Networking and exchange in mission-oriented innovation processes

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Innovation for Transformation –
Fostering innovation to address societal challenges

Results Paper 2

Networking and exchange in mission-oriented innovation processes

Results Paper 1: Good practices in mission-oriented innovation strategies and their implementation
Results Paper 3: Addressing societal challenges through disruptive technologies
Results Paper 4: Fostering innovative startups in the pre-seed phase
Results Paper 5: An agenda for the future: Innovation for transformation

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REINHARD MOHN PRIZE 2020

Fostering Innovation. Unlocking Potential.

As part of the "Fostering Innovation. Unlocking Potential." project, which was launched within the framework of the Reinhard Mohn Prize 2020, we have conducted a global search to identify noteworthy examples of innovation-promoting initiatives, mechanisms and strategies that could be applied to promoting innovative capacity in Germany and Europe. One objective of our efforts has been to ensure that Germany remains technologically – and thus economically – competitive. But another key objective here is to address societal challenges while ensuring humane, democratic and inclusive economic development. We start from the premise that two paradigms – "strengthening innovation and technological competitiveness" and "solving societal problems through innovation" – can be combined to mutually reinforce each other.

Innovation for Transformation

Although Germany regularly performs well in international rankings of competitiveness and innovative capability, a closer look at things shows that despite all its strengths and the confidence key economic indicators suggest, the intensity of innovation – particularly in key digital technologies – in Germany as well as Europe has been on the decline in recent years. Moreover, Germany has delivered hardly any disruptive innovations, that is, those innovations that fundamentally change the rules of a market or consumers' usage behavior. This is problematic both in terms of economic as well as societal considerations – particularly since the answer to many of the societal challenges we currently face might very well be found in the innovations of leapfrogging technologies. Our project aims to help unlock this potential and make the solutions it delivers a reality.

With this vision in mind and in line with Reinhard Mohn's vision of "Learning from the World," the Bertelsmann Stiftung conducted extensive global research on good practices that are applied in various international contexts. In cooperation with the Fraunhofer Institute for Systems and Innovation Research ISI, the findings have been summarized in four results papers. Each paper has a different focus but explores the extent to which competitiveness can be linked with mission-driven approaches to societal issues.

- The **first paper** outlines the theoretical framework used for the global study and draws on selected international case studies to show how a broader umbrella strategy for innovation can effectively combine technological and economic competitiveness with efforts to solve societal issues. The paper explores in particular the aspects of governance involved with innovation policy and shows what Germany has to learn from examples in other countries.

- The **second paper** (present study) examines how the development and diffusion of new and societally relevant technologies can be promoted through appropriate networking mechanisms that engage actors in business, research, politics and civil society in open innovation processes. The paper thus features several examples of good practices found in other international contexts that both Germany and Europe can learn from.

- The **third paper** takes a close look at how the framework conditions for disruptive innovations in particular can be strengthened. It also describes the lessons learned in countries such as Israel, Japan and the United States that are relevant for Germany in its efforts to become a top location for innovation.

- The **fourth paper** is devoted to the question of how to improve the conditions for establishing and growing societally relevant (high-tech) startups in their initial phase of being founded. The paper thus presents a variety of good practices from examples around the world and discusses their key takeaways.

- **Conclusions** derived from all four papers are integrated into the **"An agenda for the future: Innovation for transformation"** publication.

Each paper is available at www.bertelsmann-stiftung.de/innovation-for-transformation-en.

In the future, only communities that face up to global competition and repeatedly demonstrate their ability to innovate and perform can succeed and endure.

Reinhard Mohn

CONTENT

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Key findings

- In an era of digital transformation and enormous societal challenges, Germany and Europe are under pressure. Maintaining international competitiveness requires keeping pace with potential rivals, especially in key technological areas (such as AI). At the same time, an innovation policy oriented toward ambitious societal goals ("mission-oriented approach") is needed in order to address challenges such as climate change. The future viability of the economy and society more broadly thus depends upon the ability to expand innovative capacity and focus technological innovations more strongly on the solution of societal problems.

- Creating stronger networks and improving exchange between innovation-relevant actors hold considerable potential in this regard. By networking political, economic, research and civil society actors strategically together in open-innovation processes, different areas of expertise can be combined in a complementary way, and innovations can be aligned more precisely with societal needs. As a result, technological advances contribute to societal development as well as to economic success. In addition, this allows innovations to be better diffused.

- Diverse institutionalized forms of networking and exchange between heterogeneous actors (e. g., innovation clusters) already exist in Germany. However, they often lack an orientation toward societal challenges. To remedy this, new approaches are needed, or existing instruments need to be developed further.

- With the aim of facilitating knowledge transfers, we present seven exemplary instances of international good practices. In each case, exchange and networking processes designed to foster innovation combine the two paradigms of "strengthening economic and technological competitiveness" and "solving societal problems." The analysis is intended to provide inspiration for a modern mission-oriented innovation policy in Germany and Europe.

- In providing these examples, we distinguish between three models of institutional exchange: 1) cluster concepts, 2) matching solutions, and 3) cooperative (research) infrastructures.

- Traditionally, these models are intended to strengthen (regional) economic performance. However, the case studies show how the concepts can be adapted in order to address both competitiveness and societal needs.

I. Cluster concepts: Connecting heterogeneous regional actors with common goals

- Clusters are typically used to network different regional actors sharing a common goal more tightly together. The intensive exchange between the actors helps boost regional innovative capability. The examples of Sweden's Lindholmen and Ideon science parks show that this approach can be expanded to societal concerns.

- In these science parks, the policy, business and research sectors are together realizing large-scale development projects in a needs-oriented, dialogue-driven manner, working to produce concrete solutions to societal problems (such as sustainable mobility solutions, or achievement of the SDGs). At the same time, the parks function as catalysts for regional innovative capability and economic strength.

- The cooperation is reflected in the organizational structure; working alongside research institutions and companies, cities and municipalities are involved throughout the entire innovation and value-creation process, a model referred to as a quadruple-helix organization. This reduces organizational and cultural barriers, and helps tailor innovations better to market demands.

- In Germany, the existing networking infrastructure could in the future be oriented more strongly toward meeting societal needs. To do so, the creation and further development of quadruple-helix structures should be accelerated, with the goal of integrating political and civil society actors in particular more deeply

into open-innovation processes. With regard to substantive orientation, the SDGs could serve as a set of normative guiding principles.

II. Matching solutions: Combining demand with efforts to solve problems quickly and effectively

- Matching approaches can be used to quickly and effectively link those driving demand with innovations or those who innovate. Given the low transaction costs associated with digital platforms, which also have strong network effects and a potentially extensive geographic reach, they are particularly attractive for matching efforts.

- The example of Start-Up Nation Central in Israel shows how large companies and innovative (high-tech) startups can be brought together. The organization's platform enhances the (international) visibility of Israeli startups and positions them as trendsetters that drive new ideas.

- The EU's Social Challenges Innovation Platform links suppliers and consumers of social innovations. By explicitly focusing on pre-defined challenges, this digital environment strengthens the emergence and dissemination of societally relevant and beneficial innovations.

- Combining the conceptual framework of Start-Up Nation Central with that of the EU's Social Challenges Innovation Platform could deliver a promising approach. It could result in the creation of a matching platform by which (high-tech) companies could present their solutions to societally relevant problems in a way that is widely visible.

- Intermediary, regionally based organizations can also bring together various actors within an innovation system. Canada-based Mitacs serves as a model in this regard, as it places young researchers in companies and public institutions working on innovation-relevant (research) projects. It draws on a nationwide network and its comprehensive understanding of the innovation needs on the demand side.

- The scope of broad-based matching platforms in Germany and Europe can be significantly expanded, particularly with regard to startup support, societally desirable innovations, and the transfer of personnel between the worlds of research and application. Establishing platforms effective at fostering and disseminating innovations is advisable, both in terms of strengthening competitiveness and finding solutions to societal problems.

III. Cooperative (research) infrastructures: Creating strategic, long-term linkages between research and the private sector

- Cooperative (research) infrastructures, such as those seen with industry-on-campus concepts, foster within the framework of development projects long-term cooperation between research institutions and private companies (public-private partnerships). This type of cooperation can be used to help solve societal problems.

- The Australian Cooperative Research Centres Program addresses challenges such as civil contingency planning and cybersecurity. Success factors include bundling know-how across sectors and orienting activity toward end users (e. g., the public sector).

- Canada's Mila aims at developing principles-based AI systems that benefit society. It therefore links basic research with entrepreneurial applications and fosters the creation of networks between institutions and infrastructures – both at home and abroad.

- German cooperation initiatives should do more to ensure that their activity is value-oriented and cross-sectoral in nature. In other words, they should not limit their activity to the worlds of business and science alone and should place the end user at the center of such activity. Germany's Research Campus Program marks a good start in this regard, but it should be developed further in terms of the issues it addresses and its organizational reach.

1. INTRODUCTION

1.1

Strengthening innovative capacity through exchange and institutional networking

Given the urgency of current societal challenges, a new innovation-policy paradigm is increasingly coming to the fore. While "traditional" innovation policy focused primarily on enhancing economic growth and enterprise competitiveness, innovation policy today is expected to contribute more significantly to addressing urgent societal challenges, for example by aiding in efforts to combat climate change or by developing new mobility concepts for urban spaces (UN 2019). An innovation policy intended to contribute to the solution of one or more clearly defined societal problems (thus carrying out a so-called mission) is defined as "mission-oriented" (see Results Paper 1 in this series).

Innovation can serve not only entrepreneurial goals, it can also contribute to the development of society.

In this regard, we argue that the paradigms of "strengthening economic growth and technological competitiveness" and "solving societal problems through innovation" should not be regarded as mutually exclusive, but rather as mutually reinforcing when linked together within a strategically designed innovation policy. As numerous examples show, this interplay opens a broad range of opportunities for German innovation policy. For example, new and more efficient motor and battery technologies developed here in Germany could secure the future growth of the domestic auto industry and promote international competitiveness, while simultaneously contributing to the success of the transport-technology shifts urgently needed in Germany and elsewhere around the globe. The same applies to the energy sector and the switch to renewable and climate-friendly energy sources. The current global coronavirus pandemic has also highlighted the urgent need for medical-care improvements and a breakthrough in the search for a suitable vaccine. Healthcare-sector innovations achieving these goals would certainly serve business objectives, but would also enhance society's overall welfare.

This results paper uses international examples of good practices to discuss how combining these paradigms in a strategy focused on building networks between the business, research, policy and civil society sectors can succeed in German innovation policy.

In this regard, the key question is the following: How can appropriate framework conditions be used to steer scientific curiosity, entrepreneurial creativity and citizens' needs collectively and more strongly in the direction of societally desirable solutions, while also generating competitive advantages for companies? The present paper discusses such opportunities with a view to involving actors from the research, business, policy and civil society sectors more deeply in open-innovation processes (see JIIP 2018; Larrue 2019). The central thesis of this study is that constructing networks between these actors and establishing a practice of open-innovation processes would modernize regional and sectoral innovation systems. Furthermore, integrating diverse perspectives in this way would enhance the problem-solving capacities of the associated innovation activities. Insofar as innovation processes are directional (see Results Paper 1 in this series) and thus purposefully designed to achieve societally defined objectives, networking and open-innovation processes become increasingly important aspects to consider. Both networking and open-innovation processes allow for important signals to be registered by those involved with the process of specifying objectives and thereby help correct developments that have gone off course. As a result, the path of innovation hews more closely to the desired objectives.

In this study, networking is defined as the synergistic interaction of actors from a variety of societal areas and disciplines in the context of open-innovation processes, in which scientific expertise, entrepreneurial know-how, user needs and the needs of citizens are brought together to develop new technologies that can contribute to realizing societal missions (Nowotny et al. 2001; Hessels and van Lente 2008). From an institutional perspective, networking of this kind can be implemented through cluster concepts, matching solutions or cooperative research infrastructures, among other alternatives. In this context, openness means that the development of new technologies, processes or services is based not only on the know-how of an individual enterprise, but also on the ideas, concepts and values of society as a whole (Chesbrough 2006). Synergies then result from the interactions between individuals or groups with complementary areas of expertise, increasing the network's overall innovative capacity (Lööf and Broström 2005).

The strength of open-innovation processes arises from the characteristics of innovation itself. According to the findings of innovation economics, innovation processes are not linear – that is, they do not proceed in a step-by-step manner from basic research to applied research to practical application. Rather, innovations emerge through constant feedback, in which actors question old knowledge, collect and exchange experiences, and create or adapt new knowledge. Accordingly, innovations can be realized

Open innovation processes bring together actors from the research, business, public and civil society sectors.

only through cooperation, and through the economic and social interactions of a variety of different actors (Koschatzky 2001; Koschatzky 2003; Warnke et al. 2016). The degree to which involved parties are actively participating may differ, and some may be engaged only during certain stages of the process. The spectrum ranges here from selective involvement (e. g., while problems and needs are being defined) all the way to participation throughout all phases of value creation. In this regard, open-innovation processes are characterized by the fact that they internalize external knowledge ("outside-in process") but can also externalize internal knowledge ("inside-out process") (Chesbrough 2006). One key assumption of the present study is that for innovation processes to be able to address societal challenges effectively, appropriate institutional framework conditions needed to steer networking activities toward societally desirable outcomes.

This results paper thus assumes that involving the broadest possible set of actors through an institutionally structured network can productively link the established growth- and competition-oriented approach with the new mission-driven approaches to societal issues (see JIIP 2018; Larrue 2019). Integrating policymakers, entrepreneurs, investors, potentially affected users of new technologies, citizens and patients into open-innovation processes of this kind increases the likelihood that new technologies will better address overall societal needs, and that innovations will be diffused more rapidly and according to plan. In addition, consciously focusing innovation processes on solving societal problems is likely to attract additional actors and entrepreneurial-minded people who are motivated by the desire to produce added societal value through their engagement (Sayer 2011). In the following section, we will examine three specific network concepts to illustrate how this interaction between a range of different actors can be successful.

THESIS

Fostering innovation that ensures technological progress and economic competitiveness for societal benefit requires the use of innovative instruments to establish open innovation processes. Such processes enable actors from the business, research, policy and civil society sectors to network strategically with one another and engage in productive exchange.

According to the traditional understanding of closed innovation processes, companies protect their knowledge against external access in order to minimize knowledge outflows and generate profit from their technological lead in knowledge. However, participating in open-innovation activities focused on solving societal problems need not be a losing proposition for enterprises as long as the associated processes of cooperation and exchange are governed by clear rules (Pénin and Neicu 2018). If this is the case, the networking and cooperation fundamental to open innovation can generate numerous tangible business advantages for participating enterprises. For example, they may be able to:

- **Increase sales opportunities:** Networks ease the process of accessing new markets, while new use cases for mission-oriented technological solutions potentially allow companies to serve global demand.
- **Improve learning processes:** Working with universities, specialized research institutions, customers, suppliers and end users accelerates innovation processes and the development of high-quality products (von Hippel 2008).
- **Leverage complementarities:** Networks facilitate access to the contacts and services small companies in particular rely on.
- **Minimize risks:** Other actors' participation helps minimize risks that may arise from missteps in entering new markets or institutional contexts.
- **Improve the company's image:** The company can gain greater credibility, developing a reputation as an innovative problem-solver, and thus as an appealing employer.

Non-profit-oriented actors such as the state, the research community or civil society may also derive a number of advantages from exchange with companies in open-innovation processes. For example, they can:

- Tap profit-oriented sources of entrepreneurial creativity to help address societal problems.
- Incorporate practical know-how in the development and implementation of innovative solutions.
- Expand avenues for bringing solutions to market and encouraging their use, by tapping into companies' existing distribution and marketing structures.
- Secure greater financial flexibility.
- Support the domestic economy by directly communicating and transferring scientific findings.
- Mobilize and motivate new entrepreneurial activities that explicitly contribute to the solution of societal problems.

With these potential benefits in mind, this results paper discusses a series of international good practices that illustrate how institutional support can help orient innovation processes more strongly toward societally desirable objectives. From these case studies, we will extract aspects worthy of emulation, as well as lessons that may be applied within Germany.

The international case studies deal in detail with three forms of exchange and networking:

1. Constructing networks between diverse but geographically concentrated actors, and integrating these actors across the length of the value-creation process (cluster concepts).
2. Connecting suppliers with consumers of solutions (so-called matching concepts).
3. Engaging in strategic cooperation and developing shared research infrastructures.

1.2

Methodological approaches to promoting open-innovation processes: Cluster concepts, matching solutions, cooperative research infrastructures

There are many different forms of exchange between actors from the research sector and from other societal areas such as the private sector, civil society or the public sector. These range from implicit exchange in personal networks to jointly conducted research projects to shared (research) infrastructure. The institutional framework conditions and approaches for facilitating such interactions are as different as the exchange formats themselves. In the following section, we will first describe forms of institutionalized exchange deemed to be particularly innovative, and then illustrate them further on the basis of positive case studies from abroad.

Ultimately – alongside pure research cooperation on the basis of models such as contract research – we can distinguish three forms of institutionalized networking that play a role in innovation policy. These include 1) cluster concepts, 2) matching solutions and 3) cooperative research infrastructures (see Figure 1).

Cluster concepts, matching solutions and cooperative research infrastructures are all models found in traditional innovation policy. Their objectives are often purely economic, focusing on new business models, economic growth and the development of new markets. Against the background of the combination of paradigms described above, we have selected case studies that illustrate how the various exchange formats can be used to develop solutions for specific societal problems, thus generating significant added societal value.

FIGURE 1
THREE FORMS OF INSTITUTIONALIZED NETWORKING: AN OVERVIEW

Form of institutionalized exchange	Description	Objective in accordance with traditional innovation policy
Cluster concepts	Networks of diverse but geographically concentrated actors, focused on achievement of a common goal	Strengthen regional innovative capability and enhance (regional) economic growth
Matching solutions	Activities that match suppliers with consumers, or problems with solutions	Generate network effects
Cooperative (research) infrastructures	Long-term contract-based cooperation between a company and at least one research institution in the form of a public-private partnership	Pursuit of strategic long-term research and development projects, as well as development of new research areas

Model 1: Cluster concepts
A cluster refers to a group of diverse regional actors that have been brought together in a network, and which work together to achieve common objectives. This may include companies, suppliers and service providers from similar economic sectors and industries, as well as research institutions both within and outside universities. Professional associations, industry groups and chambers of commerce, and regional business-development entities may also be a part of a cluster (VDI/VDE 2017).

The cluster concept is based on the idea that favorable regional framework conditions and the geographical proximity of key actors within an innovation system can have a positive effect on the innovative capability of enterprises and regions (and thus also on economic performance), if these actors are able to work together better. From a substantive perspective, most cluster approaches focus on the development of new and cutting-edge technologies, sectors and business models that appear to offer significant developmental potential within the specific region. Many countries thus provide support to clusters as an integral aspect of their regional economic-policy strategies.

Science parks are one specific manifestation of a cluster solution. The primary objective of science parks is to generate regional prosperity and economic growth by fostering a culture of innovation and enhancing the competitiveness of participating companies and knowledge-based organizations. In order to achieve this, the science park seeks to facilitate knowledge and technology transfers between the participating actors, or promote the creation and growth of innovative companies by offering support services such as access to high-quality work spaces, laboratories or technical infrastructure. The science park then acts as a kind of catalyst, helping to translate scientific knowledge and newly developed projects into innovative products, and ultimately helping to make such products economically viable (Hansson et al. 2005). A number of studies have confirmed that geographic concentration encourages companies and research institutions within science parks to cooperate with one another more often – and above all more intensely – than do those outside such clusters (Hervás Oliver and Albors-Garrigos 2009; Vásquez-Urriago et al. 2015).

Science parks can be organized in quite different ways. They can be non-profit or profit-based institutions that are either entirely or partially owned by a university or a non-university research institution. Alternatively, they may be owned by a company or some other private institution, while maintaining a contractual or other formal relationship with a research institution.

However, to ensure a productive division of labor, the various actors involved should complement one another to a significant degree. At the same time, an international orientation also plays an important role. Since the knowledge needed for development projects in certain areas is often unavailable locally, it is especially important to be open to global knowledge flows, or so-called global pipelines. If a project is not integrated into such supra-regional knowledge flows, there is a risk that its store of available knowledge may prove insufficient to reach the project's goals, as participants concentrate too fully on regionally available knowledge and local conditions. This outcome is referred to as the "lock-in effect" (Fritsch 2015).

Due to their openness to a broad variety of actors, science parks represent one instrument that in theory enables the benefits from both innovation-policy paradigms to be combined. For example, in addition to companies, universities and research insti-

tutions, other actors such as public sector agencies, professional associations or civil society groups can be involved in different ways. This allows solutions to societal problems – typically with a regional focus – to be developed, tested and implemented.

Summary: Characteristics and benefits of cluster solutions

- Networks are created between institutions and actors in research, business, the public sector and civil society.
- Geographical concentration of diverse actors is used to further innovation processes.
- (Typically) entail a focus on cutting-edge sectors and business models.
- The (regional) economy's innovation capability and competitiveness are enhanced.
- Research and development results are converted more rapidly into innovative products and services.
- New networks are created involving innovative forms of cooperation.

Model 2: Matching solutions

The matching concept can be traced back to social reformer Frank Parsons (1854–1908). In his "trait and factor" theory, Parsons explained how new potential could be created by matching characteristics and skills (traits) on the one hand with operational requirements (factors) on the other. In doing so, he made a major contribution to the practice of placing workers efficiently.

The goal of matching activities is to bring together representatives of the supply and demand sides of an equation, or to create networks between actors with differing expertise, experiences and knowledge. Thus, the matching principle can also be used as an instrument for creating networks between different actors in the context of open-innovation processes. In theory, matching models can be used to bring together actors from any societal area. For this reason, while the instrument remains relevant from the point of view of traditional innovation policy, it also holds potential with regard to developing solutions for societal problems, as is the aim in mission-oriented innovation policy. Matching concepts can take many forms. For example, well-connected institutions may provide specialized subject-area experts to research and development projects, thus building bridges between actors in business, research, the public sector and civil society.

However, digital platforms are a much more widespread form of matching concept. These have become especially important in the course of the digitalization of the economy and society, serving as vital links in networks connecting far-flung groups of actors. Indeed, without such platforms, these groups would not be able to interact, or would be much less efficient in doing so. Examples of such digital platforms include social networks on the internet, search machines, online marketplaces, comparison and review

portals, app stores, and sharing platforms. Thus, digital platforms today have a growing influence on business models and even entire value chains. They also have significant economic potential in themselves, as shown particularly by Google, Apple, Facebook and Amazon, the operators of the four largest digital platforms. Together, these four companies have achieved a market capitalization of more than €1.5 trillion. This corresponds to about half of Germany's annual gross domestic product (BMWi 2020).

Digital platforms are characterized by a network structure. Platform participants network with one another by exchanging data and information. Because the various groups of actors want to interact with one another, the platform's overall benefits and appeal rise as the number of users increases. The bigger the network, the greater the advantages for its participants. In themselves, markets based on platforms are not new. For example, supermarkets, trade fairs and travel agencies are also ultimately platforms. However, the network effects offered by digital platforms are comparatively great. Such platforms demonstrate significantly greater scalability and reach, because they are unbound by geographical limits – even if there may be cultural, linguistic or legal hurdles – and because they can react relatively swiftly and flexibly to increased demand simply by adding additional computing capacity.

Digital platforms or network organizations can also play an important role in innovation processes. For example, many companies find it difficult to locate employees who possess the know-how needed to implement specific development projects or translate new technologies into practical applications. In this regard, innovative and well-tailored matching concepts offer solutions for networking the right actors quickly and easily together. In their specialized function as recruiting instrument, they can reduce search and transaction costs significantly (Wruk et al. 2018).

Thanks to their network effects and reduced transaction costs, matching concepts also offer the ability to integrate actors from different societal areas, such as citizens, NGOs, associations and government agencies, thus fostering the development of open-innovation processes. As a consequence, digital platforms and network-based organizations represent innovative approaches that enable the two innovation-policy paradigms – strengthening economic growth and technological competitiveness on the one hand, and solving societal problems through innovation on the other – to be combined.

Summary: Characteristics and benefits of matching concepts

- Network effects.
- Actors from different societal areas are matched with one another, creating networks.
- Supply side is brought together with demand side.
- Model is highly scalable, with broad reach.
- Transaction costs are low.

Model 3: Cooperative (research) infrastructures

In recent years, long-term partnerships between research and industrial entities and efforts to develop networks have gained increasing prominence. These strategic partnerships have resulted in the creation of new organizations, for example in the form of research-based spinoffs, research institutes that are connected to but legally independent from universities, and public-private partnerships. When developing this kind of cooperative (research) infrastructure, various actors combine their R&D capacities, for example by investing in shared research facilities, laboratories or test centers (Koschatzky and Stahlecker 2015).

One specific form of cooperation between the research and business sectors is exemplified by the so-called industry-on-campus concept (ibid.). While originally developed in the United States, this concept has since been used in a number of different countries. Large multinational companies in particular have invested alongside universities in strategic partnerships and the development of shared research and development capacities, establishing joint research centers and laboratories. This type of public-private partnership is a form of contract-based cooperation between at least one company and one research institution or university, focused on R&D and innovation activities.

In such a strategic cooperation, the actors involved generally combine financial resources over a long-term time horizon, with the intention of expanding their various complementary activities during this period. This kind of institutionalized partnership is typically intended to carry out strategic research projects, or even open up completely new areas of research. In addition, both sides generally expect the cooperation to involve some degree of technology transfer, ultimately with the potential for commercial exploitation. There are numerous other benefits for both partners as well, especially in the form of better resource allocation. For example, both parties benefit from new knowledge, shared learning effects, and an expansion of know-how, expertise and capacities. In addition, such relationships generate benefits associated with specialization – so-called economies of scope – and enable synergies to be exploited. Development times and costs can be reduced, while potential risks are minimized and shared (Hagedoorn et al. 2000; Becker and Dietz 2004).

Corporate interest in strategic partnerships has increased in recent years in large part due to intensifying competitive pressure and the growing urgency of innovation. Ever-more-complex technical challenges and perpetually contracting product life cycles mean that companies are increasingly unable to carry out research and development projects independently or in the absence of partnerships. In addition, this type of cooperation enables companies to make contact with skilled workers and potential future employees (Coombs et al. 1996; Becker and Dietz 2004; Koschatzky and Stahlecker 2015).

A number of motives for increased cooperation with industry partners can also be identified on the part of (public) universities and research institutions. In particular, science- and research-policy framework conditions have become increasingly flexible, expanding state-funded research institutions' autonomy and freedom of action. Moreover, society's rising expectations for technology transfer (particularly with regard to universities), greater autonomy with regard to exploitation rights, and the realities of public budget cuts have increased such institutions' willingness to enter into partnerships between the public sector and private companies. Especially for universities and research institutions, these cooperative ventures represent an opportunity to raise additional long-term third-party funding. Policymakers have also recognized the potential held by cooperative relationships of this nature, and strategic consortium-style partnerships between academic institutions and industry entities are thus increasingly being supported with public funds (Koschatzky and Stahlecker 2015).

However, industry-on-campus concepts can also pose risks, presenting the participating partners with challenges. For example, actors may lose control over strategically important knowledge, perhaps due to the opportunistic behavior of network partners or other parties within a cooperative venture. Fear of such a loss can ultimately reduce some entities' willingness to enter into cooperative research and development projects of this kind. For this reason, it is important to define fair rules of conduct for all participants with regard to intellectual property, regulating the confidentiality and use of intellectual-property rights (Koschatzky and Stahlecker 2015).

To ensure that this instrument generates added societal value – a defining characteristic of mission-oriented activity – it is also important to involve additional societal groups in the innovation process. This involvement can facilitate the process of developing a shared mission, and push the project to address specific societal challenges more substantively. Moreover, it can ultimately help any new technologies developed be more broadly accepted throughout society (JIIP 2018; Larrue 2019).

Summary: Characteristics and benefits of cooperative (research) infrastructures

- Relationships are based on strategic partnerships between different institutions, for example between a company and a research institution or university (public-private partnership).
- Typically implement joint research and development projects.
- Involve long-term planning horizons.
- Focused on strategic research projects and/or development of new research areas.
- Partnerships offer synergistic effects and specialization-related efficiency gains.
- Risk is partially shared.

FIGURE 2

TYPOLOGY OF THE THREE FORMS OF INSTITUTIONALIZED NETWORKING

FORM OF INSTITUTIONALIZED NETWORKING

- Cluster concepts
- Matching solutions
- Cooperative (research) infrastructures

POSSIBLE FUNCTIONALITY AND DESIGN

Involvement of all relevant actors:

- Research sector
- Private sector/industry
- Policymakers/public sector
- Civil society

Focus on innovation-policy paradigms:

Strengthening competitiveness

- ▶ Strong
- ▶ Moderate
- ▶ Not present

Solving societal problems through innovation

- ▶ Strong
- ▶ Moderate
- ▶ Not present

International orientation:

- ▶ Strong
- ▶ Moderate
- ▶ Not present

BENEFITS OF THE EXCHANGE MODEL

- Creation of new networks, with innovative forms of cooperation
- Exploitation of network effects
- Exploitation of synergistic effects
- Highly scalable, with broad reach
- Reduction of transaction costs
- Strengthens the regional economy's innovation capability and competitiveness
- More rapid conversion of R&D results into innovative products and services
- Faster and more efficient matching of supply and demand
- Development of new research and development fields

1.3

Criteria for selecting case studies

In selecting the international case studies presented here, we have focused primarily on the novelty of the instruments used – at least within the German or European context – as well on the projects' clear orientation toward societal needs. In this regard, the aim is to identify institutional framework conditions that use innovative means to facilitate open exchange between diverse actors, while also generating benefits for society. The examples are intended to explicitly embody potential instruments of a mission-oriented innovation policy, rather than being oriented exclusively toward the achievement of economic goals.

This focus on societal needs should be as clear as possible, for example by trying to help achieve the United Nations' Sustainable Development Goals (SDGs).[1] Efforts to develop solutions for societal problems should be integrated into the formulation of project objectives, and the results should be clearly visible in the project's operational work.

Cross-sectoral openness was another criterion. For example, to have been selected, the innovation-policy instrument must go beyond simply bringing together representatives from the research and business sectors, instead being open to additional societal actors such as non-governmental organizations (NGOs), social entrepreneurs, citizens or the public sector. Involving different actors in the various developmental and procedural stages of the value chain (in the sense described by our definition of open innovation) is an excellent way to increase the societal relevance of the support-policy instruments employed (Larrue 2019). This involvement should receive active and targeted support. In this regard, it is vital that the instrument not be based on one-sided technology transfer (e.g., from an academic institution to industry); rather, it should entail a reciprocal exchange of knowledge in different directions. As additional criteria, we considered whether the project's work was subject to regular and transparent evaluation, whether the project's strategy had been operationalized with transparency, and the degree to which the instruments were potentially transferrable to other settings. This last criterion is significant because the examples presented here are explicitly intended to offer lessons for German (and to some extent European) innovation policy.

Our case studies show that open innovation processes can deliver societal benefits.

1 For further details on the UN development goals, see www.un.org/sustainabledevelopment/sustainable-development-goals/ (accessed December 12, 2020).

2.

Good practices in institutional networking

In the following, we present several practical examples of each model of institutional exchange – cluster concepts, matching solutions and cooperative research and development infrastructures – drawn from a variety of countries. The case studies were identified during our research into good practices, and were analyzed and developed in a process that included on-site visits by Bertelsmann Stiftung representatives, qualitative interviews and intensive literature research. This included conversations with employees of the institutions presented, as well as with local and international experts (see 4.1).

In line with our guiding vision of "learning from the world", we examine case studies from several countries.

2.1

International examples of good practices: Cluster concepts

Swedish innovation policy is designed both to address global societal challenges and to enhance the economy's international competitiveness (for a general analysis of Swedish innovation policy, see Results Paper 1 in this series). Its specific objectives include:

- Promoting economic growth
- Increasing the productivity of the Swedish economy
- Increasing the efficiency of public-service delivery
- Enhancing the welfare of the Swedish population (Fagerberg 2016; Fagerberg 2017; Edquist 2019)

In addition, Sweden is a forerunner in terms of developing and testing new policy instruments that facilitate the development and dissemination of innovations, and which help steer innovation as a whole in a mission-oriented direction (Fagerberg 2016; Edquist 2019).

The clear mission-oriented approach can be seen in Sweden's science parks. Science parks are not in themselves a new instrument in the field of innovation policy or regional economic development. Indeed, in recent decades, numerous science parks have been created in many countries, taking a multiplicity of different forms (technology parks, technology and business incubators, innovation camps, etc.) and focusing on a wide variety of substantive thematic areas. However, Sweden's science parks stand out within this realm for their early focus on societal needs – with this turn taking place as far back as the 1980s and 1990s – and the integration of such issues into their core missions. Consequently, there is also significant involvement by the public sector and other actors from civil society. The various host cities or communities are often themselves participants in the science parks, and play an important role in defining the substantive orientation of their main development projects. (Most) Swedish science parks are organized under the Swedish Incubators & Science Parks (SISP) umbrella organization. This group has 62 members across Sweden, representing a total of 5,000 individual companies and more than 70,000 employees (SISP 2020).

We look here in more detail at the Lindholmen Science Park and the Ideon Science Park, two specific examples characterized by a particularly strong societal focus, and which exhibit particularly innovative institutional framework conditions facilitating exchange and networking.

2.1.1 SWEDEN | LINDHOLMEN SCIENCE PARK

Developing cutting-edge mobility concepts

The Gothenburg-based Lindholmen Science Park focuses on research and development in the area of mobility and transport, in large part due to its geographical proximity to the headquarters of the Volvo automotive group. Around 85 % of the institution's resources are used within this area. However, its additional fields of activity include information and communications technology, visualization technologies, media, and artificial intelligence. The science park was founded by Chalmers University of Technology and the city of Gothenburg. Additional operators of the not-for-profit company include the University of Gothenburg, the Gothenburg Business Region, the Swedish Road Administration and a number of industrial partners from various sectors including the Volvo Group, Ericsson, TeliaSonera and Saab. The science park's strategic partners include the region of Västra Götaland, Vinnova (the Swedish state's research-funding organization) and the Swedish Civil Contingencies Agency. A number of start-ups have established themselves within the science park itself, benefiting from the close connection to industry and research institutions, as well as from the "neutral arena" provided for their business models.

The substantive work in Lindholmen is divided into strategic flagship projects, which are defined according to a quadruple-helix organization (see Figure 4), thus including representatives from the research community, the private or industrial sector, the public sector and civil society. These research and development projects are intended to produce innovations that enhance the (regional and national) economy's competitiveness and offer solutions to urgent societal problems. The science park supports this development process from the point at which a problem is first identified, through the development of a solution, and ultimately all the way to the point of implementation, ensuring that relevant actors are involved.

There are currently 10 strategic flagship projects, which are in turn subdivided into smaller research and development projects with numerous national and international partners (Lindholmen Science Park 2020). According to our interviewees, the projects are oriented toward the "needs of today's society," taking a pragmatic approach in doing so. Thus, instead of an idealistic "nice to have" mindset, the projects are guided by a solution-oriented "need to have" calculus. Constant exchange (e. g., through

LINDHOLMEN SCIENCE PARK

- Location: Gothenburg, Sweden
- Founded: 2000
- Type of organization: Non-profit organization
- Substantive focus: Mobility and transport, information and communications technology, media and AI
- About 50 employees in the science park itself
- About 250 companies, with a total of around 10,000 employees

workshops and round-table events) with public sector actors (such as the city of Gothenburg) and civil society groups helps ensure that the project work remains focused on creating solutions to the most pressing problems.

The *Drive Sweden: A new approach to mobility* project is a good example of a strategic flagship project of this kind. Drive Sweden is an interdisciplinary and cross-sectoral cooperation platform intended to develop novel and sustainable mobility concepts for society. It focuses particularly on the issues of environmental friendliness, safety and efficiency. The goal is to combine and further develop approaches involving self-driving and networked automobiles, car-sharing concepts, and integrated payment systems. To this end, the project brings together actors from a broad range of societal spheres and sectors, as complex solutions of this kind cannot be developed solely by automobile manufacturers or IT service providers, and cannot be independently coordinated or implemented by a single city or region. Civil society actors are involved in the development projects on an ongoing basis, ensuring a high level of public engagement. As a strategic innovation program, Drive Sweden has been funded since 2015 by Vinnova, the Swedish innovation agency, as well as the Formas Swedish research council and the Swedish Energy Agency, with the current financing period lasting a total of 12 years (Drive Sweden 2020).

Overall, Lindholmen Science Park sees itself as a facilitator that promotes and proactively shapes dialogue between actors and sectors that otherwise often act in isolation from one another. In this sense, it not only brings actors to the table together, but also plays a lead role in project development, for example by raising funds and reaching out to other potentially interested actors. A high degree of credibility is critical here; this is ensured by the fact that the science park has considerable in-house technical expertise (many of its employees have an engineering background), and that it is independent of the individual stakeholders. This latter point is crucial, as the projects often involve the use of sensitive information. The consensus-based process for defining objectives also increases actors' willingness to take an open stance toward other stakeholders and think beyond their usual modes of activity.

The Lindholmen Science Park actively involves civil society actors in technology projects.

2.1.2 SWEDEN | IDEON SCIENCE PARK

The sustainable science park

IDEON SCIENCE PARK

- Location: Lund, Sweden
- Founded: 1983
- Type of organization: Non-profit organization
- Substantive focus: Future transportation, smart cities, smart materials, health technology
- About 9,000 employees
- About 400 companies

The Ideon Science Park, located in Lund in southern Sweden, is focused on the development of key digital technologies, and is additionally committed to promoting economic sustainability. In this way, it combines efforts to enhance competitiveness – primarily within the regional economy – with the solution of societal problems. Founded in 1983, Ideon is the oldest science park of its kind in Scandinavia. Due to its proximity to Lund University, it was able to build early bridges between the research, business and public sectors. In addition, Ideon Science Park maintains close ties to the nearby Malmö University. The two universities together have a total of more than 75,000 students.

Ideon's societal mission can be seen particularly in the formulation of its objectives, and in the substantive areas in which it focuses its work. Its primary objectives are to promote greater sustainability and foster the use of key digital technologies in areas of major societal relevance. The science park achieves both goals by fostering cross-sectoral cooperation, and by facilitating intensive exchange between researchers and non-academic actors such as companies, government agencies and civil society groups. From a substantive perspective, Ideon focuses on the following four core areas:

- **Future transportation:** Companies based at the science park work with universities and research institutions to develop solutions and responses to key challenges and trends in the mobility sector. The goal is to develop innovative concepts in the areas of networking technology, self-driving automobiles, electric vehicles and car-sharing.

- **Smart cities:** This broad area encompasses projects ranging from lighting systems, sensors and big data to social entrepreneurship and behavioral studies.

- **Smart materials:** This area refers to new materials and their use, among other topics. It is a response to the growing need for lightweight materials that exhibit certain functionalities or which are easy to maintain. The focus here is particularly on 3D-printing techniques and prototype construction.

- **Health technology:** This area focuses on new technical solutions that can be used within the healthcare system, and particularly by patients themselves. Examples of development projects include web-based tools linking doctors and pharmacies, smart watches able to monitor bodily functions, the use of artificial intelligence to identify potential risks, and 3D printers used to produce exoskeletons.

In addition, Ideon is carving out a new focus on sustainablality. To this end, it has launched a variety of sustainability projects with the goal of contributing to the achievement of various UN SDGs, and thus generating added societal value. These include the following:

- **UN SDG and UN Global Compact Training:** As the world's first science park, Ideon has joined the United Nations Global Compact, the largest voluntary corporate sustainability initiative worldwide. Within this framework, Ideon offers workshops for resident companies that want to integrate the 17 SDGs into their strategic business models.

- **Matching newly arrived academics with Ideon companies:** With the help of a project supported by the European Social Fund, the science park matches IT professionals from abroad with internships in resident IT firms, with the aim of bringing together job seekers and companies in a targeted way.

- **Energy Cooperation Southern Sweden:** This project, funded by the Swedish Energy Agency, works on energy innovations intended to help counteract climate change.

- **IDEON Coder Kids:** With the goal of inspiring more children to learn how to program, Ideon Science Park organizes an annual event with resident IT companies that gives children insight into programming.

- **The Yes Way:** With this project, the science park supports diversity among entrepreneurs, with specific offerings for women and people from non-Swedish backgrounds.

Also worth highlighting are Ideon's efforts to develop networks between actors from different sectors of society in the context of open-innovation processes. For example, open and innovative processes of exchange within the science park are a key aspect of the services it offers. To this end, Ideon has developed its own open-innovation strategy to help companies develop an appreciation for the topics of open innovation and co-creation. It has created a subsidiary called Ideon Open specifically for this purpose; this entity works with companies in a number of ways to test open-innovation processes.[2] One key element in this regard is the principle of collaborative co-creation. This involves developing a cooperative open-innovation approach that is adapted anew for each individual project, a process that takes place over several successive steps. Ideon Open offers support here particularly in the initial identification of challenges, the definition of specific targets and milestones, and the search for suitable cooperation partners across the entire value chain able to be integrated into the various project phases. In addition, Ideon Open advises companies on handling patents and other project results that may have intellectual-property implications, as well as on financing issues. Overall, the company provides projects with support until they have successfully developed a prototype; moreover, it helps clients work out the details of their individual business models right up until the first customer contracts have been signed.

FIGURE 3
TYPOLOGY OF THE CLUSTER CONCEPT: SCIENCE PARKS

FORM OF INSTITUTIONALIZED NETWORKING

Cluster concept (specifically: science park)

POSSIBLE FUNCTIONALITY AND DESIGN

Actors involved:

- Research sector
- Private sector/ industry
- Policymakers/ public sector

Focus on innovation-policy paradigms:

Strengthening competitiveness
▶ Strong

Solving societal problems through innovation
▶ Strong

International orientation:

▶ Strong

BENEFITS

- Enhances the regional economy's innovation capability and competitiveness
- Joint development of solutions for local and regional challenges
- R&D results are converted more rapidly into innovative products and services
- Development of new research and development fields

2 For a detailed overview of Ideon Open's offerings, see: https://ideonopen.com/offers/ (accessed December 12, 2020).

2.1.3

Lessons learned with relevance for Germany

Unlike many traditional science parks, the Swedish science parks have a strong thematic focus on societal needs and challenges. This can be seen particularly in their organizational structures. Cities and municipalities are themselves participants in the science parks, and help shape the topics addressed and the design of the main development projects. In this way, the science parks represent the ideal form of the quadruple-helix organization, particularly with regard to ownership structure, financing and substantive focus. The quadruple-helix approach describes the increasingly tight connections being formed particularly between the research, industrial, public (or state) and civil society sectors (see Figure 4). This expands the triple-helix analytical model developed in the 1990s for the study of organizational and institutional arrangements between academia, businesses and the state, adding civil society as an additional actor dimension (Etzkowitz and Leydesdorff 2000; Carayannis and Campbell 2009). The approach seeks in this way to reflect the complexity of innovation activities and the diversity of participating actors and social contexts.

Thanks to the increased intensity of cooperation between the actors, the organizational and cultural barriers that in the past kept these four spheres separated are proactively weakened, facilitating stronger and more productive exchange (Arnkil et al. 2010; Carayannis und Campbell 2012). A significant advantage of this type of networking is that societal needs are given direct consideration in the development of products and services.

In this context, the Lindholmen Science Park's flagship-project structure is worthy of particular emphasis, as it integrates a broad range of value-chain actors as well as stakeholders and potential users into the development process. This enables innovators to identify fields of activity in a flexible and needs-oriented way, while employing a medium- to long-term perspective for their research and development projects. As a result of this model of cooperation, new mobility concepts for the region are being developed, electric bus systems for cities are being tested, and digital technologies are being trialed within the healthcare sector, for example. Ideon Science Park's open-innovation strategy also clearly shows how a broad variety of actors with differing areas of expertise can be integrated across the length of the value chain. The science parks thus function as a catalyst for innovative ideas, while enhancing the innovative capability of their entire home regions.

The success of this model is evident in recent years' growth rates. Currently, the number of companies participating in Sweden's 32 science parks has risen to more than 6,000. This includes numerous research-based spinoffs and small-to-medium-sized enterprises, as well as many large international corporations such as Volvo, Ericsson, Bosch and Sony. In total, nearly 100,000 knowledge-intensive jobs have been created in the vicinity of the science parks (SISP 2019). Sweden's science parks have thus become an important pillar of the country's innovation system.

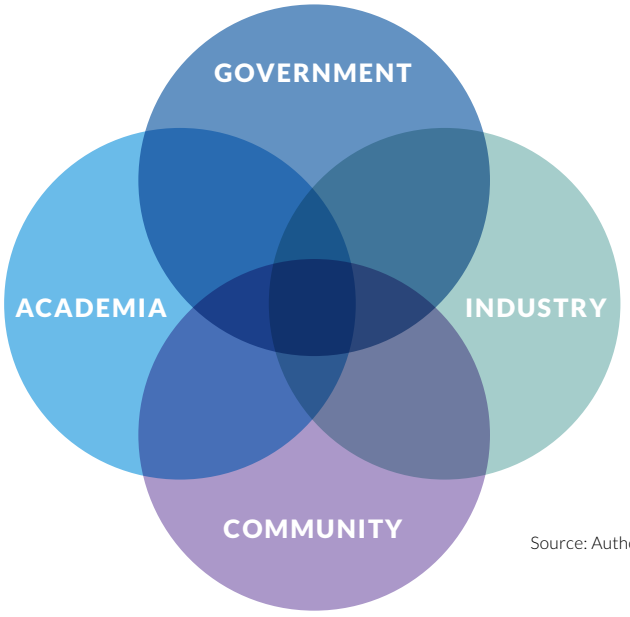
Overall, the examples described here embody successful approaches to building networks between a variety of actors, a defining aspect of mission-oriented innovation policy. Development projects are oriented toward clearly formulated needs, while at the same time taking companies' individual profit interests into account, thus exemplifying the successful combination of our two paradigms – strengthening economic growth and technological competitiveness on the one hand, and solving societal problems through innovation on the other. The examples thus show how science parks, a particular manifestation of the cluster approach, can be used to pursue different but complementary innovation-policy goals.

Germany too is home to numerous science parks, particularly in university- and industry-rich locations. To be sure, these entities too are to some extent following an innovation-policy approach that is increasingly oriented toward specific societal challenges – for example, with the Federal Ministry of Economic Affairs and Energy's Leading-Edge Clusters Competition.[3] However, the clusters funded to date have not yet developed the breadth of impact and thematic depth seen in the Swedish science parks. In particular, there has been less effort to expand purely technological or economic motivations so as to include societal concerns, and to integrate actors able to introduce societal considerations into value chains. In this regard, it would be useful to strengthen the link between technological expertise and real societal needs, for example by establishing and expanding quadruple-helix structures with correspondingly substantively focused priorities and a normative orientation toward the SDGs.

Thematic areas such as mobility, healthcare and energy production in particular, due to their societal importance and the significant level of expertise already available within Germany, would seem to be a natural fit with this model. Science parks of this kind would be a valuable complement to the instruments currently used to implement mission-oriented innovation policy. Germany already possesses a well-developed networking infrastructure and widespread expertise in networking. Thus, conditions are already quite favorable for steering cluster initiatives and similar instruments toward the pursuit of specific missions. For this to succeed, however, appealing visions will be needed, ideally developed jointly with the relevant local stakeholders.

FIGURE 4

NETWORKS BETWEEN THE POLICY, RESEARCH, BUSINESS AND CIVIL SOCIETY SECTORS IN THE QUADRUPLE-HELIX APPROACH



Source: Authors

3 For further details, see: https://www.clusterplattform.de/CLUSTER/Navigation/EN/Home/home.html (accessed December 12, 2020).

2.2

International examples of good practices: Matching solutions

In the following section, we present three international case studies involving matching solutions that function in various ways to link demand and supply within the innovation system, while also building networks between different societal actors. Start-Up Nation Central is an independent, non-profit based, based-in-Israel online organization for the country's startup ecosystem that introduces young companies from Israel to potential cooperation partners from around the world. The European Social Challenges Innovation Platform (SCHIP) has set out to create an online ecosystem able to address urgent social challenges through innovative solutions. Canada's Mitacs is an intermediary organization that places highly skilled staff within companies, ministries and other public authorities within the context of specialized programs.

2.2.1 ISRAEL | START-UP NATION CENTRAL

The online platform for the national startup ecosystem

Start-Up Nation Central is an online platform from Israel that provides information on that country's national startup ecosystem, and thus helps build synergistic networks between potential cooperation partners. Its Start-Up Nation Finder presents data on more than 6,500 young, innovative Israeli companies, including their business models, locations and founding dates. This enables interested investors, research institutions, established small-to-medium-sized enterprises (SMEs) and large multinational corporations to engage in well-targeted searches for potential cooperation partners. Moreover, these entities can also create their own profiles on the platform, providing information and presenting themselves to others who may be seeking partners. Start-Up Nation Central additionally uses the platform to provide information on new technological trends, thus reducing the effort and expense of such search efforts. At the same time, it increases the visibility of young, innovative companies in Israel.

START-UP NATION CENTRAL

- Country: Israel
- Founded: 2013
- Online platform for information on Israeli startups
- Type of organization: Non-profit organization
- Substantive focus: Agritech, cybersecurity, digital health, smart manufacturing, fintech, watertech
- About 6,500 companies

Startups often pursue novel business models and expand the existing range of available products and services. Research-based spinoffs from the academic community in particular play an important role in transferring new knowledge and technologies into practical application. In this regard, they also act as trend scouts, providing inspiration to established companies. As potential partners, they can additionally contribute to the joint development, marketing and application of innovations (EFI 2019).

Thematically, the Start-Up Nation Finder platform focuses primarily on technologies and sectors that on the one hand show significant market potential, and on the other offer promising solutions to societal problems deemed urgent from the Israeli perspective. It thus focuses particularly on innovative and sustainable agriculture- and water-related technologies, cybersecurity, digital health, smart manufacturing and fintech. In this way, Start-Up Nation Central connects companies, trade associations, governments and non-governmental organizations from around the world with the Israeli innovation system.

With its global reach, Start-Up Nation Central reflects the increasing internationalization of the Israeli high-tech sector. This has been made particularly clear by the rising number of multinational companies that have opened research and development centers in Israel in recent years. At the same time, more and more Israeli companies are expanding internationally, establishing locations in other regions of the world. This is also intensifying the competition for skilled workers (Israel Innovation Authority 2019). Start-Up Nation Central is responding to the

increased demand particularly for engineers and developers by helping companies with their recruiting efforts and assisting them in making contact with potential new employees.

In addition, the platform makes a particular effort to place members of previously underrepresented and disadvantaged population groups, such as Palestinians or women in certain professions. For example, Start-Up Nation Central has worked with companies to develop a number of training and internship programs oriented toward specific groups of people, with the aim of making it easier for them to find jobs. In doing so, the platform is seeking to ameliorate the shortage of skilled workers while simultaneously fostering integration and diversity within companies.

FIGURE 5

TYPOLOGY OF THE MATCHING CONCEPT: ONLINE PLATFORM I

FORM OF INSTITUTIONALIZED NETWORKING

Matching concept (specifically: online platform)

POSSIBLE FUNCTIONALITY AND DESIGN

Actors involved:

- Private sector/ industry
- Research sector
- Policymakers/ public sector
- Civil society (in this case, trade associations and NGOs)

Focus on innovation-policy paradigms:

Strengthening competitiveness

▶ Strong

Solving societal problems through innovation

▶ Moderate

International orientation:

▶ Strong

BENEFITS

- Strengthens the Israeli innovation system
- Effective placement of skilled workers with low transaction costs
- Global reach generates network effects
- Contributes to the solution of societal challenges, while generating significant market and application potential
- Helps promote inclusion and diversity within companies

2.2.2 EUROPE | SOCIAL CHALLENGES INNOVATION PLATFORM (SCHIP)

The online platform for social innovations

SOCIAL CHALLENGES INNOVATION PLATFORM

- European online platform for social innovations
- Time in operation: December 2016 through June 2019
- Total budget: €3.5 million
- A total of 68 innovators selected and provided with funding to address 59 challenges
- Project coordination: META GROUP SRL (Italy)

Financed by the European Union, the Social Challenges Innovation Platform (SCHIP) promotes the development and application of sustainable social innovations with clear societal benefit. The goal of SCHIP is to link creative companies and social entrepreneurs with organizations and agencies that have reached out to the platform for help with specific local problems. The digital-platform model is intended to allow as many social innovators and small-to-medium-sized enterprises (SMUs) as possible to participate. The project is led by Italy's META GROUP SRL, a consulting firm specializing in the area of innovation. The firm also coordinates the distribution of financial grants to the social innovators. Additional project partners include the European Business and Innovation Center Network (AISBL) from Belgium, and the IMPACT HUB GmbH from Austria.

The platform is designed so that public institutions, municipalities, cities, citizen initiatives and other groups, as so-called challenge owners, can define social challenges and problems and post them on the platform. Private providers, SMEs and social entrepreneurs can then present their innovative ideas in a pitch, and apply to address these challenges as solution providers. After a successful review, the provider undergoes an intensive six-month mentoring program, and receives a grant of €30,000 in order to develop the idea and implement it as a solution to the social problem. Through 2019, a total of 59 challenges from 15 European countries had been chosen in two separate selection rounds. The challenges were grouped in the following areas:

- **Aging** (five challenges)
- **Education** (eight challenges)
- **Employment/skills** (five challenges)
- **Energy** (one challenge)
- **Environment/food** (10 challenges)
- **Health/disability** (six challenges)
- **Youth** (one challenge)
- **Refugees/migration** (four challenge)
- **Smartcities/mobility** (six challenges)
- **Social inclusion/gender** (15 challenges)[4]

Out of 392 applications, 68 solution providers were ultimately selected and provided with funding.

The challenge that received the most applications in the first round came from Vienna, and was described as follows: "Make conscious consumption mainstream in Vienna." This challenge seeks to promote responsible and sustainable consumption, thus contributing to the 12th UN Sustainable Development Goal on sustainable consumption and production practices. Specifically, the city is looking for innovative companies using market-based approaches to offer sustainable goods, services and products in an appealing, accessible and cost-effective way, thus fostering sustainable consumer behavior.

In another challenge, a Munich-based NGO also asked about innovative approaches able to induce behavioral changes within society, this time in relation to climate protection. Thus, the "Climate Protection Now" challenge asked for low-threshold solutions that could create incentives for the general public to take action against climate change. Another example of a social challenge is the search for a

4 Some challenges were categorized under more than one topic area.

"sustainable care system for the elderly in small settlements." Here, a long-term care provider located in Friesland, in the Netherlands, asked for innovative concepts and ideas for improving the long-term care situation for people needing such care in a sparsely populated region.

In addition to financial support from the platform, the companies that successfully apply for funding as solution providers receive Europe-wide visibility for their achievements, enabling them to position themselves on the continent as social innovators.

With this support for a digital platform designed to disseminate social innovations, the EU is breaking new ground. Platforms such as SCHIP follow a demand-driven and user-centric approach to selecting solutions. They focus on social and societal challenges that are primarily defined using bottom-up processes. At the same time, digital platforms such as SCHIP enable broad-based participation by social innovators and companies, and allow innovative solutions for societal challenges to be tested.

FIGURE 6

TYPOLOGY OF THE MATCHING CONCEPT: ONLINE PLATFORM II

FORM OF INSTITUTIONALIZED NETWORKING

Matching concept (specifically: online platform)

POSSIBLE FUNCTIONALITY AND DESIGN

Actors involved:

- Private sector and industry (in this case, primarily startups and social entrepreneurs)
- Research sector
- Public sector (in this case, cities and municipalities)
- Civil society (in this case, trade associations and NGOs)

Focus on innovation-policy paradigms:

Strengthening competitiveness
▶ Moderate

Solving societal problems through innovation
▶ Strong

International orientation:

▶ Strong

BENEFITS

- Network effects due to cross-European reach
- Uses social innovations to solve local/regional challenges
- Provides funding to startups and social entrepreneurs
- Platform is demand-oriented and user-centered

2.2.3 CANADA | MITACS

Matchmaker between industry and the academic research sector

Like digital-platform solutions, intermediary organizations can help build networks between key actors in the research and innovation system, using innovative approaches to develop tailor-made matching solutions. Mitacs in Canada is one example of such an intermediary organization. It is a non-profit research organization that conducts research and training programs in cooperation with Canadian universities, private sector companies and the government. Funding is provided by the Canadian federal government as well as by various provincial governments. Mitacs' primary objective is to foster innovative capability across Canada as a whole. To this end, it works on behalf of the government to develop instruments facilitating personnel transfers. From a substantive point of view, the organization specializes in technological and social innovations, cooperating to this end with more than 70 universities and 6,000 private companies.

Mitacs was founded in 1999, initially as a national network of centers of excellence for the support of applied and industrial research in mathematics- and natural-science-related disciplines (as reflected by the entity's original name, The Mathematics of Information Technology and Complex Systems). At the time, despite performing industry-related research work, many young researchers were later unable to find employment in the private sector. Notwithstanding their intense cooperation with research institutions, most companies did not recruit graduates, doctoral students or post-docs from the excellence centers, which meant that the young researchers either had to shift their areas of focus or move to the United States for work. At the same time, labor productivity in the Canadian industrial sector was declining, particularly in comparison to the United States, the country's most important trading partner. This was primarily due to a lower capital intensity and lower capacity utilization among the Canadian companies (Rao et al. 2008). Mitacs itself attributed the weak innovative capacity particularly to insufficient networking and the lack of exchange between the research and industrial sectors, which in these years was highly selective and largely project-focused. To remedy this situation, the organization initially developed pilot-style instruments designed to facilitate the transfer of personnel between the academic research and private sectors.

Mitacs' most important instruments in building bridges between the research and industrial sectors are research projects undertaken within the context of internships. Under its Accelerate program, Mitacs matches highly skilled students and young researchers with paid research projects. This allows them to work at companies on strategic research and development projects for terms lasting a minimum of four months. The companies can in turn apply to the organization in order to recruit young workers of this kind. As a part of its services, Mitacs employs so-called business-account experts who act as intermediaries; these staffers are in constant contact with companies from many different sectors, discussing current technical challenges and problems with them, and exploring possible research and development projects. Moreover, about 75 Mitacs business-development specialists are embedded at around 70 universities. These individuals maintain close contact with academics, and can quickly recruit potential candidates for projects. Mitacs bears half the costs for the research staffers it helps place, with these

MITACS

- Country: Canada
- Founded: 1999
- Type of organization: Non-profit network-based organization
- Cooperation with more than 70 universities and 6,000 companies, with 25 locations
- Has supported and placed employees with more than 20,000 (research) projects

costs varying from project to project. The remainder of the cost is paid by the companies themselves. The minimum level of funding provided per young researcher is CAD 10,000.

This instrument enables companies, with the help of the recruited staffers, to carry out research and development work with significant innovative potential quickly and flexibly. For their part, the young researchers working on these projects are able to gain familiarity with working environments outside the academic research system, develop new skills, expand their personal networks, and work on research and development projects with high practical and applied relevance. Since 2003, Mitacs has supported more than 20,000 such projects, coached and placed more than 33,000 students and young researchers, and assisted more than 3,600 international cooperative research ventures. More than a third of the individuals placed have remained at the company following the end of their project assignment. In this way, Mitacs acts as a matchmaker between the academic research and industrial sectors, increasing the Canadian economy's innovation potential. The range of projects supported is today open across the technological spectrum. Placement opportunities for students and researchers have also expanded. In line with a broader, open conception of the innovation system, the placement service today encompasses projects carried out by non-profit organizations, NGOs and associations. The aim in this regard is to provide explicit support for social innovation as well.

In addition, Mitacs has worked for several years with the Canadian Science Policy Fellowship Program to transfer the project model to the political arena. Through this program, funding is provided for post-doctorate-level placements of up to 12 months within political institutions (e. g., ministries). This is intended to allow young researchers, with their academic and analytical capabilities and critical thought, to contribute to evidence-based decision-making processes in various political fields. The aim is to help generate research-based solutions to societal challenges.

As a non-profit organization with its own legal form, Mitacs has considerable flexibility in acting, particularly when developing new exchange or networking instruments, pursuing cooperation opportunities with private sector companies, or setting its own staff hiring and remuneration policies. Many of Mitacs' business-development positions, for example, are co-financed by universities. Unlike many direct state funding programs, the organization can develop and test new instruments relatively autonomously. It is broadly independent of parliamentary legislative periods, and thus has the security to engage in overall long-term planning.

FIGURE 7
TYPOLOGY OF THE MATCHING CONCEPT: INTERMEDIARY ORGANIZATION

FORM OF INSTITUTIONALIZED NETWORKING

Matching concept (specifically: intermediary organization)

POSSIBLE FUNCTIONALITY AND DESIGN

Actors involved:

- Private sector/industry
- Research sector (in this case, students and young researchers)
- Public sector (in this case, government agencies)

Focus on innovation-policy paradigms:

Strengthening competitiveness
▶ Strong

Solving societal problems through innovation
▶ Moderate

International orientation:

▶ Moderate

BENEFITS

- Regional anchoring and cross-regional networking create network effects
- Researchers are placed in companies that engage in R&D, as well as in government agencies
- Helps implement R&D projects more rapidly
- Enhances Canadian companies' innovative capabilities

2.2.4

Lessons learned with relevance for Germany

The three international case studies presented here use different innovative instruments to link demand and supply more rapidly and effectively, especially with regard to the specific know-how possessed by individual people. In this regard, they help foster innovation while taking societal needs into account, albeit in different ways.

Israel's Start-up Nation Central is particularly internationally oriented, a fact that allows the platform to increase young Israeli companies' visibility and expand their international reach at the same time. With its focus on high-tech startups, the platform is concentrating specifically on innovation-system actors that adopt disruptive ideas more readily, and implement them in more radical innovations, than do established companies, thus acting as trend scouts and pioneers of new technologies and business models.

This focus on innovative startups is particularly important from the German point of view. As Results Paper 4 in this series shows, Germany's startup sector has considerable catching up to do relative to its counterparts in many other developed economies. For example, the rate of startup creation relative to the overall number of companies is significantly lower than in France, the Netherlands or the United Kingdom. In research-and-development-intensive industrial sectors, Germany even has the lowest startup intensity in cross-national comparison (EFI 2020). Matching platforms similar to the Israeli good practices example could help remedy this. While there is already a considerable range of general job platforms here in Germany, providers with a focus on making innovation-relevant matches (e. g., investors with startups, companies with universities, etc.) are rare. The few active platforms of this kind are typically limited to the German-speaking world, are often limited to just a few individual forms of cooperation, and list only a small pool of stakeholders. In addition, by presenting few opportunities to participate actively in solving societal problems, these services are missing an opportunity to increase the appeal of collaboration for many actors.

The European SCHIP also has an international orientation, but instead focuses exclusively on social innovations. To this end, it has defined a total of 10 societal challenges, within which users identify specific local problems, and for which social entrepreneurs can offer tailor-made solutions. This is a new approach, in which the digital-platform instrument, with its great networking potential, is applied to the area of social innovations.

Both platforms offer inspiration beyond the specific implementations identified here. For example, it would be conceivable to merge the models respectively underlying Start-Up Nation Central and the Social Challenges Innovation Platform, thus developing a high-visibility platform on which innovative (high-tech) companies could present their solutions for societally relevant problems, and where potential users could in turn find the solutions they need. A platform of this nature would help orient young companies and perhaps entrepreneurial innovation overall more strongly toward societal challenges. Moreover, it would also make it easier to integrate civil society actors into innovative processes, which is particularly important in the development and application of new technologies (as shown in the previous chapter's case study on Sweden's science parks).[5]

5 Launched by the Digital, Work & Society Policy Lab within the German Federal Ministry of Labour and Social Affairs, the Civic Innovation Platform is one such effort in this regard. However, it is still too early to assess the impact of this platform. For more information, see www.civic-innovation.de/en/home (accessed January 7, 2021).

In addition, consideration should be given to a European initiative that utilizes the Start-Up Nation Central approach across the entire continent, thus creating stronger, more synergistic networks between the member states' various startup ecosystems. Expanding this to the entire internal market would also significantly increase the number of participants, and thus the probability of finding solutions that fit specified problems. In terms of content, a platform of this kind could focus on core EU themes, taking a mission-oriented development approach. One such example might be the new Green Deal, with which the EU Commission has set the goal of reaching net-zero emissions for greenhouse gasses by 2050.[6] A platform of this nature would increase the visibility of European startups and give them a more international reach. Moreover, young companies would have the opportunity to develop innovative ideas and concepts, for example with respect to using resources more efficiently, restoring biodiversity or combating pollution. In this way, the two previously identified paradigms – promoting competitiveness and economic growth, and developing novel contributions to the solution of overall societal problems – could be tied more closely together. To be sure, the UpLink digital platform (created by the World Economic Forum) already works to bring decision-makers together with innovators who have developed solutions that may help achieve the SDGs.[7] However, there remains sufficient room beyond this task for an initiative focused specifically on European needs and demands.

For its part, Mitacs in Canada places graduates and young researchers with companies and state institutions in the context of (research) projects. The organization is closely intertwined with the country's universities, and is well-connected throughout the Canadian business sector. Mitacs therefore acts as a recruiter for industry-related research and development projects, by placing appropriate staff within companies that have a need for specialized know-how. In this way, the organization promotes not just technology transfer, but also the transfer of staffers from the academic research sector into the private sector and other areas. Ultimately, this also helps reduce potential hurdles in the transition to the working life (which can otherwise be associated with high economic costs). This intermediary function is particularly interesting from the German perspective. Certainly, most German universities have professional career centers that prepare students for the transition from university to work. However, Germany does not yet have an organization that is well-connected both within companies and universities that works on a nationwide basis to carry out this kind of highly targeted matching function. A European-level solution that conducted matching services of this kind across national borders could also be helpful, given the widespread shortage of skilled workers in some individual member states.

Matching platforms can be key to a mission-oriented policy.

6 For further details on the EU Commission's Green Deal, see: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_de (accessed December 12, 2020). 7 See https://uplink.weforum.org/uplink/s/ (accessed December 12, 2020).

2.3

International examples of good practices in cooperative (research) infrastructures

Cooperative infrastructures for research and development are a long-term form of knowledge exchange between different actors that is generally codified by a contract. There are many possibilities for the formal design of such an approach. In the following, we highlight an industry-on-campus concept used in Australia and a Canadian model for networking different research institutions as a means of establishing an ecosystem for AI developments within the country.

2.3.1 AUSTRALIA | COOPERATIVE RESEARCH CENTRES PROGRAM (CRC)

Building long-term research partnerships

Australia's Cooperative Research Centres (CRC) program was launched by the government in 1990. According to the initial program guidelines, it was primarily meant to link outstanding research activities in the public and private sectors, and to build further upon them. The main objective of the CRC is to address key societal challenges through medium- to long-term research partnerships between publicly financed research institutions, companies and end users, generating tangible economic, environmental and social impact (Australian Government 2013).

One special feature of the CRC model is thus this explicit end-user orientation. Unlike many other industry-on-campus concepts, the goal is not primarily one of cooperation between the academic and private sectors. Rather, the program focuses on joint research and development for so-called end users such as companies or associations, as well as public entities such as agencies and public safety institutions.

COOPERATIVE RESEARCH CENTRES PROGRAM (CRC)

- Country: Australia
- Start: 1990
- Organizational form: Industry-on-campus model (public-private partnership)
- Funding provided to a total of 92 cooperative research centers

The funded centers' work falls into six substantive areas, structured around specific regional societal challenges in Australia:

- **Manufacturing technology** (12 centers to date)
- **Information and communication technology** (14 centers to date)
- **Mining and energy** (13 centers to date)
- **Agriculture and rural-based manufacturing** (16 centers to date)
- **Environment** (24 centers to date)
- **Medical Science and technology** (13 centers to date)

Since the start of the program, a total of 92 such CRCs have been funded. The state covers up to 50 % of the project costs, although there is no minimum or maximum amount with regard to the center costs eligible for funding. As a result, the grants awarded to the CRCs supported to date have ranged from AUD 7 million to AUD 75 million. The financial support provided through the CRC program is thus very flexible, and is quite substantial in comparison to other industry-on-campus programs. In the current 20th funding round, the maximum project duration is 10 years, without the possibility of renewal. Consequently, the CRCs must develop a sustainability plan, and once the state funding has expired, present a strategy to secure and sustain their activities. The net economic effect of the program between 1991 and 2017 is estimated at AUD 7.5 billion. Accordingly, the overall benefits have exceeded program costs by a factor of 3.1.[8]

As with other public-private partnership (PPP) models, the public funds provided to the CRCs must be supplemented by private funding of at least the same amount. This may be contributed in monetary form, or in the form of material or staff resources used in the joint project. Another goal is to encourage the explicit participation of SMEs. This is often difficult in

8 For further details on the evaluation of the CRC centers, see: https://www.business.gov.au/grants-and-programs/cooperative-research-centres-crc-grants (accessed December 12, 2020).

Australia, as SMEs there are typically smaller than their counterparts in other economies, and often lack the financial resources needed to engage in a CRC. Their contributions are therefore generally not of a financial nature, consisting instead of personnel capacities, machines or equipment, for example.

In addition to the actual research and development work, education and training in particular are important goals of the CRC program. The centers are evaluated and rated on the basis of their contribution to scientific education (e. g., in the form of master's and doctoral theses), as well as the successful training of "industry-ready graduates."

A specific example of a cooperative research structure of this kind is the Cyber Security CRC, which has received government funding of AUD 50 million with a duration of eight years. Launched in January 2018, the Cyber Security CRC is focused on the development of innovative projects intended to increase Australia's cybersecurity capabilities. The aim is to use close cooperation between industry, academia and policymakers to break down existing sectoral barriers and develop market-ready solutions for pressing problems in the cybersecurity field. The industry-oriented research and development project is meant to address both the technological and the political and economic aspects of cybersecurity. Additional goals for the center are to raise awareness of cybersecurity issues in Australia, and to provide support to IT professionals and young researchers in this field. From a substantive perspective, the Cyber Security CRC deals with two strategic research topics:

- **Critical infrastructure security:** A core component here is protecting infrastructure and widely used technologies against cyberattacks.
- **Cybersecurity as a service:** The program aims to develop a subscription model for technical solutions that can be integrated into companies of different sizes via a cloud delivery mechanism, so as to increase security against cyberattacks without the use of additional hardware.

FIGURE 8

TYPOLOGY OF COOPERATIVE INFRASTRUCTURES: THE INDUSTRY-ON-CAMPUS CONCEPT AND PUBLIC-PRIVATE PARTNERSHIPS

FORM OF INSTITUTIONALIZED NETWORKING

Cooperative infrastructure (specifically: industry-on-campus concept/public-private partnerships)

POSSIBLE FUNCTIONALITY AND DESIGN

Actors involved:

- Research sector
- Private sector/industry
- Public sector

Focus on innovation-policy paradigms:

Strengthening competitiveness

▶ Strong

Solving societal problems through innovation

▶ Moderate

International orientation:

▶ Not present

BENEFITS

- Pooling of financial resources and R&D capacities
- Development of new research areas
- Synergistic effects and specialization-related efficiency gains
- Training and continuing education of skilled workers and young researchers
- Development of long-term solutions for regional or country-specific challenges

2.3.2 CANADA | MILA

Principles-based development of AI systems

The renowned Montreal Institute for Learning Algorithms (Mila) stands as an example of how networking between outstanding research facilities and opportunities for direct application can be fostered at the regional, national and international levels – with the goal of enabling the development and use of AI systems that are values-driven and thus of societal benefit.

Mila was created in 2017 as the result of collaborative efforts among four institutions of science in Montreal: the Université de Montréal, McGill University, the Polytechniqe Montréal and HEC Montréal. With a network of 450 researchers, it is now one of the world's largest non-university research laboratories for machine learning and AI. In 2019 and 2020, Milas received more than CAD 330 million in total from the Ministry of Innovation, Science and Economic Development.

MILA

- Country: Canada
- Founded: 2017
- Part of a supraregional network of AI research centers
- Links basic research and technical application with a commitment to ethical principles
- Staff includes 450 researchers

Mila serves a core function in Canada's community of research on AI. Together with the Vector Institute in Toronto and the Amii (Alberta Machine Intelligence Institute) in Edmonton, it forms one of the key pillars of the pan-Canadian AI strategy. Its objectives include developing scientific and technological excellence, promoting interdisciplinary research and increasing foreign investment in R&D. It also aims to expand Canada's national pool of talent, establish hotspots for startups and link SMEs with large companies.

Mila pursues an AI strategy that includes societal and ethical considerations alongside its technological and economic aspects. It is thus committed – certainly in the sense of a mission-oriented innovation policy – to the principles-based development and use of key digital technologies. This commitment is articulated in the Montreal Declaration for a Responsible Development of AI from 2018, which was co-developed by Mila and which formulates recommendations for the ethical handling of AI (for details on this, see Results Paper 1 of this series).

A broader goal of this sociopolitical mission is to strengthen public confidence in key digital technologies beyond the country's borders and to create a common vision of human-centered AI systems that orients developers and users alike. Ultimately, the goal is to develop a global reference for AI systems that considers the aspects of human rights, inclusion, diversity, innovation and economic growth in equal measure. This kind of approach demonstrates how international networking and collaboration can serve as drivers of a collective negotiation of codes of conduct. In so doing, it stands in clear contrast to those approaches taken in more authoritarian countries.

In addition, the example of Mila demonstrates how regionally located innovation centers can establish themselves and become active in international networks. Mila has become a central actor within an

ecosystem in which research institutes, universities, laboratories and businesses work together to develop AI applications that, primarily via startups, are transferred into commercial use. Mila thus provides companies such as Novartis, Microsoft, Quantum Black (McKinsey), startups as well as research facilities, universities and non-governmental organizations the expertise and physical spaces in which to pursue such goals. In this context, networking involves above all linking institutional actors and infrastructures to provide the foundation of a thriving ecosystem for AI technologies.

Mila is the hub of a supraregional network structure. It also serves to link the various actors in the innovation process by bridging the gap between basic research and the commercial application of digital AI systems. This form of institutional networking is actively supported by the government, which is providing CAD 100 million over a five-year period to help establish Scale.AI, a so-called supercluster in Quebec. Scale.AI aims to apply AI or robot technologies to better network the value chains found within the retail sector, manufacturing industry, communication technologies, and transport and information technologies.[9] The networking activity promoted by Mila is clearly motivated in part by economic policy, but it also pursues mission-oriented goals, as the development of AI systems that are underpinned by ethical principles shows.

FIGURE 9

TYPOLOGY OF COOPERATIVE INFRASTRUCTURES: INSTITUTIONALIZED NETWORKING BETWEEN RESEARCH AND DEVELOPMENT FACILITIES

FORM OF INSTITUTIONALIZED NETWORKING

Cooperative infrastructure (specifically: institutionalized networking between research and development facilities)

POSSIBLE FUNCTIONALITY AND DESIGN

Actors involved:

- Research sector
- Private sector/industry
- Civil society

Focus on innovation-policy paradigms:

Strengthening competitiveness
▶ Strong

Solving societal problems through innovation
▶ Moderate

International orientation

▶ Strong

BENEFITS

- Fosters competitiveness and Canadian companies' tech leadership
- Strengthens societal trust in key digital technologies
- Creates new fields of application and business models for AI
- Brings together basic research, applied research and practical applications

9 See www.scaleai.ca/about-us/ (accessed December 12, 2020).

2.3.3

Lessons learned with relevance for Germany

Cooperative infrastructures for research and development are key to facilitating the interaction of different actors in open-innovation processes that are designed to target goals of benefit to society. In the past, many countries established infrastructures that promote networking between actors, along the lines of an industry-on-campus concept.

The development of cooperative infrastructures – originally an instrument of traditional innovation policy – is often aimed at strengthening the competitiveness of regional companies and promoting relevant and already established industrial sectors. However, the Cooperative Research Centres Program (CRC) in Australia in particular shows how this form of exchange and networking can also serve to solve societal problems in terms of a mission-oriented innovation policy. Numerous centers here are dedicated to topics such as sustainable agriculture and forestry, disaster and environmental protection or ensuring the security of digital networks. A key aspect of the success of the program is the way in which the centers bundle know-how from science, business and the public sector. In addition, CRCs are much more end-user oriented, unlike the German Research Campus Program, for example, which focuses on the exchange between science and business actors. Typical end users include companies as well as associations and public institutions such as public agencies, all of which are directly involved in the implementation of the solutions developed by the CRC. The fact that these end users are broadly distributed across the economic, social and administrative sectors also helps advance the dissemination of innovations. German initiatives to foster instruments of exchange and institutional networking should also aim to reach across sectors in the context of a mission-oriented innovation policy and ensure that their activities are driven by end-user needs.

German initiatives also lack an emphasis on the transfer of competent personnel across disciplines and sectors. In this regard, the Australian case study offers an example from which to draw upon. The CRC program has identified the qualification, training and continuing education of skilled workers and young researchers in application-oriented research and development projects as key to ensuring the development and transfer of know-how. Thanks to the interdisciplinary nature of its cooperation and training programs, the CRCs young researchers face significantly greater employment opportunities than their counterparts elsewhere, both in industry and in public research institutions (Manathunga et al. 2011). The CRCs thus increase the innovative capacity and competitiveness of participating companies while simultaneously promoting the diffusion of technological solutions in practical use.

The example of Mila from Canada illustrates how important supraregionally networked institutions and infrastructures are for anchoring the development and commercialization of AI systems in ethical norms. By providing targeted support and infrastructure as well as creating networks between those

A key aspect of success is the way in which know-how from research, business and the public sector is combined.

conducting research and those that apply applications in practice, Mila helps startups establish themselves and high-tech businesses expand globally. Mila creates networks between various actors within the AI innovation system and creates new opportunities for the use of principles-based AI systems. These networks are also a key factor in overcoming the gaps in support, or "valley of death" that often prevails by linking basic research with technical application and fostering entrepreneurship. This problem arises when innovative ideas from research are not applied in practical application at an early stage of development because of a lack of sufficient investment on the part of companies and investors wary of the financial risks involved.

In addition, Mila aims to increase public confidence (in Canada and elsewhere) in key digital technologies by developing and disseminating ethical principles for the use of AI. In terms of combining paradigms as elaborated at the beginning of this paper, this case study thus links traditional networking concepts with aspects of mission-oriented innovation processes. In Germany, creating broad public acceptance of and trust in new and digital technologies in particular demands that platforms of exchange and networking instruments must also be just as firmly anchored in normative principles and function across sectors.

The industry-on-campus approach has played a role in Germany for several years. Within the framework of the Federal Government's High-Tech Strategy, the Federal Ministry of Education and Research (BMBF) provides financial and non-material support for long-term cooperation between public research institutions and private businesses with its Research Campus – Public-Private Partnership for Innovation funding initiative that was launched in 2011. This initiative marked the first government-support program for public-private research partnerships in the country. The maximum funding period of fifteen years with a maximum of €2 million per designated research campus and year is divided into three phases of five years each, and thus offers each institution a long-term perspective for adapting their research strategy to current developments and needs. At present, there are nine research campuses across Germany receiving funding support that involve a total of 200 various actors that work together. About one-fourth are based in research and one-third in business, of which more than half (54 %) are SMEs.[10]

At this point in time, it is impossible to predict the impact of the Research Campus Program on Germany's innovation system. As the first, relatively recently launched and thus far the only state funding initiative for cooperative research infrastructures in the country, it is designed for the long term and to prove adaptable to learning processes (Koschatzky et al. 2016). The examples of good practices in other international contexts featured here can therefore serve as a source of inspiration for the activities conducted on German research campuses, the selection committee in determining and evaluating other research campuses, and for the further development of the funding program as a whole.

10 For further details on the BMBF's Research Campus Program, see: www.bmbf.de/de/forschungscampus-oeffentlich-private-partnerschaft-fuer-innovationen-562.html (accessed December 12, 2020).

3.

Conclusion and outlook

This results paper argues that creating institutionalized networks between various actors from the research, business, public and civil society sectors is essential in order to strengthen economic competitiveness through innovative technologies and solutions, while at the same time addressing urgent societal challenges. This is based on twin hypotheses: that the interactions of these actors within networks increases companies' innovative capacities, and that open, networked innovation processes of this kind are simultaneously oriented more strongly toward societally desirable goals, because they better integrate the perspectives of users and other affected groups. Overall, the present paper aims to provide inspiration for policies that offer greater support for instruments of exchange and institutional networking intended to generate societally relevant innovations. The COVID-19 crisis, coming as it has amid numerous other pressing challenges, has made clear that the capability to generate and implement suitable solutions to urgent problems is crucial for our society.

This paper presents case studies from Sweden, Israel, Canada, Australia and the EU level that illustrate how actors from different areas of society network with one another in innovative ways in order to pursue traditional innovation-policy goals – such as developing new business models and strengthening competitiveness – as well as to generate as much added societal value as possible, a key objective of mission-oriented innovation policy. Most of the examples discussed here of policies and programs that promote instruments of exchange and institutional networking describe familiar mechanisms of traditional innovation policy. Indeed, many countries still

Technological progress, economic competitiveness and societal development go hand in hand.

use them today for the purposes of (regional) economic development. These instruments were developed for goals such as achieving leadership within certain key technological areas, promoting (regional) economies, developing new business models, or opening up new markets. However, the examples show how these instruments can be further developed so as to achieve the goals of mission-oriented innovation policy, even as they continue to enhance economic competitiveness.

Even Sweden's science parks were originally created within the context of a traditional innovation policy. Under the SISP umbrella organization, however, they began to orient their activities toward specific societal needs at a very early date. To this end, to the greatest degree possible, they have created open-innovation processes that follow the quadruple-helix approach, allowing end users, civil society actors and policymakers to participate alongside representatives of the research and business sectors.

Strengthening the involvement of users, consumers and civil society actors in open innovation processes is a key takeaway.

The same is true of the Australian Cooperative Research Centres (CRCs). They too employ a traditional innovation-policy instrument, in this case public-private partnerships (PPPs). However, they have distinguished themselves through their strong end-user orientation and a focus on societal and regional challenges.

Start-Up Nation Central is another example in which societal challenges are given a high priority. While this digital platform focuses primarily on promoting Israel as a location for high-tech startups, it has in recent years developed programs aimed at the inclusion of underrepresented or disadvantaged groups within the population, such as women in STEM professions or Palestinians. In this way, the platform helps contribute to societal sustainability and equal rights.

Canada's Mila creates networks between AI-focused research institutions that emphasize the need for ethics-driven systems design. Mila thus aims to formulate normative guidelines for AI development and promote societal trust in key digital technologies through principles-based research, development and application.

The case studies show how building networks between different actors, opening up innovation processes, and facilitating the interplay of complementary areas of expertise, stocks of knowledge and interests can generate synergies and increase overall innovative capability. In addition, they illustrate how the

two innovation-policy paradigms – "strengthening economic growth and technological competitiveness" on the one hand, and "solving societal problems through innovation" on the other – can be explicitly linked, thus achieving the greatest possible overall added societal value.

Conditions in Germany are extremely favorable with regard to seizing the opportunities arising from the "solution-oriented opening and networking" described here. In recent years, domestic innovation policy has supported the development of a remarkably dense network of institutionalized forms of bridge-building, as well as exchanges and technology transfers between heterogeneous actors. There has accordingly been extensive experience with this now well-differentiated set of policy instruments. As a consequence, the know-how necessary for designing and implementing programs that promote institutionalized networking is widely diffused at the regional and municipal levels. Thus, the existing "networking infrastructure" and embodied stock of knowledge about networking constitute an excellent starting point for efforts to push the current set of instruments to address societal challenges in a more targeted way.

This calls for innovative support initiatives and programs that aim at a reorientation of the existing set of policy instruments. This in turn will require correspondingly far-reaching vision and ambition, courageous political leadership, and a sincere invitation to potential change agents and institutional entrepreneurs to contribute their ideas and commitment to open and broadly networked innovation processes. In this regard, even if they cannot always be translated on a one-to-one basis to the German or European context, the international case studies detailed in this results paper offer numerous highly promising ideas and inspirations.

Germany's innovation policy infrastructure should be geared to solve societal problems.

4. APPENDIX

4.1

Global research on good practices – our interview partners

INSTITUTION / ORGANIZATION	INTERVIEW PARTNER
1E9 (Munich)	Herbert Mangesius
acatech – National Academy of Science and Engineering (Munich)	Dr. Jan Henning Behrens
Bertelsmann Foundation (Washington)	Irene Braam
Briter Bridges (London)	Dario Giuliani
Bundesverband Deutsche Startups e. V. (Berlin)	Christoph J. Stresing
Business Finland (Helsinki)	Pekka Sivonen
Canadian Institute for Advances Research (CIFAR) (Toronto)	Rebecca Finlay
Center for Data Innovation (Brussels)	Eline Chivot
Centre for Social Innovation (Toronto)	Raissa Espiritu
Co-Lab Sweden / Förnyelselabbet (Stockholm)	Pia McAleenan
Digital Catapult (London)	Brian MacAulay Cordelia O'Connell Jessica Rushworth
Ecosia (Berlin)	Dr. Wolfgang Oels
European Commission – Directorate-General Research and Innovation (RTD) (Brussels)	Maximilian Steiert Renzo Tomellini Isabel Vogler
Federal Ministry for Economic Affairs and Energy (BMWi) (Berlin)	Thomas Jarzombek, MdB
Federal Ministry of Education and Research (BMBF) (Berlin)	Engelbert Beyer Dr. Gisela Philipsenburg
Fonds de Recherche du Québec (FGR) (Montreal)	Julie Dirwimmer Sophie Gauthier-Clerc Benoit Sévigny
Founders Foundation (Bielefeld)	Sebastian Borek
German Chamber of Commerce and Industry in Japan (AHK Japan) (Tokyo)	Dr. Lucas Witoslawski
German Consulate General Montreal	Dr. Markus Lang
German Institute for Japanese Studies (DIJ) (Tokyo)	Dr. Susanne Brucksch Prof. Dr. Franz Waldenberger

INSTITUTION / ORGANIZATION	INTERVIEW PARTNER
German Research Center for Artificial Intelligence (DFKI) (Berlin)	Julia Gundlach
Innosuisse (Bern)	Eliane Kersten Marc Pauchard
Innovate UK – UK Research and Innovation (UKRI) (London)	Dan Hodges
Innovation Policy Lab – Munk School of Global Affairs and Public Policy, University of Toronto	Travis Southin Prof. David Wolfe, PhD
Institute for Competitiveness (I-Com) (Brussels)	Mattia Ceracchi
Internet Economy Foundation (IE.F) (Berlin)	Amelie Drünkler Clark Parsons
Japan Science and Technology Agency (JST) (Kawaguchi)	Prof. Hiroshi Nagano Tomoko Sawada
Kienbaum Consultants International (Cologne)	Stephan Grabmeier
Laboratorio de Gobierno (Santiago de Chile)	Roman Yosif
LabX – Laboratório de Experimentação da Administração Pública (Lisbon)	Bruno Monteiro
Lindholmen Science Park (Göteborg)	Tord Hermansson
MaRS Discovery District (Toronto)	Matthias Oschinski, PhD Dwayne Simms
Max Planck Institute for Innovation and Competition (Munich)	Prof. Dietmar Harhoff, PhD
Ministère de l'Économie et de l'Innovation Québec (Montreal)	Inji Yaghmour
Ministry of Economic Affairs, Agriculture & Innovation (The Hague)	Luuk Klomp
Ministry of Economic Affairs and Climate Policy (The Hague)	Koen de Pater
Ministry of Economic Affairs and Employment of Finland (Helsinki)	Anita Silanterä Kirsti Vilén
Ministry of Economic Development, Job Creation and Trade Ontario (Toronto)	Vasu Daggupaty Alex Lee Ernst Lueger

INSTITUTION / ORGANIZATION	INTERVIEW PARTNER
Mitacs (Montreal)	Coryell Boffy
Montreal Institute for Learning Algorithms (Mila) (Montreal)	Stéphane Létourneau
Nesta (London)	Peter Baeck Albert Bravo-Biosca, PhD Marieke Goettsch Eva Grobbink
Ontario Digital Service (Toronto)	Waqas (Wes) Iqbal
Organisation for Economic Co-operation and Development (OECD) (Paris)	Caroline Paunov
PHINEO gAG (Berlin)	Dr. Andreas Rickert
Prototype Fund – Open Knowledge Foundation Deutschland e. V. (Berlin)	Adriana Groh
Reinhard Mohn Institute for Corporate Management, University Witten/Herdecke	Prof. Dr. Guido Möllering
Roland Berger GmbH (Berlin)	Dr. Julia Oppermann
RWTH Aachen, Center Smart Services (Aachen)	Benedikt Moser
SDGx (Berlin)	Christian Walter
Sitra (Helsinki)	Timo Hämäläinen, PhD Markus Kalliola Paula Laine
Staatslabor (Bern)	Alenka Bonnard
Startup Genome (Berlin)	Marc Penzel
Swedish Incubators & Science Parks (Stockholm)	Kajsa Hedberg
UnternehmerTUM (Munich)	Johannes von Borries
Vector Institute (Toronto)	Cameron Schuler
Vinnova (Stockholm)	Göran Marklund Judit Wefer, PhD
ZEW – Leibniz Centre for European Economic Research (Mannheim)	Dr. Georg Licht

4.2

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4.3

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