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INNOVATION AND ENTREPRENEURSHIP ECOSYSTEM DIAGNOSTIC

UKRAINE



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Acknowledgements and Disclaimer

This report is prepared by David Cheney (Senior Innovation Consultant) with contributions from Andrey Zolotarev (Innovation Policy Specialist) and Jamil Wyne (Consultant). The team was led by Anwar Aridi (Innovation Specialist - Task Team Leader), the editor of the report, with support from Iryna Kuzmina and Victoria Tetyora.

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1818 H Street NW
Washington, DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

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Table of Contents

List of Acronyms	1
Executive Summary.....	2
Introduction	10
// Purpose and Scope.....	10
// Methodology and Organization	11
Innovation Ecosystem for Existing Companies.....	14
// Overview	14
// Industry and Market Structure	15
// Leadership, Governance, and Policy.....	17
// Access to Knowledge and Technology	20
// Finance	23
// Human Capital.....	24
// Supports.....	26
Innovation Ecosystem for Entrepreneurial Companies	28
// Overview	28
// Leadership, Governance, and Policy.....	29
// Finance.....	31
// Markets.....	33
// Culture	35
// Human Capital.....	36
// Supports.....	37
Innovation Ecosystem for Multinational Companies in Ukraine	40
// Overview	40
// Industry and Market Structure	41
// Leadership, Governance, and Policy.....	41
// Access to Knowledge and Technology	42
// Human Capital.....	43
Conclusions and Next Steps.....	44
References.....	48
Appendix I. List of Interviewees.....	51
Appendix II. List of Ukrainian Intermediaries, Entrepreneurship Support Organizations, and Equity Investors.....	53

List of Tables

Table 1. Number of Enterprises Introducing Innovations in Ukraine	15
Table 2. Global Innovation Index Quality of Governmental Institutions	18
Table 3. Global Competitiveness Index Financial Market Measures	23
Table 4. Global Innovation Index Human Capital Indicators	24
Table 5. Global Competitiveness Index Human Capital Indicators	24
Table 6. Global Innovation Index Infrastructure Indicators.....	26
Table 7. Global Competitiveness Index Infrastructure Indicators	26
Table 8. Sample Financial Capital Indicators: Ukraine versus Benchmark Countries	31
Table 9. Financing of Innovation from the Foreign Sources in 2000–2014	40

List of Figures

Figure 1. Share of Innovative Enterprises, Percent	14
Figure 2. GERD 2005–2014	21
Figure 3. Business Reforms since 2009	29
Figure 4. Breakdown of Investment Sizes.....	33
Figure 5. Organizations Supporting Entrepreneurship in (Number of Organizations Created Annually)	38

List of Acronyms

BEEPS	Business Environment and Enterprise Performance Survey
CIS	Commonwealth of Independent States
EaP	Eastern Partnership
EBA	European Business Association
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
FDI	Foreign Direct Investment
EU	European Union
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GSP	Global Solutions Program
I&E	Innovation and Entrepreneurship
ICT	Information and Communication Technology
IDCEE	Investor's Day Central and Eastern Europe
IFC	International Finance Corporation
IMF	International Monetary Fund
IP	Intellectual Property
IT	Information Technology
KPI	National Technical University of Ukraine Kyiv Polytechnic Institute
MEDT	Ministry of Economic Development and Trade
MNE	Multinational Enterprise
MESU	Ministry of Education and Science Ukraine
NAPC	National Agency for the Prevention of Corruption
NASU	National Academy of Sciences of Ukraine
NBU	National Bank of Ukraine
NIS	National Innovation System
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
S&T	Science and Technology
SaaS	Software as a Service
SIDA	Swedish International Development Cooperation Agency
SME	Small and Medium Enterprise
SOE	State-owned Enterprise
STI	Science, Technology, and Innovation
TT	Technology Transfer
UN	United Nations
UVCA	Ukrainian Venture Capital and Private Equity Association
VC	Venture Capital

Executive Summary

This report is one of several analytical pieces developed by the World Bank's Ukraine Technical Assistance on Innovation Support project, supported by the Swedish Ukraine Financial and Enterprise Sector Recovery and Growth Trust Fund. This report attempts to (a) identify the gaps that impede enterprise innovation in Ukraine and (b) develop recommendations for policy reforms and support instruments. The three supporting analytical pieces performed by the Ukraine Innovation Support project team are as follows:

- **Ukraine Science, Technology, and Innovation Public Expenditure Analysis**, which attempts to evaluate the quality mix of public support programs for science, technology, and innovation (STI) and provide recommendations for the improvement of the support programs' effectiveness
- **Ukraine Intellectual Property and Technology Transfer Regulatory Review**, which attempts to identify regulatory and framework impediments for the commercialization of publicly funded research and recommends reforms and policies that could improve the framework conditions for intellectual property (IP) and technology transfer (TT)
- **Fiscal Incentives for Science, Technology, and Innovation Best Practice Review**, which reviews different international good practices in introducing fiscal incentives for supporting STI and provides policy recommendations relevant to the implementation of such incentives in Ukraine

This report adopts a comprehensive definition of innovation as the successful new application of knowledge, in the form of new products, services, or processes. This application can be either new to the world (first introduction anywhere in the world), new to the market (first introduction to a country's market), or new to the firm (first use by a specific firm). Innovation is strongly linked to productivity growth and underlies improvements in a country's standard of living. Over the long term, a country's ability to develop or adopt new technologies and put them to use is a major determinant of a country's economic health and standard of living.

Because innovation involves the introduction of products, services, or processes into use, companies are the main innovators. Consequently, this report focuses on understanding the environment in Ukraine, referred to as the 'innovation ecosystem', that affects companies' ability to innovate. This includes the business/market structure, government policies and programs, human capital, research and development (R&D), the financial environment, and various kinds of infrastructure.

The report assesses the Ukrainian innovation and entrepreneurship (I&E) ecosystem with respect to three categories of companies:

- Existing Ukrainian companies
- New entrepreneurial companies
- Foreign companies making innovation-related investments in Ukraine

The report is based on available literature and previous studies, as well as interviews with domestic companies, multinational companies operating in Ukraine, entrepreneurs, venture capitalists and private equity firms, business associations, universities, and researchers studying industry and innovation in Ukraine. The team also met with representatives of the Ukrainian government and public sector stakeholders such as the Ministry of Economic Development and Trade (MEDT), Ministry of Education and

Science (MESU), Ministry of Finance, the Presidential Administration, parliament members and committees, the Reform Delivery Office, the National Academy of Sciences of Ukraine (NASU), and some Ukrainian scholars and researchers of business innovation (full list of interviewees in appendix I). The scope of the study did not allow for in-depth examination of the regional aspects of innovation in Ukraine or focus on a specific industrial sector. The main purpose of study was to provide a broad diagnostic of the environment for innovation and entrepreneurship in Ukraine, as a precursor to assisting the Government of Ukraine in implementing innovation-related policy reforms and the development of innovation support organizations and programs.

Findings

Innovation Potential of Ukraine: Toward an Innovation-based Economy

Ukraine has great potential to develop an innovation-based economy driven by its immense talents and entrepreneurial skills. It has many features that other transition economies envy: a well-educated and talented workforce; a long tradition of science and technology (S&T) research; significant natural resources and agricultural production capacity; a successful information technology (IT) industry; increasing access to markets in Europe; and a large and successful knowledge diaspora that can provide knowledge and access. These features provide great potential for Ukraine to rapidly advance if some of the challenges detailed in this report can be overcome on the sectoral level as well as economy wide. This, of course, requires a clear government commitment at the highest levels to supporting innovation and innovation reforms and a clear vision to transition the Ukrainian economy to a knowledge-based, innovation-driven economy.

Innovation Ecosystem for Existing Companies

Innovation activity in Ukrainian companies is currently low by international comparison—just 17 percent of companies are innovative (defined as introducing a new product or process, either in the market or just in their enterprise) compared to a European Union (EU) average of 49 percent. Most innovation is ‘new to firm’, most commonly through purchasing of equipment, rather than ‘new to the world’ innovation.

Innovation in Ukrainian firms is low for several structural reasons, including the following:

- Industry is concentrated in sectors that are usually characterized as low R&D sectors (metals and heavy engineering).
- The Ukrainian market provides little motivation for innovation due to low competitive pressures. The legacy of state-owned enterprises (SOEs) and weak competition policy has led to lack of competition and market demand for innovation. Most firms are focused on the domestic market and, thus, are not facing pressures to innovate from the international marketplace.

R&D and innovation in Ukrainian industry have been declining. As trade has shifted from the Russian Federation and Commonwealth of Independent States (CIS) countries toward the EU, industrial output has shifted away from technology-based manufacturing toward commodity agriculture and metals, resulting in a decline in R&D and innovation. The defense industrial complex (aerospace and aviation) has also been hit by this shift.

Small and medium enterprise (SME) innovation is especially weak in Ukraine. SMEs are hurt by a lack of skills, knowledge, and financing, as well as by weak competition policy. Because large SOEs and former

SOEs are not innovative in general, there is little demand for innovative SMEs as suppliers. There is no functioning innovation support system to help provide SMEs with access to knowledge and technology. SMEs are poorly integrated in western international value chains, which are often a source of knowledge transfer.

Ukrainian companies that seek to innovate face a difficult environment. While each industrial sector has its own set of issues, interviewees from each sector described how, in different ways, poor performance of state institutions severely limited its performance. The issues included conflicting regulations, slow permitting and approvals, delays at customs, and poor performance of SOEs (from railroads to blood banks). These severely hamper the ability of companies to innovate and compete in international markets.

Research institutions and universities do not effectively support innovation in Ukrainian companies. Both are structured to service the old, pre-independence economy and are in need of major reform to adapt to the new private sector realities. However, there is little demand from business for such institutions to support innovation.

A bright spot is the growth of the IT outsourcing industry, which provides software development services for international clients. Most IT outsourcing firms have been using individuals as self-employed contractors. The outsourcing service model avoids many of the problems of the weak business and policy environment, and the use of self-employed contractors is encouraged by the Ukrainian tax policy. Although this study did not examine thoroughly specific industrial sectors, other industries, such as agriculture and foods, have great potential for innovation and growth. Further research and analysis of the innovative potentials of the agricultural sector, especially in ways that it could harness the country's IT talent to increase productivity and efficiency, could be useful to guide sectoral innovation policy and program design.

Ecosystem for Entrepreneurial Companies

The overall environment for entrepreneurship in Ukraine has many challenges; however, some entrepreneurs are succeeding in building globally successful ventures. Ukraine has improved processes for business formation, but licensing, permits, taxes, and corruption continue to be major problems. Ukraine's industrial structure with large noncompetitive SOEs, and high barriers to entry and exit, reduces opportunities for entrepreneurs. Poor insolvency laws and weak IP increase the risks for entrepreneurship.

Ukraine has a small but promising group of innovative entrepreneurial companies that are focused on international markets. These high-growth potential firms have found ways to reach international markets, acquire venture capital (VC) financing and business advice, and find manufacturing partners. They have been aided by an informal mentoring network as well as the Ukrainian diaspora. These firms are strongly encouraged by their financiers and mentors to incorporate their companies overseas, where rule of law is stronger, managerial experience is available, and they can be closer to their leading markets (typically the United States and western Europe). As foreign companies, they outsource services to individual contractors in Ukraine. This strategy allows these start-ups avoid corruption, weak insolvency and IP laws, and corporate taxes in Ukraine. While this approach is not ideal for Ukraine in the long run (due to foregone tax revenue and likely increasing 'brain drain', for example), it is a workable approach that allows entrepreneurial companies to grow and contribute some value to Ukraine, in spite of the weaknesses in the Ukrainian business environment.

The culture in Ukraine has not historically been supportive of entrepreneurship, and there have been relatively few entrepreneurial success stories to date, leading to a lack of role models that would make entrepreneurship attractive. Recently, there have been a growing number of accelerators, incubators, and events to support entrepreneurship, but there is potential to significantly expand these activities (see list in appendix II). The number of entrepreneurial companies is primarily limited by the pipeline of potential entrepreneurs with fundable ideas, which is in turn limited by the number of people with the motivation and skills to be entrepreneurs. Interviewees suggested that based on the country's amount of technical and creative talent, the pipeline of fundable ideas could be greatly increased (by perhaps a factor of 10) with more programs to encourage entrepreneurship and to provide training and seed funding.

Innovation Ecosystem for Multinational Companies in Ukraine

Foreign direct investment (FDI) is critical to bring technology, management skill, and capital to Ukraine. FDI in Ukraine is low compared to peer countries (and declined in 2014–2015 due to the eastern crisis). Most FDI is focused in relatively low-innovation sectors, such as machine building, metals, food processing, and finance/banking.

Foreign multinationals limit their investments in Ukraine due to high business risk, including war, political instability and uncertainty, corruption, and weak rule of law. Interviewees noted the risk of government confiscation of property. Some international IT firms are not investing due to concerns about freedom of speech/press and overly intrusive cybersecurity policies.

With some exceptions, Ukraine's technology capabilities do not attract large foreign investments. IT is an important exception. In addition to outsourcing firms, a significant number of international firms have set up technology centers, often for software development. There is also some foreign investment in areas such as aerospace, drawing on capabilities developed in the Soviet era.

Ukraine's talent, low costs, and large market size could drive additional FDI if barriers to investment are removed. Ukraine has been taking steps to remove barriers to investment, such as joining the Organisation for Economic Co-operation and Development (OECD) declaration on investment and multinational enterprises (MNEs). Some multinational companies operating in Ukraine, however, express skepticism about the government's commitment to fighting corruption.

/// Cross-cutting Findings

Leadership, Governance, and Policy

Existing Ukrainian companies, entrepreneurial firms, and foreign firms operating in Ukraine all view corruption, outdated or conflicting regulations, slow approvals, and poor functioning of state institutions as barriers to innovation and business performance. Government bureaucracy either passively resists innovation or actively inhibits change that threatens existing vested interests. Additionally, technical regulations that are tied to the former Soviet Union rather than the west inhibit participation in international value chains.

Current innovation-related policies are rarely coordinated among ministries and are poorly implemented and funded. There is little coordination of innovation policy among the MESU, the MEDT, the Ministry of Finance, and ministries with sectoral and regional responsibilities. Recommendations from previous innovation studies have, in general, not been effectively implemented or funded.

The IP legal framework is sound, but there are issues with implementation and enforcement, including lack of clarity regarding the responsibility of different ministries and lack of institutional capacity to implement the framework (For a detailed discussion of the IP Framework, see the Ukraine Intellectual Property and Technology Transfer Regulatory Review prepared by the World Bank team).

Innovation programs at the regional level are uneven and are, in general, poorly funded. However, there are some examples of successful regional programs, such as the information and communication technology (ICT) cluster in Lviv.

Some business organizations, including the IT Ukraine Association, the European Business Association (EBA), and the U.S. Chamber of Commerce in Ukraine, are actively advocating for an improved business climate, but many industries lack associations that advocate for policies that promote innovation and competitiveness.

Access to Knowledge and Technology

Ukraine's once-strong S&T institutions have weakened since independence and are poorly structured and funded for innovation. Most government R&D funding goes to the NASU, which is nevertheless poorly funded and is in decline, with aging staff and facilities (for a detailed discussion of Ukraine's public expenditures on R&D, see Ukraine Science, Technology, and Innovation Public Expenditure Analysis report prepared by the World Bank team). The structure of research institutes is tied to old areas of economy—former state-owned companies, defense, and resource industries—rather than emerging areas of the economy. IP protection and TT mechanisms are weak. Some companies work informally with NASU researchers as individual consultants, which, while not ideal, does provide a mechanism for NASU research to provide value to the economy.

Universities receive little research funding and are (with some important exceptions) poorly connected to industry. As a result, many faculty are viewed as both out of date in their fields and unable to prepare students for research or work in private companies.

Finance

Access to finance is rated by SMEs as a major barrier to growth. Debt financing is limited, and interest rates are high. Most investments in innovation are internally financed by companies. Equity financing through stock market is mostly unavailable due to weak institutions and rule of law. Ukraine has some private equity firms and venture firms, which are funding some innovative companies.

International VC funds will invest in Ukrainian entrepreneurs if they see a good opportunity. In this sense, VC funding is limited not by capital but by fundable companies. However, investors will want the company to be established outside of Ukraine. VC funding for firms focused on the Ukrainian market is much more limited.

Capital is relatively mobile in search of high returns; therefore, lack of finance for innovation in Ukraine may be largely a symptom of other problems—perceived political instability, corruption, lack of confidence in judicial system, and foreign currency control regulations—that prevent investment.

Human Capital

While Ukraine's education system continues to have strengths in math and science, universities need fundamental reforms. Universities are weak in matching education to meet the current skill needs of employers and are insufficiently flexible and adaptive, especially in fast-moving areas such as IT. The structure of universities and training institutes, as well as their curriculum, is matched to the old economy not the future economy. Weak business and management education may be a barrier to innovation and entrepreneurship.

Due to lack of job opportunities for university graduates, many highly skilled Ukrainians work in other countries or work for companies based in other countries. However, even people with good job prospects in Ukraine may seek to move to other countries where long-term opportunities are perceived to be better, reflecting concerns about the ability of the government to improve the country.

Supports/Infrastructure

Transportation infrastructure in Ukraine—roads, railways, and ports— is viewed as weak and can be a barrier to integrating Ukrainian industry into international supply chains and thus is a barrier to foreign investment and innovation. ICT infrastructure is adequate in major cities, enabling the IT outsourcing industry.

Research infrastructure (facilities and equipment) has declined significantly over the last 20 years. Innovation and entrepreneurship infrastructure, such as S&T parks, incubators, and business accelerators, have been established but many are inactive and only a few are successful. There is no broad system to provide innovation support (knowledge transfer and technology transfer) to SMEs, although some EU programs are focused in this area.

Next Steps

The purpose of this I&E ecosystem diagnosis is to serve as a platform for developing recommendations. The diagnosis suggests some priority areas.

First, it is clear that Ukraine has major systemic and structural issues to address to develop a well-functioning I&E ecosystem in the long term. These include

- **Broad governance reform**, including reducing corruption, restoring trust in government, reforming the judiciary, improving regulations, and other institutional areas;
- **Addressing issues of industrial structure**, including strengthening competition policy, reforming SOEs, supporting SMEs, and supporting technology-based industries through cluster policies or 'smart specialization'; and
- **Fundamental reforms of public research institutes and universities**, including reforming the NASU and piloting targeted programs that could bring research activities closer to the needs of local industries (for more details on reforming the NASU, see Ukraine's STI Public Expenditure Analysis Report recommendations).

Reforms in each of these areas are critical for innovation and also for the overall performance of the private sector and the investment attractiveness of the country. Developing comprehensive solutions to

each of these issues is beyond the scope of this report, and there are already efforts under way in most of these areas, by the EU, the World Bank, and other development organizations.

Second, the report suggests some areas where shorter-term and more targeted interventions can improve Ukraine's I&E ecosystem. Previous reports on innovation in Ukraine led to numerous recommendations but little sustained implementation, often due to lack of commitment or of budget allocated for programs. Thus, this report focuses instead on a narrower innovation agenda that is intended to be implementable. The goal is to provide sustained attention to removing barriers to innovation and to build on programs that are already working to create momentum toward further reforms. The suggested actions could fall into the following categories:

Strengthen Innovation Leadership and Coordination

Although innovation is critical to Ukraine's future—ultimately determining the productivity of the economy and Ukraine's standard of living—currently, there is no institutional focus on innovation in Ukraine's government. Actions that affect innovation are spread throughout many ministries and public institutions, and there is a lack of coordination and advocacy within the government for actions to remove barriers to innovation and improve industrial competitiveness.

Ukraine should have an innovation agency that

- Develops, advocates, and publicizes a national vision of an innovation-based economy;
- Serves as a platform to (a) channel the voice of industry regarding identifying and removing barriers to innovation on the sectoral and horizontal levels and (b) advocate for innovation-related reforms, including steps to reduce corruption, implement reform regulations, support entrepreneurship, and expand public and private R&D expenditures and collaborations;
- Identifies working I&E programs and scales them up in coverage and magnitude through technical and financial support and
- Design, administer, and implement pilot support programs targeting enterprise innovation and entrepreneurial activities.

This agency should work closely with industry groups to understand what the industry needs to succeed in innovation and should work closely across ministries of the government to remove barriers to innovation and to implement innovation support programs. Importantly, it should work to earn the trust of the industry—the low current levels of trust between the industry and the government constitute a major barrier to effective innovation programs. As various government policy changes are considered, the innovation agency should ensure that the reforms have industry input regarding how the reforms would affect innovation and the competitiveness of firms. The agency should provide continuity in government innovation reform efforts in contrast to the current disintegrated approach. It should advocate for sustainable budgets for innovation programs and advocate for competition policy, universities, and public research institutions reform.

Identify and Scale up Working Approaches

Given the uneven record of previous discontinued initiatives, we suggest a modest near-term strategy of building on initiatives that already appear to be working. The following is a non-exhaustive list of potential focus programs:

- **Expanding entrepreneurship support programs, such as building on the Science Park and entrepreneurship programs at Kyiv Polytechnic Institute (KPI).** Our interviews suggested a strong potential and need for expanding the pipeline of new companies. Expanded entrepreneurship support programs targeting investment readiness of start-ups, including training programs, seed funds, incubators/accelerators, business plan competitions, and mentoring, could have an immediate impact. Building on the successful programs in universities can also be expected to support reforms and culture change at universities.
- **Building on and expanding regional cluster programs.** Regional strategies involving local government, industry, and universities' approaches can develop strong regional innovation ecosystems. Often, effective industry-government-university collaboration is easier to build at the regional level than at the national level. The IT cluster in Lviv may be a good model to scale into other regions and industries. The EU-supported regional smart specialization strategy is a useful way to proceed with such programs.
- **Addressing the identified and immediate needs of already growing and leading sectors.** For example, the IT and agriculture industries have been growing and exporting but have identified research, educational/training, and logistical needs for improving productivity and competitiveness. The envisioned agency and/or the respective ministries could take the lead on working throughout the government bodies to remove the barriers and address these immediate needs.

Pilot New Innovation Support Programs

In addition to the immediate roles articulated above, the innovation agency could design, administer, and implement pilot support programs to innovative enterprises and start-ups to scale up and grow. Currently, there are few, if any, public support programs (other than European or donor-supported programs) that innovative Ukrainian enterprises could apply and compete for. The pilot programs, such as innovation vouchers, innovation grants, and research collaboration grants, to name a few, could follow or adapt models implemented in several benchmark economies and learn from countries' experiences in setting up, implementing, and monitoring such programs. The ability of this new agency to lead such pilots depends on the level of competence of its staff, access to financial and technical resources, its degree of autonomy, and the commitment of the government to the innovation agenda, to name a few.

The World Bank team, through the Innovation Support project, has been providing technical support to the MEDT and the Reform Delivery Office in the context of designing and setting up such an innovation agency (currently labeled as the Innovation Development Office) based on a request from the Prime Minister's Office. The mission, governance and institutional structure, areas of focus, and pilot support programs are all currently under consideration by the main stakeholders. This report helps make the case for such an agency and its missing role in supporting enterprise innovation but intentionally holds back from prescribing the details of the institution and its programs. The details of these programs will be developed with stakeholders as a next step.

Introduction

Purpose and Scope

This report is part of the World Bank's Ukraine Technical Assistance Mission on Innovation Support project, supported by the Swedish Innovation Driven Economic Recovery and Growth Promotion in Ukraine Trust Fund. It summarizes the strengths and weaknesses of Ukraine's innovation and entrepreneurship ecosystem in three areas:

- Promoting innovation by existing Ukrainian companies
- Creating innovative new companies
- Attracting innovation-related foreign investments to Ukraine

Innovation is the successful new application of knowledge, in the form of new products, services, or processes. This application can be either new to the world (first introduction anywhere in the world), new to the market (first introduction to a country's market), or new to the firm (first used by a specific firm). In transition economies, such as Ukraine, importing ideas and technology from abroad are often the main source of innovation.

Innovation is strongly linked to productivity growth in an economy and underlies improvements in standard of living. Over the long term, a country's ability to develop or adopt new technologies and put them to use is one of the most important factors determining a country's economic strength and standard of living, as well as its ability to meet other societal needs.

Because innovation, by definition, is putting new products, services, or processes into use, companies are the main innovators. Universities, research institutions, or individual inventors may develop a new idea or technology (invent), but almost always, it is companies that put the knowledge to use in new products, services, or processes (innovate).

This report focuses on innovation from the perspective of the companies. The ability of companies to innovate depends on many things, including finances, human resources, access to markets, a supportive legal environment, and other factors. A country's environment that affects companies' ability and motivation to innovate is often referred to as the country's innovation system, or often innovation 'ecosystem', implying an analogy to biological ecosystems. This report looks at the set of institutions, programs, laws, and policies that affect innovation in Ukraine with the goal of identifying areas where the World Bank can assist in strengthening the system. The purpose of the report is to provide a broad background on the innovation system of Ukraine, to serve as a basis for informed discussions about policies, programs, and organizations to support innovation.

Methodology and Organization

To analyze Ukraine’s innovation ecosystem, we started with the entrepreneurship ecosystem framework developed by the Babson College Entrepreneurship Ecosystem Program.¹ This assesses the ecosystem in six categories:

- **Policy** - Leadership and government institutions/programs
- **Finance** - Availability of different types of funding for entrepreneurs
- **Markets** - Availability of early customers and networks to sell products and services
- **Culture** - Societal norms regarding risk taking and entrepreneurship and availability of role models
- **Human capital** - Labor force skills and quality of education/training for entrepreneurs
- **Supports** - Availability of infrastructure, supporting services, and nongovernment institutions that support entrepreneurship

We used this framework for assessing the innovation system for entrepreneurial companies, in the Innovation Ecosystem for Entrepreneurial Companies section of this report.

For existing Ukrainian companies (Innovation Ecosystem for Existing Companies section), we modified this framework to incorporate some elements that are important for innovation in existing companies. In particular, we expanded the ‘markets’ section to also include a discussion of industrial structure, and we added a category on ‘access to knowledge and technology’ to cover industries’ connection to research organizations and other sources of knowledge. We deleted the element on ‘culture’ because most of the discussion of culture and innovation either occurs in the context of entrepreneurship, which is covered in that section, or in the context of corporate culture, which is beyond the scope of this analysis. This led to the following six categories:

- **Industry and market structure** - Does the industry structure and markets encourage innovation? This involves the industrial structure of the country, the access to markets and market demand for innovation, and the degree of competition that provides motivation for innovation.
- **Leadership, governance, and policy** - Is there a strategy and are there effective policies to support innovation? Do government regulations, intellectual property (IP) policies, and tax policies support or inhibit innovation? Is there coordination among key institutions—industry, academia, and government—in innovation policy?
- **Access to knowledge and technology** - How well do universities and research institutions provide knowledge and technologies to companies? How affectively do Ukrainian companies access knowledge and technology developed in the rest of the world?
- **Finance** - How available is finance, through a variety of mechanism and incentives, for technology and innovation?
- **Human capital** - What is the quality and quantity of skills needed for innovative businesses? This encompasses scientific and technical skills, business skills, and workforce skills. It depends

¹ Babson Entrepreneurship Ecosystems Project. “Entrepreneurship Ecosystem Lessons.” Online at <http://entrepreneurial-revolution.com/lessons/>. Accessed June 6, 2017.

primarily on the quality of educational and training institutions and their connection to business needs.

- **Supports** - This includes physical infrastructure, information and communication technology (ICT) infrastructure, research and development (R&D) and testing facilities, and networks among institutions and science parks/technology parks.

For the section on attracting innovative foreign companies (Innovation Ecosystem for Multinational Companies in Ukraine section), we used the same framework as for existing Ukrainian companies.

There are, of course, many common features in the innovation ecosystems for existing, entrepreneurial and foreign companies. In each section we have tried to focus on the factors that are different for each category of firm, and have tried to minimize repetition of the common factors.

The strength of using this framework is that it provides a systematic way to examine the many elements of a country's environment that are known to be important for innovation, and we look at each element from the perspective of different categories of company. The broad scope of the analysis, however, makes it difficult to go into much detail in any specific area.

We reviewed extensive prior work that included

- Major innovation reviews and strategy documents,
- Academic papers on Ukraine innovation and industry,
- Global Competitiveness Index and Global Innovation Index reports, and
- Statistics and survey results produced by Ukraine Statistical Office, World Bank, and others.

The prior work on innovation in Ukraine includes several major studies: the European Commission Policy Support Facility's Peer Review of the Ukrainian Research and Innovation System (2016) (European Commission 2016; Schuch et al. 2016), the United Nations Economic Commission for Europe Innovation Performance Review (2013) (United Nations Economic Commission for Europe 2013, 152), and the three-volume project funded by the European Union (EU) (Rumpf et al. 2011; EU Project "Enhance Innovation Strategies, Policies, and Regulations in Ukraine" 2011a and 2011b). These studies are collectively quite comprehensive in their analysis and recommendations.

In addition to these studies that focus on Ukraine's innovation system, other major studies also address industrial innovation. The Export Strategy of Ukraine (International Trade Center and MEDT 2017) provides much information on the competitiveness and innovation status of Ukrainian industry. The Strategy for Agriculture and Rural Development (Ministry of Agrarian Policy and Food of Ukraine 2015, 213) and the Hi Tech Strategy (MEDT 2017) address innovation in important segments of Ukrainian industry. In addition, as part of this overall project, separate studies were commissioned on fiscal incentives and IP.

This study seeks to build on the prior work in two main ways. First, it takes a broad systematic view by examining all elements of the innovation ecosystem. And second, based on the understanding that firms are the principal innovators, it views innovation from a company perspective, considering the environment for innovation for existing, new, and foreign companies.

We also conducted interviews with individuals from Ukrainian companies, foreign companies operating in Ukraine, startup companies, industry associations, and academic experts. We also conducted interviews

with individuals from relevant government ministries, members of parliament, universities, and NASU. These are listed in appendix I.

At the same time, it is important to note the limitations of this study. We did not study or conduct interviews in the different regions of Ukraine, and we did not go into any depth into individual industrial sectors. Our interviews covered a small and nonrepresentative sample of Ukrainian companies and missed many sectors. The regional and sectoral aspects of innovation ecosystems are not addressed in any detail here.

The previous studies on innovation in Ukraine show a high degree of consensus about the nature of Ukraine's challenges with respect to innovation, as well as many of the necessary steps to address the problems. However, these studies and strategies have frequently not led to effective action—few recommendations have been implemented or sustained through changes in government, policy, and personnel. Given the wealth of these prior studies and the paucity of implementation, we focused on understanding the broad challenges and identifying concrete steps that can be implemented.

This study is organized in three parts:

- Innovation Ecosystem for Existing Companies
- Innovation Ecosystem for Entrepreneurial Companies
- Innovation Ecosystem for Multinational Companies in Ukraine

Each section begins with an overview of information about the category and then assesses the relevant elements of the innovation ecosystem. A final section summarizes findings and assesses some options for where the World Bank might focus its efforts.

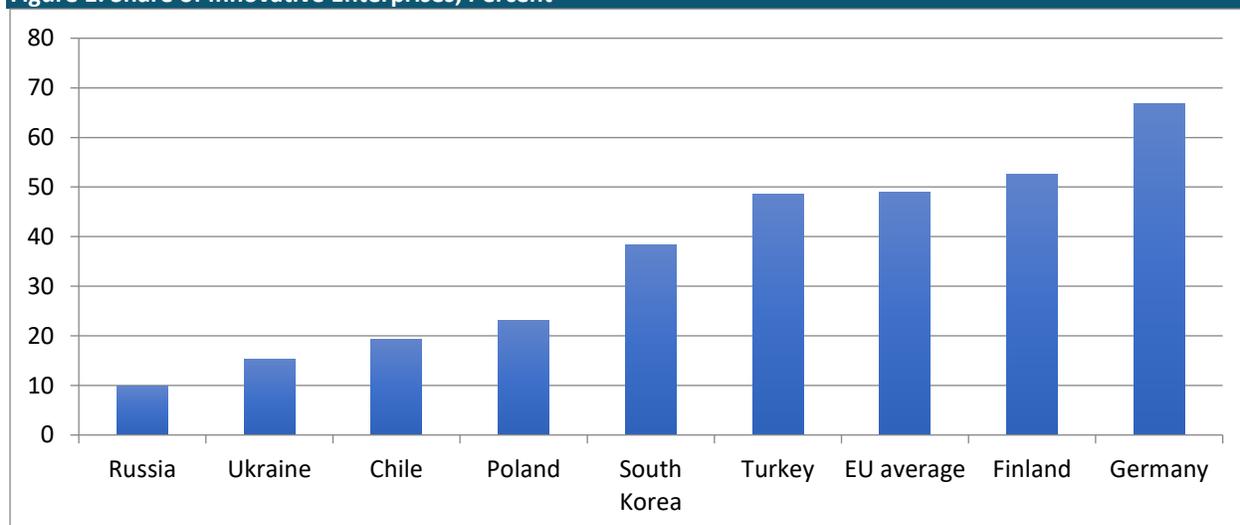
Innovation Ecosystem for Existing Companies

Overview

We discuss the innovation ecosystem for Ukraine's companies in six sections. This section provides an overview of some data on innovation in Ukrainian companies. The next six sections will discuss different elements of Ukraine's ecosystem: (a) industry and market structure; (b) leadership, governance, and policy; (c) access to knowledge and technology; (d) finance; (e) human capital; and (f) supports.

The overall observation is that enterprise innovation in Ukraine is weak and generally declining, both in large and small companies. Ukraine's innovation survey, which follows EU Community Innovation Survey methodology, found that the percentage of Ukraine industrial enterprises conducting innovative activity in 2015 was 17.3 percent² compared to an EU average of 48.9 percent.³ See figure 1.

Figure 1. Share of Innovative Enterprises, Percent



Sources: [http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Share_of_innovative_enterprises_by_main_type_of_innovation,_2010-12_\(1\)_\(%25_of_all_enterprises\)_YB15.png](http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Share_of_innovative_enterprises_by_main_type_of_innovation,_2010-12_(1)_(%25_of_all_enterprises)_YB15.png) ; Indicators of innovative activity 2016, Higher School of Economics, Moscow

As is expected in a transition economy, the bulk of Ukrainian innovation is 'new to the enterprise' innovation rather than 'new to the market' innovation. Of the 414 enterprises that reported introducing product innovation in 2015, 114 introduced new to the market innovations while 342 introduced new to the enterprise innovations. Similarly, on a per product basis, of the 3,136 innovative products introduced, 548 (17.5 percent) were new to the market while 2,588 (82.5 percent) were new only to the enterprise.

² Statistic Service of Ukraine.

³ [http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Share_of_innovative_enterprises_by_main_type_of_innovation,_2010-12_\(1\)_\(%25_of_all_enterprises\)_YB15.png](http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Share_of_innovative_enterprises_by_main_type_of_innovation,_2010-12_(1)_(%25_of_all_enterprises)_YB15.png)

Type of Innovations	Number of Enterprises Introducing Innovation
Any type	723
New product	414
- New to the market	114
- New to the enterprise	342
New process	400

Source: Statistic Service of Ukraine.

Note: Some enterprises may have introduced multiple types of innovation.

Of the funds that Ukrainian companies invest in innovation (UAH 13.8 billion), over 80 percent is for the acquisition of machines, equipment, and software and only 15 percent is for R&D. The large proportion of new technologies acquired with equipment suggests that the primary goal for the purchase of such technologies was mainly the modernization of enterprises, and not the creation of products new to the market or the enhancement of innovation activity. Ukraine is a net importer of technology—it purchases more technology than it transfers out.⁴

Industry and Market Structure

Ukraine’s industrial structure hampers its innovation performance. Ukraine’s main industries—agriculture, metals, and heavy manufacturing—are ones that are not R&D intensive (in Ukraine or in most other countries). Ukraine’s main industrial sectors are heavy engineering; ferrous and nonferrous metallurgy; shipbuilding; automotive; aerospace; manufacturing and supply of power plants; and oil, gas, and chemicals industry (Schuch et al 2016). Ukraine’s top five exported products in 2014 were maize; crude sunflower seed and safflower oil and fractions; spelt, common wheat, and meslin; semi-finished metals; and non-agglomerated iron ores and concentrates.⁵

High-technology exports, by contrast, are relatively weak. In 2015, high-technology exports were 7.3 percent of manufactured exports, which is low compared to the average of the EU (16 percent), the Organisation for Economic Co-operation and Development (OECD) members (17 percent), and the world (18 percent). High-technology exports in current U.S. dollars in 2015 were US\$1.4 billion, a sharp decline from US\$2.6 billion in 2012.⁶ According to the Global Innovation Index in 2016, high-technology exports less reexports were 2.9 percent of total trade, which ranked 45 out of 128 countries.⁷

Ukraine’s concentration in low-R&D industry reduces Ukraine’s rate of business-supported R&D. Given this, as well as Ukraine’s general economic development status, Ukraine’s gross domestic expenditure on research and development (GERD) performed by business, is not particularly low at 0.4 percent of gross domestic product (GDP) (40th out of 128 countries in the Global Innovation Index).⁸ Similarly, in the Global Competitiveness Index, Ukraine’s ‘company spending on R&D’ is ranked 68th out of 138 countries (World Economic Forum 2016, 350-351). Ukraine ranks lower on ‘availability of latest technologies’ (93 out of 138) and ‘firm-level technology absorption’ (74 out of 138) (World Economic Forum 2016, 350-351).

Ukraine’s innovation performance has generally been deteriorating. Ukraine used to be more tightly linked to the Commonwealth of Independent States (CIS) countries and was able to export R&D-intensive

⁴ Statistic Service of Ukraine.

⁵ wits.worldbank.org

⁶ data.worldbank.org

⁷ Global Innovation Index 2016. “Ukraine.”

⁸ Global Innovation Index 2016. “Ukraine.”

goods to them. As trade with the CIS countries has declined and trade with Europe has expanded, exports have become more concentrated in commodity agriculture and metals, which are less R&D intensive. As a result, the sectors of the economy that have tended to be more innovative have shrunk. As the EU Policy Support Facility study noted, two-thirds of business spending on R&D is concentrated in machine building, an industry that has contracted since independence in 1991. Russia has been the main customer for machine-building products of Ukraine, and it is assumed that this industry will further decline (Schuch et al 2016).

A second key aspect of industry and market structure that affects innovation is the degree to which companies face competitive pressures to innovate and the degree to which customers demand and expect innovation (Porter 1990). Ukraine's industrial structure is also weak in this regard. The Global Competitiveness Index ranked Ukraine 99 out of 140 countries on 'intensity of local competition', 98th in 'extent of market dominance', and 136th in 'effectiveness of anti-monopoly policy'.⁹ Judges and prosecutors are inadequately trained to ensure that new legislation to improve competition is being effectively followed (International Finance Corporation 2014). Large firms constitute 0.1 percent of companies in Ukraine, but account for almost 50 percent of revenues and employ roughly 40 percent of salaried workers.

Local competition is weak, and the lack of competitive pressure delays technology acquisition (United Nations Economic Commission for Europe 2013, 25). Large enterprises do not act as drivers for innovation in the economy. The lack of demand for innovation from large firms limits the market for new technology-based firms to serve as suppliers of innovative products to the large firms and limits the demand for local innovation. Local competition and domestic markets are dominated by a limited number of business groups, reducing competition. In addition, the sufficient size of the domestic market reduces firms' need to export, which would create pressures to innovate to face international competition. The overall situation is one where most Ukrainian companies have little motivation for innovation and, consequently, invest little in innovation.

The noncompetitive industrial structure is due in part to the presence and the history of state-owned enterprises (SOEs). Many sectors of the economy have a history of government subsidization and little competition. Business skills needed for operating in competitive markets were underdeveloped. Many SOEs have been privatized, but there are still 3,340 state-owned business entities, of which only 1,829 are operating companies, employing nearly 0.9 million people.¹⁰ The SOEs are active in areas such as energy and machine building and include such companies as producer of energy turbines Turboatom, energy generator Centerenergo, and energy company Naftogaz. SOEs have been linked to corruption and are part of a system that scares away potential investors, drives off international donors, and makes it hard for small and medium enterprises (SMEs) to compete (Hontz 2016).

Innovation varies substantially by industrial sector. This study did not examine the dynamics of different industrial sectors in Ukraine. The industry sectors that had the highest percentage of firms reporting innovations in 2015 were¹¹

- Production of main pharmaceutical products and pharmaceutical medicines - 47.5 percent;
- Production of automotive vehicles, trailers, and semitrailers - 38.2 percent;

⁹ World Economic Forum, The Global Competitiveness Report 2015–2016. Country/Economy Profiles: Ukraine. p. 354–355.

¹⁰ Ukraine's Top-100 State-Owned Enterprises. Full Year 2014. Ministry of Economic Development and Trade.

¹¹ Statistic Service of Ukraine.

- Production of computers, electronics, and optics - 37.5 percent;
- Other transportations - 36.1 percent;
- Production of coke and oil chemistry products - 28.6 percent; and
- Production of electric equipment - 28.2 percent.

One industry that deserves a special mention is the information technology (IT) industry, which does not share the history of state involvement and in contrast to many other technology-related industries has been growing substantially. Estimates for 2016 show 90,000 IT professionals, more than 1,000 IT service companies, and exports of software outsourcing of at least US\$2.5 billion.¹² The number of people working for the top five outsourcers has more than doubled over the past five years (Degeler 2016). This industry includes many Ukrainian and foreign-headquartered firms that primarily provide software outsourcing services for companies outside of Ukraine. Many of the software developers who work in this industry are self-employed contractors, a situation encouraged by Ukraine's tax policies.

Leadership, Governance, and Policy

This section addresses the effectiveness of government strategy, policies, and institutions to support innovation. It discusses both (a) the general environment created by the government that affects companies' ability to do business generally and (b) the government's leadership, policies, and programs specifically to support innovation. Ukraine has challenges in both areas.

With regard to the general influence of the government on the business environment, there is widespread agreement that government performance inhibits business development and innovation in Ukraine. The Global Competitiveness Index lists the 10 most problematic factors for doing business as¹³

1. Corruption,
2. Policy instability,
3. Inflation,
4. Inefficient government bureaucracy,
5. Access to financing,
6. Government instability,
7. Tax rates,
8. Tax regulations,
9. Foreign currency regulations, and
10. Inadequate supply of infrastructure.

Similarly, the Global Competitiveness Index ranks Ukraine in the bottom quarter of countries on a wide range of indicators, such as property rights, IP protection, diversion of public funds, irregular payments

¹² Ukraine Digital News and AVentures. IT Ukraine: IT Services and Software R&D in Europe's Rising Tech Nation. Version 1.11. April 2016. Accessed online at http://www.uadn.net/files/ua_hightech.pdf, June 21, 2017.

¹³ World Economic Forum, The Global Competitiveness Report 2016–2017. Country/Economy Profiles: Ukraine. p. 350–351.

and bribes, judicial independence, wastefulness of government spending, efficiency of legal framework in settling disputes, organized crime, and others.¹⁴

The Global Innovation Index also ranks Ukraine near the bottom of countries in measures related to the quality of governmental institutions.¹⁵

Category		Rank (out of 128)
1.	Institutions	101
1.1	Political environment	123
1.1.1	Political stability and safety	125
1.1.2	Government effectiveness	88
1.2	Regulatory environment	84
1.2.1	Regulatory quality	105
1.2.2	Rule of law	110
1.2.3	Cost of redundancy dismissal and salary weeks	49
1.3	Business environment	79
1.3.1	Ease of starting a business	29
1.3.2	Ease of resolving insolvency	113
1.3.3	Ease of paying taxes	81

A USAID-supported survey of SMEs generated a similar list of key impediments to business development in 2015. These impediments were placed in 10 groups:

“The first place in the ranking belongs to the group of factors which include the consequences of military aggression of the Russian Federation and the general political instability in the country (59%). Second largest group of problems relates to tax legislation, in particular the complexity of tax administration, permanent changes in the legislation, and frequent changes in the tax and other reporting forms (54%). The third group of problems which contributed to limited business activity in the SME sector is associated with unfavorable market conditions, low demand, and high level of competition (48%). The fourth group of problems marks the financial component of SME activities, including lack of funds, high interest rates for credits and other borrowed capital (36%). Fifth in the ranking is the group of barriers associated with high regulatory burden and corruption (36%). The sixth group of factors encompasses burdensome currency regulation and inflation (35%). The lack of skilled workforce and the necessary production capacity represent the seventh group of factors (20%). The eighth place in the ranking takes the inefficiency of the state apparatus (17%). The remaining obstacles account for less than 4%.”¹⁶

These issues are collectively a large drag on the innovative performance of companies. If companies believe the benefit of innovation will be lost to corruption, they will not invest in innovation. Efforts required to comply with regulations take energy and resources away from innovation. Policy instability means that the government programs intended to support innovation will not be effective or sustained. The corruption, regulatory burden, and ineffectiveness of the government means that the industry will not trust the government sufficiently to work together to improve innovation in Ukraine.

¹⁴ World Economic Forum, The Global Competitiveness Report 2016–2017. Country/Economy Profiles: Ukraine. p. 350–351.

¹⁵ Global Innovation Index 2016. “Ukraine.”

¹⁶ USAID Ukraine: Annual Business Climate Assessment 2015. <http://lev.org.ua/en/abca.html>.

Technical regulations, including many health, safety, environmental, and product regulations and technical standards, are a subset of the government’s overall regulatory role that is particularly important for innovation. Ukraine’s system of technical regulations is viewed as hindering modernization through its complexity, lack of self-regulation, obsolescence, and huge scope for administrative discretion (United Nations Economic Commission for Europe 2013, 53). They often are not harmonized with international standards, which creates barriers to trade. All local producers must manufacture products in conformity with national standards, most of which were developed in the 1970s and 1980s. There is work going on to reform regulations and harmonize them with the EU. For example, a project of EU4Business is working to support deregulation with a particular focus on SMEs in priority sectors.¹⁷

An area of governance that is especially important to innovation is IP policy and institutions. As part of this project, the World Bank commissioned a separate study to examine IP and technology transfer in Ukraine (Stankovic 2017). A key conclusion from this report is that the main obstacle to the overall effectiveness of the IP system is not the substantive law, but rather its implementation and enforcement. The major issues are the lack of clear division of roles and responsibilities and poor coordination across various ministries and other actors in IP and TT matters, as well as weak institutional capacity in implementing the intended IP and TT framework. The IP ownership rules for publicly funded technologies are scattered throughout different legal acts, which have conflicting provisions. This creates ambiguity, uncertainty, and confusion. Ukrainian technology transfer intermediaries are not effective in their commercialization efforts despite their official existence in most R&D-active institutions.

With regard to the government’s ability to develop and implement policies and programs specifically to improve innovation, there have been multiple innovation-related studies and initiatives in Ukraine in recent years, reflecting the recognition of the importance of innovation as a driver of growth and competitiveness (United Nations Economic Commission for Europe 2013). Ukraine officially recognizes the importance of the National Innovation System (NIS) approach (adopted by the government’s act, June 17, 2009) that considers subsystems of government regulation, education, knowledge generation, innovation infrastructure, and production (United Nations Economic Commission for Europe 2013).

The implementation of innovation supporting policies, however, has been weak (United Nations Economic Commission for Europe 2013). Many policies and programs to support innovation that were officially adopted were not fully funded. Organizations were created but then changed when the government changed. The lack of engagement of key innovation actors in the design process has also undermined implementation. As a consequence, there is a substantial distrust of the motives of many people in the government, as well as skepticism about the government’s ability to develop and implement useful programs. As the EU-funded study noted in 2011, “The idea of knowledge-based economy, driven by innovation, has been discredited in the Ukrainian society, due to many ineffective and inconsistent actions by the public authorities and announced measures that were never been put in practice.”¹⁸ “A key problem in Ukraine is the gap between the stated policy goals and actual implementation of policy measures. Official declarations regarding the need for innovative development are not supported by carefully tailored measures and, especially, by appropriate and efficient mechanisms, programmes and framework conditions.”¹⁹

¹⁷ EU4Business. Progress and Creating Impact. 3rd Project Steering Committee Meeting. Presentation. April 28, 2017.

¹⁸ EU Project “Enhance Innovation Strategies, Policies, and Regulations in Ukraine”. 2011b. p. 38

¹⁹ EU Project “Enhance Innovation Strategies, Policies, and Regulations in Ukraine”. 2011b. p. 43.

Coordination of government programs is also a major problem. Innovation-related activities are distributed across a wide range of ministries, and coordination mechanisms are weak or missing (United Nations Economic Commission for Europe 2013). The Ministry of Education and Science (MESU) has the lead responsibility for innovation, but the Ministry of Economic Development and Trade (MEDT) is responsible for the R&D policy and competitiveness of industry, technology transfer to the business sector, and some science and technology (S&T) programs targeting economic development. The Ministry of Finance has an important role by determining the national budget for the research and innovation sector. The Ministry for Foreign Affairs is responsible for international agreements with other countries and international organizations (which provide a substantial amount of R&D funding) (Schuch et al 2016). The National Academy of Sciences of Ukraine (NASU), receives around 50 percent of the yearly state budget allocated for S&T. Research and innovation activities are also carried out in research institutions and universities subordinated to the Ministry of Health, Ministry of Infrastructure, Ministry of Internal Affairs, Ministry of Culture, and Ministry of Agrarian Policy and Food. All these ministries have some sector budgets related to research and innovation activities (Schuch et al 2016).

There is poor coordination among these ministries and agencies, weak coordination between the national and the regional level, limited cooperation between public research institutes and the higher education sector, and weak science-industry cooperation (Schuch et al 2016). As a United Nations (UN) study noted, "...there is not a clear governance structure to arbitrate conflicts, ensure the integration of different goals and define consistent agendas. This weakness contributes to the proliferation of inconsistent and poorly funded initiatives, and an inefficient complexity of legal rules." (United Nations Economic Commission for Europe 2013, xvi) There is a current plan to establish an Innovation Development Office, but the scope and responsibilities of this office—and its ability to provide the needed coordination—are not yet clear.

Regional programs are another important dimension to the government innovation policy. Many aspects of the innovation policy, such as industry cluster development strategies, support for SMEs and entrepreneurship, S&T parks, and university-industry collaboration, are done at the regional level in many countries, and regional governments are often viewed as more responsive to the needs of local industry.

Ukraine has varying resources and needs at the regional level.²⁰ Many governmental powers, however, are centralized. In particular, only the Verkhovna Rada of Ukraine can pass laws; the regions can provide funds from their own regional budget for research and innovation but have limited ability to fund programs or design programs that require a change in law. Ukraine's regions were asked in 2006 to develop regional innovation plans. Most regions have tried to develop elements of local S&T and innovation infrastructures (for example, research institutes, techno-parks, universities, and hi-tech companies) but have had little capacity or funding to do so. Some of the regions and bigger cities have their own departments and offices responsible for innovation issues. Some regions have special programs on innovation; others support innovation as part of general programs of social and economic development.

Access to Knowledge and Technology

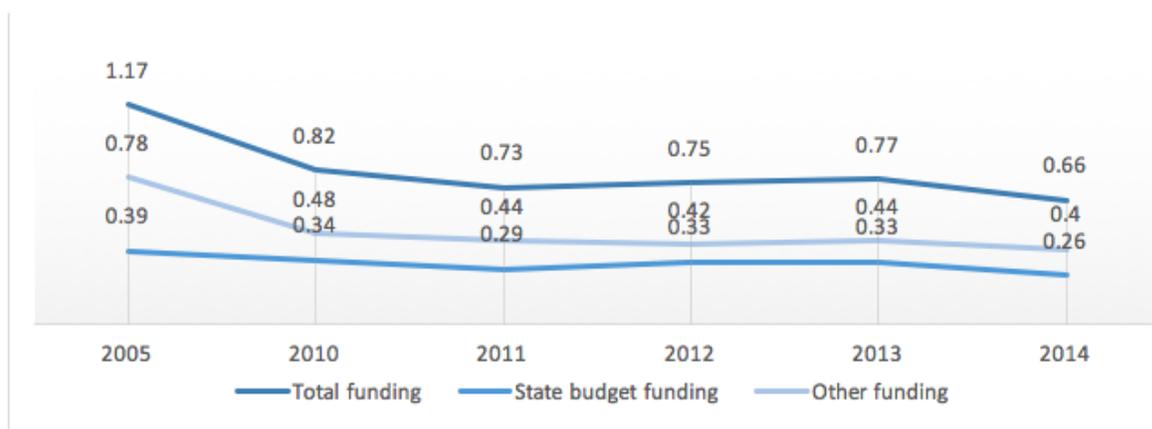
This section addresses the extent to which Ukrainian universities and research institutions provide knowledge and technologies to companies and how effectively Ukrainian companies access knowledge and technology developed in the rest of the world. The EU Policy Support Facility's 2016 study looked

²⁰ This section draws on chapter 12 in Rumpf et. al. 2011; and Schuch et al, 25.

extensively at how Ukraine’s research system contributes to innovation (Schuch et al 2016). Much of the material here is derived from that report.

Ukraine had historically strong S&T institutions in the Soviet era, but these have been declining in post-Soviet era. Ukraine’s GERD decreased from 1.17 percent of GDP in 2005 to 0.66 percent in 2014 (see Figure 2). This caused a decrease in the total number of researchers and led many researchers to seek work in other countries. In spite of this decline, Ukraine’s R&D expenditures are still relatively strong compared to countries at a similar level of development—the Global Innovation Index ranks Ukraine 54th out of 128 countries in GERD/GDP.²¹

Figure 2. GERD 2005–2014



Source: Schuch et al 2016, p. 28, data from OECD.

A further problem is that Ukraine’s R&D system is not currently well structured to support innovation. The NASU consumes above 50 percent of the state budget allocated for R&D. Other specialized academies of sciences, including the Ukrainian Academy of Agrarian Sciences, the Academy of Medical Sciences, the Academy of Pedagogical Sciences, the Academy of Legal Sciences, and the Academy of Arts consume another 25 percent of the state R&D budget (Schuch et al 2016, 32–33). The academies are largely focused on basic research and are mostly supported with institutional funds rather than competitively awarded project funds. Funding for the NASU has been declining, and the remaining funds have been focused on supporting existing staff, with the result that both the facilities and staff are aging. Funds for research equipment and materials are minimal, making it difficult to do high-quality work. While the academies used to be closely tied to the needs of the Soviet Union, these connections declined with independence and the academies shifted to more basic research. While some academies do some applied work for the government or corporate sponsors, most work is basic research. The academies have technology transfer offices, but patenting and technology transfer has been weak.

Universities account for only 7 percent of GERD but employ two-thirds of persons with doctorates. Scientifically educated personnel at universities are mostly engaged in teaching, rather than research. Only half of the around 350 universities perform any kind of R&D, and many of these do only limited R&D. According to the national statistics, universities produce almost 78 percent of research papers, but the NASU has more publications in internationally recognized journals (Schuch et al 2016, 32–33).

²¹ Global Innovation Index 2016. “Ukraine.”

The lack of research funding for universities is a problem because universities have advantages over research institutes in how they contribute to innovation. In particular, universities have a built-in mechanism for transferring knowledge to industry, in that they produce graduates who go to work for industry or start companies.

Links between industry and the academies and universities are weak. Industry-academia co-authorship is rare, and there is little technology transfer. An indicator of industry-academia relations is the number of publications co-authored by researchers in both public and private institutions, per million of population. While the EU average is typically in the 30s, Ukraine is typically around 1 (Schuch et al 2016, 35).

While, in general, universities do minimal research and contribute little to innovation, there are exceptions. For example, Kyiv Polytechnic Institute (KPI) has industrial partnerships and creates spin-offs and operates a science park that has mechanisms for facilitating interaction with industry.

Part of the weak technology transfer between research institutions and industry may be due to the lack of connection with industry in setting R&D priorities. Public investment is oriented toward broadly defined R&D priorities, rather than based on communication with industry about specific R&D needs. The technological innovation priorities of Ukraine as stipulated by law are in the fields of energy, energy efficiency, and transportation in general, but also specific fields (rocket and space; aircraft industries; shipbuilding; armament; and military technologies), new materials with emphasis on nanomaterials, agro-industry, biomedicine (medical services, treatment devices, and pharmaceuticals), cleaner production and environmental protection, and ICT and robotics.

Another contributor to weak technology transfer is that, as discussed in a previous section, Ukrainian industry has not been focused on innovation and has had little demand for R&D. As noted earlier, industry gets new technology primarily in the form of purchases of machines and equipment.

Finally, for SMEs, the costs of developing relations with technology organizations are rather high, and the frameworks for interaction are too rigid for their needs. Collaboration between science and business is hampered by the lack of information on opportunities and the high costs faced by organizations in the search for partnerships (United Nations Economic Commission for Europe 2013).

There are also regional variations in the degree of cooperation between enterprises and S&T institutions. In a survey of 600 Ukrainian businesses, firms were asked to assess the level of cooperation between enterprises and S&T institutions in their region using a scale from 0 (no cooperation) to 9 (strong cooperation). The average level among all regions was 3.9, which means weak cooperation. However, a high level of standard deviation of this indicator shows that some enterprises have strong cooperation, especially in Vinnitsa, Zaporizhia, Odessa, and Poltava regions and Kyiv city.²²

In addition to the NASU and the universities, Ukraine has a variety of industrial research institutes, engineering departments, and special engineering bureaus that are associated with specific economic areas and focus on industrial R&D (Schuch et al 2016, 32). A heritage of the Soviet system, these organizations are formally subordinated to the different ministries and state agencies but have been partially privatized. These organizations receive some (typically less than 25 percent) of their financing from the state in the form of block grants, giving the ministries the right to be involved in the nomination of their directors. The rest of the financing is contracted both from state-owned and private companies.

²² <http://www.ier.com.ua/en/publications/articles?pid=4902>.

Regarding getting access to international knowledge, Ukrainian companies have not been well connected internationally. Most of the companies have been focused on domestic markets, and many international knowledge links have been with Russia and have been declining. The lack of Ukrainian international patents, especially in countries other than Russia, indicates a weak integration of Ukrainian companies in global value chains.

With respect to international collaboration in research, Ukraine has low but steadily increasing levels in international scientific co-publications per million population. The expansion of research collaboration with Europe, and especially participation in the Horizon 2020 program, is a very positive development (Schuch et al 2016, 6–7). For example, there is collaboration between the EU and Ukrainian aircraft R&D organizations in the Aero-UA project, funded under the Horizon 2020 program.²³

Finance

This section addresses the availability of finance, through a variety of mechanisms and incentives, for technology and innovation. Access to finance is rated by firms as one of their biggest obstacles. In the 2013 World Bank/International Finance Corporation (IFC) enterprise survey, ‘Access to Finance’ was most frequently listed by firms as their biggest obstacle, slightly ahead of corruption and political instability. Access to finance was especially a problem for medium-size firms.²⁴ In the Global Competitiveness Index, Ukraine ranked poorly in financial market measures, with rankings mostly in the bottom third of countries.

Category	Ukraine Rank (out of 140)
Availability of financial services	101
Affordability of financial services	123
Financing through local equity market	118
Ease of access to loans	87
Venture capital availability	102
Soundness of banks	140
Regulation of securities exchanges	135

However, the Global Innovation Index scores Ukraine relatively well on some areas, ranking Ukraine 18th on ease of getting credit.

According to Ukraine’s innovation survey, the main source of financing for innovation for existing firms is the firm’s own funds (97.2 percent of the total volume of innovation expenditures). The other 2.8 percent of funding includes very limited amount of state, municipal, international, and domestic investors.²⁵

External financing of innovations is rarely used. Financing in Ukraine is mostly through the banking system, and innovation projects are often not attractive for bank financing. Interest rates are high, and credit risks are great (Vovchak and Rudevskya 2016). Venture funds exist, but many fund profitable but not necessarily innovative enterprises (such as hotels and retail stores, not technology-based firms) (Krasovska 2012).

A problem in assessing the adequacy of financing is that while often firms complain about access to capital, investment firms often complain about not having good investment opportunities. Capital is

²³ <http://www.aero-ua.eu/>.

²⁴ World Bank and International Finance Corporation. Ukraine Country Profile 2013. Enterprise Survey.

²⁵ Statistic Service of Ukraine.

considered to be relatively mobile and will readily cross international borders if there are good investment opportunities. Often, perceptions of lack of capital may reflect other problems. In the case of Ukraine, lack of capital may reflect perceptions of high risk by the investment community, which may be due to political instability, corruption, concerns about the legal system, currency controls, or other factors.

As part of this project, the World Bank supported an analysis of fiscal incentives for science, technology, and innovation (STI) activities, such as tax incentives (Guceri 2017). The report identifies the costs and benefits of a variety of fiscal incentives to support STI that have been widely used worldwide and considers which might be relevant to the Ukrainian context. The report lays out a framework that maps government objectives to the economic justification for intervention in areas related to STI. The report notes that there are a variety of market failures that result in a suboptimal level of innovation activities, and it identifies fiscal incentives that could address some of the market failures. However, the study cautions that administrative inefficiencies, such as low state capacity, corruption, or simply the lack of resources may make such initiatives ineffective. The study recommends that Ukraine focuses on ensuring macroeconomic stability and improvements in the business climate before providing tax incentives to support R&D. It also recommends that Ukraine invests in capacity building to implement fiscal incentives in the future, which involves developing a suitable skill set within the Ministry of Finance to be able to analyze the predicted cost and benefits of tax incentives, to collect reliable data on private R&D and innovation efforts, and to be able to evaluate the effects of innovation incentives.

Human Capital

This section addresses the quality and quantity of skills needed for innovative businesses. This encompasses scientific and technical skills, business skills, and workforce skills. It depends primarily on the quality of educational and training institutions and their connection to business needs.

Human capital is an area of relative strength for innovation in Ukraine. Ukraine inherited a relatively well-developed education system from the Soviet Union, and university enrollment is very high (80 percent) (Schuch et al 2016, 7). The education system has particular strengths in math and science education, and this has led to a very strong IT workforce. On international indicators, Ukraine scores among top countries on investment in education and on higher education enrollment.

Global Innovation Index Indicator	Rank (out of 128)
Human capital and research	40
Education	20
Expenditure on education, % of GDP	18
Government expenditure per pupil, secondary, % of GDP per capita	18
School life expectancy, years	40
Tertiary education	24
Tertiary enrolment, % gross	10
Graduates in science and engineering, %	27

Source: Global Innovation Index 2016. "Ukraine."

Global Competitiveness Index Indicator	Rank (out of 140)
Secondary education enrollment, gross %	39
Tertiary education enrollment, gross %	14
Quality of the education system	54

Global Competitiveness Index Indicator	Rank (out of 140)
Quality of math and science education	38
Quality of management schools	87
Internet access in schools	44
Availability of specialized training services	78
Extent of staff training	74

Source: World Economic Forum. "The Global Competitiveness Report 2015–2016." Country/Economy Profiles: Ukraine. p. 354–355.

While these are strengths relative to most other transition economies, these indicators also show weakness in management school, availability of specialized training, and other areas. A recent World Bank skills report also identified a range of areas where improvement is needed (Del Carpio et al. 2017), including the following:

- Ukrainians have high levels of basic cognitive skills but the educational system does not produce enough people with practical skills, the right kind or level of skills, or up-to-date knowledge.
- The formal education and training suffers from weak governance and an inefficient funding system.
- Skills training outside the formal education system is limited. Partnerships between firms and education institutions are scarce, with only a fifth of the firms in key sectors maintaining regular contacts with educational and training institutions.
- Little reliable information is available on current and emerging skills demands that would allow students, educators, and training providers to make good decisions or make their program offerings relevant to labor market conditions.
- The labor code and other labor market institutions do not facilitate an adaptable labor market or foster conditions that are conducive for the creation of more and better jobs.

The study found that skills gaps significantly constrain firms' performance in Ukraine: 40 percent of firms in four key sectors (agriculture, food processing, IT, and renewable energy) report a significant gap between the type of skills their employees have and those they need to achieve their business objectives.

Our interview results were consistent with these findings. While firms are able to hire people with strong basic skills, universities are viewed as not well connected to industry and not providing relevant skills. Industry representatives in diverse areas such as IT and agriculture advocated for major reforms in the education and training system.

Other concerns are that

- PhD enrollment is low by international comparison, which indicates an overall low interest to pursue scientific careers. More students are shifting away from science and engineering degrees toward the social sciences and humanities (this is likely related to the declining funding for S&T).
- Although the level of tertiary education attainment is high, the absorption capacity of the Ukrainian economy is limited, and many Ukrainians are overqualified for the jobs they hold (Schuch et al 2016). Consequently, many talented Ukrainians seek work in other countries, which, at least in the short term, leads to a loss of human capital to Ukraine (in the long run, it may lead to greater international connections and perhaps return to Ukraine in the form of knowledge and capital).

In summary, while human capital is generally a strong part of Ukraine’s innovation ecosystem, it could be stronger with reforms and better connections between education and industry. In addition, declines in the R&D system may be weakening some of the historic strengths in S&T training.

Supports

This section addresses the adequacy of various kinds of infrastructure, including transportation, communications, R&D facilities, S&T parks, and other business support infrastructure.

Tables 6 and 7 show the Global Innovation Index and Global Competitiveness Index rankings for Ukraine in various infrastructure categories:

Global Innovation Index Category	Rank (out of 128)
Infrastructure	99
Information & communication technologies (ICTs)	87
ICT access	62
ICT use	92
Government’s online service	105
E-participation	74
General infrastructure	110
Electricity output, kWh per capita	49
Logistics performance	59
Gross capital formation, % of GDP	123
Ecological sustainability	100
GDP per unit of energy use, 2005 PPP US\$ per kg oil equivalent	115
Environmental performance	44
ISO 14001 environmental certificates per billion PPP US\$ of GDP	81

Source: Global Innovation Index 2016. “Ukraine.”

Note: PPP = Purchasing Power Parity.

Global Competitiveness Index Category	Rank (out of 140)
Quality of overall infrastructure	82
Quality of roads	132
Quality of railroad infrastructure	28
Quality of port infrastructure	108
Quality of air transport infrastructure	97
Available airline seat km per week, millions	61
Quality of electricity supply	75
Mobile telephone subscriptions per 100 people	32
Fixed telephone lines per 100 people	44

Source: World Economic Forum. “The Global Competitiveness Report 2015–2016.” Country/Economy Profiles: Ukraine. p. 354–355.

Transportation infrastructure is viewed as deficient, with dangerous roads and inefficient railroads (OECD 2016). While this is more a barrier to business in general rather than innovation, our interviews indicated some ways that infrastructure hurts innovation. For example, it is difficult for Ukrainian farmers to shift to higher value-added crops, such as fruits and vegetables, without a better transportation infrastructure

to get their produce to export markets quickly. ICT infrastructure, on the other hand, appears to be adequate to support the IT industry, at least in the major cities.

With respect to research infrastructure, Ukraine had nearly 20 percent of the experimental facilities of the USSR, including nuclear reactors, astronomic observatories, and ships for marine research, but a substantial part of this infrastructure has been lost or deteriorated (Schuch et al 2016, 33–34). Today, the research facilities are outdated and underfunded. Ukraine still has some R&D infrastructures in operation that are internationally recognized, mostly located at different institutes of the NASU, including 15, most in the natural sciences, that are included in the European Research Infrastructure Observatory (Schuch et al 2016, 33–34).

With respect to S&T parks and other innovation support infrastructure, Ukraine has created a significant number of entities, but many are reported to be inoperative or ineffective. In recent years, Ukraine has established 12 technology parks; 17 science parks; 28 business incubators; 25 innovation centers; 9 centers for science, innovation, and information; several technology transfer units at higher education institutions; and a dedicated Ukrainian institute of scientific and technical expertise and information (Schuch et al 2016, 30). In 1999–2005, a variety of tax incentives were available for firms in technology parks, including exemption of custom duties on imports of material and equipment, tax credits, and lower interest rates on loans (United Nations Economic Commission for Europe 2013, 33). These benefits were abolished in 2005, because the new government blamed some technology parks for unlawful activities. As a result, the activities of technology parks declined.

One working university-based science park is the one at the National Technical University of Ukraine Kyiv Polytechnic Institute (KPI) in 2007, which has had success in developing spin-off companies, attracting foreign investment, and providing innovation and entrepreneurship training at other Ukrainian Universities.²⁶

With regard to broader innovation and business support services, Ukraine does not have comprehensive programs. Innovation and business support infrastructure is underfunded and not equipped with tools, methodologies, and knowledge to provide state-of-the-art support services.²⁷ Startups and SMEs often lack mechanisms to tap into the knowledge needed to innovate and to develop internationally competitive products and services. As noted before, networks among industry and between industry, government, and academia are weak.

²⁶ Information provided by KPI Science Park, February 2017.

²⁷ Rumpf et. al. 2011. p. 83–84.

Innovation Ecosystem for Entrepreneurial Companies

Overview

The formation and growth of new innovative companies are a critical component of innovation in countries. New companies are often the best way to bring new technologies to the market, and new companies are often the first to apply new approaches in existing markets. Entrepreneurial companies generally have less bureaucracy and are less constrained by conventions and past investments. The presence of entrepreneurial companies creates a more dynamic marketplace and increases the level of competition—and the motivation to innovate—for existing companies.

This section provides a summary of Ukraine’s entrepreneurship ecosystem. It follows a similar framework to the one used in the previous section and analyzes the entrepreneurial ecosystem in six categories:²⁸

- **Policy** - Leadership and government institutions/programs
- **Finance** - Availability of different types of funding for entrepreneurs
- **Markets** - Availability of early customers and networks to sell products and services
- **Culture** - Societal norms regarding risk taking and entrepreneurship and availability of role models
- **Human capital** - Labor force skills and quality of education/training for entrepreneurs
- **Supports** - Availability of infrastructure, supporting services, and nongovernment institutions that support entrepreneurship

In analyzing the innovation ecosystem for entrepreneurial companies, it is important to make some distinctions between the types of companies and to note some problems in the data. There are several types of companies that are similar to but different from the innovative entrepreneurial companies that we are focused on. Some companies are new but not innovative—such as many new retail stores and restaurants. There are also SMEs that are innovative, but are not new or entrepreneurial—such as long-standing small manufacturers that may use new technology. Finally, there are self-employed individuals who are microenterprises but essentially function as contract employees; while they provide services that may be somewhat innovative, they are not growth-oriented entrepreneurial companies.

A further complication is that many of the most ambitious and innovative entrepreneurs in Ukraine—those that provide products or services to international markets—choose to establish their companies outside of Ukraine, for reasons discussed later. They tend not to employ people in Ukraine but rather use self-employed contractors in Ukraine.

As a consequence of these distinctions, there is little reliable data on the innovative entrepreneurial companies that we are most interested in. Data on SMEs and recently formed companies include many non-innovative and non-entrepreneurial companies.²⁹ Many of the most innovative entrepreneurial

²⁸ “Babson Entrepreneurship Ecosystems Project.” Entrepreneurship Ecosystem Lessons. Online at <http://entrepreneurial-revolution.com/lessons/>. Accessed June 6, 2017.

²⁹ It is estimated that less than 5 percent of SMEs are innovative or growth-oriented. (Friedrich Naumann Foundation for Freedom 2014)

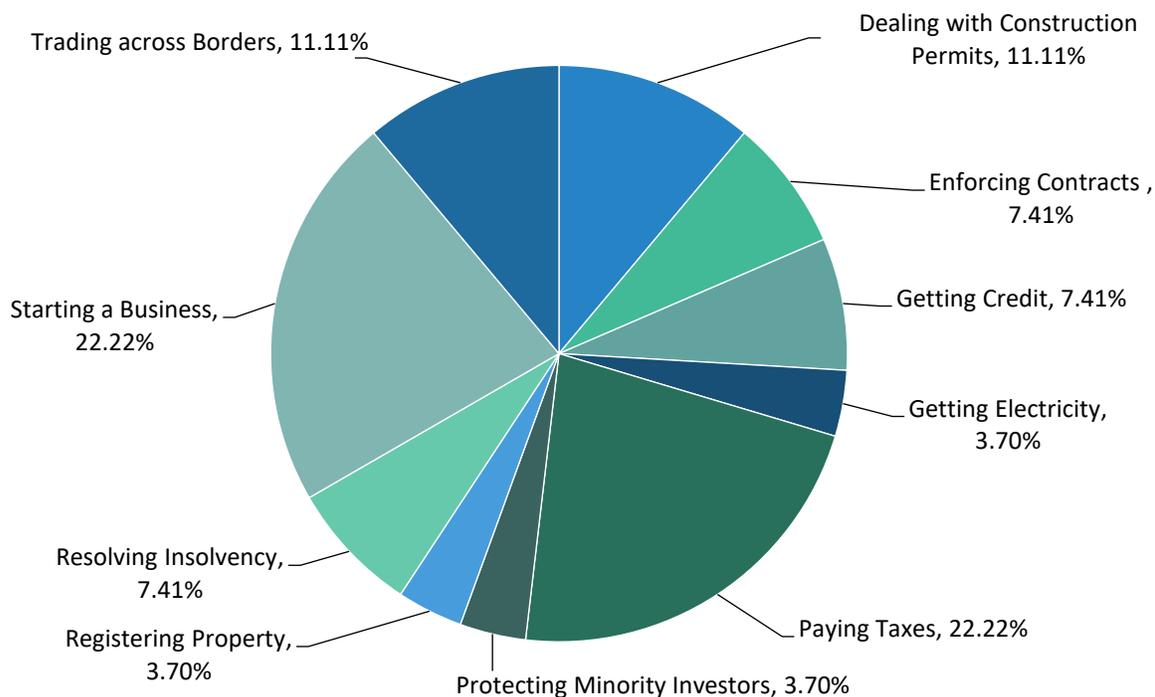
companies formed by Ukrainians and using Ukrainian human resources are not registered as Ukrainian companies and so are not included as such in government statistics.

Leadership, Governance, and Policy

The policy environment for entrepreneurial companies is mixed. On the one hand, Ukraine has made notable efforts to improve the ease of doing business and starting companies. On the other hand, many barriers to starting new businesses remain, and fundamental problems with corruption and rule of law remain major barriers to business. Many entrepreneurial companies that want to sell to international markets establish themselves outside of Ukraine, in part to avoid the problems of working with the Ukrainian government. These issues are expanded upon below.

In the World Bank’s Doing Business Report, in 2017, Ukraine ranks 80th overall compared to a ranking of 140 in 2013.³⁰ Since 2009, Ukraine’s government has passed 27 reforms targeted at its business environment. Of these reforms, the World Bank viewed 25 as improving the country’s business environment and viewed 2 as hurting it. Of the 27 reforms, 6 were in the category of starting a business.

Figure 3. Business Reforms since 2009



Source: World Bank Doing Business. <http://www.doingbusiness.org/reforms/overview/economy/Ukraine>

Ukraine reformed its business registering procedures, decreasing the number of procedures to start a business. In 2016, the government amended the Law of Ukraine ‘On state registration of legal and physical entities - entrepreneurs and civil organizations’ (U.S. Department of State 2016). This amendment modified the business and property registration system (U.S. Department of State 2016). As a consequence of reforms, Ukraine ranks 20th (out of 190 countries) with respect to ease of starting a

³⁰ <http://www.doingbusiness.org/data/exploreeconomies/ukraine>.

business.³¹ Similarly, Ukraine has also consistently improved in the area of property registration, currently ranking 63rd, up from 88th in 2014.

While these reforms are positive, additional reforms are needed. Ukraine ranks 115th in trading across borders, which indicates entrepreneurs face barriers in doing business across borders. Additionally, the country ranks 140th and 130th overall in terms of dealing with construction permits and getting electricity, respectively. Both of these factors impinge on entrepreneurs' capacity to obtain basic resources needed to run their business.

Rule of law is another key issue. As with existing Ukrainian companies, as discussed earlier, corruption hurts entrepreneurs. In the World Bank's 2013 enterprise survey on Ukraine, 15 percent of companies indicated that corruption was a challenge, versus 3.4 percent in Poland, 1.4 percent in Belarus, 0.9 percent in Latvia, and 2.6 percent in Romania.³² Transparency International stated that only 32 percent of private and public companies in the country abide by transparency and accountability principles (Transparency International 2017). Bribes and other corrupt practices are common and inhibit growth (Friedrich Naumann Foundation for Freedom 2014). Corruption often is linked to the government's business supervision practices. State authorities create specific requirements for businesses and undertake regular inspections to see if entrepreneurs are abiding by these requirements. According to the Friedrich Naumann Foundation for Freedom, both the number of authorities dealing with business supervision and the number of inspections per company are notably above the international averages (U.S. Department of State 2016). In addition to imposing administrative burdens on entrepreneurs, this practice also facilitates corruption as inspectors can more easily blackmail companies (U.S. Department of State 2016). There is also a lack of confidence in the independence of the judiciary system.

To combat corruption, the government formed the National Agency for the Prevention of Corruption (NAPC) in 2015. In 2016, the Ukrainian parliament approved the legislative amendments to oblige government officials to file electronic declarations and introduced criminal responsibility for providing false information. As of February 2015, Ukraine also has an e-procurement system that improves transparency in public spending and is intended to reduce corruption by eliminating or minimizing human involvement in the tender process (U.S. Department of State 2016).

Another aspect of the environment for entrepreneurship is the tax structure, which has very low tax rates (5 percent) for self-employed people. As a result, many businesses are structured to use contractors rather than employees, although in many cases, they essentially function as employees and receive some employee-like benefits. This encourages self-employment, but may discourage companies from growing, at least with respect to hiring employees.

As noted in the previous section on the innovation environment for existing companies, IP laws are adequate but the implementing institutions are weak.

In response to this environment, entrepreneurs, especially those seeking to sell their products or services to international markets, form their companies in other countries that have less corruption and a stronger rule of law.³³ They then outsource services from individual contractors in Ukraine, taking advantage of the low tax rates for self-employed individuals. This system is a workable response to the weak governance and rule of law in Ukraine, but it prevents Ukraine from capturing the full benefits of startup companies.

³¹ World Bank Doing Business website. <http://www.doingbusiness.org/data/exploreeconomies/ukraine>.

³² World Bank Enterprise Survey, 2013.

³³ Based on interviews with several entrepreneurs and venture capitalists in Kiev, April 2017.

They also protect their IP outside of Ukraine (often by filing a provisional patent in the United States, which offers a low-cost way to establish an early filing date and allows the company to file a full patent within a year). For entrepreneurs with first-to-the-world technology, their largest initial markets are likely to be in the United States and Europe, and so, patent protection in these markets is more important than in Ukraine.

Finance

Funding is a critical resource for any private enterprise, particularly ones that hope to grow. Access to finance is often cited as a barrier to growth for young companies. Many organizations, including commercial banks, angel investors, venture capital (VC) funds, and private equity funds potentially contribute to financing entrepreneurial firms.

Financing for entrepreneurship is low in Ukraine compared to other countries, and many SMEs believe lack of financing is a barrier to their growth. On the other hand, venture capitalists operating in Ukraine suggest that the key issue is the lack of fundable investments. They believe that ample money is available for good investment opportunities. At least some entrepreneurs, whom we interviewed, have had little difficulty in finding funding.

According to a variety of international indicators, financing for entrepreneurs and SMEs is tight. As indicated in table 8, loans are less available, interest rates are higher than in benchmark countries, and VC is not available. This deters many entrepreneurs from accessing capital (Baiashvili and Frewer 2016).

Indicator Name	Unit	Ukraine	Germany	Russian Federation	Latvia	Belarus	Poland	Romania
Lending interest rates^a	% interest rate	14.8	4.6	8.3	3.69	n.a.	n.a.	n.a.
Venture capital availability	Ranking	123	21	87	79	n.a.	82	125
Ease of access to loans	Ranking	112	15	115	90	n.a.	44	110

Source: World Economic Forum Global Competitiveness Report 2016–2017.

Note: a. World Development Indicators 2017;

With respect to financing of SMEs in general, according to research from the World Bank and European Bank for Reconstruction and Development (EBRD), approximately 40 percent of SMEs in Ukraine state that access to financing is a moderate, major, or very severe obstacle. While over 60 percent of SMEs claim to need a loan, only 15 percent of small firms and 22 percent of medium-size firms have received bank loans or lines of credit.³⁴ The European Investment Bank (EIB) argues that these figures discourage other entrepreneurs from approaching banks to seek funding. Large numbers of SMEs that need a loan

³⁴ Ukraine Enterprise Survey: Country Highlights. National Bank of Ukraine, Business Outlook Survey, 2013. These results are derived from an in-house analysis of the World Bank/EBRD Business Environment and Enterprise Performance Survey (BEEPS) database, whereby SMEs are defined as companies with less than 100 employees.

(over 70 percent) get discouraged even before applying. SMEs identified high interest rates, excessive collateral requirements, and complex procedures as the main discouraging factors.³⁵

A combination of capital inadequacy, asset quality, and governance issues prevent many banks from lending. While the Central Bank is in the process of addressing these challenges, banks have minimal engagement with SMEs. As of July 2015, the banking sector consisted of 126 banks, 3 of which are state-owned (including EIB's partners Ukreximbank and Oschadbank). The state plays a significant role in the sector, especially following the recapitalizations in 2009. The number of banks decreased during 2014–2015 as the National Bank of Ukraine (NBU) declared more than 50 banks insolvent (Baiashvili and Frewer 2016).

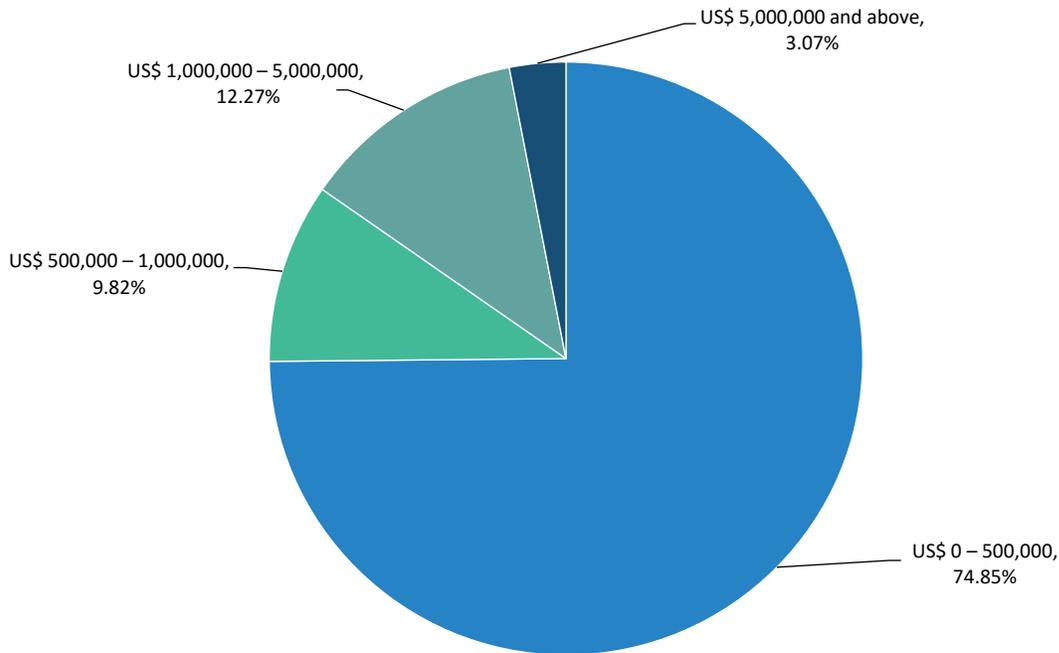
The access-to-finance challenges are also observed in Ukraine's foreign direct investment (FDI) barriers (International Finance Corporation 2014). An estimated 87 percent of small firms and 82 percent of medium-size enterprises stated that they are unable to attract foreign investment, increasing their reliance on domestic financing.³⁶ Foreign investors also face substantial challenges in accessing the Ukrainian market. Beyond legal barriers, foreign investors must contend with a lack of transparency and an uncertain regulatory environment in Ukraine. To that end, among Eastern Europe and Central Asia countries in the World Bank's Investing Across Sectors indicators, Ukraine's restrictions on foreign equity ownership are some of the most severe (World Bank 2010).

Financing for technology-based startup appears to be somewhat better. The Ukrainian Venture Capital and Private Equity Association (UVCA) investors book lists 5 incubators/accelerators, 17 venture funds, 1 corporate venture fund, 6 private equity funds, and 5 other organizations, including the EBRD and an angel investors network (UVCA 2017). These include both Ukrainian investment funds that operate internationally, as well as foreign-based funds that operate in Ukraine. Similarly, Crunchbase data show that there are at least 15 angel investors and 18 funds or firms with VC funds operating in the country (see appendix I). Since 2009, there have been at least 195 investments made in Ukrainian start-ups. As shown in figure 4, nearly three quarters of these investments were under US\$500,000, suggesting that most are early stage investments (although due to the lower cost of operating in Ukraine, investment funds go much further than in the United States).

³⁵ Ukraine Enterprise Survey: Country Highlights. NBU, Business Outlook Survey, 2013. These results are derived from an in-house analysis of the World Bank/EBRD BEEPS database, whereby SMEs are defined as companies with less than 100 employees.

³⁶ Ukraine Enterprise Survey: Country Highlights. National Bank of Ukraine, Business Outlook Survey, 2013. These results are derived from an in-house analysis of the World Bank/EBRD BEEPS database, whereby SMEs are defined as companies with less than 100 employees.

Figure 4. Breakdown of Investment Sizes



Source: Crunchbase investment numbers, 2017.

From our discussion with entrepreneurs and venture capitalists, three points emerged. First, enterprising entrepreneurs with good ideas in Ukraine are able to get access to capital. International capital is always looking for good investment opportunities, and networks exist that give Ukrainian entrepreneurs the opportunity to get their ideas presented to potential funders. Due to the exchange rate and salaries in Ukraine, good ideas from Ukraine can be very attractive investments. The entrepreneurs we met with said they were able to get funding from a variety of sources, including international accelerators, Kickstarter, and seed funds.

Second, from the point of view of venture capitalists, the problem is not a lack of funding but a lack of good deals to fund. They believe Ukraine needs more programs to encourage people to be entrepreneurs and to provide the basic skills and seed funding to expand the number of ideas that get developed into companies.

Third, a requirement of international finance is often to establish in a country outside of Ukraine. Investors want their money in countries that have strong, predictable, and reliable legal and financial institutions. They also want the companies to have a strong presence in their leading markets, which are more likely to be the United States and Western Europe, rather than Ukraine. Thus, financing is available, but the consequence is that the companies will not be headquartered in Ukraine.

Markets

For entrepreneurs to succeed, they need access to customers—consumers, other firms, and the government—that seek innovative products and services. Ideally, these markets will be local and domestic—it is easier to produce innovative products that meet customer needs if one has close links to

those customers, and it is easier for entrepreneurs to get products to the market if they do not have to meet the requirements of international trade. However, if domestic markets are not favorable, it is essential that entrepreneurs gain access to international markets.

As one of the largest countries in Europe, with 44 million people, Ukraine potentially has a sizable domestic market. However, its relatively low GDP per capita and weak economy mean that there is relatively little disposable income for buying innovative products and services.

Markets vary by industry, and this study did not look in detail at specific industries. As noted in the section on existing industry, some general characteristics of Ukraine's economy and industry are not highly supportive of providing markets for entrepreneurs:

- The general (and increasing) orientation of the Ukrainian economy toward producing commodity materials and agriculture means that the economy is growing in sectors that are relatively less innovative and thus provides fewer opportunities for entrepreneurs.
- Weak competition policy and the dominance of state-owned companies (or large, formerly state-owned companies) makes it more difficult for startups to break into many markets. The lack of innovation of state-owned companies means they are not avid consumers of new technology and do not provide a good market for innovative startups.
- The government does not have procurement or R&D policies that favor startups (such as small business contracting preferences or a small business research program).

With respect to participation of Ukrainian companies in international markets, as noted before in the section on innovation in existing Ukrainian companies, regulations can be a barrier for entrepreneurs to export. Technical regulations that were harmonized with the former Soviet Union but not the EU prevent selling of certain products in the EU.

Given the limitations of the Ukrainian market, many Ukrainian entrepreneurs, especially in IT-related areas, see their markets as international rather than in Ukraine. We had discussions with several Ukrainian entrepreneurs who saw the United States as their initial market, due to both the size of the market and the receptivity of customers to innovation, and consequently, they typically set up marketing and business operations in the United States. U.S. funds and accelerators such as Garage Technology Ventures and Y Combinator have supported Ukrainian entrepreneurs. Additionally, support organizations in Istanbul and London have welcomed Ukrainian start-ups while other young companies have already accessed foreign markets such as Poland, Malaysia, Singapore, Moldova, Switzerland, Norway, Germany, Austria, Netherlands, and Italy. Similarly, according to PwC, Ukrainian IT companies played a significant role in developing blockchain technology enterprises throughout the world.

Yevgeny Sysoyev, managing partner of Ukrainian fund AVentures, estimated in 2014 the Ukrainian technology industry market to be about US\$5 billion, divided among outsourcing, R&D centers of global companies, and e-commerce (Satell 2014). Sysoyev also pointed to a growing population of software development firms that created their business models on designing, building, and marketing their own products for the global market (Satell 2014). A common theme in Sysoyev's discussion of the Ukrainian start-up community is that, despite the country's tech competencies and given its small size, the majority of technology start-ups are forced to think globally from day one and primarily target global markets.

Culture

It is widely understood that a nation's or region's culture is an important part of the environment that promotes or restrains entrepreneurship. Some aspects of culture that are thought to be important are as follows:

- The extent to which being an entrepreneur is accepted and admired (relative to working in large organizations or established professions). For example, do parents support their children being entrepreneurs, or do they discourage them and push them into more conventional jobs?
- The extent to which people are allowed to try something and fail, learn from it, and try again. Is failure looked on as a valuable learning experience or as a permanent black mark against a person's reputation?
- The extent to which there are successful entrepreneurs who can serve as role models for potential entrepreneurs.
- The extent of social capital—the links, shared values, and understandings in society that enable individuals and groups to trust each other and thus work together.³⁷
- The extent to which society supports creative and unconventional activities in general (versus conformity).

For the most part, we do not have solid data on these characteristics in Ukraine. The following discussion is based on inferences from similar economies as well as observations from our interviews.

With regard to general attitudes to entrepreneurship, on the one hand, there are many microenterprises and self-employed individuals, but these may not represent a culture supportive of entrepreneurship. Many self-employed individuals are much like employees but with limited benefits and are categorized as self-employed for tax purposes (Friedrich Naumann Foundation for Freedom 2014, 28). Self-employment may represent not entrepreneurship but rather a lack of other employment options.

The relationship between the outsourcing industry, with its many self-employed technology workers, and entrepreneurship is mixed. On the one hand, some see the outsourcing industry as drawing talent away from true entrepreneurship, which would ultimately bring greater value. On the other hand, the outsourcing industry has provided jobs and developed skills for many technologists, and at least some of these may be later motivated to form their own companies (Degeler 2016; GoalEurope 2013).

While the Soviet Union generally suppressed private enterprise and entrepreneurship, it did not eliminate entrepreneurial behavior. The Soviet economy gave rise to a secondary, underground economy that was quite entrepreneurial (Shvarts 2010). State enterprise managers also needed to behave in entrepreneurial ways to acquire resources for their firms in the bureaucracy.

Successful entrepreneurs, especially the ones who have become wealthy through a successful exit (such as an acquisition or initial public offering), can help to attract others who want to become entrepreneurs. There have been a few role models of successful technology entrepreneurs in Ukraine. Jan Koum, co-founder of WhatsApp, and Max Levchin, the co-founder of PayPal, are both originally from Ukraine. Additionally, to date, Ukraine has had several small acquisitions, including Lookser, which was bought by

³⁷ This definition of social capital comes from "What Is Social Capital?" *OECD Insights: Human Capital*. OECD. Accessed online at <https://www.oecd.org/insights/37966934.pdf>, June 9, 2017.

Snapchat for US\$150 million, and Viewdle, which Google acquired for US\$30 million (Seedstars World 2016). While these deals have undoubtedly helped to spur interest in entrepreneurship and helped to bolster the ecosystem, more successes and recognition of this success can be expected to support the development of an entrepreneurial culture.

Social capital is important to support entrepreneurship because entrepreneurs must work with—and often need help from—many people outside of their family or organizational structures. One of the often-cited reasons for the success of Silicon Valley is the willingness of people to help others through networking and advice (Hwang and Horowitz 2012). Ukraine is generally viewed as being low in social capital (Gatskova and Gatskov 2012), primarily due to the destruction of civil society in the Soviet era. While this may be true in general in Ukraine, our impression from our interviews is that members of the entrepreneurial community in Ukraine are very willing to assist others.

Other studies have noted that other characteristics of former communist countries are adverse for entrepreneurship, with workers tending to be more interested in job security and avoiding uncertainty, more likely to reject control and responsibility for work, and tending to show less initiative (Frese 1995). Similarly, the cumbersome process for closing businesses increases the consequences of a failed business and can deter entrepreneurs from taking the risk of starting a business. As noted earlier, the Global Innovation Index ranks Ukraine near the bottom of all countries (113 out of 128 countries) in ‘ease of resolving insolvencies’,³⁸ and IFC has noted this as a challenge for entrepreneurs (IFC 2014). This contributes to the overall culture of risk aversion.

The culture of corruption may hurt entrepreneurship in several ways. Entrepreneurs may fear that the fruits of their work may be lost to corruption, either from payments for bribes, or hostile takeover of the company by other firms that may have improper relationships with government. The fact that there are prominent examples of people having become rich through government connections and acquiring government assets and in some cases through corruption rather than through innovation-based entrepreneurship may encourage people toward the former rather than the latter.

The prevailing culture in Ukraine does not seem to be overly favorable toward entrepreneurship although there are pockets of support. This suggests that active measures are needed to support entrepreneurship through training, support programs, and communications of successes.

Human Capital

Ukraine has both strengths and weaknesses with respect to human capital for technology entrepreneurship. On the positive side, as noted previously, Ukraine has a large population of individuals with strong education in math, science, and engineering and a large number of people who have developed IT skills and are working as IT professionals. As IT-related fields are promising for entrepreneurship (for such reasons as low capital costs, high rates of technical change, and ease of access to both information and global markets), this is particularly advantageous for entrepreneurship in Ukraine. The IT outsourcing industry and the expanding number of multinational technology firms that have opened R&D or technology centers in Ukraine are further evidence of the country’s talent pool. In addition to the large pool of technical talent, the exchange rates and wages mean that technological talent

³⁸ Global Innovation Index 2016. “Ukraine.”

in Ukraine is less expensive than many other countries, including Russia or Poland (Satell 2014). This means that it is less expensive to start IT companies using Ukrainian talent than elsewhere.

In addition, on the positive side, a few universities are supporting start-ups. Data from Crunchbase shows that students from KPI and Taras Shevchenko National University of Kyiv have founded at least 80 companies, which account for about 40 percent of all companies founded by alumni in Ukraine on the Crunchbase database. Additionally, Dnipropetrovsk National University, Kyiv National Economic University, and National University of Kharkiv account for another 17 percent of companies created by alumni. While the Crunchbase figures are not exhaustive or representative of the complete level of university entrepreneurship in Ukraine, the fact that five universities are responsible for over 50 percent of companies founded by alumni in this data set suggests that a few, but only a few, of Ukraine's universities are effectively supporting entrepreneurship.

There are also several weaknesses regarding human capital for entrepreneurship in Ukraine. First, although math and science skills are strong, university training needs to be better. Universities, with few exceptions, are not up to date in the fields and do not provide the IT training that industry needs. Many IT people have math or science backgrounds, but are essentially self-trained in IT. Some higher-level skills needed for senior software developers are lacking. IT developers also need a better understanding of business needs. Interviewees strongly believed that universities need major reform to provide better education in all fields, but specifically in fast-moving IT fields.

Second, business and management skills needed for entrepreneurship are weaker than technology skills, and only a few universities actively promote entrepreneurship. Interviewees noted that skills in marketing are hard to find in Ukraine. Financial skills are also needed. According to European Investment Bank research, banks hesitate to lend to entrepreneurial ventures due to entrepreneurs' lack of financial literacy. Simultaneously, absent financial literacy, entrepreneurs do not understand the full range of funding options from which they could benefit from and how to best work with banks and other financial entities to obtain them (EIB 2016). Other studies have pointed out to a broader lack of managers and managerial talent in Ukraine, which affects firms of all sizes and industries (Fuxman 2004).

Third, as noted above, while a few universities encourage entrepreneurship, most do not. University support for entrepreneurship may affect the number of students seeking to be entrepreneurs. The venture capitalists we interviewed believed there needed to be a much greater deal flow based on the amount of talent in Ukraine. Many more people could be encouraged and given the training to start companies, and this would increase the number of companies that VCs would be able to fund.

Finally, Ukraine struggles with both retaining its own human capital and in bringing foreign talent for specialized skills. In the World Economic Forum's 2016–2017 Global Competitiveness Report, Ukraine placed 127th out of 138 countries in retaining talent and 93rd at attracting talent. In our interviews, many people noted that the entrepreneurs are encouraged to relocate their companies outside of Ukraine and that many IT professionals and others are seeking to move to other countries (especially Poland) where wages may not particularly be higher but that there was a sense that the future may be brighter and the government was working better.

Supports

The 'supports' element of the entrepreneurship ecosystem includes supporting institutions and programs specifically for entrepreneurship, such as incubators and accelerators, as well as more general

infrastructure (transportation and communications) that may be needed for successful startup companies.

In the first category, Ukraine has a small but growing number of accelerators, incubators, events, and co-working spaces. Currently, accelerators and incubators total 10 in Ukraine, and there are at least two co-working spaces in the country (GoalEurope 2013). Of the most active accelerators in Ukraine, two are EastLabs and Happy Farm incubators, which had made a total of 47 investments between them as of 2016, according to Crunchbase. Both institutions adhere to standard accelerator models, with EastLabs offering four months of incubation, financial capital, networking opportunities, and mentorship. Happy Farm specializes in mobile, gaming, social networking, and Software as a Service (SaaS), offering each start-up US\$15,000 and advisory services (Gani 2015).

Additionally, Kiev is home to several events that attract major players in Ukraine’s entrepreneurship ecosystem. For example, IDCEE (Investor’s Day Central and Eastern Europe) is a yearly investment conference, for investors, executives, and entrepreneurs (Gani 2015). Likewise, iForum is one of the largest conferences in Ukraine, drawing over 5,000 people and a number of international corporations and local start-ups (Gani 2015). Lastly, Seed Forum Ukraine, part of the global Seed Forum network, convenes incubators, accelerators, universities, the government, and large ICT corporations in the country. Currently, the forum has built a network of 3,000 entrepreneurs, 270 SMEs/start-ups, and 1,000 ICT experts (Gani 2015).

The co-working spaces include KvivWorking, an initiative created by Startup Ukraine, which provides workspace, office equipment, conference rooms, and networking opportunities. Additionally, iHUB (Innovation Hub) offers start-ups a professional environment to work in and an opportunity to network with its global network across 40 countries (Gani 2015).

Figure 5. Organizations Supporting Entrepreneurship in (Number of Organizations Created Annually)



Source: Data compiled from Baiashvili et al 2016, Degeler 2016, EIB 2016, Friedrich Naumann Foundation for Freedom 2014, Gani 2015, GoalEurope 2013, Satell 2014, and Crunchbase (Crunchbase.com).

Figure 5 shows the number of entrepreneurship support organizations created in Ukraine each year since 1991.³⁹ It indicates a substantial increase in the number of new such organizations since 2010, and suggests a substantial development of the entrepreneurship ecosystem.

The success and effectiveness of many of the support institutions to date is not yet clear, nor is the extent to which the existing organizations meet the need, or potential need, for their services. At least some of our interviews suggested that the potential exists to substantially increase the training and support for entrepreneurs. In addition, most of the existing support organizations cater to IT-focused companies, and there appears to be relatively little support for entrepreneurs in other businesses.

³⁹ Figures reflect the number of organizations supporting entrepreneurship that were founded in the indicated years, based on online research. We define “organizations supporting entrepreneurship” to include incubators, accelerators, venture capital funds, angel investment networks, science and technology parks, co-working spaces. The numbers may not include some less visible organizations.

Innovation Ecosystem for Multinational Companies in Ukraine

Overview

Attracting FDI is an important aspect of a country's innovation strategy. FDI, in addition to bringing in capital needed for innovation, usually brings with it new technology (such as manufacturing equipment) and skills. These may include technical production skills as well as managerial skills and knowledge of the requirements for operating in international markets. Foreign investments in research, through both company R&D centers as well as investments in universities and research institutes, can help expand the innovative capacity of the country by training and providing employment for scientists and engineers.

Ukraine has some assets to attract innovative foreign companies. These include its large, well-educated workforce, especially with respect to ICT skills, and, at current exchange rates, relatively low wages. However, there have also been serious barriers to investments by foreign companies, particularly with regard to corruption and weak legal institutions. As a result, the potential of FDI to encourage innovation remains largely untapped (Schuch et al 2016). This section looks at the environment for foreign investment in areas that can contribute to innovation in Ukraine.

Data on FDI in Ukraine are complicated by several factors. The events of 2014 in east Ukraine and Crimea both discouraged foreign investment and limited data on those parts of the country. The conflict with Russia and the increased interaction with the EU have changed the patterns of trade. The depreciation of the hryvnia also affects FDI statistics. Much of what shows up in government statistics as FDI in Ukraine comes from Cyprus or other countries, where it is thought to not be genuine foreign investment but rather domestic investments that have been routed through third countries for tax reasons (known as 'round tripping'). Moreover, as discussed previously, there may be substantial foreign expenditures on technology development in Ukraine that take the form of services provided by individual Ukrainian contractors to foreign entities (at least some of which are firms established by Ukrainian entrepreneurs outside of Ukraine). As a result of all of these factors, FDI data in Ukraine may not provide a consistent or accurate picture of the technology-related investments by foreign entities.

Regarding overall levels, FDI in Ukraine is low compared to the top-attracting FDI countries, such as Hong Kong (China), Luxembourg, Mozambique, or Ireland, whose FDI inflows in 2013 ranged between 20 percent and 50 percent of the national GDP. In Ukraine, in the same year, FDI was only 2.13 percent of GDP (Schuch et al 2016, 20). In 2012, Multinational enterprises (MNEs) from the EU employed about 200,000 people in Ukraine, while MNEs from the United States employed an estimated 26,000. One area where foreign-owned enterprises dominate is mobile telephony (OECD 2016).

Funding for innovation in industry from foreign investors in 2014 was only 2 percent, a significant drop compared to 2013, as shown in table 9.

Table 9. Financing of Innovation from the Foreign Sources in 2000–2014⁴⁰

Year	% of Total Financing of Innovation in Industrial Sector
2000	12.4
2010	30.0
2013	13.2

⁴⁰ Financing of innovation in Ukraine. Presentation by Professor Igor Yegorov at the 9th session of the Team of Specialists on Innovation and Competitiveness Policies, UNECE, Geneva, 3–4 November 2016.

The share of foreign investments in R&D in Ukraine has also dropped, but to a lesser degree, from a high level of about 25 percent of GERD in 2010–2013 to 19.8 percent (UAH 2.2 billion) in 2014 (Schuch et al 2016). However, this share of foreign investments in Ukrainian R&D is still relatively high compared to the other Eastern Partnership (EaP) countries.

Industry and Market Structure

Ukraine, with a population of 45 million, has a significant market, and this encourages some foreign companies to invest in innovation to meet the needs of the local market. For example, international food companies adapt products for the Ukrainian market.⁴¹

In general, the industrial structure of Ukraine has not been favorable to technology-related FDI. As noted previously, high- and medium-technology industries have been shrinking as trade has shifted from Russia, which imported Ukrainian technology goods, to Europe, which imports mostly commodity metals and food from Ukraine. Similarly, FDI is concentrated in areas that are not R&D intensive. Financial services (26.5 percent) and manufacturing (26.2 percent) together account for 53 percent of the total inward FDI stock, with trade and repair representing an additional 13 percent. Metallurgy accounted for half of the total FDI stock in manufacturing (12.2 percent of the overall FDI stock). Food processing also has a significant share. Despite the country's comparative advantage in agriculture, this sector has a very modest share of the total FDI (1.3 percent).

An area where there is substantial multinational presence is IT. Ukraine has a large and growing population of multinational technology companies. According to figures published in the *KyivPost*, Ukraine's IT industry is worth over US\$5 billion, with over 500 outsourcing companies, 50,000 engineers, and 100 global R&D centers (Gani 2015). Samsung, Boeing, Oracle, Magento, and Ubisoft, among others, have all created R&D centers in Ukraine. Approximately 45 percent of these corporations have headquarters in the United States, with the others having their homes across four different continents (Dev-Pro.net 2016). The Samsung R&D Institute Ukraine had a staff of over 1,000 employees in 2013 and planned to expand to 2,000. Boeing's design center in Kiev employed more than 200 people in 2013 (Alexandrova 2017).

Leadership, Governance, and Policy

Barriers to FDI in Ukraine include unstable institutions, uncoordinated policies, and inadequate business conditions. According to a European Business Association (EBA) Survey,⁴² foreign investors believe that the biggest obstacles for investment in Ukraine are widespread corruption (average score - 8.5 points out of 10 possible) and lack of trust in the judiciary (7.5 points). The military conflict in the east (6.1 points) and unstable currency and financial system (6 points) were the next most highly ranked obstacles. Among the most positive actions that the Government of Ukraine could take to attract foreign investment, survey respondents mentioned relaunching the judiciary by vetting existing members and hiring new judges (average score - 7.6 points out of 10 possible) and the prosecution of large numbers of high-level officials

⁴¹ Interview with Nestlé. April 2017.

⁴² "Dragon Capital and the European Business Association Survey Results." Accessed online on June 26, 2017.

http://www.dragon-capital.com/en/about/media/press_releases/corruption_and_lack_of_trust_in_the_judiciary_in_ukraine_are_the_largest_obstacles_for_foreign_investors.html

and judges for corruption (7.4 points). At the same time, the third most highly ranked government actions are ensuring the International Monetary Fund (IMF) program remains on track and liberalization of foreign exchange controls (including canceling the dividend repatriation ban)—both received a score of 6.2 points.

A recent OECD study also pointed to corruption, the ongoing conflict in the Donbas region, political instability, capital-account restrictions introduced to stabilize the exchange rate, weak competition/anti-monopoly policy, and tax policy that puts high burdens on the formal sector relative to the informal sector as major barriers to investment (OECD 2016). State involvement in the economy also deters foreign investment (IFC 2014). For example, in 2010, the government created the State Food and Grain Corporation, which secured state control over domestic food prices and grain export quotas, which has discouraged FDI into the agricultural sector. The government is also known to show favoritism toward domestically produced equipment, which again deters both foreign competition and investment (IFC 2014).

Our interviews with multinational companies in Ukraine supported these views. Interviewees pointed to lack of confidence in anticorruption measures and noted the risk of government confiscation of property (a concern highlighted by a government raid on Dragon Capital, a company we interviewed, during the mission). Some international IT firms are not investing due to concerns about freedom of speech/press and overly intrusive cybersecurity policies.

OECD also noted the progress Ukraine is making to improve the investment climate (OECD 2016). In 2016, Ukraine was invited to become the 47th adherent to the OECD Declaration on International Investment and Multinational Enterprises. This indicates Ukraine's commitment to work toward improving integration into the world economy and promoting responsible business conduct. In the past few years, Ukraine has made significant progress in improving its investment policy framework, including adopting the principle of nondiscrimination of foreign investment, including general provisions on foreign investment protection, simplifying establishment and licensing procedures, and increasing transparency (OECD 2016). Ukraine has also recently undertaken policy reforms in many of the areas covered by the OECD Guidelines for Multinational Enterprises (Guidelines), including human rights, labor rights, consumer protection, and corporate governance.

A study by Akholi Research (Hatch 2016) concluded that until Ukraine resolves ongoing corruption and IP protection risk, Ukraine will not be able to materially develop high-tech and high-value manufactured goods exports. It noted that the ICT service development and exports are less affected by these factors and can continue to expand in the present environment.

Access to Knowledge and Technology

Due to the long-term decline in research institutions, described in previous sections, technology capabilities in Ukraine are not the main attractions for FDI. As mentioned above, some multinational firms have set up software development labs in Ukraine, but for the most, the attraction is the human talent and the relatively low costs rather than the knowledge or technology. Some foreign companies, including Samsung, Boeing, and Siemens, are also investing and collaborating with Ukrainian universities. There has also been some foreign investment in aerospace, drawing on capabilities developed in the Soviet era. For

example, the Ukrainian Research Institute of Aviation Technology received funding from Russia, China, the Islamic Republic of Iran, the Czech Republic, Poland, France, and others.⁴³

Human Capital

The availability of a large, well-educated workforce at a relatively low cost is an attraction for FDI, as is demonstrated by the number of technology firms that have set up office and labs in Ukraine and the amount of IT outsourcing. Foreign companies in areas outside of IT are also able to find adequate talent.⁴⁴ There is recognition of strong basic math and science education in Ukraine, as well as problem solving skills. At the same time, the lack of top research universities and the decline of Ukrainian research institutes means that Ukraine is not viewed as a place to find top researchers.

⁴³ Ukrainian Research Institute of Aviation Technology. August 2, 2012.
http://www.ukrniat.com/index.php?option=com_k2&view=item&id=453:ukrainian-research-institute-of-aviation-technology&Itemid=546&lang=en Accessed online on June 26, 2017.

⁴⁴ Based on interviews with multinational companies. Kyiv, April 2017.

Conclusions and Next Steps

This assessment of the innovation and entrepreneurship ecosystems of Ukraine shows that Ukraine has some positive aspects and substantial potential for innovation and also many challenges. The main strengths are the high education levels and strong math and science skills, which are attracting IT work, in the form of outsourcing, R&D centers of global companies, and new software companies. Entrepreneurship is expanding, and many entrepreneurs are finding ways to sell to international markets.

Market conditions in agriculture and basic industries are driving growth and exports. While these are not considered high-technology industries, there is substantial potential for innovation and technology to improve productivity and competitiveness of these industries. The combination of high skills, low costs at current exchange rates, and increasing connections to European markets should drive growth and investment in a number of industries where innovation can improve productivity and living standards in Ukraine.

However, Ukraine faces substantial challenges. One main challenge is the need for government reform. Corruption, excessive and poorly designed regulations, lack of effective rule of law, lack of implementation of programs, and frequently changing governments and policies all create a large drag on business, prevent effective government-industry collaboration, and serve as barriers to innovation, foreign investment, and trade. The weaknesses in government have also made effective innovation policies impossible.

The second main challenge is industrial structure. As trade has shifted from the former Soviet countries to western Europe, manufacturing industries have declined in favor of agriculture and commodities, leading to less demand for R&D and innovation. The legacy of SOEs has led to non-innovative companies and a lack of domestic competition, which is a stimulant to innovation. As a result of these features, demand for enterprise innovation is low.

The third main challenge is the need for reform in key institutions that are critical for innovation: higher education and research institutes. Universities are of prime importance because of their role in education, transfer of knowledge, and entrepreneurship. In many countries, universities serve as the anchor institutions of innovation ecosystems, generating ideas through research and transferring knowledge through the training and graduation of students. Although Ukraine's overall strong education in math and science is a plus, Ukrainian universities are not research intensive, are not well connected to current industry needs, and are not current in their curriculum or teaching styles.

Public research institutes are a more difficult problem. Government laboratories in many countries, even when they are well funded, often have challenges in contributing to innovation due to weak linkages to industry and poor technology commercialization mechanisms. Ukraine's public research institutes consume a large portion of national funds allocated for R&D, have aging staff and facilities, and are not well matched to Ukraine's current industrial needs.

These challenges suggest that Ukraine has major systemic and structural issues to address to develop a well-functioning innovation and entrepreneurship (I&E) ecosystem in the long term. These include

- **Broad governance reform**, including reducing corruption, restoring trust in government, reforming the judiciary, improving regulations, and other institutional areas;

- **Addressing issues of industrial structure**, including strengthening competition policy, reforming SOEs, supporting SMEs, and supporting technology-based industries through cluster policies or ‘smart specialization’; and
- **Fundamental reforms of public research institutes and universities**, including reforming the NASU and piloting targeted programs that could bring research activities closer to the needs of local industries (for more details on reforming the NASU, see Ukraine’s STI Public Expenditure Analysis Report recommendations).

Reforms in each of these areas are critical for innovation and also for the overall performance of the private sector and the investment attractiveness of the country. Developing comprehensive solutions to each of these issues is beyond the scope of this report, and there are already efforts under way in most of these areas, by the EU, the World Bank, and other development organizations.

Second, the report suggests some areas where shorter-term and more targeted interventions can improve Ukraine’s I&E ecosystem. Previous reports on innovation in Ukraine led to numerous recommendations but little sustained implementation, often due to lack of commitment or of budget allocated for programs. Thus, this report focuses instead on a narrower innovation agenda that is intended to be implementable. The goal is to provide sustained attention to removing barriers to innovation and to build on programs that are already working to create momentum toward further reforms. The suggested actions could fall into the following categories:

Strengthen Innovation Leadership and Coordination

Although innovation is critical to Ukraine’s future—ultimately determining the productivity of the economy and Ukraine’s standard of living—currently, there is no institutional focus on innovation in Ukraine’s government. Actions that affect innovation are spread throughout many ministries and public institutions, and there is a lack of coordination and advocacy within the government for actions to remove barriers to innovation and improve industrial competitiveness.

Ukraine should have an innovation agency that

- Develops, advocates, and publicizes a national vision of an innovation-based economy;
- Serves as platform to (a) channel the voice of industry regarding identifying and removing barriers to innovation on the sectoral and horizontal levels and (b) advocate for innovation-related reforms, including steps to reduce corruption, implement reform regulations, support entrepreneurship, and expand public and private R&D expenditures and collaborations;
- Identifies working I&E programs and scales them up in coverage and magnitude through technical and financial support; and
- Design, administer, and implement pilot support programs targeting enterprise innovation and entrepreneurial activities.

This agency should work closely with industry groups to understand what the industry needs to succeed in innovation and should work closely across ministries of the government to remove barriers to innovation and to implement innovation support programs. Importantly, it should work to earn the trust of the industry—the low current levels of trust between the industry and the government constitute a major barrier to effective innovation programs. As various government policy changes are considered, the innovation agency should ensure that the reforms have industry input regarding how the reforms would

affect innovation and the competitiveness of firms. The agency should provide continuity in government innovation reform efforts in contrast to the current disintegrated approach. It should advocate for sustainable budgets for innovation programs and advocate for competition policy, universities, and public research institutions reform.

Identify and Scale up Working Approaches

Given the uneven record of previous discontinued initiatives, we suggest a modest near-term strategy of building on initiatives that already appear to be working. The following is a non-exhaustive list of potential focus programs:

- **Expanding entrepreneurship support programs, such as building on the Science Park and entrepreneurship programs at KPI.** Our interviews suggested a strong potential and need for expanding the pipeline of new companies. Expanded entrepreneurship support programs targeting investment readiness of start-ups, including training programs, seed funds, incubators/accelerators, business plan competitions, and mentoring, could have an immediate impact. Building on the successful programs in universities can also be expected to support reforms and culture change at universities.
- **Building on and expanding regional cluster programs.** Regional strategies involving local government, industry, and universities approaches can develop strong regional innovation ecosystems. Often, effective industry-government-university collaboration is easier to build at the regional level than at the national level. The IT cluster in Lviv may be a good model to scale into other regions and industries. The EU-supported regional smart specialization strategy is a useful way to proceed with such programs.
- **Addressing the identified and immediate needs of already growing and leading sectors.** For example, the IT and agriculture industries have been growing and exporting but have identified research, educational/training, and logistical needs for improving productivity and competitiveness. The envisioned agency and/or the respective ministries could take the lead on working throughout the government bodies to remove the barriers and address these immediate needs.

Pilot New Innovation Support Programs

In addition to the immediate roles articulated above, the innovation agency could design, administer, and implement pilot support programs to innovative enterprises and start-ups to scale up and grow. Currently, there are few, if any, public support programs (other than European or donor-supported programs) that innovative Ukrainian enterprises could apply and compete for. The pilot programs, such as innovation vouchers, innovation grants, and research collaboration grants, to name a few, could follow or adapt models implemented in several benchmark economies and learn from countries' experiences in setting up, implementing, and monitoring such programs. The ability of this new agency to lead such pilots depends on the level of competence of its staff, access to financial and technical resources, its degree of autonomy, and the commitment of the government to the innovation agenda, to name a few.

The World Bank team, through the Innovation Support project, has been providing technical support to the MEDT and the Reform Delivery Office in the context of designing and setting up such an innovation agency (currently labeled as the Innovation Development Office) based on a request from the Prime Minister's Office. The mission, governance and institutional structure, areas of focus, and pilot support programs are all currently under consideration by the main stakeholders. This report helps make the case

for such an agency and its missing role in supporting enterprise innovation but intentionally holds back from prescribing the details of the institution and its programs. The details of these programs will be developed with stakeholders as a next step.

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Appendix I. List of Interviewees

PUBLIC SECTOR STAKEHOLDERS

Presidential Administration Office

Parliament Committees/Committee for Industrial Policy and Entrepreneurship and Committee for Informatization and Communications

Reform Delivery Office under the Cabinet of Ministers of Ukraine

Ministry of Economic Development and Trade of Ukraine

Ministry of Education and Science of Ukraine

Ministry of Finance of Ukraine

State Agency for E-Government of Ukraine

National Academy of Sciences of Ukraine (NASU)

Institute of Biochemistry, NASU

Institute for Economic Research and Policy Consulting

INTERNATIONAL DONORS

Delegation of the EU to Ukraine

European Bank for Reconstruction and Development/SME Finance and Development Group

European Commission/Support Group for Ukraine

Swedish International Development Cooperation Agency (SIDA)

PRIVATE SECTOR COMPANIES, NETWORKS, AND ASSOCIATIONS

1. ARTKB, www.artkb.net
2. Almaz Capital, <http://www.almazcapital.com/>
3. Association of Pharmaceutical Research and Development, <http://aprad.org.ua/>
4. Avatar, www.avataragro.com
5. AVentures, <http://aventurescapital.com>
6. Biofarma www.biofarma.ua
7. Business Accelerator GrowthUp, <http://growthup.com/en/>
8. Cardiomo Care, Inc, <http://cardiomo.com/>
9. Chumak, <http://www.chumak.com/>
10. Ciklum, <https://www.ciklum.com/>
11. CLUST-UA: Ukrainian Cluster Development Agency, www.clust-ua.org
12. Coworking "Platforma," <http://coworkingplatforma.com/>
13. Distributed Lab, <https://distributedlab.com/>
14. Dragon Capital, <http://www.dragon-capital.com>
15. European Business Association (EBA), IT Committee, <http://www.eba.com.ua/>
16. Google Ukraine
17. High-Tech Office, www.ht-office.org

18. Hushme, <http://gethushme.com/>
19. KM Core – International Hi-Tech Holding/Borsch Ventures Agro, <http://www.kmcore.com/ru;>
<http://borschventures.com/>
20. Kyiv School of Economics, www.kse.org.ua/
21. Luxoft, <https://www.luxoft.com/>
22. National Development and Innovations Foundation, <http://www.ndif.org.ua/>
23. National University of “Kyiv-Mohyla Academy”/CP “Public Innovation Network of Ukraine,”
<http://www.ukma.edu.ua/>
24. Nestle Ukraine LLC, www.nestle.ua/
25. 1991 Open Data Incubator, <http://1991.vc/>
26. Petcube, <https://petcube.com/>
27. Portmone, <https://www.portmone.com.ua/r3/uk/>
28. PricewaterhouseCoopers, <http://www.pwc.com/ua>
29. Science Park “Kyivska Polytechnika,” <http://www.spark.kpi.ua/en>
30. Science Park “University of Shevchenko,” <http://scp.univ.kiev.ua/en>
31. Startup Network, www.startup.network
32. Ukrainian Alliance of Web Entrepreneurs
33. Ukrainian Business Angels Network, <http://uangel.com.ua/>
34. Ukrainian National IT Factory (UNIT), www.unit.ua
35. Ukrainian Venture Capital and Private Equity Association, <http://uvca.eu/>
36. VDNG Tech, <http://vdngtech.com/>

Appendix II. List of Ukrainian Intermediaries, Entrepreneurship Support Organizations, and Equity Investors

START-UP INCUBATORS AND ACCELERATORS

1991 Open Data Incubator http://1991.vc/	<p>1991 is the first noncommercial incubator in Ukraine that transforms state open data into start-ups.</p>
Polyteco Science City http://kpi.ua/en/polytecosciencecity	<p>Polyteco is based at the National Technical University of Ukraine (KPI). The incubator helps to create, launch, and commercialize new and innovative ideas of students, postgraduates, and young scientists from the university in the sphere of IT.</p>
Sikorsky Challenge Innovation Ecosystem https://www.sikorskychallenge.com/business-incubator/	<p>Sikorsky Challenge business incubator (part of Sikorsky Challenge Innovation Ecosystem) supports start-up projects at the start-up creation and seed investment stage and commercialization of the project.</p>
iHUB Incubator http://ihub.world/en/about-us/	<p>iHUB incubator offers start-ups education and skills, mentorship support, and help in getting investments and high-quality infrastructure so that the teams could focus on creating their own business and have everything they need to succeed. iHUB is supported by the Ministry of Foreign Affairs of Norway and operated by Seed Forum not-for-profit organizations.</p>
Platforma: Incubator and community of co-working http://coworkingplatforma.com/	<p>Platforma offers co-working space and other business development services, including law, IT, marketing, finance, education, and lifestyle.</p>
Happy Farm Business Incubator/Accelerator http://happyfarm.com.ua/	<p>Founded in 2012, Happy Farm is a business incubator that provides business development services for start-up teams (or companies) and also assumes further support and investment attraction in start-up companies. The purpose of the business incubator is the commercialization of new technologies and developments in the IT sector.</p>
WannaBiz (former incubator, transformed into seed fund) http://wannabiz.com.ua/#About	<p>Founded in 2012 by three young IT entrepreneurs in Odessa, WannaBiz became one of the most active start-up incubators in Ukraine. In September 2015, WannaBiz transformed into a seed fund, virtually stopping its incubation activity.</p>
University of Shevchenko Science Park http://scp.univ.kiev.ua/en	<p>The mission of the park is the advancement and commercialization of smart R&D and technology projects in the field of theoretical and applied sciences.</p>
GrowthUP Accelerator http://growthup.com/en/	<p>GrowthUP is the first Ukrainian accelerator dedicated to technology start-ups that works with projects from the earliest stages of development. The accelerator was established in 2008 by BayView Innovations consulting firm, a subsidiary of the BVU Group.</p>
Radar Tech http://radartech.com.ua/	<p>Radar Tech is the technological cluster that unites sectoral/industry corporate accelerators.</p>
Telecom Accelerator 2.0 http://radartech.com.ua/telecom/#home	<p>Telecom Accelerator 2.0 is one of the Radar Tech competition programs funded by KyivStar mobile operator to find, accelerate, and integrate innovative technologies in telecommunications.</p>

ENTREPRENEURSHIP EVENTS, COMPETITIONS, AND CHALLENGES

SingularityU Ukraine Global Impact Challenge http://singularityukiyv.com/gic/	<p>Global Impact Challenges are annual competitions held in partnership with sponsor organizations worldwide and organized by geography and theme. These competitions act as a platform to identify outstanding entrepreneurs, leaders, scientists, and engineers with the most innovative ideas for positively affecting millions of lives locally and globally within the next 3–5 years. The winner of each competition is invited to attend the Global Solutions Program (GSP) free of charge.</p>
Sikorsky Innovation Challenge http://startup.kpi.ua/	<p>This annual competition aims to spur Ukrainian innovation and allows emerging entrepreneurs to hone their ideas and receive funding for product development, including tracks for young innovators, computer sciences, engineering, robotic technologies and smart machines, mathematics, and so on.</p>
Kyiv Startup Week https://www.facebook.com/KyivStartupWeek/	<p>This is a series of events designed to bring members of local and international tech communities together to exchange experiences and ideas.</p>
iForum http://2016.iforum.ua/en/	<p>This is an annual major IT conference in Eastern Europe (part of the Kyiv Startup Week).</p>
Startup contest Innovation Spring, Lviv http://itcluster.lviv.ua/en/paged/innovatsijna-vesna/	<p>This start-up contest invites to implement ideas and projects and turn them into technology-based start-ups in seven areas: energy efficiency, road construction, cultural management, solid waste management, open data, lifts, business tourism/tourism.</p>
The Vernadsky Challenge http://vernadskychallenge.com/en	<p>The Vernadsky Challenge is the brainchild of Noosphere Ventures' founder Max Polyakov and Google Ukraine's Director Dmitry Sholomko. It is a start-up competition for engineering and design projects.</p>
IT Arena Lviv https://itarena.ua	<p>This is an annual three-day event for IT professionals.</p>
ITEM-2017: Problem Solving Conference on IT-business development, Dnipro https://item.com.ua/	<p>This is the largest conference in Central Ukraine about IT business and development. It is the fifth year ITEM Conference will take place in 2017 in which around 1,000 developers, project managers, quality assurance professionals, and IT business managers from all over Ukraine are going to attend.</p>

START-UP MENTORS, PROMOTERS, AND DIASPORA NETWORKS

Techstars http://www.techstars.com/ http://www.techstars.com/events/	<p>Semyon Dukach is the Managing Director of Techstars in Boston. He is also known as a top angel investor and is invested in several Ukrainian start-ups, such as Preply, Petcube, and uGift.</p>
Ukrainian Venture Capital and Private Equity Association http://uvca.eu/en/events	<p>It aims to spread the word about Ukraine's achievements and opportunities and to support investors in every aspect, from providing information to establishing international connections at the industry and government levels. It organizes conferences and education events in western Europe and supports Ukrainian events.</p>

Ukrainian Business Angels Network http://uangel.com.ua/	Ukrainian Business Angels Network provides a platform for entrepreneurs to meet investors and for investors to locally and internationally syndicate. It is a closed group of high net worth individuals or entities interested in financing start-ups on their early stage of development.
AlmazCapital http://www.almazcapital.com/	It invests in early-stage, capital-efficient technology companies.
AVentures VC fund http://aventurescapital.com/	It is an early-stage venture firm focused on growing businesses in Ukraine and central and eastern Europe.
Startup Network https://startup.network/ https://startup.network/events/archive/	It is an investment platform, founded by Aleksander Soroka, for participants in the venture market—startups, private investors, and consultants—which helps entrepreneurs find the first round of investment for their start-ups, investors—to effectively invest—and professional advisers—to capitalize on this process. It regularly organizes events in the United States and eastern Europe, including in Ukraine.
AmBAR http://www.ambarclub.org/ http://www.ambarclub.org/events	AmBAR (American Business Association of Russian-speaking Professionals) is the largest Russian-speaking business network of entrepreneurs, investors, engineers, lawyers, and other professionals headquartered in Silicon Valley. It regularly holds knowledge sharing events such the regular Silicon Valley Open Doors (http://www.svod.org/) conference.
Nova Ukraine charity http://novaukraine.org/	Nick Bilogorskiy is an active Ukraine-focused entrepreneur in the valley, founder of Nova Ukraine charity, and organizer of various Bay Area start-up events.

VC AND PRIVATE EQUITY FUNDS

VC Funds		Private Equity Funds	
1	AlmazCapital	1	HP Tech Ventures
2	AVenturesCapital	2	Aval-Brok LTD
3	Digital Future	3	Dragon Capital
4	Chernovetskyi Investment Group	4	Horizon Capital
5	Empire State Capital Partners	5	ICU
6	GrowthUP+ VC Fund	6	iTech Capital
7	ICU	7	Ramsis Capital
8	Imperious Group	8	Siguler Gulf Company
9	Internet Invest Group	9	4I Capital Partners
10	KM Core/Borsch Ventures		
11	Runa Capital		
12	TA Venture		
13	TMT Investments		
14	SMRK VC Fund		
15	SigulerGuff		
16	Vostok Ventures		
17	WannaBiz		

Source: Ukraine Venture Capital Association Investors Book 2017: Who is Who on The Ukrainian Investment Market.
<https://www.slideshare.net/UVCA/uvca-investors-book-2017-who-is-who-on-ukrainian-investment-market>

