Medium[a]	-(*)	+(*)	Not significant	Not significant
	High growth firms	Not significant	Not significant	Not significant	Not significant
	Non high-growth firms[a]	Not significant	Not significant	Not significant	Not significant
	Established after Jan 2014	Not significant	Not significant	Not significant	+(***)
	Established before Jan 2014[a]	Not significant	Not significant	Not significant	-(***)
SMEs Innovativeness	Being in an innovative sector	Not significant	Not significant	Not significant	+(**)
	Not being in an innovative sector[a]	Not significant	Not significant	Not significant	-(**)
	Research based	Not significant	Not significant	Not significant	Not significant
	Not research based[a]	Not significant	Not significant	Not significant	Not significant

Explanatory factors		Additionality of public support – Question D5: Was the public support for any of your company's innovation projects such that the innovation would not have been developed or introduced without this support?			
		Total added value	***Partial added value - scope***	***Partial added value - scale***	***Partial added value - timing***
	High share of innovation expenditure on turnover	Not significant	+(**)	Not significant	Not significant
	Low share of innovation expenditure on turnover[a]	Not significant	-(**)	Not significant	Not significant
	Having introduced radical innovation	Not significant	Not significant	Not significant	Not significant
	Having introduced incremental innovation[a]	Not significant	Not significant	Not significant	Not significant
Type of public support received					
Financial support		+(***)	+(***)	+(*)	Not significant
Awareness raising support		-(*)	Not significant	Not significant	Not significant
Support for specific skills		Not significant	Not significant	+(*)	+(*)
Support for knowledge and tech transfer		Not significant	+(***)	Not significant	Not significant
Innovation management support		Not significant	Not significant	Not significant	Not significant
Support for identifying innovation potential		Not significant	Not significant	Not significant	Not significant
Support for internationalisation		Not significant	Not significant	Not significant	Not significant
Support for cooperation and networking		+(*)	Not significant	Not significant	Not significant
Share of public support received					

Explanatory factors	Additionality of public support – Question D5: Was the public support for any of your company's innovation projects such that the innovation would not have been developed or introduced without this support?			
	Total added value	***Partial added value - scope***	***Partial added value - scale***	***Partial added value - timing***
High share of public funds received out of total RDI expenditure	+(***)	Not significant	+(**)	Not significant
Low share of public funds received out of total RDI expenditure	-(***)	Not significant	-(**)	Not significant
Level of government of the public support received				
EU	+(***)	Not significant	Not significant	Not significant
National	+(*)	Not significant	Not significant	Not significant
Regional/federal	Not significant	Not significant	Not significant	Not significant
Local (incl. city level) [a]	Not significant	Not significant	Not significant	Not significant
Type of barrier				
Financial	+(**)	Not significant	Not significant	Not significant
Internationalisation	Not significant	Not significant	Not significant	Not significant
Digitalisation	+(**)	Not significant	Not significant	-(*)
Incubation	+(**)	Not significant	Not significant	Not significant
Financial information	Not significant	Not significant	Not significant	Not significant
Other (non financial) information	Not significant	Not significant	Not significant	Not significant
Lack of skills (acquisition from outside)	-(***)	Not significant	Not significant	Not significant

Explanatory factors	Additionality of public support – Question D5: Was the public support for any of your company's innovation projects such that the innovation would not have been developed or introduced without this support?			
	Total added value	***Partial added value - scope***	***Partial added value - scale***	***Partial added value - timing***
Lack of in-house skills for business development	Not significant	Not significant	Not significant	-(**)
Networking and cooperation	+(**)	Not significant	Not significant	Not significant
Market access	Not significant	Not significant	Not significant	Not significant
Innovation complexity	-(**)	+(**)	Not significant	Not significant
Green and sustainable innovation	Not significant	Not significant	Not significant	Not significant
Goodness-of-fit (Count R-Squared -%)	68.5%	81.4%	91.8%	87.6%

*Source: Authors' elaboration on SMEs survey data. "+" indicates that the corresponding variable positively influences the probability of having experienced the specific added value; in contrast, "-" indicates a negative influence. *,**,*** indicates statistical significance at 10%, 5%, and 1% level respectively. In all the specifications, we also controlled for the type of innovation introduced (i.e. products, services, etc.) and the results do not change significantly. Constants are not reported. Observations range from 1,463 to 1,419. The apex "a" identifies the reference category of dummy variables.*

C.3.5 Gaps in existing SME innovation support

Gaps are examined in two ways.

- **Firstly, we exploited the question E.1 of the questionnaire, which asked SMEs for what type of innovation activities they would need better support.** Specifically, for each item reported in Table 22, Column 1, SMEs were asked to assign a score from 1 (No support is needed) to 5 (Very much support is need). 1,956 SMEs replied to this question and the percentage in parenthesis reports the share of them that answered "Much or very much support".
  The items investigated with this question strictly mirror the barrier items in Section C.3.1) and the items in the question related to the level of satisfaction (Table 18 in Section C.3.4). Therefore, the rationale applied to construct the binary and the composite categorical variables is the same as the one applied in the case of barriers in section and when investigating the level of satisfaction.
  Accordingly, the (ordered) logit models estimate **the probability of the need of a better support as a function of a set of explanatory variables** (see below).

- **The second approach exploits the questions C.1 about the barrier and the question C.6 regarding the level of satisfaction about the support received (see above).** Both of them are five-point Likert scale questions: the first one investigates on the level of importance of a specific barrier item (the higher the level the higher the importance); the second one investigates on the level of satisfaction of the support received, which in turn mirrors the barrier items (the higher the score assigned, the higher the level of satisfaction). For instance, while question C.1 asks about the level of importance on the financial barrier, question C.6. asks what is the level of satisfaction about the financial support received, and so on.
  The gap is measured by the difference between the score assigned to the barrier and the score assigned to the satisfaction item by item. It goes from -4 to +4: a positive value indicates that the perceived barrier has not still properly addressed and there is an existing gap; in contrast, a negative value or a zero value indicate that the gap has been closed/addressed (according to the SMEs' perceptions).

At this point, our binary and the composite categorical variables have been constructed by following the same procedure as the one applied above.
In this case**,** the econometric analysis examines **the probability of observing the gap as a function of a set of explanatory variables (see below).**

The following set of explanatory variables were used:

- Geographical factors (North-continental EU, Southern EU, Eastern EU, Extra EU);
- Sector (Manufacturing, services, innovative/non-innovative sector);
- Type of SMEs (micro, small, medium, innovative vs non innovative, high-growth, new vs old established firm, share of R&D expenses, research based);
- SMEs innovativeness (being in innovative vs-non innovative sub-sectors, research based, share of R&D expenses on turnover, having introduced radical or incremental innovation);
- Type of public support received (as reported in Section C.3.3);

- Share of public support received out of total R&D expenditure;
- Level of government of the public support received. i.e. European, National, Regional, Local (only for gaps);
- Type of barrier as reported in Section C.3.1 above (only for needs).

Table 22. Need of better support as dependent variable in the econometric analysis

ID	*Need of better support as investigated in the questionnaire (% of SMEs that selected "Much or very much support")*	*Name of the dependent (outcome) variable as used in the econometric model*	*Dependent variable as used in the econometric model*
	Column 1	Column 2	Column 3
1	Financial support for R&D&I activities **(85%)**	**Financial support need**	**Binary variable:** 1 if Much or very much support; 0 Otherwise
2	Internationalisation **(57%)**	**Internationalisation support need**	**Binary variable:** 1 if Much or very much support; 0 Otherwise
3	Incubation activities **(30%)**	**Incubation support need**	**Binary variable:** 1 if Much or very much support; 0 Otherwise
4	Better information on access to financing possibilities **(66%)**	**Financial information support need**	**Binary variable:** 1 if Much or very much support; 0 Otherwise
5	Better information on other non-financial innovation support possibilities **(44%)**	**Non-Financial information support need**	**Composite categorical variable** Min=0; Max= 3
6	Better information on new technologies, new regulations **(40%)**		
7	Involvement in regulatory sandboxes to test new regulatory requirements for innovative products /services **(40%)**		
8	Better access to skills/talents / qualified staff **(38%)**	**Acquisition skills from outside support need**	**Composite categorical variable** Min=0; Max= 2;
9	Acquiring specific skills **(31%)**		
10	Acquiring innovation management skills (e.g. for the development of an including innovation strategy) **(30%)**	**Nedd for the the in-house skills for business development**	**Composite categorical variable** Min=0; Max= 5;
11	Design management **(20%)**		
12	Service innovation **(26%)**		
13	Organisational innovation including the use of IT and e-business **(25%)**		
14	IP management (patents, copyrights, trademarks) **(41%)**		
15	Cooperation and networking between different R&D&I actors including support for technology transfer **(45%)**	**Networking and cooperation support need**	**Composite categorical variable** Min=0; Max= 3;
16	Linkages with finance providers **(60%)**		
117	Value chain creation / embedding into value chains **(32%)**		

Source: authors elaboration. The item "Other" is not reported in the Table

Table 23. Gaps in existing SME innovation support as dependent variable in the econometric analysis

ID	*Gap by item as difference between barriers (C1) and Satisfaction (D6) (mean gap in parentheses)*	*Name of the dependent (outcome) variable as used in the econometric model*	*Dependent variable as used in the econometric model*
	Column 1	Column 2	Column 3
1	Financial support for R&D&I activities **(0.70)**	**Financial gap**	**Binary variable:** 1 if positive (>0) 0 Otherwise
2	Internationalisation **(0.82)**	**Internationalisation gap**	**Binary variable:** 1 if positive (>0) 0 Otherwise
3	Incubation activities **(0.27)**	**Incubation gap**	**Binary variable:** 1 if positive (>0) 0 Otherwise
4	Better information on access to financing possibilities **(0.14)**	**Financial information gap**	**Binary variable:** 1 if positive (>0) 0 Otherwise
5	Better information on other non-financial innovation support possibilities **(0.4)**	**Other (non-financial) information gap**	**Composite categorical variable** Min=0; Max= 3
6	Better information on new technologies, new regulations **(0.18)**		
7	Involvement in regulatory sandboxes to test new regulatory requirements for innovative products /services **(0.25)**		
8	Better access to skills/talents / qualified staff **(0.91)**	**Skills acquisition from outside gap**	**Composite categorical variable** Min=0; Max= 2;
9	Acquiring specific skills **(0.33)**		
10	Acquiring innovation management skills (e.g. for the development of an including innovation strategy) **(0.49)**	**In-house skills for business development Gap**	**Composite categorical variable** Min=0; Max= 5;
11	Design management **(0.38)**		
12	Service innovation **(0.35)**		
13	Organisational innovation including the use of IT and e-business **(0.38)**		

ID	*Gap by item as difference between barriers (C1) and Satisfaction (D6) (mean gap in parentheses)*	*Name of the dependent (outcome) variable as used in the econometric model*	*Dependent variable as used in the econometric model*
	Column 1	**Column 2**	**Column 3**
14	IP management (patents, copyrights, trademarks) **(0.40)**		
15	Cooperation and networking between different R&D&I actors including support for technology transfer **(0.48)**	**Networking and cooperation gap**	**Composite categorical variable** Min=0; Max= 4;
16	Linkages with finance providers **(1.35)**		
17	Value chain creation / embedding into value chains **(0.77)**		

Source: authors elaboration. The item "Other" is not reported in the Table

Table 24. Probability of declaring that more public support is needed in a certain area as a function of SMEs' characteristics, type and share of public support received, and barrier faced.

Explanatory factors		Needs for more public support – Question E1: For which types of activities would you need better support?							
		Financial	Internationalisation	Information on financial support	Information on non-financial support	Skills acquisition from outside	In-house skills for business development	Incubation	Networking and cooperation
SME characteristics									
Geographical factors	North-Continental EU[a]	-(***)	-(***)	-(***)	-(***)	-(***)	-(***)	-(***)	-(***)
	Southern EU	+(***)	+(***)	+(***)	+(***)	+(***)	+(***)	+(***)	+(***)
	Eastern EU	+(***)	+(***)	+(***)	+(***)	+(***)	+(***)	-(***)	-(***)
	Extra EU	+(***)	+(***)	+(***)	+(***)	+(***)	+(***)	+(***)	+(***)
Sector	Manufacturing	not significant	not significant	not significant	not significant	not significant	not significant	not significant	-(*)
	Services[a]	not significant	not significant	not significant	not significant	not significant	not significant	not significant	+(*)
Size/type	Micro	+(***)	+(*)	+(**)	not significant	-(*)	-(***)	+(*)	+(**)
	Small	-(***)	+(*)	-(**)	not significant	+(*)	-(**)	-(*)	-(**)
	Medium[a]	-(***)	-(*)	-(**)	not significant	+(*)	+(***)	-(*)	-(**)
	High-growth firms	+(*)	not significant	not significant	not significant	+(*)	not significant	not significant	not significant
	Non high-growth firms[a]	-(*)	not significant	not significant	not significant	-(*)	not significant	not significant	not significant
	Established after	+(***)	not significant	+(***)	not significant	not significant	not significant	+(***)	+(***)

Explanatory factors		Needs for more public support – Question E1: For which types of activities would you need better support?							
		Financial	Internationalisation	Information on financial support	Information on non-financial support	Skills acquisition from outside	In-house skills for business development	Incubation	Networking and cooperation
	Jan 2014								
	Established before Jan 2014[a]	-(***)	not significant	-(***)	not significant	not significant	not significant	-(***)	-(***)
SMEs Innovativeness	Being in an innovative sector	not significant	not significant	not significant	-(*)	not significant	-(**)	not significant	not significant
	Not being in an innovative sector[a]	not significant	not significant	not significant	+(*)	not significant	+(**)	not significant	not significant
	Research based	+(*)	not significant	not significant	not significant	-(*)	-(*)	not significant	+(**)
	Not research based[a]	-(*)	not significant	not significant	not significant	+(*)	+(*)	not significant	-(**)
	High share of innovation expenditure on turnover	+(**)	not significant	-(*)	-(*)	-(*)	-(**)	-(***)	not significant
	Low share of innovation expenditure on turnover[a]	-(**)	not significant	+(*)	+(*)	+(*)	+(**)	+(***)	not significant
	Having introduced radical innovation	+(***)	not significant	not significant	-(*)	-(*)	-(***)	+(*)	not significant

Explanatory factors		Needs for more public support – Question E1: For which types of activities would you need better support?							
		Financial	Internationalisation	Information on financial support	Information on non-financial support	Skills acquisition from outside	In-house skills for business development	Incubation	Networking and cooperation
	Having introduced incremental innovation[a]	-(***)	not significant	not significant	+(*)	+(*)	+(***)	-(*)	not significant
Type of public support received									
Financial support		-(*)	not significant	-(*)	not significant	not significant	not significant	-(**)	-(*)
Awareness raising support		not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Support for specific skills		not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Support for knowledge and tech transfer		not significant	not significant	not significant	not significant	-(*)	not significant	not significant	not significant
Innovation management support		not significant	not significant	not significant	+(**)	not significant	not significant	not significant	not significant
Support for identifying innovation potential		not significant	not significant	not significant	+(**)	not significant	not significant	not significant	not significant
Support for internationalisation		not significant	+(**)	not significant	not significant	not significant	not significant	not significant	not significant
Support for cooperation and networking		not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Share of public support received									
High share of public funds received out of total RDI expenditure		-(*)	not significant	not significant	not significant	not significant	not significant	-(*)	-(**)

Explanatory factors	Needs for more public support – Question E1: For which types of activities would you need better support?							
	Financial	Internationalisation	Information on financial support	Information on non-financial support	Skills acquisition from outside	In-house skills for business development	Incubation	Networking and cooperation
Low share of public funds received out of total RDI expenditure[a]	+(*)	not significant	not significant	not significant	not significant	not significant	+(*)	+(**)
Type of barrier								
Financial	+(***)	-(**)	+(***)	not significant	not significant	not significant	not significant	not significant
Internationalisation	not significant	+(***)	+(**)	+(**)	not significant	not significant	not significant	-(*)
Digitalisation	not significant	not significant	+(**)	+(***)	not significant	Not significant	not significant	not significant
Incubation	not significant	not significant	not significant	not significant	+(**)	+(*)	+(***)	not significant
Financial information	+(*)	not significant	+(***)	not significant	-(**)	Not significant	not significant	not significant
Other (non financial) information	not significant	**+(*)**	+(**)	+(***)	+(**)	+(***)	not significant	+(***)
Lack of skills (acquisition from outside)	not significant	not significant	not significant	+(**)	+(***)	+(***)	not significant	not significant
Lack of in-house skills for business development	not significant	not significant	not significant	not significant	+(***)	+(***)	not significant	not significant
Networking and cooperation	not significant	not significant	+(**)	not significant	not significant	not significant	not significant	+(***)
Market access	not significant	**+(***)**	not significant	not significant	not significant	not significant	not significant	not significant
Innovation complexity	+(*)	+(*)	not significant	+(*)	+(***)	+(*)	not significant	+(**)
Green and sustainable innovation	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant

Explanatory factors	Needs for more public support – Question E1: For which types of activities would you need better support?							
	Financial	Internationalisation	Information on financial support	Information on non-financial support	Skills acquisition from outside	In-house skills for business development	Incubation	Networking and cooperation
Goodness-of-fit (Count R-Squared - %)	85.5%	70.2%	71.4%	70.8%	68.7%	60.1%	77.9%	66.5%

*Source: Authors' elaboration on SMEs survey data. "+" indicates that the corresponding variable positively influences the probability of declaring that specific support need.; in contrast, "-" indicates a negative influence. *,**,*** indicates statistical significance at 10%, 5%, and 1% level respectively. In all the specifications, we also controlled for the type of innovation introduced (i.e. products, services, etc.) and the results do not change significantly. Constants are not reported. Observations range from 1,956 to 1,230. The apex "a" identifies the reference category of dummy variables.*

Table 25. Probability of experiencing the gap as a function of SMEs' characteristics, type and share of public support received, and level of government of the support.

Explanatory factors		GAP: difference between barriers (Question C1) and satisfaction (Question D6)							
		Financial Gap	Internationalisation Gap	Information on financial support Gap	Information on non-financial support Gap	Skills acquisition from outside Gap	In-house skills for business development Gap	Incubation Gap	Networking and cooperation Gap
SME characteristics									
Geographical factors	North- Continental EU[a]	-(***)	-(***)	not significant	-(*)	-(***)	not significant	not significant	-(**)
	Southern EU	+(***)	+(***)	not significant	-(*)	+(*)	not significant	not significant	+(**)
	Eastern EU	-(***)	+(**)	not significant	+(*)	+(**)	not significant	not significant	+(**)
	Extra EU	+(**)	+(***)	not significant	-(*)	+(**)	not significant	not significant	+(***)
Sector	Manufacturing	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant

Explanatory factors		GAP: difference between barriers (Question C1) and satisfaction (Question D6)							
		Financial Gap	Internationalisation Gap	Information on financial support Gap	Information on non-financial support Gap	Skills acquisition from outside Gap	In-house skills for business development Gap	Incubation Gap	Networking and cooperation Gap
	Services[a]	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Size/type	Micro	+(***)	not significant	+(*)	not significant	not significant	-(**)	not significant	not significant
	Small	-(***)	not significant	-(*)	not significant	not significant	-(**)	not significant	not significant
	Medium[a]	-(***)	not significant	-(*)	not significant	not significant	+(**)	not significant	not significant
	High-growth firms	+(**)	not significant	not significant	not significant	+(*)	not significant	not significant	not significant
	Non high-growth firms[a]	-(*-)	not significant	not significant	not significant	-(*)	not significant	not significant	not significant
	Established after Jan 2014	+(***)	not significant	not significant	not significant	not significant	not significant	+(***)	not significant
	Established before Jan 2014[a]	-(***)	not significant	not significant	not significant	not significant	not significant	-(***)	not significant
SMEs Innovativeness	Being in an innovative sector	not significant	not significant	not significant	not significant	not significant	+(**)	not significant	not significant
	Not being in an innovative sector[a]	not significant	not significant	not significant	not significant	not significant	-(**)	not significant	not significant
	Research based	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
	Not research based[a]	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant

Explanatory factors		GAP: difference between barriers (Question C1) and satisfaction (Question D6)							
		Financial Gap	Internationalisation Gap	Information on financial support Gap	Information on non-financial support Gap	Skills acquisition from outside Gap	In-house skills for business development Gap	Incubation Gap	Networking and cooperation Gap
	High share of innovation expenditure on turnover	not significant	not significant	not significant	not significant	not significant	not significant	-(*)	-(*)
	Low share of innovation expenditure on turnover[a]	not significant	not significant	not significant	not significant	not significant	not significant	+(*)	+(*)
	Having introduced radical innovation	+(***)	not significant	not significant	not significant	not significant	not significant	not significant	not significant
	Having introduced incremental innovation[a]	-(***)	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Type of public support received									
Financial support		-(***)	not significant	-(***)	-(***)	not significant	not significant	-(**)	not significant
Awareness raising support		-(*)	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Support for specific skills		not significant	not significant	not significant	not significant	not significant	-(*)	not significant	not significant
Support for knowledge and tech transfer		not significant	not significant	not significant	not significant	-(*)	not significant	-(**)	not significant
Innovation management support		not significant	not significant	not significant	-(*)	not significant	not significant	not significant	not significant

Explanatory factors	GAP: difference between barriers (Question C1) and satisfaction (Question D6)							
	Financial Gap	Internationalisation Gap	Information on financial support Gap	Information on non-financial support Gap	Skills acquisition from outside Gap	In-house skills for business development Gap	Incubation Gap	Networking and cooperation Gap
Support for identifying innovation potential	not significant	-(*)	not significant	not significant	not significant	not significant	not significant	not significant
Support for internationalisation	not significant	-(***)	not significant	not significant	not significant	not significant	-(**)	not significant
Support for cooperation and networking	not significant	not significant	not significant	-(***)	-(***)	not significant	not significant	-(*)
Share of public support received								
High share of public funds received out of total RDI expenditure	-(***)	not significant	-(***)	not significant	not significant	not significant	not significant	not significant
Low share of public funds received out of total RDI expenditure[a]	+(***)	not significant	+(***)	not significant	not significant	not significant	not significant	not significant
Level of government of the public support received								
EU	-(***)	-(***)	-(*)	-(*)	-(***)	not significant	not significant	-(***)
National	-(**)	not significant	-(**)	-(**)	not significant	not significant	not significant	not significant
Regional/federal	not significant	not significant	-(**)	not significant	not significant	not significant	-(**)	not significant
Local (incl. city level) [a]	not significant	not significant	not significant	not significant	not significant	not significant	not significant	not significant
Goodness-of-fit (Count R-Squared - %)	74.2%	73.4%	60.8%	73.3%	60.3%	60.0%	65.9%	60.8%

Source: Authors' elaboration on SMEs survey data. "+" indicates that the corresponding variable positively influences the probability of observing the gap.; in contrast, "-"

Explanatory factors	GAP: difference between barriers (Question C1) and satisfaction (Question D6)							
	Financial Gap	Internationalisation Gap	Information on financial support Gap	Information on non-financial support Gap	Skills acquisition from outside Gap	In-house skills for business development Gap	Incubation Gap	Networking and cooperation Gap

*indicates a negative influence. *,**,*** indicates statistical significance at 10%, 5%, and 1% level respectively. In all the specifications, we also controlled for the type of innovation introduced (i.e. products, services, etc.) and the results do not change significantly. Constants are not reported. Observations range from 1,007 to 984. The apex "a" identifies the reference category of dummy variables.*

C.4 Bayesian Network Analysis in a nutshell

We used the Bayesian Network (BN) analysis to shed light on all the possible interlinkages between variables and look more deeply into the effectiveness and the role of public innovation support for SMEs in Europe. The analysis allows to visualize and estimate all direct and indirect interdependencies among the set of variables considered, synthetise the main evidence, and identify underlying patterns in the data.

Bayesian Networks (BNs), denoted as $B = (G, \Theta)$, are probabilistic graphical models that are defined by two components;

1. **a network structure, a directed acyclic graph (DAG)**, denoted by $G = (\boldsymbol{V}, A)$ in which each node $v_i \in \boldsymbol{V}$ corresponds to a random variable X_i. Specifically, the DAG consists of directed edges $a_{ij} \in A$ connecting the set of random variables (nodes) $X_1, X_2, \dots, X_n$. An edge from node X_i to node X_j indicates that a value taken by the variable X_j depends on the value taken by the variable X_i. Node X_i is then referred to as parent of X_j, and similarly X_j is referred to as child of X_i. Therefore, the DAG visualises the sets of descendants, that is the set of variables from which a given node can be reached on a direct path.
2. **a set of parameters**, denoted by Θ, which provides dependences among the random variables in the form of conditional probability distributions. For discrete random variables, these conditional probabilities are represented by a table (i.e. conditional probability tables – CPTs) listing the probability that a child node X_j takes on each of its values for each value of its parent X_i, that is $P(X_j = x_j | X_i = x_i) = \theta_{x_j|x_i}$. If X_j has two or more parents, it depends on their joint distribution, because each pair of parents forms a convergent connection centred on X_j. In this case, the conditional probability of X_j can be calculated using the chain rule (given a topological ordering of X_i):

$$P(X_j = x_j | X_{i+1} = x_{i+1}, \dots, X_n = x_n)$$

which can be also expressed as:

$$P(X_j = x_j | X_i = x_i \; for \; each \; X_i \; which \; is \; parent \; of \; X_j).$$

This above formula, known as Local Markov Property,[141] says that each variable in the network is conditionally dependent only on its parents, or similarly, that each variable in the network is conditionally independent of its-non descendants ($X_{de(i)}$), given the set of its parent variables ($X_{pa(i)}$).[142] Formally:

$$X_i \coprod X_{V \setminus de(i)} | X_{pa(i)} \; for \; all \; i \in V$$

Therefore, given a set of random variables $X = (X_i)_{i \in V}$, a BN $B = (G, \Theta)$ defines a unique joint probability distribution (JPD) over $\boldsymbol{V}$, which is broken down into local conditional distributions. The Local Markov Property allows the factorisation of the JPD, that is:

141 This formula is preferable to that obtained from the chain rule because the conditioning sets are typically smaller.

142 Russell, S. J. and Norvig, Peter (2003), Artificial Intelligence: A Modern Approach (2nd ed.), Upper Saddle River, New Jersey: Prentice Hall.

$$P_B(X_1 = x_1, X_2 = x_2, \dots, X_n = x_n) = \prod_{i=1}^{n} P_B\left(X_i \middle| X_{pa(i)}; \Theta_{X_i}\right) = \prod_{i=j}^{n} \theta_{X_i|X_{pa(i)}}$$

In this framework, the main role of the network structures is to express the JPD into conditional independence relationships among the variables in the model through graphical separation.

In the simplest case, the BN is defined by an expert, who specifies the DAG and for each node X_i the local distribution for X_i conditional upon its parents. In more complex applications the network structure and parameters must be learned from data, which is a challenge pursued within machine learning with the application of one or more types of data-driven learning algorithms. **We estimated the BNs presented in this report by applying the Greedy Thick Thinning algorithm**, which is based on the Bayesian Search approach.[143] In the thickening phase, it begins with an empty graph and iteratively adds the next arc that maximally increases the marginal likelihood of the data given the model. This is repeated until no new arcs can be added that will increase the likelihood. Next, in the thinning phase, it repeatedly removes arcs until no arc deletion will increase the likelihood.

While the Greedy Thick Thinning algorithm is able to automatically connect random variables with each other by optimizing procedures, the interpretation of direction of arcs in causal terms with observational or survey data is threatened by two problems, which are well known in statistics: latent variables and selection bias. Therefore, the direction of the arrows needs to be validated by the policy analyst on the basis of prior knowledge on the variables, the policy theory and the relevant literature. They provide the necessary background information to interpret as causal the direction of plausible interaction between the variables.[144]

Once estimated, **the prediction accuracy of the network has been validated by using the technique of leave-one-out (LOO) cross-validation.** The *K-fold crossvalidation* method divides the data into two subsets: training and testing. Specifically, the method divides the data set into K parts of equal size, trains the network on K-1 parts, and tests it on the last, Kth part. The process is repeated K times, with a different part of the data being selected for testing. The *leave-one-out* method is an extreme case of *K-fold crossvalidation,* in which K is equal to the number of records (n) in the data set. In LOO, the network is trained on n-1 records and tested on the remaining one record. The process is repeated n times. Experts advise to use the LOO method, as the most efficient evaluation method, whenever it is feasible in terms of computation time. Its only disadvantage is that it may take long when the number of records in the data set is very large.[145]

The implementation of BNs used in this report was from the **GeNIe Modeler software package** (BayesFusion LLC, https ://www.bayes fusion.com/).

[143] Cheng, J., Bell, D. A., & Liu, W. (1997). An algorithm for Bayesian belief network construction from data. In Proceedings of AI & STAT'97, Citeseer. Cooper, G. F., & Herskovits, E. (1992). A Bayesian method for the induction of probabilistic networks from data. Machine learning, 9(4), 309–347.

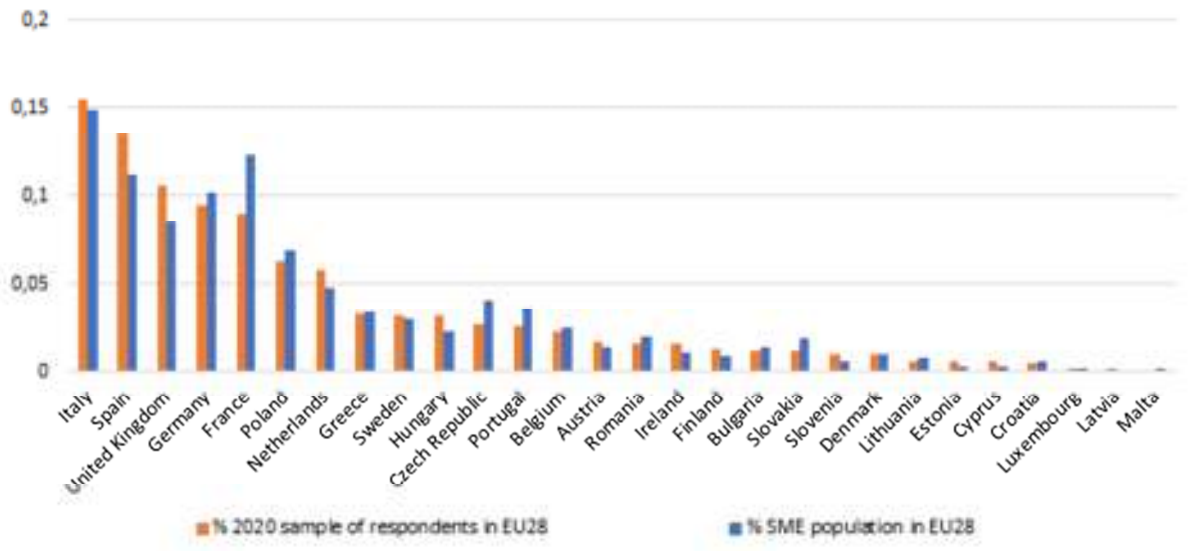
[144] Pearl, J. (2000), Causality: Models, Reasoning, and Inference, Cambridge, UK: Cambridge University Press.

[145] See GeNIe user manual (5/20/2020, p. 507). See also: Kiss, L., Fotheringhame, D., Mak, J. et al. The use of Bayesian networks for realist evaluation of complex interventions: evidence for prevention of human trafficking. J Comput Soc Sc (2020). https://doi.org/10.1007/s42001-020-00067-8

Annex D: Sample frame

A total number of 2,176 enterprises responded to the survey. Respondents are active in all EU-28 Member States, with the sample ensuring a statistically significant geographic distribution: it was calculated that there is no statistical difference between the geographical distribution of SMEs in our sample as compared to the population of SMEs in EU28 in 2019.[146] Compared to the previous consultation held in 2009, higher participation of respondents from small countries was registered. In addition to respondents from EU countries, 7% of the sample is made up of SMEs from extra-EU countries, all but three coming from countries associated to H2020[147].

Figure 21: Distribution of SMEs from EU28 participating in the 2020 survey and of SMEs in 2019 in EU28, by country



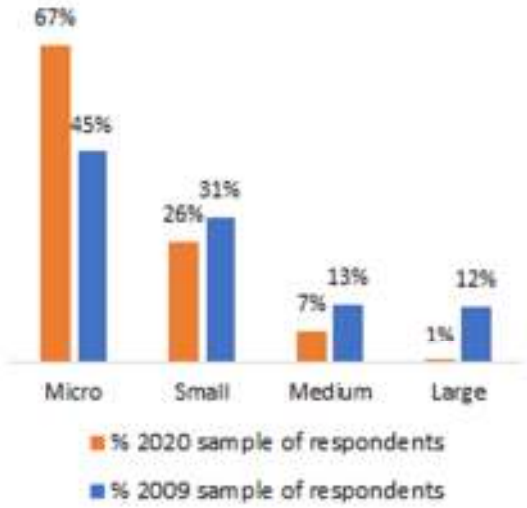
SOURCE: AUTHORS' ELABORATION OF SURVEY RESULTS AND OF DATA FROM THE SME PERFORMANCE REVIEW DATABASE. A TOTAL OF 2,004 RESPONDENTS IN THE EU28 PROVIDED INFORMATION ON THE COUNTRY OF ORIGIN IN THE 2020 SURVEY.

The large majority of enterprises surveyed were micro and small companies (see Figure 2225).[148] Although to a much lesser extent than in the 2009 consultation, where micro enterprises were 45% of respondents, this category is still under-represented in our sample as in 2019 it accounted for 93% of all European SMEs[149]. Although more than one-third of the sample declared a turnover annual growth rate of more than 10% over a three year period, only 16% of the respondents can be considered high-growth enterprises[150] and 5% can be considered "gazelles", as they have been established after January 2014. Overall, around half of the respondents are newly established enterprises and half are enterprises

[146] The correlation index between the geographical distribution of the sample and the population is equal to 97%. We calculated the difference by country between the percentage of respondent SMEs to our survey and the existing percentage in the population. The difference is statistically equal to zero (t=0.0847; p-value=0.9331).
[147] Among the respondents coming from countries not associated to H2020, one is from USA, one from Taiwan, and one from Zimbabwe.
[148] The size of the enterprises has been defined based on the number of employees and annual turnover in 2019, according to the Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises. In case of discrepancy between the class defined according to the staff number and that defined according to the turnover, the first one prevails.
[149] Data from the SME Performance Review. The correlation index between the size distribution of the sample and of the population is equal to 66%.
[150] Following the Eurostat definition, micro-enterprises have been excluded. High-growth enterprises are defined as "enterprises with at least 10 employees at the beginning of their high-growth period and with post average annualised growth in the number of employees (or turnover) greater than 10% per annum over a three year period" (Annual Report on European SMEs 2018/2019).

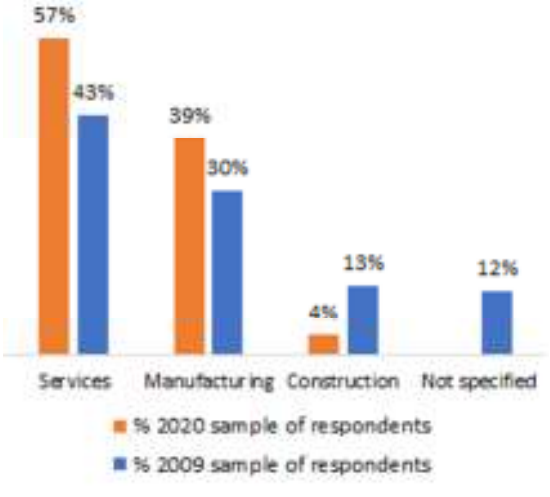
established more than four years ago. In terms of macro-sector, the services sector is under-represented, although more respondents operate in it compared to 2009 (58% vs 43%), while the manufacturing sector is over-represented, covering 38% of respondents but only 8% of total SMEs in Europe. Only 4% of respondents operate in the construction sector, while it accounts for 14% of all EU SMEs.

Figure 22: Survey of SMEs. Distribution of respondents in 2009 and 2020 according to the staff employed in the previous year (2008 and 2019)



SOURCE: AUTHORS' ELABORATION OF SURVEY RESULTS AN RESULTS OF THE 2009 PUBLIC CONSULTATION.
A total of 2,165 respondents answered this question.

Figure 23: Survey of SMEs. Distribution of respondents in 2009 and 2020 across sectors



SOURCE: AUTHORS' ELABORATION OF SURVEY RESULTS AN RESULTS OF THE 2009 PUBLIC CONSULTATION.
A TOTAL OF 2,145 RESPONDENTS ANSWERED THIS QUESTION.

Innovative SMEs tended to participate in the survey more often than non-innovative SMEs. This is due mainly to two reasons: first, the survey primarily reached past applicants to INNOSUP actions and the SME Instrument, as they received a direct invitation to participate in it[151]. Secondly, innovation intermediary organisations helped disseminate the survey through their networks, which typically target enterprises interested in innovation. The fact that more innovative sectors are over-represented (e.g. IT, chemical, pharmaceutical, R&D sectors) while less innovative sectors, especially in construction and services, are under-represented confirms that respondents to the survey were usually more prone to innovation. In fact, we calculated a positive correlation between the number of responses received and the innovation level of each sector.[152] As a result, our survey gives particularly valuable insights into the opinions and behaviours of innovative SMEs in Europe. At the same time, however, the sample is also composed of SMEs operating in non-innovative sectors and which have not recently introduced any innovation. The comparison between the two groups was then part of our analysis and the results highlight any significant difference emerged between them.

[151] 55% of respondents received a direct invitation.
[152] The level of correlation between the sector distribution (in terms of sector innovativeness level) of the sample and of population is good for the manufacturing (equal to 75%) and lower for the service sectors (40%).

The characteristics of the sample described above were carefully taken into account in the analysis and interpretation of results. In particular, we have statistically controlled whether variables such as the size, the geographic position, the sector, the propensity to innovate, the fact that the SME has already received public innovation support or not affect the responses to the survey. In this regard, it is worth mentioning that differences in the sample's composition may limit the comparability of our results with other surveys'.

Table 26. Comparison between the 2020 Survey on effectiveness of innovation public in Europe, the Community Innovation Survey and the Survey on the Access to Finance of Enterprises

	2020 Survey on effectiveness of innovation public in Europe	Community Innovation Survey	Survey on the Access to Finance of Enterprises
Topics covered	Main barriers to innovation Types of innovation introduced **Forms of innovation support received by SMEs** **SMEs' level of satisfaction with the support received** **Gaps in existing SME innovation support**	Main barriers to innovation[153] Types of innovation introduced[154] Ongoing or abandoned innovation activities Innovation activities and expenditures for product and process innovations Cooperation for product and process innovations Intellectual Property Rights	Financial situation of enterprises Need for external financing Availability of external financing and market conditions
Geographical coverage	EU28 + other H2020 associated countries	EU28 + other H2020 associated countries	16 Countries: Belgium, Germany, Ireland, Greece, Spain, France, Italy, Cyprus, Luxembourg, Malta, Netherlands, Austria, Portugal, Slovenia, Slovakia, Finland
Size of surveyed enterprises	Micro: 67% Small: 26% Medium: 7% Large: 1%	Micro: 0% Small: 79% Medium: 17% Large: 4%	Micro: 41% (EC round: 52%) Small: 32% (EC round: 34%) Medium: 20% (EC round: 10%) Large: 7% (EC round: 5%)
Sector of surveyed enterprises	Services: 57% Manufacturing: 39% Construction: 4%	Limited to innovation core activities (Com.Reg. 995/2012) – NACE B – M73	Services (+ trade): 65% (EC round: 70%) Manufacturing: 22% (EC round: 17%) Construction: 13% (EC round: 13%)

SOURCE: AUTHORS

As far as intermediaries, a **total of 498 different intermediary organisations** responded to our survey. They come from 45 different countries, although 92% of respondents work in the EU28. The sample shows a good variety in terms of types of organisations, encompassing cluster organisations, business representatives, public agencies, incubators and science parks, research centres, digital innovation hubs, higher education institutions and others, operating mainly at EU, national and regional level. As regards the type of innovation support provided, a large part of respondents facilitates networking and cooperation between

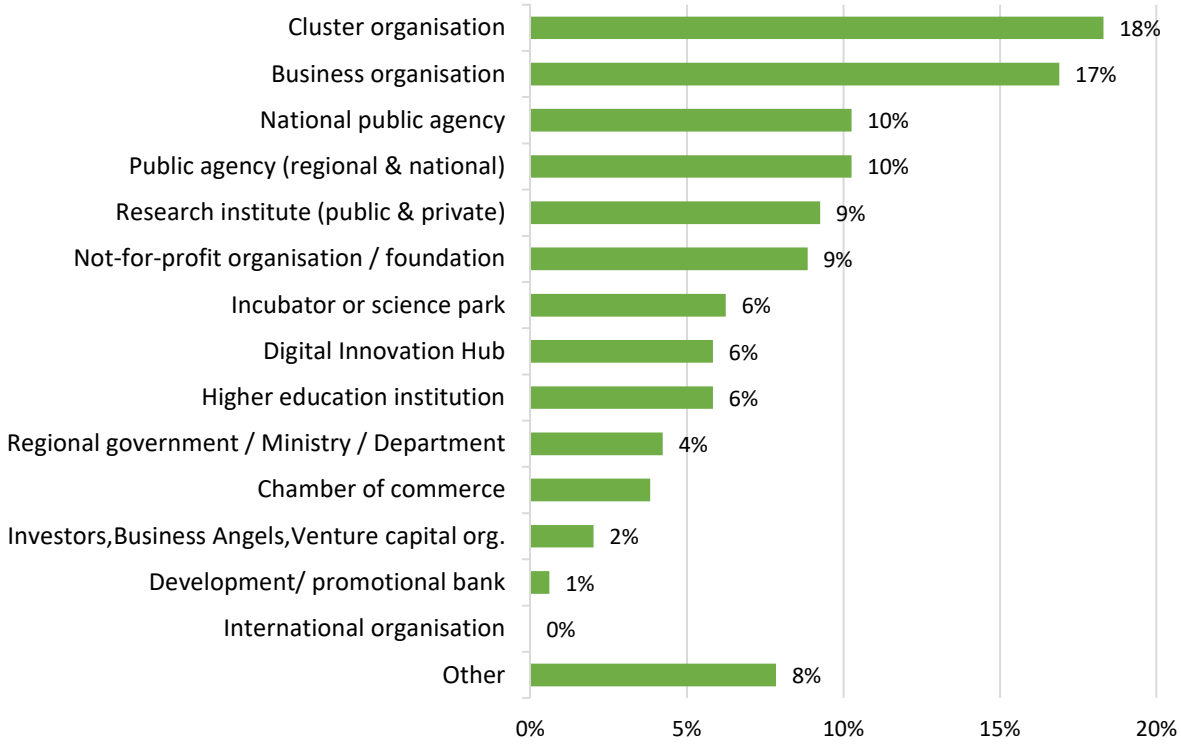
[153] The barriers listed in the CIS concern only access to finance, access to skilled staff, collaboration with partners and access to market. The 2020 Survey on effectiveness of innovation public in Europe comprises a wider set of possible barriers, including lack of information on support possibilities, lack of information on the market and regulations, insufficient support for incubation, value chain creation and internationalisation, lack of innovation management skills.

[154] The CIS questionnaire refers to the specific types of activities for each type of innovation (i.e. product or service, process, organisational and marketing). For comparison purposes, our survey had to use, instead, the categories of the 2009 consultation.

actors (84%), raises awareness about support possibilities (74%) and facilitates technology and knowledge transfer (63%). Other activities carried out by the survey's respondents are consultation on access to finance, internationalisation, innovation and IP management support, provision of information on new regulations and new technologies, support for cluster development or for incubation. One third of respondents also finances innovation projects (including R&D).

The majority of respondents allocated less than EUR 1 million to their innovation support scheme in 2020 and supported less than 100 companies every year, while the source of the budget is increasingly from external resources. Around half of the intermediaries participating in the survey targets either micro, small or medium enterprises, whilst 39% of them target particular firm types, especially innovative start-ups.

Figure 24: Survey of intermediaries. Distribution of respondents by typology



SOURCE: AUTHORS' ELABORATION OF SURVEY RESULTS AND RESULTS

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

– by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

– at the following standard number: +32 22999696 or

– by email via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications at: https://publications.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1952 in all the official language versions, go to EUR-Lex at: http://eur-lex.europa.eu

Open data from the EU

The EU Open Data Portal (http://data.europa.eu/euodp/en) provides access to datasets from the EU. Data can be downloaded and reused for free, for both commercial and non-commercial purposes.

EA-04-21-094-EN-N

doi: 10.2826/7745
ISBN: 978-92-9460-562-7