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DELIVERABLE 8.2

REPORT ON DESIGN OF DEMAND-DRIVEN INNOVATION POLICIES

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Introduction

As stated in the Project Document of the Seventh Framework Programme FP7 – Policy Incentives for the Creation of Knowledge: Methods and Evidence (PICK-ME), Work Package 8, titled "Policy Incentives for the Creation of Knowledge: Methods and Evidence" (WP8), the objective of WP8 is to distill policy implications and to identify best practices for demand-driven innovation from earlier deliverables (WP2 – WP7). Deliverable WP8.2 summarizes the demand-driven innovation policies formulated in WP2 – WP7 and derives implementable policy measures for policy makers to undertake.

Deliverable WP8.2 is an amalgamation and a synthesis of the policy summaries submitted by each of the WPs. The submissions will be posted on http://www.pick-me.carloalberto.org/index.php/documents?id=8 (direct Internet links to the policy summaries will be known simultaneously with their publication). References to the literature appear in the posted WPs' submissions and were not repeated in the text of WP8.2. The theoretical foundation of the platform as a policy tool for competent demand-pull is presented in an opening write-up by the Coordinator and is followed by: a review and taxonomy of supply-side and demand-side innovation policies (WP2); development of an integrated analytical framework (WP3); and demand and the rate and direction of R&D and innovation efforts (WP4).

The remaining WPs present applied and empirical foundations with a strong focus on the regional themes most relevant for the EU: the evolution of demand and dynamics of knowledge-base in knowledge intensive sectors (WP5); demand and skills-matching in local labor markets (WP6); and the evolution of demand, sectoral development, and the organization of innovative activities (WP7).

After a brief summary of the theoretical and empirical analysis for each WP, we present policy implications formulated so as to enable governments to use the considerable amount of public demand for goods and services as a strategic tool to pull a generation of new technological knowledge and the introduction of major technological changes.

The Platform as a Policy Tool for Competent Demand-Pull[1]

The competent demand-pull hypothesis takes advantage of recent advances in the economics of innovation and technological knowledge, which enables it to avoid the ambiguities of the standard demand-pull hypothesis. Demand can pull the introduction and adoption of new superior technologies only if and when it is "competent" (i.e. devised by creative customers). Moreover, it has to be accompanied by qualified user-producer interactions that make the necessary access to external knowledge possible and allow its effective use as an input into the recombinant generation of technological knowledge.

When demand is not competent and takes place in a context whereby firms are not able to make its reaction creative, its effects on upstream productivity are negative or negligible. Specifically, the effects of demand-pull will be negative when the firms that receive the additional flows of demand use rigid inputs that can be changed only in the long-term. Effects will consist of an increase in prices and a reduction in the efficiency of the production process, which takes place in out-of-equilibrium conditions. The effects of demand-pull will be negligible, in terms of total factor productivity, when firms cannot access external knowledge, but rather rely upon flexible inputs, both capital and labor, that make it possible to adjust quickly to the demand levels moving on the existing map of isoquants in equilibrium conditions.

This framework leads to focus attention on the types of knowledge interactions that link each sector to the others. Knowledge interactions are, by definition, bilateral. Active participation of both parties is necessary. Demand can pull the actual increase of efficiency by means of the introduction or adoption of superior technologies only if the pulled agents can generate new technological knowledge. This takes place if the pulled agents can activate fertile knowledge interactions with the pullers (i.e. the agents

[1] Source: Communication dated 22 July 2014, sent by Cristiano Antonelli and the leading institution is Fondazione Collegio Carlo Alberto

from which the increase of demand originated). The identity of both the pulled and the pullers is relevant for the demand-pull hypothesis to apply.

More precisely, consider A and B being two user-sectors that demand products of the producer-sectors X and Y. We argue that the increase of the demand of A and B to X and Y will have positive effects on the total factor productivity dynamics of X and Y only if the user-producer interactions between the downstream and the upstream sectors are competent enough to support the creative reaction of upstream sectors, resulting ultimately in the generation of new technological knowledge and the eventual introduction and adoption of new technologies. For the same token, we can further elaborate our argument. Assuming that both downstream sector A and B increase their demand for the products of the same upstream sector X, the effects will be more substantial for the pair of sectors that has stronger user-producer knowledge interactions.

This approach enables discrimination of the effects of demand-pull across sectors according to the conditions of the knowledge generation process. Demand-pull does not apply everywhere and at all times: it applies only when the relations among users and producers support the creative reaction of firms caught in out-of-equilibrium conditions by the unexpected increase of the demand. Pulled sectors will be able to innovate according to the quality of knowledge interactions with their pulling sectors. The derived demand of the downstream sector will be able to pull the increase of efficiency of the upstream sectors only if and when it is coupled with high levels of technological advance. The demand of the downstream sectors, in other words, can influence the innovation of upstream sectors only if it is expressed by knowledge-intensive sectors. The increase of productivity levels in upstream sectors is pulled by the twin effects of an increase in the derived demand of downstream sectors and an increase in the levels of the total factor productivity of downstream sectors. This twin effect qualifies derived demand to become competent.

The quality and intensity of knowledge interactions at work between users and producers is crucial to implement the competent demand-pull hypothesis. Knowledge interactions play a central role in the generation of technological knowledge and in the eventual introduction of technological innovations by firms that face an increase in the demand for their products. Such knowledge interactions are crucially based on connections that are provided by the market transactions through which the creative users direct their derived demand towards innovative suppliers. The latter receive from the former not only the orders of goods, but also essential knowledge inputs that they use in responding to out-of-

equilibrium market conditions as much as demand of innovative suppliers helps the former to generate new technological knowledge and fasten their rates of introduction of new technologies.

An important implication from the above discussion is that the users involved in the system experience productivity increases that are directly related to the innovative activity of the rest of the system. The contribution of the system to the actual levels of technological advancement of each agent consists in the spillovers of pecuniary knowledge externalities entering the recombinant generation of technological knowledge and enabling the introduction of technological innovations. Such spillovers take place in both the provision of innovative inputs introduced by innovative (i.e. upstream) producers that are creatively adopted by the downstream customers, and in the provision of knowledge inputs or knowledge impulses by sophisticated (i.e. downstream) users to their upstream producers.

Users can no longer be regarded as passive customers and, specifically, as passive adopters of innovations introduced upstream. Learning by using is a powerful process of accumulation of competence that enables the adoption technological innovations and is at the origin of many innovations introduced by users to adapt new capital goods or intermediary inputs to their own needs. Creative adopters are able to accumulate specific competences by means of learn-by-use processes that make it possible to upgrade the inputs provided by upstream suppliers with the introduction of new technological knowledge and to transfer the knowledge acquired to the producers. The systematic user-producer interactions that parallel the flow of goods favor the knowledge feedbacks from users and adopters to the original suppliers of the innovation.

The new appreciation of the powerful effects of learning by using in the adoption process complements the well-known effect of learning by doing and makes it possible to appreciate both the upstream and downstream linkages as important vectors of pecuniary knowledge externalities. Indeed, both effects are relevant carriers of knowledge spillovers that are more attractive because of the cheaper recombinant generation of new knowledge, both in upstream producers and downstream users. The new competent demand-pull hypothesis applies in the special circumstances that allow combining the stimulations exerted by an increase in the levels of demand with the knowledge interactions that make it possible to generate and exploit new technological knowledge. Knowledge user-producer inter-sectoral interactions exert a crucial role in the recombinant generation of new technology that combines internal inputs of tacit and codified knowledge with external ones. The co-evolution of demand and knowledge generation conditions lies at the heart of the competent demand-pull hypothesis. Demand-

pulling works if and when the generation of new knowledge is made possible by competent customers that make, in the first place, the coupling of market transactions and knowledge interactions between users and producers possible.

An important example of competent demand-pull is the analysis of the evolution of the procurement strategy of the FIAT group. The competent demand-pull strategy enacted by FIAT permits combining its internal know-how with that of the first-tier suppliers (FTSs), allowing FIAT to take advantage of synergies and technological partnerships via collaborative strategies. A variety of "de-layered" organizational relations are introduced by the coordination strategies, and these relations benefit from a wider pool of resources and knowledge where technological collaboration can take place vertically (i.e. within the FIAT supply chain), horizontally (i.e. between FIAT and different original equipment manufacturers (OEMs)), and diagonally (i.e. through different supply chains by means of FTSs that cooperate with different OEMs). Innovation is the outcome of the integration of top-down and bottom-up innovative processes and is implemented via the bi-directional exchange and communication of technical information, innovative capabilities, and the results of R&D and design activities developed by both FIAT and the FTSs. Here, the transformation also includes changes in the number and quality of actors, integration in the platform of new suppliers and partners according to new emerging technological needs, and the exclusion of old ones.

The adoption of a platform organization signaled important changes in the way in which FIAT coordinates procurement and manages external supplies.

A clear example of such changes is the adoption of the Advanced Product Quality Planning (APQP) methodology in managing the suppliers network and their activities by FIAT. Before the adoption of APQP, the design of new cars, component characteristics, and purchasing from suppliers was defined ex-ante and dominated by the design centrally defined by FIAT: given ex-ante characteristics of components, FIAT allocated prices and identified suppliers. With the adoption of APQP and the progressive decentralization of activities generated by the accumulation of competencies by suppliers, the process reverted. Now FIAT states the general design and characteristics of a new car model and communicates this information to the network of suppliers. Each supplier, depending on its specific technological knowledge and to the price and quality requirements, develops a project for the production of a given component or system. Competition among suppliers creates the conditions for the more suitable projects to emerge, allowing FIAT to choose the most appropriate supplier. Only after the

competition and selection process will FIAT and the supplier define the characteristics and prices of the component or system (e.g. during the negotiation process).

Such a change contributes to the development of an innovation platform where medium-sized suppliers obtain a new centrality in both the organization of and innovation in car production due to their ability to accumulate and create new internal technological knowledge. The performance of the system now is very much conditional on the performance of these FTSs, together with the restored innovation and coordination capabilities of FIAT, especially in terms of higher efficiency in production, a better quality of components and modules, and the innovative capabilities brought into the process.

From the viewpoint of the external governance and the coordination of the network of suppliers, the task of progressive transfer of upstream strategic activities and autonomy from FIAT to suppliers, established in the 1990s, involved not only FTSs, but also, nowadays, second-tier suppliers (STSs), and can be seen as an effective mechanism of the dynamic coordination of the division of innovative labor.

Although the decision to adopt and implement the innovation platform was decided centrally by FIAT, its new mode of coordination implies the combination of top-down resources and capabilities provided by the OEM (i.e. the general and macro template of a new car) with bottom-up innovative activities provided by specialized suppliers (i.e. the implementation of modules and components with new features and performance). This combination is especially relevant in terms of the dynamic coordination of the production of new car models. A given new car model is now an emergent property of the collaborative efforts of FIAT and suppliers along the entire production chain, targeting the development and exploitation of complementarities in different activities, technologies, and spaces of competencies. The introduction of a new car model is now possible in that the OEM and the specialized suppliers co-design the features of a variety of components and modules to be integrated into a new final product. The effective coordination of this innovative process is now possible because of the adoption of a distributed platform that supports interaction between the different organizations.

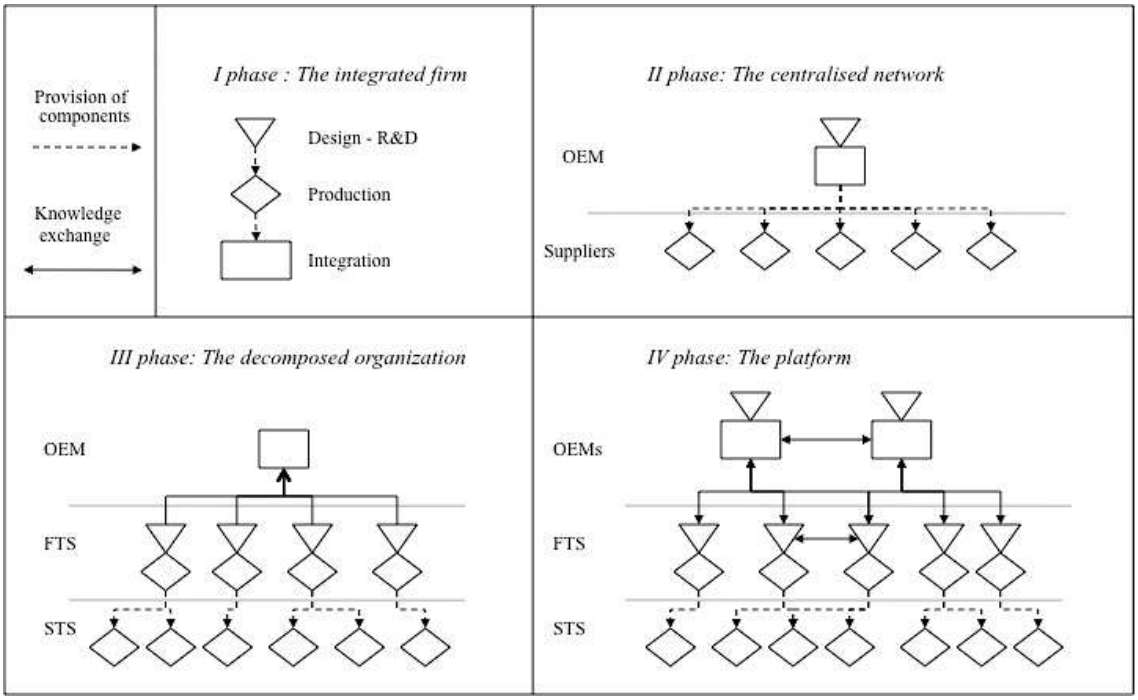
Table 1. The Evolution of the Competent Demand-Pull Strategy

Phase	Coordination Structure	Organization Characteristics	Innovation Process	Drivers of Change	Procurement
Phase I: 1970s	The firm	• Vertical integration of production • Internal accumulation	• Innovation in isolation	• Diseconomies of scale	• Procurement of specialized

		of R&D • Internal accumulation of capabilities in the design of car models • Internal accumulation of capabilities in technology design			inputs
Phase II: 1980s	The centralized network	• Outsourcing of small components and spare parts • Central coordination of suppliers by the OEM • Exclusive supply from small suppliers to the OEM	• Ex-ante and top-down design of car models, components and technology • Innovation undertaken internally by the OEM	• Diseconomies of scope (OEM) • Decreasing returns to R&D (OEM) • Financial constraints (OEM) • Economies of specialization and learning (suppliers)	• Outsourcing of production phases
Phase III: 1990s	The decomposed organization	• Suppliers benefit from economies of specialization and learning • FTSs emerge as innovators at the local and international levels • Outsourcing of components • Outsourcing of design in both components and modules • Modular product and system architecture design	• Outsourcing of R&D and design • Bottom-up (FTS-driven) innovative processes	• Losing control (OEM) • High transaction costs • High levels of hold-up problem	• Outsourcing of self-contained components
Phase IV: 2001 – ongoing	The platform	• In-sourcing of innovative and value adding activities • Acquisition of external resources built in Phase III • Vertical cooperation between OEM and FTSs • Horizontal cooperation between OEMs and between FTSs • Internal to the OEM product and system architecture design	• Integration of top-down (OEM) and bottom-up (FTSs) innovative processes • Co-design • Co-innovation		• Procurement strategy integrated into collective innovation process

Table 1 shows the evolution of the competent demand-pull strategy and is a summary framework of the phases and structures discussed. The following graphic (Figure 1) illustrates how the coordination of innovation activity has evolved during different phases of competent demand.

Figure 1. The Evolution of the Coordination of Innovation Activity



Platforms are effective tools to implement a competent demand-pull strategy when, within complex innovation systems, an array of horizontal and vertical interactions coexist, such as vertical cooperation between OEMs and suppliers, shared platforms between OEMs, arm's length transactions and spot contracts within modular networks of first-tier and second-tier-suppliers, and quasi-integration between users and producers based on long-term co-design strategies. Innovation is the outcome of the integration of top-down and bottom-up innovative processes and takes place in a truly cooperative way: by means of a bi-directional exchange and the communication of technical information, innovative capabilities, and the results of R&D and design activities developed by the different actors involved in the network. This is the space represented by articulated and hierarchical networks, guided by leading firms, and that combines both knowledge transactions and knowledge interactions as sources of

external learning. Procurement systems centered on platforms are able to combine the advantages of the exploitation of knowledge complementarities among a variety of organizations with the benefits of network cohesion and the sharing of common goals.

The application of the competent demand-pull approach implemented by FIAT to public demand would make it possible to use the sizable public demand for goods and services as a strategic tool to pull a generation of new technological knowledge and the introduction of major technological changes (Patrucco, 2014). The competent demand-pull strategy implemented by FIAT shows that public procurement could become an effective tool to support innovation as much as military procurement of weapons.

Policy Implications

Similar to the application of the competent demand-pull approach implemented by FIAT, the use of public demand by a government could make it possible to use the substantial public demand for goods and services as a strategic tool to pull a generation of new technological knowledge and the introduction of major technological changes. The competent demand-pull strategy implemented by FIAT also shows that public procurement can become an effective tool to support innovation, but caution is due as such implementation requires high levels of competence and managerial responsibility.

Review and Taxonomy of Supply-Side and Demand-Side Innovation Policies (WP2)[2]

The bulk of innovation and technology policies have been designed by relying on a supply-side perspective, while the demand-side has long been neglected in innovation policy. The literature review showed four key dimensions that drive innovation: culture, markets, contexts, and institutions. Table 2 below summarizes the dimensions.

[2] Source: Communication dated 28 June 2014, sent by Amnon Frenkel and the Institution is Samuel Neaman Institute For Advanced Studies In Science and Technology (SNI)

Table 2: Key Processes of the Supply-Side and Demand-Side Innovation Policies

Dimension	Key Processes		
	Supply Side	**Demand Side**	**Both Demand & Supply**
Culture	Government investment in human capital (HC) and HC development	Market driven forces	
Culture and Context	Government-targeted programs supporting innovation	Demand attractiveness of the private sector	
Culture, Context, and Institutions	Key skills development		
Culture and Market		Lead market	Labeling and awareness
Market and Context		Cluster strategies	
Context	Government policies to foster innovation		Public-private cooperation
	Public funding of private entities		Standardization

As shown in the table above, national policy, regulation, and government procurement are the key dimensions for sustaining the creation of new technologies or innovation paths. National policy is also essential in creating lead markets and is vital to generating exports and boosting economic growth. Lead markets are also strongly associated with the market and cultural innovation dimensions. It is not clear which, of these, are the key dimensions that determine whether a country will be a leading or lagging market. Scholars have attempted to address this challenge by suggesting a set of criteria to examine the situation without much success. However, one thing from this analysis is evident: global firms are the key beneficiaries of lead markets, as lead markets act as a testing ground for new products and can subsequently reduce the risk of failure in new product launches elsewhere.

Demand attractiveness from the private sector is a key dimension in the development of an array of activities in the market. It is bi-directional and related to the context and culture innovation dimensions

and focuses on a firm's knowledge stock (e.g. mainly its R&D activity). The larger the proportion of R&D activity, the larger the impact will be on business intensity.

Demand-driven innovation policies allow maximum flexibility and the resilience of market forces along with the removal or reduction of bureaucratic regulations or procedures. Supply-side innovation policies are the opposite and feature both direct and indirect interventions by government agencies.

Regarding the cluster strategies dimension, one prevailing theory suggests that related variety strengthens regional economic growth through spillover effects between products and industries, as one firm builds innovation on the activities of another. Global markets claim "distance is dead." However, in this context, distance isn't dead at all, but rather lives when proximity enhances connectivity among agents that are working within related industries, capturing the spillovers in their innovative activities. Agglomeration clusters in the same area (e.g. city or region) act as a source of regional development contributing to the general welfare.

Innovation must follow a standardization process in order for basic research to converge into a well-defined technology. Standards help enterprises to build focus, cohesion, and critical mass in the formative stages of a market. Standards and standardization codify and diffuse state of the art technology and best practices.

Labeling and awareness interact with both the culture and market dimensions and explore channels for educating and protecting consumers without hindering the introduction of innovative products. Young people, in particular, are evolving to become the focus of consumerism and of the cultural trends in which the demand side underpins modern and highly innovative economies.

Education also relates to higher education driven by universities and research institutions through public-private cooperation. This ecosystem component interacts with the context innovation dimension and focuses on technology transfer from the public to the private sector. In this regard, universities that represent publicly funded institutions now play a major role in innovation research.

Mapping National Innovation Ecosystems[3]

[3] Source: Communication dated 28 June 2014, sent by Amnon Frenkel and the Institution is Samuel Neaman Institute For Advanced Studies In Science and Technology (SNI)

A national competitive strategy is important to identify the relative advantages of a country in terms of products and industries. This identification enables us to know the strongest aspects of an economy to generate jobs, income, wealth, exports, and sustained growth.

National strategic planning is generally regarded as top-down and driven by the country's political and business leadership. But an analysis of national innovation ecosystems has shown the crucial importance of combining top-down strategic innovation policies with bottom-up policies driven by the infrastructure of existing capabilities. These capabilities find meaning in the innovation anchors, in our analysis, which differ widely across countries in their influence on the evolution of innovation ecosystems and their skill in implementing national strategic goals. These anchors, and the dimensions to which they belong, contain the foundation on which nations can build their strategic innovation policies, by strengthening innovation-fostering processes that are closely connected to national objectives. Each nation, therefore, must outline its own unique, specific national innovation policy, according to the strengths and weaknesses identified in its innovation ecosystem, building on its innovation accelerators, which help the country achieve its objectives for improving the wellbeing of its citizens.

The effective innovation ecosystem is created by the combination of effective top-down innovation policies, initiatives, and energy. Assigning top-down policies to the supply-side and bottom-up initiatives to demand-side is very simplistic approach; yet, in general, market forces are more of a bottom-up nature.

Policy Implications

The significance of constructing visual innovation ecosystems goes well beyond their specific content. An economy-wide understanding of the innovation system and its drivers is crucial to identify effective consensual innovation policies. We predict a two-stage process in which experts from all parts of society meet to engage in understanding and mapping the ecosystem, and only after reaching consensual agreement on how the system works (and why perhaps it does not), debate how policy interventions can be most effective. By attaining a deep understanding of national innovation ecosystems, and by studying those of other nations, we believe that European innovation policies will be more innovative, more effective in their national impact, and more integrative in their Europe-wide design.

Development of an Integrated Analytical Framework (WP3)[4]

Moving Towards a "Learning Society"

Growing evidence suggests that continued economic development is dependent on an increasingly differentiated economy. To meet the needs of a changing, differentiated economy, the composition of the labor force, as well as its competencies, must also develop and differentiate over time.

This is achieved through the development of a "learning society," which is a system that requires constant learning during the course of an individual's career, and can be accomplished through a combination of reduced barriers to entry and exit in certain areas and training and educational programs that are flexible enough to adapt to changing labor market demands.

Co-Evolution of Demand and Innovation

Innovation does not contribute to economic development without a corresponding demand for new products. Earlier analysis based on the TEVECON economic development model illustrated that demand and innovation must co-evolve with positive and negative feedback loops; hence, demand, innovation, and the economic policies designed to affect them are intertwined.

Economic policies should foster a productive arrangement capable of achieving both demand and supply-related factors, as well as one that can generate the disposable income required to purchase new goods and services and the exports needed to support a positive trade balance. Economic policies aimed exclusively at demand risk being unable to achieve either.

Heterogeneity of Consumers as a Driver of Innovation

[4] Source: Communication dated 7 July 2014, sent by Matthias Mueller and the leading Institution is Universitaet Hohenheim

The influence of consumers on innovation is often oversimplified. To understand innovation, we need to understand demand. Further analysis from our TEVECON economic development model showed that the heterogeneity of demand and, hence, consumers are the major drivers of innovation.

The heterogeneity of demand, itself, fosters innovation engagement in firms. In regards to heterogeneous consumers, supply-side subsidies can be less effective than demand-side subsidies and have major drawbacks.

Demand and the Rate and Direction of R&D and Innovation Efforts (WP4)[5]

In this WP, we argue that policies should provide incentives to stimulate the demand-side of innovation in order to improve the trial-error process embedded in the creative-destruction process, which is a prerequisite for innovation. We further argue that small and fast growing firms can serve as a key tool of the demand-oriented approach to innovation. Institution building for innovation at all levels should therefore target the needs of these firms. The phenomenon of these rapidly growing entrepreneurial firms has received increasing attention in research on growth and innovation and, in particular, in a number of contributions in this project which analyze the role of young high-growth firms (gazelles) in increasing innovation. These catalytic firms are the expression of demand-pull growth. The literature on gazelles started in the 1980s, when David Birch postulated that a major share of new jobs is created by SMEs; in particular, new and highly innovative SMEs. The hypothesis that high growth SMEs create two-thirds of all jobs in the United States has been amply established. These results were also confirmed in Europe.

Policy makers can not only aim at building fundamental institutions that support gazelles, but should also aim at removing bottlenecks in factor markets that hinder growth rates. A demand-side policy provides stronger incentives to risk-takers, skilled people to work for gazelles, and higher stronger incentives for capital to lend to gazelles. Policies for giving R&D subsidies should, in a demand-side policy perspective, be constructed so as to target gazelle firms.

[5] Source: Report on the Integrated Analytical Framework, submission date: 30/06/2013, Name of Coordinator: Cristiano Antonelli; Name of lead partner for this deliverable: Fondazione Collegio, including a section on Policy Implications which was posted as "Demand-driven innovation policies in the European Union," CASE Network Studies and Analyses No. 468 02.2014

Government interventions and instruments to support both demand-led innovation instruments (e.g. PPI) and supply-side instruments (e.g. grants) are important and are discussed below. We classify these interventions into four distinct sets:

1. Improve the business environment for innovative firms, including strengthening the legal environment and anti-monopoly policies, improving standards aimed at product quality, and building human capital.
2. Conduct research, development, and innovation (RDI) in state-owned organizations as a tool for supporting innovation in key areas vital to state security and energy in which private business would not invests and direct state control over R&D is deemed essential.
3. Provide grant subsidies for RDI in private companies (e.g. matching grants, loans, incubators, industrial parks, loans, guarantees, equity in venture capital funds, and special economic zones).
4. Support the public procurement of RDI from private companies (see WP8 Deliverable 1 for a full discussion of PPI).

Each of these instruments might be suitable in a specific country environment or policy structure. For example, PPI and state-ownership could be more direct forms of interventions, allowing closer control over the early stages of the innovation process. Grants, however, are more suitable when the flexibility of the instrument is desired. Grants can subsidize the early stages of development for products or services that governments cannot procure or where there is no immediate demand for within the public sector (e.g. EC Horizon 2020, new SME instrument, US SBIR, and UK SBIRI).

In parallel with launching initiatives to support institution building, policy makers should adopt policies to spur participation in world R&D, as cooperation with researchers and multinational corporations abroad is an effective way to tap into the global knowledge pool, enabling both technological and intellectual transfer of know-how. The policies include: a cooperation-friendly intellectual property rights regime, subsidized exchange study abroad for scientists and those with doctoral degrees, less restrictions on immigration of researchers, and incentives for multinational corporations to establish R&D centers in the host country.

At the theoretical foundation of this WP lies the famous dilemma of Schumpeter: the role of SMEs in innovation versus the role of the large corporation in innovation. In practice, the economy is somewhere between these two extremes, where each economic system (or in short, ecosystem) is different.

Schumpeter's creative-destruction process is dependent on the entry of new firms, rivalry, selection among new firms and the business environment for innovation, and, finally, acceptance of the inevitable necessity of destruction.

Evolution of Demand and Dynamics of Knowledge-Base in Knowledge Intensive Sectors (WP5)[6]

Related Diversification

Diversification can be understood as an emerging process through which new activities develop out of existing ones, and the scope and outcome of this process are fundamentally affected by the technological and cognitive constraints at the national and regional scale. Countries and regions need to develop new economic activities to compensate for inevitable processes of stagnation and decline in their economies. The accessibility, urban density, size, industrial specialization, related variety, and institutional and governance structures are the key features of the regions which determine their potential to recombine local resources and diversify into new areas. In this regard, it is a pre-condition that public policy avoids "picking winners" that do not fit into the regional actual and potential industrial space. It is recommended that local policy makers shift their focus from the industries that are present in the region to those that could be present. Policy makers should be more persistent to define their diversification opportunities in terms of local capabilities rather than in terms of some preferred industrial mix, as the underlying capabilities structure in regions provides a pool of opportunities, however, it also sets limits to new developments that do not utilize this capability structure, and policy interventions should be aware that policy effects display only over a long time period.

Inter-industry relatedness (i.e. the degree to which two firms are active in related markets and are associated with shared technological experiences, knowledge-bases, and with similar products and markets) enables a powerful framework for policy to identify regional potentials and to select activities as potential sources for diversification. The opportunities for regions to diversify into new related activities can be identified by measuring the degree of technological relatedness between industries.

Our studies showed that aiming for more specialization is likely to increase the problem of over-specialization and regional lock-in. Instead, it is recommended to target specialized diversification into

[6] Source: Communication dated 20 June 2014, sent by Riccardo Cappelli and the leading institutions are Universiteit Utrecht, Universite de Nice-Sophia Antipolis and Samuel Neaman Institute For Advanced Studies In Science and Technology (SNI)

related technologies that generate new economic activities that can utilize local related resources. Such a policy has the objective to broaden and renew the industrial structure of regions by making them branch into new related activities. This objective is achieved by encouraging and enabling crossovers and recombinations between related industries that can create complementary assets.

Even though it is not wise to follow "picking-the-winner-policies," policy prioritization that targets industries in regions where they have a strong presence and where potentials of new recombinations are high is still required. As a result, it might be wise to avoid targeting new industries that occupy a peripheral position in the industry space of the region, and it might be wiser for policy to go for new industries that can more easily connect to and be embedded in the industrial structure of a region, because this increases its probability of survival and, thus, the probability of policy success.

It can be derived from our studies that backing declining industries is not necessarily a bad thing to do, but this depends on the degree of relatedness of this declining industry with existing industries. To support declining industries that take a peripheral position in the industrial portfolio of a region is not a smart policy from a relatedness perspective, because these industries have already a high probability to exit the region. This is fundamentally different from local industries that have strong technological ties with other industries in the region. When such a related industry would be confronted with a temporary demand fall, its demise and loss could seriously damage the dynamics of the other local industries to which it is technologically related, and thus, policy might seriously consider to step in and avoid such a cascade effect, which might erode the whole underlying capability base.

Policy Implications

1. Policy can play an active role in enabling and activating knowledge transfer mechanisms through which related industries can connect at the regional scale. This can be realized through entrepreneurship policies that focus explicitly on experienced entrepreneurs from related industries.
2. The activation of knowledge transfer mechanisms is also achieved through a labor market policy that focuses on mobility across industries, with an emphasis on mobility between related industries, because this leads to the formation of knowledge networks and the transfer of skills between industries that provide complementary resources.

3. Policy can also focus on establishing collaborative research networks with a focus on research collaboration between related partners within the same region or located in different regions.

Agents and Diversification: Policy Implications

The growth, decline, and industrial reorientation of existing establishments tend to reinforce a region's existing capability base, while new establishments truly change it and, hence, induce structural change.

Institutions and Diversification: Policy Implications

Policy aimed at improving and speeding up the diversification process should consider that in countries with low institutional quality, this could be obtained mostly by favoring the development of nearby sectors. Directly favoring the creation of very distant industries might result in severe failures, since the lack of necessary supporting infrastructure and institutions may doom these initiatives before positive diffusion effects occur. Such policies might have a positive effect only in the presence of a good education system that enables countries to keep producing in sectors less related to its current productive structure.

More flexible labor markets favor more unrelated diversification and, so, if countries strive for more unrelated diversification, making labor markets more flexible, institutionally speaking, would help. As policy is fully embedded in societies, societies with a more long-term orientation also enable policies that are more open and responsive to long-term diversification processes. Several implications can be drawn:

1. National institutions matter for the nature of regional diversification, as countries with stronger general-purpose capabilities find it easier to jump to a new product, while countries characterized by weaker general-purpose capabilities rely more strongly on relatedness with existing products when diversifying into new industries.
2. Economic institutions are the least relevant for diversification, with the exception of having open trade networks that favor unrelated diversification.
3. Political institutions play a very important role. Democracy, especially if well established, favors diversification in distant products. Within the restricted set of developed countries, coordination in labor relations strengthens path-dependence, while coordination in the corporate governance domain is less important.

4. Educational institutions reduce the importance of the current productive structure only for products that have been already established in the past.
5. The long-term orientation of societies affects, in a relevant and consistent way, the process of diversification.

Externalities in the Presence of Viral Entrepreneurship: Policy Implications

This research presents an unusual event associated with the germination of high-tech companies, which grew out of the idea of a high-tech entrepreneur who established the RAD BINAT Company in Israel in the 1980s. Over the years, through a deliberate effort of the founder, entrepreneurs who departed from the parent company founded further companies. During the following three decades, the companies that were thus born gave birth to other companies. This created a unique ecosystem, represented by RAD, which included, at its peak expansion, about 129 companies, some of which were closed over the years or were purchased by other companies and ceased to operate as independent entities. Our results have consequences for public policy that could encourage the emergence of similar systems. Still, there are several strong policy implications that flow from our study of the RAD ecosystem.

A major contributor to the RAD cloud was the existence of a strong venture capital (VC) industry able to finance meritorious start-ups. While RAD provided some funding, most of the funding was external. Israel's VC industry was fostered by a unique government policy: a government VC fund known as Yozma. Yozma was established by the Israeli government and offered matching funds to external VC investors. Within three years, ten more funds were established, with capitalization of over $20 million each, and the VC industry took off, attracting many foreign-based VC funds that, to this day, predominate in Israel's VC industry. It is doubtful whether the RAD cloud could have grown so rapidly without strong venture backing.

The main policy implications of the study relate to the creation of vibrant dynamic cities. Knowledge-based urban development is rapidly gaining momentum due its potential for inducing economic growth and creative people are drawn to such cities. These cities are created by strong public policy, combining physical, communication, and educational infrastructure with cultural events, great public schools,

universities, and pleasant environments. Tel Aviv is such a city. It is doubtful that the RAD cloud could have happened without the ambience of Greater Tel Aviv and its attractive environment for creative people.

Demand and Skills Matching in Local Labor Markets (WP6)

Demand for Innovation and Local Availability of Complementary Skills (WP6.1)[7]

The empirical analyses conducted indicate that labor mobility effects firm performance and regional development, but this effect depends on the industries from which new employees are recruited and the life cycle stage an industry is in. Overall, a positive effect of labor mobility between related and unrelated industries is found in our studies. Related labor mobility has a positive effect on plant productivity growth, plant survival in young industries, plant employment growth in mature industries, and regional productivity growth. Labor recruitment from unrelated industries increased plant survival and employment growth and lessened regional unemployment growth, while it had no effect on plant productivity growth and regional employment growth. By contrast, labor recruitment from the same industry lowered performance (with the exception of plant employment growth). It had a negative effect on plant productivity growth, it increased regional unemployment growth, and it had no effect on regional employment and productivity growth.

Denmark, Sweden, Germany and The Netherlands are the four countries in which more detailed empirical research was conducted to highlight relevant and complementary aspects. The study on Denmark aimed to determine the impact of labor mobility on plant performance making use of a sophisticated indicator of revealed relatedness that measured the degree of skill relatedness between sectors on the basis of the intensity of labor flows. It exhibited that the effect of labor mobility is significantly dependent on the type of novel accessible skills and the degree to which they match existing skills at the plant level. Inflows of related skills had a positive impact on plant productivity growth, while inflows of skills that are similar to existing skills had a negative effect.

The study on Sweden investigated the relationship between labor market externalities and regional growth by testing for the importance of labor mobility across skill-related industries. The analysis made

[7] Source: Communication dated 20 June 2014, sent by Riccardo Cappelli and the leading institutions are Universiteit Utrecht, Universite de Nice-Sophia Antipolis and Samuel Neaman Institute For Advanced Studies In Science and Technology (SNI)

use of a sophisticated indicator that measured the degree of skill relatedness between all industries and employed actual labor flows between 435 four-digit industries within 72 Swedish functional labor market regions to estimate how labor market externalities were related to regional growth in the period from 1998-2002. Results showed that a strong intensity of intra-regional labor flows between skill-related industries impacted positively on regional productivity growth.

The study on Germany looked at the role of labor mobility as crucial channel for the diffusion of knowledge through a regional economy. By studying the evolution of 11 German manufacturing industries in the period from 1975-2003, the analysis showed that the recruitment of new employees from the same and unrelated industries in the same region and from skill-related industries from other regions had boosted plants' productivity during the early phase of their life cycle. By contrast, during the mature phase, plants performed better when they recruited labor from local skill-related industries. Besides these general insights, large differences between industries remained evident.

The analysis on Netherlands investigated the impact of labor mobility as key determinant for the economic performance of firms. By using plant-level data for Dutch manufacturing and services industries for the period from 2002-2009, the analysis focused on market entry by new plants and examined their survival chances and post-entry employment growth rates. Results showed that the relevance of intra-industry and inter-industry inflows from related and unrelated industries depends on industries' life cycle stages. In addition to that, strong evidence was found in support of the claim that the geographical origin of labor inflows shaped the relationship between labor inflows and industry life cycle.

Policy Implications

1. Stimulate labor mobility across related industries through information provision and the removal of institutional bottlenecks. For example, employees, employers, and other stakeholders should be made aware that intra-industry labor mobility is generally bad for their economic performance. Discourage companies from recruiting from the same industry and workers from changing job within the same industry; encourage moving across skill related industries.
2. Stimulate private labor consultancy businesses, labor mediation offices, and public employment agencies to encourage companies and workers to make moves between industries, because it

seems beneficial for all involved. Policy action is required, as there is a natural tendency for all of these stakeholders (e.g. employers, employees, public mediation organizations, and sector organizations) to focus on their own industry because of incomplete information, uncertainty, and entrenched interests.

3. Inform stakeholders which industries are related to their own industry, to identify those opportunities, so employers can seriously consider recruiting people from related industries, and employees can seriously consider moving there. This also implies that institutional bottlenecks (e.g. laws, rules) that prevent companies from connecting and exchanging labor across industries should be removed to encourage inter-industry labor mobility. Finally, local policy makers should be encouraged to pursue industrial policy to ensure there is a large presence of local related industries that provide complementary resources to each other and that will give a boost to local labor mobility from which local companies will benefit economically.

Demand for Innovation and the Mobility of Skilled Labor (WP6.2)[8]

The accumulation of human capital is fundamental to enhance regional economic performance. People are the depositories of ideas and skills and their physical mobility over space is a primary channel of knowledge diffusion. This statement explains why countries, regions, and cities are continuously and systematically competing for attracting knowledgeable individuals. The winners of the new economic landscape are the ones who succeed in improving themselves as center of agglomeration for knowledge flows.

The analysis conducted in the context of WP6 is aimed at investigating the determinants and impact of the mobility of graduates and skilled individuals for three relevant countries: the UK, Italy, and Israel. The empirical findings provide relevant insights on the determinants of the mobility of skilled individuals, in particular recent graduates, and on the relevance of skilled mobility as a key channel of knowledge transmission.

The role of graduate and skilled migration is at the root of the policy agenda at the national, European, and international level. In 2008, the Brussels EU Council declared: “In order to become a truly modern

[8] Source: Communication dated 20 June 2014, sent by Luisa Gagliardi and the leading institution is London School of Economics

and competitive economy, and building on the work carried out on the future of science and technology and on the modernization of universities, Member States and the EU must remove barriers to the free movement of knowledge by creating a "fifth freedom" based on enhancing the cross-border mobility of researchers, as well as students, scientists, and university teaching staff." More recently, the UK Department for Business, Innovation, and Skills (BIS) declared that "[i]f the UK is to compete effectively in the global economy, it must continue to attract entrepreneurs and researchers, and enable companies to recruit skilled employees." These statements confirm widespread consensus of the need to develop a successful position in the global competition for talent. Within this general framework, different aspects have been emphasized by the analysis of graduate and knowledge mobility in different geographical contexts.

Matching Demand and Supply of UK Graduates: Geographical and Career Trajectories

This analysis assesses the skill-development trajectories of recent university graduates by looking at migration as key mechanism to achieving an education-job match.

In particular, the role of migration in helping the achievement of such a match was identified at two different career points: approximately within the first year and the fourth year after graduation. Given the peculiar economic role of the UK capital region (which accounts for 20% of the GDP), the analysis also separated between graduates who move to London and those who relocate to other UK regions. The analysis confirmed that migration can be a skill-sorting mechanism, but only to the extent to which it allows graduates to achieve their first matched job. Results, in fact, showed that inter-regional migration is crucial to achieve an education-job match at the beginning of employee's career. After that, relocating at the aggregate UK level turns out to be not significant.

However, the national result hid important sub-regional differences: late migration, for those in the virtuous trajectory, was negatively related to an education-job match, unless the destination was London. The UK capital, while serving as a waiting room at the early career stage of graduates, provided important opportunities for education-job matches at later stages. These results suggested that higher-education policies should take into account the spatial and temporal dynamics through which different graduates' backgrounds translate to the labor market. The analysis confirmed that UK graduates are largely absorbed by the London (and surrounding) market, raising questions on the potentially unfulfilled demand for skills in more peripheral areas of the country. A deeper investigation into the

skills demanded in peripheral regions, supported by adequate fora for discussion between HEIs and local employers, may provide valuable insights and enhance the knowledge-base development of peripheral regions.

The analysis did not find a significant effect of inventors' mobility on the full sample of English firms, and this result seemed to be driven by heterogeneity across firms in their capability to take advantage of external sources of information. In support for this claim, in fact, when the analysis was restricted to firms showing a stronger attitude towards the exploitation of external sources of knowledge, the effect of mobility became more relevant. We interpreted our results as a suggestive indication for the emergence of heterogeneous effects associated to firms' specific characteristics. The availability of novel information due to the relocation of knowledgeable individuals seems to be not relevant per se; rather, it became a significant input once we accounted for the effective capability of local firms to take advantage of new available knowledge by exploiting external sources of information to complement internal skills.

Results also provided indirect preliminary evidence for the mechanisms through which the mobility of knowledgeable individuals impacts a firm's innovative performance. The effect on those firms exploiting more extensively external sources offered some support for the role of externalities linked to the spatial clustering of different sources of knowledge in specific spatial contexts. Mobility has been increasingly seen as a primary channel through which knowledge spills over space, since knowledge itself tends to travel along with the people who master it. In a demand for innovation framework, powerful policy implications are linked to this claim.

Policy Implications

1. Our analyses point to the need to attract valuable individuals with distinctive skills that are linked to local demand conditions. This evidence advocates the design of policy options that are aimed at tackling structural weaknesses, especially in peripheral regions, to favor retaining these valuable resources, while strengthening local capabilities to take advantage of their skills and competencies. The upgrading of local capabilities in the light of existing specializations is a crucial step towards better economic performance.
2. Policy initiatives aimed at attracting knowledgeable individuals from an enrichment of the local knowledge-based needs to be complemented by capacity building strategies.

3. Policies targeting local firms, with the aim of increasing their capability to absorb and exploit external sources of information, through effective linkages with other co-located actors, are a necessary complement to fully embrace the benefits of mobility.

Education-Job Matching and Job Selection

This analysis explores the role of personal attributes (e.g. the education, study, and work-side characteristics of the individual) and spatial characteristics (e.g. the locational and innovation milieu) on education-job match attainment and spatial job selection. The analysis suggested that "hard-science" graduates are better matched with jobs than "social science" and "humanities and arts" graduates. Younger age cohorts and self-employed individuals were also found to be better matched with jobs. Empirical findings also suggest that work experience (i.e. starting work prior to graduation) and graduating from a research university are negatively linked to education-job match attainment. The last finding results from the diverse study curricula offered at Israeli research universities as compared to those available at colleges. College study curricula concentrate on limited fields of study (e.g. mainly law, accounting, and business administration), which are traditionally better matched with jobs and are more likely to have demand in the market. The study curricula in research universities include many humanities and arts fields, which are usually poorly matched with jobs.

The investigation also offered interesting insights on the spatial implications of work selection and the impact of the innovation milieu on education-job attainment. Graduates who studied in universities and colleges in the core are more likely to achieve education-job match than graduates who studied in higher education institutions located in the southern periphery. Concurrently, graduates from northern universities and colleges "migrate" to the core in their search for jobs, but to a much lesser degree than southern graduates, who have a significantly higher probability to work at the core. The findings of this research suggested that a mismatch exists between the supply of university and college graduates in peripheral regions and the demand for these graduates in the local (peripheral) labor markets. In the context of the core-periphery dichotomy in Israel, interesting results were found regarding the impact of the "innovation milieu" on education-job attainment. Increasing the offered wage rate in scientific and technological occupations and the supply of jobs in the high-technology service sector at a fixed ("flat") rate across regions slightly decreases "education-job" matching differences between core and peripheral regions. By contrast, enhancement of the regional "innovation environment" (e.g. the

number of patent applications) works the opposite way, increasing education-job matching disparities between core and peripheral regions.

Although "innovation milieus" in the regions are important, policy makers should recognize that the creation of innovation milieus is an incremental process that is mostly demand-driven. Innovation milieus are more likely to flourish and develop in core regions or in large urban areas characterized by economies of scales and by an abundant supply of factors of production. Therefore, in the case of peripheries, demand-driven initiatives alone could not solve the education-job matching problem, which is vital for the prevention of perpetual out-migration from these regions.

Policy Implications

1. Supply-side steps must be taken by the central government to ensure the necessary conditions for better education-job matching to exist. These may include creating incentives (e.g. tax exemptions) for large multi-national firms to locate in the periphery and by working towards increasing the industrial variety in peripheral regions, especially in the tertiary and quaternary sectors.
2. Public policy relating to the effect of age on education-job matching must provide older individuals with the proper tools for retraining and career change (e.g. especially in the scientific and engineering fields) in order to increase their chances for reintegration into the labor market.

The Relationship Between the Evolution of Demand and Sectoral Development (WP7)[9]

The research interest behind the analysis developed in this study arises from the assumption that multinational corporations (MNCs) possess more advanced technology due to its access to superior knowledge, and that uncompensated benefits from MNCs into recipient industries may leak out through the process of learning through interactions. Empirical analysis confirms this hypothesis. However, certain issues must be taken into account. First, domestic firms' absorptive capacities play a key role in facilitating the exploitation of the potential positive externalities arising from MNCs and in encouraging foreign enterprises to engage in cooperative dynamics. This evidence is further reinforced by the two

[9] Source: Communication dated 20 June 2014, sent by Luisa Gagliardi and the leading institution is London School of Economics.

case studies on Italian MNCs investing in the UK and highlighting the role of domestic capabilities as key factor of attraction. Second, deliberate market strategies followed by domestic firms may also represent a relevant dimension. In the two-way relation between MNCs and domestic firms, substantial attention has been devoted to the analysis of the internationalization strategy promoted by foreign enterprises, while the focus on domestic firms' heterogeneity has remained underexplored. Indeed, we find that the effect of MNCs' investments is particularly pronounced for domestic firms showing a significant engagement with its regional and national market, which, in turn, is the locus in which different mechanisms of knowledge transfer from foreign to domestic firms operate. In addition, firms that are already part of a multinational group are less affected by the positive externalities coming from other MNCs. These economic actors have reasonably fewer incentives to engage in patterns of cooperation since they already have access to the infrastructure channeling the diffusion of global knowledge. This evidence suggests a further element of complexity that policy makers need to take carefully into account.

Policy Implications

Policies need to be oriented towards improving the conditions for the up-take of innovation activities by foreign enterprises and the effective diffusion of these innovations. In a demand driven context, this implies:

1. Upgrade human capital in line with demand, linking higher education programs to industries and specializations for which demand exists. This implies mapping the skills required by both domestic and foreign firms and well as improving collaboration between firms and other institutions. Universities, in particular, should be encouraged to work with specific MNCs, providing both on the job training for existing employees and dedicated training for prospective employees.
2. Invest in public R&D to encourage existing subsidiaries to engage in high value-added activities, while building domestic capabilities to take advantage of the uncompensated benefits associated with them. In a demand-driven perspective, this implies fostering long-term research projects in key areas to generate outputs (e.g. patents or academic publications) that may act as relevant inputs for research establishments of MNCs or domestic firms. It also entails investing in specific sectors with the aim of developing innovations to meet the needs of the economic actors, both foreign and domestic, operating in these industrial contexts.

3. Focus on enhancing the likelihood of cooperation with MNCs by matching the characteristics of recipient sectors. Traditional demand-driven initiatives that exploit the incentives for attracting MNCs without attempting to maximize linkages with the domestic economy are likely to result in a net negative sum game. Heterogeneity across domestic firms in terms of market strategies shows that the likelihood of interaction with foreign actors may be also hampered by deliberated choices. The correct mapping of the structure and characteristics of domestic firms is at the root of effective policies aimed at the attraction of foreign enterprises. In this view, it is also important to put in place an adequate system of incentives to favor the emergence of cooperative dynamics. This implies embedding the MNC's subsidiary into the local innovation system by introducing its role as a potential partner rather than competitor.

The MNC Experience in Israel (WP7.4)[10]

The effect of MNCs on the economy of Israel was explored in relation to the demand for innovation. The empirical evidence arising from our earlier report accentuated the need to promote demand-driven innovation policies and instruments.

Policy Implications

1. Implement standards specifically targeted at raising the quality of the local industry and local firms (e.g. especially in production and hardware development). High quality standardization will enable local firms to better compete with foreign firms (e.g. non-MNCs located outside Israel) in supplying MNCs sophisticated goods and services, thus raising demand for local innovation. Standardization is also an efficient tool in increasing the possibilities to exploit technological opportunities on a broader basis and in developing interface capabilities.
2. Expand current government incentives for the support of existing and new MNC subsidiaries and R&D centers (e.g. via grants and tax incentives). Emphasis should be placed on diversifying the activity of MNCs (e.g. moving from R&D to manufacturing).
3. Expand government-initiated R&D incentives aimed at fostering collaboration between MNCs, local companies, and the academia. R&D incentive programs help share some of the risks inherent to all R&D activities through attractive financing, the creation of unique partnerships

[10] Source: Communication dated 28 June 2014, sent by Daphne Getz and the leading institution is Samuel Neaman Institute For Advanced Studies In Science and Technology (SNI)

between industry and academic institutions, and the facilitation of international cooperation. These programs help firms to actively pursue R&D and, thus, develop, produce, and market a wide-range of cutting-edge products that compete successfully in world markets. These types of collaborations are beneficial both for MNCs and for local firms due to the externalities and knowledge spillovers that they promote.

4. Provide targeted support for local firms dealing with technological domains that could provide complementary support (e.g. in terms of goods and services) to the activity of foreign R&D centers and MNC subsidiaries.
5. Promote long-term investment in technological education, which is vital for the survival and fortification of the high-technology industry.

APPENDIX