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NATIONAL STRATEGIC REFERENCE FRAMEWORK 2007 – 2013

Operational Program "Development of the Competitiveness of the Bulgarian Economy" 2007-2013

BULGARIA

Reimbursable Advisory Services Program on Innovation

Innovation Infrastructure Flagship Projects: Pre-feasibility Study

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Private and Financial Sectors Development Department
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The World Bank

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Project: BG161PO003-5.0.01-0003 Effective Management of Operational Programme "Development of the Competitiveness of the Bulgarian Economy" 2007-2013, financed under Priority Axis 5 "Technical Assistance" of the Operational Programme, co-financed by the European Union through the European Regional Development Fund

CURRENCY AND EQUIVALENT UNITS

(as of November 22, 2013)

Currency Unit	=	BGN (Bulgarian Lev)
US$1	=	1.45 BGN
1 BGN	=	US$0.69

WEIGHTS AND MEASURES

Metric System

ABBREVIATIONS AND ACRONYMS

BAS	Bulgarian Academy of Sciences
CCI	Cultural and Creative Industries
CEO	Chief Executive Officer
COM	Council of Ministers
EC	European Commission
FDI	Foreign Direct Investment
FP7	Seventh Framework Programme
GDP	Gross Domestic Product
GOB	Government of Bulgaria
IBI	Innovation-Based Incubators
ICT	Information And Communication Technology
IP	Intellectual Property
IPR	Intellectual Property Rights
MBE	Machine, Building and Electronics
M&E	Monitoring and Evaluation
MEE	Ministry of Economy and Energy
MEYS	Ministry of Education, Youth and Science
NGO	Non-Governmental Organization
NIF	National Innovation Fund
NRP	National Reform Program
OP	Operational Programs
OPC	Operational Program on Competitiveness 2007-2013
OPIC	Operational Program on Innovation and Competitiveness 2014-2020
PA	Priority Axes
R&D	Research and Development
RDIs	Research and Development Institutes
RIS3	Research and Innovation Strategy for Smart Specialization
SME	Small And Medium Enterprises
STEM	Science, Technology, Engineering and Mathematics
TTOs	Technology Transfer Offices

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I. EXECUTIVE SUMMARY

This report highlights benefits of establishing publicly funded innovation infrastructure as a means of achieving the goals of Bulgaria's Research and Innovation Strategy for Smart Specialization (RIS3). It provides a framework to complete the feasibility studies for Bulgaria's flagship innovation infrastructure projects once they have been identified.

The report discusses the preconditions and best practices for establishing and managing two types of innovation instruments that could play an important role in advancing Bulgaria's innovation agenda, as they have in other new EU Member States: Fabrication Laboratories (Fab Labs), a type of prototyping laboratory; and Innovation-based Incubators (IBIs). As tools for implementing national research and innovation policy, the Fab Labs and IBIs will be eligible for EU Operational Program co-financing.[1]

International experience has shown that the success of publicly funded innovative infrastructure projects depends on the extent to which they are not standalone operations, but (a) play an active role in the broader development strategy of the country and the region; and (b) are part of an ecosystem of business, research institutions, government agencies and funding programs that work together to promote innovation, competitiveness, technology transfer, and other key public policy objectives.

The most critical factor for the success of Fab Labs and IBIs is their capacity to respond to economic drivers to take advantage of opportunities in sectors with significant potential for innovation-driven growth. In Bulgaria, these sectors include pharmaceuticals, food processing, machine building and electronics, as well as information and communication technologies (ICT) and cultural and creative industries (CCI)[2], the growth of which also spurs innovation in other economic sectors.

[1] Under Operational Program *"Innovation and Competitiveness"* 2014-2020 (OPIC), Investment priority 1 (*Encouraging the investments in the scientific research and innovation activity),* Fab Labs and IBIs would support the achievement of:

- Specific objective 1.1: *"Creation and strengthening of the capacity of the Bulgarian enterprises for the development and embedding of innovative products, processes and business models through investments in scientific-research activity and innovations;"* and
- Specific objective 1.2: *"Improvement of the conditions for the realization of innovation activity, including through development of the cooperation between the business and scientific media and improvement of the conditions for commercialization of the scientific researches."*

OPIC financing is also available for innovation infrastructure that supports the development of high- and medium-technological products and knowledge-intensive services, and that promote regional specialization and opportunities in scientific fields.

[2] These sectors were reviewed in the World Bank Report "*Inputs to Bulgaria's RIS3*" August, 2013

Fabrication Laboratories (Fab Labs)

The global revolution in digital manufacturing has dramatically expanded access to industrial-grade digital fabrication technology, and is transforming the landscape of business models, value chains, and cross-border trade. Fab Labs play a critical role in this new innovation ecosystem by providing the facilities and support services that make it possible for entrepreneurs, researchers, and small businesses to access technologies allowing them to turn innovative ideas into working prototypes.

Establishing a flagship Fab Lab in Sofia, along with an incrementally established network of specialized Fab Labs located throughout the country, could have a catalytic impact on Bulgaria's development by spurring innovation and creating synergies among innovators. Moreover, this kind of innovation infrastructure could amplify the impact of EU funds by generating spillover effects for other parts of the innovation ecosystem, especially if operated in tandem with other innovation instruments such as IBIs. With EU support, Bulgaria could build a state-of-the-art flagship Fab Lab and a network of smaller, more specialized labs that could elevate Bulgaria's innovation infrastructure to global standards.

Fab Labs can be created at varying levels of complexity, and for purposes of comparative analysis, the following three levels are presented for discussion:

- *A basic Fab Lab* focuses on core equipment and fundamental activities such as fabrication and prototyping. It requires a relatively modest initial investment in machinery and managerial resources.
- *An intermediate-level Fab Lab* incorporates teaching and more advanced machine capabilities and generates revenues through workshops and new product development. Intermediate Fab Labs are connected to business incubators and promote the growth of new businesses based on digital fabrication technology.
- *An advanced-level Fab Lab* has a strong focus on product development and 'go-to-market' services for users. An experienced manager oversees the development of products and assists clients in seeking business opportunities and obtaining funding. An advanced Fab Lab can also replicate many of its own machines to create spin-off labs locally. While the initial investment would be larger than a basic level Fab Lab, the amount is still modest, as illustrated in the body of this study.

These different levels of complexity of three types of Fab Labs are shown in Figure 1.

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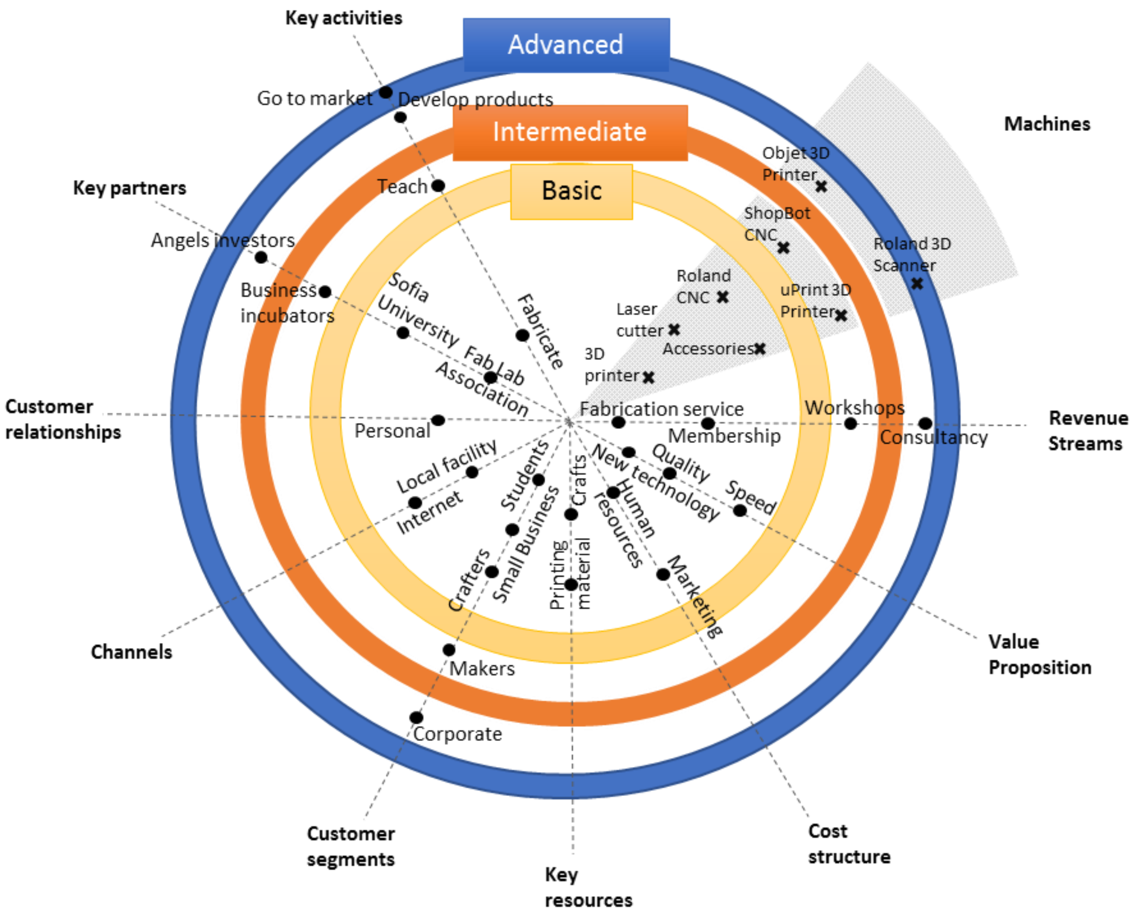
Figure 1: Three Models for Fab Labs



Source: Authors' compilation.

Considering the rapid pace of technology development and the limited capabilities of basic and intermediate Fab Labs, Bulgaria's policymakers may find it advisable to invest straightaway in an advanced facility, which offers greater flexibility to promote digital fabrication capabilities over a wider community of users and provides more opportunities for revenue generation and for connecting clients with global markets. The real value of an advanced Fab Lab, however, is in its contribution to the public good by facilitating science technology engineering and mathematics (STEM)-focused skills development, and knowledge sharing, jobs, applied R&D, and advancing manufacturing.

Most Fab Labs require start-up funding from public authorities, non-market driven entities such as foundations, or donor subsidies. However, operation of the Fab Lab must be driven by private sector management approaches, with both business and STEM professionals as directors and board members. The Fab Lab should be an independent entity, free from the programmatic interference of other institutions, but should be situated under an established entity that can contribute to its administrative and financial oversight.

Flagship Innovation-Based Incubator

Promoting the incubation of small innovative firms is part of the EU's strategy to develop clusters of new technologies and knowledge-based activities in new member states, particularly where entrepreneurial potential is untapped. IBIs based on industrial traditions (e.g., automotive technologies) and R&D strengths (e.g., biotechnology) can contribute to networking and job creation, assist R&D centers in commercializing know-how, and help universities and businesses generate sustainable spin-offs.

Establishing a flagship IBI in Sofia dedicated to knowledge-intensive start-ups and the commercialization of research would help Bulgaria address public policy goals and support innovative firms with high growth potential. It would also provide a focal point for Bulgaria's community of innovators, who could learn from each other. Currently in Bulgaria there are government-led support schemes and seed capital funds/ accelerators financed under the JEREMIE program that provide services similar to those offered by IBIs. However, the bureaucratic nature of government-run innovation support schemes tends to discourage applicants; and existing seed funds/ accelerators focus exclusively on business ideas in rapidly growing sectors, such as ICT, and not on innovation start-ups that require more time to mature, such as pharmaceuticals and biotechnology, machine building and electronics, food processing. Further, there are only a few of the existing business support services that offer comprehensive mentoring, networking or help with project management, and do little to bridge the gap between research and industry.

Effective innovation incubators are business demand driven and respond to the sector-specific needs of start-ups by providing a range of services, nurturing business ideas through all stages of product/service development. In addition to business planning, access to funding and support with addressing regulatory and intellectual property rights issues, innovation incubators may link start-ups to critical facilities such as experimental facilities for start-ups in food processing; advanced laboratories for the biotech start-ups, prototyping laboratories for the start-ups in the machine building electronics sector, etc.

Incubation generally involves several stages during which promising business projects are identified, developed and market tested. Figure 2 shows the activities at each stage of incubation.

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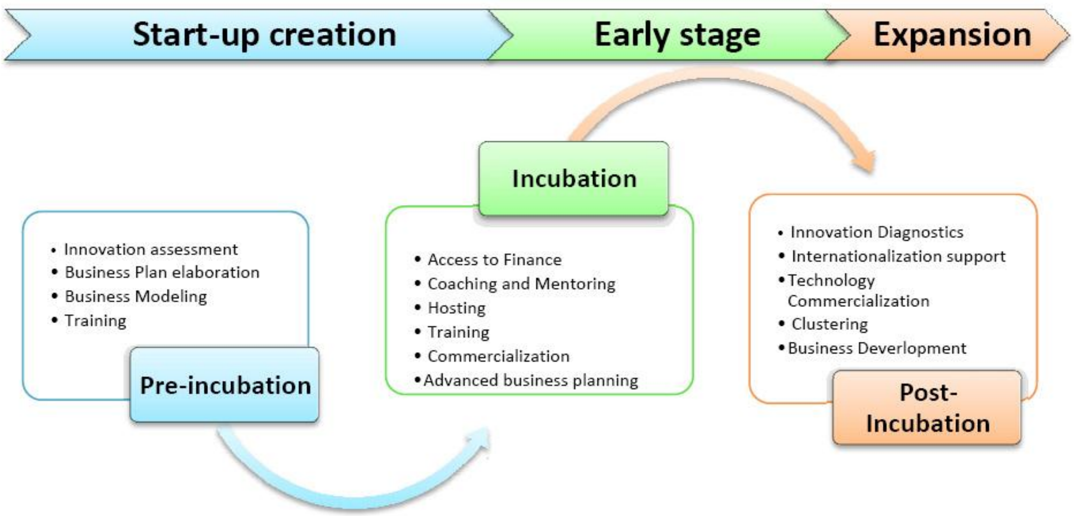
Figure 2: Stages of Incubation



Bulgaria's innovation environment is not yet sufficiently developed to support privately funded IBIs. Therefore, their operations need to be subsidized from public sources over an extended period of time. It is recommended that the Operational Program *"Innovation and Competitiveness"* 2014-2020 covers not only establishment cost but also provides some operational subsidy over the entire seven-year funding cycle. Full public subsidies will be needed for over the initial three years of operation but will gradually diminish as the start-ups mature and begin to generate revenues, and the IBIs recoup their equity stake in tenant companies.

Past experience with incubators and seed funds/accelerators in Bulgaria[3] shows that the most critical success factors include responding to business demand, introducing professional management and the performance indicators. Successful incubators have relied on professional, independent management with strong private sector expertise, as opposed to management dominated by government officials or academics. However, all stakeholders should be consulted in designing and establishing the IBI, including representatives from the government, universities, the private sector, business associations and sector development initiatives.

[3] EU-funded business incubators in Bulgaria in the past ten years, as well as more recent seed/accelerator funds and accelerators financed by JEREMIE program.

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II. FLAGSHIP FAB LAB PRE-FEASIBILITY STUDY

1. Introduction

This pre-feasibility study will help decision makers in Bulgaria to understand the potential catalytic impact that Fabrication Laboratories (Fab Labs) can make to promote the country's innovation and competitiveness, as well as support other top government priorities. Bulgaria faces a number of challenges, which call for both immediate as well as medium term actions. This pre-feasibility study is a preparatory analysis to enable Bulgaria's authorities to undertake a successful full-fledged feasibility study of an investment opportunity into a flagship Fab Lab based in Sofia and/or the establishment of Bulgaria's Fab Lab Network (BFLN). Therefore, the main objectives of this study are to:

(i) describe the best practices and catalytic impact of proof of concept Fab Labs worldwide and the rational for deploying them in Bulgaria;

(ii) delineate main phases, resources and information that would be required during a full-fledged feasibility study;

(iii) provide preliminary recommendations and options to consider for establishing a flagship Fab Lab (and possibly, a network) in Bulgaria by conducting an initial assessment of market demand, operational and financial feasibility requirements, in light of Bulgaria's specific objectives.

This pre-feasibility study covers investment options and priorities, initial scoping and costing parameters of three identified deployment options for Fab Labs in Bulgaria, as well as governance and financing structures. Outputs will ultimately provide the technical and financial assessments of Fab Lab deployment scenarios at a level of detail sufficient to write the terms of reference for a feasibility study. The methodology for conducting this pre-feasibility study was based on primary research (through phone interviews with EU-based Fab Lab managers listed in Annex 2), extensive secondary research, direct expert knowledge from the Fab Lab at University of Chile and Manchester Manufacturing Institute in UK, and in-depth knowledge of Bulgaria's innovation environment. The pre-feasibility study process was concluded with the workshop on November 19, 2013 in Sofia, comprised of stakeholders representing innovation ecosystem in Sofia – entrepreneurs, researchers, educators, business and industry, who unanimously supported the establishment of Fab Labs in Bulgaria, and confirmed the potential of local demand.

Within the scope of this pre-feasibility study, a preliminary estimation is provided of demand and opportunity for establishing the flagship Fab Lab in Sofia (with a potential to establish Bulgaria's National Fab Lab Network (BFLN)). Given the evident challenges in quantifying market demand in Bulgaria due to the novelty of this fabrication laboratory concept and lack of knowledge by potential local users about the services of Fab Labs, such quantitative demand analysis must be an integral part of the next phase (Feasibility study), in which it is

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recommended that a detailed market survey be carried out and comprehensive consultations be conducted with key stakeholders from across the innovation ecosystem in all regions in Bulgaria. Meanwhile, in this pre-feasibility study, a preliminary demand analysis is based on extrapolation from information collected during the interviews of established Fab Labs that are based in Europe and particularly, in Central European countries. The analysis is also based on the review of geospatial, economic, industry, stakeholder, and job creation perspectives of demand in Bulgaria. These areas should be evaluated in greater depth during the next phase full-scale feasibility study.

Based on the analysis conducted during this pre-feasibility study, the World Bank team concluded that:

1. Assuming proper design and implementation, a Flagship Fab Lab (and/or a Bulgarian Fab Lab Network) could serve as a catalyst for individual and other innovators in Bulgaria's innovation and economic ecosystem;
2. Fab Labs are so new to the markets, that typically few potential users would be aware of them. Therefore, in conducting market demand analysis, it might be difficult to quantitatively demonstrate sufficient demand for services to launch Fab Labs in Bulgaria, but international practices demonstrate that once a Fab Lab's services become available, potential local users become aware of its valuable capabilities, and demand increases rapidly. Design of a market demand analysis should take these issues into consideration.
3. The real value of a Fab Lab is not in the profits it can generate, but in the multiplier effect of its contribution to the "public good" and positive spillovers generated through knowledge sharing to promote STEM-focused and entrepreneurial skills that catalyze job creation, applied R&D, innovations, creativity and manufacturing in Bulgaria -- similar to the contribution of universities, libraries, and the like.
4. Dependent on Bulgaria's innovation objectives, the government should be prepared to seek subsidies to establish and maintain Bulgarian Fab Labs, based on their serving the "public good" and their catalytic potential to drive innovation in Bulgaria to new and higher levels. In most countries, Fab Labs appear to have required start-up funding from public authorities or other non-market driven entities, like a charitable foundation or a private donor.
5. It is recommended in Bulgaria that the Advanced model of Fab Lab deployment be implemented from the beginning of the project. Among three models constructed for discussion during this pre-feasibility study (Basic, Intermediate, Advanced), the Advanced model offers greater value and flexibility to promote digital fabrication capabilities over a wider community of users and considers a broader set of technologies and services in order to achieve the financial sustainability.

The chapter on Fab Lab Pre-Feasibility Study is structured in the following way: after providing a background on the Fab lab concept in Section 2, Section 3 presents a market assessment of potential demand for Fab Labs in the context of the Innovation Ecosystem in Bulgaria. Section 4 analyses the dynamics of potential stakeholder groups. Section 5 presents

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three Business Model options for Fab Lab deployment. Section 6 explains Governance and Operational Management considerations. Section 7 covers Facilities and Services. Section 8 explores Financial Feasibility and options for return on investment according to the three models of Fab Lab deployment. Section 9 illustrates Risk Evaluation and Risk Management strategies. Section 10 recommends options for a Monitoring and Evaluation framework. Section 11 summarizes the next steps in Planning and Implementation phases.

2. Background

The establishment of Proof of Concept laboratories was endorsed under Bulgaria's Operational Program "Innovations and Competitiveness" (OPIC) for the period 2014-2020. The core objective of OPIC is to transform Bulgaria into a dynamic competitive economy, based on innovation and optimization of the manufacturing chains and high value-added sectors. Proof of Concept laboratories, specifically Fabrication Laboratories (Fab Labs), were selected as one of the flagship innovation instruments for Thematic Objective No.1 "*Strengthening of the Scientific Research Activity, Technological Development and Innovations"* under Priority Axis "*Entrepreneurship, export and production potential as a base for accelerated growth*".

The decision in Bulgaria to consider establishing Fab Labs, as a type of Proof of Concept labs, was inspired by their multi-dimensional impact and their sweeping proliferation around the world, with 6% monthly average growth rate of established laboratories in 2012-2013. Fab Labs revolutionize not only the way products are prototyped, designed, manufactured, and shared, but also bring a wide spectrum of socio-economic benefits to the countries where they operate. Already, Fab Labs are being seen as the emerging vehicle driving the Third Industrial Revolution[4], which is characterized by the combination of digital and open access manufacturing/fabrication (Box 1).

Box 1: Defining the Terms

In this report, the following definitions are used:

- '*Proof-of-Concept Lab'* refers to a general environment (facilities and services) for prototyping products and ideas.
- '*Digital fabrication*' allows an individual to design and produce tangible objects on demand, by using digital fabrication equipment converting data into objects and objects into data (MIT Prof. Neil Gershenfeld).
- '*Fabrication Laboratory (Fab Lab)*' is a type of proof-of-concept laboratories and 'maker spaces' that is equipped with services and an industry-grade technologies and fabrication tools to convert digital designs into functional physical objects, and physical things into digital designs, as exemplified by MIT Center of Bits and Atoms' fab labs [1].
- '*Additive manufacturing (AM)'or '3D printing'* is a process of making tangible objects by joining materials based on a three-dimensional digital model, typically adding consecutive layers of material, as opposed to subtractive manufacturing methodologies.

[4] Troxler, P. Making the 3rd Industrial Revolution. In J. Walter-Herrmann & C. Büching (Eds.), FabLabs: Of Machines, Makers and Inventors. Bielefeld, 2013: Transcript Publishers.

- *'Computer Aided Design (CAD)'* is a process where computer software allows assistance in the design process[1].
- *'Computer Aided Manufacturing (CAM)'* is a process where computer-operated machines assist in the manufacturing process.
- '*Disruptive Innovation*' describes a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors [2].
- '*Inclusive Innovation'*- is getting more (performance) for less (cost) for more (people)[2].
- '*Innovation Value Chain*' is a path from an idea to a product that can be exemplified as follows: (i) idea generation, (ii) basic research, (iii) proof of concept, (iv) early-stage technology development, (v) product development, (vi) production and marketing.
- '*Rapid Prototyping'* is a set of techniques that enable the rapid fabrication of tangible parts or functional devices at a reduced scale of production to test and adjust for a final product.

[1] http://fab.cba.mit.edu
[2] Christensen, C. "The Innovator's Dilemma" (2011)
[3] Mashelkar, A.R. and Prahalad, C.K. "Innovation's Holy Grail" (2012)

The first Fab Lab emerged ten years ago in 2002 at the Massachusetts Institute of Technology (MIT)[5], and the concept is based on the fundamental principle of providing broader public access to new digital fabrication tools that allow them to build physical objects directly from digital designs (example in the Figure 3: Scheme of sharing digital designs globally to produce physical objects locally in Fab Labs). A Fab Lab provides to a broad public an accessible environment (industry-grade technologies, facilities, education, mentorship) for prototyping and digital fabrication of innovative ideas and products. It thus can be a catalytic stimulus for knowledge sharing, entrepreneurship, and research. Fab Labs also mitigate the risks associated with launching new products and ideas by eliminating failures when products are launched in real life. Fab Labs today are also seen as an interconnected global community of learners, educators, technologists, researchers, makers and innovators, who have collectively created a knowledge-sharing network that currently spans 63 countries[6.]

Figure 3: Scheme of sharing digital designs globally to produce physical objects locally in Fab Labs

[5] More precisely, the Fab Lab concept was the brainchild of MIT Prof. Neil Gershenfeld, Director of the Center for Bits and Atoms at Massachusetts Institute of Technology.
[6] http://fablabamersfoort.nl/nl/fablabs-globally.

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Source: based on Jens Dyvik "Making Living Sharing" (2013).

Rapid advances in new disruptive technology like 3-D printing, advanced robotics, and others, have made it possible to create prototypes quickly and cheaply using digital designs. These capabilities, made available through Fab Labs, enable individual entrepreneurs and researchers to prototype, change and actualize ideas into finished products. Accordingly, Fab Lab vehicles are being introduced on an accelerating basis both in developed and developing countries.

Overall, Fab Labs can change patterns of fabrication, promote science, technology, engineering and mathematics (STEM) skills, create businesses and jobs, and drive economic growth and productivity. They do this by providing the opportunity for practically anyone in the broader public with creative ideas to participate in the design, production, and distribution of products and services. A growing global network of Fab Labs have generated an entire new realm of possibilities at the local level to stimulate innovations, inventions and applied research across industries. Neil Gershenfeld coined this movement as the 'digital fabrication revolution'[7].

Fab Labs reinforce several types of innovation, such as (i) 'catalytic' or 'inclusive innovation'[8] and (ii) 'distributed' or 'open innovation'[9]. The former kind broadly enables and encourages the public to participate in the process of innovation and contributes to the creation of affordable products or processes, while the latter encourages using both external and internal knowledge to generate innovative ideas. Fab Labs do this by providing ready public access to 'disruptive' technologies, such as 3D printing, which allows users to make products cheaper and more efficiently.

By engaging in Open Innovation, Fab Labs would have the opportunity to reach a wide range of users and utilize a global database of knowledge network. Open Innovation is the

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[7] Gershenfeld, Neil. How to Make Almost Anything. The digital fabrication revolution. Foreign Affairs, November/December 2012.
[8] R. Mashelkar and V. Goel (2010). "Inclusive Innovation: More from Less for More"
[9] Chesbrough, H. Open Innovation: The new imperative for creating and profiting from technology.

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opposite of "closed innovation," the term broadly used to define companies that make limited use of external knowledge and limit the use of knowledge to only internally generated R&D. In many cases, it is individuals from different industries with different ideas and expertise that offer a solution. Open source incentives are distinct from earlier uses of intellectual property, leading to inefficiencies and biases in R&D investment. Open source style of software development remedies a defect of intellectual property protection, namely, that it does not generally require or encourage disclosure of source code[10]. Needless-to-say, open-source innovation offers important opportunities for Bulgaria where researchers and inventors can be linked to the global innovation value chain as contributors to problem-solving efforts of open-source challenges.

Fab Labs in Bulgaria can make a catalytic contribution to indigenous innovation and stimulate new expeditious ways for Bulgaria to design and manufacture. In Bulgaria, market coordination failures and high costs prevent inventors, engineers and entrepreneurs from rapid experimentation and prototyping. Therefore, Fab Labs can have an unprecedented, high-impact potential as a catalyst to Bulgaria's innovation and competitiveness efforts. Fundamentally, establishing Fab Labs in Bulgaria would overcome systemic inefficiencies by providing broad access to high-tech equipment, expertise and mentorship; thereby, creating a conductive enabling environment for incubating research and entrepreneurial ventures. Moreover, through SMEs spawned, the new Fab Labs can generate "deal flow" attracting Bulgarian and foreign investors to offer start-up financing and other new sources of access to capital for Bulgarian entrepreneurs.

Making Fab Labs available in Bulgaria would support a range of individual and collaborative research to achieve educational, commercial, creative, and social purposes. Bulgarian Fab Labs will function as a springboard of support for innovators who are engineers and entrepreneurs to move along the entire innovation value chain – from defining idea, prototyping, early-stage technology and product development to production and marketing. Different Fab Labs have different business models, some Fab Labs focus only on proof of concept stage, while others encompass several phases along the innovation value chain that include incubation and go-to-market services (see

[10] Open Source Software: The New Intellectual Property Paradigm, Stephen M. Maurer and Suzanne Scotchmer
NBER Working Paper No. 12148
March 2006

Figure 4: Fab Lab's Role in the Innovation Value Chain). Although in the former example, Fab Labs are connected to downstream capability through close linkages to the next phase organization and location of an incubator.

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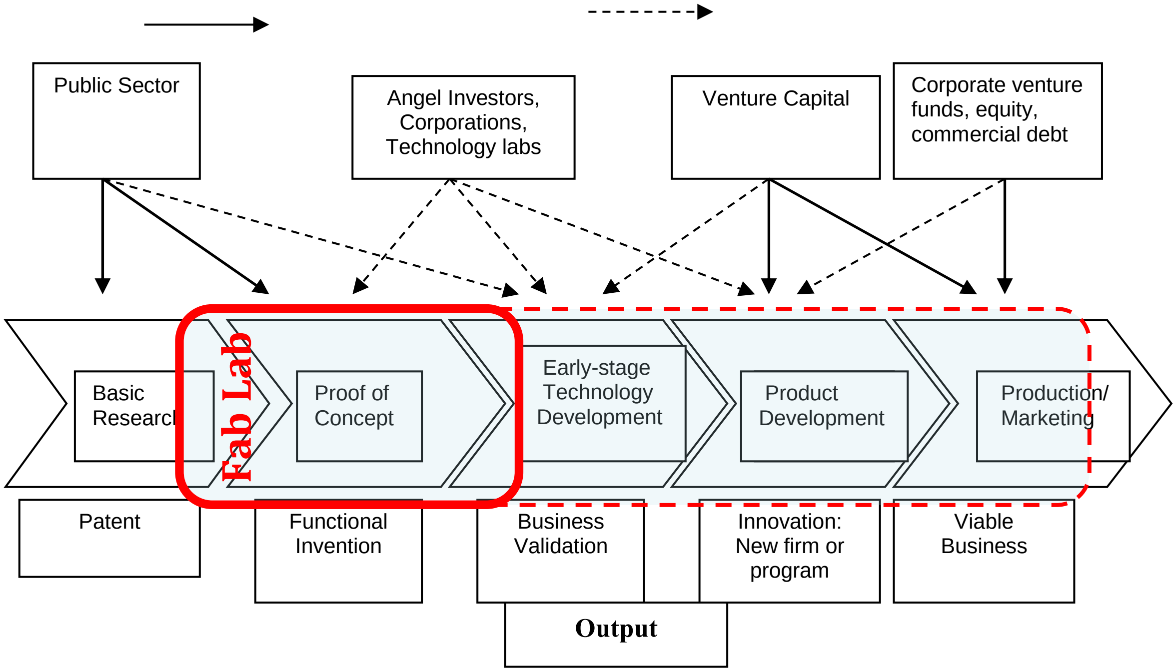
Figure 4: Fab Lab's Role in the Innovation Value Chain



Source: Overlay, World Bank 2012, Bulgaria: Supporting Innovation through Operational Program Competitiveness 2007-2013.

Based on best practices worldwide, rapid proliferation of the Fab Labs over the past few years demonstrates the panoply of benefits for competitiveness and innovation. Fab Labs are equipped with digital manufacturing tools that enable people to build 'almost anything', learn new skills in STEM disciplines, in entrepreneurship and in go-to-market concepts. Through the Fab Lab vehicle, a broader Bulgarian public would be able to develop inventions, create new businesses, produce new personalized products, share digital designs through the Internet and participate in the global Fab Lab network and International Fab Academy. Fab Labs empower individuals and companies through capacities and skills to create, innovate and manufacture new products, businesses and services by themselves and for themselves, so called "personal digital fabrication".

In order to preliminary evaluate and demonstrate the cross-cutting contribution of Fab Labs, a summary of economic, innovation and social outcomes is presented in Table 1. During the full-scale feasibility study, it would be important to examine these areas in more detail.

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Table 1: Potential Impact of Fab Labs

Fabrication Laboratory (Fab Lab)				
Economy, Exports, Competitiveness	**Innovation**	**STEM Education, Human Capital**	**Innovation- and Technology-based Business Development**	**Job Creation and Social Development**
Engaging broader public in innovation stimulates new economic development; Increase of manufacturing - exports and shift from low-skill to medium- and high-technology intensity products; - Diversify export portfolio; - Opens opportunities to advances in innovation; - Puts Bulgaria on par with more developed nations in digital fabrication potential; -Strengthen Bulgaria's competitive advantage;	- Increase product innovation ; - Induce disruptive and design thinking; - Rapid prototyping to test products and ideas; - Igniting early technology adoption; - Collaborative and distributive innovation; - Multi-disciplinary and applied R&D; - National-, region-, city- innovation; - Increase innovation output (e.g., patents); - Tap into global manufacturing on the cloud; - Increasing the stock of useful knowledge; - Active catalyst to Bulgarian creativity and builds capacity to execute ideas commercially	- Attract students to STEM Education - Attract more citizens (students, entrepreneurs, professionals) into STEM professions; - Shift from low-skill intensity to medium/high; - Introduce public to high-tech and disruptive technologies; - Mitigate 'brain drain' of STEM-focused researchers, graduates and professionals; - Attract diaspora; - Educating the community; - Teaching skills in computing (CAD/CAM), digital fabrication, engineering, electronics, programming, design, creative thinking.	- Generating a critical mass of enterprises (SMEs) that combine engineering and entrepreneurship modalities; - Networks formation and multi-disciplinary collaboration (researchers, engineers, entrepreneurs, etc); - New business opportunities, commercialization; - Incubation of business ideas; - Creative entrepreneurship ; - Creation of new businesses, enterprises or firms - Combines Bulgaria's inherent strengths in STEM with an invigorated entrepreneurial spirit	*Job Creation* - Relevance of skill training; - Create new opportunities for employment; - Improving income stability; - Train new skilled personnel; - New skill sets in Bulgaria to use latest most advanced 'disruptive technologies' such as 3D printers and related equipment in new ways *Social development* - community building in the underserved or remote areas ; - skill building - provides platform for jobs and expanded employment opportunities in diverse new SMEs

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← Knowledge Hub, Knowledge generation and diffusion →
← Technology adaptation, penetration →
← Cross-sector (Manufacturing, ICT, Cultural and Creative Industries, Agriculture, etc.)→
Fab Labs as bridges (public-private-academia partnership)

Source: Author's compilation

In building a Fab Lab Network for Bulgaria (BFLN), a foundation for the Network and proof of concept could be achieved through establishing Bulgaria's first Flagship Fab Lab in Sofia. After establishing the viability of the Fab Labs concept in Sofia, Bulgaria's Fab Lab network could be rolled out and tailored to specific needs of each location where Fab Labs can maximize their value. Each such Fab Lab could have a unique thematic focus, depending on the top priorities of a given region or city; however, all of them would share a core set of equipment and processes. The Flagship BFLN member lab would serve as headquarters for BFLN and could be located, for example, at Sofia Tech Park or University, or physical location convenient to potential users with a supportive institutional infrastructure. The main thematic areas to be covered by the different Fab Labs would be focused on Bulgaria's selected priority sectors, taking into account real demand for such Fab Lab services.

Box 2: Government-supported National Fab Labs: A Growing Trend

Fab Labs can be considered essentially as a "public good" designed to serve the common welfare in stimulating and supporting innovation and socio-economic development and growth, as well as application-side of STEM skills. Fab Labs do this by providing public access to high-tech digital fabrication equipment, proof-of-concept incubation, educational workshops and mentorship. . This leads to job creation, businesses, entrepreneurial ideas, and thereby, contributes to expansion and modernization of diverse industry sectors, exports, and to strengthening STEM education and applied R&D (across universities, research organizations, and even high-schools.

The governments of US, Russia, Spain, UK and France have recognized the multi-dimensional impact of Fab Labs and established their own local National Networks of laboratories, as a vehicle to drive the top national development priorities, such as strengthening STEM education, technology entrepreneurship, innovation, and mitigation of brain drain and unemployment.

Examples of national Fab Lab networks inspired and supported by public authorities include the following:

France**:** currently with 22 established Fab Labs, and 20 in planning and development, France has the highest concentration of Fab Labs in Europe.

Russia: Russia's Ministry of Economic Development is in the process of establishing the world's largest national Fab Lab network with support of private-source funding (20 laboratories in Moscow, and over 100 laboratories across Russia).

United Kingdom**:** 8 Fab Labs in network (4 Fab Labs were built over past 3 years, and 4 more Fab Labs are confirmed to be opened by the end of first quarter in 2014).

Spain**:** Barcelona City Council has adopted the Fab City concept, where Fab Labs are to become integrated as the main fabric of the city. Barcelona City Council also has signed a Memorandum of Understanding with the World Bank on how to jointly promote citizen technology and innovation and to share knowledge on sustainable urban development and the use of ICT in delivery of public services [1].

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***United States*:** Senator Bill Foster's bill for a national network of Fab Labs (a minimum of one per district) is currently being debated through the U.S. Congress. Multinational companies are also showing a desire to engage by committing their own funds to use the creation of new fab labs to support their CSR agenda and access future capability.

Risks: One of the risks that can be foreseen is that during the deployment of Fab Labs, as part of network at scale, there's a possibility of overlooking the benefit of tailoring Fab Labs to the local needs of region, city or community. Therefore, it is recommended that the government finds local champions and supports the collaborative selection of the appropriate business model for a Fab Lab.
[1]http://wbi.worldbank.org/wbi/news/2013/05/15/barcelona-city-council-and-world-bank-sign-agreement-share-knowledge-urban-technolog

The impact of the 'digital fabrication revolution' through Fab Lab networks is profound, it mitigates the Digital Divide, catalyzes creation of learning societies and promotes knowledge-driven innovation. Through the Fab Lab model, it is possible to enable and empower the broadest possible array of innovators to participate in creating their own technological tools and in finding solutions to their own problems[11]. Therefore, by establishing its own Fab Lab in Sofia, as the basis for a nation-wide Bulgarian Fab Lab Network (BFLN), Bulgaria can also begin to tap the global knowledge-sharing network of Fab Labs. Doing so would contribute to creating an innovation enabling environment for other contributors to thrive by bringing together participants from around Bulgaria and across the innovation ecosystem – e.g., individual entrepreneurs, established firms, start-ups and SMEs, STEM faculty and students, designers and technologists – and connect them to the world. Access to local Fab Labs and the interconnectivity platform they offer creates substantial benefits across society through new jobs that ensue as a result of entrepreneurial SMEs being created to capitalize on emergent abilities to digitally fabricate new products.

[11] Mikhak, B. et al. Fab Lab: an alternative model of ICT for development.

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Figure 5: Fab Lab as Innovation Ecosystem Connectivity for Bulgaria

Source: Author's overlay, based on FAB8ZN Conference Presentation by South Africa Department of Science and Technology.

Recent technology advances are transforming traditional 'Industrial Prototyping' into a revolution of 'Personal Digital Fabrication and Manufacturing'. Developed in the last 20 years, 'rapid prototyping' broadly refers to a set of technologies that takes a computer-aided design (CAD) document and converts it into a physical object through additive and subtractive methods[12] -- usually in industrial settings. Fab Labs generally provide open access to the creative public to the standard Fab Lab list of the high-tech equipment[13]. Therefore, in order to distinguish the 3D printing technology and the concept of Fab Lab, the Fab Lab provides overall solutions to the main challenges in producing new products through expanded access to the industrial-grade technologies, educational programs, incubation and mentorship services; thus, reducing product development cost and time to the market. Notably, 3D printers as one of the core equipment items for rapid prototyping was added to the Fab Lab standard list only about three years ago (see Figure below following). As the Fab Lab network and its capability grow, more processes and equipment will be added, and therefore, a capacity to expand needs to be taken into account in the long-term planning.

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[12] Frost & Sullivan, 2010. Advances in Rapid Prototyping and Rapid Tooling for Automobiles.

[13] http://www.fablabinternational.org

Figure 6: Technology Snapshot: 3D Printing

Technology Overview	• The printer creates the model a layer at a time by spreading a layer of powder (plaster, or resins) and inkjet printing a binder in the cross-section of the part. • Surface finishing requirement post manufacturing is not very high. • Support structures are not required. Variety of resins can be used with models which can be machined, electroplated and colored. • Objet, Z Corporation, EnvisionTEC, Optomec are some of the major companies in the 3D printing sector.
Why is it important?	• Manufactured products can be machined/electroplated/painted and taken through conventional processes of mass manufacturing. • A wide variety of polymers and resins can be used, among which ABS is the most popular choice for 3D printers. • Increasing usage across many industries due to fast turnaround time and lower costs compared to other RP methods.
Impact	• Major research using inkjet printing in the fields of tissue engineering, mass customisation and multimaterial printing is taking place. • Areas of application aerospace, medical, entertainment, consumer durables, personal manufacturing, archaeology, arts, and mass customization.

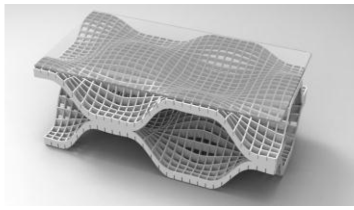
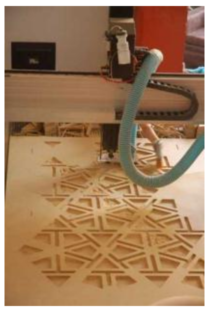
Source: Frost & Sullivan, 2011. Advances in Rapid Manufacturing = Technology market Penetration and roadmapping.

Fab Labs support innovation broadly across sectors, and especially, the "priority sectors" related to Bulgaria's Smart Specialization Strategy. Fab Labs can be designed to have a cross-sector focus or be tailored to specialize in sectors predominating in the local eco-system, and can be further focused by the needs of private sector industry involvement and university participation. From a policy perspective, manufacturing has greater learning spillovers than other sectors[14], which can justify focusing policies on developing higher-value added industry through Fab Labs. And although, manufacturing and ICT remain the main focus for the application of the Fab Labs model, the spectrum of potential industries where Fab Labs could contribute to innovation is extensive (see the examples Table 2).

Table 2: Examples of Industries that Fab Labs contributed to worldwide

Priority Sectors	Product innovation originated in Fab Labs

[14] Stiglitz,J. Greenwald, 2013. Creating a Learning Society: A New Approach to Growth, Development, and Social Progress.

<table>
<tr>
<td>Manufacturing</td>
<td>Fab Lab Colombia:
 
 
Source: http://www.fablabcolombia.com/</td>
</tr>
<tr>
<td>ICT</td>
<td>

Fab Lab Manchester (UK)
<u>Nifty MiniDrive</u>: This brand new device allows anyone to increase the storage space of their MacBook computer, and is due to hit the retail market in 2013. The Nifty MiniDrive, invented by Manchester-based trainee lawyer Piers Ridyard, is designed to fit neatly into the SD card slot of any MacBook computer, becoming a semi-permanent part of the device, and avoiding the cost and inconvenience of upgrading it. Piers came up with the concept in January 2012, designed the product almost overnight and turned to Fab Lab Manchester to help test its feasibility before prototype stage. After launching the project on Kickstarter, the world's largest crowd-funding web platform for creative concepts, he has now raised over $384,000 to supply almost 13,000 Nifty MiniDrives to those who have 'backed' the product – making the device the UK's most successful Kickstarter project ever, and ranking 11th in the world. Source: http://www.fablabmanchester.org/).

Fab Lab (Afghanistan) FabFi (http://fabfi.fablab.af) is an open-source, fab lab-grown system using common building materials and off-the-shelf electronics to transmit wireless ethernet signals across distances of up to several miles. With FabFi, communities can build their own wireless networks to gain high-speed internet connectivity -- thus, enabling them to access online educational, medical, and other resources. (Source: Fab Foundation)</td>
</tr>
</table>

Medical, Health, Pharma	***Fab Lab Manchester (UK)*** *"Toric marker"*: North West NHS Innovation Hub, TrusTECH, manufactured a prototype-marking tool for a pioneering form of cataract surgery. The use of Fab Lab's rapid prototyping facilities enabled the device to be produced far more quickly and at a fraction of the cost of conventional steel prototypes. As a result, the device is now being manufactured and sold commercially by Malosa Medical (Source: http://www.fablabmanchester.org/).
Food Production	***Cornell Fab Lab (USA)*****:** 3D food printing has a tremendous impact on the sustainability and velocity of future food production. Cornell University Fab Lab collaborated with New York's French Culinary Institute to develop cooking technology using a specially equipped 3D printer. Cornell's computational synthesis lab has created software tools that allow engineers to create edible objects using complex geometries that even a skilled chef would have a great deal of trouble creating by hand. Food 3D printer allows one to create pureed ingredients that can then be layered onto one another via special extruding heads, much as conventional rapid prototyping machines print thin layers of plastics, metals, or glass.
Creative and Cultural Industries	***Fab Lab Barcelona*** (http://fabtextiles.org/): 3D printed fabric, shoes, jewelry, accessories. ***Fab Lab Manchester (UK)*** *RomeyD Clothing Company* (http://www.romeyd.co.uk/) Mark Rome started attending Fab Lab open days in 2011. As an aspiring but unemployed mid-20's graphic designer, he was very interested in using the laser cutter and vinyl cutter to demonstrate his design skills, and ultimately look to create a portfolio of work that would put him in a stronger position to find work in his chosen profession. After becoming an expert on using the vinyl cutter in the lab, Mark had an idea of starting his own T-shirt making business. He used the lab to test out his designs and invested in a second hand vinyl cutter to create some 1-off shirts for friends at home. Over the last year, Mark has now managed to build his own independent clothing company – RomeyD clothing, which sells his own designs on t-shirts, hats and artistic graffiti canvases. (Source: Fab Foundation)
Energy-efficiency, Sustainability	***Fab Lab San Diego (US)*** *Hydrogen Maker Development Kits:* By combining open source hardware together with Fab Lab's distributed fabrication and rapid-prototyping concept, Fab Lab and Horizon created a socially accelerated pathway towards clean energy innovation with a hope to enable a people-driven, grassroots implementation of zero carbon solutions across the globe. Hydrogen Maker Development Kit allows assembling hydrogen-fueled infrastructure solutions for low power products. (http://www.fablabstore.com/collections/maker-development-kits-tm) ***Fab Lab Manchester (UK)*** *Smart Citizen platform*:

Architecture, Construction	 ***Fab Lab Barcelona*** *Solar House*: Originally created as an entry to the European Solar Decathalon Competition, the design, interior and exterior of this solar house were made entirely in the Barcelona Fab Lab. Earning the People's Choice award in the competition, plans are to franchise this model and process in China first -- then, across the globe. This approach allows for rapid prototyping of personalized housing locally and has implications for relief efforts and housing shortages across the globe. Solar House has also introduced significant technological innovations, such as the world's most efficient flexible solar panels, made with both Spanish and American technology. (http://www.iaac.net/projects/fab-lab-solar-house-3)

Source: Author's compilation, Fab Labs web-sites, Fab Foundation.

The 21st Century phenomenon of Fab Labs has become a vehicle for opening access to major disruptive technologies throughout developed and developing countries, urban and rural areas, allowing such access for even remote communities. The velocity of technological change and innovation is escalating exponentially. Disruptive technologies – such as digital engineering, robotics, 3D printing – are changing the landscape of economies and ways to do business at an unprecedented pace. According to a recent McKinsey report[15], policy-makers and societies need not only respond the current technological progress, but what's more important is to prepare for future technologies.

Thus, countries that embrace technology innovation are better able to keep pace with others who are also advancing. As technology change becomes more rapid and its pace accelerates, merely maintaining the status quo is no longer a viable option for a country, because doing so, would be the equivalent to falling behind. Bulgaria needs to decide how to invest in new forms of education and innovation infrastructure, and figure out how to embrace disruptive economic change to be able to strengthen Bulgaria's comparative advantages. Instituting the Fab Lab model will be a step in helping Bulgaria to start catching up on the innovation levels of other EU member states, and support its own creative geniuses.

3. Market and Innovation Ecosystem Demand in Bulgaria: Pre-Feasibility Assessment

3.1. Advancing Bulgaria's Innovation Policy

In line with EU 2020 vision and Bulgaria's national targets, the way to becoming a knowledge economy is through improved technologies, innovation, and higher-value added

[15] McKinsey Global Institute, 2013. *Disruptive technologies: Advances that will transform life, business, and the global economy.* http://www.mckinsey.com/insights/business_technology/disruptive_technologies

products. A key factor to increase the competitiveness of the Bulgarian economy is to empower individuals, communities and companies with the capacity to create new business, products and services. Fab Labs (as a type of Proof of Concept Labs) will help Bulgaria in building this work force.

Strengthening the country's skills and technological capabilities would encourage Bulgarian firms to develop new products and invest in efficient production processes, increasing the share of high value-added products and services in total exports and improving the country's competitiveness. Knowledge creation and innovation are driven by market competition and entrepreneurship; however, where market forces are unlikely to produce the desired outcomes, they can be induced by carefully targeted government support focusing on promoting competition and innovation intensity. Such support, including from EU funds, would unleash the innovation potential of Bulgaria's business and research communities and increase growth and competitiveness.

3.2. Estimated Demand from Market and Innovation Ecosystem

Within the scope of this pre-feasibility study, this section provides a preliminary "toolkit" for constructing an approach to estimate potential demand and opportunity for establishing the flagship Fab Lab in Sofia. Given the evident challenges in quantifying market demand in Bulgaria during this pre-feasibility phase due to the novelty of these fabrication laboratories and lack of knowledge by potential local users about the services of Fab Labs, quantitative demand analysis must be an integral part of the next phase (Feasibility study). During that phase, it is recommended to carry out a detailed market survey and conduct comprehensive consultations with key stakeholders from across the innovation ecosystem in all regions in Bulgaria to assess who the likely customers of the Fab Lab will be, what specific services they can be expected to use and how much they would be willing to pay for such services. Further data analysis would include the costs of substitute or competing services as a means of verifying market pricing.

3.2.1. Extrapolating user demand from European Fab Labs to Bulgaria

Developing theoretical demand model in order to be able to make comparative analysis of the three levels of Fab Lab models – Basic, Intermediate and Advanced. At this stage of pre-feasibility study, the preliminary demand analysis used in the financial models and discussion later in this chapter is based on an extrapolation of primary research information collected from various sources during interviews with established Fab Labs based in Europe, and particularly in Central and Eastern Europe (CEE), and is applied to an understanding of conditions in Bulgaria, as a means of estimating what might be realistically possible demand and operating costs in Bulgaria for theoretical Fab Lab services over the coming 7-year period. The list of interviewed Fab Labs is referenced in Annex 2, and the comparison model of a selected sample is introduced in Annex 5 for further discussion.

Number of Users

As a result of interviews with Fab Labs, the aggregate number of users for various services could be expected to start with a small number per period, and to rise as information on the Fab Lab's capabilities becomes available and word spreads about its usefulness. Further to this point on estimating demand, a theoretical Fab Lab can also be anticipated to reach capacity at some point, and given the risk of new competing technologies arising, it is likely that eventually, a given Fab Lab might only serve a specific niche of users, unless it can be continuously upgrade in response to the market. Thus, there will likely be a leveling of demand at times for established Fab Labs. It is premature at this point to be able to chart definitely what the ebbs and flows of Fab Lab economics could be in CEE countries, as the concept is emergent, and most if not all the Fab Labs in the region have been either recently established (e.g. Croatia Fab Lab), or operating for less than 2-3 years (Fab Lab Hungary). Another common trend for the Eastern European fab labs that we interviewed (Hungary, Croatia, Latvia, Romania, Ukraine) is that these laboratories are very small (one-two paid employee and only several pieces of machinery), and are dependent on modest private funding or the revenues generated from fabrication services.

Potential Types of Fab Lab Services

While there is an array of services that are fairly common among many Fab Labs, every Fab Lab we interviewed had a different mix of users dependent on the needs of the given marketplace, the basis for establishing the given Fab Lab (e.g., university Fab Labs are designed to serve needs of students and professors; private architectural firm based Fab Lab is designed to support the firm's model building, etc.) and the specific equipment the Fab Lab possesses. A Fab Lab in Silicon Valley (USA Tech Shop at Menlo Park) is able to charge an individual membership fee of $1,395 per year for practically unlimited usage; however, the Fab Labs managers in the CEE region said they had difficulty attracting yearly and even monthly "subscribers", because individual entrepreneurs and researchers typically did not need to use the Fab Lab facilities frequently enough to justify a long-term membership program. Thus, most individual customers in the CEE would buy access to specific Fab lab machines on a "pay-as-you-go" basis – by the hour or minute or material used.

User fees for a theoretical Fab Lab in Bulgaria were estimated on the basis of fees charged at CEE labs, in taking a conservative approach, discounted somewhat for the Bulgaria market. Similarly, corporate customers typically would just hire out the Fab Lab services under a research contract, rather than have their technicians and engineers come in themselves to use Fab Lab's machines. However, the Fab Lab in Hungary indicated that it has some form of weekly membership pass, so it is possible that in Bulgaria, there could be a limited number of Fab Lab customers both individual and corporate, which would indicate a demand for an appropriately priced membership fee suited to their needs.

Identifying Services which are Essential

Despite the difficulty in assessing user demand, Fab Lab "workshops" are required for everyone who will use the Fab Lab equipment themselves, as opposed to buying the consulting services of the Fab Lab operator. These courses are typically 1-3 hours long, fixed-price training that are prerequisite for using a given machine or machines. The topics of workshops vary depending on each Fab Lab innovation ecosystem to attract more users to Fab

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Labs. From discussions with Fab Lab operators, this is one of the most consistent and lucrative sources of Fab Lab revenues, and is only dependent on the number of persons the Fab Lab can attract to use its equipment – once or multiple times.

Demand-pull vs. Supply-push

During the interviews, the common trend for establishment of the large government-funded Fab Labs (and networks) was initially supply-driven due to the novelty of the concept at the local level, and the realization by governments about the role of Fab Labs as a "public good". Once the initial capacity and knowledge were built within first few years, the bottom-up demand followed the supply-driven government initiatives. Box 1 exhibits the national fab labs (and funded networks) in France, Russia, Spain, UK, and USA.

In conclusion, as noted no Fab Lab is alike within the same country or the region. Among the Fab Labs interviewed, with the exception of "workshops" and some fees for equipment usage, it was very hard to draw comparisons in order to derive any kind of correlation. The number of users (and other metrics we asked) varied significantly across the Fab Labs depending on the number and type of machines deployed in the particular Fab Lab, months/years in operation, hosted or stand-alone establishment status, public or private funding, weak or strong innovation ecosystem, etc., were all variables. Ultimately, without having conducted a full-blown Feasibility Study in Bulgaria, the figures used in the financial models are indicative best-estimated extrapolated from amalgamated data from other Fab Labs in the CEE region, which can serve as a useful guide for researchers designing, developing and executing the Feasibility Study.

3.2.2. Regional Geospatial Context

Based on current geospatial distribution across Europe, a flagship Fab Lab in Sofia (possibly hosted by the Sofia Tech Park or University) will have a competitive advantage in the Eastern Europe region. Currently, there are over 240 Fab Labs[16] around the world, in comparison to only 50 Fab Labs in 2011. The recent trend during the past two years demonstrates a 6% average monthly growth rate of Fab Labs worldwide. The largest concentration of Fab Labs is in Europe (150), followed by North America (50), Asia (21), Africa (19) and South America (11). As illustrated by the geospatial map of Europe below, there are only a few Fab Labs in Central and South Eastern Europe, and these appear to be deployed at Basic, and Intermediate levels. Therefore, a professionally organized and managed Fab Lab at an Advanced level of deployment in Bulgaria would give the country and its innovators a competitive advantage and an even more significant advantage to serve as a regional Hub.

[16] Data from http://lab.limouzi.org/fabwiki-full.html

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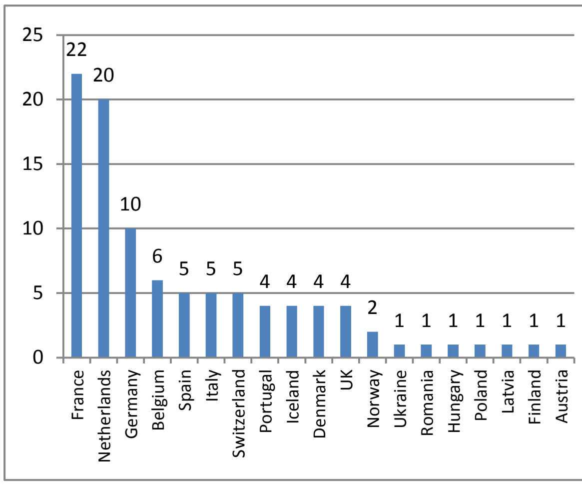
Figure 7: Geospatial distribution of Fab Labs* in Europe

Source: http://fablabamersfoort.nl/nl/fablabs-globally
Notes: (i) Data includes established, in development, and planned fab labs; (ii) The Fab Lab shown in Bulgaria is currently in planning.

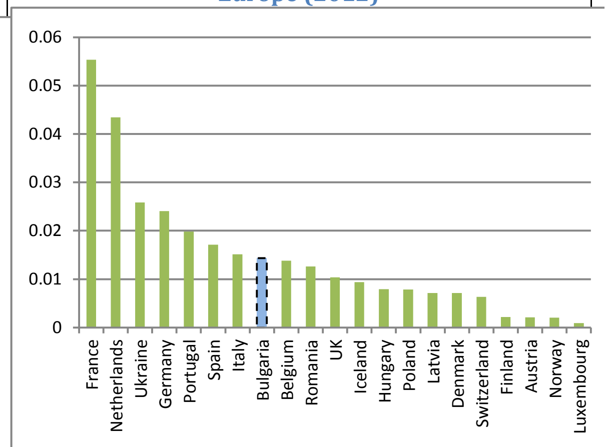
In Europe, the top five countries with the highest number of Fab Labs are France, followed by Netherlands, Germany, Belgium and Spain (see Figure 81 below). By establishing a fully operational Fab Lab, Bulgaria will position 9th among 21 European countries in terms of the number of Fab Labs relative to GDP per capita (Figure 9).

Figure 8: Fab Labs* in Europe (2012)



Source: http://fablabamersfoort.nl/nl/fablabs-globally.
Notes: *data includes only established fab labs, except Bulgaria, to demonstrate comparison.

Figure 9: Fab Labs* to GDP per capita Index in Europe (2012)



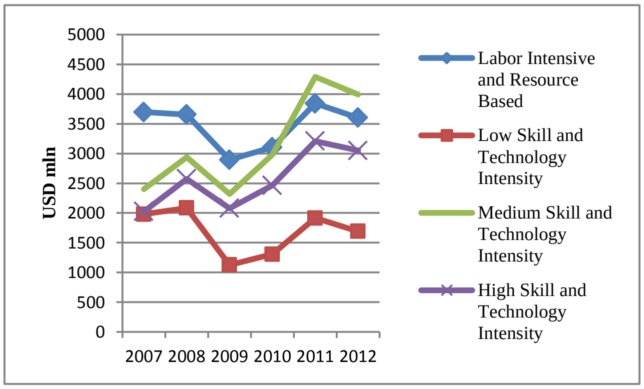
Source: author's compilation based on data from FabLab wiki and World Development Indicators.
Notes: *data includes only established fab labs, except Bulgaria, to demonstrate comparison.

3.2.3. Economic Drivers

Fab Labs as part of the larger country network would have a higher 'leverage effect' on the Bulgarian economy as a whole, responding to and generating future growth opportunities in the most promising sectors. Fab Labs contribute to creation of the knowledge-driven sectors. There are sectors with a significant potential for innovation-driven growth, such as the machine building and electronics, pharmaceuticals, food processing. Also Bulgaria's ICT and CCI sectors can not only grow by innovating, but in this process, can also help spur innovation in other economic sectors.

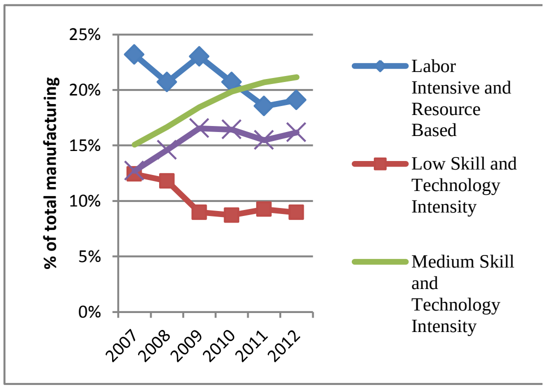
Fab Labs provide an opportunity to move the technological frontier, shifting manufacturing productivity toward higher skill and technology intensity products. During the past several years in Bulgaria, manufactured products constituted the largest share of exports. It is noteworthy that products with medium skill and technological intensity gradually advanced from 15% in 2007 to 21% in 2012 (Figure 10: Bulgarian Exports of Manufacture Products by Level of Skill and Tech Intensity (absolute values, USD mln)). Given the prevalence in the past of the Bulgarian manufacturing sector and the focus on knowledge-driven re-industrialization as the OPIC priority in the 2014-2020 period, Fab Labs today would be strongly positioned to play a significant role in the Bulgarian market – both from a demand and from an opportunity perspective. Fab Labs would also reinforce Bulgaria's transition from largely low-tech and resource-based to an innovation- and knowledge-driven economy[17]. According to the WEF Competitiveness Report 2013-2014, Bulgaria climbed to 57th ranking position (1=best; 148=worst) in comparison to 62nd position in the previous year.

Figure 10: Bulgarian Exports of Manufacture Products by Level of Skill and Tech Intensity (absolute values, USD mln)



Source: WITS based on Comtrade

Figure 11: Bulgaria: Exports of Manufacture Products by Level of Skill and Tech Intensity (% of total)



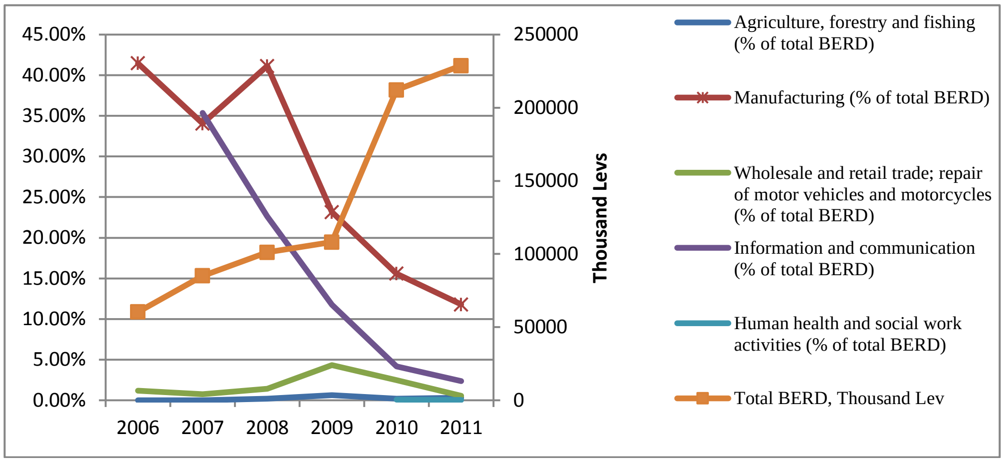
Source: WITS based on Comtrade

3.2.4. *Innovation, R&D, Knowledge*

From a firm-level perspective, however, a majority of Bulgarian firms operate below the technology frontier. According to the European Commission report[18], "their growth is based on non-R&D sources of productivity improvements and embodied knowledge diffusion, as opposed to knowledge generation". Therefore, a Fab Lab would contribute to knowledge generation in R&D and innovation toward formation of a knowledge-based economy and society. Another strong indicator for the urgent need of introducing Fab Labs to Bulgaria is that manufacturing R&D is decreasing relative to the total business enterprise research and Development (BERD), despite the recent growth of BERD expenditure in absolute terms between 2006 and 2011.

[17] Bulgaria is still generally characterized by low-tech and medium-low tech exports, and overall industrial production in Bulgaria declined by 2.4% on annual basis, according to the National Statistics Institute.
[18] Radosevic, S., Strogylopoulos, G. 2012. Research and Innovation Strategies for the Smart Specialization. Assessment of the case of Bulgaria. European Commission, 2012.

Figure 12: Business R&D expenditure (BERD) by top economic activity* (% of total BERD)

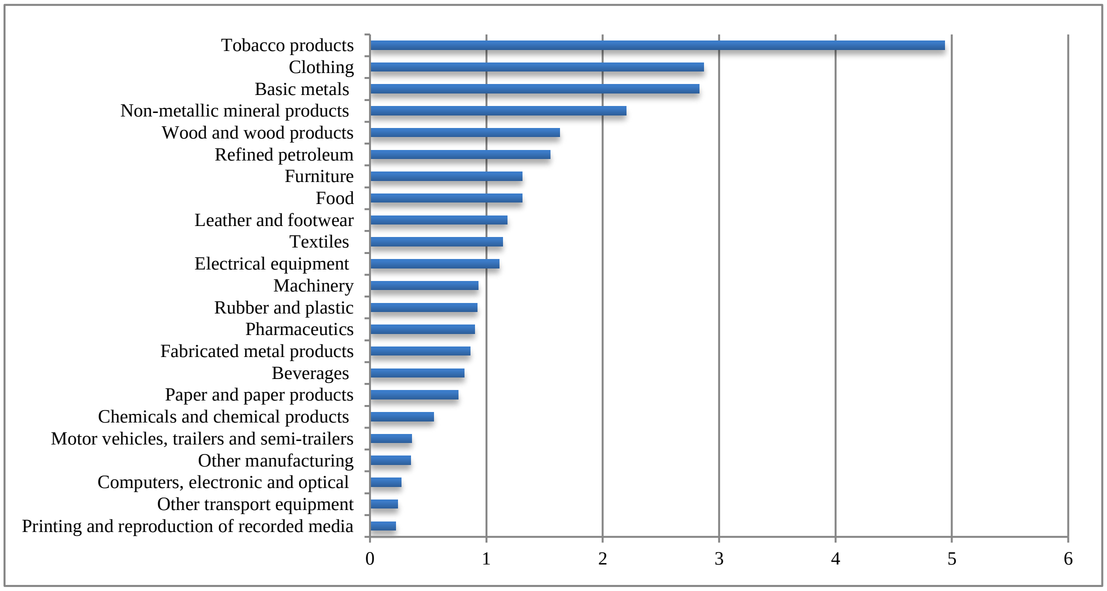


Source: National Statistical Institute of Bulgaria, http://www.nsi.bg
Notes: *excludes confidential data

Although each Fab Lab is unique in terms of activities and business models depending on its community and region, decision makers may take into account revealed comparative advantage (RCA) index[19] in manufacturing industries. With this, they can analyze with a sector focus of Fab Labs within the national innovation infrastructure network, and assess which industries could benefit on a margin of increased knowledge and technology absorption. The following manufacturing industries were identified to have top RCA in Bulgaria relative to the world's average -- basic metals, clothing, non-metallic mineral and wood.

[19] Revealed comparative advantage (RCA) uses the trade pattern to identify the sectors in which an economy has a comparative advantage, by comparing the country of interests' trade profile with the world average (UN Stats).

Figure 13: Revealed Comparative Advantage (RCA) index in manufacturing industries in Bulgaria, 2011



Source: Data from European Competitiveness Report 2013: Towards Knowledge Driven Reindustrialization.

3.2.5. Human Capital, Skills and STEM Education

The experience of taking an idea from design through prototype and fabrication is enriched and accelerated in a Fab Lab context. Accordingly, Fab Labs offer a platform for strengthening STEM skills and education in ways that few other mechanisms can. This way, development of human capital and skills goes beyond purely academic environment and is applied directly to work experience and practical applications of knowledge.

Fab Labs are increasingly being adopted by schools and universities around the world as platforms for project-based, hands-on STEM education and research. Users learn by designing and creating objects of personal interest or according to curriculum. Empowered by the experience of making something themselves, they both learn and mentor each other, gaining deep knowledge about the machines, the materials, the design process, and the engineering that goes into invention and innovation. In educational settings, rather than relying on a fixed curriculum, learning happens in an authentic, engaging, personal context, one in which students go through a cycle of imagination, design, prototyping, reflection, and iteration as they find solutions to challenges or bring their ideas to life.[20]

From the experiences of Fab Labs that we interviewed, students and entrepreneurs were the most active in using the Fab Lab services. Therefore, Fab Lab's services and educational programs in Sofia can be promoted among the students and faculty in the universities listed either

[20] Fab Lab Foundation

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in the table below that represent the top 10 universities by the number of published articles, or in Annex 4, where universities are listed by specialization and ranking. In 2012, the top three most popular specializations in which students graduated with a Bachelor's degree, were Business Administration and Personal Services, followed by Engineering. From the combined degree Bachelor's and Master's, the majority of students graduated from Business Administration, Social and Behavioral Sciences, followed, again, by Engineering. And, again, among PhDs, Engineering takes the third place as well.

Table 3: Top 10 Bulgarian universities based in Sofia (by number of articles published in peer-reviewed journals)

Affiliation	Bulgarian articles published in peer-reviewed journals
Sofia University St. Kliment Ohridski	8212
Bulgarian Academy of Sciences	7099
Medical University of Sofia	3914
Georgi Nadjakov Institute of Solid State Physics Bulgarian Academy of Sciences	2692
Institute for Nuclear Research and Nuclear Energy Bulgarian Academy of Sciences	2617
Institute of Organic Chemistry with Centre of Phytochemistry IOCCP Bulgarian Academy of Sciences	2449
University of Chemical Technology and Metallurgy Sofia	2126
Technical University of Sofia	1833
Institute of General and Inorganic Chemistry Bulgarian Academy of Sciences	1634
Institute of Physical Chemistry Bulgarian Academy of Sciences	1469

Source: SCOPUS, 2013

Fab Labs play a catalytic role by providing public access in the universities to high-tech and 'disruptive' technologies, such as 3D printing, as a way to upgrade skills and the manufacturing base. According to the Registry of Accredited Higher Educational Institutions in Bulgaria, the total number of higher schools is 52. A total of 42 of them are universities, of which 37 are public universities. The number of tertiary education graduates as a share of the population aged 30-34 is 27.7%, which is close to the EU27 average – 33.6% for 2011. The number of PhD graduates is 0.6 per 1000 population aged 25-34, which is about 3 times less than EU 27 average (1.5)[21].

3.2.6. Job Creation

Fab Labs contribute to creating entrepreneurial jobs linked to the fields of science, technology, and engineering. Bulgaria is among the countries with structural unemployment, where bold

[21] Erawatch

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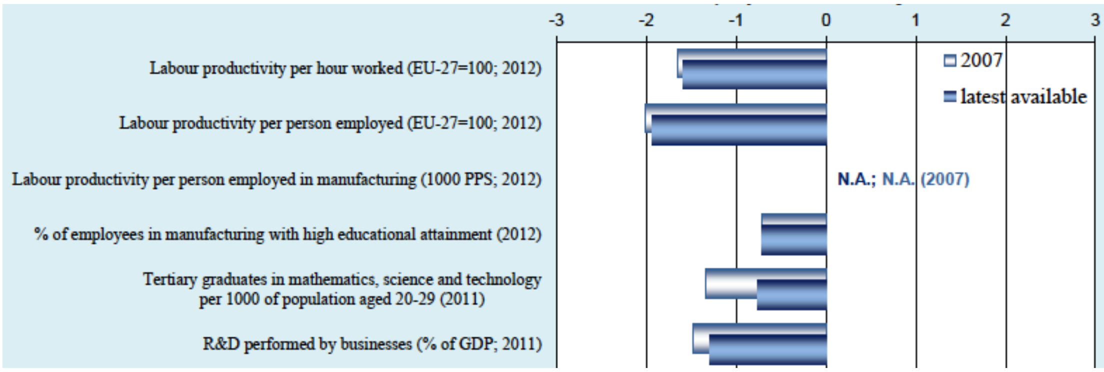
reforms targeted at increasing employment and competitiveness are urgent. Therefore, such measure as establishing the network of Fab Labs that would catalyze STEM education and research combined with entrepreneurship seems to be highly relevant. In 2012, labor productivity per hour worked was well below the EU average (see Figure 14).

Figure 14: Labor Productivity Indicators in Bulgaria, 2012



Source: European Competitiveness Report 2013: Towards Knowledge Driven Reindustrialization.
Notes: The gap between the EU average (0) and the country values (+, -) is measured in standard deviations.

4. Stakeholder Analysis

Stakeholder analysis examines potential demand for Fab Lab services, identifying current gaps in services and a composition of the potential deal flow. The cornerstone exercise for this would be the multi-stakeholder consultations and market survey during the actual feasibility study (a preliminary sample of questions is introduced in Annex 3).

The most important task would be to start building the local Fab Lab community of creative users, who are driven by the opportunities that a Fab Lab would provide. For Bulgaria, this would mean plugging into the global knowledge-sharing Fab Lab network to "collaborate globally and manufacture locally". In the meantime, the focus of this section is to preliminarily assess the groups of stakeholders that can be potentially engaged as users and partners for the Flagship Fab Lab established in Sofia and the Fab Lab Network in Bulgaria.

The following composition of stakeholders (Sofia and other regions) can be considered for conducting market research and consultations:

- *Companies and entrepreneurs* (business tenants from Sofia Tech Park and other Tech and Industrial parks; existing tech firms (manufacturing/ICT/design firms); start-ups and individual entrepreneurs; Business incubators; makers (tech shops, makerspaces, hackerspaces, e.g., InitLab in Sofia)
- *Academia (*STEM university students, faculty, school students)

- *Innovation Infrastructure* (Research and Innovation Centers, Technology Transfer Offices (TTOs))
- *Individuals* (Professionals from industries, technologists; Designers; Artists, crafters; Architects; Hobbyists)
- *Community social groups* (e.g., since Fab Lab is a community maker space that encourages creativity and innovation, it's open for users from various communities, including rehabilitation programs, etc.)

Box 3: Relevant Initiatives in Sofia

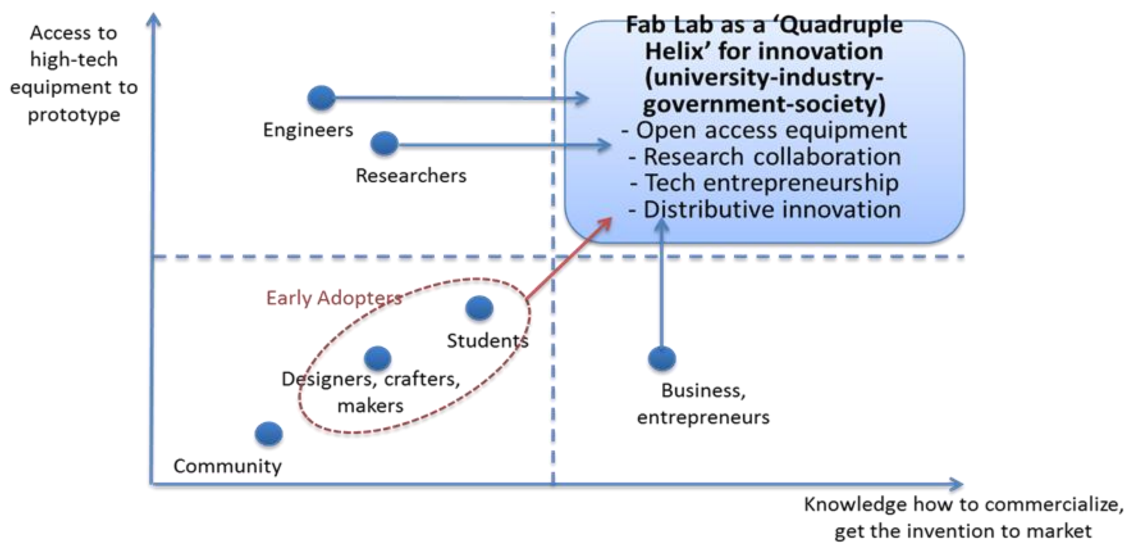
R&D Laboratory "CAD/CAM/CAE in industry" (3CLab) was established in 1988 in Technical University of Sofia. Since 1993 Laboratory works with industrial partners from Bulgaria, Europe and USA. continuously developing and improving capabilities, using contemporary CAD/CAM/CAE technologies and the potential of highly qualified engineers (currently 15 engineers). 3C Lab provides partners with engineering and consulting services that include the new product development through prototyping and industrialization for fast and effective realization of new ideas and minimizing the time to market. Main activities include: (1) research and technical specification, (2) engineering analysis and simulations, (3) conceptual and detailed design, (4) digital and physical prototyping, (5) testing and measurement, and (6). Over 90 successful subcontracted projects with West European and USA Companies was developed in Laboratory. A great number of students are educated and work in the Laboratory, using contemporary CAD/CAM/CAE technologies. [1]

Smart Fab Lab (SFL) is currently under construction and is planned to open in December 2013. It was registered as Limited Company (Ltd.) in the summer of 2013 by shareholders Digital Spaces Living Lab (DSLL) (http://www.digitalspaces.info/), Transformatori Association, and a few private investors. It is hosted by the Laboratory for Urban Design (http://transformatori.net/laboratory-urban-design/), which is 150 square meters working space on the backyard of the University of Architecture, Civil Engineering and Geodesy. The first batch of equipment will be available in Smart Fab Lab from January 2014 that would include a Makerbot Replicator, an iModela, two workstations for 3D design and prototyping, a Kinect for 3D model capture, an electronic workbench, mobile devices for 3D design using various mobile apps, etc. A grant from the America for Bulgaria Foundation will be used to purchase 2 bigger machines (CNC and a laser cutter) in early 2014. SFL is planning to attract students of architecture, designers, architects, inventors, makers, engineers, hackers, etc. The three main areas on which SFL will focus: (1) Smart cities, smart buildings, smart architecture, smart transformations of public spaces; (2) Smart objects- smart sensors, wearable devices/sensors, smart mobile device accessories, smart clothing and accessories, the Internet of Things (IoT); and (3) Smart mobile apps for design and manufacturing. [2]

Source:
[1] http://3clab.com, interview
[2] Founders of Smart Fab Lab, interview

In order to map the potential user demand for Fab Lab in Sofia, the Quadruple Helix[22] model of innovation was used. Quadruple Helix represents academia, industry, government and society that work in tandem to achieve a knowledge economy. The suggested dynamics of stakeholders in Sofia (and Bulgaria) is represented in the Figure 15: Stakeholder analysis and an opportunity for Fab Lab in Sofia, Bulgaria below. Fab Lab services will fill the gap that currently exists between the access to high-tech technologies and business knowledge on commercialization ("go to market") of product development. Fab Lab in Sofia would strengthen the industry-university collaboration and catalyze technology entrepreneurship and innovation.

Figure 15: Stakeholder analysis and an opportunity for Fab Lab in Sofia, Bulgaria



Source: Authors' compilation
Notes: Quadruple Helix refers to the knowledge production and innovation concept developed by E. Carayannis (http://www.innovation-entrepreneurship.com/content/1/1/2)

First, it is especially important to enroll students as early adopters of the Fab Lab concept, because they are typically the early adopters of new technology, and are quickly adapting at implementing its use. Students in diverse academic disciples are likely to have interesting ideas and projects that can be developed at the Fab Lab. In this regard, the following technical and vocational universities and educational institutions across Bulgaria[23], in particular, can play

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[22] Quadruple Helix refers to the knowledge production and innovation concept developed by E. Carayannis (http://www.innovation-entrepreneurship.com/content/1/1/2)
[23] http://www.studyinbulgaria.com/technical-universities-in-bulgaria/#sthash.efFvGM4v.dpuf

instrumental roles in assisting their students (and indeed, their professors, too) by introducing them to the Fab Lab and encouraging them to use it:

- Technical University Sofia
- Technical University Varna
- Technical University Gabrovo University of Forestry
- University of Architecture, Civil Engineering and Geodesy
- University of Chemical Technology and Metallurgy
- Sofia Agricultural University
- Plovdiv University of Mining and Geology "St. Ivan Rilski"
- "Todor Kableshkov" University of Transport
- University of Food Technologies
- State University of Library Studies and Information Technologies
- College of Telecommunications and Post
- Agricultural College Plovdiv
- Higher School of Civil Engineering (VSU) "Lyuben Karavelov" Higher School – "Telematika"College

Innovation infrastructure in Bulgaria is mostly delinked, and therefore, a large proportion of demand for Fab Lab services will be in research- and innovation-focused organizations. Existing R&D and innovation-oriented institutions are highlighted in the Table 4: Summary of Bulgaria's Present Innovation Infrastructure on Bulgaria's innovation infrastructure.

Table 4: Summary of Bulgaria's Present Innovation Infrastructure

	Structure	Quantity	Objectives
1	Research Infrastructure	7	Prioritizing the most prominent existing research infrastructure and resources into national research complexes
2	Joint Innovation Center, BAS	1	Coordinating and supporting BAS institutes in research and innovation
3	Centers of Excellence, BAS	8(9)	Providing training/continuing education in the relevant fields; connection with education and business sectors
4	R&D Sectors at HEI	7	Interaction between universities and businesses in introducing research projects
6	Technology Centers	4 under OPC	Promoting innovation by improving dialogue and cooperation between business and academia to intensifying
7	Centers for	5	Promoting entrepreneurship at HEI

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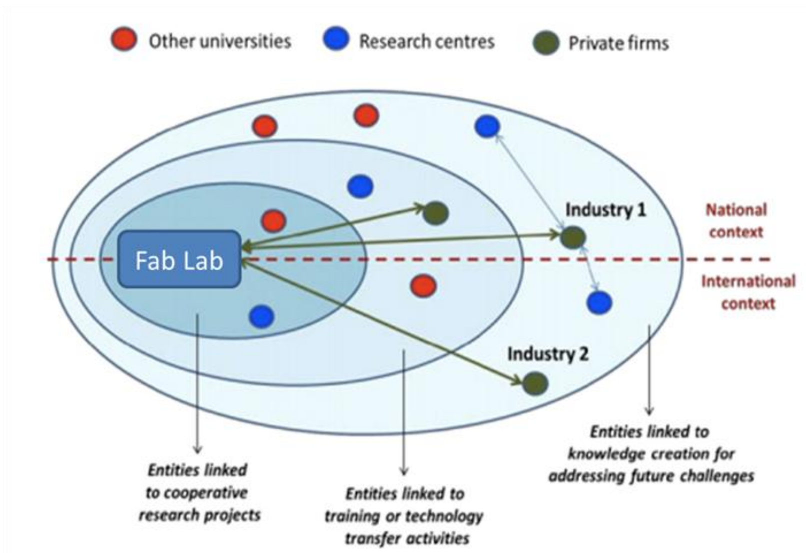
	Entrepreneurship		
8	Business Incubators (BI)	3 (presently existing)	Promotion of entrepreneurship
9	Innovative Clusters	12 under PHARE, 16 under OPC	Business networking
10	Sofia Tech Park (in development)	1	Opportunity to become a modern hub of science and business and attract world class scientists

Source: World Bank "Input to Action Plan on Innovation Commercialization Plan in Bulgaria" (2013).

Figure 16: Mapping Fab Lab's linkages to other stakeholders in Innovation Ecosystem (either for Sofia or Bulgaria)



Source: Author's overlay, based on Leon, G. 2013. Analysis of university-driven open innovation ecosystems.

5. Proposing Fab Lab Business Model Scenarios

To achieve long-term sustainability as well as to create, deliver and capture value, the Fab Lab in Bulgaria must develop and continuously refine its business model as it gains operating experience. This model will define with a good degree of precision key partners, key activities, the Fab Lab's value propositions, what relationships with customers will be supported, what segments of customers will be targeted, what are the key resources and the distribution channels of the Fab Lab. The business model also will define the cost structure and revenue streams to understand key financial aspects to manage costs effectively and to maximize income opportunities from diverse sources, while remaining focused on "public good" objectives, which are broader than merely financial.

Although design and development of the model can draw upon proven approaches and experiences of Fab Labs in other countries, Bulgaria's approach must be tailored specifically to its objectives, needs and conditions to add real and lasting value in stimulating innovation, development of Bulgarian human capital and the growth of new businesses. Lessons for Bulgaria can be drawn during the Feasibility Study stage from building on the base of the International Fab Lab Comparison in Annex 5 and conducting deeper research and analysis. At this stage it seems clear that there are a multitude of approaches that could be taken for the flagship Fab Lab and those in its Bulgarian network.

Three incremental levels of Fab Lab deployment could be considered for a Bulgarian Fab Lab and BFLN. Figure 17: Proposed Fab Lab Business Model Illustrating three incremental levels of deployment illustrates these incremental levels of Fab Lab deployment:

- ***A "Basic Level" of deployment*** considers core equipment and fundamental activities of any Fab Lab, which is mainly fabrication and machine hiring. This level of deployment considers also a basic level of initial investment and a conservative cost for human resources, both of which investment and managerial capabilities would increase incrementally at the next two higher levels.
- ***At an "Intermediate Level",*** a Fab Lab's core business model is teaching and incorporates better machine capabilities. Revenues are accrued by using the machines through various workshops and foster the generation of new products. At this level the Fab Lab also incorporates relations with business incubators and promotes or facilitates the generation of business that are based on digital fabrication technology.
- ***At an "Advanced Level",*** the Fab Lab's business model incorporates a strong focus of product development and 'go-to-market' services for users. It also incorporates advanced 3D printing machines and the capability to route large pieces of wood. An experienced manager is a mandatory component to the staff, with the capability to seek for business opportunities, obtain funding and oversee the development of products carried by the Fab Lab members and users.

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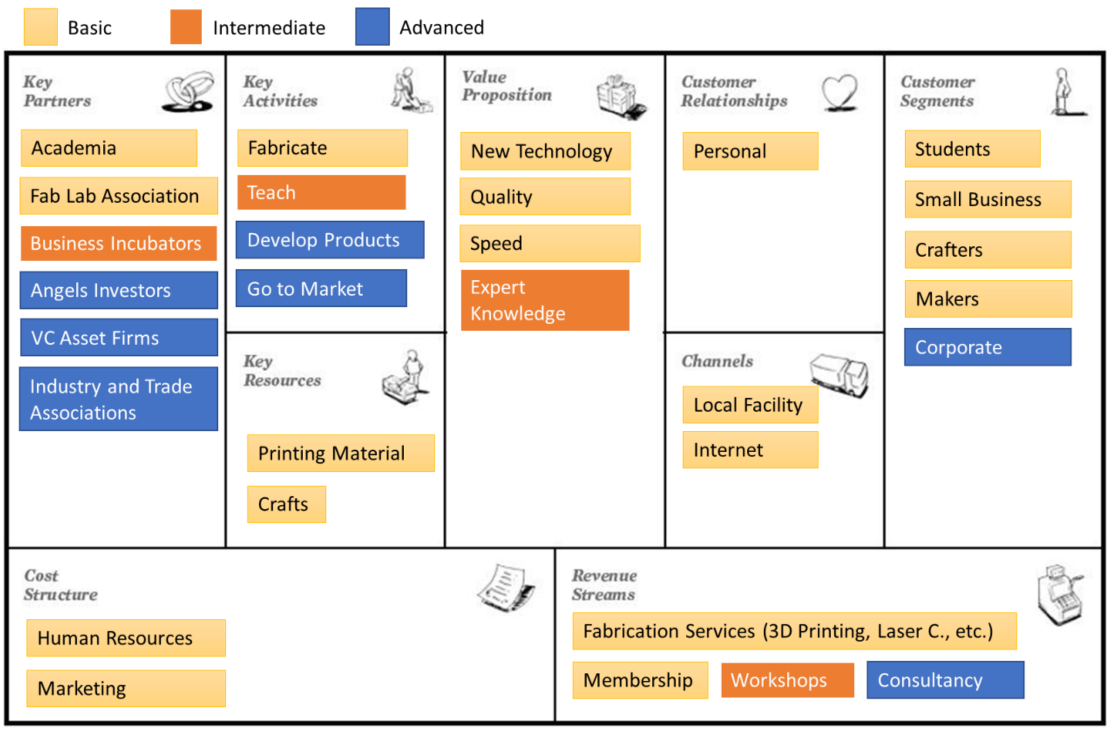
Figure 17: Proposed Fab Lab Business Model Illustrating three incremental levels of deployment



Source: Authors' compilation, background is Business Model Canvas (http://www.businessmodelgeneration.com/canvas).

Key Partners

The Fab Lab International Association is universally considered a key partner in start-up and operation of any Fab Lab. The Fab Lab International Association provides critical guidance on the operation, initial deployment and potential applications of any Fab Lab. It can be an important source of information and support and can provide a channel for collaboration with the global network of Fab Labs. For example, regional Fab Labs exist nearby in Croatia and Romania, and leading Fab Labs in Europe – like Fab Lab Manchester in the UK and Barcelona in Spain – are likely willing partners for Fab Lab Bulgaria, as collaborating among Fab Labs is integral to their operations and highly beneficial to Fab Lab users.

Important partners of Fab Labs are typically universities and business incubators, where in many cases, Fab Labs are physically located. As early adopters of technology, students are a primary group of potential clients of a Fab Lab; thus, universities are especially important partners at the Basic Level of Fab Lab deployment. They can channel their professors and students with interesting projects to be developed at the Fab Lab, and through their TTO's, they can offer another source of Fab Lab users. Similarly, business incubators are a ready source of Fab Lab user supply from among their pool of emergent SMEs. At an Intermediate Level of deployment, a Fab Lab should provide tools for the development and commercialization of new products. At this level, innovation-based business incubators should become key partners incorporated in a close working relationship with the Fab Lab. Each of these two innovation ecosystem partners play important roles, and as such, selected institutions could be good candidates to host Fab Labs that comprise the BFLN connected with the Flagship Fab Lab recommended to be located in Sofia.

At an Advanced Level of Fab Lab deployment, Angel investors and Venture Capital firms become potential key partners. Such commercially-oriented individuals and firms can provide important guidance for the generation of new Fab Lab business. They also can bring their experienced advice and counsel as well as funding in support of the Fab Lab management and to the Fab Lab users, as those clients transform their ideas into fabricated products, and ultimately, into commercially-viable businesses. Similarly, specialized trade and industrial associations are also likely Fab Lab partners at the Advanced Level of deployment, because the association members would be interested in availing themselves of Fab Lab services and technology. In the case of such associations, some could be good candidates to host specialized Fab Labs in the BFLN to meet the needs of their members directly, while maintaining a close connection to the Flagship Fab Lab.

"Partnering" implies a two-way exchange, and indeed, the establishment of a Fab Lab in Bulgaria can play an important catalytic role in stimulating existing universities and incubators to leverage Fab Lab technologies and networks globally. Moreover, the products and innovations emanating from Fab Labs also create a pipeline of viable investment opportunities, and thereby stimulate the organic emergence of Bulgarian Angel investors and Venture Capitalists. Thus, establishment of one critical piece of the innovative economy ecosystem influences development of others and each begins to serve and leverage one another.

Key Activities

The fundamental activity of a Fab Lab is to fabricate parts by using digital fabrication technologies. At a Basic Level of deployment, the members of a Fab Lab should master the skills of digital fabrication. Under an Intermediate Level of deployment, a Fab Lab should incorporate teaching activities through workshops and one-on-one training of how to use the machines as well as how to fully exploit emerging trends in digital fabrication to create new businesses. Finally, at the Advanced Level of deployment, a Fab Lab must also be capable of incorporating activities pertinent to product development and actual go-to-market with the resultant products.

Key Resources

Critical to a Fab Lab's operation are access to essential equipment, qualified personnel, essential materials for fabrication and appropriate facilities. The fundamental equipment needed to serve the needs at all three levels of Fab Lab deployment are described in detail in Section 8 on Facilities and Services. Management and staffing requirements are usually not large – approximately 1-2 people at the Basic Level with increased staff as needed to provide specialized services, and more administrative and management staff would be needed if the Fab Lab is independently operated. The relevant key staff positions are described in Section 7 on

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Governance and Operational Management Considerations. With respect to materials, the main resources for the operation of a Fab Lab are 3D printing material, wood, metals, electronics (arduino, electronic breadboard, batteries, motors, servo motors, motor shields, soldering, sensors, and resistors) and various specialized crafts supporting materials. Some of these materials will be available in Bulgaria, and others will have to be imported. Facility needs can vary significantly, and are especially dependent on the services offered, and examples are illustrated in Section 8 on Facilities and Services. The extent of services offered to users at the Fab Lab facility and its size will depend largely too on whether the Fab Lab is a self-standing, independent entity, or if it is created to be part of an existing "host" organization, like a university, incubator or a business or technology park.

Value Proposition

A main element in the value proposition of Fab Labs is how they make access to new disruptive technology broadly accessible to a wide range of the public and create significant synergies. It seems that the most important value of a Fab Lab is the "catalytic role" it can play socio-economically to provide a platform for stimulating the creative energies of innovators in Bulgaria. The new technologies, products and services that stem from the creativity of individuals and companies will benefit all of Bulgarian society and contribute to economic development. Such increase in the value of Bulgarian intellectual capital will help establish Bulgaria's image and reputation as a source of cutting-edge innovation and can serve to attract innovators and investors.

Value is also derived incrementally from on-going improvement in quality of service, quality on prints and parts that are manufactured in Bulgaria. Speed of delivery is also a very important aspect of the Fab Lab's direct value proposition. Expert knowledge can be incorporated on an Intermediate Level of deployment. Professionals incorporated in the Fab Lab team with good experience in digital fabrication can provide valuable expertise to Fab Lab users on the applications of digital fabrication technology. Ultimately though, Fab Labs could be viewed as the "libraries," "meeting halls," "universities," and "factories" of the Digital Age for communities, through which innovators come together to share create and share knowledge and produce products quickly with new technologies. As such, they are little different from other essential services the State or local government provides to enhance the intellectual capital, health and welfare of its population.

Customer Segments

The types of Fab Lab users will largely be dictated by the mix of equipment, staff expertise and services the Fab Lab can offer. Under a Basic Level of deployment, the main customers are expected to be students, small businesses, and crafters. On an Intermediate Level of deployment, a Fab Lab should provide spaces for "makers" to develop their prototypes and actual inventions in-house. On an Advanced Level of deployment a Fab Lab, should be able to offer consultancy services to corporations.

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Customer Relationships

The Fab Lab must aggressively reach out to attract users and the community it serves and to educate key publics on the benefits a Fab Lab offers. The range of what can be accomplished in Fab Labs is slowly becoming known to potential users. Many Fab Labs offer free usage just to attract users and introduce them to the Fab Lab's capabilities. To ensure that Fab Lab patrons will become repeat users and make more extensive use of the Fab Lab, relationships with customers must be maintained at a supportive and personal level during all the stages of deployment.

Channels

The Fab Labs services are provided at the local facility where the Fab Lab operates, but through an interactive global network of Fab Labs, users among designers, developers and fabricators can exchange data freely. Thus, while serving a given local community, Internet connections provide an entire new set of alternatives for the distribution of products that are designed and fabricated at one or more Fab Labs. The new paradigm on digital fabrication brings the possibility to distribute products globally by exploiting various on-line services that allow people to bring on the market their designs and be paid for their IP and other contributions to the final product.

Operating Cost Structure

A Fab Lab's operating cost structure is dictated by a relatively few components, and in the aggregate, total annual operating costs are not very substantial given the potential benefits and impact in support of innovation. They include primarily the need for competent human resources and their training and development; materials and supplies consumed by cutting equipment in fabricating models and finished products; rent and other routine expenses related to facilities; marketing and outreach to attract users and educate the community; and participation in international and local conferences to network and acquire Fab Lab knowledge. In terms of personnel, at a Basic Level of operation, the staff typically comprises designers, while at an Advanced Level of deployment engineers with solid background in digital fabrication are more essential.

Revenue Streams

Sources of revenue will vary with the focus of the Fab Lab and stage of development. At a Basic Level of deployment, revenues are obtained through digital fabrication services, machine user fees and in some countries, by user memberships. At an Intermediate Level of deployment, workshops are incorporated as an important source of revenue. Finally, services of consultancy and business mentorship (go-to-market services) are incorporated at the Advanced Level of deployment.

It appears, however, that at the present early stage of the Fab Lab model's existence, Fab Lab financial self-sufficiency is rather hard to achieve during the first years of operations. Rather, reliance on public funding through grant support seems to be the rule for the

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relatively short history of most existing Fab Labs. As such, Fab Labs appear to be more in the nature of a "public service" broadly supporting socio-economic development. Even most privately-owned Fab Labs do not appear to be self-sustained by revenues from outside users; rather, the company has purchased Fab Lab equipment to support its core business (e.g., architectural design and modeling), and the owners allow users access to their equipment during down times to capture some additional revenue to offset the cost of the equipment. For some users, they do not even charge fees, but do so to encourage users, who might pay in the future.

Sector-specific or Multidisciplinary

Based on the Market and Stakeholder analysis, it is recommended to identify the appropriate business model for a Bulgarian Flagship Fab Lab (or various Fab Labs as a part of the BFLN), considering either sector-specific focus or multidisciplinary approach. It is useful to start developing the architecture of alignment between the Fab Lab's mission, objectives and value proposition for Bulgaria, to draw linkages and sources for funding, based on Business Model Canvas introduced earlier. In the example of 3-year old Fab Lab in Nairobi Science and Technology Park, this Fab Lab, like many others around the world, is still publicly funded, but looking to diversify in future. In the meantime, Fab Lab community identified several streams of revenue: (a) hourly access and local production, (b) workshops, training, degree certification, (c) product incubation, business creation, individual entrepreneurs, (d) products and services: software, installation, curriculum, (e) network and skills mobilization, (f) Fab Labs as a source of consultants, (g) Fab Labs as a touristic attraction.[24] As reported, fabrication laboratories usually combine these models. This is illustrative of the challenges Fab Labs face in being able to generate enough revenue to cover operating costs.

Box 4; University of Nairobi Science and Technology Park Fab Lab

"This lab is about 3 years old and is the first Fab Lab to be integrated into a business incubator environment. It is situated on the University campus, but not associated with any one department, rather with the new Science and Technology Park initiative coming out of the government. The users are local inventors and entrepreneurs as well as recent University graduates from engineering. The Fab Lab is a terrific resource for the inventors and students to work on prototypes and ideas, and as importantly, to improve upon ideas already in process. This lab has about 8-10 small business ideas incubating. While only a few ideas originated in the fab lab, all of the inventors are improving their designs in the fab lab. The fab lab is also being used to train non-university people in advanced technical skills through Fab Academy. This lab is successful enough that the government wants to invest in a network of fab labs in this same context throughout Kenya. An interesting aspect of this lab is the relationship with the government, which backs the lab so far as to consider policy changes and supports to help it succeed, including import tariffs to protect businesses incubating out of the fab lab there. This lab is so far, entirely government funded, with plans to have the incubator take over financial support in the future". (Fab Lab Foundation)

[24] http://cba.mit.edu/events/12.08.FAB8/workshops/LifeCycleReport.pdf

6. Governance and Operational Management Considerations

6.1. Organizational and legal form (roles, duties, responsibilities, accountability)

The selection of appropriate structure in organizing a Fab Lab enables the effective operation of the Fab-Lab over the long-term and facilitates partnering with private sector entities, including venture capitalists. Of foremost consideration for efficient operations and transparency should be the need to ensure that the Fab Lab is driven by commercial, market-oriented decision-making mechanisms and subject to appropriate public oversight while it is receiving public funds and fulfilling primarily a socio-economic development objective.

Ultimately and as a prelude to its development, the objectives of the Bulgarian Fab Lab must be clearly articulated and agreed upon. Knowing the Fab Lab's objectives will be absolutely critical to how it is structured, funded, staffed and operated. This point is illustrated by the referenced descriptions to various Fab Labs in Chile, Romania, and other countries, which have diverse objectives varying the outcomes in their performance.

Defining the legal status of the Fab Lab depends on whether the Fab Lab would be established as an independent unit (with its own separate legal structure and operations) or whether it would be connected to an existing institution, as a hosting entity. The latter, for example, might be a university, company, research center, tech park, etc. This is a strategic decision and the flexibility of the Fab Lab and costs associated with its operations will depend on the form of such structure and its relationship to other entities. If the Fab Lab is hosted, for example, by a university or the Sofia Tech Park, the hosting entity would be able to leverage its resources and existing capabilities to support the Fab Lab though back office support, shared facilities and an existing institutional structure of which the Fab Lab would be a sub-element. Otherwise, if the Fab Lab were to be operated as a self-standing, totally independent entity, it would have to develop all the foundational elements and its operational activities from scratch. Moreover, it would have to be sufficiently capitalized to carry all the costs related to operating a self-standing entity.

Notwithstanding the benefits of operating the Fab Lab under the umbrella of a hosting entity, it is critical that the Bulgarian Fab Lab be able to retain some level of independent decision-making and operations. This is in order for it to more easily be able to receive external payments from the private sector, as well as receive funding from OPIC or national or municipal budgets without raising state aid issues. Moreover, the Fab Lab will have a distinct mission to carry out that dictates it have the independent authority to set direction, develop strategy to achieve its specific objectives and to make decisions independent of the host organization's interference, but subject to specific rules on the relationship with its host and with appropriate governance. Ultimately, a good deal of care must be exercised and special attention to clarify division of rights, responsibilities and authority between the Fab Lab and any host organization.

The exact form of the Fab Lab's legal structure will also be a critical consideration in securing funding. Whether the Fab Lab is organized as a not-for-profit organization, self-

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standing entity, subsidiary of a larger entity or some other mixed legal or public-private form will be dependent primarily on the rules governing state aid and the economic realities of operating the vehicle. It seems at this stage given the need for public funding, the Bulgarian Fab Lab must be public and non-profit in form. This requires an indication of where the money will come from and for how long, and deciding on the legal form based on very thorough review of EU state aid rules for the particular legal form chosen.

If the Fab Lab is established with public funds, and its success generates strong private interest in support of further development and expansion of the Fab Lab, then the State would need to consider how to capitalize on that interest. Thus, it could sell shares, or otherwise structure an interest, in the Fab Lab to such interested private parties under a public-private partnership scheme. At that point, the Fab Lab would have to be operated in a completely different way, focused more on commercial than developmental objectives. Ultimately though, for a Fab Lab to attract private investment it must demonstrate clearly its profit potential and the means for private investors to capitalize either on the Fab Lab's stream of revenue or it potential to generate capital gains on sale to future investors. Such potential for a Fab Lab in Bulgaria is not apparent under current conditions.

Similarly, a municipality or university might take a strong interest in supporting the Fab Lab as EU funding diminishes. If the Fab Lab was established with EU funds under OPIC, the money received from selling a share of the Fab Lab to a private partner, if possible, would need to go in a special fund that can be used only for the purpose for which the original funding was provided, and then the Fab Lab could generate profits and share such revenue with the private partners. For now, though, if the Fab Lab is established with OPIC funds, there are rules on it charging fees, etc. As an essential consideration in the initial stages of the feasibility study, issues concerning the legal form must be resolved. The challenges of identifying the right kind of partner for or host of a Bulgarian Fab Lab is captured well in the following comment, "Roughly two in three Fab Labs are currently set up and run by institutions rooted in the old world order. These institutions by their very nature are alien to lateral power relationships, struggle to understand polycentric structures and heterarchies, and fail to embrace a peer-production commons.[25]"

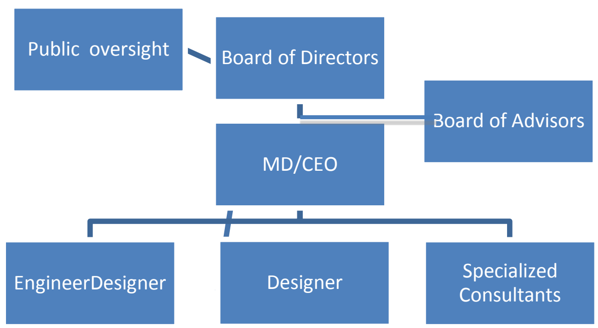
6.2. Internal Governance and Management Structure for the Fab Lab

Accordingly, the Fab Lab, whether linked with a host entity or self-standing, must have its own internal governance structure. This would typically include a Board of Directors, to which the Fab Lab's Management would report and be accountable to, and a Board of Advisors, as well as other bodies, such as a Supervisory Board, as dictated by Bulgarian law.

[25] Troxler, P. Making the 3rd Industrial Revolution. The Struggle for Polycentric Structures and a New Peer-Production Commons in the Fab Lab Community. To appear in: J. Walter-Herrmann & C. Büching (Eds.), FabLabs: Of Machines, Makers and Inventors. Bielefeld, 2013: Transcript Publishers.

The selection process for the Board of Directors or similar board is critical to ensuring the success of the Fab Lab. The individuals chosen must be experienced professionals with a mix of relevant business and technical skills needed to oversee the direction of the Fab Lab. While some Directors might be associated with stakeholders, they have to be able to independently execute their fiduciary responsibilities to the Fab Lab. The Board's role will be typical of traditional Boards of Directors and include hiring competent Managers, approving the Fab Lab's operational strategy and budget and related oversight. The typical relationship between responsible parties involved in a Fab Lab's governance is illustrated in the following organizational chart:

Figure 18: Fab Lab Organizational Chart



The Board of Advisors, typically appointed by the Board of Directors with advice of management, would also bring specialized, seasoned professional experience to strengthen the Fab Lab. These individuals would not generally have an oversight role, but be independent professionals chosen for their specific technical and business skills to provide advice and counsel to the Directors and Management. Dependent on the entity, however, they might be called upon to review and opine on conflict of interest issues and the like.

6.3. Management and Human Resources

Competent Management will provide a significant key to the success of the Fab Lab as the team of managers and staff will be responsible for the day-to-day operations and long-term viability of the function. There are essentially two approaches for management of similar such operating entities as the Fab Lab – one is for the Board of Directors to tender for an external "management company" that would be given responsibility for the Fab Lab's day-to-day functional operations; and the second would be for the Board to hire directly individuals, who will build a team and organization internally and as an integral part of the Fab Lab from the ground up.

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Whether there are competent management companies available to operate a Fab Lab in Bulgaria would need to be determined, but it should be possible to build a solid team of local managers and staff directly. In building local capacity, hiring management directly provides the Fab Lab's Board a more intimate relationship to shape the development of the Fab Lab and the means to contribute to developing an experienced cadre of management professionals capable of operating Fab Labs and related vehicles; thus, supporting the innovation ecosystem of Bulgaria. The latter approach also allows the Board more flexibility in making changes in individual managers, instead of having to replace the entire management company if they were unsatisfied with performance.

6.4. Managing Director/CEO

Taking the latter approach of building the Fab Lab's management and staff, first and foremost would be recruiting the Fab Lab's Managing Director/CEO (MD). The MD would be responsible for the overall operations of the Fab Lab in the provision of its services and in the institution of its policies and procedures and systems of internal controls – all for Board consideration and approval. The MD would work closely with the Board on development of the Fab Lab's strategy and its plans for attracting resources necessary for sustainable operations after the EU funding has ended. The MD would also develop the Fab Lab's budget and hire staff appropriate to the Fab Lab's needs and be responsible for the Fab Lab's communications with the public and key stakeholders. As such, the MD position will require extensive outreach and good communications skills.

Thus, the MD will need to have the technical skills to oversee the provision of the Fab Lab's services, business skills to manage its operations and sound communications abilities to reach and deal with the various stakeholders. This MD position will likely require educational and professional experience in technical disciplines such as engineering, R&D and the like, as well as in business and finance, and a level of maturity of at least 5 years and more likely 10 years of professional experience to deal effectively with all the parties and responsibilities involved in managing the Fab Lab.

In the case of both the MD and other managers and staff, the salary levels must be sufficient to attract and retain competent professionals, who will be committed to building the Fab Lab over the long-term. To ensure their continuing professional development, appropriate training must be incorporated into their employment packages, as well as other benefits typical in Bulgaria.

6.5. Additional Staff

At a minimum, the Fab Lab would also require at its start a Designer with good background in digital fabrication to provide technical support to users, and relevant clerical staff, as appropriate. The Designer should essentially man the front desk as a helper able to provide general technology assistance. The Designer should demonstrate mastery in the operation of all the Fab Lab machines, as well as to know about the programming and operation of electronic rapid prototyping devices such as Arduino boards. Moreover, this person should also

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master the skills of computed aided software (CAD) commonly used in a Fab Lab (such as SolidWorks). The Designer should be capable of providing more specific assistance in support of specialist designers and others working in a consulting capacity giving classes and workshops on selected topics.

If the Fab Lab is a self-standing entity, it would need a financial officer to administrator the organization's financial affairs, record-keeping, information systems and the like. However, it might be possible to hire out this function to an external consultant. If the Fab Lab is hosted by a larger established entity, that back-office financial/administrative function could be provided by the host organization.

6.6. Capitalizing on Independent Consultants for Specialized Expertise

In addition to specialized trainer giving lectures and workshops on selected topics, a business planning expert should be available at the Fab Lab. This position would be needed on a regular basis to provide feedback and support on fundamentals from business creation and planning to business development and operational issues. This advisor could also be a potential investor, service provider or a member of an industrial mentoring association, among the Fab Lab's network.

Likewise, on Intellectual Property issues and Regulatory matters, the Fab Lab, like many traditional incubators, should have access to basic expertise in Intellectual Property (IP) rights and regulatory matters to help users understand what the fundamental rules. This is so the users can know what they need to consider in protecting their interests and in securing their IP rights through discussions with proper legal counsel. The Fab Lab clearly should not be giving legal advice; rather, like the business planning expert, it could make available at its facility on a regular basis an IP specialist to provide basic education. This would include education on the types of IP rights, how they can be used and the pros and cons of IP protected development versus open source hardware. Knowledge about the various types of licenses (such as those provided by Creative Commons and GPL) should be maintained.

7. Facilities and Services

7.1. Location and premises

A Fab Lab located in Sofia will contribute to accelerating the dynamics of Bulgarian innovation by providing access to the latest technologies for prototyping tangible products and services, advanced 3D printing tools and a whole new environment for creativity and entrepreneurship. Although technology related companies can be found throughout Bulgaria, there is a concentration of tech firms and emergent institutional infrastructure supporting an innovative economy located in the environs of Sofia. This includes universities, technical institutes, industrial parks and other key components of an innovation ecosystem, as well as the

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technology and business professionals needed to manage the Fab Lab, and sophisticated users, who can appreciate its value.

As a pioneering flagship Fab Lab in Sofia commences operations and tests the market, a broader interlinked network of Fab Labs could be established at selected locations around the country. The locations of the member Fab Labs of this network would be based on an assessment of innovation potential and estimated demand from sound, verifiable research. Such a network would bring the advantages and lessons learned from the flagship Fab Lab in Sofia out to local users in these areas. Moreover, such a Bulgarian Fab Lab Network (BFLN) would provide channel innovators in these regional sites to others around the country, creating synergies that would not be possible otherwise.

A Fab Lab cannot be isolated from the industrial and research activities that are carried by other innovation stakeholders. Therefore, the physical location of the proposed Sofia flagship Fab Lab and others in the BFLN should be convenient users. University-based Fab Lab's should be easily accessible for receiving students from neighboring universities and users from various nearby companies. The Fab Lab staff should also be actively engaged in local outreach by attending meetings and giving demonstrations. They should be broadly able to promote the capabilities of the Fab Lab as well as the potentials of digital fabrication technology. Outreach, effective communications and networking are critical activities for the Fab Lab, and must be adequately staffed and budgeted for.

Ideally, the Bulgarian flagship Fab Lab should be located in Sofia, in a place near the following areas of activity: (1) Universities, (2) Technical Colleges and Institutes, (3) Key components of the innovation ecosystem, (4) Woodcrafters neighborhood, (5) Industrial Parks.

The Fab Lab should also be in contact with the main ICT stakeholders, including telecommunications-related companies, centers of information processing, etc. One of the main goals of a Fab Lab is to facilitate the production of technology related products by providing access to state-of-the-art technology for invention and innovation. Some basic components of the existing ICT infrastructure and professional expertise should be exploited to facilitate such endeavor.

The successful deployment of a Fab Lab entails setting up strong connections with local, regional and international stakeholders. First and foremost, the local community should be made to realize the existence of the Fab Lab to encourage the Lab's potential users to visit the facilities. At the local level, Fab Lab staff should be in regular contact with universities, high schools, business incubation centers, manufacturing associations, craft-making associations, industrial associations, and inventors clubs. A local level of awareness can be achieved by organizing contests for university students, by inviting school teachers to visit the facilities together with their students, by establishing links with local hacker clubs, or electronics stores. The Fab Lab should reach out to tech businesses through trade associations and social organizations that are related to technology.

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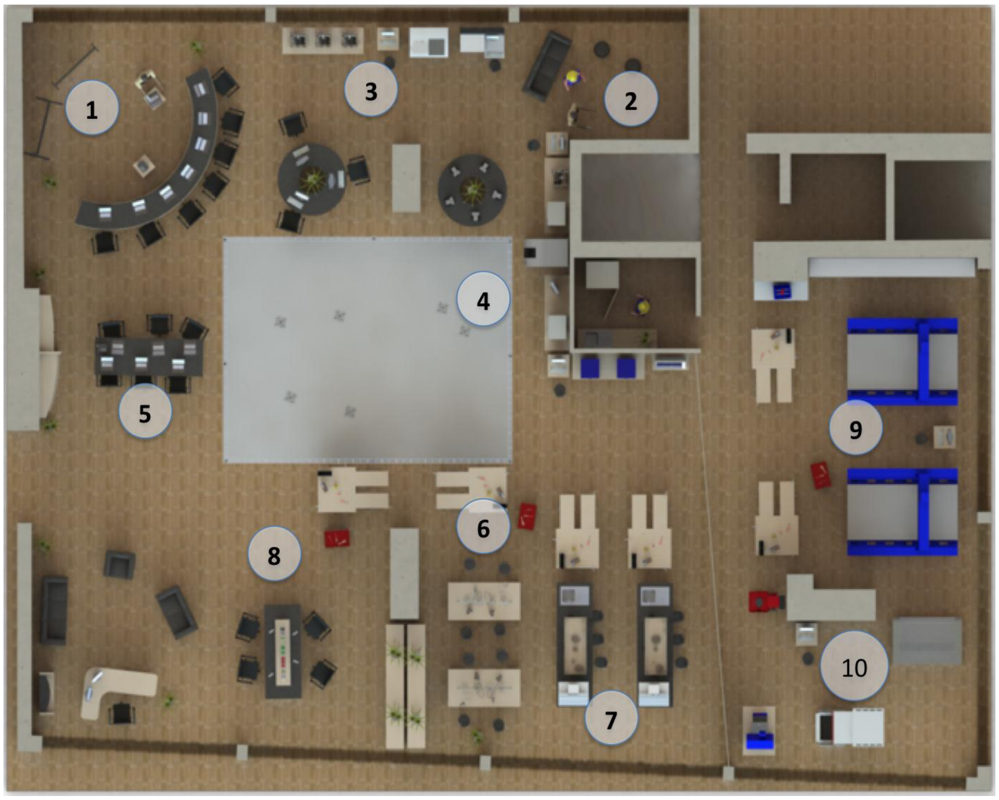
Connections at the regional level ensure collaboration with other laboratories and the organization of regional fairs, conferences and contests. This can be achieved by maintaining a regular communication with other Fab Labs in the region, exchanging experiences on the purchase of machines and about the convenience of using one or other pieces of equipment. Organizing regional activities such as the Fab Academy[26] and organizing local Maker fairs.

At the international level, it is very important for members of a Fab Lab to participate in international Fab Lab conferences and to attend the World Maker Faire. These international activities are very important to learn about potential uses of the Fab Lab and interesting projects. The Fab Lab staff can learn about the use of new digital fabrication tools and new fabrication process that can be applied to local product development and community problem-solving. The management and staff of the Fab Lab should routinely undertake training to expand their skills and increase their knowledge of Fab Lab equipment and advances in technology. At the international level, the Fab Lab staff should consider attending the main events, such as the international Fab Lab conference and the World Maker Faire[27].

Ideally, the Fab Lab should provide the following resources: Spacious work area with many worktables, compressed air at each worktable, conference room, access to computer workstations, WiFi, refrigerator and microwave oven, coffee machine, rooms for hosting global innovators in residence, and storage space. It might even contain its own retail store with a small library. In addition, a help desk with back office support, such as printer, scanner, and fax machine are useful. An interesting model to attract people is to provide the Fab Lab with a small cafe shop, making it easier for newcomers on digital fabrication to be encouraged to make use of the facilities.[28] See Figure 19: Example of Fab Lab Physical Layout, one proposed layout for a Fab Lab facility.

Figure 19: Example of Fab Lab Physical Layout

[26] http://www.fabacademy.org
[27] http://makerfaire.com
[28] http://tokyo.fabcafe.com



Source: Zagal, J.C. et al. "Fab Lab as an Implementation Tool of the CDIO Program", 9th International CDIO Conference, Massachusetts Institute of Technology and Harvard University, June 9 – 13, 2013.

Notes: (1) Conference room with video conferencing equipment, (2) design space (3) 3D printing cluster, (4) 3D Scanning space, (5) Workstations, (6) Assembly tools and Assembly tables, (7) Molding and soft casting processing tables, (8) electronics workshop, (9) CNC routers, (10) laser cutting devices. The layout also comprises spaces for a help desk and coffee.

7.2. Equipment

A Fab Lab should be equipped with a set of rapid prototyping tools and machines to enable the expedient manufacture and testing of new products in reality. In addition, a current good practice is to promote the use of digital fabrication technologies, so that new designs coexist with the current revolution on digital manufacturing.[29] The task of defining a convenient set of digital fabrication tools to produce "almost anything" with a limited budged was already undertaken by a group of researchers at MIT.[30] They conceived the idea of a digital fabrication laboratory (Fab Lab), which is a workshop equipped with a standard set of machines and processes to facilitate

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[29] Lipson, H. Kurman, M. 2013. Fabricated. The New World of 3D Printing, J. Willey & Sons Ed.
[30] Gershenfeld, N. 2007. Fab: The Coming Revolution on Your Desktop-From Personal Computers to Personal Fabrication, Basic Books Ed.

communications and provide a modern means of fabrication for their users. The members of a Fab Lab are able to share digital designs through the Internet and collaborate on global projects. For example, they can send the digital design of a bicycle to another Fab Lab where this design can be materialized again thanks to the use of the same set of tools and processes. This new form of collaboration enables a whole new set of business models and entrepreneurial possibilities.

3D printers are a fundamental component on every Fab Lab. According to Lipson,[29] the technology of 3D printing is revolutionizing the world of manufacturing and democratizing access to the means of production. There are some fundamental principles of this technology that are unique.[29] Manufacturing a complex shape, for example, costs the same as manufacturing a simple one; thus, complexity is free for a 3D printer. Variety is free in contrast to traditional production lines. Some 3D printers are even able to produce interlocked components; and therefore, no assembly line is required for producing the related goods. 3D printing enables production with almost a zero lead-time, and with almost no operator skills. Many of the principles for the production chain in classical manufacturing are now questioned with this disruptive technology.

Sofia Fab Lab should be provided with the tools that are defined by the Fab Lab international community, as appropriate for a Fab Lab[31]. The ideal equipment, at an advanced level of deployment, of a Fab Lab comprises the following: (1) 3D Printing: 1 Objet 30 Pro, 8 Makerbot Replicator II, 1 uPrint SE Plus, (2) CNC Routers: 1 ShopBot Desktop, 1 PRSalpha Full Size CNC, 1 Modela MDX-20 CNC. (3) Cutters: 1 Vinyl 24 Roland cutter, 1 Epilog Laser FiberMarkFussion 32 cutter (4) 3D Scanning: 1 LPX 600 DS 3D Scanner, (5) Vacuum Forming, (6) Injection Molding, (7) Metal Lathe, (8) CNC Embroiderer, (9) TIG and (10) MIG welder.

In a case where the Fab Lab is deployed in a series of different stages over time, it is important to define a priority ranking between the machines. If the budget is initially small, under a Basic Level of deployment, the most important machines are: 3D Printers (starting from the less expensive Makerbots), ShopBot Desktop, Vinyl Cutter, an inexpensive Laser Cutter, and an inexpensive 3D scanner such as a Microsoft Kinect. For an Intermediate Level of deployment, the priority must follow to the CNC routers. Finally, to complete the overall list, the fundamental equipment recommended for the Bulgarian Fab Lab at an Advance Level of deployment is outlined in Financial Feasibility Section 9.1 below, with a detailed description of unit costs. The total machine specification establishment cost estimated for the Bulgarian Fab Lab, as shown in that table is € 271,890.

7.3. Fab Lab Services

A Fab Lab should host workshops and provide office space for continuous mentoring in various fields, as well as providing different types of services that are connected with the

[31] http://www.fablabinternational.org

goal of creating new products and companies by using digital fabrication technologies. These services would include:

Fabrication Services. At a Basic Level of deployment, the Fab Lab should provide the service of fabricating parts with digital fabrication machines. A rate per hour of use of a machine should be assigned to the production of parts. Values for the use of different machines can be in a range from 5-18 EUROS per hour of use more or less, dependent on the machine.

Machine hiring. Some machines can be hired per hour of service to users who had been approved through a basic safety course and machine operations training, as well as a course on the use and capabilities operation of a particular machine. The fees for using such machines would be less than that for hiring "Fabrication Services," because those machines are operated by the certified user. To become certified at most Fab Labs interviewed requires attendance at a basic 1-hour workshop for a fee in the range of 20 EUROS.

Workshops and classes. At an Intermediate Level of deployment, the Fab Lab should provide more advanced training and executive mentoring in the following areas of expertise:

- Safety and Basic Use (Compulsory for all the members) and all users, other than customers merely hiring the services of the Fab Lab staff to execute their orders,
- Design and CAD/CAM Software, Electronics (Arduino),
- CNC (Concepts, Machine specific),
- Fabrication (Vacuum Forming, Injection Molding, Mold making for rubber, silicone, urethane and epoxy casting resins, Sandblasting and Powder Coating, Carbon Fiber Basics),
- Laser cutting,
- Machining (Milling, Lathe, Knurling and Threading on a Lathe),
- 3D Printing,
- 3D Scanning,
- Textiles (Sewing Machine, CNC Embroider),
- Woodshop,
- Workshops (IP Protection, Fundraising, etc.).

Training at these workshops can be provided by local professionals or by international guest experts.

Business planning consultancy. At an Advanced Level of deployment Fab Lab, a business expert should be available to provide feedback and support on fundamentals from business creation and planning to managing and growing a business. This advisor could also be a potential investor or a member of an industrial mentoring association. The Fab Lab could make these arrangements with an independent consultant, who offers his services for a fee to the designer.

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The consultant will gain access to potential business opportunities to invest and provide additional advanced advisory services. In any event, the cost structure for any such ancillary services as this, R&D monitoring, IP rights protection and the like highlighted below, will be dependent on local market forces, and are difficult to estimate in the abstract, but should be more closely examined in the Feasibility Study.

R&D monitoring. Connections with research centers should be facilitated for people working on advanced projects that can have a potential link or interest from a research perspective. The Fab Lab should maintain a list of contacts with these centers. This service could be used to generate fees or it could be included in what a user pays when a subscriber or paying an hourly user fee for accessing the facility. Making such connections will be facilitated if the Fab Lab is established under a Consortium of entities.

Product development and Services. Most of early stages of product development should be empowered by the tools and advice provided at Fab Lab. Knowledge about the use of project versioning tools (such as Git, Mercurial, etc.) should be maintained. Beyond conception and prototyping, the Fab Lab should provide guidelines for manufacturing scalability (It is not the same to make 1, 100, or 10,000 units of something) and for achieving continuous product improvement through community feedback. Fab Lab should also provide guidance for exploiting the global manufacturing ecosystem. Availability of factories in the cloud, such as MGF.com or Ponoko should be considered.

Support with intellectual property issues. A Fab Lab should provide support on the pros and cons of IP protected development versus open source hardware. Knowledge about the various types of licenses (such as those provided by Creative Commons and GPL) should be maintained.

Support with regulatory issues (registration of products/services in heavily regulated industries*)*. The Fab Lab should provide expertise about the various tools and procedures for registering products, trademarks and names at the national, regional and international level.

Market intelligence and marketing consultancy. At an advanced level of deployment, the Fab Lab should support a Go-to-Market strategy for international and domestic commercialization of products (e.g., exploit tools such as Etsy, Storenvy, Shapeways, etc.). Go-to-Market support refers to the task of providing guidance on using new distribution channels for connecting the business with customers. These new type of digital products can be delivered globally by exploiting various distribution tools that have become available recently. Examples of these tools are web services such as Shapeways, Ponoko and Sculpteo that allow designers to expose their creations to a large global market as well as to outsource fabrication and simplify distribution. Other tools such as Kickstarter and Indiegogo allow makers not only to fund-raise for their projects, but also to build a community of customers, while keeping advertising costs to almost zero. Since these tools are not well-known among standard incubators, it is a Fab Lab that should provide expertise on how to exploit these new alternatives.

Public outreach. Outreach is achieved by means of public events and the organization of local maker fairs. Members of the staff should attend international events such as the world maker faire.

Networks/linkages with industry, business incubators, entrepreneurs. A Fab Lab should maintain strategic connections with potential users from the industry, business incubators, Angel investors, Venture Capitalists, entrepreneurs and national institutions that can help in the promotion of new business.

Support access to funding. Support with access to crowd funding tools such as Kickstarter, Quirky or Indiegogo. These tools provide for simultaneous funding, market research and customer community construction. Training on the generation of good advertising videos and good practices for uploading projects to crowd funding tools should be given.

Support at handling country-related obstacles (language, customs procedures, etc.). The Fab Lab should also provide support for foreign makers and innovators, who are willing to work on the development of their ideas in Bulgaria. A room for hosting international innovators in residence is becoming a good practice in between Fab Labs.

8. Financial Model

Under today's conditions and based on the interviews conducted during this study (see Annex 2), the majority of institutional Fab Labs are not usually intended to be profit-generating operations. Fab Labs provide a new technology platform for disruptive innovation approaches to design and develop products and to manufacture and distribute them based largely on the digital fabrication technologies. Fab Labs have tremendous implications for development of 21st Century societies, and as such, their most important impact in innovation and in contributing to the public welfare. The purpose of a Fab Lab is to promote innovative capabilities and socio-economic development objectives through public accessibility to the application of new breakthrough technologies.

The challenges for a standalone Bulgarian Fab Lab to achieve "financial sustainability" based on current market conditions and the potential for charging user fees become apparent in reviewing various models. Earlier in 2013, World Bank advisors reviewed a proposal to the Bulgarian Government for a "mini Fab Lab Sofia" dated 11th December 2012. In the response titled "World Bank's Perspective on the Current Draft", the team emphasized that much deeper research needed to be done to validate the market and to assess whether the services offered would be needed by the likely customers and establish their willingness to pay for such services. The World Bank's review also questioned the sustainability of such an independent Fab Lab and emphasized the need for a long-term financial commitment of support from a government agency or very advanced research institute. It is essential that deeper market research must be carried out during the feasibility study, and notwithstanding the apparent level of demand at given prices, if Bulgaria wants to achieve what a Fab Lab can offer as a public good, then the Fab Lab will require some level of public support.

8.1. Financial Model

To provide an indication for flagship Fab Lab, a theoretical financial model was constructed from information provided by Fab Lab operators in Central and Eastern

European (CEE) countries and adapted for Bulgarian conditions in order to draw comparisons among the Business Models discussed in Section 6. This model illustrates the challenges in shaping an appropriate Fab Lab model for Bulgaria. In order to analyze different scenarios and assumptions, this model in the excel format can be used as a toolkit to adjust the input parameters and scenarios. We recommend deploying the Advanced Model based on its value proposition in terms of impact and likelihood of financial sustainability. Moreover, there are also higher levels of potential revenue sources linked to new business generation through an Advanced Fab Lab that are not considered in the table provided below, since they are difficult to assess in the abstract in Bulgaria at this early stage.

Under existing Fab Lab working models, most Fab Labs are forced to rely on some sort of external subsidies. These subsidies are in the form of State grants, local community support, private and foundation grants, and core business operations, for which the Fab Lab equipment is primarily used. In the case of such latter Fab Labs, the core business support of the facility (e.g., an architectural firm's production of models for clients) allows users to benefit from the Fab Lab services at an affordable cost, including some users for free (e.g., former professors and local architecture students). Similarly, university-based Fab Labs, which are frequently free to students and professors, user fees are charged to others. In these situations, the private business or university has acquired the necessary Fab Lab equipment to serve its own needs, and capitalizes on its availability to generate some additional revenue from external sources to supplement its budget. The fees provided by such external users alone typically do not come close to the covering the operational costs of the Fab Lab facility.

Establishment costs: To establish an effective and useful Fab Lab for the short and long term, the complete MIT equipment list must be purchased (see discussion of equipment in Section 8.2). In addition, the space must be furnished with adequate tables, desks, and shelves as outlined in the

Table 5: Advanced Fab Lab – Estimated Establishment Costs for Sofia, Bulgaria.

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Table 5: Advanced Fab Lab – Estimated Establishment Costs for Sofia, Bulgaria

#	Description	Unit cost (FOB) ($USD)	Cost (FOB) ($USD)	Coutry of Origin
Quantity	**3D Printing**			
1	Objet 30 Pro	$65,000	65000	USA
8	Makerbot Replicator II	$2,500	20000	USA
1	uPrint SE Plus	$25,000	25000	USA
		Total 3D Printing	**$110,000**	
	Cutting			
1	Epilog Laser FiberMark Fussion	$80,000	80000	USA
1	Ventilation accesory for Laser c	$3,000	3000	USA
1	Roland MDX 24 Vinil Cutter	$2,500	2500	Japan
		Total Cutting	**$85,500**	
	CNC routers			
1	ShopBot PRSAlpha 96	$20,000	20000	USA
1	ShopBot Desktop	$5,000	5000	USA
1	ShopBot Accesories	$7,000	7000	USA
1	Roland MDX 20	$5,600	5600	Japan
		Total CNC Routers	**$37,600**	
	3D Scanning			
1	Roland LPX 600 DS	$18,000	18000	Japan
		Total 3D Scanning	**$18,000**	
	Accessories/Supplies			
1	Workstations, Electronics and T	$15,000	15000	China
1	Accesories, materials, supplies	$21,000	21000	China
		Total Accesories	**$36,000**	
	Total Equipment Cost (FOB)		**$287,100**	
	Shipping (estimation)		$15,000	
	Total Equipment (CIF)		**$302,100**	
	Total import duty & taxes		$75,525	
	Total Initial Establishment Cost ($USD)		**$377,625**	
	Total Initial Establishment Cost (€Euro)		**€ 271,890**	

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Operating costs: For public authorities, Table 6 provides an estimate of the annual operational costs for the Advanced Model Fab Lab located in Sofia, Bulgaria. The Table includes a manager salary to oversee the entire operation, do the outreach, marketing and fund-raising and deal with the Fab Lab's hosting entity as well as network with Fab Lab's abroad and within Bulgaria as the BFLN is developed. The manager would also assist clients and provide services in support of the Fab Lab's staff. Also included are front desk personnel salary (two designers working on rotating shifts), an engineer salary to assist clients with more complex needs, maintain the equipment and the like. Rent, electricity, Internet, services, attendance at international conferences and fairs, cost of outreach and publicity are also listed. These costs are adjusted to the estimates of local expenses of Sofia that were obtained from InvestBulgaria.br and discussions in Sofia.

Table 6: Advanced Fab Lab: Estimated Annual Operating Costs for Sofia, Bulgaria

Human Resources	Monthly net salary (*)	Monthly gross salary	Number of Empl	Year Cost
Manager (10 years experience)	€ 2,000	€ 2,600	1	€ 31,200
Engineer (5 years experience)	€ 1,100	€ 1,430	1	€ 17,160
Designer (5 years experience)	€ 700	€ 910	1	€ 10,920
Designer (junior)	€ 500	€ 650	1	€ 7,800
	Total Human Resources			**€ 67,080**
Rent	Monthly rent (	Per sq. m		
300 sq meters in business park	€ 2,948	€ 8		€ 35,376
	Total Rent			**€ 35,376**
Other costs	Montlhy cost (	Months		
Electricity, heating and cooling	600	12		$7,200
PoC Lab consumes double of a house				
Internet	Monthly cost (	Access points		
Fast internet service	€ 50	2		€ 600
Outreach	Cost	No. of Empl.		
Participation/Travel Cost Conference Attendance (2 employees)	$5,000	2		€ 10,000
Marketing, Publicity, road show, exhibitions				€ 5,000
	Total Other costs			**€ 15,600**
Training/Education				
Fab Lab Academy Participation (2 empl. per year)				€ 10,000
Sub running costs (€ Euro)				**€ 128,056**
Contingency (10%)				€ 12,806
Total running costs (€ Euro)				**€ 140,862**
(*) Source: http://www.investbulgaria.com				

As a preliminary assessment, in order to ensure that all estimated establishment and operating costs during the initial 7-year period OPIC 2014-2020 are covered, the Fab Lab should strive to be at or near its breakeven point in Net Cash Flow. Based on the Table 7: Establishment and Operational Costs for Fab Lab models for the 7-year period, the Operational Program for Innovation and Competitiveness (OPIC) 2014-2020 should reserve approximately EUR 1.3 million; however, it is expected that the Fab Lab will generate approximately EUR 1 million in revenue during the first 7 years, so the burden on OPIC funding can be expected to be in a lower range. Further to this point, the need for public support for ongoing operations after approximately 7 years should be diminished substantially.

Table 7: Establishment and Operational Costs for Fab Lab models for the 7-year period

Fab Lab Model	Estimated Establishment and Operational Costs (7 years)	Estimated Projected Revenue (7-years) (without depreciation of equipment, maintenance costs, etc.)
Advanced	€ 1,257,921	€ 1,003,870
Intermediate	€ 930,631	€ 625,328
Basic	€ 704,391	€ 373,500

Estimated revenue. For public authorities, the revenues would provide the financial indicative assessment of the return on public investment. Key drivers of revenue streams for Fab Lab in our financial model are (i) workshop revenues, (ii) machine hiring revenue; (iii) consulting services.

Overall, revenue is obtained by means of:

(1) **Personal memberships:** Fab Lab in Hungary charges only daily or weekly passes, and the fees are minimal. Such memberships have been attempted by Fab Labs in the CEE, however, without the success experienced in the US market.

(2) **Corporate memberships:** intended for micro-, small-, and medium businesses, as larger businesses typically would be able to purchase the underlying equipment or hire the Fab Lab's consulting services.

(3) **Workshops and Classes:** In addition to 1-2 free public days, these can be open to any person at a rate of 20EUROs per three-four hours of classes. During the 1st year of operations the entrance fee to classes can be further minimized to serve the larger community. Workshops and classes are necessary in order to operate machines and invoke design and innovative thinking.

(4) Fee for fabrication services.

(5) Fee for machine hiring.

(6) Revenue from business mentorship (incubation/go-to-market) and other advisory services.

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Financial sustainability criteria. For investors and financial professionals, the sustainability of Fab Lab implementation models can be assessed by the Net Present Value (NPV) and the break-even point in the net profits. Given the assumptions made as a base indicator, the Table following below exhibits the estimated cash flow for the Advanced Fab Lab model. As discussed earlier in this chapter, although the estimated cash flow shows that NPV is negative, and break-even is achieved on the 7th year of operation[32], this is an indicative cash flow model that represents the methodology for calculating the financial returns, serving as a toolkit for the prospective calculations once the input variables are validated during the full-fledged feasibility study.

In addition, it should be clearly understood that a Fab Lab's focus is not on profit-generation, but on wide socio-economic impact; and therefore, a given Fab Lab's value cannot be assessed only on the basis of its financial statement and NPV. Indicative financial assessments are constructed for Basic and Intermediate Models of Fab Lab, and are presented in Annexes 7 and 6, respectively. Therefore, given the relatively small difference in upfront investment in equipment and facilities to establish a Fab Lab, there is an advantage in investing in the Advanced Level model from the beginning.

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[32] Based on the interviews, a few small stand-alone Fab Labs (Ltd.) shared that they have a goal to reach the break-even point in the net cash flow within first 4-5 years. However, only one example claimed to have achieved it (Fab Lab Hungary). At this pre-feasibility study phase, we could not verify this information, which would likely require a meeting in Hungary with the Fab Lab operator to permit deeper and more comprehensive review of critical financial components.

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Table 8: Estimated Net Cash Flow Statement for Flagship Fab Lab in Sofia, Bulgaria

Advanced Fab Lab: Estimated Revenue								
Discount rate (nominal)	10%							
Projected Inflation	2.0%							
Discount rate (real)	7.8%							
Depreciation Rate	14%							
Variable cost base	4000							
Corporate Tax	10%							
	Years							
	0	1	2	3	4	5	6	7
Individual Pass Fee (core machines are not included)		€ 15	€ 20	€ 20	€ 20	€ 20	€ 20	€ 20
Users who purchased passes		15	13	20	18	25	30	50
Individual Pass revenue		€ 225	€ 260	€ 400	€ 360	€ 500	€ 600	€ 1,000
Business/SME Pass:		€ 50	€ 50	€ 50	€ 50	€ 50	€ 50	€ 50
Number of Business Passes purchased		3	6	7	8	11	15	20
Business/SME Pass revenue		€ 150	€ 300	€ 350	€ 400	€ 550	€ 750	€ 1,000
Fee for consulting service (with operator, big machines), Average Fee		€ 10	€ 12	€ 12	€ 12	€ 12	€ 12	€ 12
Hours per Month		30	60	90	135	202.5	303.75	455.625
Months		10	10	10	10	10	10	10
Consulting Service revenue		€ 3,000	€ 7,200	€ 10,800	€ 16,200	€ 24,300	€ 36,450	€ 54,675
Machine hiring (no operator)		€ 5	€ 7	€ 10	€ 10	€ 10	€ 10	€ 10
Hours per user per day		4	6	6	6	6	6	6
Users per Day per month		1	2	4	6	8	10	12
Days per Month		20	20	20	20	20	20	20
Months per Year		10	10	10	10	10	10	10
Machine Hiring revenue		€ 4,000	€ 16,800	€ 48,000	€ 72,000	€ 96,000	€ 120,000	€ 144,000
Workshop Fee per hour		€ 20	€ 30	€ 30	€ 30	€ 30	€ 30	€ 30
Number of Workshops per Month		10	12	15	18	20	22	20
Months per Year		10	10	10	10	10	10	10
Users per workshop		5	10	10	10	10	10	10
Workshop revenue		€ 10,000	€ 36,000	€ 45,000	€ 54,000	€ 60,000	€ 66,000	€ 60,000
Business mentoring, Average Fee Per hour *		€ 10	€ 15	€ 15	€ 15	€ 15	€ 15	€ 15
Hours per Week		6	6	6	6	6	6	6
Weeks Annually		30	30	30	30	30	30	30
Mentorship Revenue		€ 1,800	€ 1,800	€ 1,800	€ 1,800	€ 1,800	€ 1,800	€ 1,800
Free Public Hours and associated costs								
				3D Printers		Workstations	3D Printers	
			Machine repl:	€ 14,800		€ 15,000	€ 14,800	
Establishment Cost	(€ 271,890)							
Public/Foundation Finance	€ 271,890							
Annual revenue		€ 19,175	€ 62,360	€ 106,350	€ 144,760	€ 183,150	€ 225,600	€ 262,475
Annual Operating Costs		(€ 128,556)	(€ 128,556)	(€ 128,556)	(€ 128,556)	(€ 128,556)	(€ 128,556)	(€ 128,556)
Operating Profit		(€ 109,381)	(€ 66,196)	(€ 22,206)	€ 16,204	€ 54,594	€ 97,044	€ 133,919
Replacement/ Maintanance Cost				(€ 14,800)		(€ 15,000)	(€ 14,800)	
Depreciation		(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)
Operating profit before Taxes		(€ 149,508)	(€ 106,323)	(€ 77,133)	(€ 23,923)	(€ 533)	€ 42,117	€ 93,792
Taxes		€ 0	€ 0	€ 0	€ 0	€ 0	(€ 4,212)	(€ 9,379)
Net Profit		(€ 149,508)	(€ 106,323)	(€ 77,133)	(€ 23,923)	(€ 533)	€ 37,905	€ 84,413
Net Cash flow		(€ 189,635)	(€ 146,450)	(€ 117,260)	(€ 64,050)	(€ 40,660)	(€ 2,222)	€ 44,286
Net Present Value (NPV)	(€ 445,794)							
NPV (12%)	(€ 414,400)							
NPV (15%)	(€ 393,887)							

*this represents 2/3 of the toal fee that goes to Fab Lab, with 1/3 being paid to the coach.

8.2. Options for funding strategies

EU Structural Funds

Public funding will be essential in creating and operating the Bulgarian Fab Lab, and funding from EU programs should be explored as a means to support the establishment of a Fab Lab in Bulgaria. Examples of EU funding programs that have been used by other Fab Labs are: The European Fund for Regional Development (used by Fab Labs in Belgian and Netherlands). The PEACE III funding program was used to fund Fab Labs in Northern Ireland. Other Sources of co-financing the Bulgarian Fab Lab should also be considered.

The JEREMIE initiative was developed in cooperation with the European Commission, and offers EU Member States, through their national or regional Managing Authorities, the opportunity to use part of their EU Structural Funds to finance small and medium-sized enterprises (SMEs). JEREMIE does so by means of equity, loans or guarantees, through a revolving Holding Fund acting as an umbrella fund.

State Aid issues are highly complex and difficult to assess and apply in the abstract. These issues must be resolved in the feasibility study. For example, if the Fab Lab is listed as a measure in the OPIC -- with a dedicated amount and implementation schedule, then State aid rules implications could be narrowed down to a possible pool. If the OPIC just states that the Fab Lab is an investment priority under a priority axis (as it does now), then there are too many possible implementation models that invoke the corresponding amount of State aid implications. It is important during the course of the Feasibility Study to decide on the model for the Fab Lab in light of OPIC and based on the State aid implications for each proposed model.

Private Investments

Another alternative to fund a Fab Lab would be wealthy individuals with an interest in supporting Bulgarian tech innovation. In the case of Latvia, one such individual seeded the Fab Lab there with a grant for purchasing Fab Lab equipment. Potential investors or financial supporters can also be identified among educational institutions, foundations, and manufacturing or trade associations whose members can benefit from having a Fab Lab sited in Bulgaria.

Establishment of National Fab Lab Fund

In order to ensure seamless financial sustainability from short- to long-term, some governments decide to create a fund, an analogue to the US Fab Lab Fund, which coordinates and supports the US network of Fab Labs to implement the applied educational STEM programs, to provide consulting services and to support opening of new laboratories.

Innovation Vouchers

An Innovation Voucher, which is also a part of innovation instruments for OPIC 2014-2020, is a form of a coupon entitling the owner to approach a knowledge institution to purchase its services. The Voucher encourages behavioral change in SMEs in traditional sectors towards innovation through technical assistance, and can benefit Fab Labs in Bulgaria. Therefore, it would be recommended to include the Fab Lab services to the list of knowledge institutions the Innovation Voucher

Corporate Social Responsibility (CSR) funds from MNCs

Most multinational corporations (and the number is growing) have strong CSR programs with a generous allotment of funds. Establishment of Fab Labs in schools and universities from the educational and pedagogical perspective fits the mission of CSR and community development; and therefore, it is possible that a Bulgarian Fab Lab could be supported through this channel, provided an interested MNC or large Bulgarian company could be recruited.

Grants

Some governments opt for giving grants to SMEs to use 3D printing in Fab Labs (such as in the UK). Foundation grants are another possibility that would need to be explored to support a Bulgarian Fab Lab at the level of the Fab Lab directly and/or to provide support to its users.

Calls for Proposals

Through a crafted tender process and Call for Proposals, as outlined in further detail in Section 10.2, it might be possible to identify and attract qualified hosts/co-sponsor institutions, which would independently develop and manage a Fab Lab or Fab Labs in Bulgaria and share in the establishment and operating costs of the given lab(s).

8.3. Financial Feasibility Conclusion

From a business model perspective, implementation of the Advanced model of Fab Lab would be the preferred approach. This model is rich in terms of providing various alternatives for revenue while maintaining the core functionalities of a Fab Lab. The Advanced model alos provides more flexible opportunities for expansion of the Fab Lab's capabilities, and it offers better opportunities to bring to wider global markets new products that are developed in Bulgaria. One should note that the suggested Advanced Fab Lab inventory is much more complete than the inventory suggested by MIT, this corresponds to a trend followed by leading Fab Labs toward increasing the capabilities for rapid fabrication over a wide range of materials and possibilities, to be flexible and stay apace of rapidly-developing technologies.

From a financial feasibility perspective, it is recommended that the Advanced model of Fab Lab deployment be implemented from the beginning of the project. Even though the NPV of the Advanced model is negative, it is better than the NPVs of the Intermediate and the Basic models, and one should consider that there are additional potential revenue sources linked to business generation in the Advanced model that are not considered because they are difficult to assess at this point. The Advanced model offers to promote digital fabrication over a wider community of users and considers a broader set of technologies. As illustrated in the table in Section 9.1, the break-even point is achieved earlier (fourth year) in the Advanced model than in the Intermediate model (fifth year), as illustrated in Annex 6, and for the Basic model (sixth year), as illustrated in Annex 7. Given a Fab Lab's potential socio-economic impact, its value

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cannot be assessed only on the basis of its financial statement and NPV. Yet, the indicative financial assessments constructed for Basic and Intermediate Models and presented in Annexes 7 and 6, respectively, are helpful in showing that for a relatively small difference in upfront cost in equipment and facilities, there is an advantage to investing in the Advanced Level model from the beginning.

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9. Risk Evaluation and Risk Management

9.1. Potential Risks for a Fab Lab in Bulgaria

Bulgarian Fab Lab will be subject to similar risks faced by Fab Labs generally, as well as to risks more specific to Bulgarian conditions.

In reviewing the operations of various Fab Labs and discussing problems, some common pitfalls for establishing long-term operationally sustainable Fab Labs appear to be:

1) failure to incorporate model balancing private management leadership with public financial support and integrating a workable public-private governance mechanism into operations;
2) failure to develop a financial model to provide for long-term funding;
3) failure to attract and retain an engaged and highly-skilled team of managers and staff;
4) failure to generate local client demand and a viable community of Fab Lab users;
5) lack of an ability to match technology skills with business skills, or to provide complimentary support services for Fab Lab users; and
6) concerns about digital fabrication facilitating the theft of intellectual property when products are transmitted as designs and can be produced on demand – i.e., how to prevent those designs from being replicated without permission.

There are also risks related to Bulgaria's local institutional and regulatory environment which could impact the viability of a Fab Lab as the country embarks on efforts to develop an innovative economy.[33] Most such risks stem from the overall development level of Bulgaria's ecosystem/instutional infrastructure and of the human capacity needed to support an innovative economy. Careful assessment of existing and planned institutions supporting an innovative economy and how they will contribute to collaboration with the Fab Lab will need to be made. Similarly, since the Fab Lab concept is new to Bulgaria, the skills to promote, manage and operate the Fab Lab may not be readily available. Moreover, the potential users of the Fab Lab may not even be familiar with these new technologies and able to appreciate how they could be applied to their work. Thus, once competent Fab Lab management is recruited, they will need to create a program of education and substantial outreach to inform the potential user community on the benefits of the Fab Lab and to stimulate demand. It is also possible that a carefully crafted Tender process through a Call for Proposals, as outlined in further detail in Section 10.2, could

[33] The most problematic factors generally speaking for doing business in Bulgaria are outlined in the WEF Competitiveness Report 2013-2014.

provide a means of identifying qualified hosts/co-sponsors in developing and managing Fab Labs, and through their co-investment, reduce the Government's risk.

Furthermore, with the many new concepts and approaches in building an innovative economy, staff in government oversight agencies are not likely to be well-versed in these subjects. Their lack of knowledge could slow approval processes and decision-making decisions. Similarly, a comprehensive body of goverenment policies are being developed to promote innovation, and there will likely be issues to be worked out over time in implementation of those policies. If government officials and responsible staff are not knowledgeable in the innovation support mechanisms and their real world implementation processes, government could be an impediment to action.

9.2. Risk Mitigation Strategies

Notwithstanding the common pitfalls and the Bulgarian-specific risks of establishing a Fab Lab, it should be possible to anticipate in advance most common pitfalls as well as the Bulgarian-related challenges and to compensate in ways that address them. For the first two common pitfalls, risk should be ameliorated through upfront work in sound design of the Fab Lab and recognition of the need for sufficient public support as a major factor in its sustainability. As noted in the Governance section of this Report, there are fundamental and proven models that balance public and private roles in similar such institutions that require public-private partnering.

For Bulgaria, the challenge will be in selecting a workable approach under its conditions, and implementing it. That is all achievable through proper consideration and sound judgment. Similarly, as a new cutting-edge mechanism to stimulate innovation, the Fab Lab will not be sustainable for some years without public or charitable funding to offset insufficient commercial market demand for its services. That reality must be factored into the Fab Lab's financial model from the outset. At least in the case of Bulgaria's financial model, long-term public financing can be secured from the OPIC. After that funding expires and the Fab Lab is well established, funding could be derived from a combination of national and local public funding and co-financing by private sector entities through a PPP, foundation and CSR grants, pay as you go user fees, workshops and other services.

Common pitfalls 3, 4 and 5 (in Section 8.1.) are interrelated, and by selecting and retaining competent managers, particularly the Fab Lab's Managing Director (MD), these operational risks can be significantly ameliorated. This will mean that adequate compensation and benefits must be provided over the long-term to the MD and others on the staff, and there must be an appropriate budget for outreach, education and promotion of the Fab Lab concept and as well as attractive services available to its users to stimulate demand. The mix of services that will bring users into the Fab Lab will depend on the unique needs of Bulgarian designers and innovators. In the course of organizing the Fab Lab in Bulgaria and marketing of the Fab Lab concept, the highest sources of demand will become apparent. Fab Labs fill a community role,

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and potential partners – like universities, incubators, independent design firms, and others – specific to Bulgaria can best be identified.

Theft and infringement of Intellectual Property Rights is an ever present threat in any situation, and given the "open source" nature of some Fab Lab models and that it can be difficult to control how someone uses a digital design, suspicious Bulgarian innovators might be reluctnat to use the Fab Lab. As the global network of Fab Labs grows and the concept has matured, solutions to such problems are emerging. Now in fact, files of digital fabrication designs can be sold in a regulated way, like music and entertainment. From a practical perspective in some niches that do not support mass manufacturing, the designer only need cater to specialized interests. Patent protections on digital fabrication designs can work only if there is some barrier to entry to using the intellectual property and if infringement can be identified. Anyone with access to the tools can replicate a design anywhere; it is not feasible to litigate against the whole world. Instead of trying to restrict access, flourishing software businesses have sprung up that freely share their source codes and are compensated for the services they provide. E-bay like clearhouses, such as Ponoko, have been established to collect royalities from use of such digital designs, as one means for designers to benefit from their IP. The spread of digital fabrication tools is now also leading to a corresponding practice for open-source hardware.

Ultimately with respect to the Fab Labs creation, maintenance and usage, it is a question of cost-benefit analysis, and for Bugaria, the socio-economic benefits to the local community and nation of a Fab Lab and the innovation it can stimulate far outweighs the risks cited. For a relative small initial investment in equipment, facilities and staff and a portion of ongoing operating support, Bulgaria has an opportunity to create a vehicle providing critical stimulation to SME innovators, the academic community, researchers. This is an opportunity Bulgaria should consider very carefully.

10. Monitoring and Evaluation (M&E) Framework Options

Essential to good governance and oversight are systematic means to evaluate operations and performance. Although some evolution to reflect the realities of the marketplace will likely take place, the objectives of creating the Fab Lab and attendant measures of performance should be clear from the start. Accordingly, along with development of the Fab Lab and defining its specific objectives, clear measures of performance must be established and baseline data collected as a means of assessing actual performance on a regularized periodic basis. As actual operations commence additional measures might become apparent and can be added to the mix.

M&E model/system performance indicators for Fab Labs

Although each Fab Lab is unique, some generally-recommended performance indicators to consider are the following:

- number of users and volume of use per month,
- number of products that are being developed per year,

- number of patents per year,
- number of projects that go for crowd funding internationally,
- number of subscribers,
- amount and percentage share of support from local community,
- collaborative partnerships with other institutions supporting innovation, like universities, high schools, R&D institutes, trade associations, etc.
- Day-to-day operations of the Fab Lab should meet a basic occupancy or use level for the space and equipment. For example, a suggested scale[34] could be:
  - Occupancy/equipment usage below 30% rated as too low,
  - 40% of occupancy/equipment usage rated as fair, and
  - 80% of occupancy/equipment usage rated as very good.
- A convenient metric to assess broadly the financial performance of the Fab Lab is the growth in average EBITDA (i.e., Earnings, which equal Revenue minus Expenses Before Interest, Taxes, Depreciation and Amortization)[35] of the Fab Lab during the last three years of evaluation, but ultimately, achieving Cash Flow Breakeven[36] will be essential for the long-term sustainability of the Fab Lab as an on-going business. However, it seems clear that few Fab Labs standing on their own would achieve such profitability; thus, a more realistic measure could be the share of public funding of the Fab Lab's budget and whether the public contribution is decreasing.
- Development of local SMEs stemming from their use of the Fab Lab and metrics, such as their increasing number of employees, their growth in EBITDA, etc., could serve as another measure demonstrating broad impact of the Fab Lab, if that information can be collected from such independent third parties while they are using the Fab Lab and even more so, after they leave.

[34] Such figures would largely be indicative of client demand for use of the Fab Lab and a reflection of the effectiveness of the Fab Lab in attracting users. Ultimately, it is the revenue and cash flow generated by users which will be determinative of the Fab Lab to sustain itself.

[35] While EBITDA is a good metric to evaluate profitability, it does not evaluate cash flow essential for maintaining an ongoing business. It also does not account for the necessary cash to fund working capital and for replacement of obsolete equipment, which in some businesses can be significant.

[36] The cash flow breakeven point serves as a critical calculation in evaluating the financial health of a business. It takes into account not only how much the business needs in revenue to its expenses, but also when that cash from those sales will be collected in comparison to when the businesses bills for it expenses (e.g., rent, salaries, supplies, etc.) are due. By calculating a cash flow breakeven point, business managers can foresee periods when they have to draw from the company's reserves, borrow money or even sell assets to cover essential expenses.

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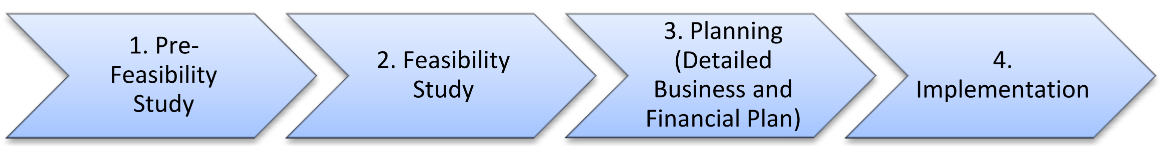
These are just a few of an array of possible performance measures, all of which can be more carefully defined once the structure and objectives of the Bulgarian Fab Lab are determined. In that regard, a likely long-term goal for Bulgaria would be to foster the creation of new manufactured products that can contribute to the Bulgaria export economy. Thus, a measure would need to be established to assess the impact of the Fab Lab for standard users developing designs that are not likely to have impact on exports, and possibly for corporate users, which are engaged in or supporting manufacturing of goods with export potential.

Ultimately, the performance of Fab Labs (like technology business incubators and other innovation development vehicles) should be judged largely by their results achieved. These entities primarily serve the public good by contributing to socio-economic objectives. They have a significant qualitative impact on individual developers, businesses, the local community's overall economic development and other related priorities. Thus, the real long-term impact achieved is immensely more important than short-term measures, such as occupancy rates or failure rates.

11. Next Steps: Feasibility Study, Planning and Implementation

From a high-level perspective, the sequence of phases exhibited in Figure 20 represents the key steps in the process of establishing the flagship Fab Lab and the attendant Fab Lab Network in Bulgaria.

Figure 20: Phases during Project Implementation



11.1. Preparing the Feasibility Study

Call for proposals to conduct feasibility studies (including business demand surveys and preferred site surveys) for flagship Fab Lab in Sofia (and if decided regionally-based Fab Labs).

The preparations for the Fab Lab Feasibility Study typically would involve these key steps[37] (which can be undertaken simultaneously):

[37] The international guidelines (InfoDev, UNIDO) for undertaking feasibility studies were adapted to the context of Fab Lab.

1. Formation of a development team (e.g., a task force or steering committee comprised of representatives from key stakeholder groups, international experts, government, etc.);
2. Development Team's capacity building: Learning about the Fab Labs and digital fabrication from the practitioners (World Bank can facilitate a virtual or face-to-face workshop), also there's a potential to attend the annual conference FAB 10 as a critical benchmarking and networking event for all Fab Labs around the world in July 2014;
3. Securing resources for planning and implementation of the feasibility study;
4. Planning a feasibility study: to share a common vision of
    a. a business model;
    b. the road map for conducting the feasibility study; and
5. Undertaking a feasibility study, conducting consultations, market survey, consensus building, etc.

While the feasibility study development team (e.g., "task force") is being brought together (ideally, public-private partnership), it is important to set aside a time to collectively plan the feasibility study. Collaborative and iterative design will engage stakeholders' to 'buy-in', and will allow the team to address the interests of different stakeholder groups and consider top policy priorities. At this stage, it is advisable to agree on the roadmap for conducting the feasibility study and its main components.

By definition, the feasibility study should be an inclusive, open, consultative process that examines the potential barriers and benefits of investing resources in a Fab Lab and the BFLN. The feasibility study might take 3-6 months to complete, depending on a number of factors. The main objectives could be to:

1) Determine objectives and governance/operating structures for a Flagship Fab Lab in order to maximize its impact;
2) Provide options and recommendations for how the Fab Lab Network in Bulgaria should be conceived and implemented, including scale of such a scheme to have critical mass and impact; and
3) To assess the feasibility of the identified options.

The main components of the feasibility study should encompass the following:

- In-depth market analysis;
- Analysis of whether Bulgarian economy, institutions, industry and market are conducive to establishment of long-term operational Fab Lab locations, in case of BFLN, and what needs to be done to lay a proper foundation;
- Financial models to ensure seamless short- to long-term funding sources and needs are evaluated;

- Recommendations for the business model;
- SWOT analysis;
- Review of specific industries/sectors that could benefit from a Fab Lab in Bulgaria, and how innovation and entrepreneurship in such sectors would lead to increased competitiveness.

An integral part of the full-fledged Feasibility Study of a Fab Lab and Fab Lab Network for Bulgaria would be in carrying out a market demand analysis through a market survey and conducting comprehensive consultations with key stakeholders from across the innovation ecosystem in Bulgaria. The full-scale market demand analysis during the Feasibility Study would have multiple objectives: (i) quantify the potential demand; (ii) build the community of potential users; and (iii) build the partnerships within the innovation ecosystem in Bulgaria (including 'quadruple helix'[38]). Consultations and focus groups would not only help to identify market demand, but also contribute to educational outreach to raise awareness, align expectations, and develop a shared vision of opportunities that Fab Lab can bring to catalyze innovation and growth in Bulgaria. Other methodological approaches to solicit information are case studies, bibliometrics, network analysis, benchmarking, scoring methods, expert opinion, etc.

The feasibility study could also include:

- *Supply Chain Analysis (SCA)* – to identify providers of 3D printing, laser cutting, suppliers of materials (e.g., aluminum, wood, electronics, brass, plastic, etc.).
- *In-depth Innovation Ecosystem Network Analysis* – linkages with tech parks, research infrastructures, technology transfer offices, business incubators, universities, engineering departments, technical colleges and institutes.
- *Cluster Mapping* – as a useful and effective strategy to strengthen competitiveness.
- *Detailed Cost-Benefit Analysis.*

During the planning phase of the feasibility study, it is important to collaboratively develop the roadmap using visual tools such as the "Business Model Canvas" applied to the Fab Lab. The process of such brainstorming exercise can be greatly informative to understand the ecosystem in which the Bulgarian Fab Lab would be operating, and to design its business model appropriately. We are using this approach in this pre-feasibility study to demonstrate three approaches to the deployment of a flagship Fab Lab. The main components of the business model are outlined in the charts following below, and in Annex 1, with each of these components "populated" with respective elements of the business model, depending on the level of

[38] Quadruple Helix (Carayannis and Campbell, 2009). The *Quadruple Helix* model is based on the *Triple Helix* model (university-industry-government) and adds as fourth helix the 'public', 'end-user', more specifically being defined as the 'media-based and culture-based public' and civil society. This fourth helix associates with "media", "creative industries", "art", "creative class' (http://www.innovation-entrepreneurship.com/content/1/1/2)

deployment for a Fab Lab in Bulgaria. As illustrated, these incremental levels are (i) Basic; (ii) Intermediate; and (iii) Advanced, which levels are determined largely by the mix in sophistication of equipment, staffing and capabilities that together increase the quality of goods and services the Fab Lab can offer.

During the design stage, the Development Team should also identify indicators for monitoring and evaluation (M&E) of Fab Lab's performance and impact. It is important from the beginning to agree on methodology and what data would be needed for *ex ante* and *ex-post* evaluations, as well as how to collect this data from the onset of Fab Lab operations or other point of time (e.g., number of users that commercialized their products made in the Fab Lab; how many users opened businesses after/during their Fab Lab membership; the increase of income as a result of the Fab Lab's support, etc.). A more detailed description of potential monitoring and evaluation options and measures for a Fab Lab are provided in Section 10.

11.2. Planning and Implementation

Call for Proposals

Alternatively to collaborating in building the Flagship Fab Lab from the ground up, the selected implementing agency (or MEE) could consider developing a Call for Proposals from potential host organizations or other qualified entities. This approach could have the advantage of turning a mere "hosting" institution into a "co-sponsoring" institution and would ensure that it is committed to the success of the Fab Lab and believes from its local vantage point that there is sufficiently strong demand for the type of Fab Lab it would propose. This is because it would be putting its own capital and reputation at stake to ensure the Fab Lab's success.

Thus, assuming there is substantial potential demand for the Fab Lab concept in Bulgaria, the location(s) of the Flagship Fab Lab and/or satellite Fab Labs could also be established by conducting such an open competition. Depending on the availability of resources and quality of proposals, the Government could decide to provide funding support to one or more applicant institutions or consortia of institutions that present the soundest governance and business models, have the capacity to manage the Flagship (or satellite) Fab Lab effectively and, very importantly, have the capacity to attract and are connected to a potentially large demand base of Fab Lab users.

The Call for Proposals could be open to academic or research institutions, techno parks, incubators or accelerators, trade or professional associations, private operators and varied consortia capable of establishing and managing one or more viable and sustainable Fab Labs in Bulgaria. The Call for Proposals would have to provide the fundamental parameters for the Fab Lab model desired by the Government, which could correspond, for example, to the Basic, Intermediate or Advanced models constructed in this study in Section 4 (we recommend the Advanced model), and other objectives the Government is seeking to achieve, against which the various applications could be assessed.

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Specified evaluation criteria could include demonstrating the ability to serve a broad user base, location which encourages collaboration with other institutions, knowledge and experience with Fab Lab equipment, ability to offer a fuller range of complementary services. The Call could specify the level and type of support the Government would provide – e.g., 50/50 matching for equipment purchase and materials, up to a fixed percentage of proposed operating budget for a fixed number of years, and require that the host/co-sponsoring entity demonstrate that it possesses the resources to maintain Fab Lab operations after grant support ends. Other standard elements like providing CVs of managers, position descriptions and descriptions of how the proposed Fab Lab would operate and the range of services it would offer, and what stakeholders could be expected to benefit from the proposed Fab Lab.

In conclusion, the Tender approach could provide a better perspective on the market demand for Fab Labs in Bulgaria, as the Applicants would have to develop a solid sense of who their Fab Lab would serve and how they would manage it to achieve sustainability given that their own resources would be at stake.

Timeline for Planning and Implementation

The estimated timeline for establishing a flagship Fab Lab is based on Fab Foundation internal guidelines and can vary from phase to phase, and therefore the months listed are approximated. Please note that each Fab Lab may take approximately 7-12 months from the first meeting before becoming fully programmatically operational.

Phase 1 (Months 1 - 3)

- First meeting between potentially hosting organizations, Ministry of Economy, World Bank and other key stakeholders in the establishment process to confirm mutual interest, readiness, and commitment.
- Submission of Fab Lab Prospectus to Fab Foundation (to register in the global Fab Lab network)
- Sign Memorandum of Understanding (MOU)
- Hire Fab Lab Manager
- Design Team Meetings commence: 1st Design Team Meeting -- design and agree on the Fab Lab business and financial models, identify curricular goals, potential outreach programs, service opportunities for each Fab Lab community as well as critical stakeholders and participants
- Fab Lab design plan assembled
- 2nd Design Team Meeting: final Fab Lab design plan and layout reviewed and initial program offerings developed
- Official review and approval of Fab Lab physical design layout
- Communications strategy development and outreach plan
- Procurement of materials, supplies and equipment

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Phase 2 (Months 3 - 6)

- Site renovation, re-construction and/or build a new site
- 3rd Design Team meeting: Monitoring and Evaluation tools designed, reviewed and completed, stakeholder development
- Meetings with existing and new partners to outline where, when, and how they can contribute to the project in both the short and long-terms
- Development of community and workforce programs and partnerships
- Monthly online Design Team progress and update meetings
- Communication Strategy for Fab Lab implementation begins
- Partnership and stakeholder development meetings continue
- Equipment arrives at Fab Labs, followed by a week-long Installation
- Immediately following installation, a week-long training and curriculum integration session with staff, students, and training team members—continue evaluation (timing and strategy needs to be negotiated with school/host organization)
- Semi-Annual reporting to key stakeholders (Ministry of Economy, World Bank, Fab Foundation and others) on programmatic, financial and operational aspects of Fab Lab

Phase 3 (Months 6 - 12 and ongoing)

- Pre-Fab Lab use evaluations of teacher, student, community users are conducted
- Fab Lab programs begin
- Maintenance of existing partnerships and development of new partnerships
- Establishment of monthly calls/VTC between the Fab Foundation team, the training team, and students and staff of Fab Lab
- Ongoing evaluation of programs and impacts
- Fab Foundation Team and hosting organization will determine follow-up training priorities and design customized professional development sessions.
- Program improvement based on feedback
- Continued program and resource development, and sustainability resource development
- Annual site visit by Fab Foundation
- Semi-Annual reporting to key stakeholders (Ministry of Economy, World Bank, Fab Foundation and others) on programmatic, financial and operational aspects of Fab Lab

Phase 4 (Months 12-36)

- Maintenance of existing partnerships and development of new partnerships
- Establishment of monthly calls/VTC between the Fab Foundation team, the training team, and students and staff of Fab Lab
- Ongoing evaluation of programs and impacts

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- Hosting organization will determine follow-up training priorities and professional development sessions.
- Program improvement based on feedback
- Continued program and resource development, and sustainability resource development
- Annual site visit by Fab Foundation
- Semi-Annual reporting to key stakeholders (Ministry of Economy, World Bank and Fab Foundation) on programmatic, financial and operational aspects of Fab Lab

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III. FLAGSHIP INNOVATION BASED INCUBATORS

1. Background

Business incubators and accelerators[39] contribute to promoting technological innovation and stimulating knowledge-driven economic growth. Both accelerator and incubator programs, help first-time entrepreneurs and start-ups with their establishment and accelerate their development; supported companies either graduate out after the specified acceleration/incubation period or are dropped from the program should they fail to meet established goals and benchmarks. Accelerators are a specific type of business incubator that tend to emerge in sectors where taking product to market is not long and is far less risky.

Business incubators could be both for-profit on non-profits, while accelerators are, in effect, purely for profit business incubators that focus on high-growth start-ups with high financial returns An accelerator could be viewed as a more evolved version of a business incubator, as accelerators are designed to facilitate fast-developing technological ideas, i.e., supporting high-growth companies, so called "gazelles"[40]; and propel them towards marketable products..

Box 5: Key differences between incubators and accelerators

Accelerators typically provide from 3 moths to a maximum 1 year 'boot camp' programs, and provide the necessary capital, mentorship, and investor networks for start-up companies to advance their ideas and products. Accelerators are mostly for-profit enterprises and the accelerator takes equity position in the start-up. Most accelerators are privately invested and offer seed funding around $20-50k to the startups, as well as mentoring services and networking opportunities to venture capitalists and angel investors, for an equity stake in the company (typically 6-8%).Physical space is less relevant in an accelerator as the focus is on "gazelles" i.e., quick graduation. Some accelerators in ICT can be even virtual with very small office space. Incubators help very early stage start-ups by offering discounted costs for rent, office space and equipment, and most importantly provide a 'company'' environment for the start-ups and foster camaraderie among start-ups which are tenants of the incubator. Most incubators are funded by grants and are not-for-profit and while providing business training and legal help, incubators typically do not offer management support. Incubators rarely offer financing support and incubator managers are not necessarily industry experts. Office space or labs i.e. physical space is the key element in an incubator. Compared to accelerators (that focus only on "gazelles") the graduation period for incubator companies is much longer: between 2 and 5 years.

[39] The distinction between business incubators and accelerators is subtle and at times these two terms are used interchangeably in both online and literature secondary sources. There are however important distinguishing features.

[40] High-growth companies, so-called gazelles, are important for economic competitiveness and development. With the increasing recognition of high-growth companies as drivers of economic and regional development, the European Commission has launched many policies and initiatives to support existing high-growth enterprises as well as to enhance their emergence. For detailed discussion see Mitusch, K., Schimke, A.: "*High-Growth Companies: Final Report"* Task 4, Horizontal Report 5, Europe INNOVA Initiative, January 2011.

1.1. Innovation based incubators

Business incubation is comprehensive business support program designed to nurture business ideas and innovation-based start-up companies for certain time duration. Traditional incubator services include facility space, flexible leases, shared use of common office equipment, direct business assistance and guidance, mentoring, networking access to capital, and other technical resources.[41] A typical innovation based incubator (IBI) also helps start-ups exploit close ties with the research community and provides emerging innovation-based businesses with an environment that would support their establishment and increase their likelihood of success.[42] Aligning financial interests in the performance of the incubator tenant company is not an imperative, but increases its chances of success.

A strong benefit of innovation-based incubation, specifically in locations with underutilized entrepreneurial potential, is creating a supportive environment for business development experiments, focusing on educating, mentoring and networking to ensure that non-feasible business ideas fail early in the process, effectively reducing up-front entrepreneurial costs, and in the process refining good business concepts to increase their chances of succeeding in the marketplace. Related objectives of IBIs are to contribute to competitiveness and job creation, help R&D centers commercialize know-how; and help universities and businesses generate spin-off activities.

Box 6: The Technology Incubator Program (Israel)

Under the Israeli Technology Incubator Program (TIP), 28 incubators were established in the period 1990-1992 in cooperation with universities, local authorities, and large firms. Each incubator was a not-for-profit entity providing financial support, consulting, and office and lab space to approximately 8 incubator companies each year and in this period about 200 projects in various stages of R&D were carried out. In 2002 the office of the Chief Scientist (OCS) started privatizing the incubators and by the end of 2006 out of the existing 24 incubators, 17 had been privatized and 1 new private Bio-Tech incubator was established. The lessons learned from the TIP are:

Strong public support for seed finance is vital. Only 2.4 percent of the incubator projects received funding from venture capitalists (VC) while still in incubation, a very low proportion considering that Israel's high-tech industry relies heavily on VC funding—52 percent of firms are funded by VCs.

Strong initial public support can decrease as projects mature. Private funding to the incubator management team increased over time, and over the years most of the incubators were privatized. Today 17 of the 24 are privately managed (though government money is still invested in all the incubators). Strong public support may be needed at the beginning but can be reduced as the program matures and shows success.

Expert networks should perform evaluations. The TIP succeeded in establishing a network of experts who assist the program in their selection process, which is vital given that projects submitted are from varied fields and reflect very specific expertise.

[41] See list of typical business incubator services as Annex 2

[42] For detailed discussion see: Research report: "*Feasibility study on Technology Incubators and New types of Business Incubators*" Small Innovative Business Support Network / SIB net (EU 31398) Riga, Latvia (2011)

The entrepreneur's share plays a big role. The TIP stipulates that at least 30% of the shares of the company (after the first round of funding) remain the property of the entrepreneur. This keeps the entrepreneur motivated and strongly involved in the company the entrepreneur has the most technological know-how needed for developing the company.
Great care should go into choosing a manager. The motivation and capability needed to assist the growing enterprises are just as important as those needed to run an existing enterprise. Thus, strong attention should be given to choosing the incubators' leading personnel. The privatization process dramatically contributed to raising the competence of the incubators' management.
Incubators need to be close to universities. Shefer and Frenkel (2002) have shown that the proximity of an incubator to a university research center is of great importance especially in the life science fields.

1.2. Accelerators

The objective of an accelerator is to mature the start-up company from inception to a stage where it is ready for the next step - growth and expansion. During the accelerator incubation period the value of the start-up company rises and the accelerator naturally makes a profit due to this increase in the value as it has equity in the accelerated company. The financing that is provided by the accelerator could be self-funded by the accelerator owner or from other sources. Typically the accelerator owner takes as share of the profits made by the more mature company (due to increase in value of firm) that is in proportion to the accelerator's contribution in financing the accelerated start-up.

The reason why accelerators have proven to be more successful than incubators is because the incentives of the various parties are aligned. The accelerator owner has the incentive to select firms that likely to succeed and finance and mentor firms to the best of his abilities so that the start-up graduates quickly with substantial increase in its value. The financiers who provide funding to the accelerator have similar incentive as their return depends on the upside created by the accelerator.

1.3. The optimal model

Accelerators provide modest initial financial support and focus on high-growth companies that can mature in very short terms. For this reason accelerators are more prevalent in fast growing sectors such as information technology and communication (ICT) and intelligent energy. Incubators are more inclusive and focus on companies operating in sectors that have high-growth potential, but do not necessarily mature quickly and require testing facilities, laboratories, office space, regulatory and intellectual property support, etc. In this context, IBIs could be appropriate not only for ICT companies and other "gazelles" (as do the seed/accelerator funds Eleven and Launchub) but also in nurturing innovation start-ups in the food processing, , electronics, biotechnology, life sciences, cultural and creative industries.

Box 7: Accelerating Solar Start-Ups

The fastest growing segment of the clean energy economy is solar electric technology adoption, including smart grid and storage management solutions, ancillary and software systems, plus financial or business model ingenuity needed to make solar happen.

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The private-sector run SfunCube Accelerator in Oakland, California unites solar entrepreneurs, advisors and investors enabling start-up solar companies to launch and scale up production. 10 promising solar start-ups join the accelerator program each year and SfunCube provides free office space, free consulting on financial, legal, regulatory, IP, marketing issues and introduces the resident start-ups to potential investors. The Massachusetts Institute of Technology is focusing on solutions that make solar power cheaper, cleaner and more reliable than fossil fuels. The MIT Engineering Systems Division focuses on 'grid parity' solutions which enable adoption of solar energy by homeowners and the Clean Energy Accelerator uses complex mathematics to discover which materials, components and chemical processes will yield the best and cleanest solar cells.

International best practice suggests a support pattern which starts with pre-incubation – i.e., all services needed to nurture the market for intensive incubation, typically focusing on developing ideas and business plans, often with competitions and in collaboration with universities. The pre-incubation process creates a 'pipeline' of firms ready to be incubated. This is followed by the core business incubation process and ends with the post-business incubation, which includes services supporting the further growth of incubator graduate companies in the marketplace. Concurrent services include outreach business incubation, namely incubation support to companies not located in the IBI but visit it from time to time; and virtual business incubation: providing business incubation support online on matters such as providing information, business plan reviews, mentoring, business guidance and advice.[43]

2. Feasibility Study

A feasibility study helps "business incubator developers decide whether a business incubator will prove effective in a particular setting, by determining if the proposed project has a solid market, sound financial base, strong community support, and true champions. Beyond that a feasibility study identifies obstacles that business incubator organizers might have to overcome and offers options for surmounting them by assessing the existing ecosystem, and the complementary and supplementary institutions. It also may look at whether a proposed business incubator will further a community's broader economic development goals."[44] Repeated consultations, in the form of focus groups, seminars, and workshops, with key stakeholders from the innovation ecosystem, the academic and business communities and the government are needed not only to determine whether the incubator is feasible and worth investing in, but also in order to align expectations and commitments.[45]

This report is intended as an exercise on completing a feasibility study for a flagship IBI that defines the type of information and resources needed to complete the study. The next step in the process, the actual study, would take up to six months for completion and would provide detailed information on process of creating the IBI, the need to raise awareness of the

[43] See table that compares incubation models in Brazil, China and the USA as annex 3
[44] A Comprehensive Guide to Business Incubation, NBIA (2004)
[45] Based on experience with similar initiatives, stakeholders are initially very enthusiastic, but often have unrealistic expectations, anticipating outcomes and impact in only a few years, rather than over more realistic period such as 8-12 years.

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benefits it will bring in advancing Bulgaria's innovation agenda to speed-up the transition of the country to a more knowledge-based economy, as well as the public the commitments to the incubator over the short and medium term.

This study would include:

- An analysis of the local conditions and the market for incubation in Bulgaria, including a flagship IBI to be based in Sofia where the demand appears greatest;
- An analysis of the entrepreneurial pool of potential clients in Bulgaria (and possibly the immediate South East Europe region);
- Existing and potential linkages to universities;
- Existing business support services network;
- Suitable space to host the incubator;
- Financial projections over the short and medium term, including commitments by governmental agencies.

It would also include a sector analysis to identify sectors where greatest economic benefit could be achieved through technological entrepreneurship supported by incubator

The typical feasibility study consolidates information in the manner presented below.

1. Market Analysis
    a. Advancing inniovation policy
    b. Responding to business demand
    c. Location
    d. Funding sources
    e. Economic drivers
    f. Entrepreneurial pool
2. Governance
    a. Incubator champions
    b. Management and human resources
    c. Selection criteria – in take and exit (graduation)
    d. Incubation period
    e. Performance indicators for monitoring and evaluation
3. Facility and Services
    a. Sources of support
    b. Access to finance
    c. Mentoring and business planning consultancy
    d. Technology assistance
    e. R&D monitoring
    f. Product development
    g. Support with intellectual property issues
    h. Support with regulatory issues
    i. Market intelligence and marketing consultancy
4. Financial Model
    a. Establishment costs

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b. Running costs
c. Sources of funding and co-financing
d. Financial sustainability criteria

3. Market Analysis

3.1. Advancing innovation policy

Promoting incubation and growth of small innovative firms is a strategic priority of the EU in Horizon 2020. Incubator operations in many EU Member States provide good examples of how incubators, along with other centers of excellence, are part of a strategy to develop clusters of new technology and knowledge-based activities upon industrial traditions and R&D strengths of the regions concerned – automotive technologies, biotechnology, electronics, software and ICT, etc. In this context, an important measurement of the demand for the technology business incubator is whether it helps implement the goals of the Bulgaria's *Research and Innovation Strategy for Smart Specialization* (RIS3).

Box 8: Innovation

Demand pull innovation originates from the intention to satisfy the needs expressed by the market and for that reason it generates incremental innovation. Results usually fit into already existing markets. Technology push innovation, however, is driven by R&D activities and from competitive advantages provided by new technologies. It generates more radical innovations and creates new market segments.

Internationally, a key factor for establishing publicly-funded IBI is the extent to which an incubator plays an active role in the broader development strategy of the region and the country as a whole.[46] European best practice indicates that successful IBIs are not standalone operations but are an integral part in the ecosystem of key stakeholders from business and research, government agencies and funding programs that work together to promote innovation, competitiveness, technology transfer and other key public policy objectives.[47]

Box 9: Role of incubators in advancing innovation policy

The incubator operations in Austria, Germany and Finland provide good examples of where this is the case: in these countries, the incubators (along with other centers of excellence, e.g. R&D centers) are part of a strategy to develop clusters of new technology-based activities based on the industrial traditions and R&D strengths of the regions concerned – automotive technologies, biotechnology, electronics, software and ICT, etc. Networking between incubators, and between incubators and other key players is seen as a critical success factor in the overall strategies. Elsewhere, networking between incubators tends to take place within the context of national associations and for the purpose of lobbying and promoting good practice in incubator management.
Directorate General, EC: "Final Report: *"Benchmarking of Business Incubators",* CSES (2002)

[46] Obviously, privately funded technology incubators would look quite differently on this issue, as their primary objective is maximizing the wealth to their own shareholders.
[47] Directorate General, EC: "Final Report: *"Benchmarking of Business Incubators",* CSES (2002)

In Bulgaria, there are business support structures and instruments, both subsidized and at market rates, whose design and operations are at least in some aspects similar to those provided by an IBI. Despite that, there is a need for IBIs as these could remedy the shortcomings of the existing support structures; for example, existing business incubators need to be refocused to the needs of innovative and technology start-ups; seed and accelerator capital funds and business angels focus only on "gazelles" and have little competition and invest in few projects; government support schemes under operational programs are bureaucratic and therefore discourage some applicants; training and mentoring is done on a voluntary basis, and the mentors typically do not get involved in the management of each project. Most importantly, however, links with the research community in all structures and instruments are very weak[48]. The IBI could specifically address the issue of bridging the gap between research and industry.

Table 9: Summary of Bulgaria's innovation infrastructure

	Structure	Quantity	Objectives
1	Research Infrastructure	7	Prioritizing the most prominent existing research infrastructure and resources into national research complexes
2	Joint Innovation Center, BAS	1	Coordinating and supporting BAS institutes in research and innovation
3	Centers of Excellence, BAS	8(9)	Providing training/continues education in the relevant fields; connection with education and business sectors
4	R&D Sectors at HEI	7	Interaction between universities and businesses in introducing research projects
6	Technology Centers	4 under OPC	Promoting innovation by improving dialogue and cooperation between business and academia to intensifying
7	Centers for Entrepreneurship	5	Promoting entrepreneurship at HEI
8	Business Incubators (BI)	3BI (presently existing)	Promotion of entrepreneurship
9	Innovative Clusters	12 under PHARE, 16 under OPC	Business networking
10	Sofia Tech Park	1	Becoming a prestigious modern hub of science and business and attract world class scientists

Source: Quantities estimated based on inputs from the ARC Fund and available information

Many types of innovation instruments, including IBI specialized by sector, would have a major impact in advancing Bulgaria's innovation agenda. For example incubators would be the appropriate instruments to promote the growth in the information communications and technology (ICT) and the cultural and creative industries (CCI) sectors, as well as possibly the proliferation of pharmaceutical start-ups focusing on biotech and life sciences. However, the

[48] Seed and accelerator funds Eleven, Launchub, Betahouse provide support to start-ups but have no direct links to the academia; programs funded under Operational Programs have also failed to achieve meaningful linkages between the research and business communities.

machine building/electronics and the food processing sectors would require a combination of innovation instruments that go beyond business incubation i.e., technology road mapping upgrading and diffusion, proof of concept and prototyping laboratories, certification laboratories, experimental facilities etc.

Sector specific incubators could provide all the set of services from the pre to the post incubation phase and provide the support to all those who have a feasible idea within a specific economic sector, (for example, food processing, machine building etc.) to unleash the real potential of the region where the IBI is located. A sectoral and/or regional focus is desirable but needs to be linked to business demand to ensure sustainability and impact. A strong recommendation is establishing incubators targeting different sectors based on feasibility studies that clearly point out the demand for such incubators and assess their potential deal flow to prevent creation of incubators that will be underutilized. According to the specificities of the sector, these may require specific infrastructure to meet the needs of the incubator tenants; for example in food processing their tenants would need experimental facilities and fields; an innovative biotech/life sciences start-up would require well equipped laboratories and significant legal support with IPR and regulatory issues, an IBI targeting machine building and electronics needs to be able to offer state of the art proof of concept and prototyping laboratories, 3D printers etc.

Table 10: Business innovation instruments aligned with RIS3

Food Processing	Machine Building and Electronics	Pharmaceuticals	ICT	CCI
Technology road mapping, Technology upgrading and diffusion Certification laboratories Experimental fields and processing facilities Competitive matching grants to for business-research collaboration Integrating clusters and innovation networks by creating a Food Tech Park in Plovdiv	Technology road mapping, Technology upgrading and diffusion Replicating successful clusters and innovation networks: electro mobiles, hydraulics, LED technology	Technology extension programs Competitive matching grants to for business-research collaboration	Business incubators with early stage financing Seed/Accelerator and VC Funding	Business incubators with early stage financing CCI-tailored matching grants for developing and integrating innovative products, processes, marketing, and organizational designs.

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Source: *"Inputs to Bulgaria's Research and innovation Strategy for Smart Specialization"* World Bank (2013)

Setting-up new innovation-based incubators with a heightened focus on technology and knowledge intensive start-ups, businesses devoted to commercialization of innovation and research, and technology scientists developing research/innovation ideas with business potential, would address current public policy goals.[49] These incubators, with a flagship IBI based in Sofia,[50] would serve existing micro and small technology firms, as well as technology start-ups operating in sectors with high growth and innovation potential.

Such flagship IBI would have a value proposition for each stakeholder group. For example, for the government, the incubator will help foster the growth of knowledge-intensive sectors that generate higher-value added products and services with significant export and innovation spill-over potential. Similarly, the incubator will help start-up companies improve their business prospects through management team-building, skills-building, idea validation, connections and technical expertise, as well as the full range of incubation services, if they are selected as IBI resident companies; for private sector supporters, the incubator will deliver a better understanding of what ventures to further invest in, and in this manner, it will help increase the deal-flow of promising projects. For mentors, in addition to their giving back to the community and finding new interests, the incubator will help them gain intimate knowledge of new start-ups where they could invest or find potential board level management opportunities once the program is over.[51]

3.2. Responding to business demand

The initial analytical feature of a feasibility study is to assess the demand for incubator services and the gaps in existing business services in the specific location that is being considered. IBIs provide services and tools, which are generally beneficial to new companies offering technology products or services. Past experiences with EU-funded business incubators indicate that the 'push model' for setting up incubators does not yield the

[49] According to a study on business incubators in the United States of the National Business Incubation Association (NBIA) from 2010, the survival rate of start-ups using business incubators is 87% compared to 44% for start-ups that didn't use incubators. Equally important is that 84% percent of companies that graduate from an incubator stay in the communities where they were incubated

[50] Sofia Tech Park, as a national innovation infrastructure platform, could host the flagship TBI and serve all companies in Bulgaria, not only those located in Sofia or the immediate area of the city. In this context it is understandable, that technology start-ups from other urban areas would likely be part of the pool of intake companies in the IBI. One could not determine where companies would locate after graduating from the incubator.

[51] Typically, mentors would apply through existing networks and business associations, where the incubator selects high-quality ventures and facilitates the relationship with them. Mentors can choose to mentor start-ups directly or be part of their advisory boards, which in essence plays a similar role to that of a mentor---to provide star-ups with hands-on support, contacts, feedback and advice with respect to strategic direction, priorities and opportunities.

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desired results.[52] Establishing a IBIs through the country, with a flagship IBI in Sofia, should be based on a 'market pull model', where the specific incubator should address specific business demand by location. In order to make a strong case for a new set of incubators i.e., the IBIs, there needs to be reflecting lessons learned from incubator programs in the past need to be properly reflected so to design the new incubator program to yield better results. The IBI program needs to address the shortcomings of exiting incubators by emphasizing critical on success factors such as establishment based on clear business demand; the need for long-term Government commitment to the IBI program; setting aside public funding to subsidize a portion of the IBI operations over an extended period; IBI management needs to be in the hands of professionals with strong private sector experience and links to venture capital, etc.Box 10: Incubator services

Locating entrepreneurs in one facility lowers costs associated with supporting a new business in this critical initial phase, so most incubators offer facility-based services by establishing a common support infrastructure. This includes offering to their tenant companies office space at flexible rates, shared use of conference rooms, reception, as well as shared basic infrastructure such as telephone, internet, printer, copier, fax, office equipment, etc. Other assistance typically takes the form of a package of business and technical support services, including guidance and mentoring on business strategy, management, marketing, financial, legal, and product development issues as well as facilitated exposure to a know-how network of outside business resources and much needed network of sources of capital. Finally, incubators help technology start-ups establish their identity and visibility of its offerings as well as provide much needed support in securing funding or investment capital for the start-ups. In exchange for these services, the incubator frequently takes a "sweat equity" share in its tenant companies on agreed upon terms when they enter the incubator.

To gain better understanding of the demand for specific business services that the incubator should offer, it is advisable to conduct a market survey.[53] This would help assess what percentage of existing companies, research institutes/universities and would-be entrepreneurs are interested in the business incubator and would form its likely entrepreneurial pool. Typically, such undertaking requires a needs analysis, or demand survey, which attempts to quantify the size of the potential market, its characteristics and needs, now and in the future. This includes defining the survey pool, data collection methods and the development of the survey instrument and analysis framework. (See survey sample as Annex 9: *"Incubator Business Demand Survey Sample").*

In addition to the survey, a key determinant for success are repeated consultations with stakeholders from the innovation ecosystem, business leaders, organizations providing support to businesses and other intermediary organizations that gather qualitative and

[52] Furthermore, specific benchmarks were rarely set for the entrepreneurs supported by most incubators, which does not contribute to helping them succeed. The low success records of incubator companies reflected poorly on the business incubators and made them obsolete.

[53] A survey was not used in selecting the site of the Sofia Tech Park. The site was chosen by consultants from the EU JASPERS Program based on a matrix appraising the suitability of five plots that were initially considered as suitable and the Ministry of Economy Energy and Tourism, the Managing Authority of OP "Competitiveness" 2007-2013 selected the current site.

quantitative data on the market. Such analysis is very important as the survey alone would be unlikely capture fully reliable market information. Generally, the survey pool is composed of 'would-be' entrepreneurs i.e., people who wish to establish a business, and thus, define the future market for incubation services; and people who already have started a business – i.e., people that define the current business incubation market. The first category of respondents is often composed of people that are unaware of the knowledge and skills they lack at the moment, have very unrealistic expectations and few of them would actually embark on a business venture; and the second group of respondents would likely not need incubation support by the time the incubator is established, as they would have either managed to achieve growth on their own, or may not need business incubation services due to a change in future market conditions.

3.3. Location

The flagship innovation incubator should be established on a solid foundation to be able to demonstrate its success potential and thus attract paying clients and attract foreign entrepreneur-developers. Its viability, to advance Bulgaria's innovation agenda, depends on securing long-term public funding to finance its creation and operations and ensuring the supply of skilled labor in industries related to ICT, engineering, natural sciences. Another critical success factor is the ability to attract new technology projects from abroad.

In Bulgaria, innovation-based companies tend to establish themselves in Sofia, where the labor pool, infrastructure, and access to financing are most favorable, and for this reason the flagship IBI should likewise be established in the city, where it can capitalize on similar resources, best meet needs and maximize its impact. Sofia, where skilled labor and managements expertise is more abundant that throughout the rest of the country, would also be the likely location for an incubator that would provide hands-on management, international expertise, intellectual property expertise and access to scientists.[54]

The vast majority of companies that benefit from incubators services in Europe are start-ups - 69.3%.[55] However, existing companies, either in early stages of development or branches of the company, account for 11.9% of incubator companies. Similar is also the percentage of university or R&D center spin-offs that take advantage of incubator services in

[54] Within its current project budget, Sofia Tech Park has a 220,000 EUR set-aside for consultancy services to the incubated companies that needed to be provided by October 2015. The services would not be provided by Sofia Tech Park but by a third party - a successful tenderer in a public procurement procedure. The rent will be subsidized to about 50% of the fair market price for similar office space. Both incentives will be considered eligible state aid. The rent subsidy will be accounted for under the *de minimis* exemption of state aid rules, while the provision of services will probably fall under the framework for innovation advisory services and for innovation support services.

[55] Experience with similar initiatives in the United States indicates otherwise, that most interested in becoming tenants of a business incubator are not start-ups, but exiting microbusinesses with up-to 3-4 employees. For detailed discussions see: "*Business Incubator Feasibility Study for Montrose, Colorado*"; Montrose Economic Development Corporation, Montrose CO, (December 2009)

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Europe - 11.2%; and a small percentage – 7.6; come from other sources, including from abroad.[56] Based on this information, we could assume that the majority of the deal flow of the flagship IBI would come from local technology start-ups, followed by micro and SME entrepreneur-innovators. However, it is likely that deal flow from entrepreneur-innovator students and researchers and deal flow from abroad would be more significant that the European average.[57]

3.4. Funding sources

While international best practice suggests that many incubators are profit-driven and privately-run, it is highly unlikely at the present time that this experience could be replicated in Bulgaria, as the country's innovation environment simply could not support a privately-funded incubator. One of the reasons that privately-funded incubators would have difficulty operating in Bulgaria today is that Bulgaria's private equity secondary market and public stock markets are underdeveloped, and thus, they do not offers viable option for an exit scenario for incubator operators holding shares in incubator companies. Also, in Bulgaria, the investment horizon of private investors is generally shorter than the time needed to benefit from investments in technology start-ups, which take time to mature and grow, while returns expectations are very high.

In the past, investors in Bulgarian companies have preferred lower risk ventures in the less knowledge-intensive sectors which, for some time, provided very high returns. There are also not that many new businesses operating in the knowledge-intensive sectors. This may be a result of cultural reluctance to entrepreneurship and access to finance issues[58] or perceptions of poor product competitiveness or insurmountable barriers to market access. Often, the poor collaboration between the science and business communities limits the access of high-quality scientists to financial resources and their drive to work on developing new market-oriented products.

For these reasons IBIs would need at least some public-funds to support their operations over the next 10 years. However, while such e public financing is essential over the initial and possible medium term, the possibility of self-sustainability over the longer-term with matching funding from private sources is core determinant for the IBI's feasibility: ultimately, this will depend directly on the ability of the IBI to stabilize financially during its first 3 years of operation. Establishing an incubator that is dependent on a continual operating subsidy is not a viable option for a very important reason: international best practice suggests that after a period of time, governments and communities will often lose interest in providing perpetual operating subsidies and they will discontinue support for an incubator that does not appear to be able to become financially self-sustainable.

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[56] European Commission, DG Enterprise: *"Final Report: Benchmarking of Business Incubators"* CSES (2002)

[57] The seed and accelerator funds Eleven and Launchub funded under JEREMIE have attracted significant deal flow from countries in the region including Armenia, Macedonia, Kosovo, Serbia, Romania

[58] Typically, the network of family, friends and acquaintances traditionally is exploited to secure early stage financing

Internationally, incubators benefit from public funds when they serve as a vehicle to implement regional strategies or policies, such as creating jobs for local communities or fostering an entrepreneurial climate, building or accelerating growth of local industry, diversifying local economies, etc.[59] For this reason, the flagship IBI would primarily serve as a tool for implementing the goals of Bulgaria's *Research and Innovation Strategy for Smart Specialization* (RIS3), as it would draw upon funds available under Operational Programs co-financed with EU funds, and from national resources dedicated to implement the RIS3.

The flagship IBI, as well potential sectorial IBIs, will be eligible for EU financing under OPIC under Investment priority 1 *„Encouraging the investments in the scientific research and innovation activity".* IBIs would support achieving both specific objectives i.e. Specific objective 1.1: *"Creation and strengthening of the capacity of the Bulgarian enterprises for the development and embedding of innovative products, processes and business models through investments in scientific-research activity and innovations"* and Specific objective 1.2: *"Improvement of the conditions for the realization of innovation activity, including through development of the cooperation between the business and scientific media and improvement of the conditions for commercialization of the scientific researches"*. Development of IBIs would directly relate to three actions of Investment Priority 1: (i) Support for innovative starting enterprises; (ii) Support for the development of infrastructure for innovations and researches; as well as (iii) Provision of services for business support. Also sectorial high-and medium tech IBIs would be eligible for financing given the OPIC emphasis towards support of high- and medium-technological productions and services of intensive knowledge and the indicative regional specialization and opportunities in the field of scientific studies.

However, in order to be successful in the establishing IBIs in Bulgaria, the design of the projects and the call for proposals must follow best practices and take into consideration the lessons learned from the poor implementation of business incubator activities under Operational Program *"Competitiveness of the Bulgarian Economy"* 2007-2013[60]. Incubators, in order to bring value added to the Bulgarian economy, must be fully integrated with the innovation ecosystem **-** i.e. must be linked to universities, financing options (e.g. JEREMIE), technology transfer services, proof of concept labs (Fab Lab), etc. An option could be leveraging

[59] There are over 1,400 business incubators in the United States, fewer that than 10 percent of these incubators are for-profit organizations (run by investor groups that take an equity stake in the start-ups) while the vast majority of business incubators in are supported by local economic development groups. Source: National Business Incubation Association (NBIA).

[60] The call for proposals under OPC to develop regional business incubators resulted in 18 contracts concluded in 2012 out of 42 proposals submitted. The funding scheme was expected to foster the development of enterprises by supporting pro-innovation infrastructure. However, a key finding during the application evaluation process was that most of the candidates did not have the capacity to establish and manage a business incubator. Due to the limited number of high-quality projects, proposals with a low technical and financial score received grants only on the basis of compliance with administrative requirements. Only one existing incubator won funding, which poses questions about the sustainability of the rest of newly established incubators. World Bank report *"Inputs to Action Plan on Innovation Commercialization Services in Bulgaria"* September 2013.

the establishment of IBIs based on already existing Centers for Entrepreneurship[61] or existing incubators (i.e. The Regional Agency for Entrepreneurship and Innovation (RAPIV) in Varna; the High-tech Business Incubator in Burgas; and The Business Incubator in Gotse Delchev (BI-GD) after careful analysis.

OPIC should cover incubator expenses over the entire 7 year funding cycle.[62] The subsidies should gradually go down as incubator companies mature and the IBIs start generating revenue from exits in equity stake in its tenant companies. However, the proceeds generated from such exits and profitable IBI operations (rent, consulting services etc.) should be 'recycled' in a special fund to expand operations. Such an exceptionally long period of subsidizing incubator operations would address the issue of lacking interest from the private sector in investing in both incubator operations as well as in start-ups. Securing IBI operations over such a long period would allow the IBIs to act as agents of change and reverse this trend – a critical mass of successful incubator graduate start-ups and revenues generated by the IBIs from exits in these start-ups in would send a positive signal to the private sector.[63]

Assuming that there is a viable market of willing investors, it would take at least 3 years from business idea formulation to viable exit from the investment in the start-up: either through an initial public offering (IPO) or trade sale. In this context, it is reasonable to assume that no earlier than 3 years after establishing the flagship IBI, its operator would be able to begin to financially benefit from its shareholdings. Accordingly, funds for the initial 3 years of the IBI operation should be fully subsidized from public sources (OPIC, national or municipal budgets etc.) and after that the support from public sources should decrease by 25 percent per year over the last 4 years.[64]

3.5. Economic drivers

The most critical success factors for an innovation-based incubator is responding to economic drivers and grasping future growth opportunities in the most promising sectors. In Bulgaria, as in other EU Member States, future growth will be driven by knowledge-intensive sectors. There are sectors with a significant potential for innovation-driven growth,

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[61] For additional information please refer to the World Bank report *"Inputs to Action Plan on Innovation Commercialization Services in Bulgaria.* September 2013.

[62] It is important to note that the IBIs may not become self-sustainable for very long period of time. There is no guarantee that the incubator would actually have stream of cash for operating expenses later when the first batch technology start-ups mature and for that reason there is no guarantee that the incubators would become self-sustainable over a reasonable 3-4 year period. For that reason a reasonable amount of funding, covering at least the 2014-2020 funding cycle, should be dedicated order to ensure that the Government does not lose interest in the IBIs if they do not perform as international experience on the matter suggests.

[63] The prolonged period takes into account that the venture capital market in Bulgaria is underdeveloped and would take time to reverse the trend and break the vicious cycle - few sources of private sector investment in start-ups because there are few successful exists from investments in start-ups.

[64] Subject to contingency support, as equity investments in unlisted companies are illiquid, and there needs to be available buyers or an IPO to provide a means for the TBI to exit from the incubator graduate start-ups.

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such as the pharmaceuticals, food processing, machine building and electronics; also Bulgaria's ICT and CCI sectors not only can to grow by innovating but also in this process help spur innovation in other economic sectors.

For example, Bulgaria has all the conditions necessary for the production of quality innovation-based food products, which make the sector attractive to investors: strong traditions, excellent climate, and a competitively priced workforce that keeps operating costs low. There are opportunities in the food processing sector for innovation in both business processes and manufacturing, to create total production chains through clusters that include companies in the primary sectors, processing, sales, and distribution. Cluster creation is apparent in the wine-making, dairy and organic products segments. An example of a bottom-up cluster initiative is the Plovdiv Agro Tech Park, which is a concept developed in the course of February - June 2013 meetings, instigated by local stakeholders that reached out to national government and local authorities.

However, innovation-driven growth in the food processing sectors is hampered by weak collaboration between research organizations and industry, ineffective exchange of information and limited interaction. In this context, it is imperative to bridge the gap between research and the market through targeted interventions. A sectoral IBI should focus on bridging this gap.

With respect to machine building and electronics, Bulgaria could become a link in the supply chain for industries with high innovation intensity and strong cross-industry effects. In Europe, investments in ground-breaking technologies such as battery-powered hybrids and electric vehicles are expected to increase significantly. Sectoral IBIs, or other publicly-funded support for innovation in this sector, should focus on areas such as electronics, automobile components, mechatronics, and hydraulics.

Based on the number of patents issued in the machine-building sector over the past two years, the highest technological innovation intensity will likely occur in the areas of internal combustion engines, electrical generators, LED lighting, and hydraulics. EU funding could be leveraged for the much needed upgrading of the technical infrastructure of the machine building and electronics sector, as well as to spur R&D and to promote technology dissemination innovation through developing innovation-driven products and technologies.

Bulgaria has a fast-growing pharmaceuticals sector that has grown without significant R&D expenditures by taking advantage of strong traditions and geographic proximity to markets in the Middle East and the former Soviet Union.[65] Now the sector is successful in the highly competitive generic drugs markets, however, future growth is dependent upon expanding into the higher-value added market segments: the development of new drugs and medical compounds, innovative medicinal delivery systems and techniques. All these areas are highly investment intensive and it is more likely that pharmaceutical businesses would enter these markets if there is targeted government support using EU funds, including a sectoral IBI that

[65] The major importers of Bulgarian drugs are Russia (27 percent of total exports), Romania (11 percent), Croatia (8 percent), Ukraine (7 percent), Germany (6 percent) and Serbia (6 percent) as of 2011.

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operates a matching grants program for incubator tenants.

The ICT sector has the greatest innovation intensity[66] and strong potential to spur innovation-based growth and promote service exports.[67] Currently, ICT accounts for 47% of total business service exports[68] with a value created per employee in 2010 is three times higher than the national average for all industries; but accounts for only about 5% of GDP - less than the ICT sectors in Hungary and Slovakia; and attracts less FDI than the ICT sectors in Romania and the Czech Republic. There is still a low level of cooperation between business and R&D institutions, including universities. Most R&D activities are concentrated in large companies, which have separate R&D units. Some international companies (VMware, SAP Labs) have substantial local offices dedicated solely to R&D activities. For ICT to become a leading driver of growth, companies need substantial targeted support. The flagship IBI should focus on ICT and should also harness the knowledge, skills and business networks of Bulgarian ICT experts living abroad to generate additional opportunities for sector development in higher value-added segments.

Businesses in the cultural and creative industries sector set the stage for technological innovation and serve as instigators of innovative technical means to deliver the cultural or creative content, as well as the pioneers in using technological innovations.[69] CCIs produce many different types of positive innovation spill-overs and are credited with promoting innovation in other sectors of the economy through their "transformative power" as the sector is driven by user-interaction and therefore contribute to the user-centered innovation responding to user/consumer tastes rather than to market trends.[70] Bulgaria's CCI businesses, in addition to acting as pioneers in technology diffusion, also lead in commercializing innovative products and solutions. However, insufficient clustering and collaboration within the sector in Bulgaria prevent building efficient networks through match-making, taking advantage of

[66] ICT accounts for 90 percent of all Bulgarian patents in USPTO for the period of 2001-2010, as well as the largest number of Bulgarian R&D projects financed under the EU's FP7.

[67] The fields with highest technological innovation intensity in Bulgaria's ICT sector, based on the number of patents issued are multicomputer data transferring, measuring, calibrating, or testing database and file management or data structures, software development, installation, and management, virtual machine task or process, database and file management or data structures, inter-program communication or inter process communication (IPC), processing architectures and instruction processing, pulse or digital communications, speech signal processing, linguistics, language translation, and audio compression/decompression, image analysis, information security, memory, radio wave antennas, artificial intelligence, recording, communication, or information retrieval equipment.

[68] Broadband Quality Score 2009 (BQS); Invest Bulgaria Factsheets, InvestBulgaria Agency, 2011

[69] Because of the constantly changing dynamic between audience and content creator CCI foster exploratory environments that unlock innovation potential and are one of the core determinants of innovative spillovers.

[70] An example that illustrates this phenomenon is that more often architects, rather than construction engineers or material scientists, are the driving force behind the development of new, lighter and energy saving building materials in pursuit to design innovative buildings, take advantage of natural light, incorporate living ecosystems, nurture different types of human interaction, highlight the need for new materials and technologies

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coaching and skill building across industries, promoting creative environment by using shared office space and shared business services, gaining "economies of scale" to succeed in the Bulgarian and EU markets. A recommended focus of the flagship IBI would in addition to the ICT also the CCI sector as creative start-ups present knowledge-based services with significant spill-over effect into other sectors of the economy.

3.6. Entrepreneurial pool

Innovation-based incubators compose their entrepreneurial pools based on an evaluation of the entrepreneurial and innovation potential of the companies operating in the sectors that will drive future growth. Incubators serve as critical "catalysts" to stimulate development of entrepreneur-innovators and in "jump-starting" innovative micro and SMEs. Similar initiatives across the globe suggest that the market for IBIs could be divided in three categories:

- serving sectors where substantial demand for something like an incubator already exists and entrepreneurs will come if it is built;
- sectors with good signs of emerging or substantially growing pool of entrepreneurs who would benefit from the incubator; and
- sectors where entrepreneurial activity is not that strong and support could build it from the ground-up.[71]

While proper data on the potential market is needed to demonstrate demand and the target pool of the flagship and regional IBIs, it is likely they would focus on sectors that show a high potential for innovation-based growth, i.e., food processing, machine building and electronics, pharmaceuticals ICT and CCI. In addition to focusing on companies operating in a growth sector, a critical consideration should be the quality and capabilities of the entrepreneur-innovators that would enter into the pool - until the technology is commercialized the incubator and the entrepreneur would need to be able to work together to put the start-up business on a solid foundation.[72]

[71] Experience with similar initiatives suggests that technology incubators offer the greatest value in sectors that are in the second or third category.

[72] As start-up exists will fuel the future growth of IBI operations from, programs should address a complexity of issues - venture capitalists know from experience that is not just the "technology" that they are buying, but also the management which develops it. Often it is impossible to substitute new "manager" for the technology's creator.

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Box 11: Regional concentration

Food processing: Varying degree of clustering, and regional distribution with highest concentration in the and South Central Region - Plovdiv, Stara Zagora, Sliven; and the South West Region: Sofia, Blagoevgrad
Machine Building and Electronics: Higher level of clustering with highest concentration in the North East –Varna; South East -Sliven, Burgas;; North Central - Shumen, Ruse, Gabrovo; and South Central Region - Stara Zagora, Plovdiv;
Pharmaceuticals: Higher level of clustering with highest concentration in the South West Region: Sofia and Dupnitsa; North Central Region: Razgrad and Troyan; and the North East Region: Varna.
Information and communication technologies: Very high level of clustering concentrated in Sofia (over 85%) and some concentration in Plovdiv, Varna Ruse.
Cultural and creative industries: Very high level of clustering concentrated in Sofia and clusters in Plovdiv, Stara Zagora, Burgas and Ruse.

Food processing is regionally distributed, with the highest concentration in southern part of the country around Plovdiv, has varying degrees of clustering across various subsectors i.e., winemaking, dairy, etc. While the R&D intensity of the sector is low, it has very high innovation intensity.

Table 11: Top 20 Growing Companies in the Food Processing Sector (2010-2011)

	Company and location	**Income growth 2011/ 2010 (in %)**	**Income 2011 (000, BGN)**	**Income 2010 (000, BGN)**	**Net profit 2011 (000, BGN)**	**Number of employees 2011**	**Number of employees 2010**
1	Mesni Produkti "Zhar" (Varna)	7,739.34	4,782	61	47	101	1
2	Nordiks (Trud)	1,866.93	12,667	644	128	16	15
3	Mandra "Riltsi" (Sofia)	272.64	16,016	4,298	572	132	56
4	Boomerang 2009 (Sofia)	269.70	4,466	1,208	683	30	25
5	Trakia 2006 (Plovdiv)	259.18	34,438	9,588	1,693	208	115
6	Bulmes Group (Sofia)	256.62	5,310	1,489	131	57	11
7	Kris-Oil-97 (Kaspichan)	172.20	6,236	2,291	132	40	38
8	Bulmalts (Sofia)	142.45	13,257	5,468	272	49	51
9	Merkez (GotseDelchev)	135.52	29,141	12,373	2,491	76	361
10	Fishcom (Sliven)	129.45	4,534	1,976	1,041	165	45
11	Eco Furazh (Varna)	120.11	5,003	2,273	1,618	61	55
12	Pleven-Mes (Pleven)	118.01	4,201	1,927	202	40	37
13	Exotic 2000 (Stara Zagora)	117.55	11,815	5,431	3,070	54	59
14	SiCo (Pleven)	103.19	4,017	1,977	58	39	24
15	Agroplant (Gramada)	94.71	2,798	1,437	313	12	12

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16	MoniMes (Haskovo)	93.18	5,691	2,946	36	38	25
17	Nova 96 (Plovdiv)	88.48	4,763	2,527	271	33	37
18	Mescom Popov (Plovdiv)	81.18	4,747	2,620	207	55	54
19	Rodopchanka (BialIzvor)	80.50	6,610	3,662	1,184	168	136
20	ZornitsaKomers (Kesarevo)	74.34	16,486	9,244	421	130	101

Source: Capital: The Most Dynamic SMEs in Bulgaria (2012).

Machine-building and electronics companies are distributed throughout the country. As the most important machine building centers declined after 1989, production is now concentrated Plovdiv (electric domestic appliances); Gabrovo (hoist production); Stara Zagora (food processing machinery and metal processing); Kazanluk (hydraulics); Varna, Rousse, Burgas (building and repair of ships and floating structures); Sliven (metal processing machinery); Panagurishte (optics and precision electronics and engineering); Silistra (wood-processing machinery); Shumen (transport machinery building).

Table 12: Top 20 growing companies in the Machine Building sector (2010-2011)

	Company and location	Income growth 2011/ 2010 (in %)	Income 2011 (000, BGN)	Income 201 (000, BGN)0	Net profit 2011 (000, BGN)	Number of employees 2011	Number of employees 2010
1	Aisberg_International (Sofia)	569.16	6,076	908	135	27	31
2	Vitte Automotive Bulgaria (Rousse)	444.65	9,526	1749	152	64	33
3	AltasCopkoLiften (Rousse)	217.04	30,915	9 751	5 319	113	83
4	Mechatronics (Gabrovo)	199.28	10,361	3 462	3 263	73	63
5	LemiTrafo (Pernik)	92.44	22,841	11 855	2 790	80	56
6	Kamt (Karnobat)	91.07	4,706	2 463	9	46	35
7	KHS-Zagora (Stara Zagora)	85.16	4,179	2 257	643	26	26
8	2C-Trifonov Sie (Sofia)	84.09	1,712	930	142	28	20
9	Elika-Elevator (Silistra)	72.53	5,300	3 072	1 917	66	46
10	SL Industries (Rousse)	70.01	6,333	3 725	94	80	59
11	Bultex-2000 (Stara Zagora)	64.36	6,045	3 678	542	62	50
12	Budeshtnost (Tchirpan)	56.96	15,839	10 091	1 413	166	210
13	BTL Industris (Sofia)	56.53	62,740	40 083	24 888	97	67
14	Dimex Lift (Plovdiv)	55.32	4,908	3 160	150	60	45
15	MIG 23 (Sofia)	52.86	8,542	5 588	413	50	47

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16	Sprinter (Montana)	50.17	14,745	9 819	3 564	59	53
17	Tremol SMD (VelikoTarnovo)	46.62	4,104	2 799	58	144	107
18	Micotronik (Stara Zagora)	46.44	5,219	3 564	2 452	32	27
19	Montana hydraulics (Montana)	46.22	7,577	5 182	827	108	88
20	ZMM Nova Zagora (Nova Zagora)	45.88	4,820	3 304	227	136	124

Source: "The Most Dynamic SMEs in Bulgaria," Capital (2012).

The production of pharmaceuticals is heavily concentrated in five locations – Dupnitsa, Razgrad, Sofia, Troyan, and Varna, while the trade offices of multinational companies are concentrated predominantly in Sofia. In terms of sector specialization, increasing the potential for R&D activities could be focused on extending the clinical trials segment in Bulgaria through industry research collaboration as nurturing biotech and life sciences start-ups.

Table 13; Top 15 Pharmaceutical Companies in Bulgaria

	2011	2010	% Growth
Actavis	157	133	9.1
Novartis	148.7	119.2	24.8
GlaxoSmithKline	140.5	108	30
Roche	135.3	130.1	4
Sopharma	113.7	109.4	4
Sanofi-Aventis	102.2	115	-11.1
Servier	88.5	81.1	9.2
Pfizer	85.1	68.2	24.8
AstraZeneca	75.8	62.1	21.9
Bayer	69.7	64.4	8.2
Abbott	59.2	53.7	10.3
Menarini	53.1	51.7	2.7
Novo Nordisk	47.2	44.1	6.9
MSD	44.4	47.2	-5.9
Chaikapharma	43	38.8	10.9

The ICT sector in Bulgaria has shown consistently excellent performance in all key aspects, and has strong potential for innovation and export-oriented growth. There has been constant growth from 2006 to 2010 in terms of revenue (14%) and profits (83%); and constant growth of export of ICT goods and services (14 times) since 2005, reaching 2 billion in 2011 (47 percent of the total export of business services).[73] The sector consists of companies of different sizes and specializations. Large companies account for one-third of employment. Sofia is the undisputed hub of the ICT sector, with more than 85% of employees. Other regions that specialize in ICT are Plovdiv, Ruse, Varna, and Burgas. Employment is equally distributed among the three ICT subsectors, but telecom contributes 73% of revenues.

Table 14: Top 20 growing companies in the ICT sector (2010-2011)

	Company and location	Income growth 2011/ 2010 (in %)	Income 2011 (000, BGN)	Income 2010 (000, BGN)	Net profit 2011 (000, BGN)	Number of employees 2011	Number of employees 2010
1	3DC (Sofia)	181.00	2 085	742	308	22	8
2	Adastra Bulgaria (Sofia)	65.29	6 990	4 229	2 087	107	83
3	Chaos Software (Sofia)	58.91	12 317	7 751	5 078	76	62
4	ICGEN corporation (Sofia)	44.15	4 571	3 171	22	23	31
5	Arbitus 72 (Razgrad)	42.73	4 887	3 424	3 365	19	18
6	Bravo Investments (Sofia)	32.64	3 832	2 889	718	19	16
7	CAPK Progress (Sofia)	32.07	37 829	28 644	440	40	37
8	Infragistics Bulgaria (Sofia)	31.07	4 653	3 550	157	100	75
9	Intelligent Systems Bulgaria (Sofia)	21.83	4 459	3 660	396	63	55
10	Musala soft (Sofia)	21.37	10 961	9 031	1 368	201	184
11	Software AG development center Bulgaria (Sofia)	20.19	6 566	5 463	351	94	85
12	Acsway Bulgaria (Sofia)	18.27	11 302	9 556	1362	168	157
13	Inter Consult Bulgaria (Sofia)	17.56	5 196	4 397	744	97	80
14	Nemethcek (Sofia)	15.98	6 460	5 570	561	114	104
15	Cisko systems Bulgaria (Sofia)	13.81	13 195	11 594	953	83	91
16	NDB (Sofia)	8.64	7 762	7 145	3293	13	12
17	Networks Bulgaria (Rousse)	4.79	6 209	5 925	311	92	103

[73] Broadband Quality Score 2009 (BQS); Invest Bulgaria Factsheets, InvestBulgaria Agency, 2011

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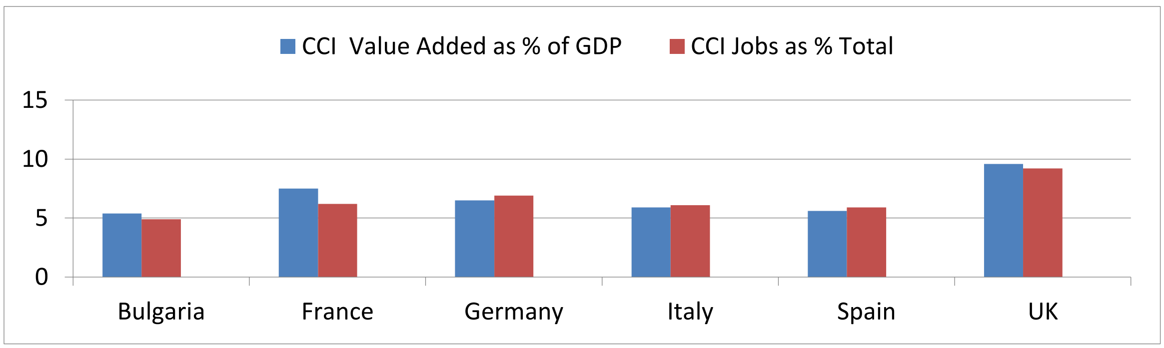
18	ICD soft (Sofia)	4.47	5 464	5 230	464	44	44
19	Microsoft Bulgaria (Sofia)	0.90	10 279	10 187	1 065	36	37

Source: "The Most Dynamic SMEs in Bulgaria", Capital (2012) page 74

Bulgaria's cultural and creative industries sector is dominated by small and micro enterprises with 10 employees or less, as well as partnerships of 2-4 free-lance practitioners. Large businesses are present in the printing, media and software development industries. However, CCIs have a significant contribution to GDP: in 2008 CCI gross value added was 5.5% and accounted for 4.9% of employed in the country and the average productivity per employee is 30% higher than the national average. More than half of the CCI businesses are concentrated in Sofia, the rest in large cities such as Plovdiv, Varna, Burgas, Stara Zagora and Ruse. There are several small clusters (mostly cultural heritage and crafts) in smaller municipalities.

Figure 21: Comparing Bulgaria to CCI leaders in Europe



Data is from 2008. Source: *"The Entrepreneurial Dimension of the Cultural and Creative Industries"* Utrecht School of Arts, K2M and Eurokleis (2010) and Author's calculations.

There is a need for CCIs clusters in Bulgaria because most businesses in the sector are micro-enterprises, and clustering would help them form of alliances on projects and to access new markets. Stronger clusters between enterprises would also increase opportunities for companies to do business. Establishing "creative incubators", or "creative hubs" (similar to technology parks) bringing creative people together i.e., architects, advertising creatives, designers, games developers, screen-writers, etc., would help induce a creative environment that can spur innovation in other sectors of the economy.

Experience from other European countries shows that creative physical spaces (such as "creative incubators" or "creative hubs"), result in forming single-location clusters, as well as broad networks that lead to the exchange of knowledge and business. Most importantly, other countries' experience in this area shows that such networks link partners based on creativity-driven innovation and promote regional growth and employment as well as provide a platform for increasing exports.

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4. Governance

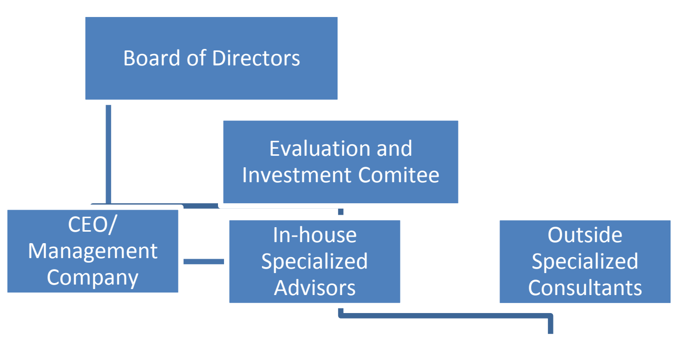
The governance model is the foundation for the financial success of the incubator. Past experience with EU-funded business incubators in Bulgaria confirms that governance model and the quality of management are one of the most critical success factors. In order for an incubator to succeed it needs professional management with strong private sectors expertise as opposed to receiving direction and guidance from government or municipal officials or academics. Another critical success factor is subsidizing not only the operations of the incubator, but the operations of the incubator tenants as well. As current practice in Bulgaria suggests i.e., model used in the case of seed/accelerators funds Eleven and Launchub funded under the JEREMIE initiative funded under OPC; this could be achieved by selecting a IBI operator through competitive bidding and providing this operator with a matching grants fund to support incubator tenant companies.

Incubators should be considered as part social investment and this usually requires public funding or a public-private partnership. Even though the IBIs in Bulgaria would need to be publicly-funded, their governance structure and management should mirror, to the maximum extent possible, these of a privately-funded and operated incubator. The development team should attempt to represent all stakeholders and relevant sectors, including: government, universities/vocational institutions, private sector, finance sector, other enterprise development initiatives/relevant sector initiatives.

4.1. Incubator champions: management and human resources

The quality of the business incubator management team (incubator champions) is critical for incubators' performance and success. International practice suggests discouraging governmental entities from championing business development initiatives like an incubator, in part because they do not provide the appropriate entrepreneurial mindset and culture to the project. For similar reasons, academic institutions are also not the best choice of incubator champions, as they rarely bring the appropriate level of entrepreneurial mindset, focus, and culture.

Figure 22: IBI Management structure



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Best practices indicate that the incubator manager/champions must possess: (a) broad entrepreneurial experience, capacity and an innovative character (b) specific knowledge in aspects of small business, marketing, finance, and technology management; (c) a wide network of contacts; (d) ability to effectively market the incubator to potential clients, sponsors, and stakeholders; (e) ability to identify clients' needs, coach clients effectively, and facilitate their access to outside resources; (f) ability to work with the board to impart the incubator's vision and mission to the general public and, through the selling of that vision, enlist support.[74] Typically, managers work part time on each project. Their remuneration should be competitive, but not excessive and they should receive a performance bonus, typically a percentage of net profit or percentage of company value paid in event of successful sale. European experience suggests that a typical business incubator has on average 2.3 management level staff (giving a ratio of management to tenant firms of about 1:9, based on the median of 18 tenant firms per incubator).[75]

Strong private sector participation in the management helps generate greater revenues from the incubator's services in form of an equity share in tenant companies. This source of income from the incubator's sale of shares to investors in such companies and potentially attracting private investors directly in the incubator[76] would reduce public subsidies eventually leading to the incubator's full financial independence in the future. International experience suggests that successful incubators leverage the expertise of venture capitalists and business angels. Since risk capital investment vehicles need deal flow, venture capitalists eagerly mentor incubator companies and actively participate in the management of technology incubators.[77]

Apart from the management, a competent administrative assistant and a receptionist-secretary usually complete the initial staff. Then, as the operations expand, as revenue grows, additional staff may be added. Most important, no matter how many people an incubator employs, the majority of staff time should be devoted to client assistance services rather than building or administrative tasks. Typically however, the main tasks of the manager are raising funds for the incubator and tenants and maintaining good relations with the managing board and professional community.

[74] The IBIs offer an excellent opportunity to leverage Bulgarian scientific and innovation business diaspora: to provide mentorship and finance to start-ups, but most importantly to provide much needed connections to international markets. The other benefit of IBIs is that they would create a pipeline for financing instruments that are being developed.

[75] The new-economy incubator has a significantly larger staff, typically ranging from 10 to 25 people. The reason for this is the particularly close involvement of the staff in the day-to-day operations and management of the incubated companies. This requires an attractive compensation package, including participation in any equity/royalty arrangements with tenants.

[76] A private investor would either buy the entire company or could possibly buy-out only the incubator at a discount reflecting the lack of a liquid market for the SME's shares. If the incubator is highly successful, a private investor might "buy-in" to the incubator and acquire a shareholding – all or in part – to capture the incubators shares in its portfolio companies.

[77] Usually for free. In case of conflicts of interest, business incubator representatives act as sell side advisors.

The effectiveness of an incubator's board of directors or advisory board is also an important factor for the incubator's success. In addition to fiduciary obligations and hiring the incubator manager, a board of directors' purpose includes thinking strategically and setting broad policy that will ensure the incubator attains the goals and objectives outlined in its mission statement. In order to achieve that purpose, all board members must be committed to the incubator's mission.[78] Ideally, professionals with diverse backgrounds and skills make a strong board. An incubator board might include business assistance professionals, technology experts, and anyone else with resources, know-how, and commitment to the incubator's mission. A major part of a board of directors' work is long-term planning—strategizing about everything from the incubator's values and mission to its budget, capital campaigns, and organizational charts. An effective board of directors focuses its attention on policy and setting a work plan for the incubator and a board that's highly involved at the strategic level can make a significant difference in the incubator's performance.[79] See Annex : Role of IBI Board of Directors

Box 12: Options for management structure

There are three general options of legal and governance structures for business incubators with variations on each and include 1) a private, for-profit corporation, 2) an independent not-for-profit corporation, and 3) a unit operating under an existing "host" not-for-profit corporation. A host not-for-profit structure entails that an incubator be established under the not-for-profit umbrella of an existing not-for-profit organization. A hosted not-for-profit structure allows the incubator access to host-administered charitable donations and public funds: including from the national and municipal budgets or EU funding provided under OPIC. A strong host can also provide instant credibility to an incubator project.[80]. Careful attention to creating a governance structure that allows the incubator to operate autonomously with its own advisory council and management staff can help assuage this concern.

As the IBI's would be publicly-funded, the structure should be carefully chosen based on analysis of state aid rules implications for each proposal. The structure should provide the greatest flexibility for incubator operations and positions it to be able to adapt to changing market dynamics and needs into the future. This structure also allows for access to public funding and private donations that are frequently required for the start-up and early years of operation of a new incubator.

For example, if the Sofia Tech Park acts as a sponsor of the IBI, it will be difficult to change the current governance structure, i.e. a party different that Sofia Tech to run the flagship IBI. The financing of the creation of the IBI would be considered state aid and the process of transferring that aid to the final users (incubated companies) will be linked to the 25 year

[78] Various NBIA documents

[79] To ensure that these responsibilities don't fall by the wayside, some boards set meeting agendas that allow time for thinking about the future or schedule half-day retreats where they can focus on the long-range plan.

[80] A key concern with a host structure is the potential for conflict between the board and management of the host and that of the incubator. Such conflict can occur if the institutional culture of the host is not compatible to entrepreneurial enterprises

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depreciation period of the buildings of the Sofia Tech Park. During that period no changes as to the ownership or the core activities could be made, unless a private investor acquires the required share of the IBI (or alternatively Sofia Tech) that satisfies the private investment intensity requirement under state aid rules.[81]. However, Sofia Tech Park could host the flagship IBI, alternatively providing rental space free of charge.

4.2. Selection criteria

Incubators select resident companies based on set criteria for admitting companies to the incubator, i.e., in-take criteria, as well as criteria for graduation from the incubator, i.e., exit criteria. International experience varies with respect to annual intake and average resident companies in an incubator. However, in order to increase their chances for success, incubators typically select firms that are most likely to survive and grow. A step to secure the best mix of tenants is to market the incubator to target audiences – particularly banks, technical universities, research and manufacturing organizations, and chambers of commerce – through professionally designed promotion campaigns. IBIs typically adopt a variety of methods to market their services and to identify potential clients: approaching prospective clients directly and by referrals are the most commonly used methods. Others methods include advertising and media campaigns, business events.

Most incubators adopt specific criteria to screen individual applicants. The selection process usually comprises: (a) a questionnaire to the candidates; (b) interview by the incubator manger to assess generally the candidate's entrepreneurial qualities; (c) review of the technical section of the business plan by a technical review group and the market, management, and financing aspects by a business; (d) contractual/lease agreements, to enable the tenant to move in.

Box 13: Common in-take criteria for incubator tenants

- developed business plan and its quality
- the commercial/technical viability of the project
- the entrepreneurial and managerial potential of the prospective tenant
- projected growth potential and job creation
- ability to pay for paid services (for example rent, even if discounted rates)82

[81] The IBI could not retain the proceeds from the sale of shares, it must return these to the OPIC, or alternatively, with the explicit agreement of the Managing Authority of the OPIC, that IBI could place these proceeds in a special revolving fund that is used to finance the same activities for which the original OPIC funding to the IBI was granted.

[82] The ability of the incubator tenant to cover the cost for paid services is sometimes overlooked based on expectations on the proceeds from the equity positions in incubated companies. As this is not a guaranteed or reliable source of income, incubators should aim to maximize rental income and provide a free rent subsidy for qualifying start-ups on exceptional basis. Typically, a rental payment as a minimum quid pro quo promotes greater appreciation of the value provided by the incubator so the tenant does not take it for granted.

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- compatibility of the project's aims with the incubator's objectives
- compatibility of the project's sector with the incubator's profile
- ability to compete with other clients
- ability to complement to the program

Typically, incubators have formal graduation or exit rules and impose strict limits on the length of time enterprises can remain tenants. Best practice experience suggests that in most cases the exit rules will require tenant to 'graduate' and leave the incubator after between 3-4 years.

Box 14: Common graduation criteria for incubator tenants

- expiration of rental agreement
- achievement of objectives
- failure to meet the aims of the incubation program
- moving to other facilities that provide other services
- moving to other facilities to get more space

An issue that should be considered in designing the IBI is how the incubator recuperates costs at graduation. If the incubator receives equity stake in the incubator tenant company in exchange for services, the presumption that the incubator will recuperate these costs by selling this equity share. However, receiving income from selling its equity stake in incubator tenant is not a given as the graduation from the incubator does not necessarily lead to a liquidity event, such as IPO or corporate acquisition. Also, shareholders frequently have administrative burdens when a company is taking certain actions so potential investors would have to spend in legal fees and administrative taxes more that the shares are actually worth. For this reason incubators should consider introducing into the rental agreement provisions that delineate the relationship between the incubator and the tenant after graduation.[83]

To secure steady rental income IBIs should consider attracting anchor tenants. Unlike incubator tenants who use the value-added services of the incubator and may receive below-market rents, anchor tenants are traditional research, development, and technology-based companies or companies providing professional services to tenants within the building. Rent income from anchor tenants would contribute to the incubator's financial stability. Anchor tenants should be selected and admitted based primarily on their compatibility with the incubator's community of clients and their ability to reliably pay the higher monthly rental fees.

4.3. Incubation period

In the EU, an average maximum length of tenancy is 3 years. Yet, there are also important sectoral factors that influence exit rules. In the case of biotechnology incubators, for example, (and any technology incubator whose companies must secure regulatory approvals on processes patents, trials, and the like), tenants will need lengthier incubator stays than 3-4 years.

[83] In an effort to recuperate costs, some incubators require that tenants pay above market rate for rental space and services after a specified period, typically in the last year of incubation.

Pharmaceutical companies in incubation may require 4 years incubation and successive rounds of infused capital over the next 5-6 years before becoming profitable. This is real problem, as the pharmaceutical and biotechnology start-ups might not be able to attract larger sums and will close mid-stream, notwithstanding a promising technology, drug platform, etc.

If economic development initiatives are looking at biotechnology, nanotechnology, and medical device development as profile areas, then they must also consider the financial implications of sustaining the incubation of companies over much longer periods of time vastly exceeding the incubator residency period related to CCI, or ICT.

Box 15: Examples of admission practices and incubation period

In the *Naiot* technology incubator has 8 to 10 resident companies at a time (admitting 4 to 6 new companies annually); the *Ytra* Program in Finland, which unites 12 regional technology incubators admits about 90 new companies per year and has about 200 companies in residence: about 16 companies in residence per incubator; in the United States the average of resident companies is about 20 per incubator.[84] Once admitted, the typical incubation period for a resident company is 2-3 years. For example, *Naiot* screens companies for 6 months prior to admitting them for a 2-year incubation period; the *Rubicon Centre* with the Cork Institute of Technology (CIT) in Ireland provides 3 months of pre-incubation assistance and admits companies for a 3 year incubation period.

4.4. Performance indicators for monitoring and evaluation

Incubators should monitor both the activities of clients and their own performance. Best practice indicates that the performance of incubators should be judged primarily in terms of the results achieved, i.e., the impact they have on businesses, wider economic development and other priorities in terms of the long-term impacts achieved rather than short-term measures such as occupancy rates or failure rates. Also incubators should obtain feedback from their tenant incubator companies and other clients on a more systematic basis, as a way of monitoring their performance. Quality standards tend to relate to service delivery rather than broader aspects of business incubator operations. [85] Incubators' performance assessment may be conducted according to three sets of variables:

Box 16: Performance indicators for monitoring and evaluations

I. Performance outcomes
- the program sustainability and growth

[84] The *Y Combinator* in California launched 172 technology start-ups in five years: annual average of 35 companies; the *Houston Technology Center* in Texas, has launched about 1000 start-ups over the past decade and has 60 resident companies at a time, the *Technology Innovation Center of Illinois*, hosts 38 companies at a time and has managed to launch 350 companies in 24 years. Data from 2011. Research report: "Feasibility study on Technology Incubators and New types of Business Incubators" Small Innovative Business Support Network / SIB net (EU 31398) Riga, Latvia (2011).
[85] Examples of general quality standards that have been developed for business incubators at an international level include the Commission's EC-BIC certification and a similar initiative by the US NBIA, and a UNIDO best practice guide.

- incubator resident/tenant firm's survival and growth,
- contributions to the sponsoring university's mission, and
- community-related impacts.

II. Management policies and their effectiveness – i.e., an assessment of the facility's management practices and operational policies in light of the program objectives in respect to:

- goals, organizational structure and governance,
- finance and capitalization,
- operational policies, and
- target markets.

III. Services and their perceived value-added, these are typically are assessed using two subcategories:

- incubator services, and
- university-related services.

As a complementary approach, incubators could be assessed more broadly with qualitative and quantitative measures that could cover the following categories: impacts, effectiveness and sustainability. There are a variety of measures that could be considered.

Box 17: Incubator assessment against impacts, effectiveness and sustainability

I. Impact/Outreach:

- Enterprises created
- Survival rate of enterprises
- Jobs generated (a) in incubated/affiliated firms; and (b) in graduated firms; (c) indirect jobs.
- Enterprises reached
- Replication of "pilot" model: If demand for space and services is strong, additional incubator could be established

II. Effectiveness

- Employment per net $ subsidy (direct and indirect).
- Taxes paid and returns to state per net $ of subsidy:
- Growth of client net worth, sales & exports
- Research commercialized
- Management dynamics (the capability of the team to provide needed services at reasonable profit-margins, to access professional services from external sources, and to win the confidence and appreciation of the clients)
- Seed venture capital mobilized
- Overall profitability of incubator: returns, direct/indirect subsidies
- Time to break-even: How many years from entry of first client has it taken for the incubator income to exceed operating expenses?
- Additionality
- Incubator expansion (the willingness of sponsors to expand incubator services)

III. Sustainability

- Revenue surplus (6 years): A TBIs cash flow, based on good accounting practices (which do vary among countries) should indicate the overall financial health, towards financial self-sustainability
- Services cost recovery (depends on the type of services and cross subsidization)
- University-business links

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- Stakeholder satisfaction
- Tenant/graduate satisfaction
- Changes in culture: relates to a necessary long-term transformation
- Enhancement of entrepreneurial skills and self-esteem
- Leveraging state policies

Source: Rustam Lalkaka *"Assessing the Performance and Sustainability of Technology Business Incubators, International Centre for Science & High Technology"* (2000).

5. Facilities and Services

The facilities of an incubator focusing on the ICT or the CCI sectors would differ substantially from a facility focusing on food processing, which must provide shared use food processing space with fully equipped commercial kitchen licensed to meet all health and sanitary standards, adequate dry, cold, and frozen storage space, packaging equipment, loading docks etc. A facility focusing on pharmaceuticals, biotech or life sciences would need a state of the art laboratory and sterile packaging facility. The success of start-ups in the machine building and electronics sector is associated with their ability to develop prototypes of innovative solutions and an incubator focusing on this sector would offer start-ups fabrication laboratories equipped with all necessary tools, including 3 D printers etc.

However, incubators, regardless of sectoral focus, provide assistance typically offered by seed funds such as a focal point where business idea authors could communicate with like-minded people and learn about entrepreneurship and shape their ideas. Like seed funds, innovation incubators build a creative environment and encourage future entrepreneurs to define their business ideas; whereas, the services provided by the incubator are fairly basic: premises, networking events and coaching. IBIs engage at this stage to filter out business ideas that are worth further investigation. Traditional incubation, however, follows two general stages to help identify business projects that are genuinely promising and will deliver the expected benefit.

During the pre-incubation stage, typically 2-6 months in duration, the incubator company sets up its management team, defines the business idea and the company's unique selling proposition and develops a business plan. In this stage, the incubator provides facilities and tools for productive planning (offices, open space workplaces, meeting rooms) coaching and funding provided to the business idea authors to spend several months for planning and fundraising.[86] The objectives in this stage is to obtain seed money and match the business idea authors with a incubator project manager.

Companies typically spend 2-3 years in the incubation stage. This stage includes product development, including applied research, prototyping and testing, market acceptance testing and first attempts to sell the product on the open market. The incubator contributes by providing manufacturing, office or laboratory premises, product development services (in-house or via outside contractors), intellectual property consulting, human resources consulting, management (incubator project manager is member of the company board or CFO or CEO);

[86] Such grants are typically the size of the average monthly income prior to joining the incubator.

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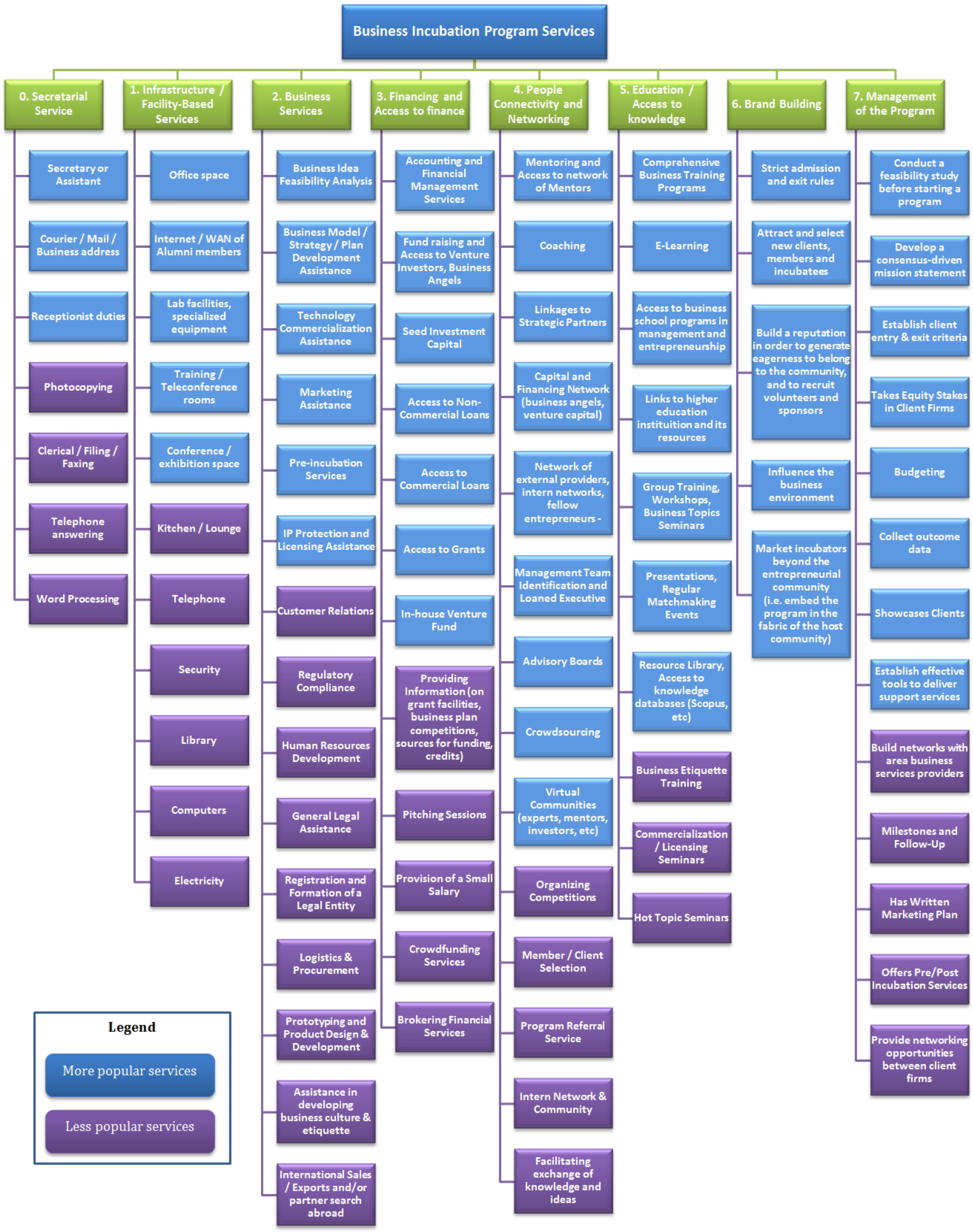
advice by skilled, experienced business owners and managers; networking and internationalization services. The objectives in this stage are to move the new company to operational profitability and prepare the company for next financing round of the venture capital pipeline.

Figure 23: Incubator Services



worldbusinessincubation.wordpress.com, Business Incubation Blog, Author Vasily Ryzhonkov

Internationally, innovation incubators have different approach to service provision and getting the right mix has a significant impact on the incubator's performance. One important issue is which services are provided in-house and what are bought from the outside. It is reasonable to have in-house competence in areas where active and regular involvement is required. Support in a narrow, specific area of expertise is provided sometimes in house if there is enough workload.

Employment of personnel with special competencies can be explained by an industry focus of the incubator that requires an understanding of technical aspects of new product ideas, a science background, as well as a very good comprehension of the regulatory framework for permitting, patenting, licensing, product compliance, etc.[87] At the same time, entrepreneurs are rational and will use all available support as long as it benefits them. For this reason, it is necessary to have a gradual approach in providing subsidized services, where the discount (share of subsidized EU financing for services rendered) goes down sharply after some duration of incubation.

International experience suggests that in a 3-year incubation period, business incubator tenants should pay for only a small fraction of the cost of services in the first year of incubation, going sharply up to 50% of full cost after the first year, and requesting them to cover the full cost of service in the year prior to graduation from the incubator. Such a mechanism, however, could bring an outflow wave of incubator companies soon after the first year of incubation is over. Another option for the flagship IBI is not discounting its services; instead, it should make sure that incubator companies get seed money and then help put that money to the best possible use.

5.1. Facility

Business incubation relies upon buildings and ICT infrastructure, and successful incubators follow client needs to complement core incubation. As general rule, buildings need to be suitable for flexible configuration, in a location that is good for business -- usually, a key determinant in selecting the site is whether the site is in geographical area favored by local entrepreneurs. For this reason, the initial criterion – location - would take into consideration the suitability of the site for the flagship IBI, as well as regionally based sectoral IBIs. An analysis of basic factors determining the suitability of the location, such as concentration of the business and research communities, business services networks and markets; should complement the survey data on the preference of businesses as to the site.

At present, the creation of a flagship IBI is feasible only in Sofia for a variety of strong supporting factors, including that the city has the critical mass of technology and knowledge based companies (and other such companies outside of Sofia have strong links and presence in the city), Sofia hosts most of the premier universities and research institutes with

[87] For example the Israeli technology incubator *Naiot* has an analyst with medical degree, a biological analyst, a regulation advisor, and in intellectual property advisor on the payroll as the incubator focuses on medical devices.

technology, life sciences or engineering focus. Sofia also hosts pre-seed and early stage support to technology businesses, i.e., Eleven and Launchub and Betahouse, that attract bright students, researchers and entrepreneurs. And for innovation-based start-ups -- where economies of scale are of paramount importance -- the number of potential users hugely affects the financial upside potential. Accordingly, companies tend to operate closer to the market or the access point to foreign markets, which in Bulgaria's case is the Capital Sofia.

5.2. Sources of support

International experience indicates that incubators have a greater chance of succeeding and if they can rely on both public and private sector funding and support. Private sector support, in addition to funding, provides much needed expertise, access to facilities, corporate venturing. It is, however, obvious that public funding is critical in the early developmental stages because it would likely take 3-5 years before the IBIs could attract private **sector funding or generate sufficient income from other sources to recuperate operational costs.**

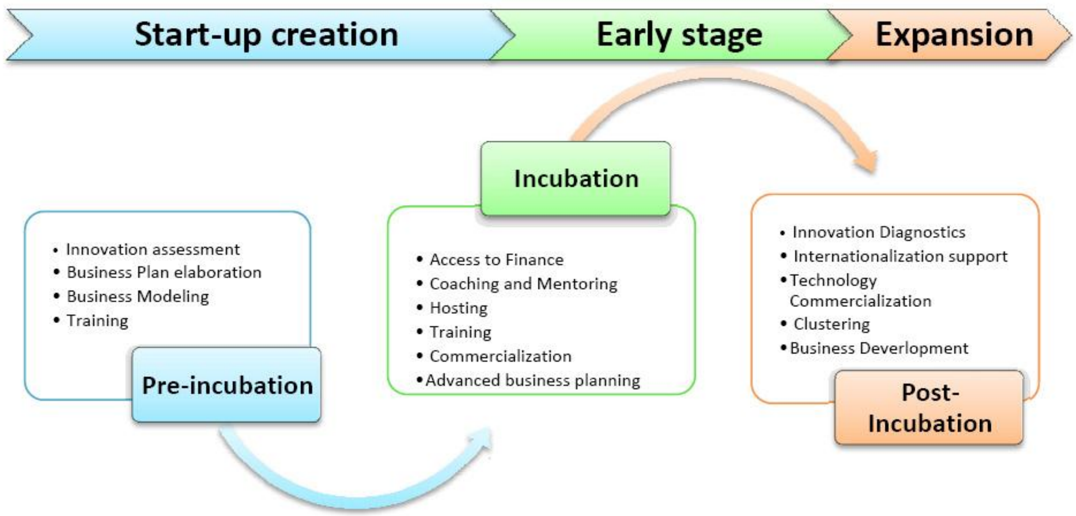
In assessing the business assistance needs of local firms and would-be entrepreneurs it is important to evaluate the ability and willingness of existing sources of business assistance to work with the incubator in meeting those needs.[88] It is understandable that a critical determinant for success is that the flagship IBI offers a comprehensive set of business assistance services that are highly sought by local entrepreneurs to help meet the needs of local start-up and small businesses, including microbusinesses and small firms seeking to expand.

5.3. Services

In general, business incubators provide pre-incubation and incubation services geared towards the helping innovation-based start-ups in their vulnerable inception stages and setting them on the path to growth.

[88] Services provided are from in-house sources, but also from outside provides, both non-profits and for-profit entities. In general, the satisfaction of business incubator companies is much higher with the services of outside for profit entities, than with non-profits. Data revealed that non-profits ten to be smaller, with less experience specifically in overcoming earlier stage incubation problems. For detailed discussion see; Montrose pp. 30-36.

Figure 24: Incubator Stages



Source: "*The Smart Guide to Innovation Based Incubators"* DG Regional Policy, European Commission 2010

Box 18: Incubator services

I. Most common pre-incubation services*:*
- Business planning and forming a company
- Training to develop business skills
- Accounting, legal and other related services
- Market research, sales and marketing
- Help with exporting and/or partner search abroad
- Help with e-business and other aspects of ICT
- Advice on development of new products and services
- Help with raising bank finance, grants, venture capital
- Access to incubator, venture capital fund, business angel network
- Advice on recruitment of staff and personnel management
- Networking, e.g. with other entrepreneurs, customers
- Mentors, board members and other senior advisers

II. Most common incubation services:
- Coaching and management training;
- Business evaluation; seed, bridge, venture capital financing and business angel network;
- Technology market intelligence, technology services (troubleshooting, applied research,
- Testing, certification;
- Premises and infrastructure support services; may include free or subsidized office space; (typically if there is a subsidy for rent, there is a graduation towards the exit to prepare the start-up for the market)

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- Part-time or full time involvement in management board or chairman position; includes contact building and gaining access to financial, technological and commercial networks;
- IPR counseling and strategy; contract research; and other advisory services.[89]
- Support with access to outside service provider networks for complex, specialized advice
- Marketing assistance
- Sales assistance
- Mentors and business coaching
- Client tracking, targets and benchmarks/program participation

While the main objective is to encourage and promote innovation-based entrepreneurship by providing relevant assistance and support, some incubators run separate programs, providing custom-made services to start-ups involved in specific knowledge-intensive sectors; examples include programs for ICT; for web and mobile technology; for biotechnology, etc. Incubator-style business support services are also the "preferred option" for companies in the cultural and creative industries sector that have very high innovation spillover and export growth potential. CCI companies are very much involved in R&D activities associated with new product development. Though outside product design, CCI impact the development of new materials to accommodate creative design solutions.[90] Companies in the sector are also pioneers in innovations combining existing technologies and processes, as well in developing new organizational forms and business models.

Creative incubators are places for nurturing entrepreneurial skills of companies from the CCI sector and are becoming one of the very important tools for inspiring innovation and promoting economic growth in Europe.

Box 19: Creative Incubators

We Tech Off is a project that supports the creation of innovative enterprises in the region of Emilia-Romagna, through the supply of services for potential entrepreneurs and technological start-ups. It includes both a virtual incubator and support program based at seven regional universities and research centers.
Bologna, Italy http://www.wetechoff.eu/

Betahaus Berlin is a co-working space in Berlin, where collaborative innovation and creativity are encouraged. It is a platform, which meets the demands of knowledge-based and creativity-based workers, expands their opportunities in the process and pushes up the rate of increase of networks, innovation and creative production.
Berlin, Germany http://betahaus.de/

[89] Early insights into range of IP rights protection and risks is crucial, emergent technology entrepreneurs need to be sensitive and alert to these issues since there is a very high change that they give away something critical by mistake.
[90] Italy has placed itself as the world leader in industrial design and the high clustering of such companies in the broader Milano regions has significant innovation spillover in traditional industries. For detailed discussion see: Elisabeth S. Meyer: *"Italian Clusters and Innovation System(s)",* Innovation Norway, Milano (2011)

Tallinn Creative Incubator is financed by Tallinn City, Enterprise Estonia and EU Funds and self-financing. It was awarded the 2nd Best Science Based Incubator 2010 for Combining Entrepreneurship with Creativity and Culture (9th Annual Conference on Science Based Incubation of The Technopolicy Network).
Tallinn, Estonia, http://www.esa.ee/eng/business-incubators

Kre*nova is financed by the EU structural funds program that supports entrepreneurs involved in culture, design and media. The incubator provides education and tools to businesses, various platforms for networking and a 1 year incubation program offering office spaces and open resource sites free of charge.
Norrbotten and Västerbotten, Sweden, http://www.krenova.se/

Creve, financed by the regional Centre for Economic Development, Transport and the Environment is an incubator for the creative sector in the region of Southwest Finland is part of HUMAK - University of Applied Sciences. It helps early stage creative companies to achieving stable growth though a 1 year incubation program.
Turku, Finland, http://creve.fi/index_en.html

Incubation Center for Creative Industries at the University of Debrecen is fully funded under EU programs and provides assistance for young micro and small business in the creative ICT industry, especially for newly started (spin-off, start-up) enterprises. In addition to incubation services it provides incubator companies access to international R&D networks to help them succeed in the international marketplace.
Debrecen, Hungary http://www.dekiik.hu/

Creative Andrejsala offers business incubation services for new (not older than 2 years) enterprises in creative industries and is supported by the European Regional Development Fund and the Investment and Development Agency of Latvia. It is designed as one-stop shop offering administrative, legal services, accounting, fund raising, marketing, partnership establishment and other business services.
Riga, Latvia, http://www.creativeandrejsala.lv/en/

The range of services that the IBI would provide to start-ups in knowledge-intensive sectors needs to be established through survey of the market demand, i.e., the assessing the needs and up-take of such services by starting companies and would-be entrepreneurs. However, even absent such survey, there is a clear indication on the demand for services[91] that the flagship IBI needs to provide, as discussed in the subsections below.

5.3.1. Access to finance

Traditional banks are generally not prepared and are ill-equipped to deal with the risks and high transaction costs of small business loans, particularly for innovation-based companies. If they do consider them, there are bureaucratic delays cash flow and collateral requirements, innovative start-ups can't meet because they typically have no sales yet and little or no tangible assets. For this reason the establishment of mechanisms by the public sector

[91] Based on input from 9 focus groups with representatives of the Government, the research and business communities on sectors reviewed in the World Bank Report *"Inputs to Bulgaria's Research and Innovation Strategy for Smart Specialization"* of August 2013; 2 focus groups with representatives of the innovation ecosystem held in February 2013; and numerous bilateral consultations with business leaders researchers and association representatives in the period November 2012-Septmebre 2013.

for promoting access to equity financing – or what is sometimes called "patient capital" – is frequently necessary to promote new product development and innovation company creation. This means that business angels, seed/accelerator funds and early-stage risk capital funds could be more involved in the operations of existing business incubators. International experience suggests setting an informal monetary target of equity investments in business incubator companies (e.g., two investments per year).[92]

The flagship IBI should have a dedicated matching grants fund in order to invest in identified high-potential businesses/business ideas - it is imperative to be able to tailor funding to each specific company in order to ensure greatest impact Based on international practice, a specialized investment committee could disburse up to €20,000 to a single start-up, also a second round of financing of up to €100,000 could be considered. Given the nature of the risk/equity capital industry in Bulgaria and support of EU programs (such as JEREMIE) to foster innovation finance, incubators with attached funds could help catalyze innovation financing and complement existing or planned interventions.

Investment guidelines should require co-financing by the private sector and solid industry relevance of the financed project, which would prevent creation of a culture of "easy grant money" and "cemetery of prototypes". The investments should be made with a view that the funded enterprise is able to achieve financing and grow once it has achieved the stated objectives of the financing. This will require financing intervention to be designed after carefully analyzing the financing gaps in Bulgaria.

5.3.2. Mentoring and business planning consultancy

In addition to providing training to innovation entrepreneurs on general business skills, marketing and 'soft skills" the IBIs would provide executive mentoring services. The IBI management would compose a pool of expert volunteers willing to serve as mentors and business counselors for IBI client companies. Mentors would be selected based on their experience with the client's industry sector and stage of development. The management of the IBI would closely monitor the interactions between mentor and incubator client, and should suggest resources that would help the mentor best serve the client business. Weekly or monthly feedback reporting mechanisms should be introduced to ensure the mentorship is providing good value to the incubator client company. Bulgaria is in a unique position to leverage the knowledge and experience of Bulgarian technology experts by augmenting the IBI program with diaspora involvement programs.

5.3.3. Technology assistance

IBIs would help start-ups overcome technical barriers to commercializing technology. Related programs would help incubator tenant companies receive assistance for free or at

[92] Israeli technology incubation program review suggested that 78,7% of all surviving incubator tenant companies attracted private investments after they graduated from the incubator. This may indicate that incubator graduates have higher investment readiness, defined as ability and willingness to attract external funding.

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reduced rates on specific technology questions or needs. Examples of such assistance include short term access to technical expertise and facilities such as: test and measurement of systems or components; analytical testing of materials; insights on existing or emerging technologies; assistance in addressing technological performance and market analysis.

The IBI management needs to compose a broad-based pool of highly-quality professionals that have the technical and business skills needed to support incubator tenant companies in technology matters. Services for such a network would be negotiated on a pro bono or reduced fee basis with guidelines for qualifications and level of service provided. The IBI should screen service providers, facilitate the interaction between the service provider and the tenant company, and establish a performance assessment mechanism to assess client progress and satisfaction.

5.3.4. R&D monitoring

A key service to innovation-based start-ups is monitoring research and development trends. Following such trends helps indicate in which way future markets would be leaning and is of paramount importance in the commercialization stage of the product that the innovative start-up is developing. R&D monitoring is also important for both, dedicating product development activities to product market segments that are new and have less competitors, as well as complementing development activities through ground-breaking technology solutions that have just become available.

Based on the information revealed in the technology road mapping process[93], the IBI would advise on technology trends and the direction globally so as to leverage the country's competence to position itself in the value chain.

5.3.5. Product development

Product development helps start-ups decide on the best product development model, the necessary resources, deploying new technologies. It is one of the most critical items that takes the start-up from a technology concept to a product that can be commercialized. The IBI will help incubator tenants transform their product ideas into a precise specification and marketing requirements for a product that can be manufactured and sold.

[93] The technology road mapping that the Government would perform for each sector would identify gaps that prevent the development of the sector, such as technological infrastructure, generic and pre-competitive R&D, specialized human capital, regulation or deregulations, other critical common infrastructure. This would provide mechanisms to incorporate in systematic business intelligence instruments like market and technology foresight; helps creating support from industry and government for joint projects for R&D consortia and common technology developments in targeted areas. The TRM would country for future challenges and opportunities caused by disruptive innovation by building human capital and competence in emerging areas.

5.3.6. Support with intellectual property issues

Experience from incubators across the globe suggests that in-house IPR support should include IP strategy formulation, patent application advisory and advise on other IP rights, such as copy rights, trademarks etc., while specialized legal support in cases of complex IP issues and infringement of intellectual property rights could be provided by reputable outside providers familiar with the work of the incubator. It is assumed that IP support would likely to be a valuable feature of the IBIs: information from participants in focus groups on protection and commercialization of intellectual property[94] and World Bank report *"Inputs to Action Plan for Innovation Commercialization Services in Bulgaria*" indicate that entrepreneurs in Bulgaria have concerns about establishing and protecting their intellectual property.[95] While the demand is established, it is advisable to conduct a survey of existing businesses and future entrepreneurs to define the scope of intellectual property protection support.

5.3.7. Support with regulatory issues

Incubators help tenant companies address regulatory issues, such as registration requirement, certification and testing for standardization and metrology purposes, as well as in addressing products/services development issues in heavily regulated industries, such as telecommunications, pharmaceuticals, biotechnology, medical devices etc. The IBIs would help guide tenant companies through the regulatory process, and provide necessary assistance in addressing specific regulatory requirements.

5.3.8. Market intelligence and marketing consultancy

The IBI would also provide assistance to start-ups on developing marketing strategies to better position its products and services. This service will include market intelligence relevant to the potential markets and competitors of the incubator tenant companies to help them determine their market opportunities and develop product/service market penetration strategies and market development metrics.

6. Financial Model

International experience shows that incubators, if properly designed and managed, can start generating profit after 8-10 years of operation. In this context, the flagship IBI will upfront support over a long period of time, with an emphasis on the initial 3 years of operation: OPIC funding for the flagship IBI should be secured for the entire 7-year funding cycle of the program. OPIC funding would cover both the costs for establishing the flagship IBI and subsidize its operations for seven years, and cover a small matching grants program. The annual operational subsidy will vary over the seven year period as it will decrease by 25 percent in years three to seven.

[94] Over 30 participants in the focus group held at the World Bank Country Office on February 27, 2013
[95] A good practice would be to provide periodic overview course on IP to new "classes" of companies entering incubators.

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The financial model assumes that 10-15 start-ups will be admitted for a 3 month pre-incubation program each quarter, 2-4 of these will be admitted to the incubator for the duration of a 3-year incubation program. It is assumed that the total number of start-ups participating in the 3 month pre-incubation program will be 40-55 per year, and 8-16 start-ups will be admitted to the incubator each year: 24-48 incubator resident companies annually. The estimates on the average costs for servicing one start-up in pre-incubation are less than €3,000 per quarter, while the cost for servicing start-up in incubation are estimated at about €20,000 per year.

The services to the start-ups in the pre-incubation program, and during the first year of incubation will be free, but the subsidies for the services will be gradually reduced in the second and third years of incubation, so that incubator companies will be paying almost market rates for services by the time they graduate. The co-payment that incubator companies will have to pay-out-of-pocket after the end of the first year will increase by 10% each quarter, so that starting with the second quarter of the second year, the company will have to co-pay 10% of the services rendered, and by the end of the last quarter of the final third year of incubation – just before graduation; the incubator company will co-pay 90% of the costs of services. In this manner, the incubator companies will be better prepared for the market.

In addition to providing services to incubator tenant companies, the IBI will also provide grant funding in the form of matching grants, where tenant companies receive 85% in grant funding if they can secure a 15% self-funding.[96] The flagship IBI would also use the subsidy to cover the business development costs of start-ups, including travel to meet partners and present the program in conferences and seminars, where IBIs annual contribution is estimated at about €200 per start-up. Event logistics to facilitate demonstration of start-ups to potential investors is expected to be €150 per start-up annually.

6.1. Establishment costs

Establishment costs will are estimated at less than € 100,000, including costs of developing the feasibility study and business plan of the flagship IBI, survey of business demand, selection and recruiting of its management and staff; purchasing office equipment, computers, internet infrastructure etc.

6.2. Running costs

The total cost for subsidizing the operations of the flagship IBI for the entire 7 year period will be a little over € 2million, whereby, the annual operational subsidy for the flagship IBI will vary over the seven year period. It will gradually decrease by 25 percent annually after year three, so that the operational subsidy is expected to be less than € 400,000 in years one to three, with the cost dropping gradually to less than € 130,000 by the end of the seven year period.

[96] Provided the IBI is operated under a management contract, the matching grants program could require the IBI operator to provide the 15% match the tenant the grant

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These costs include expenses for housing the IBI, i.e., rent, office equipment, furniture etc., as well as the salaries of the IBI management and its experts on intellectually property, technology, product development and marketing. The subsidy includes tenant costs for travel, events, public awareness campaigns, as well as a portion of the fees[97] of outside intellectual property attorneys that provide in-depth advice to start-ups on complex IP issues. Most importantly the operational subsidy includes € 100,000 per year in funding dedicated for matching grants to tenant companies at a 15% self-participation.[98] This matching grants program, part of the operational subsidy, accounts for a 25% annual decrease in subsidy after the third year of operation of the IBI.[99]

With respect to the subsidy for remunerating IBI's management and expert team, there are two options: contracting the management of the IBI to an operator selected though competitive bidding (the preferred option)[100]; or directly subsidizing their salaries from the OPIC.[101]

Table 15: Option A: Costs under Management Contract to Competitively Selected Company

	Establishment Costs (initial)	Operating Costs Y1	Operating Costs Y2	Operating Costs Y3	Operating Costs Y4	Operating Costs Y5	Operating Costs Y6	Operating Costs Y7
Feasibility Study/ Business Plan	30,000							
Recuriting Management	3,000							
Subsidy for Rent of flagship IBI facility (500 sqm)		36,000	36,000	36,000	27,000	20,250	15,188	11,391
Renovation rental space for IBI flagship (500 sqm)		2,500						
IBI facility maintenance costs		2,500	2,500	2,500	1,875	1,406	1,055	791
Office Equipment: Desks, Chairs, Filing Cabines.	15,000							
Office Equipment: Computers, Printers, Copiers	30,000				22,500			
Kitchen (Coffee machine, Refrigerator etc.)	20,000							
Internet Infrastructure (routers, cabling, switches)	600							
Internet Access (50 access points annual fee)		400	400	400	300	225	169	127
Communications (telefone, courier)		1,000	1,000	1,000	750	563	422	316
Electricity, water, heating/cooling (500 sqm space)		5,000	5,000	5,000	3,750	2,813	2,109	1,582
IBI Operator Management Fee		250,000	250,000	250,000	187,500	140,625	105,469	79,102
Matching Grants to Tennants (15% cofinancing)		100,000	100,000	100,000	75,000	56,250	42,188	31,641
Annual Operating Subsidy		**397,400**	**394,900**	**394,900**	**318,675**	**222,131**	**166,598**	**124,949**
Total Establishment Costs	**98,600**							
Total Operating Cost Subsidy 7 Year Period								**2,019,554**
Total Cost for 7 Year Period								**2,118,154**

[97] The IBI would cover on average about €300 of the fees per start-up per year.

[98] The matching grants program would be aligned with the *de minimis* exemption of the state aid rules. The tenant companies will receive about € 65, 000 (up to € 200,000 for the 3 year incubation period) whereby 85% of the amount would be a grant from the dedicated fund operated by the IBI management, and 15% would be co-financed either by the tenant or the IBI operator.

[99] Alternatively, instead of operating the matching grants fund, the IBI could assist tenants in obtaining matching grants from the Managing Authority of the OPIC, or other grant funding available.

[100] Under this option the IBI operator would receive a flat annual management fee of no less than € 250,000. In addition to forcing the IBI operator to take on ownership of the program, this option also reduces bureaucratic procedures and associated costs and efforts on the part of the managing authority of the OPIC to process monthly payments etc.

[101] Both estimates reflect the maximum anticipated number of companies in each program; namely, admitting 15 start-ups to the pre-incubation program every 3 months (totaling 55 each year); admitting 16 start-ups to the 3-year incubation program annually, so in the third year of operation the flagship IBI could host 48-50 start-ups

Table 16: Option B: Cost for Direct Operational Subsidy

	Establishment Costs (initial)	Operating Costs Y1	Operating Costs Y2	Operating Costs Y3	Operating Costs Y4	Operating Costs Y5	Operating Costs Y6	Operating Costs Y7
Feasibility Study/ Business Plan	30,000							
Recuriting Management	3,000							
Rent for flagship IBI facility (500 sqm)		36,000	36,000	36,000	27,000	20,250	15,188	11,391
Renovation rental space for IBI flagship (500 sqm)		2,500						
IBI facility maintenance costs		2,500	2,500	2,500	1,875	1,406	1,055	791
Office Equipment: Desks, Chairs, Filing Cabines.	15,000							
Office Equipment: Computers, Printers, Copiers	30,000				22,500			
Kitchen (Coffee machine, Refrigerator etc.)	20,000							
Internet Infrastructure (routers, cabling, switches)	600							
Internet Access (50 access points annual fee)		400	400	400	300	225	169	127
Communications (telefone, courier)		1,000	1,000	1,000	750	563	422	316
Electricity, water, heating/cooling (500 sqm space)		5,000	5,000	5,000	3,750	2,813	2,109	1,582
Salary Executive Director		36,000	36,000	36,000	27,000	20,250	15,188	11,391
Renumeration 7 Member Mangement Board		42,000	42,000	42,000	31,500	23,625	17,719	13,289
Salary Accounting Manager/ Finance Expert		24,000	24,000	24,000	18,000	13,500	10,125	7,594
Salary Administrative Support Staff		12,000	12,000	12,000	9,000	6,750	5,063	3,797
Salary Marketing Strategy Expert		24,000	24,000	24,000	18,000	13,500	10,125	7,594
Salary In-House IP counsel		24,000	24,000	24,000	18,000	13,500	10,125	7,594
External IP attorneys for complex IP issuses		18,000	18,000	18,000	13,500	10,125	7,594	5,695
Salary Regulatory Product Development Expert		24,000	24,000	24,000	18,000	13,500	10,125	7,594
Salary Technology Monitoring Expert		18,000	18,000	18,000	13,500	10,125	7,594	5,695
Events and Public Awareness Costs		6,000	6,000	6,000	4,500	3,375	2,531	1,898
Travel		10,000	10,000	10,000	7,500	5,625	4,219	3,164
Administrative		6,000	6,000	6,000	4,500	3,375	2,531	1,898
Matching Grants to Tennants (15% cofinancing)		100,000	100,000	100,000	75,000	56,250	42,188	31,641
Annual Operating Subsidy		**391,400**	**388,900**	**388,900**	**314,175**	**218,756**	**164,067**	**123,050**
Total Establishment Costs	**98,600**							
Total Operating Cost Subsidy 7 Year Period								**1,989,249**
Total Cost 7 Year Period								**2,087,849**

6.3. Sources of funding and co-financing

It is critical to assess in detail all implications from the perspective of applicable state aid rules when designing the IBIs funding model, specifically with respect to subsidizing its operations leveraging EU fund under OPIC and other OPs, as well as from national and municipal budget sources. State aid rules implications need to be considered also with respect to mixing public and private funding to sustain IBIs operations. A possible model would be to ensure the sustainability of IBIs through public private partnerships (PPP). PPPs are viewed by the EC as core facilitation means to promote innovation. However, in PPPs using EU funds, only the public sector entity can be the initiator and beneficiary. Correspondingly, the public entity in the PPP must sign the grant application, receive the funds and supply all documentation detailing expenses. There are several models under which EU funds can be combined with private finance in PPP projects:

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- *Grants as public capital expenditure contribution:* Under this model the EU-funded grant is used to finance capital expenditures. Payments to private partners can be only for services rendered.
- *Parallel co-financing:* Under this model the infrastructure asset or program is split into distinct parts: one financed from public sources, including EU funds as a conventional procurement; and the other as a PPP.
- *Grants as partial funding availability or user-related payments:* This model is optimal for blending grants with private finance, but it is also the most problematic to combine with EU funds grants mainly due to the n+2 rule.[102] This is because EU Structural Funds grants focus exclusively on the provision of assets, which makes them suitable for co-financing of construction costs but not for paying for infrastructure-based services.[103]

7. Planning and Implementation Steps

Developing the IBI program of with a flagship IBI based in Sofia and sector IBIS based regionally would require significant efforts in planning and implementation. The likely timeframe from program identification to launch would be no less than 18 months.

7.1. Phase I. Planning (Target for completion 6 months)

1. Identify opportunities for regional sector specific IBIs
2. Consultations with stakeholders and approval of IBI Network Program
3. Nominating the IBI Program project team
4. Analysis of sectors for flagship IBI and regional based IBIs
5. Conduct IBI SWOT Analysis for flagship IBI and regionally-based sector IBIs
6. Conduct business demand surveys
7. Conduct IBI site analysis and surveys
8. Conduct feasibility studies for flagship IFI and regional sector IBIs
9. Complete business plans for flagship IFI and regional sector IBIs
10. Selecting management/operators of flagship IBI and regionally-based sector IBIs
11. Securing funding for IBIs operations over 7 year period and assessing state aid rules implications (funding under OPIC and national sources)
12. Exploring opportunities for private sector investment in IBIs and possible PPP models

[102] The "n+2" rule under article 31.2 of Regulation 1260/1999: "*The Commission shall automatically decommit any part of a commitment which has not been settled by the payment on account or for which it has not received an acceptable payment application, as defined in Article 32(3), by the end of the second year following the year of commitment or, where appropriate and for the amounts concerned . . . The contribution from the Funds to that assistance shall be reduced by that amount.*"
[103] EU grants are designed as upfront payments towards the construction costs. This makes EU funding difficult to use for non-revenue projects like social infrastructure.

7.2. Phase II. Project Implementation (Target for completion 12 months)

1. Stakeholder consultations and endorsing IBIs business plan
2. Identify champion to lead and facilitate flagship IFI and regional sector IBIs
3. Form Steering Committee to oversee IBI program implementation
4. Finalize decision regarding IBI management and funding structure and establish it
5. Secure funding commitments for facility development and operation for the initial 7 years
6. Identifying sources of funding for IBI tenants – advisory support to incubator tenants to obtain available seed grant funding
7. Initiate design and construction of IBI sites and facility
8. Establish the IBIs boards
9. Hire IBI executive directors/managers
10. Enroll professionals for value-added resource network
11. Write leases, agreements, bylaws, etc.
12. Finalize service offerings and detail and develop pricing policy (subsidized rent and graduation of subsidies, anchor rent, consulting services
13. Finalize lease agreements with anchor tenants
14. Implement marketing and PR plan for all stakeholders
15. Implement marketing and PR plan to recruit IBI tenants companies

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Regional Development
European Fund
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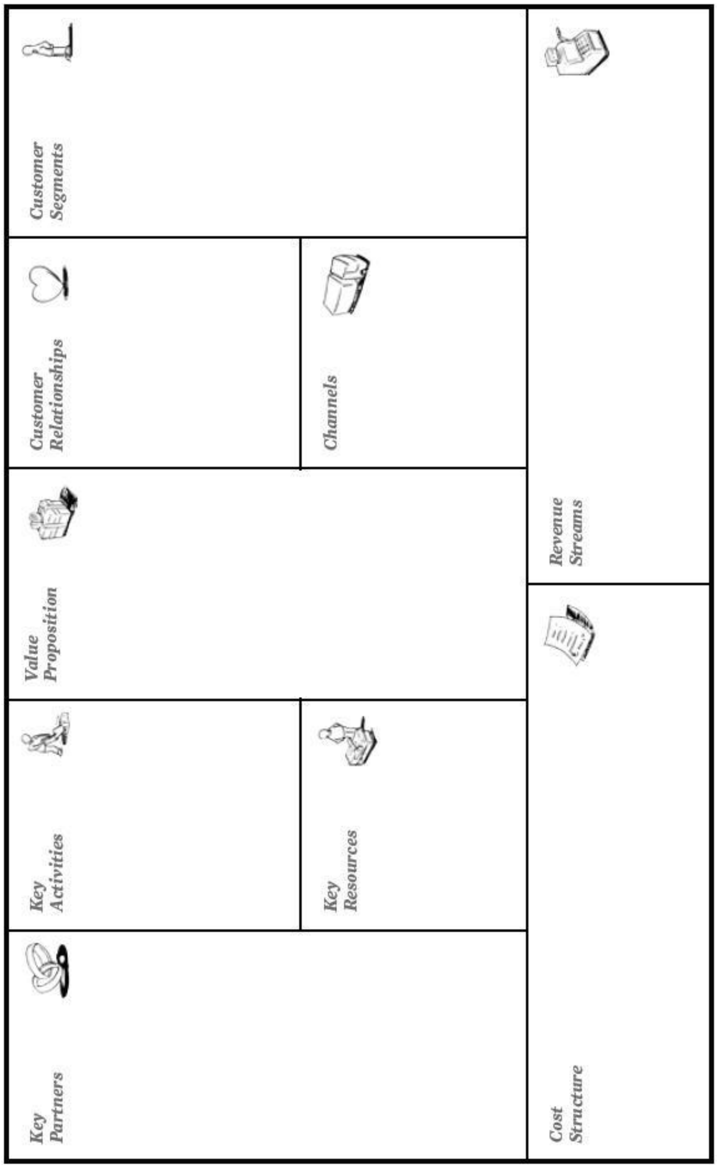
We invest in your future

NATIONAL
STRATEGIC
REFERENCE FRAMEWORK
2007 – 2013

Operational Program
"Development of the
Competitiveness of the
Bulgarian Economy"
2007-2013

Annex 1: Business Model Canvas



Source: http://www.businessmodelgeneration.com/canvas

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Annex 2: List of interviewed Fab Lab Managers and other Stakeholders

Fab Lab Name	Fab Lab Manager Name
Fab Lab Romania	Mr. Alexandru Cristal, Head
Fab Lab Croatia	Mr. Roberto Vdovic, Head
Fab Lab Ukraine	Mr. Konstantin Leonenko, Head
Fab Lab UK – Manchester	Mr. Chris Wilkinson, Board Member of Fab Lab Foundation, former Head of UK Fab Lab Network
Fab Lab Poland	Mr. Michal Cichy, Head
Fab Lab Barcelona	Mr. Tomas Diez, Head
Fab Lab Latvia	Mr. Krišs Līdumnieks, Head of Fab Lab at University of Latvia
Fab Lab Hungary	Mr. David Pap, Head
MIT Center for Bits and Atoms	Ms. Sherry Lassiter, Program Manager
3CLab and Center of Excellence (Technical University of Sofia)	Prof. Georgi Todorov, Head
Smart Fab Lab (SFL) (upcoming)	Dr. Stavri Nikolov, Founding Director of SFL

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Annex 3: Questionnaire for Interviewing Fab Labs

Background
When created?
Who was initiator (public, private, PPP)
What challenges you faced when opening the Fab Lab? How it came into existences?
What was the start-up funding? (private grant, EU, government, mix)
Any EU pre-conditions that you had to comply with?

Business Model/Activities
What is focus? Range of what it does? Mix of services?
- subsidized training course
- Fab Lab offers a whole lab and machine hire
What is basic business model?
Have you already developed some interesting products/projects?
Are there incubation services in your Fab Lab?

Activities Production/Prototyping
How many pieces of equipment?

Stakeholder/Market:
1) Who are the users? (#per month/week, % by type of total volume)
2) What role does academia play? Industry, SMEs?

Governance, Legal:
1) What is legal structure? Public? Role of Private Sector?
2) Does Gov't or private independent professional run entity?
3) Is it self-standing? Or created under umbrella organization?
4) What is Governance structure? Who comprises Board of Directors? How appointed?
5) Is there a management company? Or was management team built from ground up?
6) How large Is staff and Management? What are their functional responsibilities? What functions are outsourced?
7) What are projected staffing needs?

Financial/Investment
1) What are its sources of funding?
2) What are the sources of its revenues?
3) In what niches/services is the demand highest? Revenue highest?
4) What is the structure for revenue generation? How do the users pay? Subscriptions/memberships? Hourly

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usage?

5) What is annual budget?
6) In what areas do they see the growth coming from?
7) Basic salary range for managers?
8) What were start-up costs for equipment?
9) What are annual operating costs?
10) What is structure of financial model? Measure for success?
11) What are prospects/plan for achieving sustainability? How will they become profitable?
12) Are there any private sector or other "investors?"

Monitoring and Evaluation
Impact analysis

If there's a network of Fab Labs in your country?

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Annex 4: Universities by Specialization and Rank

Note: Specializations are included based on relevance to Fab Lab concept. Ranking was calculated based on data received

General Engineering

Name	Rank
Technical University of Sofia	73.0
University of Chemical Technology and Metallurgy	68.0
University of Mining and Geology "St. Ivan Rislki"- Sofia	55.0
Technical University of Gabrovo	55.0
Rousse University "Angel Kanchev"	51.0
University of Forestry	49.0
Technical University of Varna	48.0
National Military University - Veliko Tarnovo	47.0
University of Food Technology	46.0
"Todor Kableshkov" University of Transport, Sofia	43.0
Burgas "Prof. Assen Zlatarov" University	42.0
Trakia University - Stara Zagora	40.0
Agricultural university	39.0
"Konstantin Preslavsky" University of Shumen	
European Politechnical University	

Electrical, electronics and Automation

Name	Rank
University of Chemical Technology and Metallurgy	69.0
Technical University of Sofia	67.0
Rousse University "Angel Kanchev"	54.0
National Military University - Veliko Tarnovo	53.0
Technical University of Gabrovo	52.0
Technical University of Varna	50.0
University of Food Technology	48.0
University of Mining and Geology "St. Ivan Rislki"- Sofia	47.0
"Todor Kableshkov" University of Transport, Sofia	45.0
Trakia University - Stara Zagora	38.0
Burgas "Prof. Assen Zlatarov" University	37.0
South-West University "Neofit Rilski" - Blagoevgrad	37.0

Architecture, Construction and Geodesy

Name	Rank
University of Architecture, Civil Engineering and Geodesy	65.0
Academy of the Ministry of Interior	59.0
University of Mining and Geology "St. Ivan Rislki"- Sofia	57.0

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Varna Free University "Chernorizets Hrabar"	49.0
Higher School of Civil Engineering (VSU) "Lyuben Karavelov" - Sofia	47.0
"Todor Kableshkov" University of Transport, Sofia	45.0
"Konstantin Preslavsky" University of Shumen	41.0
New Bulgarian University	
European Politechnical University	

Informatics and Computer Sciences

Name	Rank
Sofia University "St. Kliment Ohridski"	74.0
American University in Bulgaria	62.0
New Bulgarian University	56.0
Plovdiv University "Paisii Hilendarski"	52.0
Rousse University "Angel Kanchev"	50.0
South-West University "Neofit Rilski" - Blagoevgrad	48.0
"St. Cyril and St. Methodius" University of Veliko Tarnovo	48.0
Burgas Free University	47.0
Varna Free University "Chernorizets Hrabar"	45.0
EU - Varna	44.0
"Konstantin Preslavsky" University of Shumen	38.0
University of National and World Economy - Sofia	
Burgas "Prof. Assen Zlatarov" University	
"D. A. Tsenov" Academy of Economics - Svishtov	
University of Food Technology	
University of Library Studies and Information Technologies - Sofia	
European Politechnical University	

Material and Materials Sciences

Name	Rank
University of Chemical Technology and Metallurgy	63.0
Technical University of Gabrovo	50.0
Rousse University "Angel Kanchev"	45.0
Burgas "Prof. Assen Zlatarov" University	44.0

Mechanical engineering

Name	Rank
Technical University of Sofia	64.0
Rousse University "Angel Kanchev"	57.0
Technical University of Gabrovo	55.0
University of Food Technology	54.0
University of Mining and Geology "St. Ivan Rislki"- Sofia	53.0
"Todor Kableshkov" University of Transport, Sofia	50.0

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Technical University of Varna	49.0
Trakia University - Stara Zagora	39.0
South-West University "Neofit Rilski" - Blagoevgrad	35.0
Burgas "Prof. Assen Zlatarov" University	
Plovdiv University "Paisii Hilendarski"	

Physical Sciences

Name	Rank
Sofia University "St. Kliment Ohridski"	71.0
Plovdiv University "Paisii Hilendarski"	50.0
"Konstantin Preslavsky" University of Shumen	41.0
South-West University "Neofit Rilski" - Blagoevgrad	38.0

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Annex 5: International Fab Labs Comparison Model

Parameters	MIT Fab Lab	Fab Lab Vigyan Ashram	Fab Lab Barcelona	Fab Lab Manchester	Fab Lab Budapest	Fab Lab.hr, Zagreb
	Unites States	**India**	**Spain**	**United Kingdom**	**Hungary**	**Croatia**
GDP per capita, PPP	$49,965	$1,489	$29,195	$38,514	$12,622	$13,227
Fab Lab background						
Fab Lab Web-site	cba.mit.edu	Vigyan Ashram	http://fablabbcn.org	http://www.fablabmanchester.org	www.fablabudapest.com	www.fablab.hr
Year of establishment	2001	2002	2006-2007	2010	2011	2013
Fab Lab's reported impact (as of November 2013)	Research programs and international fab lab network	Small innovations that have gone to market, and lots of rural learners in the fab lab	(1) 1st Fab Lab in Europe with MIT established Fab Academy (self-sustaining educational program); (2) Fab Lab Smart City: City of Barcelona adapted Fab Labs in each of 10 city districts; (3) Smart Citizen platform that emerged from the Fab Lab	Since opening in 2010,Fab Lab was used on more than 3000 projects (as of 2012) (e.g .innovative Hefty Drive)	First Fab Lab in Hungary	First Fab Lab in Croatia, Impact on society > No. of individual users
Connectivity of Innovation Eco-system - User Demand						
Main user groups (from highest to lowest) e.g. 1)Students is the largest group of users, followed by 2) researchers, 3)entrepreneurs, business, etc.	Students, Researchers, Faculty	students, local entrepreneurs	Students, entrepreneurs, local community, entrepreneurs	Small manufacturers, inventors, community groups, schools.	university students, entrepreneurs, start-up,; researchers	Researchers, students, private business
Average number of users who pay per week	N/A	N/A	300-400	300	12-15	5
Average number of total visitors per week	150	50	450-550	400	30-35	10

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Key affiliation of users (by industry, sector) e.g. ICT, Architecture, Manufacturing, Auto.	ICT, Architecture, Mechanical Engineering, Physics, Computer Science, education	Agriculture, Education, and small scale manufacturing	Architects, designers, artists, engineers.	Manufacturing, mechanical engineers, entrepreneurs	Designers	Manufacturing, Architecture, Industrial Design, Hobby
Financial						
Start-up Funding (public, private, both)	National Science Foundation (Public)	National Science Foundation -- first MIT outreach project	Private funding (established under the private Institute for Advanced Architecture of Catalonia (IAAC))	Public-Private (The Manufacturing Institute and the Manchester Innovation Investment Fund)	Private (This Fab Lab is hosted by a private owned Ltd. which profile is prototype development and manufacturing)	Private
Key Sources of Revenue (by type), for example: (1) Education, (2) Research, (3) Fab Lab Services (equipment).	Research	Grants and small scale manufacturing	(1) Education, (2) Research, (3) Fab Lab Services.	Prototyping service and machine hiring	At the Fab Lab the revenue comes mostly from workshops and from the machine usage fees.	1) Research 2) Services 3) Education 4) Tech Support 5) Consulting
Ongoing government funding support	Some	yes	None	Yes, through NESTA, Local Councils	None	Ongoing with project application
Years to reach the "break-even" point (return of initial investment) (if applicable)	N/A	NA	3-4 years	N/A	It has been reached in 2013	1 year (expected)
Fee Structure (if applicable)	None	None	Free to non-commercial users, paid for commercializing ideas	Free to non-commercial users on Fridays and Saturdays, but businesses and inventors can protect their ideas by paying for the service	Students free, fees from 20-100EUR	Annual fee private (approx. 50EUR) students with discount, and corporate (100EUR).
Services						
Number of equipment	Whole suite of digital Fabrication equipment	started with full fab lab, but power issues prevented use of largest machine	Over 15	Over 15	10 big machines, 7+ of small equipment	7

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Core Business Model (education, production, consulting, etc)	Education, Research	Education, entrepreurs hip small scale manufactur e	FAB LAB PRO - production, incubation FAB LAB MASTERS - research, students from architecture school FAB LAB CENTRAL - education		FabLab Budapest focusses on education and workshops to teach users how to use technology and equipment. With this we also create our user market. (We teach what is avaliable by us.)	Consulting, Support, Education, Production
Go-To-Market services/Incubatio n	To some degree (there are a few machines reached the market that have emerged from the network)	Rural incubation is a part of what they do.	Yes	No	Yes	Education/Res earch
Fab Lab Sector focus (if applicable) or Multi-sector	Research	Agriculture and rural application s	Architecture, design, art	Manufacturing, ICT	Multi-sector	Academic Research, Private Enterpraneurs
Governance						
Independent or part of umbrella-organization (techno park, school, university, research-centers, etc)	Part of MIT	Part of Vigyan Ashram, a science and entrepreneu rship school in rural Maharashtr a	Part of Institute for Advanced Architecture (IAAC), private non-profit foundation	Part of Manchester Manufacturing Institute	Independent	Independent, but operating on the premises of University and with good relationship with them
Legal registered status	University	Part of school		University	LTD	Non-profit association
Number of paid employees	2 or 3	n/a	5		3	1
Number of unpaid staff (volunteers) (if applicable)	zero	Non-profit/Ashr am	-		-	3
Fab Lab Country Network						
This Fab Lab is the central Fab Lab in the network	Global network for the Center-- 225 labs we think	They are the oldest in India, of 4, none of them has emerged as the center of an India Network	yes	Yes	Currently this is the only Fab Lab in Hungary	Currently this is the only Fab Lab in Croatia

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Number of Fab Labs within Country Network (including the First lab)	225 labs worldwide (across countries)	4	Total 12 (6 - established, 6 - in development)	8	1	1
Actual average lab increase per year	40	0.5	1-2 per year	3	-	-
Projected/planned lab increase per Year within Country Network	Double in size every 18 months (so 250 in planning)	There is a project under consideration to add 2 flagship labs, 10 college labs and 1000 mini fab labs for innovation in Kerala.	6	4 per year	4	-
Sources of Network Funding (if applicable)	Fee for service, private funding, public funding, education fees, etc.	Fee for service, private funding, public funding, education fees, etc.	Once it's registered as Association, it will have a legal status to partner with companies, apply to EU funds	Various Public funds - EU, Trusts, Private	-	Private and goverment
Country Network Governance (responsibilities of central Fab Lab, etc)	Fab Foundation presence globally--working to provide infrastructure and supports for the global network, "the glue". Helping to facilitate the growth of new labs and new networks. We enforce the Charter and the ratings for fab labs globally.	None--relationships are informal and based on collaborations, personal and professional connections.	First Fab Lab: coordination, establishment of new Fab Labs, philosophy	1 - under umbrella, others subcontracted implementation but are under independent organisations	-	First Fab Lab

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Fab Academy graduates	45 MIT students each year in university version of Fab Academy	They have tried to participate- but internet connectivity prevents live participation. They have watched videos online for free but it has not produced any Fab Academy graduates.	3 Fab Labs per year	3 Fab Labs - Manchester, Glasgow and Cardiff have participated	-	Yes

Source: Authors' compilation based on interviews.

Annex 6: Financial Assessment for Intermediate Model of Fab Lab Deployment

Intermediate Fab: Lab Machine List, Estimated Establishment Cost for Bulgaria				
#	**Description**	**Unit cost (FOB) ($USD)**	**Cost (FOB) ($USD)**	**Coutry of Origin**
Quantity	**3D Printing**			
6	Makerbot Replicator II	$2,500	15000	USA
1	uPrint SE Plus	$25,000	25000	USA
		Total 3D Printing	**$40,000**	
	Cutting			
1	Epilog Laser FiberMark Fussion 32	$80,000	80000	USA
1	Ventilation accesory for Laser cutter	$3,000	3000	USA
1	Roland MDX 24 Vinil Cutter	$2,500	2500	Japan
		Total Cutting	**$85,500**	
	CNC routers			
1	ShopBot Desktop	$5,000	5000	USA
1	ShopBot Accesories	$7,000	7000	USA
1	Roland MDX 20	$5,600	5600	Japan
		Total CNC Routers	**$17,600**	
	Accessories/Supplies			
1	Workstations, Electronics and Tools	$15,000	15000	China
1	Accesories, materials, supplies, etc.	$14,000	$14,000	China
		Total Accesories	**$29,000**	
	Total Equipment Cost (FOB)		**$186,100**	
	Shipping (estimation)		$15,000	
	Total Equipment (CIF)		**$201,100**	
	Total import duty & taxes		$50,275	
	Total Initial Establishment Cost ($USD)		**$251,375**	
	Total Initial Establishment Cost (€Euro)		**€ 180,990**	

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Intermediate Fab Lab: Operating Costs for Bulgaria				
Human Resources	Monthly net salary (*)	Monthly gross salary	Number of Empl	Year Cost
Engineer (5 years experience)	€ 1,100	€ 1,430	1	€ 17,160
Designer (5 years experience)	€ 700	€ 910	1	€ 10,920
Designer (junior)	€ 500	€ 650	1	€ 7,800
	Total Human Resources			**€ 35,880**
Rent	Monthly rent	Per sq. m		
300 sq meters in business park	€ 2,948	€ 8		€ 35,376
	Total Rent			**€ 35,376**
Other costs	Montlhy cost (	Months		
Electricity, heating and cooling	500	12		$6,000
PoC Lab consumes double of a house				
Internet	Monthly cost (	Access points		
Fast internet service	€ 50	2		€ 600
				€ 500
Outreach	Cost	No. of Empl.		
Participation/Travel Cost Conference Attendance (2 employees)	$5,000	2		€ 10,000
Marketing, Publicity, road show, exhibitions				€ 5,000
	Total Other costs			**€ 16,100**
Training/Education				
Fab Lab Academy Participation (2 empl. per year)				€ 10,000
Sub running costs (€ Euro)				**€ 97,356**
Contingency (10%)				€ 9,736
Total running costs (€ Euro)				**€ 107,092**
(*) Source: http://www.investbulgaria.com				

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Intermediate Fab Lab: Estimated Revenue								
Discount rate (nominal)	10%							
Projected Inflation	2.0%							
Discount rate (real)	7.8%							
Depreciation Rate	14%							
Variable cost base	3500							
Corporate Tax	10%							
	Years							
	0	1	2	3	4	5	6	7
Individual Pass Fee (core machines are not included)		€ 10	€ 15	€ 15	€ 15	€ 15	€ 15	€ 15
Users who purchased passes		10	8	15	18	20	25	30
Individual Pass revenue		**€ 100**	**€ 120**	**€ 225**	**€ 270**	**€ 300**	**€ 375**	**€ 450**
Business/SME Pass		€ 30	€ 30	€ 30	€ 30	€ 30	€ 30	€ 30
Number of Business Passes purchased		3	6	7	8	11	15	20
Business/SME Pass revenue		**€ 90**	**€ 180**	**€ 210**	**€ 240**	**€ 330**	**€ 450**	**€ 600**
Fee for consulting service (with operator, big machines),		€ 10	€ 12	€ 12	€ 12	€ 12	€ 12	€ 12
Hours per Month		25	50	75	112.5	168.75	253.125	379.6875
Months		10	10	10	10	10	10	10
Consulting Service revenue		**€ 2,500**	**€ 6,000**	**€ 9,000**	**€ 13,500**	**€ 20,250**	**€ 30,375**	**€ 45,563**
Machine hiring (no operator)		€ 5	€ 7	€ 10	€ 10	€ 10	€ 10	€ 10
Hours per user per day		4	4	4	4	4	4	4
Users per Day per month		1	2	4	6	8	10	12
Days per Month		20	20	20	20	20	20	20
Months per Year		10	10	10	10	10	10	10
Machine Hiring revenue		**€ 4,000**	**€ 11,200**	**€ 32,000**	**€ 48,000**	**€ 64,000**	**€ 80,000**	**€ 96,000**
Workshop Fee per hour		€ 10	€ 20	€ 20	€ 20	€ 20	€ 20	€ 20
Number of Workshops per		6	8	10	12	14	16	18
Months per Year		10	10	10	10	10	10	10
Users per workshop		5	10	10	10	10	10	10
Workshop revenue		**€ 3,000**	**€ 16,000**	**€ 20,000**	**€ 24,000**	**€ 28,000**	**€ 32,000**	**€ 36,000**
Free Public Hours and associated costs								
				3D Printers		Workstations	3D Printers	
			Machine repla	€ 14,800		€ 15,000	€ 14,800	
Establishment Cost	(€ 180,990)							
Public/Foundation Finance	€ 180,990							
Annual revenue		**€ 9,690**	**€ 33,500**	**€ 61,435**	**€ 86,010**	**€ 112,880**	**€ 143,200**	**€ 178,613**
Annual Operating Costs		**(€ 107,092)**	**(€ 107,092)**	**(€ 107,092)**	**(€ 107,092)**	**(€ 107,092)**	**(€ 107,092)**	**(€ 107,092)**
Operating Profit		**(€ 97,402)**	**(€ 73,592)**	**(€ 45,657)**	**(€ 21,082)**	**€ 5,788**	**€ 36,108**	**€ 71,521**
Machine Replacement/ Maintanance Cost				(€ 14,800)		(€ 15,000)	(€ 14,800)	
Depreciation		(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)
Operating profit before Taxes		**(€ 137,529)**	**(€ 113,719)**	**(€ 100,584)**	**(€ 61,209)**	**(€ 49,339)**	**(€ 18,819)**	**€ 31,394**
Taxes		€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	(€ 3,139)
Net Profit		**(€ 137,529)**	**(€ 113,719)**	**(€ 100,584)**	**(€ 61,209)**	**(€ 49,339)**	**(€ 18,819)**	**€ 28,254**
Net Cash flow		**(€ 177,656)**	**(€ 153,846)**	**(€ 140,711)**	**(€ 101,336)**	**(€ 89,466)**	**(€ 58,946)**	**(€ 11,873)**
Net Present Value (NPV)	**(€ 589,929)**							
NPV (12%)	**(€ 531,822)**							
NPV (15%)	**(€ 495,699)**							

*this represents 2/3 of the toal fee that goes to Fab Lab, with 1/3 being paid to the coach.

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Annex 7: Financial Assessment for Basic Model of Fab Lab Deployment

Basic Fab Lab: Machine List, Estimated Establishment Cost for Bulgaria				
#	**Description**	**(FOB) ($USD)**	**Cost (FOB) ($USD)**	**Coutry of Origin**
Quantity	**3D Printing**			
4	Makerbot Replicator II	$2,500	10000	USA
		Total 3D	**$10,000**	
	Cutting			
1	Epilog Mini 24 40W Laser Cutter	$20,287	$20,287	USA
1	Ventilation accesory for Laser cutter	$3,000	$3,000	USA
1	Roland MDX 24 Vinil Cutter	$2,500	$2,500	Japan
		Total Cut	**$25,787**	
	CNC routers			
1	ShopBot Desktop	$5,000	$5,000	USA
1	ShopBot Accesories	$7,000	$7,000	USA
1	Roland MDX 20	$5,600	$5,600	Japan
		Total CN(	**$17,600**	
	Accessories/Supplies			
1	Workstations, Electronics and Tools	$15,000	15000	China
1	Accesories, materials, supplies, etc.	$10,000	10000	China
		Total Acce	**$25,000**	
	Total Equipment Cost (FOB)		**$78,387**	
	Shipping (estimation)		$15,000	
	Total Equipment (CIF)		**$93,387**	
	Total import duty & taxes		$23,347	
	Total Initial Establishment Cost ($USD)		**$116,734**	
	Total Initial Establishment Cost (€Euro)		**€ 84,048**	

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Basic Fab Lab: Operating Costs for Bulgaria				
Human Resources	Monthly net salary (*)	Monthly gross salary	Number of Empl	Year Cost
Engineer (5 years experience)	€ 1,100	€ 1,430	1	€ 17,160
Designer (5 years experience)	€ 700	€ 910	1	€ 10,920
Designer (junior)	€ 500	€ 650	1	€ 7,800
	Total Human Resources			**€ 35,880**
Rent	Monthly rent (*)	Per sq. m		
200 sq meters in business park	€ 1,965.33	€ 8		€ 23,584
	Total Rent			**€ 23,584**
Other costs	Montlhy cost (*,*	Months		
Electricity, heating and cooling	400	12		$4,800
PoC Lab consumes double of a house				
Internet	Monthly cost (*)	Access points		
Fast internet service	€ 50	2		€ 600
				€ 500
Outreach	Cost	No. of Empl.		
Participation/Travel Cost Conference Attendance (1 employee)	$5,000	1		€ 5,000
Marketing, Publicity, road show, exhibitions				€ 5,000
	Total Other costs			**€ 11,100**
Training/Education				
Fab Lab Academy Participation (2 people per year)				€ 10,000
Sub running costs (€ Euro)				**€ 80,564**
Contingency (10%)				€ 8,056
Total running costs (€ Euro)				**€ 88,620**
(*) Source: http://www.investbulgaria.com				

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Basic Fab Lab: Estimated Revenue								
Discount rate (nominal)	10%							
Projected Inflation	2.0%							
Discount rate (real)	7.8%							
Depreciation Rate	14%							
Variable cost base	3000							
Corporate Tax	10%							
	Years							
	0	1	2	3	4	5	6	7
Individual Pass Fee (core machines are not included)		€ 10	€ 15	€ 15	€ 15	€ 15	€ 15	€ 15
Users who purchased passes		10	8	15	18	20	25	30
Individual Pass revenue		**€ 100**	**€ 120**	**€ 225**	**€ 270**	**€ 300**	**€ 375**	**€ 450**
Business/SME Pass		€ 25	€ 25	€ 25	€ 25	€ 25	€ 25	€ 25
Number of Business Passes purchased		3	6	7	8	11	15	20
Business/SME Pass revenue		**€ 75**	**€ 150**	**€ 175**	**€ 200**	**€ 275**	**€ 375**	**€ 500**
Fee for consulting service (with operator, big machines), Average		€ 10	€ 12	€ 12	€ 12	€ 12	€ 12	€ 12
Hours per Month		20	40	60	90	135	202.5	303.75
Months		10	10	10	10	10	10	10
Consulting Service revenue		**€ 2,000**	**€ 4,800**	**€ 7,200**	**€ 10,800**	**€ 16,200**	**€ 24,300**	**€ 36,450**
Machine hiring (no operator)		€ 5	€ 7	€ 10	€ 10	€ 10	€ 10	€ 10
Hours per User per Week		16	16	16	16	16	16	16
Users per Week per month		1	2	4	6	8	10	12
Weeks per Month		4	4	4	4	4	4	4
Months per Year		10	10	10	10	10	10	10
Machine Hiring revenue		**€ 3,200**	**€ 8,960**	**€ 25,600**	**€ 38,400**	**€ 51,200**	**€ 64,000**	**€ 76,800**
Free Public Hours and associated costs								
			Machine replace	3D Printers € 14,800		Workstations € 15,000	3D Printers € 14,800	
Establishment Cost	(€ 84,048)							
Public/Foundation Finance	€ 84,048							
Annual revenue		**€ 5,375**	**€ 14,030**	**€ 33,200**	**€ 49,670**	**€ 67,975**	**€ 89,050**	**€ 114,200**
Annual Operating Costs		**(€ 88,620)**	**(€ 88,620)**	**(€ 88,620)**	**(€ 88,620)**	**(€ 88,620)**	**(€ 88,620)**	**(€ 88,620)**
Operating Profit		**(€ 83,245)**	**(€ 74,590)**	**(€ 55,420)**	**(€ 38,950)**	**(€ 20,645)**	**€ 430**	**€ 25,580**
Replacement/Maintanance Cost				(€ 14,800)		(€ 15,000)	(€ 14,800)	
Depreciation		(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)	(€ 40,127)
Operating profit before Taxes		**(€ 123,373)**	**(€ 114,718)**	**(€ 110,348)**	**(€ 79,078)**	**(€ 75,773)**	**(€ 54,498)**	**(€ 14,548)**
Taxes		€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Net Profit		**(€ 123,373)**	**(€ 114,718)**	**(€ 110,348)**	**(€ 79,078)**	**(€ 75,773)**	**(€ 54,498)**	**(€ 14,548)**
Net Cash flow		**(€ 163,500)**	**(€ 154,845)**	**(€ 150,475)**	**(€ 119,205)**	**(€ 115,900)**	**(€ 94,625)**	**(€ 54,675)**
Net Present Value (NPV)	**(€ 664,688)**							
NPV (12%)	**(€ 590,721)**							
NPV (15%)	**(€ 545,439)**							

*this represents 2/3 of the toal fee that goes to Fab Lab, with 1/3 being paid to the coach.

Annex 8: Example of M&E framework for Fab Labs

General Metrics for Fab Labs DEFINITIONS BELOW	**End of Year 1 target**	**End of Year 2 target**	**End of Year 3 target**
# of direct project beneficiaries in total	Teachers: Students: Adults: Firms: Entrepreneurs:	Teachers: Students: Adults: Firms Entrepr.	Teachers: Students: Adults: Firms Entrepr.
% female			
# of indirect project beneficiaries[2]			
Total # of volunteers on project/program			
Total # of volunteer hours on project/program			
# of government institutions or nonprofit organizations with enhanced capacity as a result of the project (please list)			
# of positive media mentions for the project or Fab Lab (tweets, Facebook likes, news)			
Did the project receive any public awards - if so, how many?			
Will this project have a significant public event? If so, how many people will attend the event(s)?			
Amount of cash funds (in US$) leveraged through partnership[4]			
Amount of in-kind contribution leveraged through partnership[4]			

STEM Education Metrics DEFINITIONS BELOW	**End of Year 1 target**	**End of Year 2 target**	**End of Year 3 target**
# of additional resources made available and details of what they were			
# students participating in supported project			
# of scholarships awarded			
# of teachers trained			
# of hours of teacher training			
# of parents/community members engaged			
% of project serving students from low-income families			
# of supported students interested in pursuing			

further STEM education, certification or career			
# of supported students accepted into a post-secondary STEM program			
% change in supported student performance in national standard tests in STEM subjects			

Source: Fab Foundation, 2013.

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Annex 9: Incubator Business Demand Survey Sample

Business incubation is a public and/or private, entrepreneurial, economic and social development process designed to nurture business ideas and start-up companies and, through a comprehensive business support program, help them establish and accelerate their growth and success.

From the definition on business incubation above or from your own personal knowledge:	**Yes**	**No**
Are you aware of efforts to start an innovation based incubator?		
Do you think there is a need for an IBI to be located at XX?		
Do you think your business might use the IBI at XX?		
Do you think the technology business incubator at XX would help increase collaboration between research and business?		
Do you think an IBI would help your research institute/university in commercializing research and innovation?		
Do you think your business/ research institute/ university might play a role in supporting the IBI?		
Are you interested in starting new businesses?		
Are there services and or facilities that would encourage you to start a new business or expand your business?		
What services should an incubator offer to help new and existing businesses survive and grow?		
Help with Business Basics		
Marketing Assistance		
Assistance with e-commerce		
Accounting/Financial Management		
General Legal Services		

Help with Access to Finance Issues		
Links to Angel Investors/ venture capital		
In-house investment funds		
Networking Opportunities		
Technology Commercialization		
Links to Research Institutions and Universities		
Management Team Development		
Shadow Board of Director Members /Mentors		
Personnel Development		
Intellectual Property Management		
Inventory and Customer Management		
Linkages to Strategic Partners		
Help with Regulatory Compliance Issues		
Help with Procurement Issues		
International Trade Assistance		
Manufacturing Assistance		
Product Design and Technology Assistance		
Business Training Programs		
Economic Literacy Training		
Help with Presentation Skills		
Help with Business Etiquette		

From your experience:	**Comments**
Do you know of people who have recently started a business or who are thinking of starting a business? If so can you share information about the entrepreneurs involved and the type of business?	
Who best knows and keeps track of business start-up and business expansion information?	
If you were advising a person who was thinking of starting a business, what 2 or 3 things are most important to help that person succeed?	
What products or services not currently available would help your business be more competitive?	

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Annex 10: Surveys Responses on Incubator Services (USA)

Business Assistance Services Offered	Demand %*
Help with Business Basics	97
Marketing Assistance	82
Assistance with e-commerce	56
Accounting/Financial Management	74
General Legal Services	42
Help with Access to Finance Issues	75-80
Links to Angel Investors/ venture capital	81
In-house investment funds	28
Networking Opportunities	76
Technology Commercialization	41
Links to Research Institutions and Universities	70
Management Team Development	44
Shadow Board of Director Members /Mentors	60
Personnel Development	61
Intellectual Property Management	31
Inventory and Customer Management	55
Linkages to Strategic Partners	61
Help with Regulatory Compliance Issues	59
Help with Procurement Issues	61

International Trade Assistance	47
Manufacturing Assistance	53
Product Design and Technology Assistance	38
Business Training Programs	61
Economic Literacy Training	39
Help with Presentation Skills	64
Help with Business Etiquette	61

*Percent of incubator companies in mixed-use business incubators in the United States.

Source: S.Linder, 2002 State of the Business Incubation Industry, NBIA, 2003

Annex 11: Funding for Technology Incubators in Europe

Source of Funding for Technology Business Incubators	Percent
Subsidies - EU and other international agencies	10.1
Subsidies - national authorities and public agencies	27.3
Payments from banks and other private sector organizations	2.6
Payments from universities and other R&D organizations	3.0
Rental income and other incubator charges	39.5
Other revenue, e.g. from service contracts	11.1
Investment income, e.g. royalties, equity returns	0.8
Donations and others	5,6

Source: Research report: "Feasibility study on Technology Incubators and New types of Business Incubators" Small Innovative Business Support Network / SIB net (EU 31398) Riga, Latvia (2011).

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Annex 12: Comparison of Incubation Models (USA, China, Brazil)

Figure 2: Comparison of Incubation Models in the United States, China and Brazil

	USA	CHINA	BRAZIL
Strategic Focus	Economic development, tech transfer and commercialization.	Social mission, economic development with high tech focus.	Foster entrepreneurship, economic development, job creation, technology commercialization.
Sponsorship / Incubator Funding	Multiple levels of govt., economic development organizations, private funding	Govt. is predominant funding source for incubators and incubatees	Plural sources of funding include different levels of govt., universities and some private funds
Type of Incubatee Business	Mixed, high-tech, specialized.	Mostly high tech (software, hardware, bio-tech etc).	High-tech, mixed in social, culture and design incubators.
Service Mix	Tangible and specialized, value adding services	Mostly tangible services of an administrative nature	Both hard and soft services, such as networking.
Financial Services	Provides links to sources of financing with a few investing directly in incubatees	Links to various sources of govt. grants, bank loans and some VC funding. Rare cases in South of direct investment in incubatees.	Links to various sources of govt. funding lines, angels and VCs. Bank loans difficult to secure for start ups. Rare cases of direct investment in incubatees.
Role of Govt.	Low-supportive, but not dictatorial.	High - Visible hand.	Visible, carrot and stick, synergistic approach.

Source: Aruna Chandra, Tim Fealey *"Business Incubation in the United States, China and Brazil: A comparison of the Role of the Government, Incubator Funding and Financial Services"* Indiana State University

Annex 13: Differences between Accelerators and Incubators

There seems to be a considerable amount of confusion about the differences between business accelerators and business incubators. Many people use the terms interchangeably, but there are a number of elements that distinguish one from the other. At the same time, there are indeed overlaps across incubator and accelerator services, which might explain much of the confusion. The aim of this article is to help clarify the difference between the two.

It is sometimes easier to grasp the differences between two adjacent paradigms by first knowing about the elements that they share. For example, both incubators and accelerators prepare companies for growth by providing guidance and mentorship, but in slightly different ways, and more importantly, at different stages in the business life cycle.

Due to the staggering number and variety of accelerator and incubator services that exist out there, it is indeed difficult to provide clear definitions. In order to get this straight, let's draw an analogy and say that the life of a business is like the life of a human being. There are roughly three major stages of life: childhood, adolescence and adulthood.

Like a father to a child, an incubator provides shelter where the child can feel safe and learn how to walk and talk, by offering office space, business skills training, and access to financing and professional networks. The incubator nurtures the business throughout the startup phase (childhood) and provides all the necessary tools and advice for the business to stand on its own feet.

While learning to stand on its own is a great entrepreneurial achievement, the walk through adolescence is often wobbly and filled with challenges, and the need for guidance is far from over. As any parent knows, guiding a teenager through adolescence is perhaps the most trying period in that person's life, as the adolescent gains a sense of self and identity.

One major challenge facing most companies who operate on the verge between childhood and adolescence is that sooner or later, they get stuck in the trenches of day-today operations, and more often than not fail to incorporate long-term strategic planning in the development of the business. The company may lose track of its unique value proposition – its identity – during this phase. It is at this critical point in the business life cycle that most incubator programs end, as the firm is technically ready to spread its wings. Nonetheless, the journey towards sustained growth is far from over.

Often it becomes necessary to receive additional advice and guidance on the path towards sustained growth. Here the services provided by a business accelerator can be immensely useful. By means of acceleration services, often in the form of an "acceleration program", business accelerators help companies get through adolescence and prepare them to enter adulthood, i.e. helping them develop strong arms and legs (institutional strength), sound values and a clear mindset (vision and strategy) for the future. In other words, while incubators help companies stand and walk, accelerators teach companies to run.

An important note is that business accelerators can be roughly categorized into two categories: Seed accelerators (like Y-Combinator) and second-stage business accelerators (like Impulsa

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Business Accelerator). The Seed Accelerator derives much of its characteristics from the business incubator; their services often include provisions of pre-seed investment (usually in exchange for equity) and the focus is usually on business model innovation. In contrast to an incubator, the seed accelerator views the startup period as short, and startups are often supported in cohort batches or 'classes' during a seed acceleration program. Moreover, incubators usually provide a physical office workspace for startups in their program; this is always the case with seed accelerators.

Instead, a seed accelerator program is commonly viewed as more of a preparatory phase with a duration of just 2-4 months, during which the startup is mentored, gets access to the right network, and that ends with a "Demo Day" during which the startup gets a chance to pitch in front of venture capitalists and/or business angels. In contrast, a second stage business accelerator is very different from incubators and seed acceleration programs.

The incubator model is suitable for a large variety of companies, but over the recent decade an upsurge of high-tech startups has constituted a large part of incubator portfolios. The time a startup spends under the 'protection' of the incubator before graduating varies depending on the needs of the company for it to get on its feet, but may last for many years. On the other hand, a business acceleration program usually lasts between 3-6 months. The emphasis of the business accelerator is on rapid growth, and to sort out all organizational, operational, and strategic difficulties that might be facing the business. It can be understood as a holistic business advisory service, often bearing strong resemblance to traditional management consulting practices, but adjusted to fit small and medium sized organizations.

It is important to note that, compared to people, companies don't grow by the tides of time per se, but by means of expanding their markets. An established company can still be sucked into the trenches of operations, or face other obstacles in accelerating their business. Hence, be it a young or established company, business accelerators can step in and straighten out the journey towards adulthood. Both incubators and accelerators are important economic resources/institutions to foster and boost the growth of firms, be it from early startup or in strengthening established organizations. And as we all know, the growth of firms is the lifeblood of any economy.

Source: Impulsa Business Accelerator http://www.impulsaxl.com/business-accelerator-vs-business-incubator.html

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Annex 14: Role of Incubator Board of Directors

A major board task is to support the incubator manager. Members can help out by hosting visitors, networking with stakeholders, and making presentations—demands that can divert the manager's time away from assisting clients. Board members also can play a direct role in growing successful companies, by offering legal or financial expertise, participating on advisory boards, or making investments. However, they must understand that in these roles they are serving as volunteers under the direction of the incubator manager, not as a member of the incubator's governing body. One must not assume board members understand their roles.[104]

In order to cultivate a strong working relationship, the board of directors and incubator manager need to communicate openly and regularly. While the manager should make sure the board knows about significant matters within the incubator, the board should be respectful of staff and avoid micromanaging. The effectiveness of a board of directors depends in large part on the quality of its meetings. Carefully thought-out agendas will help the board maximize meeting time, especially if board members come well prepared. Although meetings shouldn't be excessively long, they should allow ample time to cover agenda items and for members to interact. If a board meets once a month, meetings might take an hour or two; if it meets just three or four times a year, meetings might require an entire day, and they should receive their briefing books well in advance of the meeting to allow time for study, reflection and preparation. It's not a bad idea for the board of directors to implement a yearly self-assessment, which can help reinforce members' responsibilities, clarify differences of opinion, and demonstrate to sponsors and stakeholders the board's commitment and integrity.

[104] It is advisable to use bylaws, orientation manuals, and one-on-one meetings to emphasize their duties as policy makers, not managers.

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Annex 15: SWOT Analysis: Food Processing Sector

Strengths	Weaknesses
- Strong tradition in food research, highly qualified researchers, excellent research organizations and established partnerships with food and health research institutions abroad. - High standards for food quality and safety and - Well-developed transportation and distribution network - Low labor costs - Access to the EU Markets, tradition and presence in markets in Russia, CIS and the Middle East	- Low level of R&D and innovation intensity - Weak collaboration between businesses in the sector, universities and research institutions - Outdated facilities and technologies resulting in high energy and water consumption - Inefficient supply chain due multiple intermediaries and - Limited exchange of information between research organizations and industry
Opportunities	**Threats**
- Access to EU market and traditions in markets in the Middle East and the CIS provide opportunities expansion and scale up - Increased demand for high-value added food products in both the export and domestic markets - Use of EU funds to invest in technological upgrading, logistics centers and marketing	- Higher productivity in other EU Member States - Strong depopulation of rural areas resulting in labor shortage in rural areas where processors are located - Increasing constraints in access to financing due to EU financial crisis - Increasing raw material prices and equipment prices

Source: Final Report: *"Inputs to Bulgaria's Research and Innovation Strategies for Smart Specialization"* The World Bank, August 2013

Annex 16: SWOT Analysis: Pharmaceutical Industry

Strengths	Weaknesses
- Strong traditions in pharmaceutical research and drug production, good medical research base, highly qualified researchers - Local pharmaceutical companies with modern and EU compliant manufacturing facilities that are successful in exporting generic drugs - Potential for innovation and R&D collaboration with international partners in new drug and medicinal compound production and associated early stage clinical trials leveraging the presence of multinational pharmaceutical companies - High export volumes of generic drugs to markets in Western Europe, Russia and CIS and the Middle East	- Poor collaboration between pharmaceutical companies, medical research institutions and universities - National funding for research is limited and EU financial resources are not used effectively - Limited experience in R&D associated with new drug development and early stage clinical trials activities - Limited connectivity of Bulgarian research networks with European Research Platforms and insufficient knowledge and information exchange
Opportunities	**Threats**
- Exploring established markets for generic drugs in Western Europe, Russia and CIS and the Middle East for exports in the higher value-added market segment: new drugs, medical compound, medicinal ingredients delivery systems to markets - Qualified researchers, well developed medical research base at hospitals is an opportunity to engage in all stages of clinical trials for developing new drugs, medicinal compounds and ingredients delivery systems	- Strong dependency on generic drugs - competition from Asian companies in the generics drugs segment could have negative impact on the sector - Onerous business regulation/high barriers to entry of new generic products on the market - Lack of transparent regulation and procedures for early stage clinical trials - Third countries' informal competition, parallel imports of generic drugs - Brain-drain of qualifies researchers engaged in collaborative R&D due to low salaries in Bulgaria

Source: Final Report: *"Inputs to Bulgaria's Research and Innovation Strategies for Smart Specialization"* The World Bank, August 2013

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Annex 17: SWOT Analysis: ICT Sector

Strengths	Weaknesses
- High-value per employee outperforming most of the sectors - Good R&D potential, taking into account ICT patents and ICT projects under (FP7) - Active presence of top-multinational ICT companies, with local R&D and BPO centers - Rapidly increasing contributions of local companies in the highest value added market segments - Well-developed ICT infrastructure including high-speed broadband	- Below average R&D spending & ineffective spending of funds - Inefficient system for the protection of intellectual property rights, specifically service innovation and business process innovations - Shortage of labor combining technical knowledge with business and soft skill sets - Increasing brain drain due to relatively low salaries (from a global perspective)
Opportunities	**Threats**
- Small but growing domestic market, access to and presence in global markets - Upcoming e-Government initiative will spur further innovation and growth - Opportunity for technological absorption via FDI - Leveraging diaspora knowledge and networks can create opportunities for higher value added further development and global capacity - BPO, R&D and data centers growth opportunities are significant. ICT cluster could further develop outside Sofia - There are key areas where ICT capabilities in the country are highly competitive on a global level (semantics etc.) and could be a basis for "Centers of Excellence" development	- Dependence on foreign companies for patent development

Source: Final Report: *"Inputs to Bulgaria's Research and Innovation Strategies for Smart Specialization"* The World Bank, August 2013

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Annex 18: SWOT Analysis: Machine-Building and Electrical Equipment Sector

Strengths	Weaknesses
-Strong export orientation and successes in markets in Western Europe, the Middle East and the CIS -Presence of successful international companies providing technology transfer and dissemination that can spur the next level of innovation-driven growth -Successful pilot clusters developing products in the highest value-added market segments, such as automotive components and electronics, electro mobiles, LED lighting, advanced hydraulics	-Ageing workforce -Declining number of students in engineering and devolving quality of engineering higher education. -Low and ineffective R&D spending (as measured by the number of patents) -Engineering education in need of upgrading
Opportunities	**Threats**
-There are key areas where BG is highly competitive (precision engineering and electronics, LED lighting, hydraulics) where with targeted support there is the potential to develop specialization as a niche player and "plug" into the global value chain, through partnering with leading companies. -Leverage cooperation with key EU R&D centers in the EU and abroad, to further develop local R&D capacity and increase the technology absorption.	- Increased competition from Asia due to outdated technology infrastructure - Equipment depleting competitive advantages associated with proximity to large markets, low tax burden and low labor costs through exceptionally high energy and water resource costs

Source: Final Report: *"Inputs to Bulgaria's Research and Innovation Strategies for Smart Specialization"* The World Bank, August 2013

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Annex 19: SWOT Analysis: Cultural and Creative Industries

Strengths	Weaknesses
-Dynamically developing sector -Culture of recurring high-level of investment in new technologies and in increasing staff skills and capacities -Rich cultural heritage -Vibrant domestic market and very high-level of internationalization -Access to the EU Markets, tradition and presence in markets in Russia, CIS and the Middle East	-Poor enforcement of IPR rules -Lack of knowledge and skills in IPR management and -Shortage of creative talent and persons with creative entrepreneurial skills -Severely constrained access to finance for creative entrepreneurs and CCI businesses -Very poor awareness of EU funding opportunities and limited skill and capacities how to access these -Poor collaboration between researchers and CCI businesses in content development
Opportunities	**Threats**
-Increasing education on IPR management and creative entrepreneurship -Developing CCI business models promoting CCI and creative entrepreneurship -Radically improve access to finance for CCI businesses and creative entrepreneurs, including through EU funds -Promoting CCI clusters and establishing creative incubators and hubs	-Unenforced IPR infringements and "stealing of ideas" -CCI sector development bypasses the regulatory framework governing the businesses -Establishing monopolies and de facto cartels in certain CCI sectors -Increasing "brain drain" due to uncompetitive compensation of creative talent and constraining creativity by favoring technical implementation CCI products/services

Source: Final Report: *"Inputs to Bulgaria's Research and Innovation Strategies for Smart Specialization"* The World Bank, August 2013

Annex 20: Description of Business Incubator to be hosted by Sofia Tech Park.

The Incubator will host newly registered companies and university spin-offs, which will be chosen by committee of experts with a pre – approved selection criteria. Firms in difficulties are not eligible. The enterprises eligible for participation shall not be sector specific nominated. The selection of the enterprises will be based on a sufficient well-published and open, transparent and non-discriminatory tender procedure.

The Sofia Tech Park (STP) incubator will offer modern office space, communications and equipment, and will provide professional services to companies that are in a process of incubation. The STP's incubator will perform the role of intermediary, which aims at ensuring access for the enterprises to the high-quality specialized services as well as infrastructure. By this means, it will support the enterprises in their development and will strengthen their competitive advantages. The aim of the STP's incubator as part of the measure is to enable the entrepreneurs to benefit from comprehensive services, including specialized services, rendered by incubator on attractive conditions and on prices more favorable than the market prices. The support under this part of the measure aims at creating favorable conditions for the development of enterprises conducting R&D or innovation activities, through giving access to appropriate infrastructure, providing advisory services and trainings by the STP's incubator.

The services and the rent will be provided in such way that all the support granted for the construction and the equipment of the incubator is transferred to the tenants of the incubator, based on aid scheme for tenant enterprises. The incubator may not be sold to a successor and may not change its main activities until the support for the construction and equipment is transferred to the final beneficiaries. This period will be also defined with respect to the period of depreciation of the investments and costs necessary for the establishment of the incubator.

The total amount of aid passed on to the final beneficiaries will be calculated as the discounted value of the rebates given and this amount will be compared with the value of the public funds put at the disposition of the STP for the establishment of the incubator.

The aid to the final beneficiaries is provided in the form of a reduced price for services provided by the incubator. The aid element shall be calculated as the difference between the market price for the services and the price paid by the final beneficiary. The market price will be calculated as price which reflects the full costs plus a reasonable margin.

The support shall be granted in accordance with the conditions specified in the Commission Regulation (EC) No 1998/2006 of 15 December 2006 on the application of Articles 87 and 88 of the Treaty to *de minimis* state aid. The aid to final beneficiaries will not exceed the ceiling of EUR 200 000 over a period of three fiscal years. The tenants will be informed of the amount of the aid and of its *de minimis* character. Prior to provision of the relevant service or rent a declaration about other de minimis aid received during the fiscal year concerned and the two previous fiscal years will be obtained from the final beneficiary. All the conditions set in Art. 1 of the Commission Regulation (EC) No 1998/2006 will be respected. In accordance with the

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peculiarities of the specific service or the relevant final beneficiary the rules and conditions of Commission Regulation (EC) No 800/2008 may be applied. Therefore any state aid will be passed on to the SMEs through the intermediary STP Ltd. so that no competitive advantage remains within the beneficiary. Within this building there will be some office space for rent. It will be operated in the same way as the incubator space.

STP will give a head start to a convergent or hybrid type of incubator for start-ups in the areas of new product development, new services and technologies. Hybrid models which combine broader services with more traditional incubation for both new and existing businesses have developed in many countries, particularly those with limited generic business support services, smaller economies, weak cultures of entrepreneurship, or business environments with limited resources to fund innovations. Broader, less intensive and more diverse services will help develop entrepreneurial and innovative cultures and a business environment where a critical mass of demand for intensive narrow and deep incubation does not exist to the extent needed. These will help companies along the growth path and nurture the demand for more intensive and traditional incubation services. The STP's incubator will have flexible and adaptive business model trying to combine remote, virtual and resident clients. It will partner with leading Universities in Sofia and BAS institutes in an effort to create synergies between research and technology transfer.

Other remarks:

Assistance that we might need with regard to the incubator:

1. Program designed for incubation of companies in the ICT field;
2. Program for bio-pharm incubator;
3. Acceptance documents, evaluation committee design and documents;
4. Exit criteria;
5. Synergy with Eleven, Launchhub.

Probably there will be more to add to this list in the course of developing the business plan for the incubator. Our timeframe is very constrained. We have to launch public procurement procedure for delivery of services for the incubated companies the next spring.

The incubated companies will have access to the laboratories. These for the time being are as follows:

High Performance Computing Laboratory (HPCL)

High performance computing includes any approach which allows for a beyond the state-of-art advancement in any area.

It is the Project's ambition to make HPCL a part of the contemporary European network (HPC-Europe) for scientific research of complex systems in the fields of physics, biophysics, medical physics, development of new information knowledge for high performance computing and serve as a link between academic knowledge and the community. It will be operated by Sofia University and BAS and will focus on independent research, including collaborative research and will be widely disseminated.

The following objectives, when met, will ensure the institution's excellence:

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1. Development of the intellectual potential of the associate researchers and students from the partnering institutions;
2. Participation of the associate researchers in current development of middleware;
3. Knowledge transfer (theories, models, experimental methods) from the fundamental sciences (physics, mathematics) to other areas of knowledge with more complex phenomena (economics, sociology, medicine);
4. Undertaking worldwide research in the following priority areas for Bulgaria: new materials and technologies; health and healthcare; information technologies, including quantum information; energy; energy efficiency; CleanTech development.

Partners: Sofia University's Faculty of Physics, BAS institutes, etc.

Biochemical Labs

1. "In vitro" laboratory
    a. Microbiology (pathogenic micro-organisms);
    b. Cell culture (culture lines) – biological activity;
    c. Fermentation technologies and recombinant proteins;
    d. Cell cultures "in vitro".
2. Laboratory "Extraction and synthesis of bioactive compounds"
    a. Green extraction technologies and approaches for utilization of medicinal and aromatic plants (incl. other natural resources);
    b. Derivation of bioactive compounds and creation of medicinal extracts;
    c. Isolation, characterization and modification of bioactive compounds, derived from natural resources;
    d. Synthesis of bioactive compounds (incl. natural analogues) and creation of optimized series of bioactive structures;
3. Laboratory "Physicochemical analyses of bioactive compounds, characterization of medicinal forms and molecular design"

- Characterization of medicinal forms;
- Molecular design.

Partners: STP has identified the Faculty of Chemistry and Pharmacy at Sofia University "St. Kliment Ohridski" , Faculty of Pharmacy of Medical University, BAS institutes, etc., as partner in the setup and operation of the above laboratories.

Bioinformatics Lab (BioInfoTech)

Its focus will be the creation of databases containing bio information. The Lab will use it for analysis and will safe-keep this information. The Bioinformatics Lab will generate knowledge not only in structuring new drugs, but also in developing new software instruments needed to generate such knowledge.

Bioinformatics is a strategic scientific branch, which has acquired significant role in the last few years. It unites computer science and information technologies for the purpose of processing biological data. The post-genomic technologies offer a huge amount of biological data, which

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make bioinformatics very important in comprehending and processing this enormous amount of information. As a science, bioinformatics links two significant aspects of the scientific and technological changes that have occurred in the last 50 years: molecular biology and computer sciences. This is an interdisciplinary field where the synergistic participation of the two industries creates many opportunities for new knowledge and technological transfer. Therefore, bioinformatics has strong influence over spheres such as human health, agri-business, environment, energies, biotechnologies and computer sciences.

Bioinformatics also provides the basic means and databases, which establish the foundation needed to develop the so-called "Omics" technologies. The boom of genomics and the extensive application of genomic techniques in biology and medicine facilitate the establishment of the bioinformatics as major cross-field science.

Based on the role which bioinformatics has in the development of the Life Sciences field, together with the goals set for the establishment of the Technology Park, building a BioInfoTech Lab would ensure high quality results in the interest of the community. The BioInfoTech Lab is to operate synergistically with the High Performance Computing and Cyber Security Labs.

Partners: The Faculty of Automation at TU–Sofia and the Faculties of Biology, Physics and Mathematics at Sofia University have been identified as principal partners.

Cyber Security Lab (CERT Lab)

The planned capacity and activities are in three strategic areas (units):

1. Diagnostics and analysis: based on modern methods of probabilities and risk assessment, insider threats diagnostics, incident identification and management;
2. Advanced technologies: for design and development of software and complex systems (such as e-administration, financial or health related, etc.) – the latest methods of "Secure coding" – writing secure and safe software based on principles defined by CERT (lead by the top experts, such as Robert Seacord, author of the standards in C, C++, Java); the secure architectures and software design (the hottest topics with NASA, DoD, NATO); the secure mobile and cloud-based applications (also secure payments, e-voting, etc.)
3. Methodology: prepare the organizations for "resilience" of their business – based on the latest "Resilience Management Model" (of CERT, SEI, CMU) – the model to ensure business continuity under any disruptions (from hacking to tsunami), and recovery. This is 2011 methodology incorporating practices and knowledge from practically all information security and business continuity standards (like ISO 27000, ITIL, CoBIT, CMMI for Services, ISO 20000, etc.).

The goals of the three areas/units are to:

1. Directly position Bulgaria and the CERT-Lab as an early warning (detection) centre, working at research level;
2. Guide organizations of Bulgaria and the entire region (such as large or small IT businesses, public sector and administration companies, defence companies, etc.) in synchronizing and optimizing their multiple model security and safety requirements into

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a viable and resilient operational structure. This is the trend of the new (Smart) Defence strategy (announced first by US, and currently under development by NATO).

In addition, the CERT-Lab would play a central coordination role of the existing cyber and information-security structures (like CERT centre at Ministry of Transport and Communications, the Cyber-Crime Centre at Police, awareness and research centres sporadically created at NGOs and academic/research institutions).

Upon achieving necessary security and technical capacity the Lab could become a central node for Cyber-Defence and a coordinator of a "Cyber Defence Cluster" (discussions with major stakeholders already started).

Partners: European Software Institute Foundation, Faculty of Mathematics and Informatics at SU, etc.

Cloud Computing and CAD-Licenses Sharing Lab

"Cloud technology" is an IT term referring to the utilization of shared resources, software and information on computers and other devices via the Internet. It uses software and infrastructure as services while keeping the information and user-data on servers of its own. Then it makes them accessible in a form of online business applications via a web-browser combining them with other technologies.

With the invention of the new business and technological model, organizations are mostly restructuring their IT systems substituting the traditional model with the cloud technological one in which everything is offered as a service: from software, through hardware, to storing information databases. In short, cloud technology enables network access to shared resources such as internet networks, servers, databases and software application repositories requiring minimum participation by the service provider. With the introduction of the above business model, users are provided with access to resource drain applications through portable devices such as mobile phones, laptops and PDA devices. Cloud technologies transfer the computing power and the information from the desktop computer and the portable device to mega powerful data centers, thus cutting back costs and setting up a new more flexible approach of doing business. Only the actually used resources are paid which considerably reduces the IT investment infrastructure costs. The Lab will provide access to multiple CAD-based software applications that could be used by both Universities and various businesses. This reduces investment and license-maintenance costs which are often too high of expenditure for most SMEs and Universities and allows them to use the software on a time-share basis. The use will be arranged under de-minimis regulation.

Partners: Sofia University; Technical University – Sofia; University of Architecture, Civil Engineering and Geodesy; Bulgarian Academy of Sciences.

Rapid Prototyping and Production Lab

The Rapid Prototyping and Production Lab builds upon what has already been created by the Technical University in Sofia. It will offer new opportunities for research in the field of quick prototype creation and quick production of free-form elements. It will also serve as a center for innovators and researchers that seek new solutions by using technologies to test ideas directly from computer-generated models.

This lab will make redundant the need for special instruments and equipment and will facilitate the development of complex new knowledge.

Partners: Technical University in Sofia, BAS, clusters

Virtual and Extended Reality Lab

The ultimate objective is to develop the infrastructure needed to undertake research and to introduce innovative solutions for testing and verifying the properties of products at an early design stage which precedes and supplements the rapid prototyping stage. The Lab will be jointly used with the Fast Prototyping Lab whose construction has been proposed by the Technical University in Sofia. Thus there will be synergies and capacity extension, enabling researchers to present, test and verify the properties of highly technological materials not only on-site but also via remote operating systems.

The principal task to be solved with the Lab's construction is the introduction of virtual and extended reality technologies in the process of designing and preparing various highly technological materials. The virtual and extended reality systems are still regarded as an interesting but somewhat exotic item.

Types of tasks that will be carried out in the Lab:

1. Transformation of three-dimensional models created using CAD software into a format supported by virtual reality and visual verification of the objects property systems;
2. Working out methods and work processes needed to introduce corrections to the objects being designed directly in the virtual reality systems;
3. Joint operation and efficient exchange of information between CAD software and virtual and extended reality systems;
4. Development of the virtual prototyping methods on the basis of joint operation of engineer analysis and simulation software products, and virtual and extended reality systems;
5. Data mining.

Partners: Main partner – Technical University in Sofia.

Structural Analysis and Default Tests of Electrical Systems Lab

The Lab will enable complex research and default tests of products, process optimization for research, design and introduction of new products, devices, and services. The access to high-tech equipment will help foster professional contacts between engineers from the technical spheres, the Technical University and the private sector.

Partners: Technical University in Sofia, Cluster of Microelectronics, etc.

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Fab Lab

A Fab Lab is a place where local community can innovate, learn, share and meet. It has set of tools that are common for the all Fab labs across the globe, so that a global network for sharing of knowledge, ideas and innovation is created. The Fab lab concept is built on free public access. It serves the creative minded people to test ideas, create innovations and share knowledge. The tools that are used are managed by open source software. It is essential that a Fab Lab is developed with the minimum equipment required to be considered as Fab lab as per definition by the Fab Foundation.

Annex 21: Flagship Incubator Establishment Costs and Operational Subsidies for 7 Years

The estimates below reflect the maximum anticipated number of companies in each program; namely, admitting 15 start-ups to the pre-incubation program every 3 months (totaling 55 each year); admitting 16 start-ups to the 3-year incubation program annually, so in the third year of operation the flagship IBI could host 48-50 start-ups.

Option A: Costs under management contract to competitively-selected operator

	Establishment Costs (initial)	Operating Costs Y1	Operating Costs Y2	Operating Costs Y3	Operating Costs Y4	Operating Costs Y5	Operating Costs Y6	Operating Costs Y7
Feasibility Study/ Business Plan	30,000							
Recuriting Management	3,000							
Subsidy for Rent of flagship IBI facility (500 sqm)		36,000	36,000	36,000	27,000	20,250	15,188	11,391
Renovation rental space for IBI flagship (500 sqm)		2,500						
IBI facility maintenance costs		2,500	2,500	2,500	1,875	1,406	1,055	791
Office Equipment: Desks, Chairs, Filing Cabines.	15,000							
Office Equipment: Computers, Printers, Copiers	30,000				22,500			
Kitchen (Coffee machine, Refrigerator etc.)	20,000							
Internet Infrastructure (routers, cabling, switches)	600							
Internet Access (50 access points annual fee)		400	400	400	300	225	169	127
Communications (telefone, courier)		1,000	1,000	1,000	750	563	422	316
Electricity, water, heating/cooling (500 sqm space)		5,000	5,000	5,000	3,750	2,813	2,109	1,582
IBI Operator Management Fee		250,000	250,000	250,000	187,500	140,625	105,469	79,102
Matching Grants to Tennants (15% cofinancing)		100,000	100,000	100,000	75,000	56,250	42,188	31,641
Annual Operating Subsidy		**397,400**	**394,900**	**394,900**	**318,675**	**222,131**	**166,598**	**124,949**
Total Establishment Costs	**98,600**							
Total Operating Cost Subsidy 7 Year Period								**2,019,554**
Total Cost for 7 Year Period								**2,118,154**

Note: Costs are in Euro. Calculations account for a 25% annual decrease in operational subsidy between Year 4 and Year 7.

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Option B: Costs in directly subsidizing management and expert remuneration

	Establishment Costs (initial)	Operating Costs Y1	Operating Costs Y2	Operating Costs Y3	Operating Costs Y4	Operating Costs Y5	Operating Costs Y6	Operating Costs Y7
Feasibility Study/ Business Plan	30,000							
Recuriting Management	3,000							
Rent for flagship IBI facility (500 sqm)		36,000	36,000	36,000	27,000	20,250	15,188	11,391
Renovation rental space for IBI flagship (500 sqm)		2,500						
IBI facility maintenance costs		2,500	2,500	2,500	1,875	1,406	1,055	791
Office Equipment: Desks, Chairs, Filing Cabines.	15,000							
Office Equipment: Computers, Printers, Copiers	30,000				22,500			
Kitchen (Coffee machine, Refrigerator etc.)	20,000							
Internet Infrastructure (routers, cabling, switches)	600							
Internet Access (50 access points annual fee)		400	400	400	300	225	169	127
Communications (telefone, courier)		1,000	1,000	1,000	750	563	422	316
Electricity, water, heating/cooling (500 sqm space)		5,000	5,000	5,000	3,750	2,813	2,109	1,582
Salary Executive Director		36,000	36,000	36,000	27,000	20,250	15,188	11,391
Renumeration 7 Member Mangement Board		42,000	42,000	42,000	31,500	23,625	17,719	13,289
Salary Accounting Manager/ Finance Expert		24,000	24,000	24,000	18,000	13,500	10,125	7,594
Salary Administrative Support Staff		12,000	12,000	12,000	9,000	6,750	5,063	3,797
Salary Marketing Strategy Expert		24,000	24,000	24,000	18,000	13,500	10,125	7,594
Salary In-House IP counsel		24,000	24,000	24,000	18,000	13,500	10,125	7,594
External IP attorneys for complex IP issues		18,000	18,000	18,000	13,500	10,125	7,594	5,695
Salary Regulatory Product Development Expert		24,000	24,000	24,000	18,000	13,500	10,125	7,594
Salary Technology Monitoring Expert		18,000	18,000	18,000	13,500	10,125	7,594	5,695
Events and Public Awareness Costs		6,000	6,000	6,000	4,500	3,375	2,531	1,898
Travel		10,000	10,000	10,000	7,500	5,625	4,219	3,164
Administrative		6,000	6,000	6,000	4,500	3,375	2,531	1,898
Matching Grants to Tennants (15% cofinancing)		100,000	100,000	100,000	75,000	56,250	42,188	31,641
Annual Operating Subsidy		**391,400**	**388,900**	**388,900**	**314,175**	**218,756**	**164,067**	**123,050**
Total Establishment Costs	**98,600**							
Total Operating Cost Subsidy 7 Year Period								**1,989,249**
Total Cost 7 Year Period								**2,087,849**

Note: Costs are in Euro. Calculations account for a 25% annual decrease in operational subsidy between Year 4 and Year 7.

Annex 22: Innovation Flagships Workshop, November 19, 2013, World Bank Country Office, Sofia

	Name	Company	Title
1.	David Hampson	Technology Transfer	Managing Partner
2.	Maria Kabaivanova	Telerik	Associate General Cousel
3.	Tihomir Ivanov	Soho	Community Manager
4.	Ognyan Trajanov	TechnoLogica	CEO
5.	Elena Ivanova	MEE/EU Projects Management	Snr. Associate
6.	Lora Kapelovska	MEE/EU Projects Management	Snr. Associate
7.	Milena Stoycheva	Junior Achievement	CEO
8.	Valeri Gyurov	Transformatori	Co-founder
9.	Stavri Nikolov	Digital Spaces Living Lab	Founding Director
10.	Vesselin Kaltchev	Bulgarian Cluster for Communications	
11.	Peter Tchesnovsky	Sofia Tech Park	Director
12.	Elitsa Panayotova	Sofia Tech Park	CEO
13.	Daniel Tomov	Eleven	Partner
14.	Georgi Brashnarov	Nemetschek	CEO
15.	Georgi Todorov	Technical University Sofia	Head of Lab
16.	Demir Tonchev	Print3D	CEO
17.	Zachary Hampson	Technology Transfer	Partner
18.	Galina Yoncheva	Technology Transfer	Senior Project Associate